Three Lynx Assessment

Oak Grove Hydroelectric Project
Station "P"

Portland General Electric

University of Oregon
Historic Preservation Program

Fall 2001

THREE LYNX ASSESSMENT PROJECT
UNIVERSITY OF OREGON HISTORIC PRESERVATION PROGRAM

SEPTEMBER 2001 – FEBRUARY 2002

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THREE LYNX ASSESSMENT PROJECT
UNIVERSITY OF OREGON HISTORIC PRESERVATION PROGRAM

SECTION ONE

HISTORY AND CURRENT INVENTORY ANALYSIS

INTRODUCTION TO PROJECT

The cottages at Three Lynx have served as housing to Portland General Electric employees working at the Oak Grove Hydroelectric Project's Station "P" since their construction in the 1920s and 1930s. Located in the Mount Hood National Forest, approximately 50 miles southeast of Portland, Three Lynx is comprised of a machine shed, a pool, the school, and seventeen cottages with attached outbuildings.

The first eight cottages were built through traditional construction methods, with all the pieces assembled on site from raw materials. These traditional cottages are 1.5 stories tall, with a gabled roof, daylight basement, and small front porch, also with gabled roof. These cottages are of wood frame construction, with horizontal wooden lap siding, a board-formed concrete foundation, and an asphalt shingle roof with brick chimney.

In 1929 and 1930, two orders of four house kits each were placed to the Michigan-based Aladdin Company, which had a branch in Portland. These kits consisted of precut lumber, heating system, lighting fixtures, bathroom and kitchen fixtures, fasteners, and finish materials. PGE supplied the labor and some of the materials for the foundation and plaster. The Aladdin cottages ordered were the 1929 "Victory" model, plan "S." The Victory is only one story, with a wider, hip roofed front porch and a unique rail design. Otherwise, it is similar both in style and materials to the traditional cottages already on-site.

The seventeen cottages originally formed a community, with a school and a cookhouse (cottage #36), but today, more than half of the cottages are unoccupied. Through historic preservation planner George Kramer, hired to help PGE complete its federal recertification application for the Oak Grove Project, a small class of graduate students from the University of Oregon's Historic Preservation program were asked to do a condition assessment of the cottages at Three Lynx and recommend preservation-sensitive maintenance strategies.

In the fall term of 2001, nine students, under the direction of Don Peting, visited the site, performed analysis and research, and formed a rough draft of the project contained herein. During winter term 2002, two students from the class took on the task of revising, editing and compiling this project. The project consists of two separate but related parts. Section One addresses both the history and the existing conditions at the Three Lynx site. It includes a brief history, timeline, a description of methodology, a list of character-defining features on the cottages, and a site and building inventory analysis. Section Two contains a set of preservation-minded directives designed to help maintain, preserve, and in some cases restore, the cottages at Three Lynx.

In some cases the information herein focuses more on the Aladdin cottages than on the traditional-built houses. This is due to the availability of information on the original configuration of the Aladdin buildings, information that was not found on the traditional cottages. Overall, the two house types are so similar that information regarding the maintenance of one applies also to the other.

The best recommendation that can be made is that PGE find some way to keep these houses occupied. Though tenants will cause wear and tear on the building fabric, they also create the kind of environment necessary for building

EXECUTIVE SUMMARY: THREE LYNX

The Three Lynx site is a unique cultural resource, representing the development of a Portland General Electric company town over a period of three-quarters of a century. It architecturally demonstrates the evolution of the domestic lifestyle of the company's workers; spatial needs, family organization and structure, supporting needs of school, social and recreational life. It also demonstrates the increasing affluence and change in dependence on the company town as fewer of these unique houses are still used, likely reflecting the ultimate need to live in places with more diversity, opportunity and independence. Yet, these houses of seventy plus years have remarkable integrity and are in overall good condition.

The research team has looked at the original complex of houses, some traditional and some kit, finding the original house configurations remaining mostly intact, the additive components of the house were contemporary with their time, demonstrating changes in style and technology. The purpose of this document is to serve as a management tool for the maintenance of the house fabric and to help generate an overall plan for the preservation of the town.

Completed Research

This document represents the product of a formal class from the graduate program in historic preservation at the University of Oregon studying building assessment during fall term and continued editorial work by several students in the winter term. The group did not consider any other building components than the houses and garages of the complex.

Three areas of research or investigation were conducted; (1) a building history and (2) an inventory of condition of the Three Lynx complex with determination of the houses character defining features and (3) a set of directives for the stabilization, operation and rehabilitation of the complex.

Major Research Findings

The complex, at the time of this writing, is over 70 years old. Many of the problems noted in the assessment and the given directives for their rehabilitation are the result of aging and use, climatic impact and the nature of construction systems employed.

1. The houses, their out buildings and setting provide a remarkable context in which to interpret a company town in the Cascades.
2. The houses retain the great majority of their significant historic fabric, including clear evidence of the original configurations.
3. The condition of the houses is generally very good, with the usual deferred maintenance issues and inappropriate repairs the most serious concerns.

Finally, the most important historical elements of the building are: the doors and windows with their characteristic surrounds, multiple siding types, colonnaded porches, roof forms, interior casings and trim.

METHODOLOGY REPORT

Our purpose in this class was to provide Portland General Electric, for its recertification endeavors, an assessment of the Three Lynx housing community, a part of the Oak Grove Hydroelectric Project. Towards this end, we planned to produce four things, as outlined by Don Peting in his 3rd of June 2001 letter to Deb Shellert:

1. Completed inventory forms for each house, including an architectural description, a determination of integrity and character defining features.
2. A physical assessment of each house, which would document change of the structures over time.
3. A condition assessment of each house.
4. Maintenance strategies for the structures' continued use as housing, while maintaining the historical significance inherent within them.

To accomplish these goals, we planned a site visit, for which we prepared by figuring out a method by which to assess the cottages at Three Lynx.

THE INVENTORY ASSESSMENT FORM

We first created a field assessment form for recording detailed information about the materials and condition of each house. This form had space for both the interior and exterior of each house, and was suitable for both the traditionally-built and the Aladdin houses. Each form identified the recorder, the date of the assessment, and the building number.

As the assessment teams were unable to gain access to every house interior, we have assumed that what we found in the houses that we could access to be typical. Detailed assessments of interiors can be found with the forms for house numbers 2 & 6, for the 1.5 story houses, and numbers 36, 39, & 40, of the Aladdin houses.

The assessment form directed investigation, beginning at the foundation and moving over the building in increasing detail, to exterior walls, windows, doors, decks and porches, drainage systems, roof and chimneys. For each section of the form, the recorder was prompted with issues ta consider, and for all the sections, space for material, condition, and original integrity of the existing building was given. Finally, additions and changes to what we perceived as the original building were noted.

The interiors form applied set issues to each room. The recorder was to consider dimensions, ceiling height, closet numbers and sizes, trim and millwork, outlet numbers and voltage, heat sources, ventilation sources, and the location of the room within the house. Again, material, condition, and integrity were addressed for each of the following categories: ceiling, floor, walls, windows, doors, cabinets and millwork, fireplaces (of which we found none), and appliances and fixtures.

The purpose of the form was to allow individuals with different backgrounds and training to consider the buildings in question in a manner that would be consistent across the board. By breaking the house down into its component parts, interior and exterior, a careful assessment could be made of what existed and its current condition. Often, sketches were made in addition to

THE DIRECTIVES

The directives section is composed of three parts, stabilization, operations, and rehabilitation, per the request of George Kramer. Organized by house part or building element, the directives section seeks to provide maintenance crews with a handbook on the building stock of Three Lynx. Each section is preceded by an introduction of what is typical today for that building element, and is followed by handbook-like pages describing operations and rehabilitation measures to be performed on the building.

STABILIZATION

The Stabilization section summarizes conclusions based on condition observations, and makes recommendations for stabilization, defined here as immediate actions that would stop further deterioration of the buildings and prolong their serviceable life. These recommendations are for selected exterior and interior building components. They are prioritized by their potential for long-term impact, and address only existing observed conditions, where the deteriorated integrity of assemblies and materials could potentially compromise the serviceability of the building if left untreated.

Overall, the buildings reflect a high level of workmanship. Those observed were found to be in sound condition. Moisture is a primary issue of concern. Adverse effects from moisture are currently minimal; if left alone, however, they could result in more severe and widespread damage.

Determining the future use of the buildings is of great importance. For both immediate and long-term considerations, occupancy is the best way to maintain these structures. Maintenance responsibilities, further discussed in the maintenance section, should be clearly delineated and assigned to insure their completion.

Concurrent to this, an investigation of possible foundation issues, as well as a proactive approach to retrofit the buildings seismically, could be undertaken with minimal expenditure and to substantial benefit.

OPERATIONS

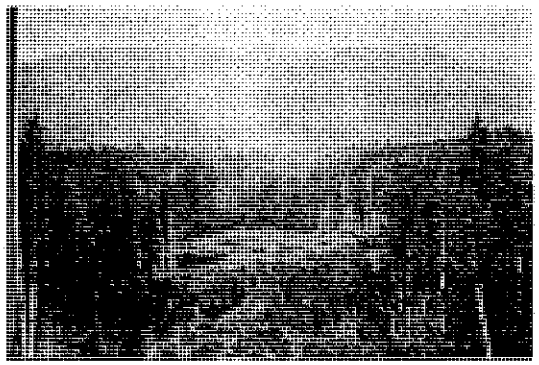
The operations directives have been designed for use by a maintenance crew as well as by the tenants of the cottages at Three Lynx. These directives provide a cyclical maintenance schedule that should foresee possible problems and prevent serious damage or deterioration. Our intention in providing these maintenance/operations directives is to direct attention to potential problems before they cause damage.

In every action taken on these structures, the character of the building – and specifically the Character Defining Features – should be carefully considered.

Caution: All painted surfaces should be checked for the presence of lead based paint. See Preservation Brief #37 Appropriate Methods of Reducing Lead-Paint Hazards in Historic Housing and the Paint section of the directives for more information!

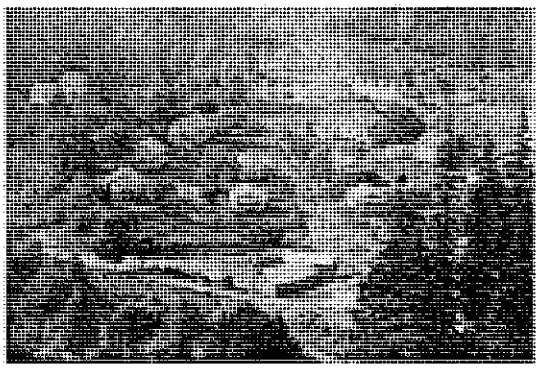
History of Three Lynx
Portland General Electric
Oak Grove Hydroelectric Project
Station "P"

THE DEVELOPMENT OF THREE LYNX



Cleared site – 1924

All cottages constructed by the end of 1930



Operational village with enlarged school

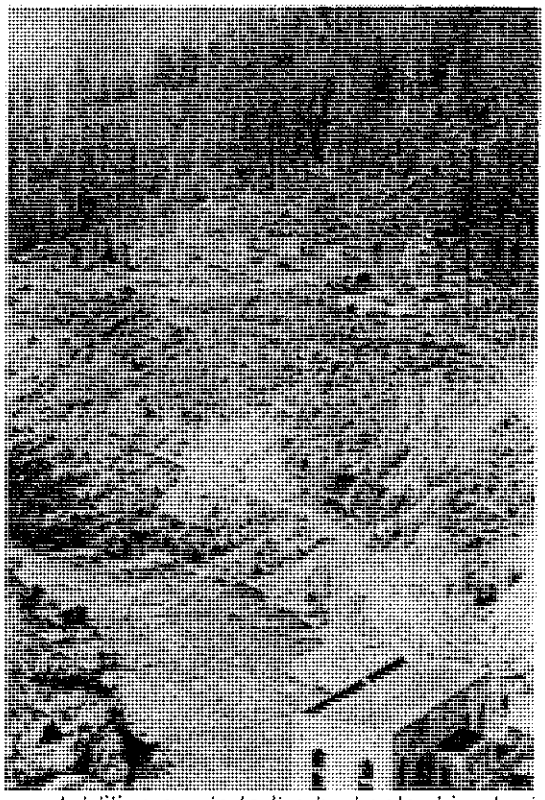
In the beginning...

Three Lynx is the site of one of Portland General Electric's (PGE) hydroelectric plants, located in the Mount Hood National Forest, approximately 50 miles from Portland, Oregon. Three Lynx, also known as Station "P" is one of many stations PGE operates.

The property began its development with the diversion of the Three Links Creek and in 1909, Southern Pacific established a survey camp and field engineer's headquarters for the preliminary construction of the Oak Grove hydroelectric plant. Portland Railway Light and Power Company, a predecessor of PGE, acquired the land on June 29, 1911, from Southern Pacific. PGE's management of the land assumed all rights, including water rights; they began to enlarge the camp in 1922.

Station "P" is located in the midst of the National Forest, about twenty miles from the nearest town. Such seclusion made it necessary to provide housing for the operators of the new hydroelectric plant and their families. A bunk house and cook house were provided for the bachelor employees, as well as company contractors, out of Portland, Gresham or Station "G", who performed periodic maintenance. By 1925, eight site-built, craftsman style cottages (cottages 2-9) were completed along with a small grade school. Between 1929 and 1930, eight "kit houses" (cottages 35-42), purchased from the Aladdin Company and delivered by rail, were assembled along with one additional cottage that replicated the Aladdin style, but was traditionally

The hydroelectric plant and early construction of Three Lynx cottages



Addition made to the hydroelectric plant

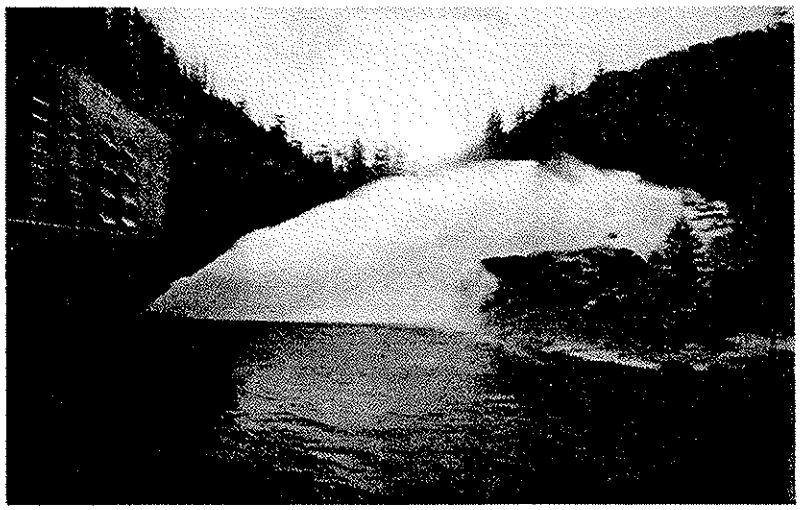
constructed by a contractor to match (cottage 44). By the end of 1930 the "village" consisted of 17 homes, the school, the speeder shed and various other out-buildings. Cottage occupants were almost exclusively Three Lynx employees, with the exception of the school staff from the Estacada School District. From the beginning, the rent of a cottage at Three Lynx, regardless of size, has been $7.50 per month. This rate has never changed for PGE employees. The school district was charged considerably more to house its on-site staff. PGE was responsible for all maintenance issues including structural, interior redecoration, exterior upkeep, and landscaping.

Over the years the village has continued to upgrade itself. The speeder shed was replaced by an operations office, roads were paved, detached garages were added, and in the late 1950s residents built a swimming pool. For most of its history, it appears that the community of Three Lynx modestly thrived on a rural, small family attitude. The village has never been completely self-sufficient, as the nearest stores and amenities are located twenty miles west in Estacada. Three critical elements fostered a sense of community and provided social settings for interaction: the cookhouse, located in cottage 36, the school, and the pool. However, with the closing of the school and the discontinued use of the cookhouse and the pool, there is little left to focus the community. In the 1970s, a shift in responsibility took place and maintenance issues regarding house upkeep, aside from structural issues, became the job of the tenant. As of December 2001, seven of the seventeen cottages are untenanted.

1909-2001 The Development of Three Lynx

Change over time

1909 — Three Links Creek diversion made by Southern Pacific Co. for survey camp & field engineer's headquarters necessary for preliminary construction of the Oak Grove Hydroelectric development



1911 — Southern Pacific Co. deeds water & all other rights & interests in the Oak Grove Development to the Portland Railway Light and Power Co.

1922 — Survey camp is substantially enlarged

1923 — *First reference on record to existence of Cottage No. 2*

1924 — Contract for the construction of 7 'traditional' cottages

1925 — Traditional cottages completed

No roads or cultivated vegetation

railroad tracks exist on site

1926 — No landscape work of record
(landscaping appears between 1926 and late 1930's photo documentation)

1929 — Aladdin Co. contract to purchase 4 five-room cottages for Oak Grove - Victory Plan S
(Cottages 10, 11,12 & 14 referred to later as No. 35-38)

1930 — Aladdin Co. contract to purchaset 4 more cottages at Oak Grove

All buildings extant today (2001) are visible in historic photos
No roads or vegetation

late 1930's — *Vegetation (plants) is apparent*

1930 - 1960 — Railroad tracks removed & replaced by dirt/gravel roads

Garages built at sometime after roads

1955 - 1960 — Swimming pool built

1958 — New wiring installed for cottages 1-6, 38 & 39
Disposal of lighting fixtures and misc. wiring for cottages 1-6 and 38 & 39

Composition roofing for 10 garages, cottages 1-6, No. 53, 55, 57, 58, 61, & 64 -68

Concrete sidewalks constructed at 9 houses, cottages 3-6, 39, 40, 41, 42 &44

1959 — New wiring installed for cottages 7, 8, 35, 37, 40, 41, 42 & 44

Composition shingle roofing installed on garage buildings 62, 74, woodshed 78 & porch for cottage 37

Rear porches enclosed for 6 cottages, No. 3-6, 8 & 9

Disposal of lighting fixtures and misc. wiring for cottages 7, 8, 35, 37 &44

1960's — Name changed from Three Links to 3 Lynx

1960 — 5 overhead garage doors installed for buildings 51, 52, 54, 55 & 58, disposal of old doors

Composition shingle roofing installed for cottages 39 & 41

Lavatory installed in cookhouse, No. 36

New toilet installed, cottage 5

1961 — Improvements to domestic water supply

Installation of oil furnaces, attic insulation & weather stripping, disposal of wood burning furnaces from cottages 1-9, 35, 37-42 & 44

Concrete walks, fence, filter, chlorinator, heat & building for swimming pool built

Storm sewer system integrated in village area, disposal of sterilizer "Lectro Bleach" from village sewer & 4 wood valve boxes from village water system

Disposal & replacement of wash basin in cottage 9 & toilets in No. 4, 6, 38, 39 & 41

Major landscaping is visible in historic photos all dirt/gravel roads are in place

1961 - 1963 — Concrete stairways built

Area plantings

1962 — Major landslide

Disposal of wood walkways

Improvements to domestic water supply & accessories for swimming pool

Laundry tray replaced in cottage 7

Disposal of kitchen sink & drainboards in cottage 9

Disposal of wood pole No. 89, 25 ft.

1963 — Telephone system upgrade in village (work continues to 1964)

Antenna & "cable" tv (work continues to 1964)

Closet additions to traditional cottages

Screen door installation for various cottages

Fence installed around cesspool drain field & bypass around swimming pool heater

Reroof buildings 37 & 44

Replace culverts in village

Replace water heater & laundry tray in cottage 5, water heater in 39

Dispose of misc. plumbing fixtures, screen doors, laundry trays, drain boards, roofs, water heaters, etc.

1964 — Repaving of roads in village

Replace sink & drainboards in 4 cottages, sinks in 7 & 44

Replace bathtub & hot water heater in cottage 39

Install water heater in cottage 4

Disposal of kitchen sinks, drainboards & cupboards in cottages 7 & 44 and bathtub & water heater in cottage 39

1966 — Remodel of cottage 2

1968 — Interior redecoration of cottage 6

mid to late 1970's — Installation of smoke detectors with yearly inspection plan (1977)

Contractor hired to maintain grounds

Shift in maintenance responsibilities- tenants responsibilities for cost, labor & materials for painting, decorating and repair (other than structural)

1973 — One house vacant

1974 — Two houses vacant

1979 — Request for reroofing cottages 7-9 for summer of 1980

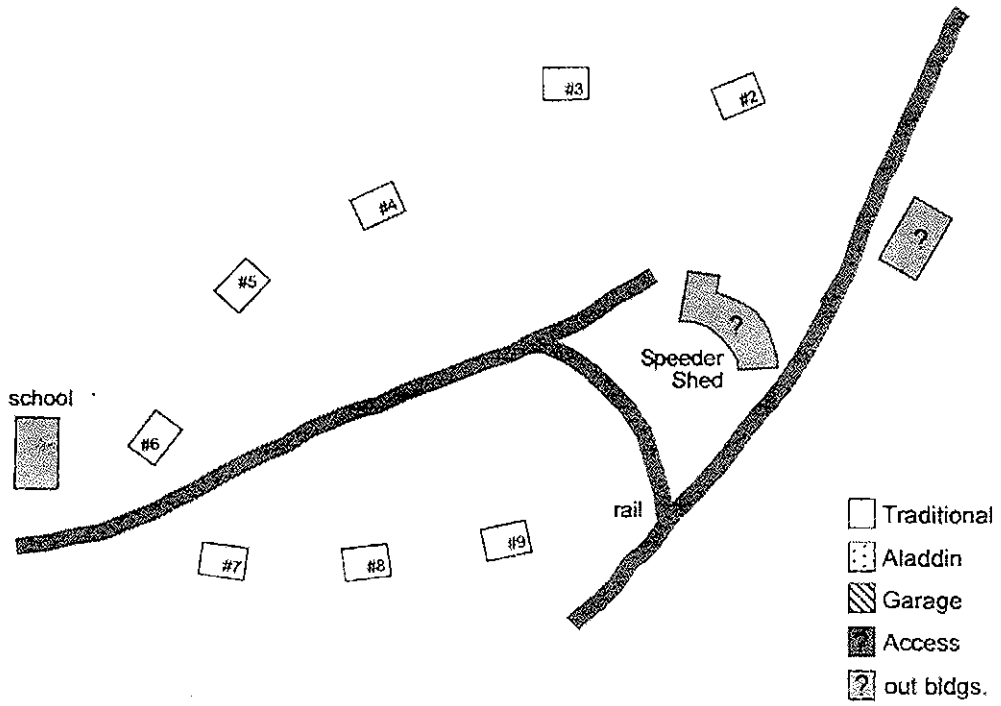
1986 — Request for relining of chimneys

1992 — Six homes are vacant

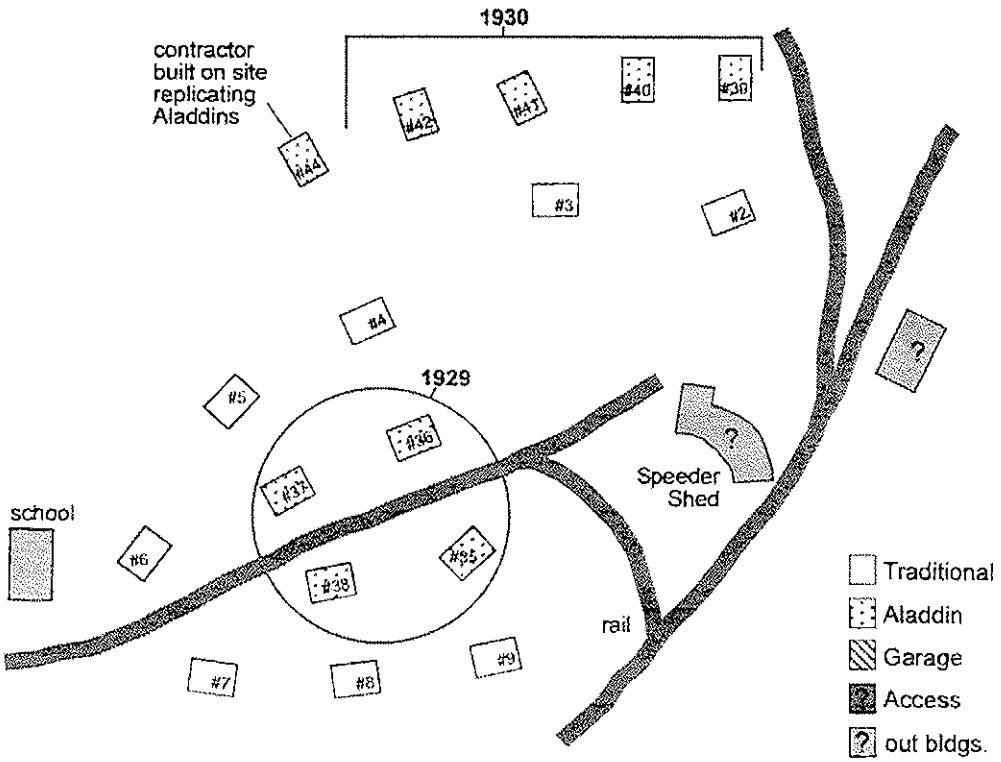
2001 — 7 homes are untenanted

University of Oregon preservation students conduct condition assessment

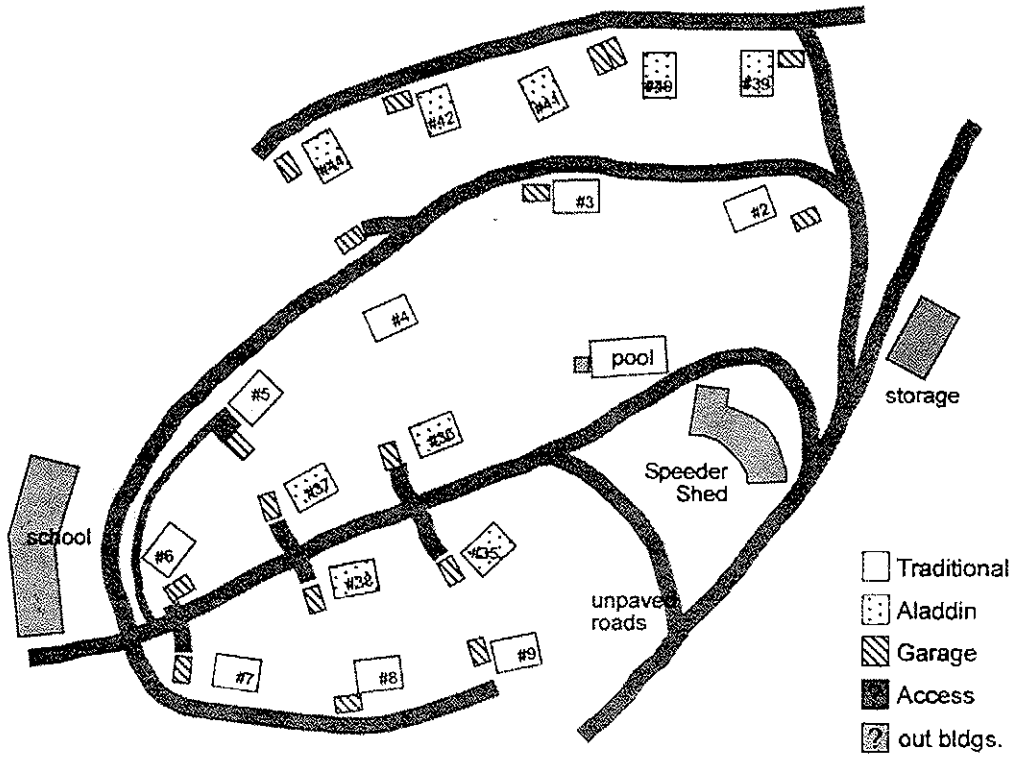
1925 Site Plan



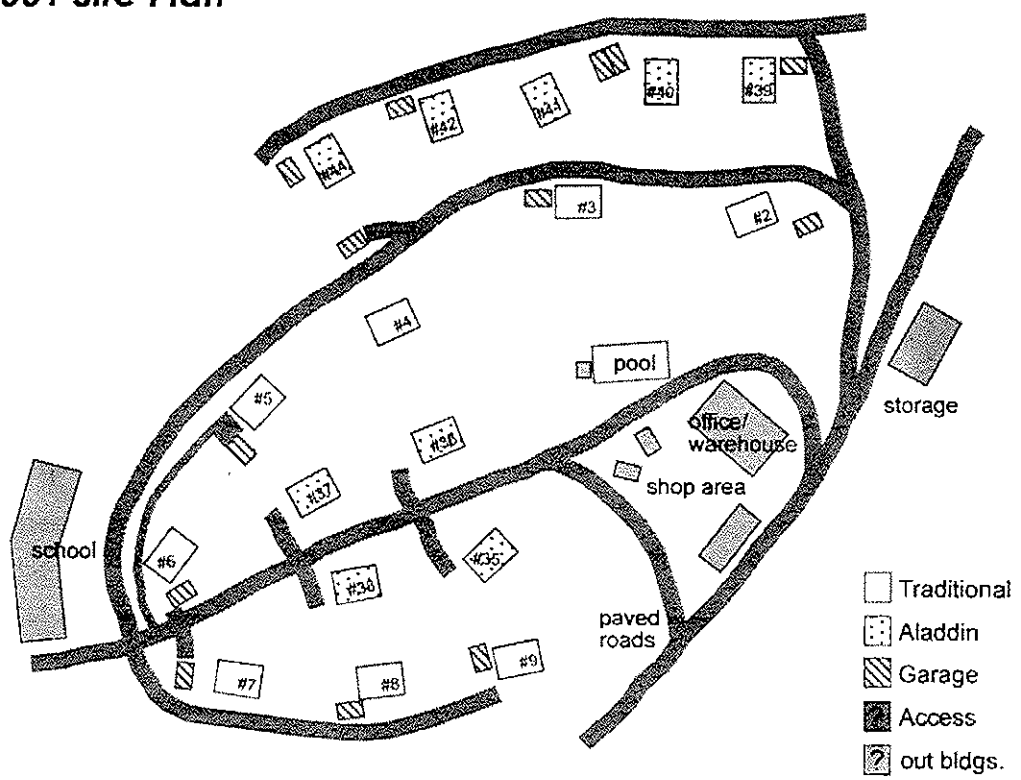
1930 Site Plan



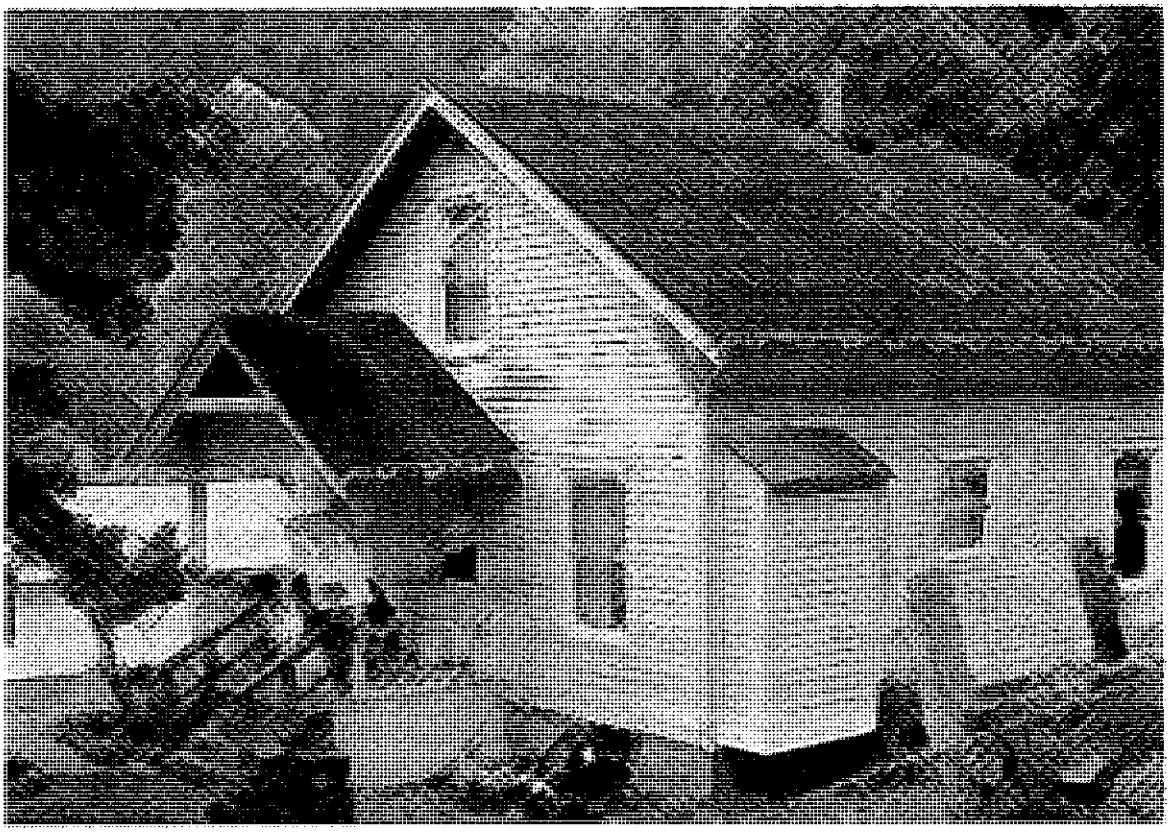
1960 Site Plan



2001 Site Plan

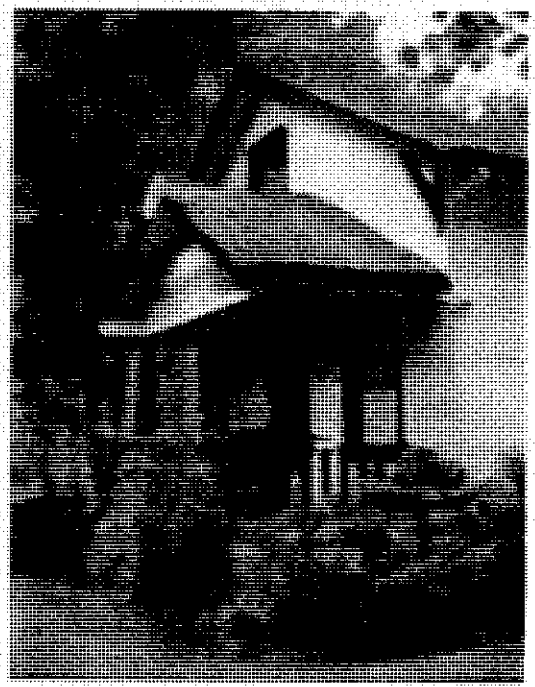


The Traditional Cottages



Traditional Cottage rendering

Eight traditionally constructed cottages were built at Three Lynx, breaking ground in 1924. The Traditional cottages are 1 1/2 story wood frame construction, over a 2/3 basement. The 'Traditional' cottages were site-built entirely by PGE with Craftsman style elements. In the admittedly brief research done for this class, no specifications were found for these cottages.



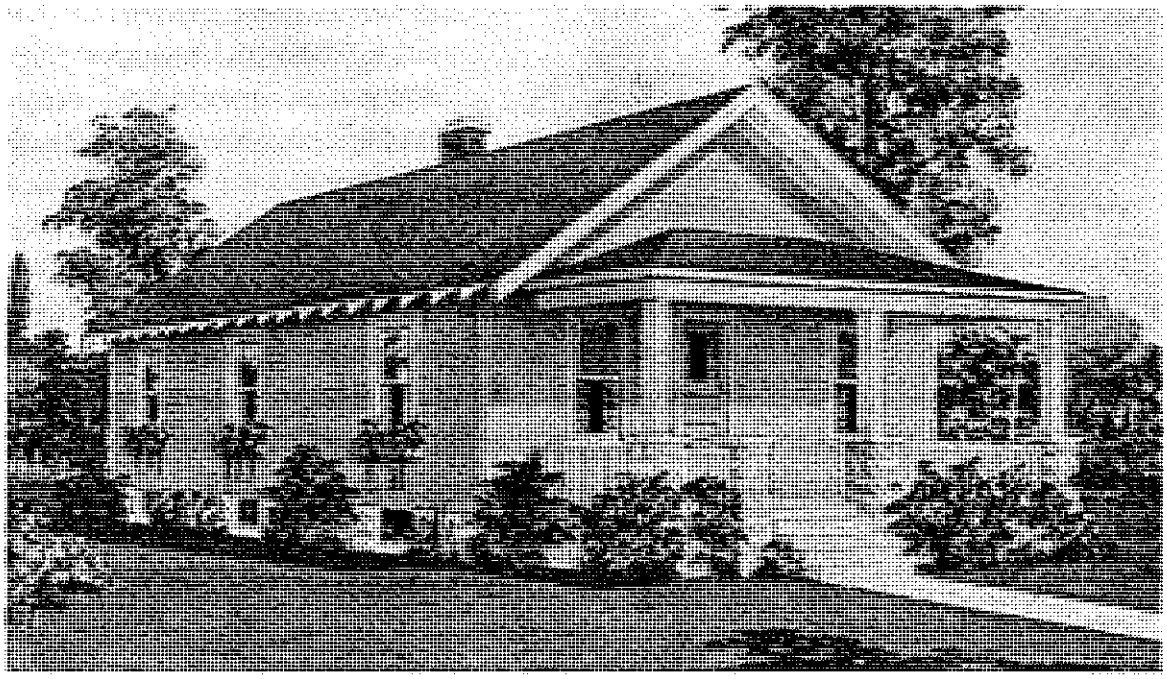
Exterior

In comparison to historic photographs, it is apparent that the exteriors of the traditional cottages have changed very little since their construction. The walls were clad in wood horizontal lap siding. The gabled roofs iincluded Craftsman triangular knee braces, and all cottages had gable roof Craftsman front porches and hip roof enclosed back porches. The gable roofs had decorative verge boards, and the porch roofs had decorative verge ties. Wooden ladders were attached to the back porches creating a fire escape from the second story window. Closet bump outs were also added to all of the traditional cottages.

Interior

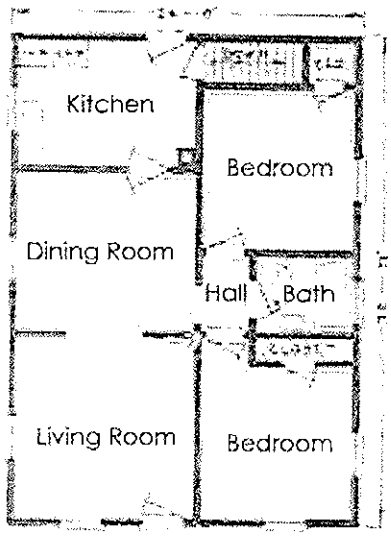
The interiors are configured with family spaces downstairs and bedrooms upstairs. Interior walls and ceilings are all plasterboard with decorative baseboard and trim surrounding windows, doors and openings. Floors are tongue and groove exposed wood, in some cases carpeted over. A long, narrow and steep staircase connects the two levels. Closet or storage space is created on the second story by the slope of the gable roof. The additional space afforded by the partial second story seems to make the traditional cottages more popular for rental than the Aladdins.

The Victory : : an Aladdin home

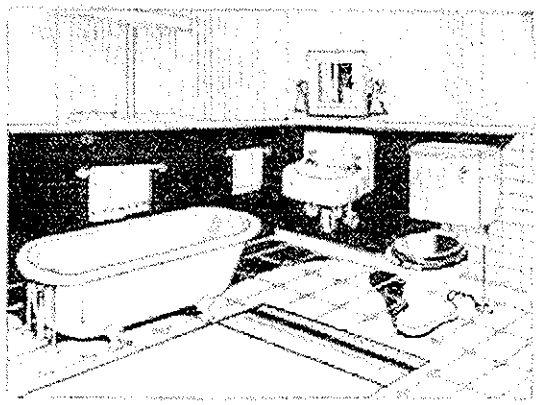


Aladdin Annual Sales Catalogue 1929

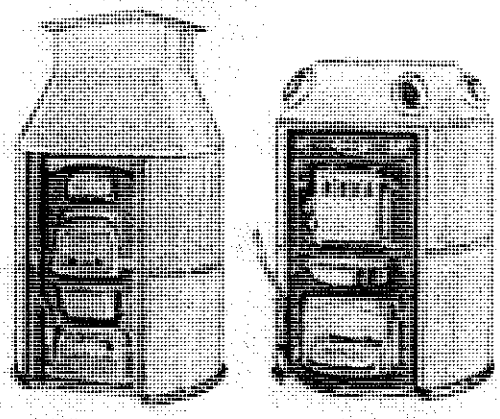
Eight Aladdin Victory Plan S homes were ordered for and constructed at Three Lynx between 1929 and 1930. The Aladdin cottages are of wood frame construction, over a 2/3 basement. PGE was responsible for the materials and construction of the concrete foundation and basement walls, hot water tanks, and plumbing materials and fittings. Aladdin supplied the rest by rail, including all major building materials, windows and doors, hardware, electrical and plumbing fixtures, furnace, and paints.



Plan S



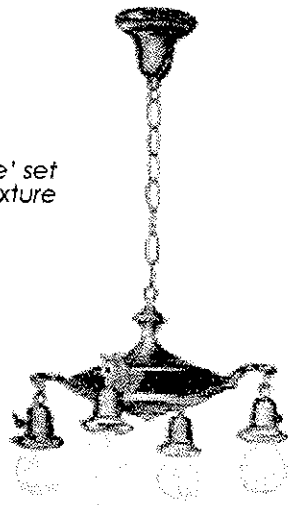
'Metropolitan' Bath room set



Hot-air pipe furnace with piped registers included

Exterior

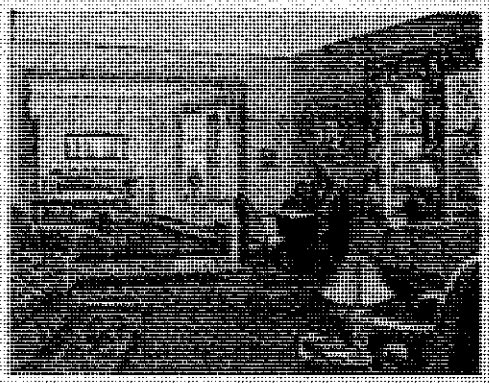
Original orders indicate that the cottages were clad in 6" bevelled wood siding. Dark red, hexagonal-butt, asphalt strip shingles covered the main gable roofs and the porch roofs. Small back porches with steps to the grade line were ordered as extras to the basic Victory kit. Records also indicate that the Three Lynx Aladdins were painted either ivory with light gray trim or light gray with ivory trim, one coat of primer and two coats of paint. The brick chimneys were specified with 8x12 flues, 6" thimbles in the kitchen and 8" thimbles for the furnace in the basement. The eight cottages appear to have been constructed exactly as specified.

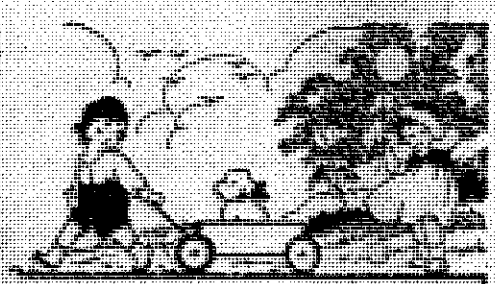


'Favorite' set light fixture

Interior

The interiors are configured according to Victory Plan S. Aladdin provided the "Metropolitan" set of bathroom fixtures, including bathtub, sink, toilet and built-in medicine cabinet. Also provided was the "Favorite" set of lighting fixtures, completely wired but without bulbs. Interior walls and ceilings are all lath and plaster with decorative baseboard and trim surrounding windows, doors and openings. Ivory enamel finish was specified by Aladdin for kitchens and baths, where as all other interior walls were specified two coats of plaster with a sand finished surface. All of the decorative trim received one coat of light oak oil stain followed by one coat of clear varnish. Currently, the varnished trim in many of the cottages has been covered with painted. Floors are tongue and groove exposed wood, in some cases carpeted over.

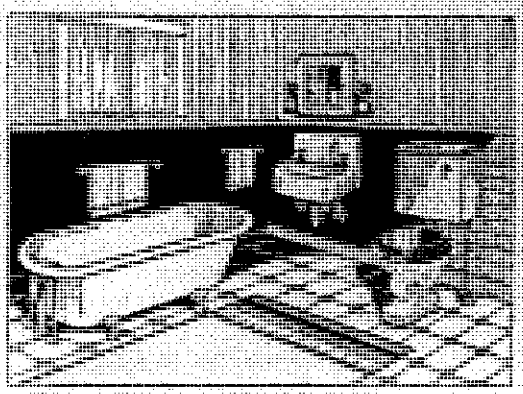




THE ALADDIN PLAN of Home Building

These Fixtures Included

A SELECTION of the heating, lighting and plumbing fixtures shown on these pages is furnished with each Aladdin Home. In connection with our description of each home, we tell you "What You Get" with that home. In keeping with Aladdin's policy to supply only the best—only articles of tested and known high quality are used. Every single piece of equipment on these pages is guaranteed to be exactly what you have a right to expect. We do not handle merchandise of any character and you can depend on getting the best only.



The "Metropolitan" Bath Room Set

THE BATH TUB of this outfit is white porcelain enameled [illegible]

THE LAVATORY [illegible]

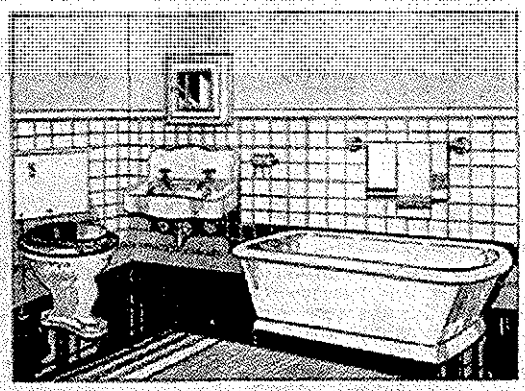
THE CLOSET COMBINATION [illegible]

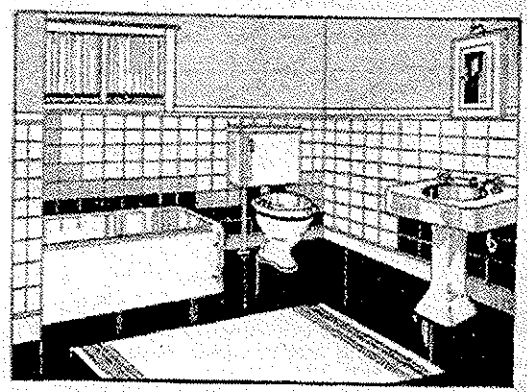
The "Roman" Bath Room Set

THE BATH TUB sets on a base as shown in our illustration. It is white porcelain enameled inside and over rim, painted on outside and base, 5' long, 30" wide and 17" deep. It has 3" roll rim and measures 22½" from floor to rim. Fitted with nickel plated waste and supply pipes, *Goodell* bathhook with "Hot" and "Cold" indexed china handles, stopper and chain.

THE LAVATORY is 24" wide and 18" deep with 4" apron and "D" shaped bowl, 13 x 15 inch. Back is 10" high and entire fixture coated with pure white porcelain enamel. Fitted with low down china indexed faucets, one marked "Hot" and the other "Cold." Nickel plated supply and waste connections to wall as shown, or will furnish same to floor at no extra cost if requested.

THE CLOSET COMBINATION is all-vitreous china with bowl of syphon wash-down type. Seat and cover finished in golden oak. Fitted with nickel plated elbow and supply pipe.





The "Grecian" Bath Room Set

THE BATH TUB of this set is a 5' full apron, built-in type. White porcelain enameled inside and out. Width over rim 31½"; height from bottom of tub to top of rim is 18". Inside depth is 16½". It is fitted with over rim bath fixtures with china indexed handles and china escutcheons together with connected waste and over-flow in end wall.

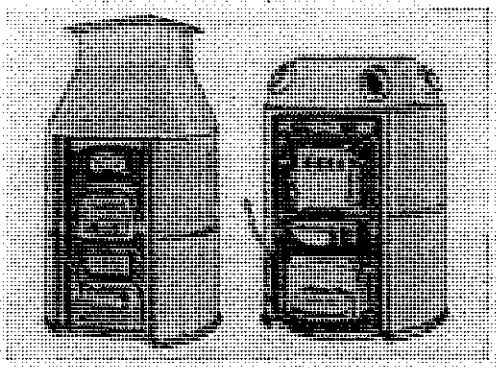
THE LAVATORY is one piece porcelain enameled supported on a porcelain enameled pedestal. Fitted with nickel plated model waste with china indexed top, fuller faucets with china handles marked "Hot" and "Cold." Nickel plated supply and waste connections to wall.

THE CLOSET COMBINATION is all-vitreous china with bowl of syphon wash-down type. Seat and cover furnished in white. Fitted with nickel plated elbow and supply pipe.

White Enameled Bath Room Wall Fixtures

With ALADDIN Houses

Pipeless and Pipe Furnaces



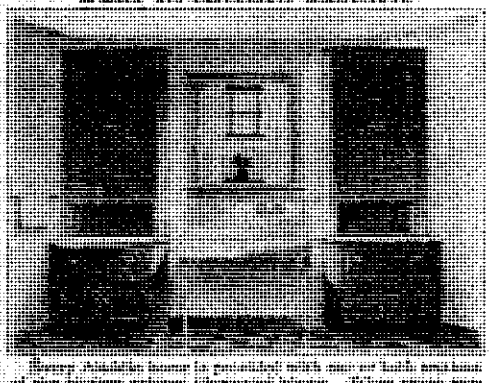
Aladdin Hot Air Pipe Furnace

Hot water or hot furnace the original pipe furnace for that home is equipped with pipe furnaces, for those of heat the rooms, registers and ducts, etc., to complete the installation. These furnaces are equipped with an all cast, self-feed, grate of heavy cast iron, and smooth fire pot. The fire pot is of extra heavy type, and in two sections, large ash pit, ash pan with handle, and combustion chamber. Casings are heavy galvanized iron, heavily insulated with asbestos board lining. It is the aim and result which is claimed a factor of economical heat. It is a simple by high grade and most efficient heater for coal and wood, and properly proportioned to provide a warm air heat system sufficient to heat your home comfortably in those severe winter weather.

Aladdin Pipeless Furnace

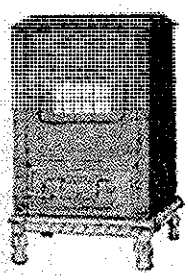
Aladdin furnaces represent the results of intensive and costly investigation, making possible a product showing wonderful heating efficiency. Heating practice has fully demonstrated that the pipeless furnace is most efficient. It is unsurpassed for fuel economy, has duplex register, the outer portion of the register taking the cold air off the floor, the center section returning the hot air. The inner and outer casings of the furnace are heavy galvanized iron, inner casing being three-ply construction; cast radiator, extra heavy fire pot, large ash pit, and grates of improved type. Furnace fully guaranteed.

Built-In Kitchen Cabinets



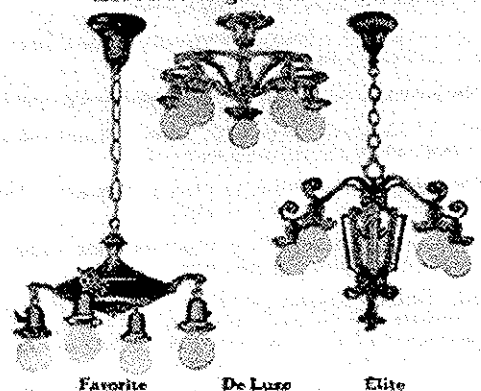
Every Aladdin home is provided with one or both sections of this kitchen cabinet. Where space permits, both sections are included. Both sections are alike. Painted drawer pulls and knobs to choice of two styles. Painted shelves are arranged as shown, while below is a roomy drawer to accommodate your dishes, silverware, etc., and equipped with enamel shelves. A convenient, shelving cabinet, located as shown, is provided for each home. These cabinets are also included in other models and there can be obtained in the same construction as that of the kitchen cabinets. See additional description of cabinets on page 14.

Fleet Circulator



The Aladdin Fleet is the latest development in small home heating plants and has proven remarkably efficient and practical for the 4 or 5 room dwelling. The Aurora is finished in baked Mahogany Porcelain Enamel. It circulates heat to all corners of the room, using the same principle employed in pipeless furnaces. Burns any fuel. Height overall 45". Width 26". Depth 17". Weight 300 pounds.

Electric Light Fixtures



Favorite **De Luxe** **Elite**

Above is shown one sample fixture of each of the three sets of lighting fixtures we furnish with Aladdin houses. In the description of each house, under the heading "What You Get," we tell you which style is furnished with that home.

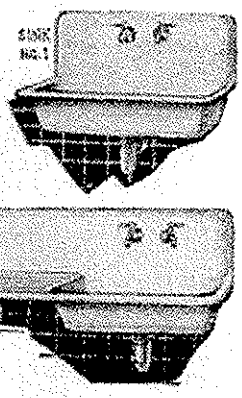
The Favorite Set is finished in Brown Tone with polished gold high lights.

The Elite Set is finished in Brown blended with Polychrome high lights.

The DeLuxe is finished in Gold blended with Polychrome high lights.

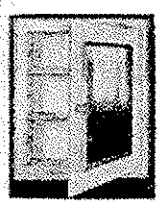
The finishes of all three sets will blend perfectly with any interior treatment you may arrange in the various rooms of your home. Fixtures are furnished from each set in proper size and style for each room. Detailed specifications for each house give you full description of all fixtures furnished.

Kitchen Sinks



Cast in one piece with roll rim. Enameled in white porcelain. Supported on concealed hangers. Complete with nickle plated fittings to wall as shown, or to floor if requested. Sink No. 1 is 18" x 24", Sink No. 2 is 42" wide, Sink No. 3 is shown in upper right hand corner between kitchen cabinets, and is 42" wide with 6" apron.

Bath-Room Wall Cabinet

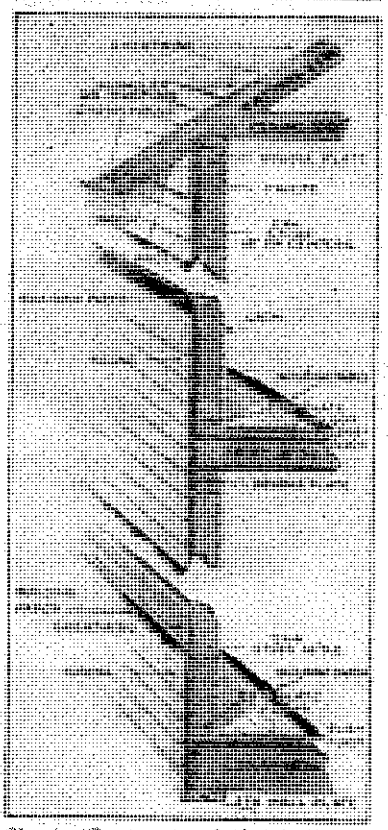


Recessed Type. All steel. Finished with three coats baked snow-white enamel. Cabinet has 10" x 14" bevel plate mirror. Glass knob and two adjustable glass shelves. Door has invisible hinges.

General Specifications

A binding guarantee is given to furnish sufficient material for the completion of each house in accordance with the specifications.

The plumbing and heating equipment and other fixtures supplied with all Aladdin houses are shown on pages 6 and 7 in this catalog. On the page illustrating and describing the house in which you are interested, will be listed just what type of equipment and fixtures are priced with that house. However, you may possibly wish to alter this list somewhat. For instance, if you do not plan on having a basement under your home and for that reason do not require a furnace, cellar windows, etc., these may be omitted. The same is true of bathroom equipment or any other items listed. In all such cases, write us for the revised and reduced price of the home you are figuring on. Moreover, if a different type of heating plant, style of plumbing, electric fixtures, etc., are desired than those specified for the home in which you are interested, write us for revised prices.



Showing Construction of Aladdin Homes

Below are listed in a general way, the materials and equipment supplied with all Aladdin homes. The exact specifications for the house of your choice will be sent to you without cost just as soon as you write us about the house you like best.

Sizes of Materials—All sizes of all timbers and lumber will be in accordance with well established engineering and architectural standards of safety and strength.

Quality of Materials—All lumber is guaranteed to be of high quality—in fact, higher than is customarily used in similar houses. Only Aladdin Certified Materials are furnished. Every Aladdin house, regardless of size or price, comes under this guarantee.

Wall Plates—Two inch by six inch wall plates are furnished to lay on top of foundation wall.

Girders—Girders or center sills are furnished to set into your foundation wall. All girders or sills are of a size to amply hold all strains and loads in accordance with engineering standards and good practice.

Cellar Windows—Furnished with each Aladdin House.

Joists—All framed, dressed and cut to fit. All joists are of a size to amply hold all strains and loads in accordance with engineering standards and good practice.

Bridging—Wood bridging, mitred and cut to length furnished for joists of first and second stories of Aladdin dwelling houses.

Sub-Floors (for both first and second stories in Aladdin dwellings).—Inch lumber, dressed, all cut to fit.

Flooring—The flooring used in Aladdin Houses is clear and knotless, tongued and grooved, accurately matched with a 2¼ inch face. It has a beautifully figured grain. The face is machined to give the very best appearance.

Studding—Size, 2 x 4 inches, all framed, dressed, and cut to fit and placed on 16-inch centers.

Wall Sheathing—Inch lumber, all dressed and cut to fit.

Rafters—All framed, mitred and beveled, dressed and, of course, guaranteed to be perfectly cut to fit.

Roof Sheathing—Inch lumber, mitred, beveled, dressed and guaranteed to be cut to fit perfectly.

Roof Covering—Asphalt slate surfaced strip shingles, either in plain green or variegated colors.

Building Paper—Highest quality, for side walls and between sub-floors and finish floors. Water or dampness cannot penetrate this insulation and it has the further advantage of being wind proof and vermin proof.

Lath—Wooden lath furnished for lining inside walls and ceilings. Plaster grounds furnished which are to be placed around all inside openings and to back up the base molding. Plaster is not included.

Side Walls—Clear Red Wood bevel siding, perfectly machined and without defects. Cedar Shingles for side walls instead of siding can be furnished for any Aladdin dwelling without extra charge.

Outside Finish—All outside finish is of Clear and Knotless Yellow Pine or Fir.

ALADDIN READI CUT HOMES

The company pledges itself to deliver your house to you without damage in shipment. If anything should be damaged on arrival we will instantly make good at our expense.

Molding—All moldings necessary to complete house are furnished in clear and knotless stock.

Window and Door Frames—Complete, including jambs, casings, stops and sills. Built of finest clear and knotless stock, perfectly machined and finished.

Window Sash—Of finest clear and knotless Fir. All edges and surfaces finished with great care. Glass in sash ready to hang.

Doors—All front doors of a design to harmonize with architecture of the house. Inside doors are of a two-panel design, carefully built of clear and knotless Fir stock and selected for attractive grain. Doors are mortised to receive lock-sets.

Main Stairs—Built from selected clear and knotless stock with especial attention to selection of grain. Newel posts, molded cap and base, steps, risers, railing and balusters carefully finished. All parts of stairs are framed, housed and machined to fit and the whole is carefully boxed by itself to insure arrival in perfect condition.

Cellar Stairs—Cellar stairs are furnished when shown on floor plans.

Interior Woodwork—Baseboard, base shoe, door and window casings, all selected clear and knotless stock, perfectly machined.

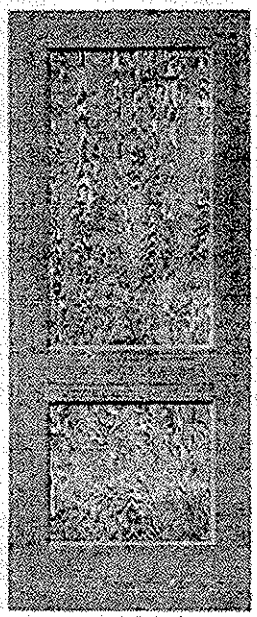
Closet Shelves—Shelves furnished for all closets, together with nailing strips and coat hooks.

Lock Sets—Solid brass for all inside doors. Beautiful up-to-date design. Glass knobs. Special front door lock-sets.

Hardware—Sash weights, sash cord, sash pulleys, sash locks, double acting floor hinge for door between dining room and kitchen, lock sets for all other doors, coat hooks for closets, flashings and all nails in proper sizes to complete house.

Outside Paint—Aladdin paints have been tested under all conditions and are guaranteed for quality and service. Your selections may follow your own tastes for body, trim, porch floor, sash, steps, etc. Send for color card.

Inside Stains and Lacquers—You may secure any effects you desire for interior woodwork. Stains and varnish, or oil and varnish are supplied if you wish to finish in the natural wood; lacquers are supplied if you wish to finish your woodwork in white or colors.



Floor Finish—Stains and high grade floor varnish are furnished for all floors.

Porch Columns—Manufactured of clear and knotless material.

Outside Steps—Front and Rear Steps of clear and knotless stock and of correct height and width are furnished when the design of house requires them.

Heating Plant—As specified for each house.

Bath Room Equipment—Includes bath tub, lavatory, closet, medicine cabinet and white enameled wall fixtures, as specified for each house.

Kitchen Equipment—Includes kitchen sink and built-in kitchen cabinet as specified for each house.

Electric Light Fixtures—As specified for each house.

Curved Arches—A curved arch can be furnished in place of any cased opening in any Aladdin home if desired, without extra cost. A curved arch is shown in interior view of the "Virginia" on page thirty-five and in interior view of the "Norwood" on page forty-one.

Reversing Plans—Plans can be reversed without charge. This will place all rooms on opposite side of house from that shown in our catalog. Kindly mention when ordering if this change is desired.

Room Sizes—Figured from outside of walls to center of partitions.

Blueprints—Complete blueprints showing every step of erection are furnished with every order so that even though you may not be a carpenter, you will know just how to erect your home.

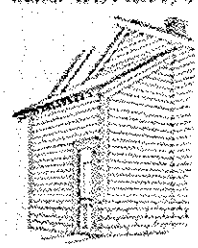
Freight Paid—Prices quoted in price list are freight paid to your station.

Foundation—Chimneys and Plaster—Brick, stone, cement, tile, plaster, sand, etc., can be had in your locality as cheaply as we could furnish them. These materials are therefore not included in the prices quoted. Chimneys or fireplaces can be located anywhere in the house you like, for we do not cut the openings for them. If you do not want the fireplace that may be shown in the plan, you need not build it.

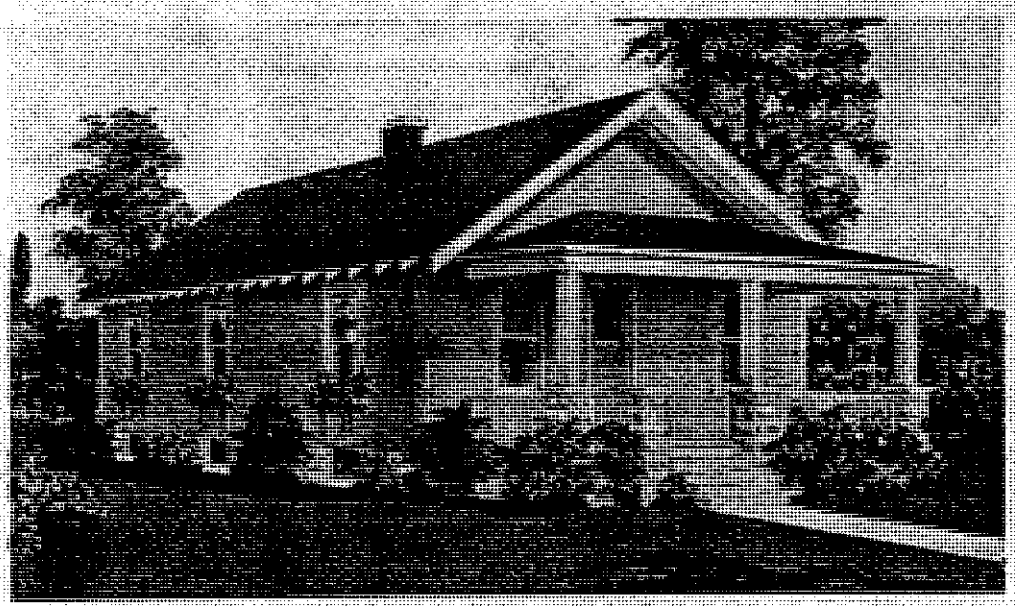
Detailed Specifications—Send for detailed specifications for the house you are interested in. In the general list as given above it is impossible to cover all points in full detail.

GRADE CELLAR ENTRANCE ADDITION

For houses that are not supplied with cellar stairs we can furnish the grade cellar entrance addition illustrated. It is 3 feet by 6 feet in size and can be attached to any Aladdin home. The outside door is at grade level and stairs lead up to kitchen and down to basement. All materials for the complete addition can be furnished for $72.00.

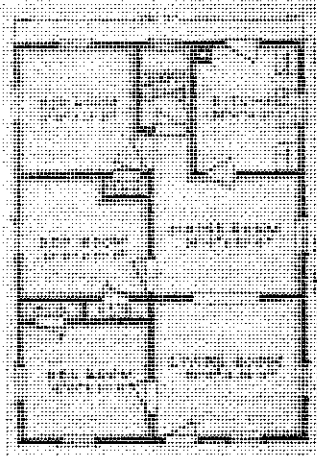


The Victory :: Priced Including Heating, Lighting, Plumbing

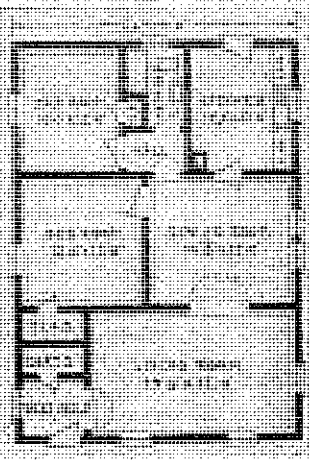


AN imposing small home of improved design, featuring a large, attractive porch, 25' x 8' in size, and especially well laid out interiors. The Victory has often been called the "architect's choice" of a small, moderately priced home providing every convenience. From the front porch to the kitchen it is a worthy example of modern home planning. Six choice plans offer a wonderful variation in interiors to suit every desire. Contented "Victory" owners in all parts of the country are enthusiastic in the praise of this superior home. The reason for this perfection is, that, among other things the materials of which the Victory is constructed must be of the very highest quality Certified Lumber. It means that the construction used in the building of the home must give strength, sturdiness, and the ability to withstand the wear of time. It means that the roof must be weather proof. The paints used must be of the highest quality to give not only an attractive home but perfect protection from the action of the weather in all seasons of the year. The completed home must be well insulated. It should be easy to heat in winter and easy to keep cool in summer. It means that the inside and outside doors must be so carefully located that they will be of convenient access in going from one room to another. These locations must also be studied to permit satisfactory arrangement of furniture and furnishings.

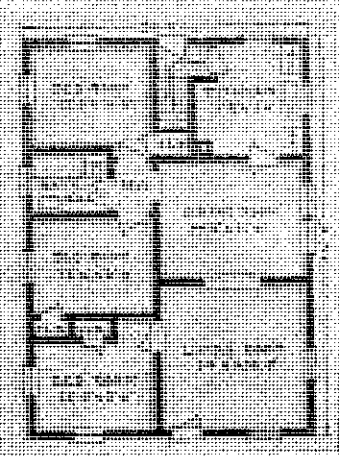
Victory Plan A



Victory Plan B



Victory Plan C



The Victory :: Priced Including Heating, Lighting, Plumbing

The location of windows is a problem in itself. Not only must the position of large pieces of furniture of common use in all homes be considered, but the number of windows to insure perfect ventilation cannot be lost sight of. Windows must be properly placed to present the best appearance within a room and also to give a balanced appearance from the exterior of the house. It has been the ambition of Aladdin to provide all these points of perfection in a home and at the same time sell that home at a lower price than it could be purchased for from any other source. This is the kind of work study and effort put into planning the Victory. Similar devotion is given to every Aladdin home. See price list enclosed.

A Victory Interior

What You Get

Ready-cut materials for "The Victory" Home (see pages 8 and 9).

In addition, the following equipment as shown on pages 6 and 7.

The Metropolitan bath-room set.

White enameled bath wall fixtures.

Inset bath wall cabinet.

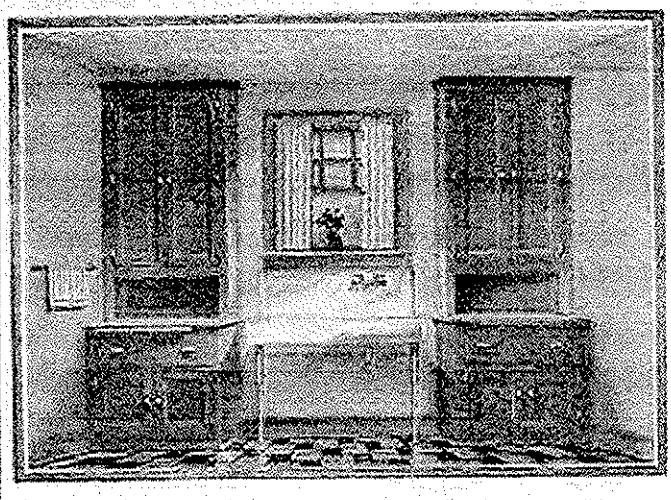
Aladdin Pipeless Furnace.

"Favorite" Lighting Fixtures.

Built-in kitchen cabinet, two sections.

Kitchen Sink No. Two.

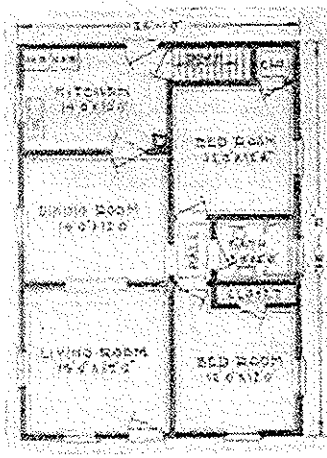
Freight is paid to your station. Write for Detailed Specifications. Any of the above items will be omitted, if desired, and deduction from the price will be made. We will also make deduction for omitting wall sheathing, or substituting of building paper.



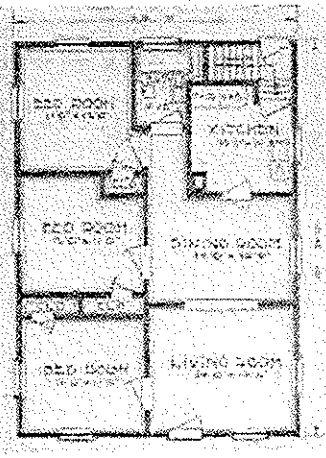
Kitchen Cabinets Supplied With Victory

The above illustration shows the Kitchen Cabinets supplied with the Victory. It also suggests a pleasing color combination. See description of cabinets on page 7.

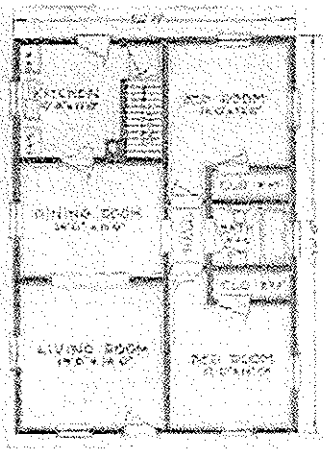
Victory Plan S



Victory Plan Y



Victory Plan Z



MEMORANDUM COVERING PURCHASE OF
ALADDIN "VICTORY PLAN 3" READI-CUT HOUSES TO
BE DESIGNATED AS COTTAGES NOS. 10, 11, 12 AND
14 AT THREE LINKS, OAK GROVE PROJECT.

PURCHASE ORDERS NOS. 62,660, 61, 62, & 63:

DATED JUNE 1, 1929

This memorandum outlines the materials which the Aladdin Company will furnish, also designates the method of shipment, and supplies information as to type of foundation, arrangement of rooms as regards reversal of plans, kind of shingles, color of paints, enamels, etc. for Aladdin "Victory Plan 3" Readi-cut houses to be designated as Cottages Nos. 10, 11, 12 and 14 at Three Links, Oregon, on the Oak Grove Project.

THE ALADDIN COMPANY WILL FURNISH:

4 - Aladdin "Victory Plan 3" houses, each in accordance with the Aladdin Company's specifications and guarantees for the "Victory Plan 3" Readi-cut home, including 22" fire pot hot-air pipe furnace, complete with the necessary floor grills and individual side wall registers for the various rooms, hot and cold air piped, smoke pipe, cold air grills, asbestos pipe covering; including electric lighting fixtures ("Favorite" set), wired and ready to hang but lamp bulbs; including plumbing fixtures ("Metropolitan" set), both room medicine cabinet and bath wall fixtures, kitchen sink No. 2 and kitchen cabinet and all doors, windows and framing, door and window hardware, lock sets, nails, paints, enamels and varnishes. Purchaser will supply all necessary cement, sand, gravel, lime, brick and plaster, also laundry trays, hot water tank, plumbing materials and fittings, and soil and sewer piping.

The furnace furnished will be supplied by you through the Marshall-Wells Company, Portland, Oregon, designated as the "Hartford" type #922. The following dimensions pertain to the furnace:

Overall diameter of furnace casing	44"
Height of furnace casing to flaring bonnet	46"
Height of flaring bonnet	14"
Diameter of top of bonnet	36"
Overall height of furnace	60"
Distance from floor line to center of hot air outlet pipes	53"
Distance from floor line to bottom of smoke outlet pipe	36"
Diameter of smoke pipe	8"
Diameter of fire pot	22"
Diameter of grate	20"
Size of feed door	9" x 12"
Grate area in square inches	314"
Size of ash pit opening	10½" x 18"
Heating surface in square inches	843"

NOTE: A detailed basement and furnace layout will be made by the Engineering Department of the Portland Electric Power Company and submitted to you for approval. All hot and cold air piping, floor grills and registers shall be furnished in the required sizes suitable for this layout.

FLOOR PLAN:

Floor plan for Cottages Nos. 10 and 12 to be reversed from that shown on page 15 of "Aladdin Homes" Catalog. See location on P.E.P.Co's. drawing DS-477.

BACK PORCH:

As an addition to the regular "Victory Plan 3", the Aladdin Company will furnish a small back porch with steps to grade line, also hand railing and roof over same.

FOUNDATION:

The Portland Electric Power Company will erect a solid wall concrete foundation, 8" thick, and [illegible] feet high from finished basement floor to top of foundation wall. The basement may be termed a 2/3 basement, 22 feet long, 26 feet wide, extending under the dining room, kitchen, back bed room and bathroom. Wall foundation will extend around the entire perimeter of the house.

OUTSIDE WALLS:

To be of clear 6" bevel siding.

ROOF:

Dark red hexagonal-butt asphalt strip shingles.

COLOR OF INSIDE FINISH:

Light oak oil stain and varnish, except ivory enamel in kitchen and bath room.

COLOR OF EXTERIOR:

Cottage No. 10, ivory with light gray trim.
Cottage No. 11, light gray with ivory trim.
Cottage No. 12, light gray with ivory trim.
Cottage No. 14, ivory with light gray trim.

DRAWINGS AND INSTRUCTIONS TO BE FURNISHED:

The Portland Electric Power Company will require that three complete sets of construction drawings and three books of instructions be furnished with each house. Drawings and instructions are to be mailed to Mr. L. D. Gearing, Advisory Engineer, Portland Electric Power Company, 909 Electric Building, Portland, Oregon.

METHOD OF MAKING SHIPMENT:

The Portland Electric Power Company will furnish a P.E.P.Co. box car for each house spotted on your siding, into which all of the materials, fixtures, etc., for one complete house are to be loaded. Materials should be loaded in the car in a manner that will best facilitate unloading in the proper sequence.

ROUTING AND SHIPPING INSTRUCTIONS:

Ship car load to the Portland Electric Power Company, c/o F. C. Bobley, Station "P", Estacada, Oregon. Car should be suitably marked for identification. Desired shipping date will be announced to you later, probably within two weeks' time.

Shipping weight as follows for each cottage:

Lumber	30,600	pounds
Panel doors	260	"
Glazed doors	85	"
Glazed sash	235	"
Walls	315	"
Paint	265	"
Sash weights	180	"
Building paper	155	"
Hardware	65	"
Linseed oil	45	"
Building woodwork	246	"
Bath tub	320	"
Lavatory	80	"
Toilet	130	"
Sink	200	"
Lighting Fixtures	85	"
Furnace (pipe)	1,400	"
TOTAL	40,690	"

PRICE:

Price F.O.B. loaded on car, your plant, per your quotation dated April 29, 1929, $1,396.46 plus $10.75 for back porch, porch roof and hand railing, or a total price each of $1,410.21.

PACIFIC NORTHWEST PUBLIC SERVICE COMPANY
PORTLAND, OREGON.

Memorandum Covering Purchase of Four Aladdin "Victory Plan S" Ready-Cut Houses, Oak Grove Project, 1930 Budget.

Dated April 26, 1930.

This memorandum outlines the materials which the Aladdin Company will furnish, also designating the method of shipment and supplies information as to type of foundation, arrangement of rooms as regards reversal of plans, kind of shingles, color of paints, enamels, etc. for Aladdin "Victory Plan S" Ready-cut houses, to be furnished during 1930 for employes at the Oak Grove Project.

THE ALADDIN COMPANY WILL FURNISH

4 - Aladdin Victory Plan S" houses, each in accordance with the Aladdin Company's specifications and guarantees for the "Victory Plan S" ready-cut home; including No. 22 Monteg oval firepot, hot-air pipe furnace, complete with the necessary floor grills and individual side wall registers for the various rooms, hot and cold air pipes, smoke pipe, oak cold air grills, asbestos pipe covering; including electric lighting fixtures ("Feverite" set), wired and ready to hang but less bulbs; including plumbing fixtures ("Metropolitan" set), bathroom medicine cabinet and bath wall fixtures, kitchen sink No. 2 and kitchen cabinet and wall doors, windows and framing, door and window hardware, lock sets, nails, paints, enamels and varnishes, also eave troughing and down spouts. Purchaser will supply all necessary cement, sand, gravel, lime, brick and plaster. Also laundry trays, hot water tank, plumbing materials and fittings, and soil and sewer piping.

The furnace furnished will be supplied by you through the Monteg Stove Works, Portland, Oregon, designated on the Monteg No. 22, oval firepot furnace. The following dimensions pertain to the furnace:

Overall diameter of furnace casing	42"
Height of furnace casing to flaring bonnet	50"
Height of flaring bonnet	15"
Diameter of top of bonnet	30"
Overall height of furnace	65"
Distance from floor line to center of hot air outlet pipes	Depend upon size of outlet.
Distance from floor line to bottom of smoke outlet pipe	40"
Diameter of smoke pipe	8"
Width of firepot	14½"
Length of firepot	22½"
Size of feed door	12" x 12½"
Grate area in square inches	198 sq. in.
Size of ash pit opening	11" x 14"
Heating surface in square inches	4623 sq. in.

NOTE: A detailed basement and furnace layout will be made by the Engineering Department of the Pacific Northwest Public Service Company and submitted to you for approval. All hot and cold air piping, floor grills and registers shall be furnish d in the required sizes suitable for this layout.

FLOOR PLAN:

Furnish material so that purchaser can follow floor plan shown on page 15 of catalog "Aladdin Homes" or can reverse floor plan if he so desires.

BACK PORCH:

Omit back porch material as purchaser has four sets on hand.

FOUNDATION:

The Pacific Northwest Public Service Company will erect a solid wall concrete foundation, 8" thick and ... feet high from finished basement floor to top of foundation wall. The basement may be termed a 2/3 basement, 28 feet long, 26 feet wide, extending under the dining room, kitchen, back bedroom and bathroom. Wall foundation will extend around the entire perimeter of the house.

OUTSIDE WALLS:

To be of clear 6" bevel siding.

ROOF:

Dark red herringbone butt asphalt strip shingles.

COLOR OF INSIDE FINISH:

Light oak oil stain and varnish, except ivory enamel in kitchen and bath room.

COLOR OF EXTERIOR:

Two cottages, ivory with light gray trim.
Two cottages, light gray with ivory trim.

DRAWINGS AND INSTRUCTIONS TO BE FURNISHED:

The Pacific Northwest Public Service Company will require that three complete sets of construction drawings and three books of instructionsbe furnished with each house. Drawings and instructions are to be mailed to Mr. E. H. Searing, Advisory Engineer, Pacific Northwest Public Service Company, 905 Electric Building, Portland, Oregon.

METHOD OF MAKING SHIPMENT:

The Pacific Northwest Public Service Company will furnish a P.N.S.P.Co. box car for each house spotted on your siding, into which all of the materials, fixtures, etc., for one complete house are to be loaded. Materials should be loaded in the car in a manner that will best facilitate unloading in the proper sequence.

ROUTING AND SHIPPING INSTRUCTIONS:

Ship car load to the Pacific Northwest Public Service Company, c/o F.G.Sobley, Station "F", Bethesda, Oregon. Car should be suitably marked for identification. Desired shipping date will be announced to you later, probably within two weeks' time.

Shipping weight as follows for each cottage:

Lumber - - - - - - - - - -	20,000	pounds
Panel doors - - - - - - -	260	"
Glazed doors - - - - - - -	88	"
Glazed sash - - - - - - - -	235	"
Nails - - - - - - - - - -	215	"
Paint - - - - - - - - - -	260	"
Sash weights - - - - - - -	150	"
Building paper - - - - - -	110	"
Hardware - - - - - - - - -	55	"
Linseed oil - - - - - - -	46	"
Building woodwork - - - -	240	"
Bath tub - - - - - - - - -	320	"
Lavatory - - - - - - - - -	80	"
Toilet - - - - - - - - - -	150	"
Sink - - - - - - - - - - -	200	"
Lighting fixtures - - - -	85	"
Furnace (wire) - - - - - -	1,400	"

Total 40,890 pounds.

PRICE:

Price F.O.B. loaded on car, your plant, per your quotations dated April 12 and 18, 1920, $1,414.77. Price for four houses $6,[illegible].

SPECIFICATIONS
FOR
THE ERECTION OF MAIN OF SIX
FIVE-ROOM COTTAGES, FOR THE
PACIFIC NORTHWEST PUBLIC SERVICE COMPANY
ON THE COMPANY'S PROPERTY
LOCATED AT STATIONS "C" AND "F" RESPECTIVELY

Dated July 26, 1930

General Conditions

In this specification the term "Contractor" is used to designate the party or parties who contract to furnish all labor necessary for the completion of the herein described cottage. The term "Owner" is used to designate the Pacific Northwest Public Service Company.

Protection and Watchman

The Contractor shall erect and maintain as required by law and as is necessary all temporary guards, railings, fences, warnings, lights, etc., during the execution of the work, for the proper protection and convenience of workmen and the public.

Drawings

The attached drawings, Folder #DE 526, 11 sheets, Dwgs. No. DE 1023, No. DE 1030 and DE 919 are hereby made a part of these specifications.

Material and Labor

All material to be used in the erection of the cottage will be furnished by the Owner. Material will be delivered on board cars on a siding as near as possible to the location of the cottage.

The Contractor shall furnish to the Owner, at least five days in advance of the time needed, a list showing quantities of materials, such as sand, gravel, cement, insulated wire, knobs, plumbing materials, etc., required in the erection, in order that the Owner will have ample time in which to deliver said materials.

All excavation, grading and backfilling will be done by the Owner.

Each concrete foundation and concrete basement walls will be built by the Owner, and the forms removed by the Owner, leaving this work ready for the erection of the cottage covered by these specifications.

All other work, not herein definitely mentioned as being done by the Owner, shall be done by the Contractor.

The Contractor will unload from the cars and deliver to the building site, all materials for the completion of the cottage.

For the cottages to be built at Station "P" (Oak Grove), the Owner will furnish a wagon, caterpillar tractor and a driver, for the use of the Contractor in transportation of materials and tools, between the cars and the building site. The Contractor shall, however, unload and load all material.

For the cottages to be built at Station "O", the Contractor shall furnish trucks or other transportation equipment.

All tools, ladders, mortar boxes, concrete mixer, material for scaffolding, and equipment used in construction work shall be furnished by the Contractor and removed from the premises by him upon the completion of the work.

Transportation

The Owner will furnish free transportation for all men and equipment used in the work between Cazadero and Station "P". Except as above, the Contractor will furnish his own transportation.

Board and Lodging

The Contractor shall make his own arrangements for quarters and meals for his men.

Temporary Buildings

The Contractor is to build, if necessary, a temporary office and tool shed, the material for these to be furnished by him.

Water

All water used in the work under the contract will be furnished by the Owner.

Excavation and Grading

The Owner will do all excavating, grading, and backfilling necessary for the completion of the work to be done under these specifications.

Concrete

A concrete floor 3 inches thick shall be poured in the basement by the Contractor, the concrete to be 1:2:4 mix. The top shall be finished with

a topping of equal parts of sand and cement 3/4 inches thick laid in one operation with the slab. The surface shall be trowelled to a smooth, even surface, sloping in all directions to the basement floor drain.

Concrete to be mixed not less than one minute in a power mixer.

Chimney

Chimney to be built as shown on the plans; flue to be 8" x 12", a 8" thimble for kitchen, and 8" for furnace to be installed. Plaster the flue on the inside throughout, and all brick-work that is to be covered by wood-work with lime and cement mortar on the outside.

Chimney to be flashed and counter flashed in such a manner as to be perfectly water tight.

Concrete footing for chimney to be built by the Contractor.

Lath and Plaster

Lath the entire first story, breaking joints every ninth lath. Lath shall not run through from one room to another, and all corners shall be solid. Put up grounds for all interior finish before lathing.

The plastering shall be 2 coat work, consisting of a good heavy coat of hard plaster, well fibered. The second coat shall be put on before the first coat is entirely dry, and shall be composed of a coat of putty mortar well trowelled, and brought to a line with a straight edge, and given a true, even surface. The entire job to have a sand finished surface.

Carpentry

Frame to be plank and true, well spiked together.

Wall and floor, and roof sheathing to be well driven together and well nailed twice to each bearing.

Walls and floor to have covering of one thickness of building paper furnished. To be well lapped and extended behind all casings, etc.

Asphalt shingles are to be laid in strict accordance with the instructions furnished by the manufacturer, which are packed with the shingles.

All trim, inside and out, shall be put on neatly in accordance with the drawings and all mills in trim and sliding to be countersunk.

Metal flashing to be installed at tops of all door and window heads.

Cabinet Work

Erect and install all cabinet work furnished, including bath room, medicine cabinet, kitchen cabinet, and bath room wall fixtures.

Electrical Work

The Contractor will wire the building complete in accordance with the plans furnished and in accordance with the latest Oregon Electrical Code, and the National Safety Code. Contractor will install fixtures, switches, etc., ready for use.

Sheet Metal

The Contractor will install all gutters, downspouts, flashings, etc. as furnished by the Owner.

Painting

Paint all outside work with three coats of paint with materials furnished. Prime the exterior work as fast as put on. Paint all exterior wood-work 2 coats in addition to priming. Paint all sheet metal work one coat of red lead and 2 coats of white lead paint. Shellac all knots before priming.

All interior wood-work, except kitchen and bath room to be given one coat of the light oak stain furnished, and one coat of varnish.

Bathroom and kitchen to have the wainscoting and wood trim given a priming coat, two coats of white lead and oil, and one coat of white enamel paint as furnished. This work to be sandpapered between each coat.

All nail holes, inside and out, to be puttied flush with the surface before priming, or first coat is applied.

Heating Plant

Set up in basement the furnace furnished, install smoke pipe and hot and cold air pipes, doing cutting and fitting as necessary. Cover pipes with insulation furnished. All registers to be fitted and entire installation left ready for use.

Plumbing

All plumbing to be installed as shown on the drawings including bath tub, water closet, lavatory, kitchen sink, hot water boiler and heater, laundry trays, and floor drain. All material to be furnished by the Owner but all cutting and fitting to be done by the Contractor. All work is to be the best and to be in accordance with the Portland City Plumbing Code.

Clean Up

At the finish of his work, the Contractor is to remove from the premises all accumulated rubbish, surplus material, scaffolding and tools, and leave the building and property in a condition satisfactory to the Owner.

Character-Defining Features of the Cottages at Three Lynx

CHARACTER-DEFINING FEATURES

All buildings have their own identity and their own distinctive character. Character refers to those visual aspects and physical features that comprise the unique appearance of each historic building. Character-defining elements include the overall shape of the building, its materials, craftsmanship and decorative details, as well as interior spaces and features. If these elements are not recognized and preserved, then the essential aspects of the building's character may be irreversibly damaged or changed. The importance of interior features and finishes to the character of the building should not be overlooked. The two distinct cottage designs at Three Lynx each have their own set of character-defining feature that are essential to their history and definition.

Character-defining features of the Aladdin cottages:

Some visible features include the gabled roof, lap siding, corner boards, and daylight basement windows.

Rectangular plan – single story
Massed plan (2x6 units)

Board formed foundation
Construction process – concrete framework was constructed of individual boards, which left their impression on the foundation walls when removed

Chamfered foundation corners
Chamfer strips were used in the framework of the concrete foundation creating angles at the four corners of the foundation wall, on the interior and exterior

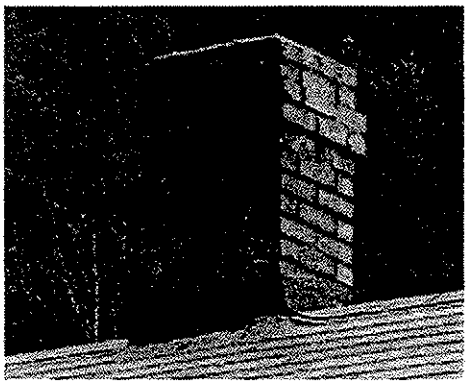
Daylight basement
Small windows were framed into the foundation framework to provide light in the basement

5 1/2" horizontal wood lap siding

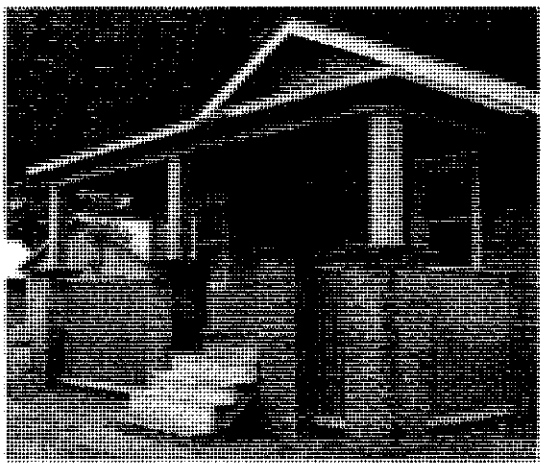
Corner boards
Located on the four exterior corners, the siding is fitted up against these boards

Front gabled roof
The main roof form gives shape to the building with its distinct pitch, front gabling indicates access points at the gabled ends, originally asphalt shingled

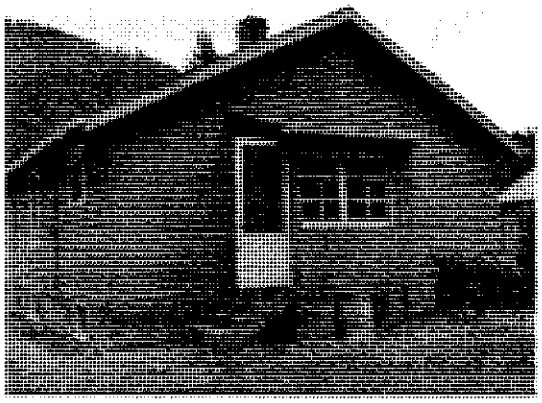
2 x 8 vergeboard at gable ends



Chimney corbel detail.



Aladdin front porch, featuring brick piers and box columns, slatted skirt/rail, and hip roof.



The character-defining back porches are all raised and covered by shed roofs.

Bead board soffit
: Finish material – indicates attention given to detail

Exposed rafter tails
: End grain left exposed (painted) with no fascia boards and an open cornice/eave

Corbelled chimney
: Chimney located at the ridge and is corbelled two courses

1/3 glazed entry doors
: Front and back doors are partially glazed, differentiated from all other interior doors

1/1 single hung windows
: Wood framed windows with fixed upper sash, lower sash operation supported by sash cord and weight pulley system

Brick pier and wooden box columns – front porch
: Serration on brick is a unique characteristic, support assembly as a whole is indicative of the Craftsman style

Tongue-and-groove porch floor
: Running perpendicular to front wall and sloping away from the cottage, still original on many cottages

Slatted porch rail and skirt
: Unique slatted design, as ordered originally from the Aladdin Co., uninterrupted vertical lines from hand rail to just above ground

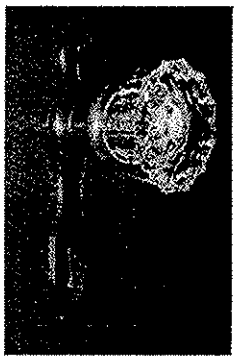
Bead board ceiling
: Finish material consistent with soffit

Hipped porch roof
: Lowered off front gable, part of Craftsman porch assembly

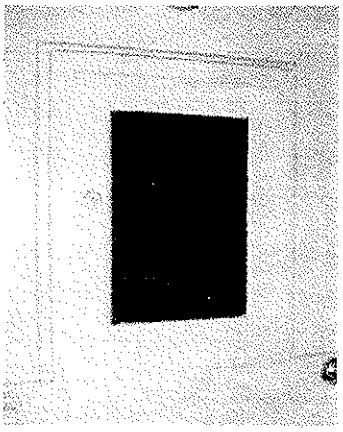
Covered back porch
: Small, raised porch off back gable with shed roof, original degree of enclosure undetermined

Character-defining features of the Aladdin interiors:

Varnished door and surround; plaster walls.



Original door handle.



Built-in medicine cabinet, part of "Metropolitan" set of Aladdin bath fixtures.

Open archways
: Wide, open archway between living and dining room

Exposed Wood flooring
: In some cases flooring is still exposed, in others carpet has been laid but wood floor still exists underneath

Plaster walls
: Lath and plaster

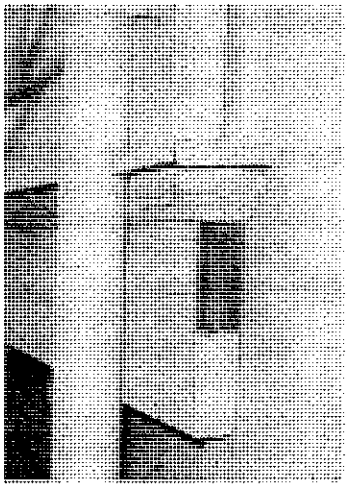
Varnished trim and doors
: Interior window and door surrounds, baseboards, and panel doors varnished, not painted

Hardware
: Door hinges, knobs, and locks; window locks of matching design

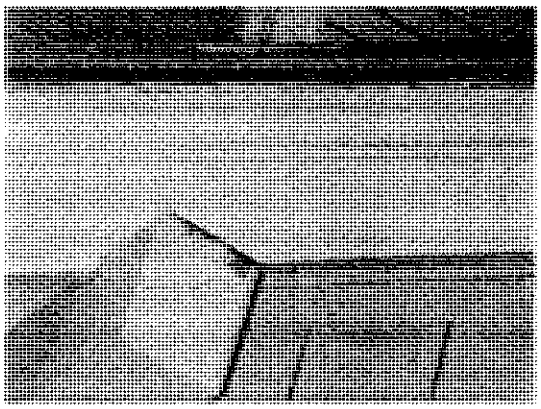
Bathroom fixtures
: Square sinks and clawfoot bath tubs are part of the "Metropolitan" set of bathroom fixtures originally sent by the Aladdin Company

Character-defining features of the Traditional cottages:

Some visible features include the board formed foundation, lap siding, corner boards, and closet attached to the left side of the cottage.



Detail of wooden water table; cut to accommodate pipe is not recommended.



Detail of vergeboard molding.

Rectangular plan – 1 ½ story

Board formed foundation
- Construction process – concrete framework was constructed of individual boards, which left their impression on the foundation walls when removed

Daylight basement
- Small windows were board framed into the foundation framework to provide light in the basement

Horizontal wood lap siding

Corner boards
- Located on the four exterior corners, the siding is fitted up against these boards

Wood water table
- Decorative horizontal trim piece projecting from siding to divert rainwater away from the building

Projecting closet extension
- An add-on consistent among all Traditional cottages, cantilevering out from floor height to top of first floor with shed roof

Front gabled roof
- The main roof form gives shape to the building with its distinct pitch; front gabling indicates access points at the gabled ends

Vergeboard at gable ends

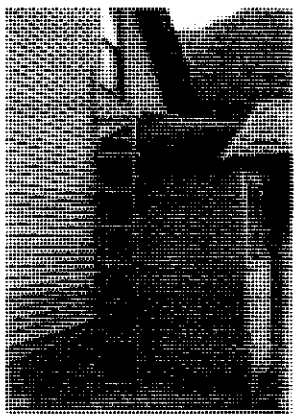
Molding at top of vergeboard
- Unique to Traditional cottages, extra piece of decorative molding covering joint where vergeboard connects with roofing

Brackets at gable overhang
- Craftsman style triangular knee braces at gable end corners support overhangs

Notched rafter tails for gutter system

Traditional front porch includes wooden skirt, railing, vergeboard with tie, purlins, and gabled roof.

Rear view of enclosed back porch.



Wooden fire escape ladder unique to Traditional cottages.

Exposed rafter tails
: End grain left exposed (painted) with no fascia boards and an open cornice/eave

Corbelled chimney
: Chimney located at the ridge and is corbelled two courses

1/3 glazed doors
: Front and back doors are partially glazed, differentiated from all other interior doors

1/1 double hung windows
: Wood framed windows with upper and lower sash operation supported by sash cord, weight, pulley system

Wood porch skirt

Wood porch railing
: Pattern/spacing of members important to maintain

Tongue-and-groove porch floor
: Running perpendicular to front wall, still original on many cottages

Gable porch roof
: Mimics the main roof gable, same pitch

Wide vergeboard on porch gable
: Mimics the main roof gable vergeboard

Decorative collar tie
: Craftsman element on porch gable

Projecting purlins at porch gable
: Craftsman porch detail

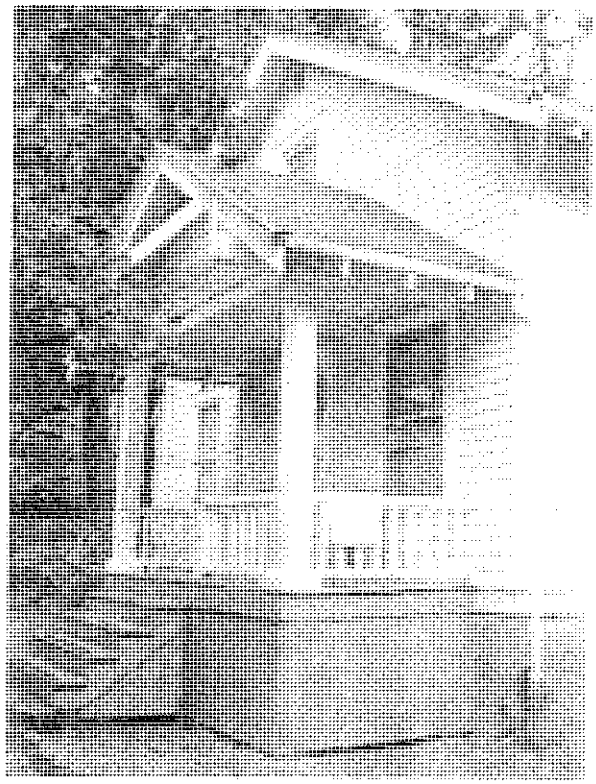
Enclosed rear porch
: Raised porch with side entry, interior stairs, windows, and hipped roof

Wooden fire escape ladder
: Located on back porch allowing access from the ground to the porch roof, which in turn allows emergency access to the upper story window , placement universal

Inventory Analysis

a house by house
analysis
of the
Three Lynx Cottages

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #2



TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924 (possibly earlier)

ORIENTATION:
NW

COLOR:
Mint Green with White Trim

STATUS:
Occupied part time

VEGETATION:
Ivy on back porch, trees close to East side of house

FRONT PORCH:
Gable roof, post WWII decking

REAR PORCH:
Shed roof, aluminum screen door with scroll details, possibly a later addition

CHIMNEY:
Full, with metal flue. Bad connection to roof

FOUNDATION:
Crack, middle of west wall

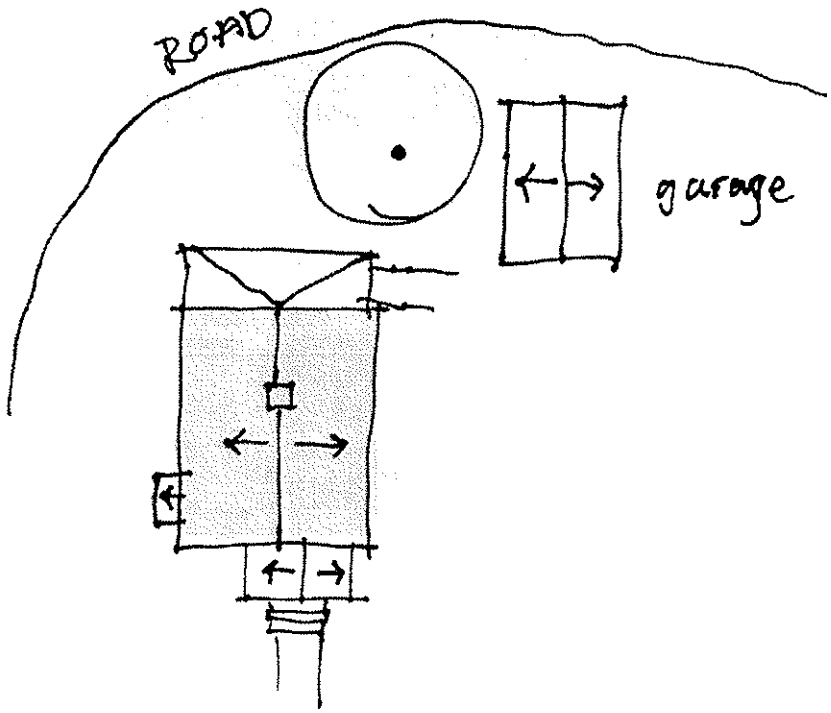
WINDOWS:
Permanently affixed aluminum storms

OTHER NOTES:

PROJECT : 3 LYNX

SITE ID: 2
RECORDER: [illegible] N
DATE: 10·7·01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK

F B

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #3

TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924

ORIENTATION:
S

COLOR:
Mustard Yellow with Brown Trim

STATUS:
Occupied

VEGETATION:
Trees close to east side side of house, close to SW corner

FRONT PORCH:
Painted plywood, with ADA ramp, unpainted steps, gable roof

REAR PORCH:
Hip roof with fire escape ladder and aluminum screen door with scroll details

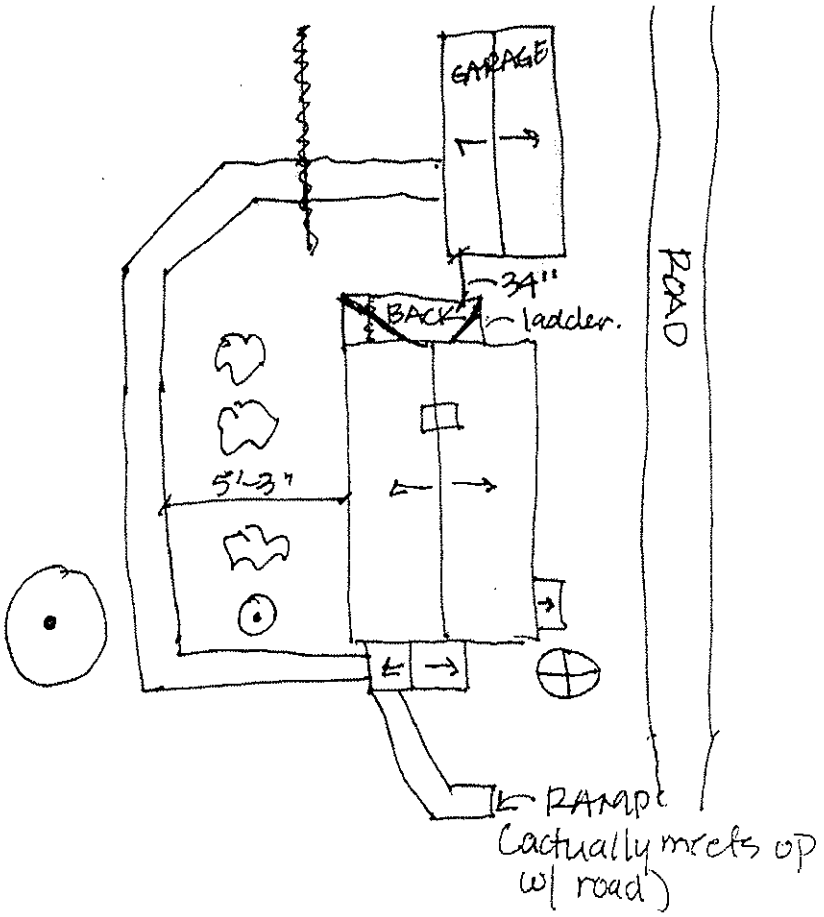
CHIMNEY:
Full, with flue and sealant at roof connection.

FOUNDATION:

WINDOWS:
No storms or hooks evident

OTHER NOTES:
Wood gutter only on N side.
Moss on roof

Site ID #3
10.7.01
CHRISTY



OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #4

TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924

ORIENTATION:
SE

COLOR:
Light blue

STATUS:
Occupied

VEGETATION:
no

FRONT PORCH:
Gable roof, T-111 skirt, treated steps and handrail

REAR PORCH:
Hip roof, vertical wood board siding and T-111 with a fire ladder and metal screen door

CHIMNEY:
Full with metal flue

FOUNDATION:
North wall formed at an angle -- appears concrete was poured twice. Parging SE corner. Hairline cracks at the bottom of foundation windows

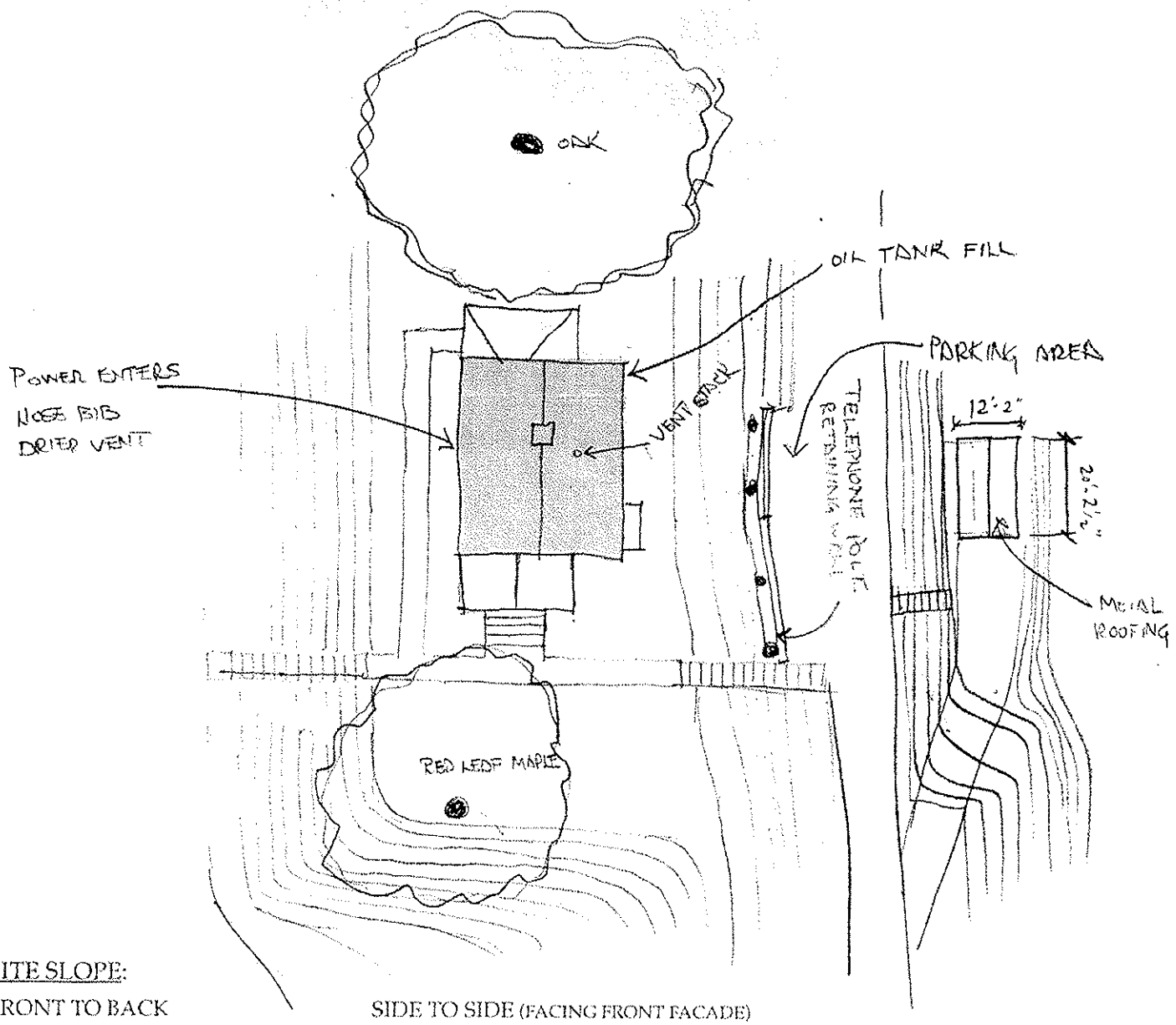
WINDOWS:
Storm hooks

OTHER NOTES:
Some damage on the East side wall

PROJECT : 3 LYNX

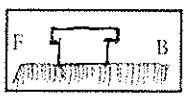
SITE ID: 4 BLUE w/WHT TRIM
RECORDER: D. STEELE
DATE: 10/7/01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

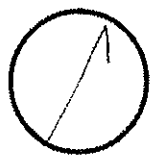


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

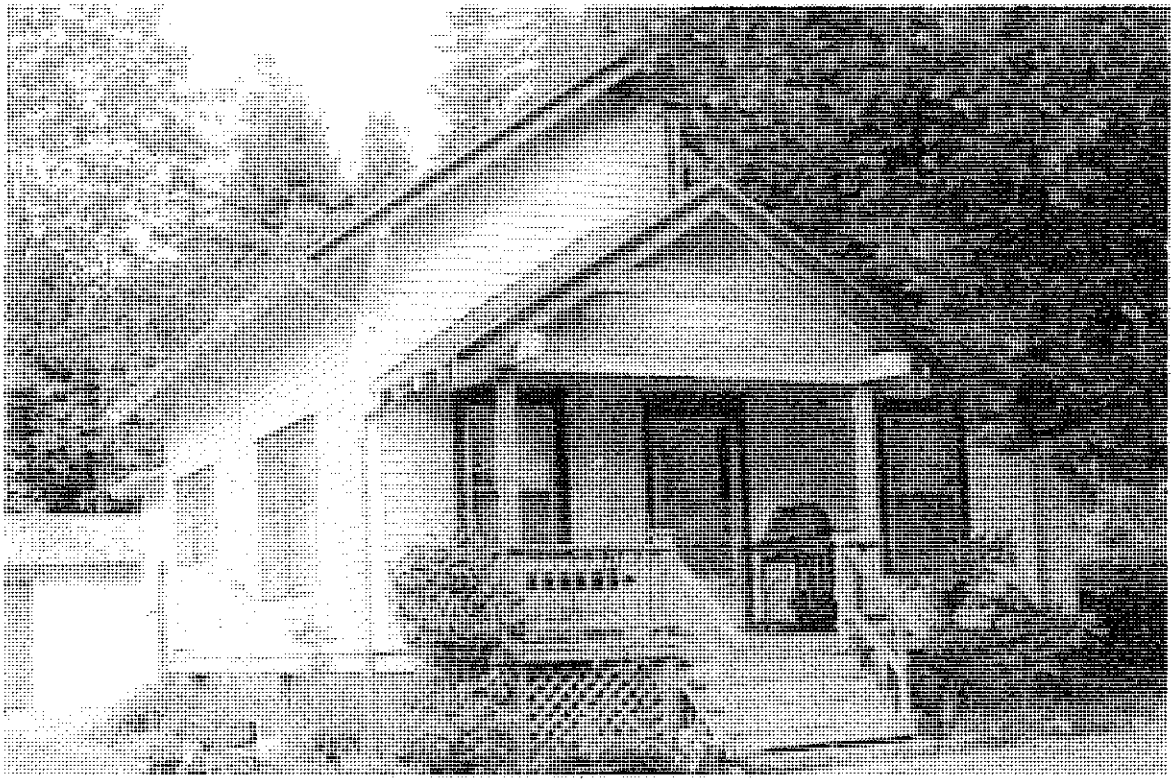
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #5



TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924

ORIENTATION:
SE

COLOR:
Pale Yellow with Brown Trim

STATUS:
Occupied

VEGETATION:
Two trees to East of front facade

FRONT PORCH:
Gable roof, aluminum screen with scroll details

REAR PORCH:
Hip roof with aluminum screen door

CHIMNEY:
Truncated with metal flue

FOUNDATION:
Concrete buttresses under the kickout;
Crack, south wall, middle

WINDOWS:
Some permanent aluminum storms. Window surrounds on the South side of the house are missing paint.

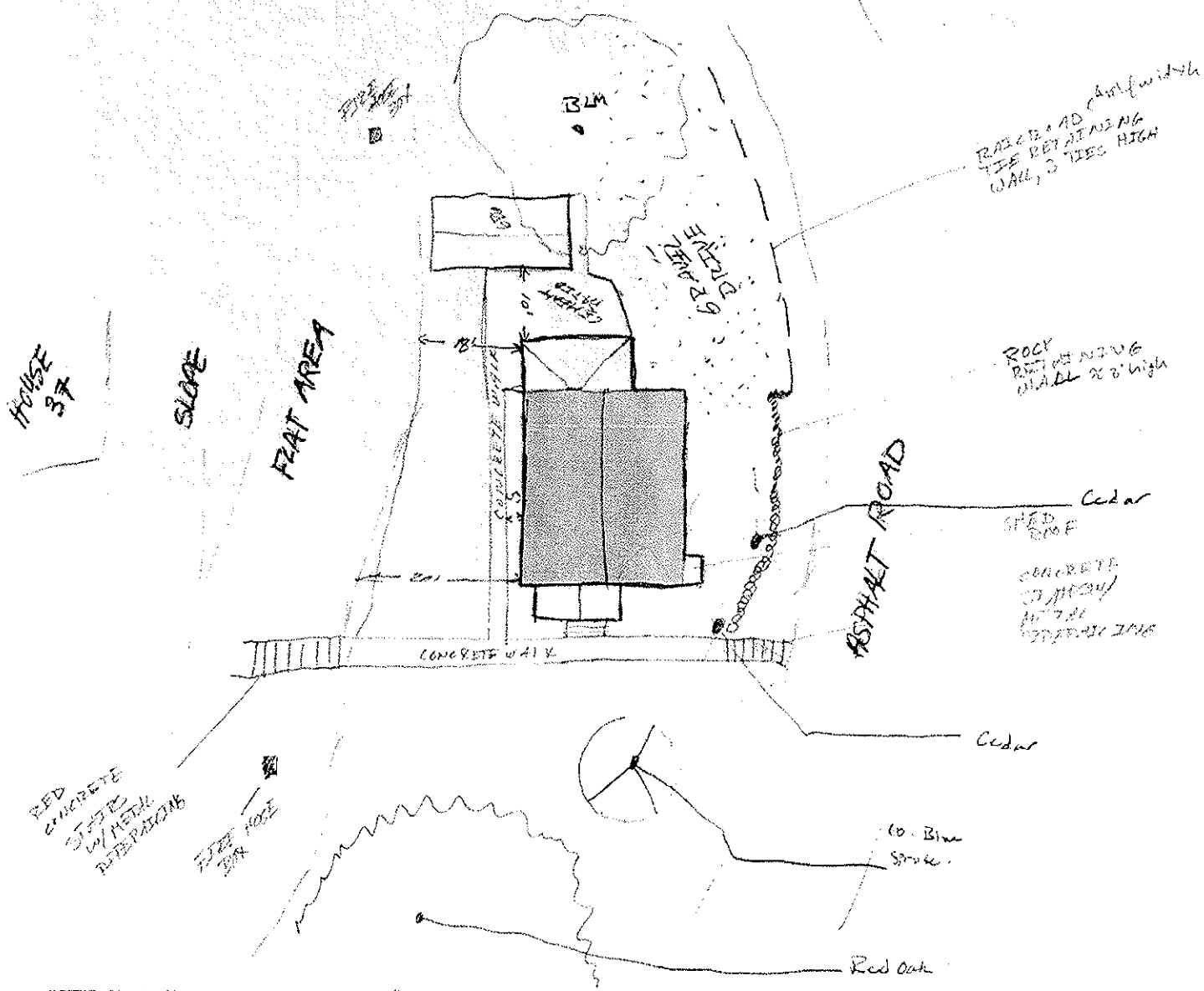
OTHER NOTES:
Water damage on the south side wall
Some evidence of gutter decay

PROJECT : 3 LYNX

PROCEDURE

1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

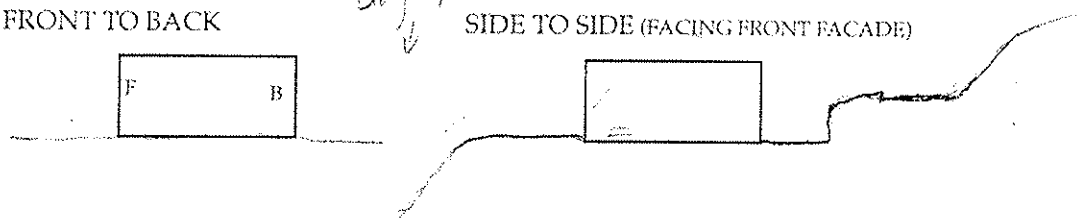
SITE ID: Bldg #5
RECORDER: Spencer T
DATE: Oct 8, 2001



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

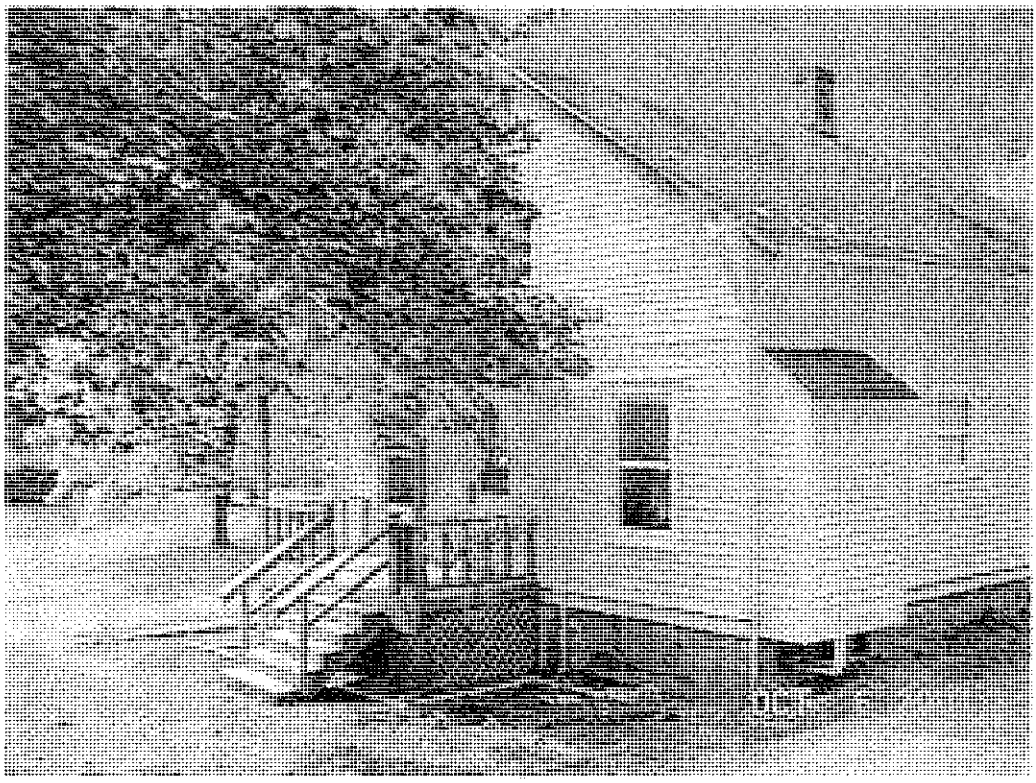
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #6



TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924

ORIENTATION:
SE

COLOR:
Cream

STATUS:
Unoccupied, used for storage

VEGETATION:
Garden around sides, non-intrusive

FRONT PORCH:
no recorded information

REAR PORCH:
Metal screen door

CHIMNEY:
Full, sealant at roof, no flue

FOUNDATION:
Crack at SE corner, parging NE corner, decay of foundation windows

WINDOWS:

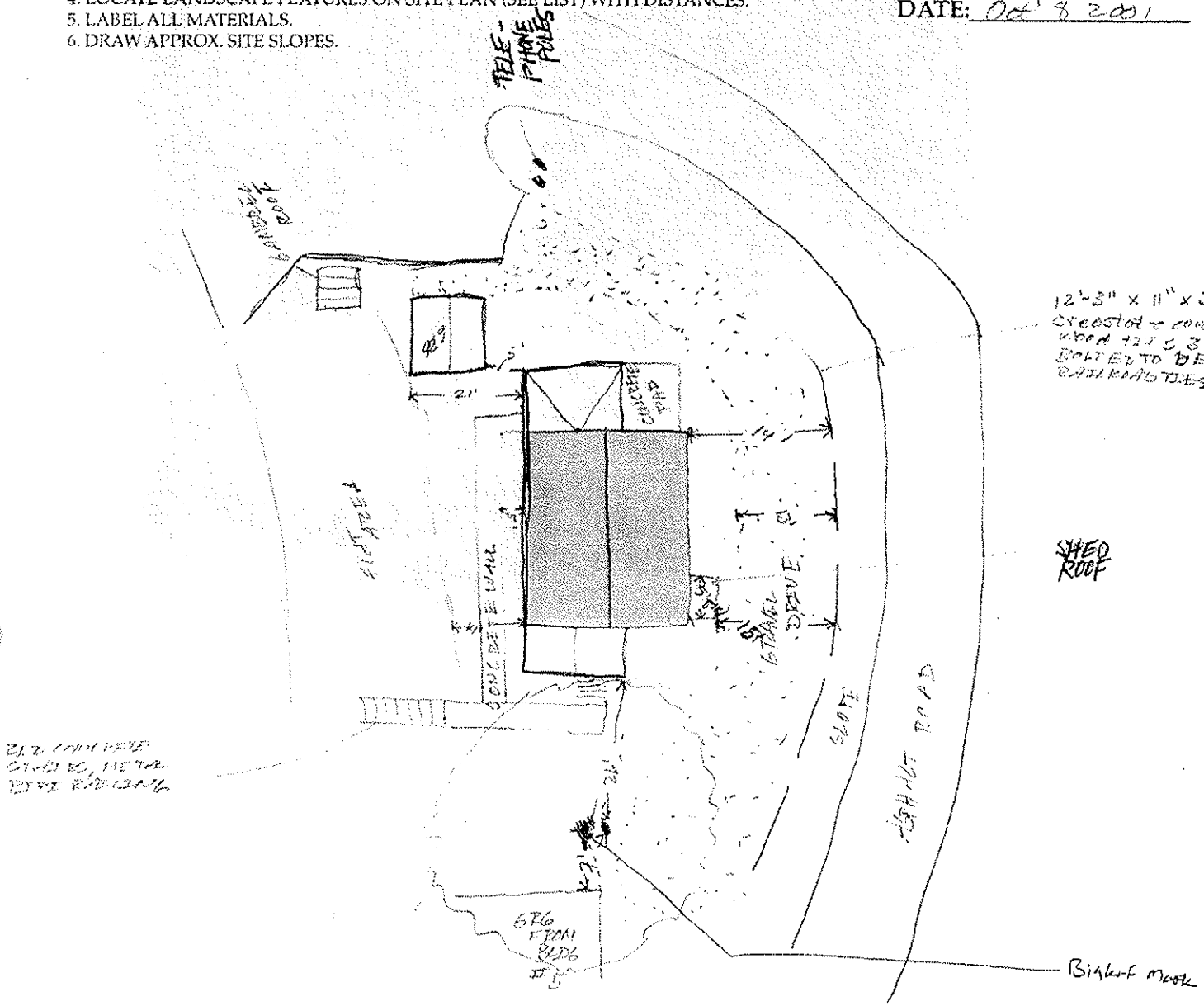
OTHER NOTES:
Painted wood bedroom floor.
Picture moldings throughout.
Downstairs smells musty - may indicate moisture problems.
Bathtub has been painted.

5 & 6 outside
Inside 14 Pass.

PROJECT : 3 LYNX

PROGEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

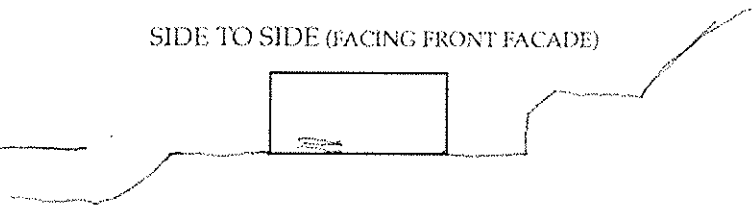
SITE ID: Bldg #6
RECORDER: Steve Hawk
DATE: Oct 3 2001



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #7

TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924

ORIENTATION:
S

COLOR:
Very Light Green

STATUS:
Occupied

VEGETATION:
None

FRONT PORCH:
Gable roof, with metal screen. Holes have been drilled in skirt.

REAR PORCH:
Hipped roof with metal screen

CHIMNEY:
Metal flue.

FOUNDATION:
Crack at SW corner

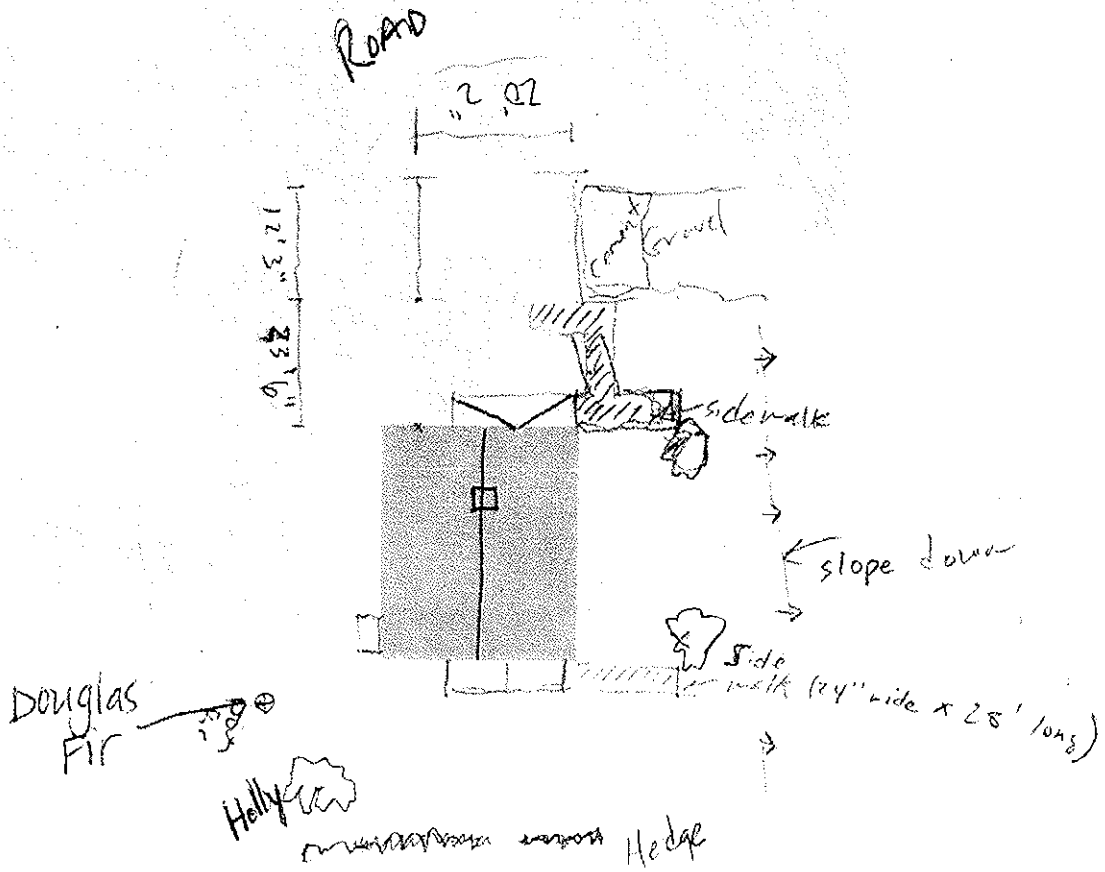
WINDOWS:
One broken light on SW face. Has storm hooks.

OTHER NOTES:
Some siding warped under kitchen window.
One broken board, SW face
Wall vents under windows
Signs of moisture damage under bathroom window.
Damaged and broken foundation windows

PROJECT : 3 LYNX

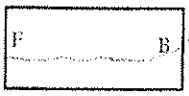
SITE ID: #7
RECORDER: Phil
DATE: 10/7/01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

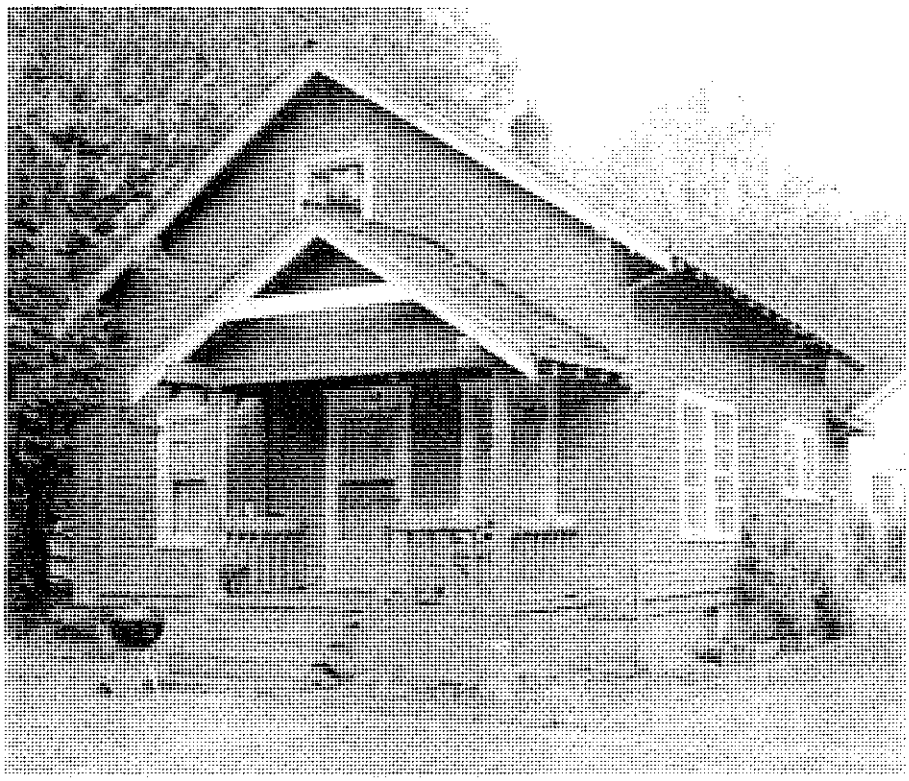
FEATURES

WALKWAY
DRIVEWAY
~~FENCE/WALLS~~
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
~~SHEDS~~

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #8



TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924

ORIENTATION:
S

COLOR:
Brown with Tan trim.

STATUS:
Occupied

VEGETATION:
Trees to W of front facade

FRONT PORCH:
Gable roof. Replaced decking. T-111 skirt, aluminum screen with scroll details.

REAR PORCH:
Hipped roof, enclosed with beadboard. Aluminum screen with scroll details.

CHIMNEY:
Full, with metal flue.

FOUNDATION:
Painted.

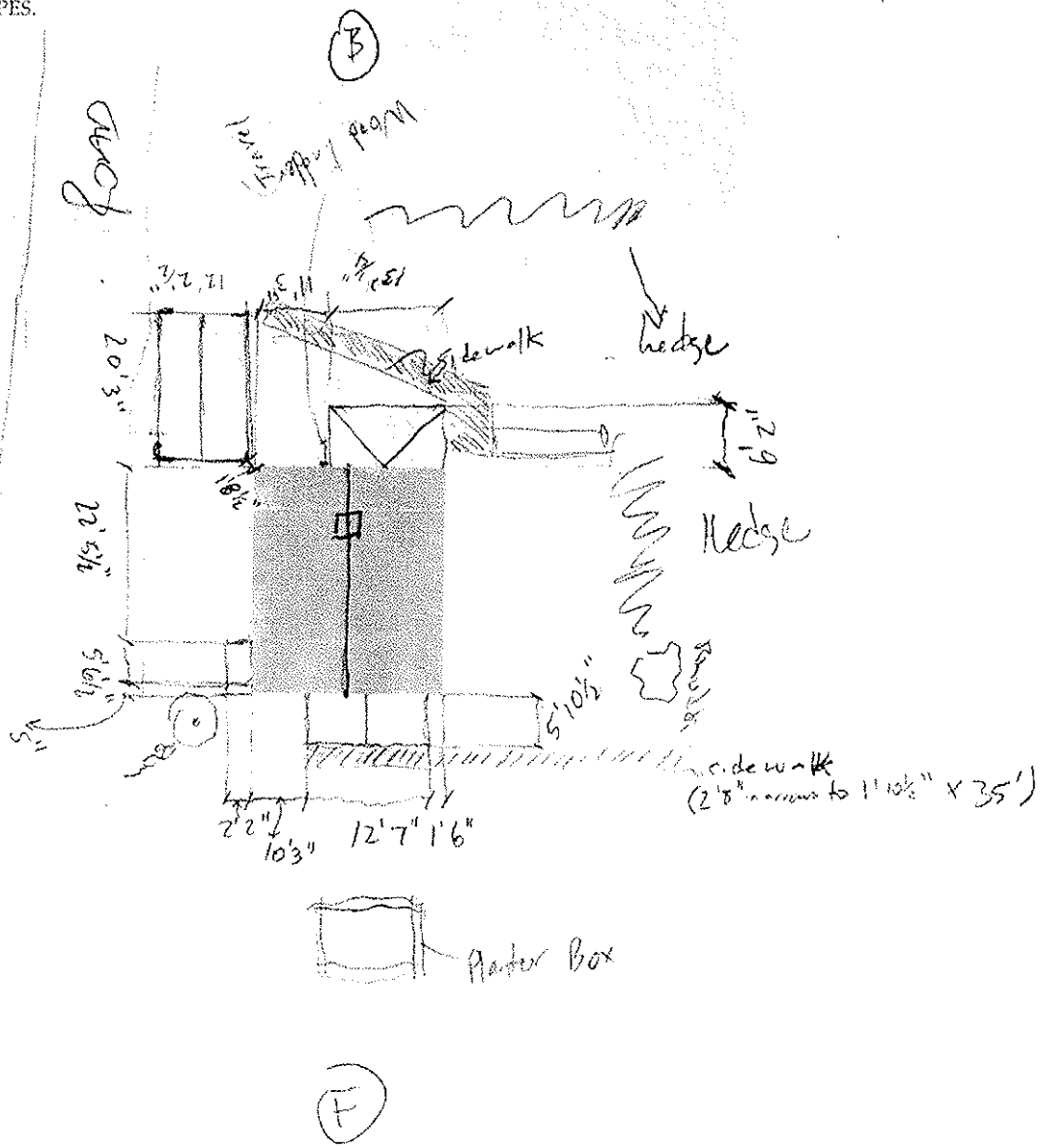
WINDOWS:
Some metal inset screens. Storm hooks.

OTHER NOTES:
Bath window is filled in
Vent above former window
Broken siding on the W side kickout
Roof has moss and ladder
Foundation window on W side is missing.
Others have plastic coverings.

PROJECT : 3 LYNX

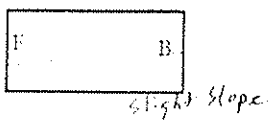
SITE ID: 8
RECORDER: MHC
DATE: 10/7/2021

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

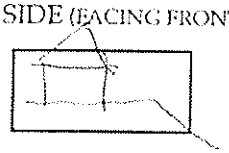


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

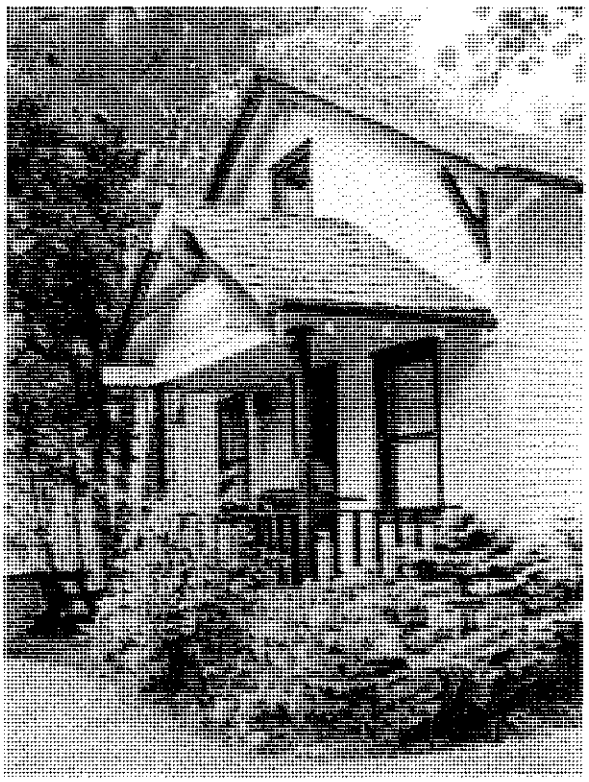
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/~~CARPORT~~
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #9



TYPE/STYLE:
Traditional, 1.5 stories, daylight basement

DATE/YEAR:
1924

ORIENTATION:
S

COLOR:
Lime Green with Forest Green Trim

STATUS:
Occupied

VEGETATION:
Trees close to front of house. Large shrubs on W side of front.

FRONT PORCH:
New flooring, parallel to house body. Gable roofed. Plastic weatherizing coverings on windows.

REAR PORCH:
Hip roof. Metal screen door.

CHIMNEY:
No corbel -- truncated? Metal flue.

FOUNDATION:
Cracks, S wall W end. E wall. N wall near W end.

WINDOWS:
New storm hangars.

OTHER NOTES:
Paint peeling on W side siding
Non-original wood shake roof

PROJECT : 3 LYNX

SITE ID: 9
RECORDER: PHIL
DATE: 10/7/01

PROCEDURE

1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

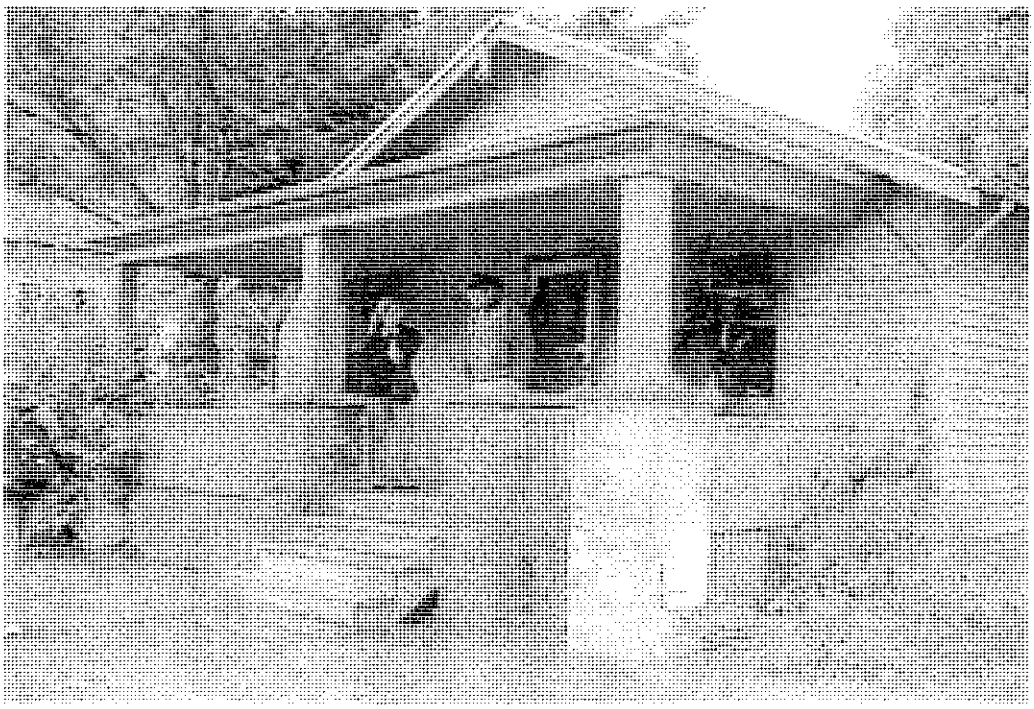
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #35



TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1929

ORIENTATION:
S

COLOR:
UNKNOWN

STATUS:
Vacant -- storehouse

VEGETATION:
Bushes to West of porch

FRONT PORCH:
Hip roof. Windows painted shut. Watch for dry rot on joists. Parged piers. Original Aladdin light fixture.

REAR PORCH:
Shed roof. Beadboard siding and roof soffitt. Plywood floors. Wood screendoor and wood steps. May be original configuration.

CHIMNEY:
Some missing bricks and deteriorated mortar. No flue. Efflorescence in basement.

FOUNDATION:
4 windows boarded up. Many small cracks.

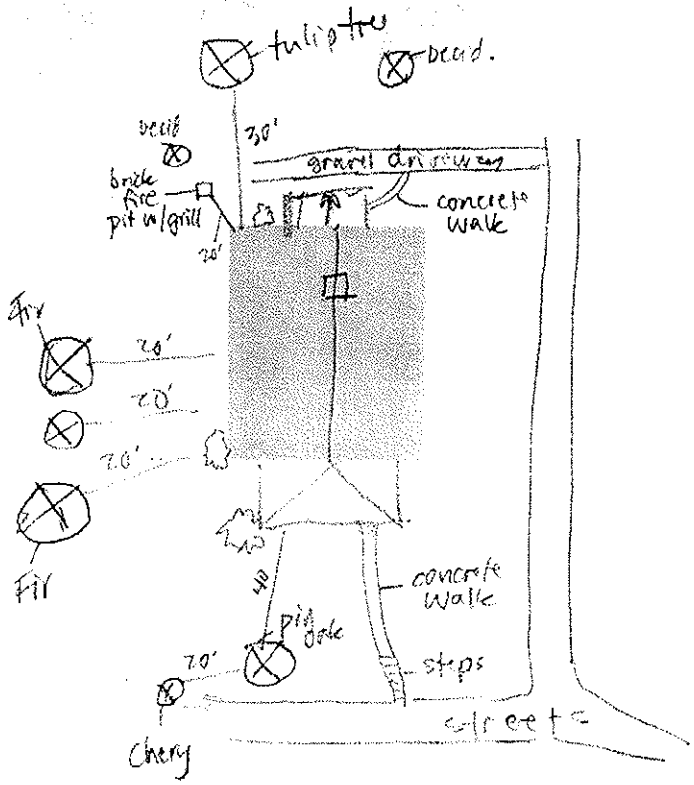
WINDOWS:
Storm hooks.

OTHER NOTES:
Bathroom window sided over. Bath has no sink or toilet. Contains some orignal varnished doors. Thimble in kitchen covered improperly. Mildew on interior walls -- living room and kitchen.

PROJECT : 3 LYNX

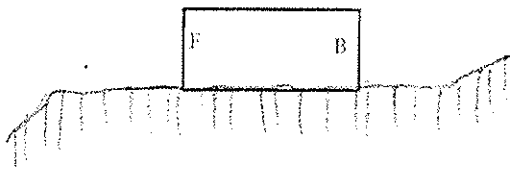
SITE ID: #35
RECORDER: MARTI
DATE: 7 OCT 01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

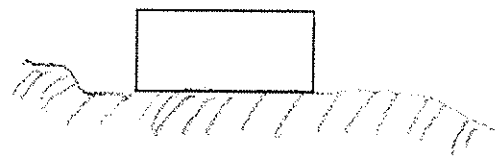


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #36

TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1929

ORIENTATION:
SW

COLOR:
Bright Yellow

STATUS:
Occasional use as field house. Once known as the cookhouse.

VEGETATION:
Vines on porch rails.

OTHER NOTES:
Some original varnished woodwork inside the bedrooms. Fixtures in the bath may be original Aladdin. Appliances in kitchen are not original, but are older and may have significance for the cookhouse. Extra attic vents in rear of house. Musty chemical smell in porch.

FRONT PORCH:
Hipped roof. Plywood deck, weathering badly, paint worn off. Bottom board of rail missing on SE corner -- all others touch ground. Aluminum screen door with scroll details. Has original Aladdin light fixture.

REAR PORCH:
Shed roof. Jerry-rigged structure: see original assessment form for details and drawings.

CHIMNEY:
Missing above roofline

FOUNDATION:
Cracks--SW side, SE side, from window on W. Recently patched vent hole.

WINDOWS:
Badly damaged sill on W side, middle window: covered with metal plate.

PROJECT : 3 LYNX

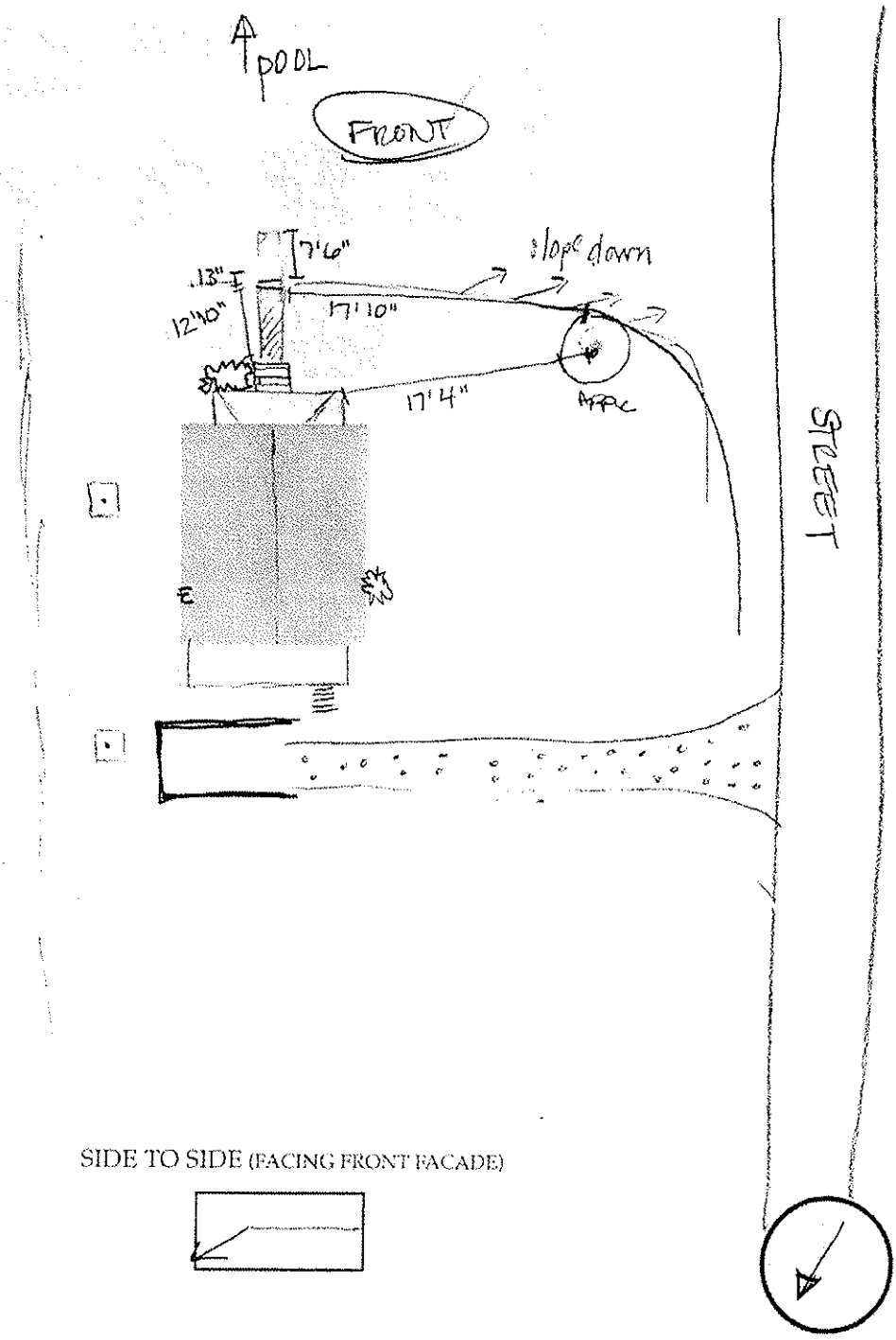
PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 36
RECORDER: [redacted] KA
DATE: 6 OCT 2001

Horseshoe game to NE side, iron poles (?) in sand

E = electric cnxn

NOTE: This house has NO chimney on the ext.



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

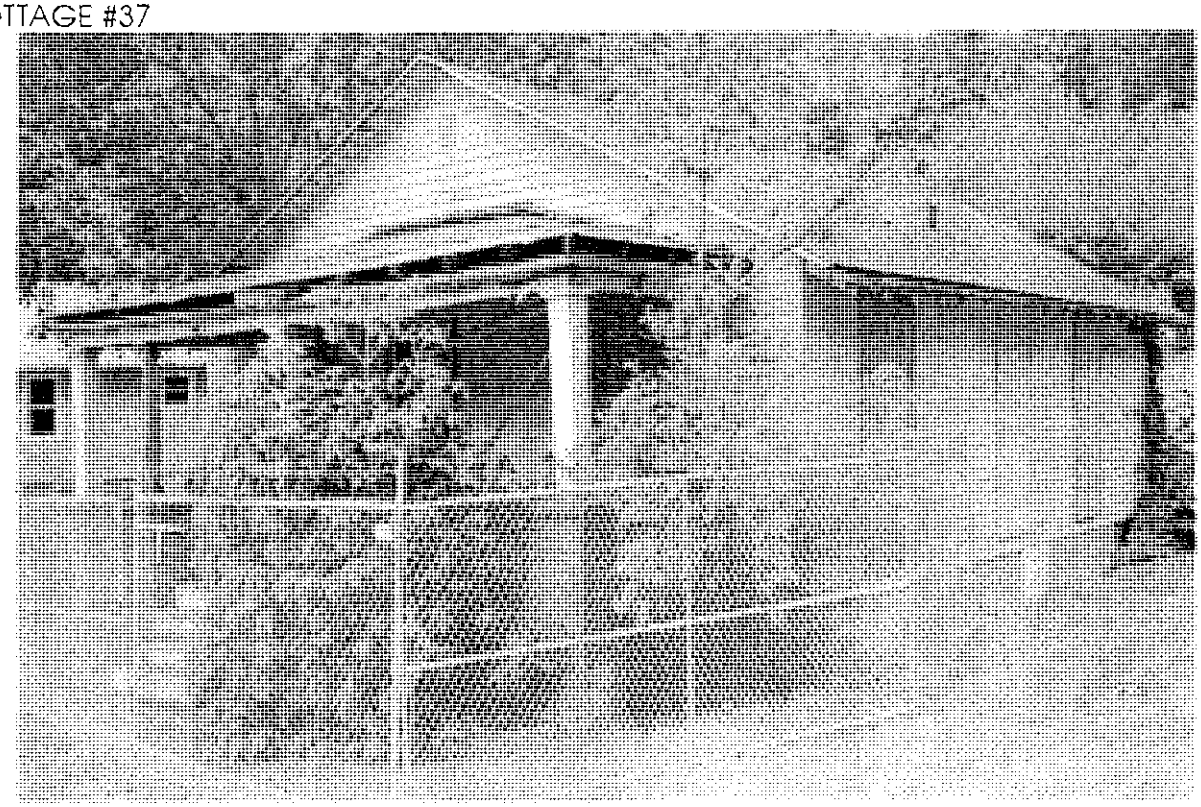
FEATURES

WALKWAY concrete
DRIVEWAY gravel
FENCE/WALLS none
ROAD labelled street

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS
concrete foundation (for garage, presumably) @ rear of house

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #37



TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1929

ORIENTATION:
SW

COLOR:
Tan

STATUS:
Boarded up, vacant. Probably unusable.

VEGETATION:

FRONT PORCH:
Hipped roof

REAR PORCH:
No roof, just floor platform. Maybe original.

CHIMNEY:
none.

FOUNDATION:

WINDOWS:
Boarded up.

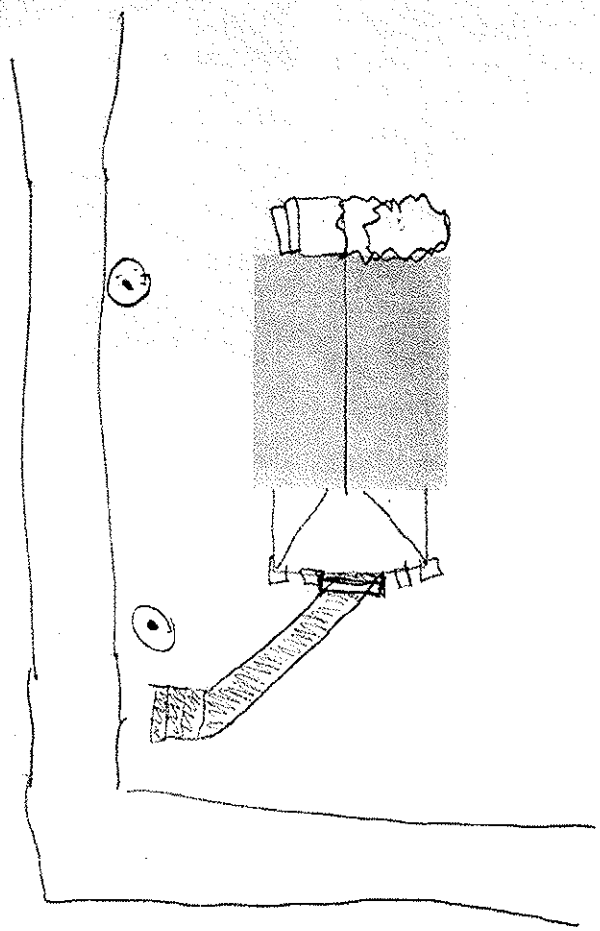
OTHER NOTES:
Has some original wooden gutters.
Siding missing on rear of building -- exposed building paper.

PROJECT : 3 LYNX

PROCEDURE

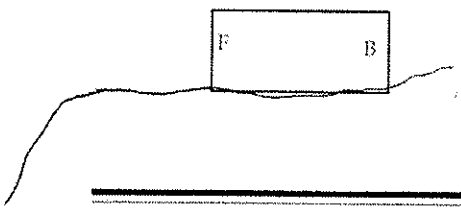
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 37
RECORDER: CHRISTY
DATE: 10.6.01



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

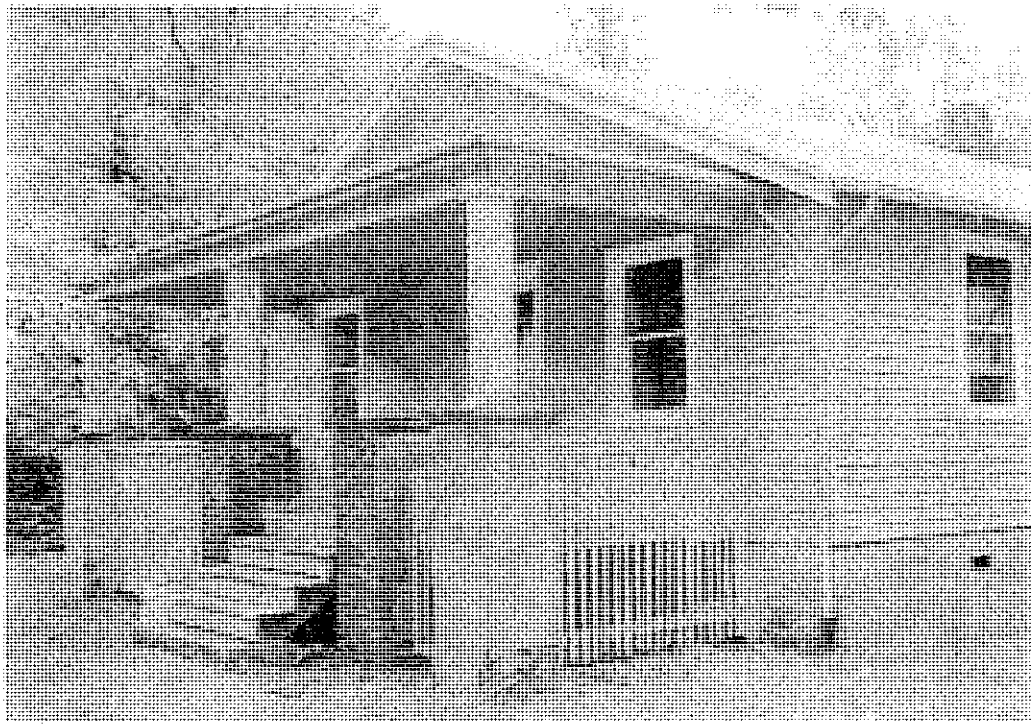
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #38



TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1929

ORIENTATION:
SW

COLOR:
Grey-Blue with White Trim

STATUS:
Vacant

VEGETATION:
no

OTHER NOTES:
Extremely weathered siding.
Loose boards on SE corner.
Some original door hardware.
Wood floors on interior
Water damage in kitchen.
Has some wood gutters.

FRONT PORCH:
Not original decking (based on size). Loose vertical rails on W side. Parged outer piers. Trim missing on wood box columns. Bow in hip roof. Original Aladdin light fixture.

REAR PORCH:
Warped floor. Shed roof. Partila enclosure with screen top half. Wood screen door.

CHIMNEY:
Deteriorated corbel. No flue. Caulking at roof connection

FOUNDATION:
No cracks noted. Some windows damaged and boarded up.

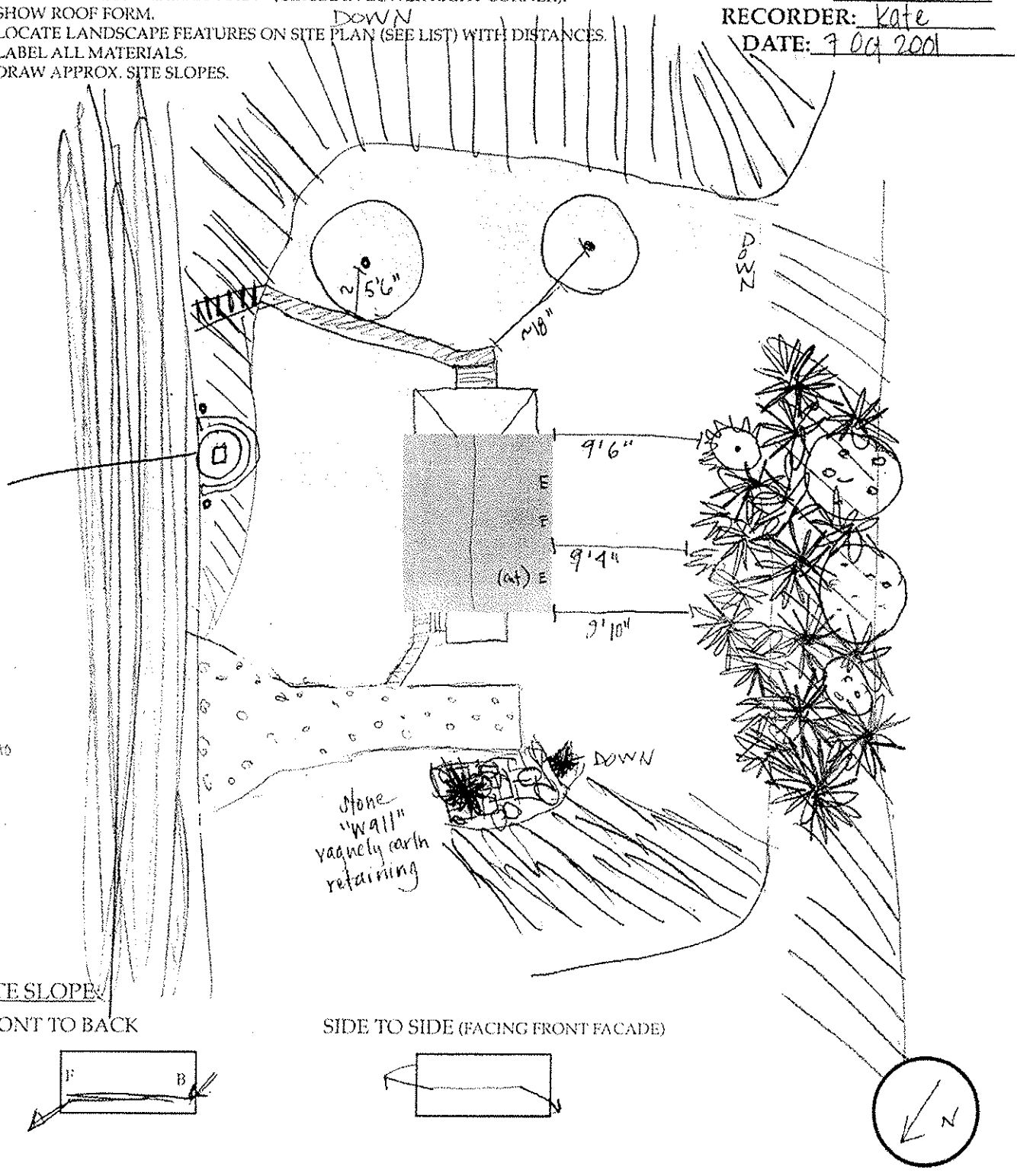
WINDOWS:
Storm hooks, as well as some storm windows. Screens on bath and NE window.

PROJECT : 3 LYNX

PROCEDURE

1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 38
RECORDER: Kate
DATE: 9 Oct 2001



concrete "manhole?" w/ warning reflectors

E = cables connecting to house

SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

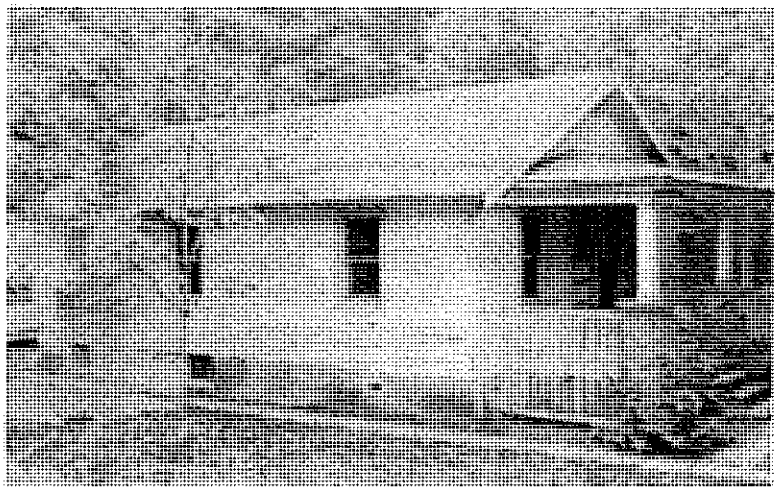
FEATURES

WALKWAY concrete
DRIVEWAY = gravel
FENCE/WALLS stone
ROAD asphalt

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #39



TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1930

ORIENTATION:
SW

COLOR:
Tan

STATUS:
Vacant

VEGETATION:
none

FRONT PORCH:
Hip roof, shows some signs of settling. Brick piers are no longer straight and show mortar damage. Rails are sagging and paint is peeling. Has metal screen door and original Aladdin light fixture.

REAR PORCH:
Small shed roof, wood screen door.

CHIMNEY:
Full with corbel and metal flue. Show weak mortar.

FOUNDATION:
Cracks: 2 on N wall, at W end; E wall, S end. Patched.

WINDOWS:
Kitchen and bath windows show signs of weathering.

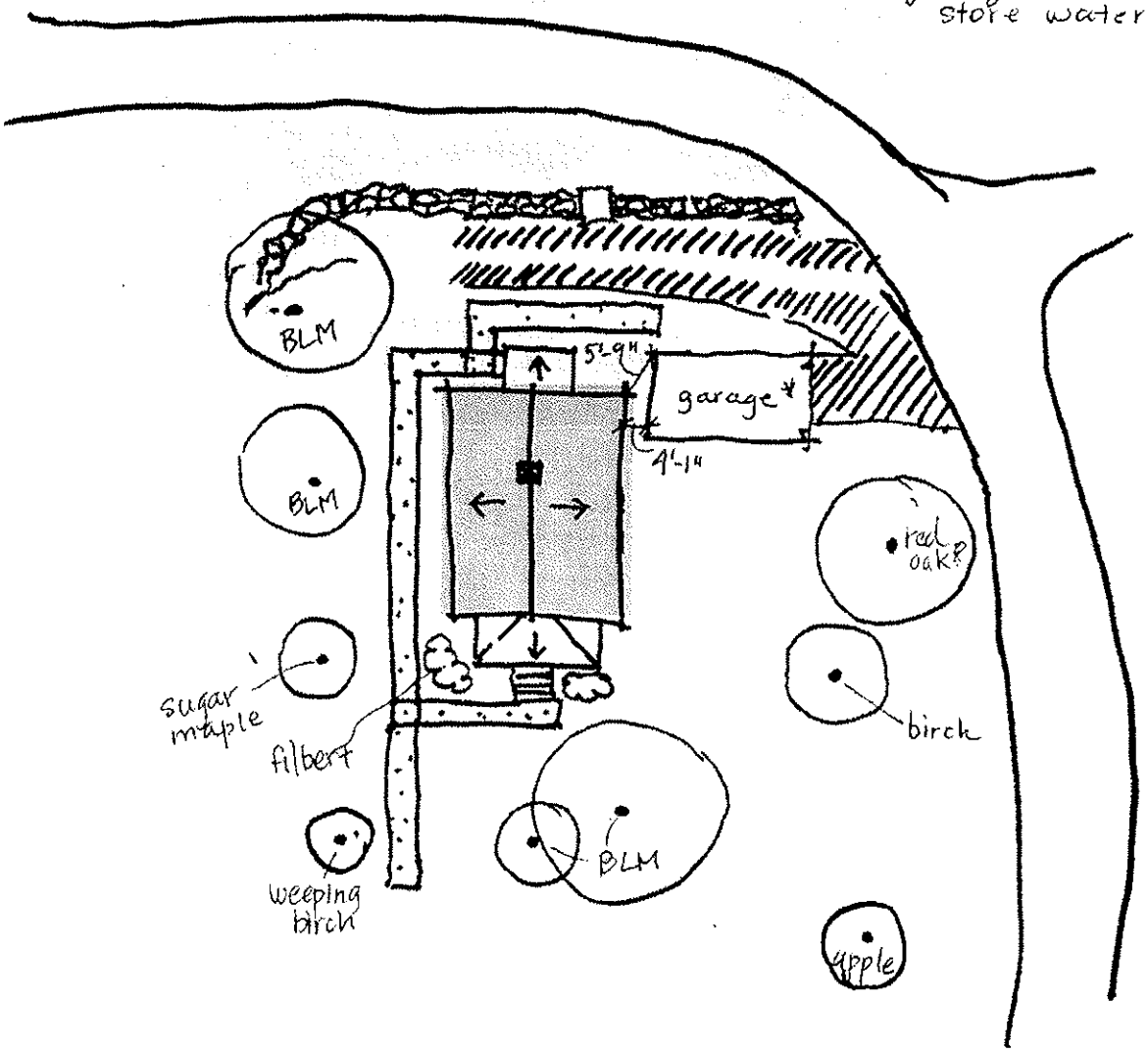
OTHER NOTES:
East wall siding damaged.

PROJECT : 3 LYNX

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

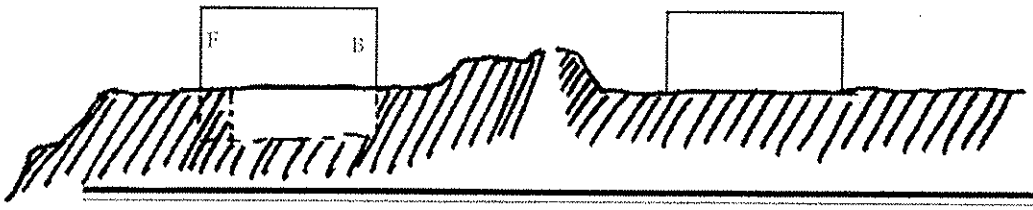
SITE ID: 39
RECORDER: CARIN
DATE: 10/6/01

* garage used to store water tanks



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

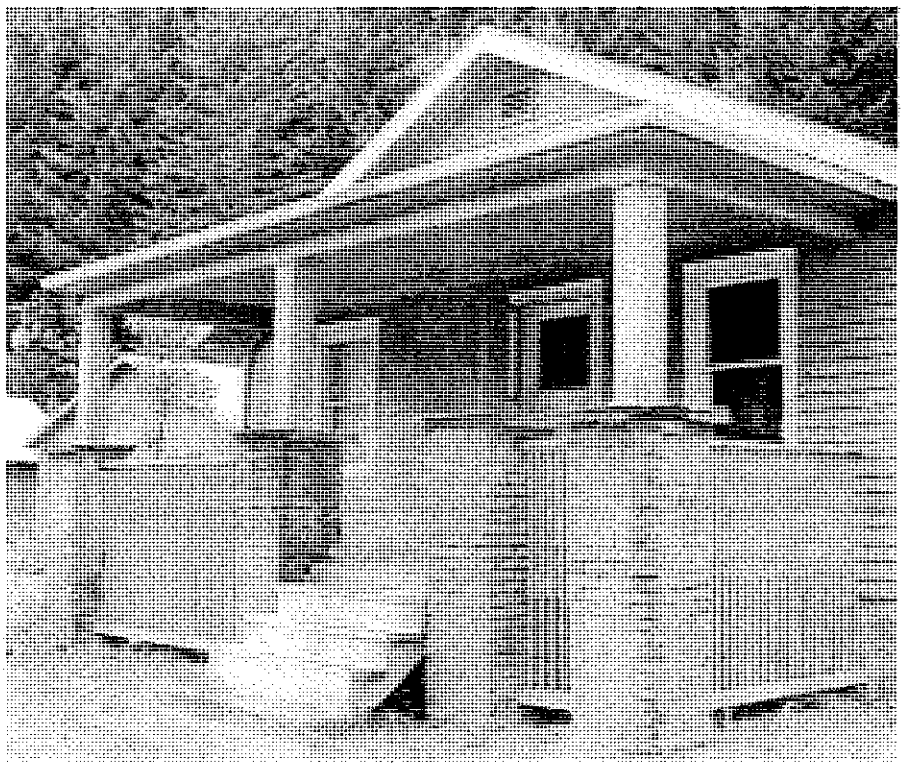
FEATURES

WALKWAY - concrete
DRIVEWAY - gravel
FENCE/WALLS - basalt
ROAD - asphalt

ASSOCIATED STRUCTURES

GARAGE/CARPORT not original
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #40



TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1930

ORIENTATION:
NE

COLOR:
Blue

STATUS:
Vacant

VEGETATION:
Bushes on N side of house

FRONT PORCH:
Hip roof. Soft mortar on brick piers. Metal screen door. Original Aladdin light fixture.

REAR PORCH:
Shed roof. Wood screen door. Jerry-rigged structure -- presumed not original.

CHIMNEY:
Full with corbel detail, no flue. Evidence of water damage in attic.

FOUNDATION:
Crack, NW corner, patched. Interior footing disrupted due to stone. No latches on windows.

WINDOWS:
Wingnut storm hooks

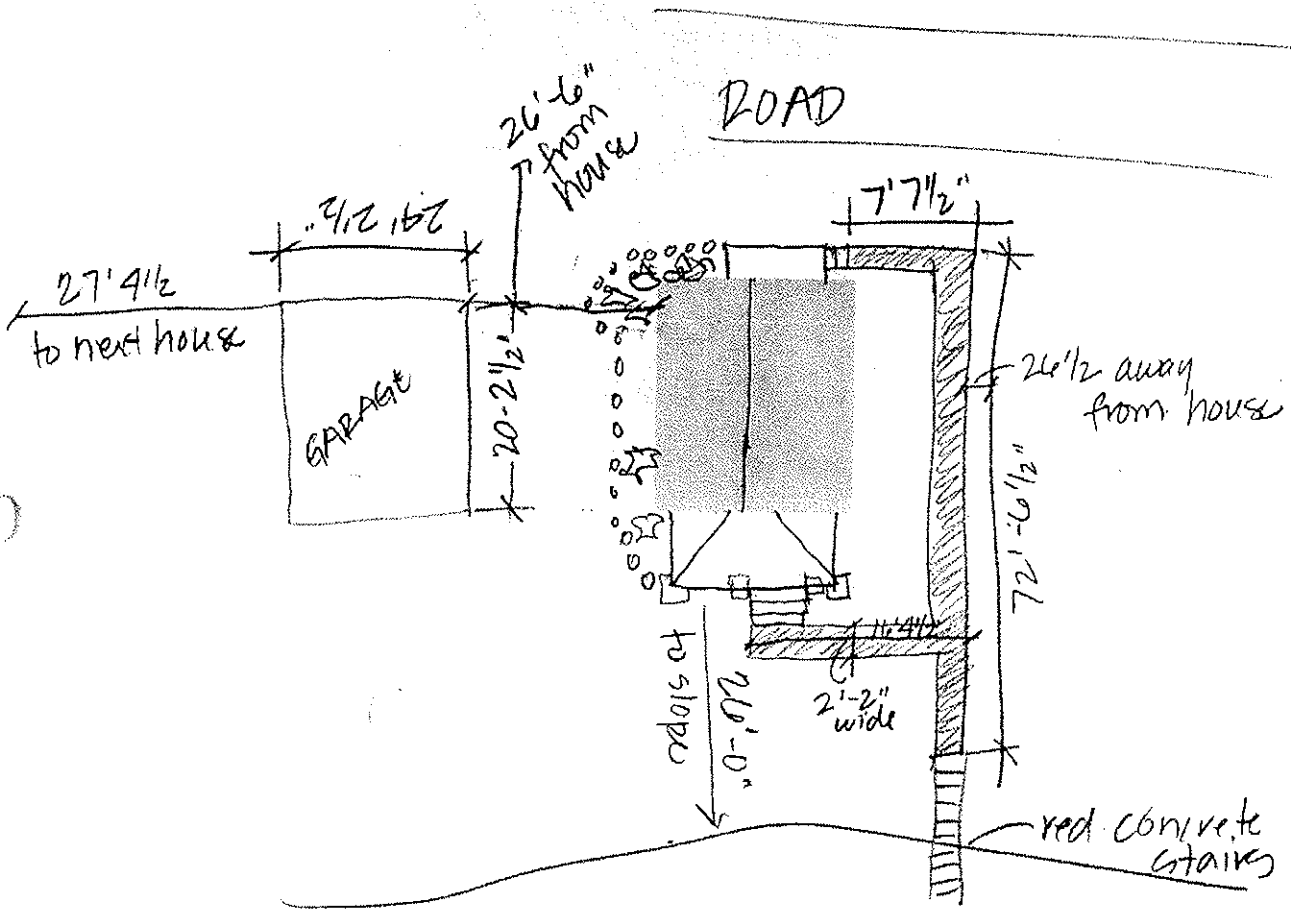
OTHER NOTES:
Zinc on roof. Toilet in bathroom may be orignal Aladdin fixture. Wall vents exist on both sides of the building, under the windows. Wood floors in the dining and living rooms.

PROCEDURE

1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

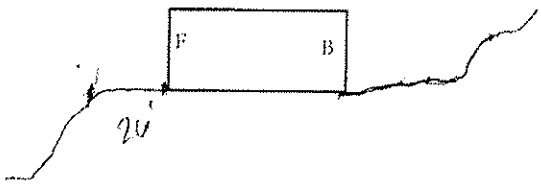
PROJECT : 3 LYNX

SITE ID: 90
RECORDER: CHRISTY
DATE: 10/16/01

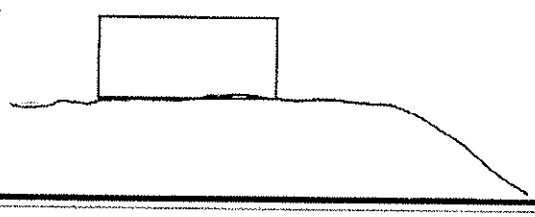


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

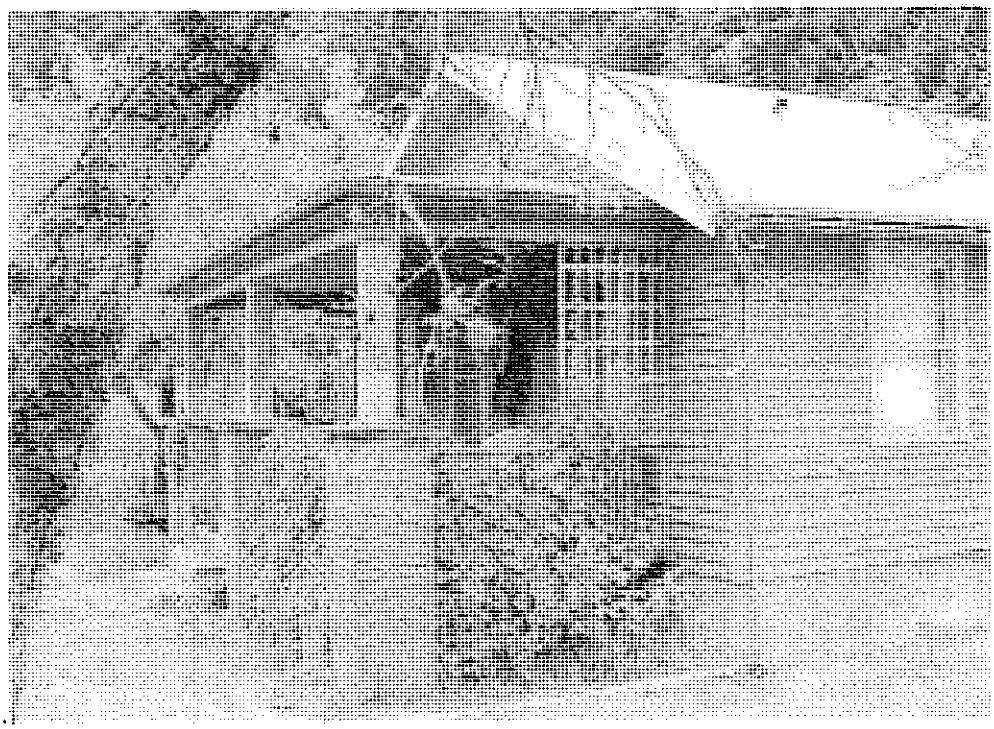
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #41



TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1930

ORIENTATION:
SW

COLOR:
Warm Brown

STATUS:
Occupied

VEGETATION:
Cultivated morning glory vines on porch rails.

FRONT PORCH:
Hip roof. Unpainted plywood floor sags. Deteriorated concrete pier caps. Aluminum screen with scroll details. Original Aladdin light fixture.

REAR PORCH:
Enclosed (like a room).

CHIMNEY:
Full, chipped corbel detail, with metal flue

FOUNDATION:
Cracks, N and S wall

WINDOWS:
SW window painted shut. Original kitchen screen. Storm hooks.

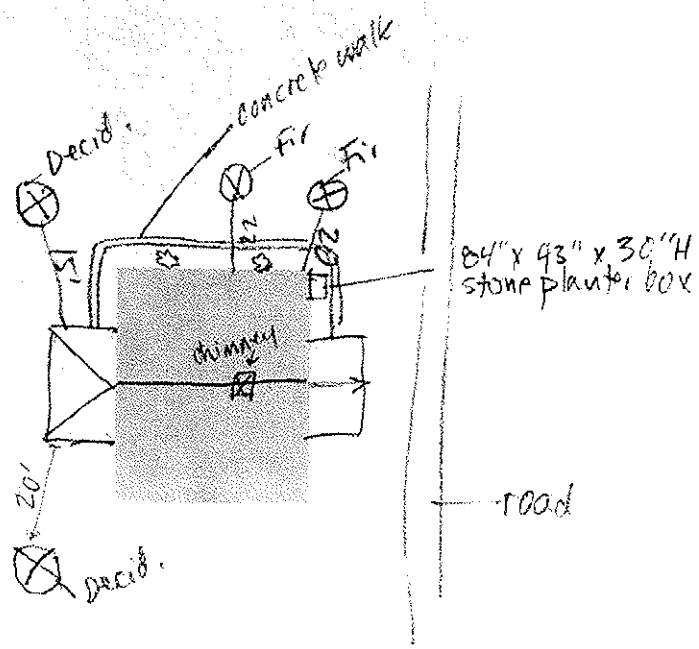
OTHER NOTES:
Split in siding, S wall, near faucet.
Extra square vent near foundation, W side.

PROCEDURE

1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

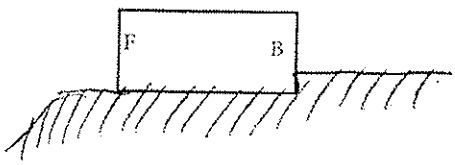
PROJECT : 3 LYNX

SITE ID: #41
RECORDER: MARTI
DATE: 7 OCT 2001



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

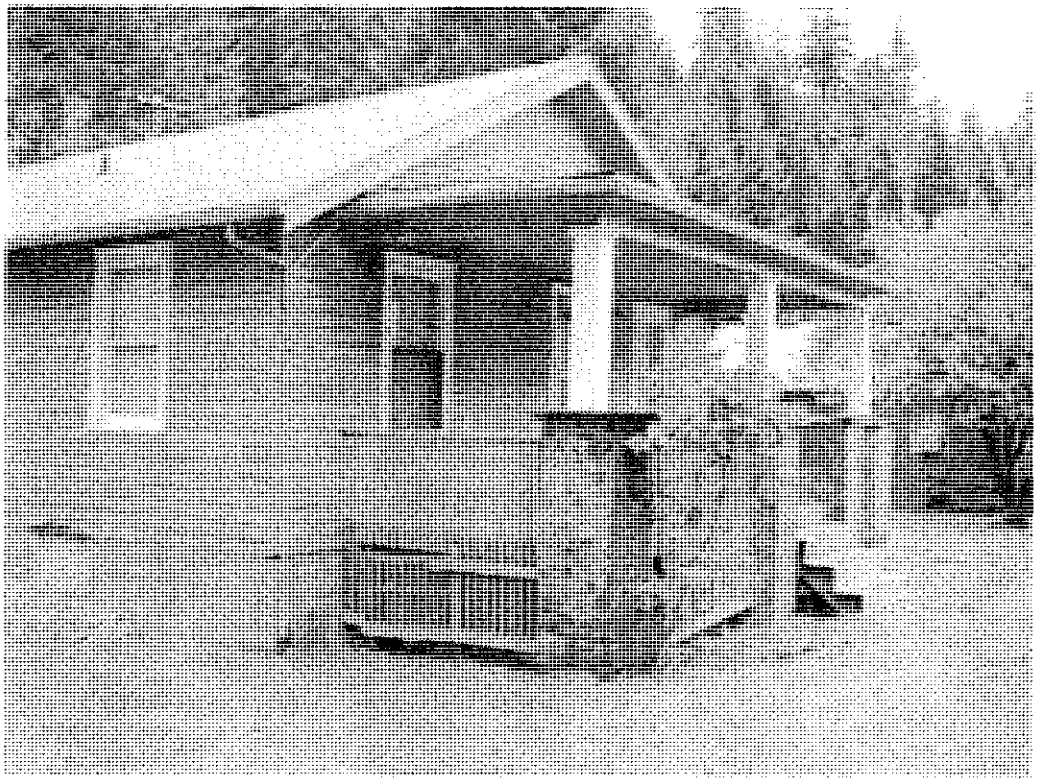
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #42



TYPE/STYLE:
Aladdin, Victory "Z", 1 story, daylight basement

DATE/YEAR:
1930

ORIENTATION:
SW

COLOR:
Beige with White trim.

STATUS:
Occupied

VEGETATION:
Vines on sides of house.

FRONT PORCH:
Hip roof. Far W pier twisting. All piers in poor condition. Aluminum screen door with scroll detail. No trim on wood box columns. Plywood deck. Missing front rail slats.

REAR PORCH:
Shed roof.

CHIMNEY:
Full with corbel detail. No flue.

FOUNDATION:
Cracks: S wall, W end. N wall, W end.

WINDOWS:
One nailed-on screen on porch. Wooden tabs -- for storm windows?

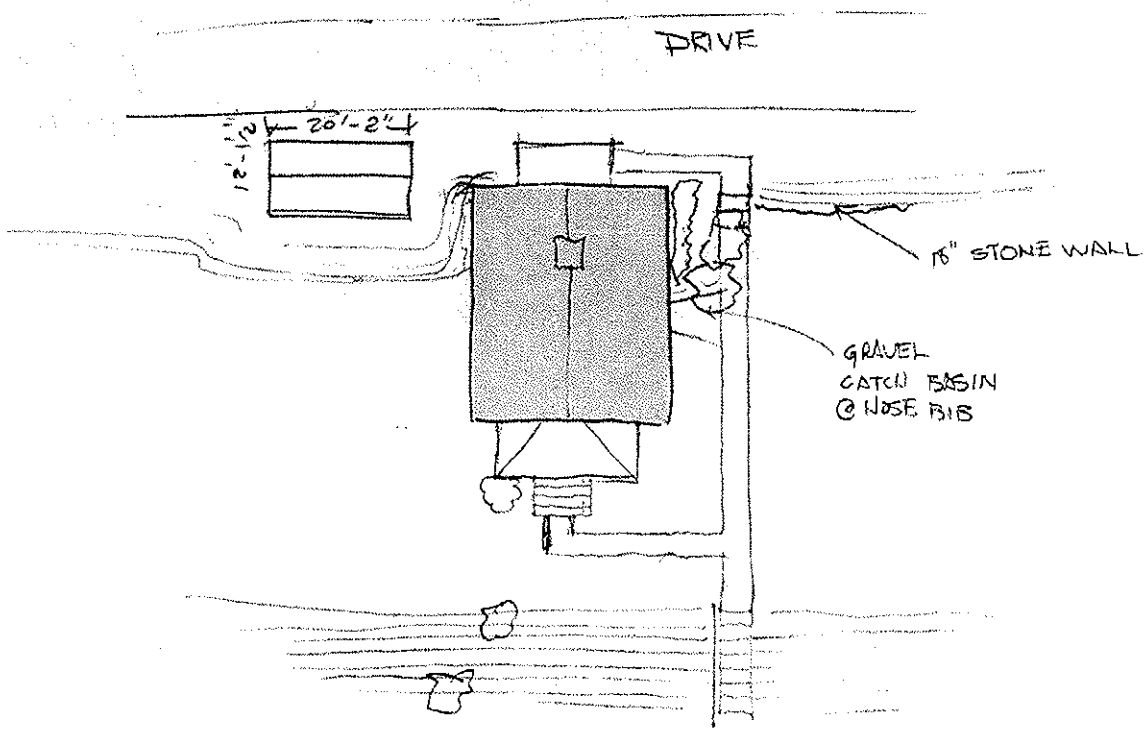
OTHER NOTES:
Pressure washer damage on siding.
Gutters are nailed on.

PROJECT : 3 LYNX -

SITE ID: 42 (BEIGE W/ WHITE TO
RECORDER: D. STEFLI
DATE: 10/7/01

PROCEDURE

1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

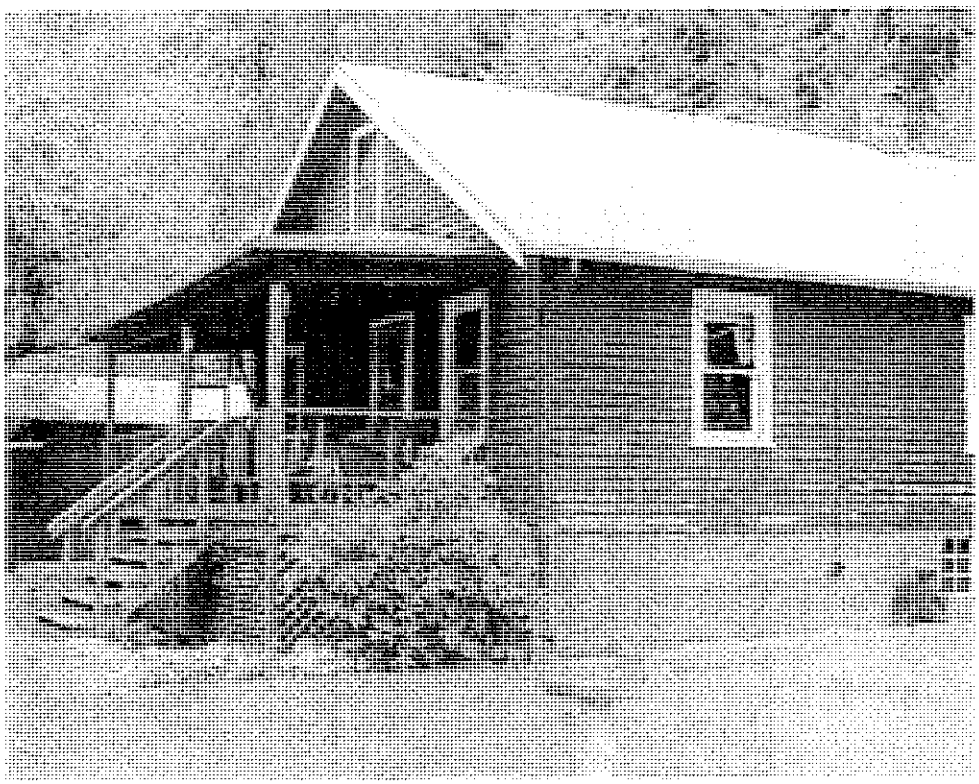
FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

OAK GROVE HYDROELECTRIC PROJECT, STATION "P"
THREE LYNX
COTTAGE #44



TYPE/STYLE:
Contractor built, without kit, to resemble Aladdin Victory model (for same cost or less); 1.5 stories

DATE/YEAR:
1930?

ORIENTATION:
SW

COLOR:
Barn Red with White trim

STATUS:
Occupied.

VEGETATION:
None

FRONT PORCH:
New, of reddish lumber, unfinished (but pressure treated?). Lattice work skirt. Metal screen door. Roof looks older than porch.

REAR PORCH:
Vertical wood siding, concrete foundation, shed roof.

CHIMNEY:
Weathered. Metal ties to roof denote possible structural problems.

FOUNDATION:

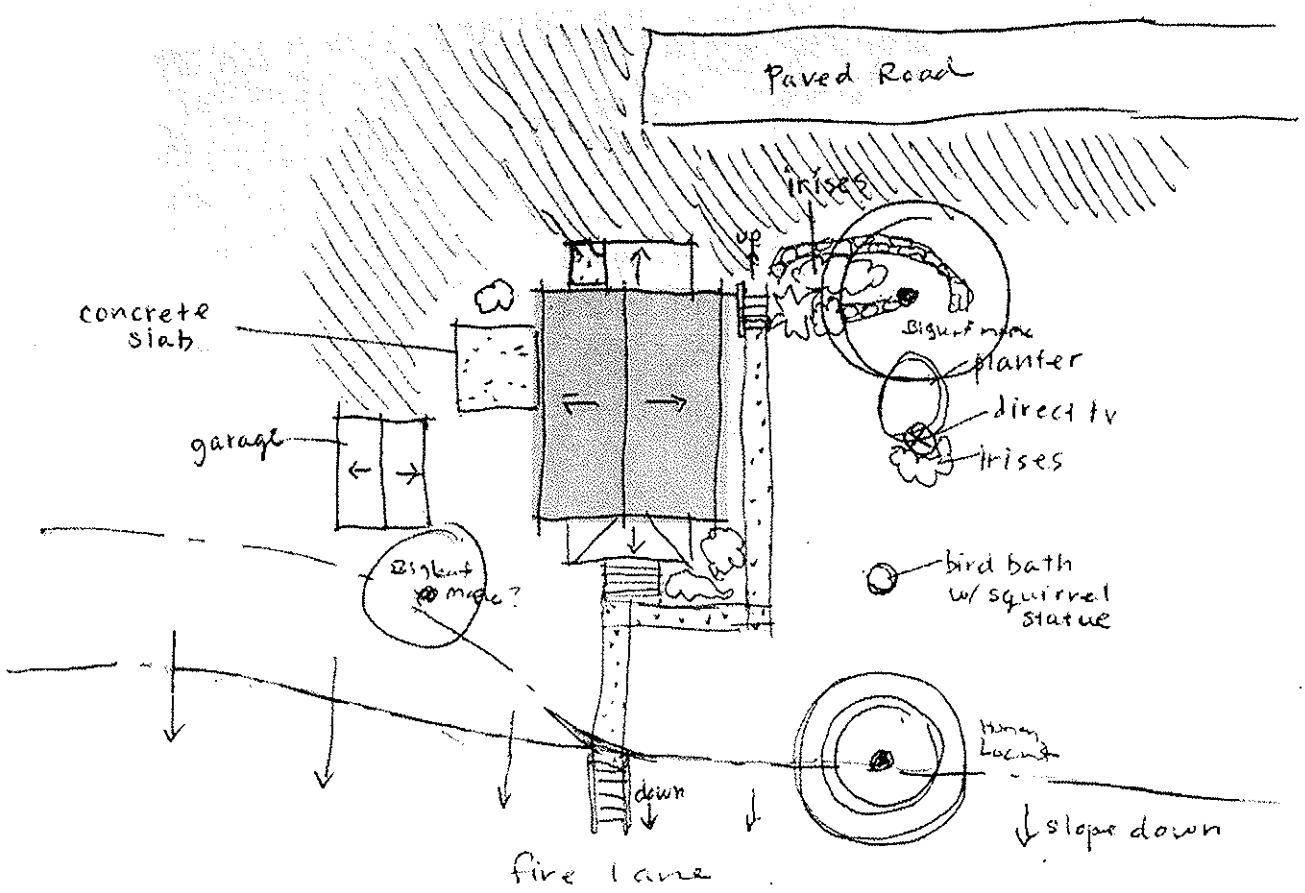
WINDOWS:
Some screens. Some bracket hooks for storms.

OTHER NOTES:
Roof ridgeline bulges upward on either side of chimney.
Some siding issues on N side.
Extra vent above front porch, into attic.

PROJECT : 3 LYNX

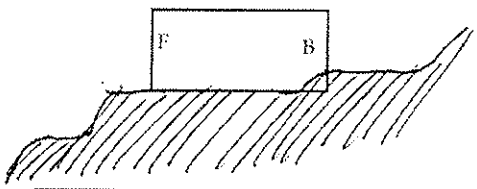
SITE ID: 44
RECORDER: CARIN
DATE: 7 OCT 2001

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

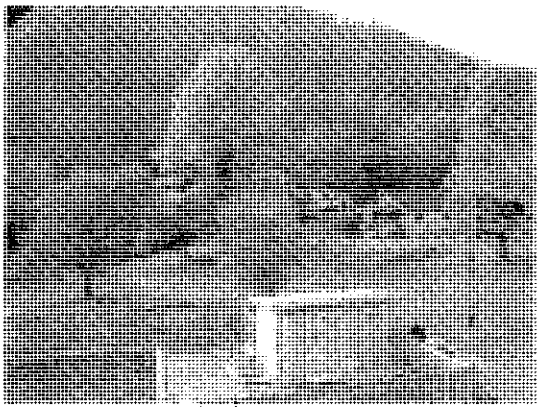
FEATURES

WALKWAY concrete
DRIVEWAY gravel
FENCE/WALLS basalt
ROAD asphalt

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

Site Analysis and Description



view north over pool

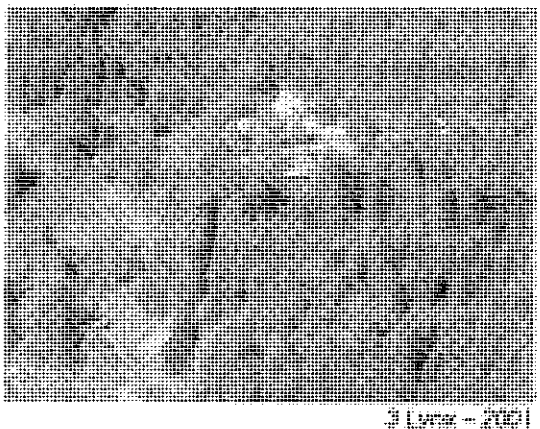
PLANT LIST

Common Name	Botanical Name
Bigleaf Maple	*Acer macrophyllum*
Japanese Maple	*Acer palmatum*
Norway Maple	*Acer platanoides*
Paper Birch	*Betula papyrifera*
Weeping Birch	*Betula pendula*
Incense Cedar	*Calocedrus decurrens*
Hazelnut	*Cornus Americana*
Flowering Dogwood	*Cornus florida*
Honey Locust	*Gleditsia triacanthos var inermis*
American Holly	*Ilex opaca*
Tulip	*Liriodendron tulipifera*
Apple	*Malus sp.*
Colorado Spruce	*Picea pungens*
Spruce	*Picea sp*
Myrobalan Plum	*Prunus cerasifera*
Cherry	*Prunus sp*
Douglas fir	*Pseudotsuga mensiesii*
Pin Oak	*Quercus pinus*
Red Oak	*Quercus Rubra*
Azalea	*Rhododendrun sp*
Rhododendron	*Rhododendrun sp*
Western Red Cedar	*Thuja phcata*

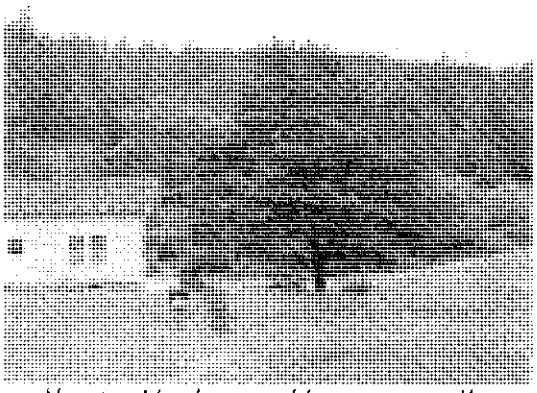
SITE PLAN AND LANDSCAPE PLAN PROCESS REPORT

The site plan and the landscape plan for the Three Lynx community were put together during the weekend site visit of October 5-7, 2001. A preliminary site sketch was created from the existing site maps. The maps were old and some of the structures no longer exist, so all roads and structures on the preliminary plan were checked for accuracy of location and size. The next step was to map all major vegetation relative to the buildings. A member of our team, who is a landscape student, walked around the site identifying trees. He also measured the canopy size and noted the tree type and location on the plan. Any major shrubs were also noted. The landscape plan only shows current vegetation and does not give the location of any historic or original plants. Once all the vegetation was mapped, the location of key features was noted on the plan. These included fire boxes, garages, and the pool.

BRIEF VEGETATION ANALYSIS



3 Lynx – 2001



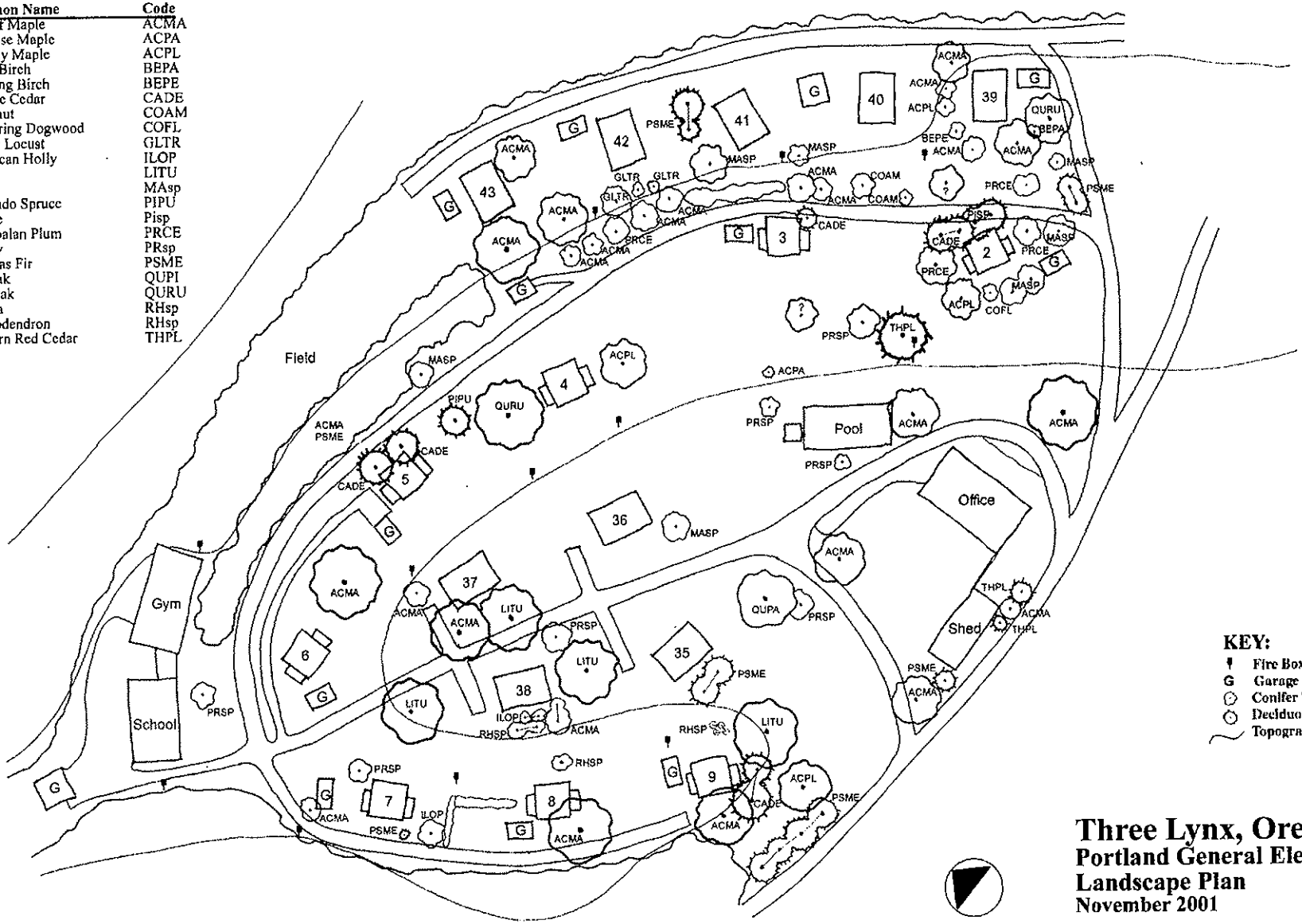
Norway Maple – most trees near cottages

Fire lane – with fire hoses & door access

It is apparent that all the vegetation on the site of the Three Lynx community is not original. Early photographs show the area when the houses were constructed and no trees were present. The trees on the site appear to be of varying ages but none appear to be older than 60 years of age. The trees closer to the houses tend to be more ornamental or fruit-bearing trees. Larger, shade trees are planted along the roads and in the open spaces. The predominant tree type in the Three Lynx community is the Big Leaf Maple. It is probable that a few of these trees were planted but many more grew naturally from seeds blown in from the surrounding landscape. There is no record detailing how many trees have been purposely removed or have fallen by natural causes. Employees familiar with the site informed us that many trees have been taken out to make the area brighter. Most likely these were larger, shade trees in the open spaces. The ornamental trees around the houses are mostly intact.

PLANT LIST

Common Name	Code
Bigleaf Maple	ACMA
Japanese Maple	ACPA
Norway Maple	ACPL
Paper Birch	BEPA
Weeping Birch	BEPE
Incense Cedar	CADE
Hazelnut	COAM
Flowering Dogwood	COFL
Honey Locust	GLTR
American Holly	ILOP
Tulip	LITU
Apple	MAsp
Colorado Spruce	PIPU
Spruce	Pisp
Myrobalan Plum	PRCE
Cherry	PRsp
Douglas Fir	PSME
Pin Oak	QUPI
Red Oak	QURU
Azalea	RHsp
Rhododendron	RHsp
Western Red Cedar	THPL



Three Lynx, Oregon
Portland General Electric
Landscape Plan
November 2001

THREE LYNX ASSESSMENT PROJECT
UNIVERSITY OF OREGON HISTORIC PRESERVATION PROGRAM

SECTION TWO

DIRECTIVES

INTRODUCTIONS TO DIRECTIVES SECTIONS

Stabilization seeks to provide information on actions deemed of immediate importance to the cottages at Three Lynx. Performance of these actions as soon as time and funds permit will substantially prolong the life of each building, as well as preventing further deterioration from existing problems. The stabilization measures deal only with problems deemed to be of immediate importance to the life of the buildings.

The **Operations** directives seek to provide information and instruction for ongoing maintenance of the housing structures at Three Lynx. These directives are intended to guide maintenance crews and/or tenants in the repeated maintenance actions that will ensure the long life of the buildings. In cases where maintenance responsibility has been given to tenants, it is recommended that some system of checks be instituted, so that buildings are ensured the maintenance they need.

The **Rehabilitation** sections seek to direct maintenance crews in preservation-minded actions regarding major changes in the buildings at Three Lynx. Rehabilitation is defined as actions taken to make an historic building more habitable by modern standards while maintaining and/or restoring the features that make the building unique. Many of the rehabilitation instructions draw heavily on the National Parks Service's Preservation Briefs. Where appropriate, these briefs are included (either whole, or selections from) within the directives section. Additional briefs thought to be pertinent have been included in the appendix.

LIST OF MAJOR ISSUES

Stabilization recommendations are prioritized in the following order:

Foundation Monitoring

Addresses fundamental question of foundation integrity, recommending monitoring of existing cracks. If cracks are determined to be stable, no further action may be needed.

Lateral Movement Prevention

With minimal intervention and expenditure, the addition of simple structural ties would safeguard of existing resources and meet current code requirements.

Drainage Improvements

Addresses both immediate benefits to building condition as well as long term goals.

Porch Pier Rehabilitation

Addresses basic minimal functional requirements of this building component for continued use. The importance of this piece stems from its generally deteriorated condition, as well as its importance in regards to the entrance to the building.

Chimney Recommendations

Presents questions concerning future use, alternatives to current conditions, and suggested actions for various conditions.

Planting Recommendations

Addresses immediate points for consideration, as well as recommending actions for future activities.

While relating to the Operations and Rehabilitation directives, the Stablization measures recommended herein stand on their own as immediate measures needed to prevent deterioration of the buildings as a whole. We recommend that these measure be considered immediately for the health of the buildings at Three Lynx.

BUILDING ELEMENTS IN ORDER OF APPEARANCE

Elements are organized from the ground up. For an alphabetized index, see the other side.

Foundation

Exterior Walls

Roof, including Gutters

Chimney

Front Porch

Back Porch

Windows

Doors

Interior Finishes

Kitchen and Bathroom

Attic and Basement

Systems

Paint

Mothballing

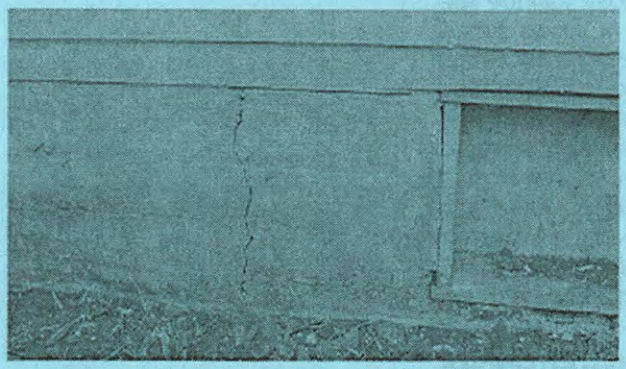
Landscape

HOUSE PARTS LIST INDEX

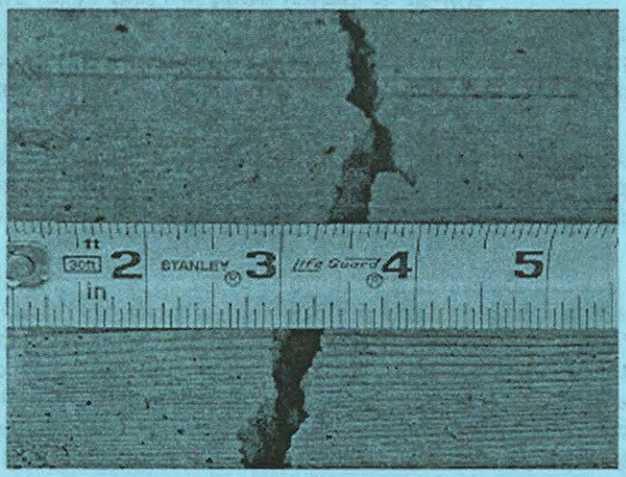
**Terms in bold have their own section

Attic and basement
Back Porch
Basement, Attic and
Bathroom, Kitchen and
Cable, see Systems
Ceiling, see Back Porch, Front Porch, or Interior Finishes
Chimney
Columns/piers, see Back Porch or Front Porch
Decking, see Back Porch or Front Porch
Doors
Drainage, see Stabilization or Landscape
Electric, see Systems
Exterior Walls
Flooring, see Interior Finishes
Foundation
Front Porch
Gutters & Downspouts, see Roof
Glazing, see Doors or Windows
Hardware, see Doors or Windows
HVAC, see Systems
Interior Finishes
Kitchen and Bathroom
Landscape/Plantings
Light fixtures, see Front Porch or Interiors
Millwork/Trim, see Interior Finishes
Mothballing
Paint
Plaster, see Interior Finishes
Plumbing, see Systems
Porch Steps, see Front Porch
Rafters, see Roof
Rails/skirts, see Front Porch
Roof
Shingles/sheathing, see Roof
Siding, see Exterior Walls
Storms/screens, Windows
Systems
Trim, see Exterior Walls or Interior Finishes
Vents, see Exterior Walls
Weatherization, see Doors or Windows
Windows

Stabilization

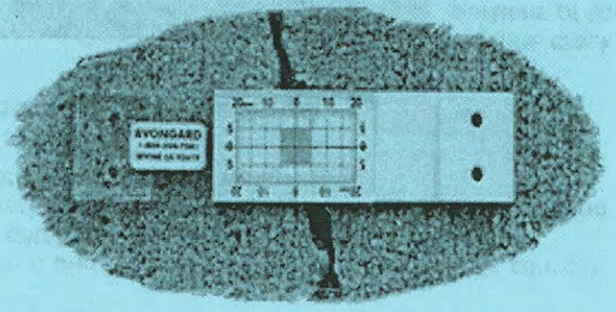


Exterior view of foundation crack.



Close up of foundation crack.

Interior view of foundation crack.



Crack monitor. Source: www.avongard.com

Foundation Monitoring

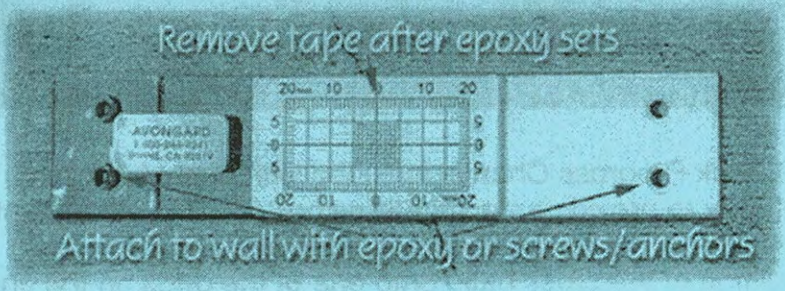
Cracking is evident in some locations. (See drawings at left.) Cracking is likely due to the foundation configuration and possible settlement. It is not known if there is continued movement. Overall the foundations appear to be stable and in good condition.

Install crack monitors as soon as possible on existing cracks to begin monitoring for movement over a 1 year span. Ideally, observations should be noted once a week with comments on the time of day, temperature, and weather conditions including humidity and rain. Movement, such as the widening of a crack during warmer summer months, may be observed. However, this may potentially pose no threat to the foundations when during colder weather the crack recedes in width.

If there is no movement then the cracks could be left as they are. If water is entering through the crack, then patch with a cementitous material. This patching mix should be softer than the concrete of the foundation so it functions as the sacrificial element should any moisture or shifting issues arise.

If there is movement, such as a permanent increase in crack width of 1/8 inch or more, then the extent and reasons for the movement would need to be determined. These reasons could include but are not limited to; subsoil conditions, drainage, and foundation configuration. More invasive stabilization efforts would likely be necessary.

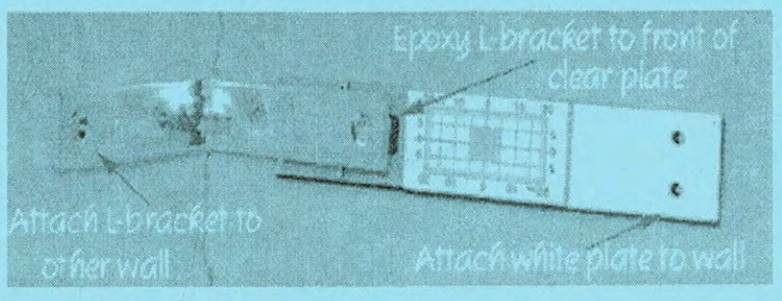
Normal Installation



Crack Monitors can be installed using either anchors and bolts / screws, 5-minute epoxy adhesive, or even a combination of both. If anchors and screws are used, the Crack Monitors can be taken down and reused , but we don't recommend this method of installation in areas easily accessible by the general public. The Crack Monitors are much less likely to be removed by vandals if they are firmly epoxied in place.

When deciding whether to use anchors or epoxy you may want to take into consideration the type of surface (for example, brick, masonry, concrete), the location, and the risks involved in drilling holes for anchors. In some cases epoxy putty (if you can find a supplier) is the best mounting medium as it can minimize surface damage, is more easily removed and helps compensate for uneven or curved surfaces.

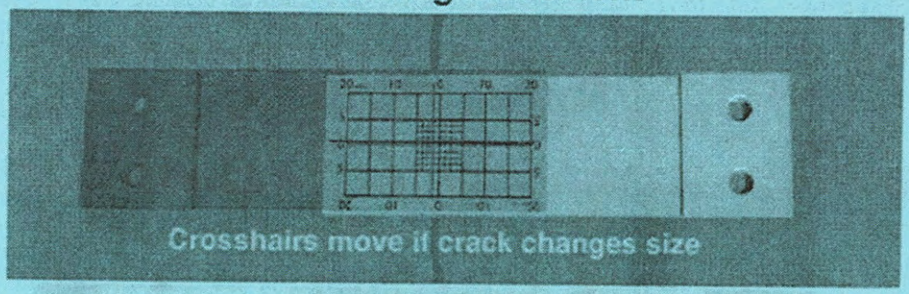
Corner Installation



The Avongard Crack Monitor can also be used if you have a crack located in a corner. Just epoxy an "L" bracket to the front of the Crack Monitor's clear plate, as illustrated in the diagrams above. For outside corners just reverse the "L" bracket.

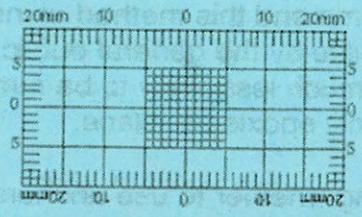
Crack Progress Chart

Recording Movement



A Crack Progress Chart is included with each Avongard Monitor to provide an accurate record of crack movement. Just check the gauge at regular intervals and copy the position of the cross hairs onto one of the grids on the chart. Once you've established a pattern of movement on the Progress Chart, an engineer can then decide what remedial action is needed.

Sample Grid from Crack Progress Chart.

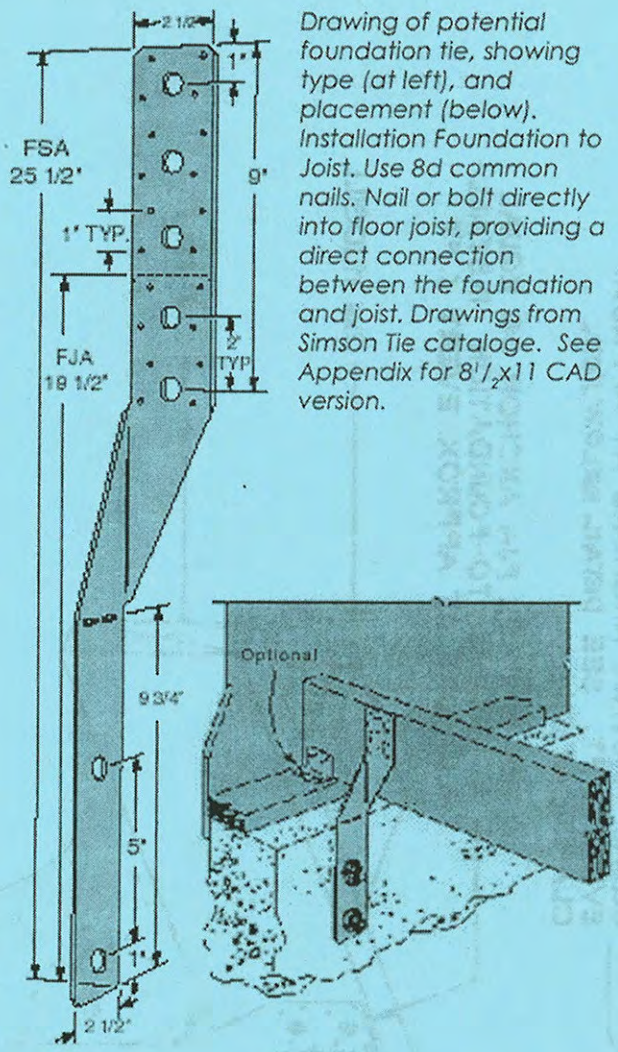


Click on Grid to download

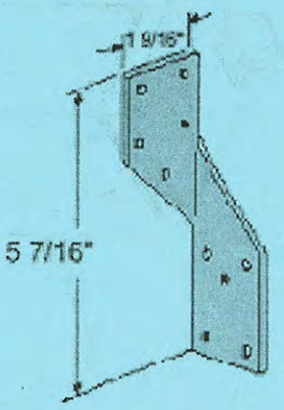
Crack Progress Chart in *.PDF FORMAT for easy printing

Go to top

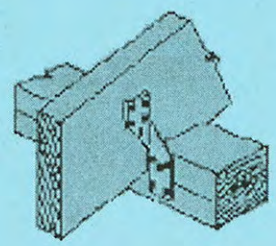
Stabilization



Drawing of potential foundation tie, showing type (at left), and placement (below). Installation Foundation to Joist. Use 8d common nails. Nail or bolt directly into floor joist, providing a direct connection between the foundation and joist. Drawings from Simson Tie cataloge. See Appendix for 8'/$_2$x11 CAD version.



Drawing of potential roof ties, showing type (at left) and placement (bottom left). It provides uplift and lateral resistance. Nail through both plates. Drawings from Simson Tie cataloge. See Appendix for 8'/$_2$x11 CAD version.



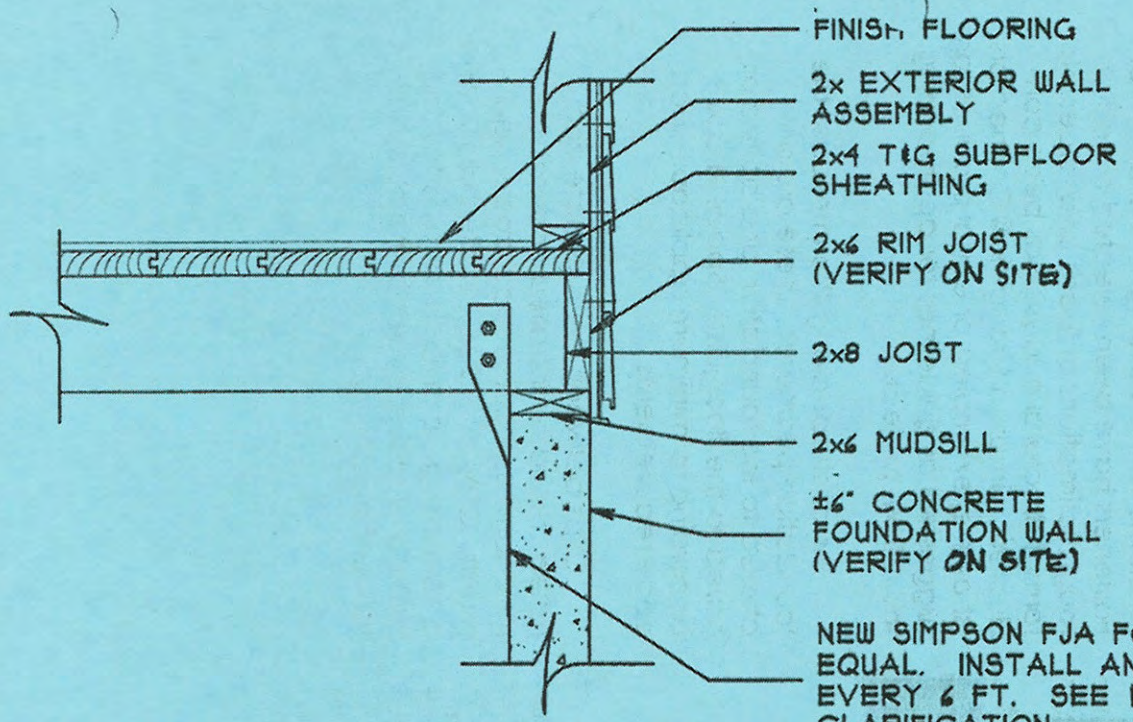
Lateral Movement Prevention

There are no ties between the ground floor sill plate and the foundation, nor between the top plate and rafters. Major winds or earthquakes could cause extensive damage due to this lack Fixing this requires only the installation of fasteners, which is cheap and quick. It is recommended that this be done as soon as possible

The following fasteners are recommended for increasing lateral resistance of the cottages. The fastener types were chosen for their unobtrusive quality and sensitivity to the buildings' historic fabric. Fasteners have been selected based on rough estimations of loads and forces. No formal structural analysis has been conducted. Simpson Strong-Tie© Connectors (shown in examples) or equal products are suggested as guidelines for approaching this retrofit project.

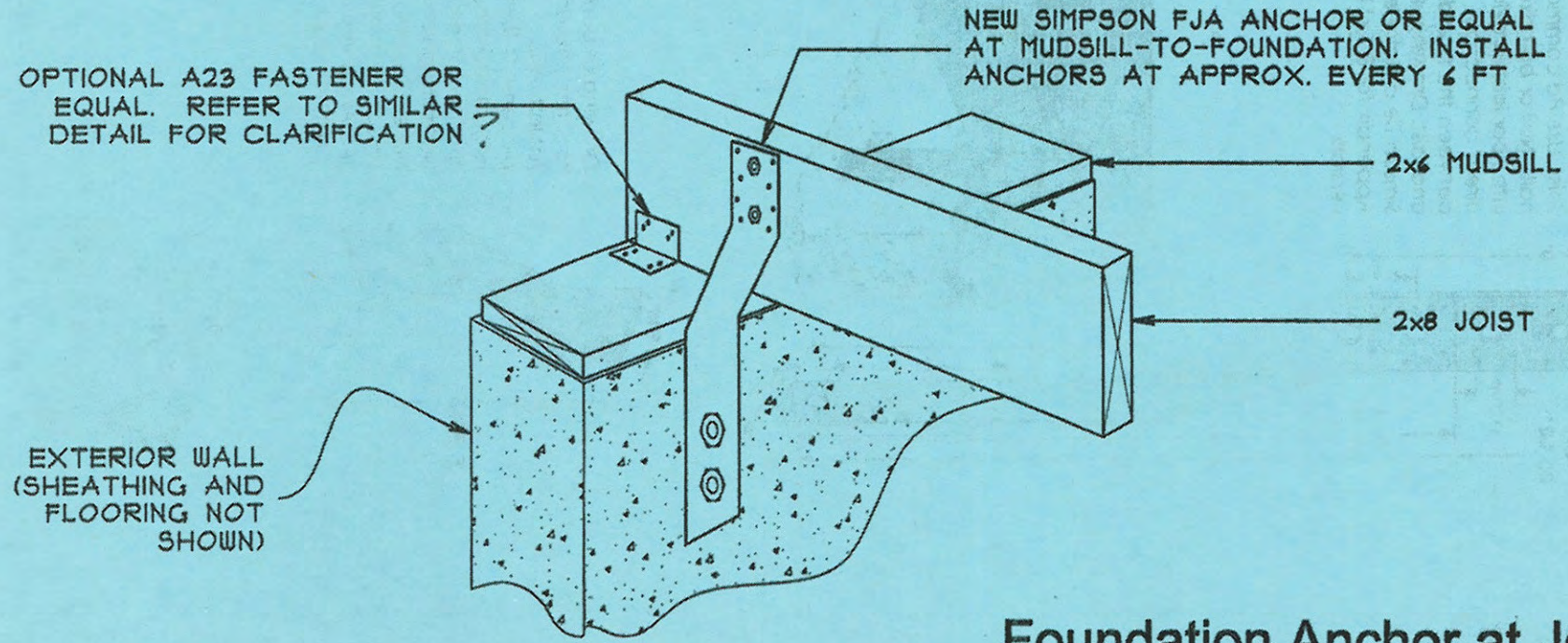
Install straps along the interior of the foundation perimeter. These are anchored to the foundation and bolted or nailed to the floor joists. Space straps according to minimum applicable local code requirements.

Clips between the top plate and rafters should be installed according to minimum applicable local code requirements. Clips could be installed at the time of re-roofing, in order to access the top plate and rafters by removing a section of the roof sheathing.



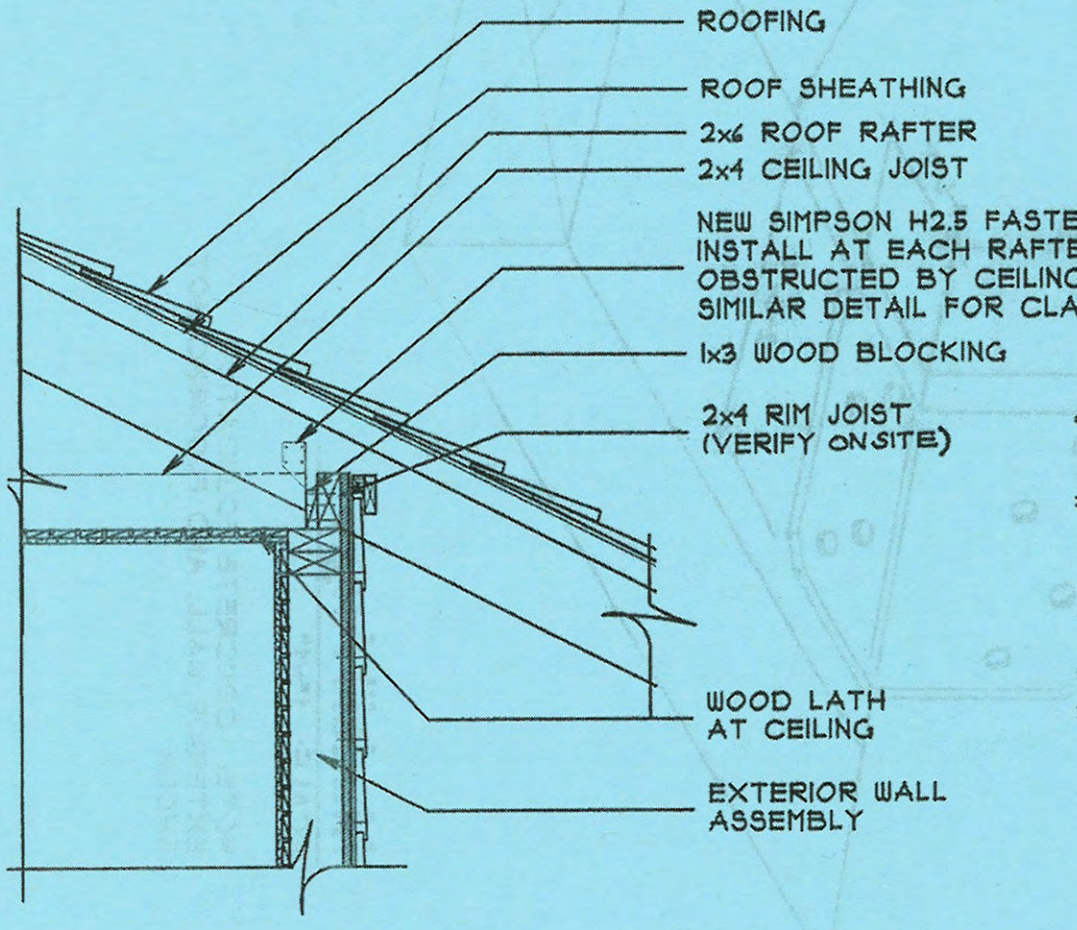
Foundation Anchor

SCALE: 1"=1'-0"



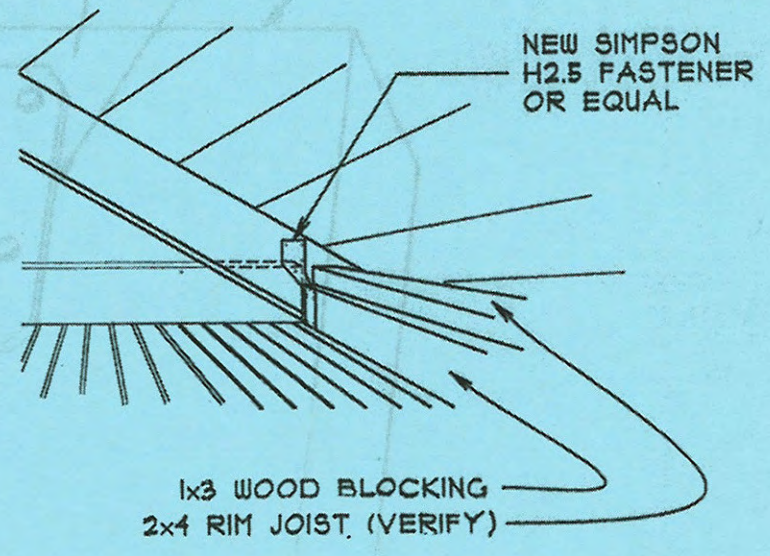
Foundation Anchor at Joist

SCALE: 1"=1'-0"



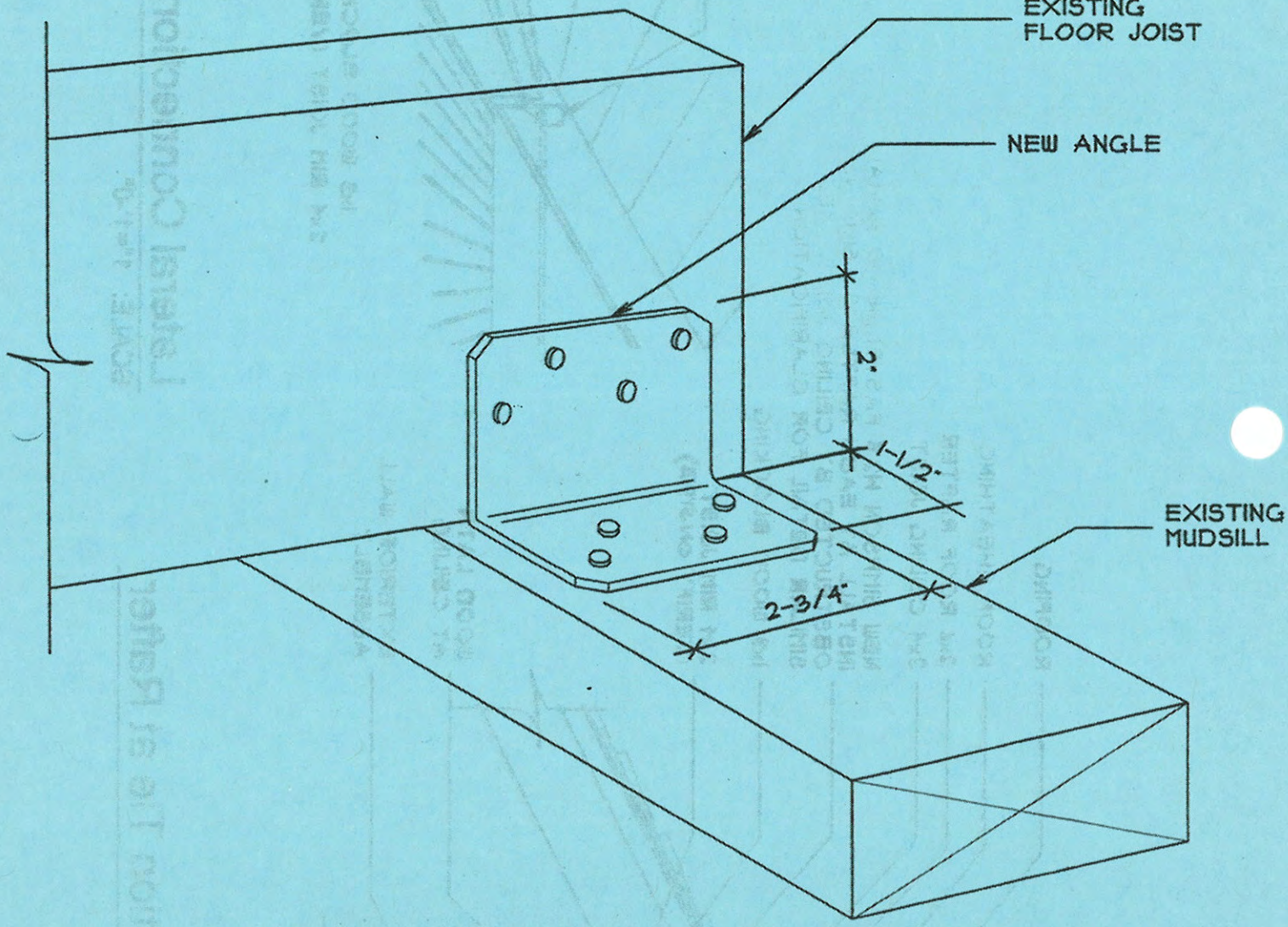
Lateral Stabilization Tie at Rafter

SCALE: 1"=1'-0"



Lateral Connection at Rafter

SCALE: 1"=1'-0"

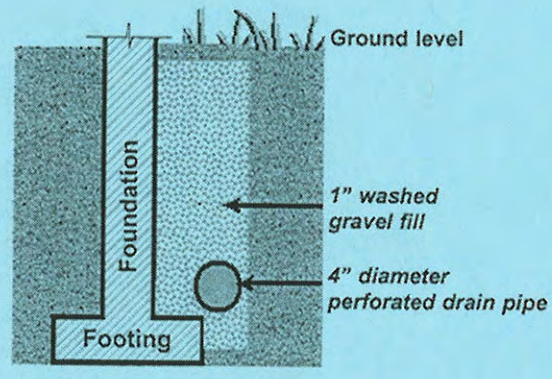


Mudsill Angle

SCALE: 1"=1"

NOTE: CONCRETE FOUNDATION, EXTERIOR WALL, AND FLOORING NOT SHOWN.

Stabilization



Detail of French Drain. Note the foundation and footing shown are speculative. Drawing not to scale. Source: www.askbuild.com

Drainage Improvements

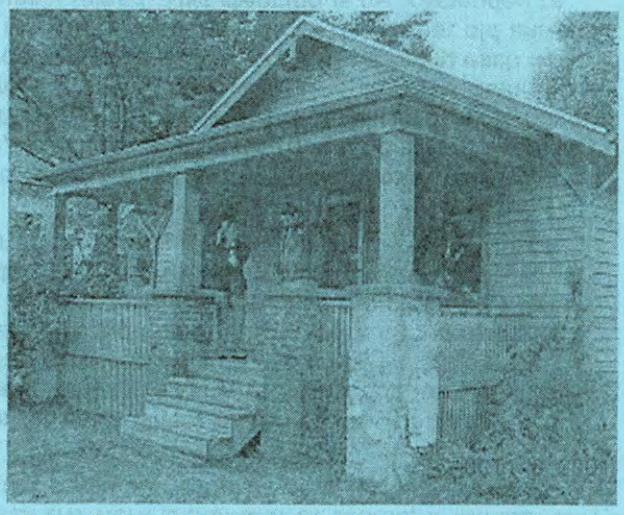
The sloping nature of the Three Lynx site makes drainage an important issue. Storm and sewer water should be kept moving away from the buildings. Methods of addressing this issue would benefit from a holistic, long-term approach addressing downspouts, drainage, and septic facilities in order to reduce moisture presence in the buildings and site.

Runoff from roofs and other impervious surfaces should be directed away from structures. A grade assessment would be beneficial to determine if there are areas that drain inappropriately. If necessary, a revised grading plan should be implemented.

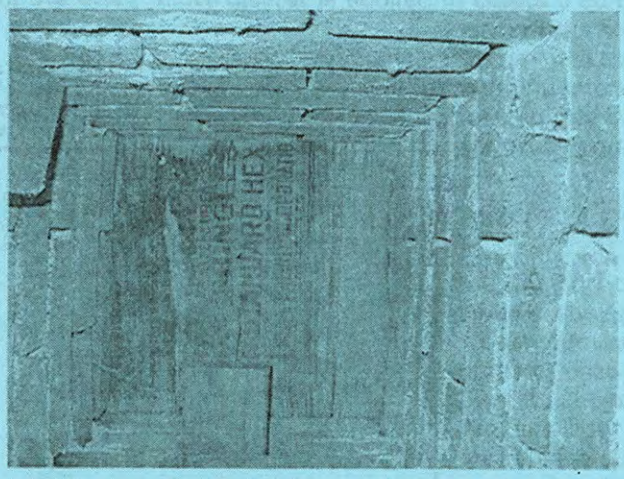
All roof drainage systems should remain operable. Discharge from down spouts should be directed out away from the building. French drains would be advantageous around the building perimeters to facilitate drainage of water in the soil. The perforated pipe should be placed next to the bottom of the foundation to collect water before it can penetrate the foundation. The french drain should be connected to the storm sewer to remove runoff. Swales (ditches) could be used to direct surface run-off from the site and direct water away from structures.

Septic conditions should be assessed by means of a pipe snake and experienced plumber to determine if the sewer lines are only backed up, or if the sewer pipe is failing. If the sewer lines only are backed up, then cleaning and continued use until such time as a service grade is deemed necessary would be appropriate. If the sewer pipe is failing, the system would need a complete upgrade. During any excavation work around the building it would be advantageous to determine the type and dimensions of the foundation.

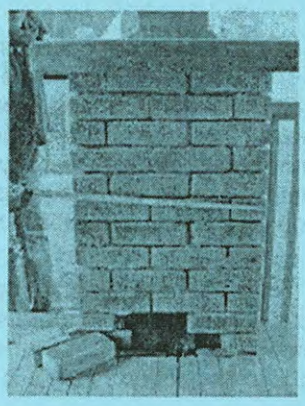
Stabilization



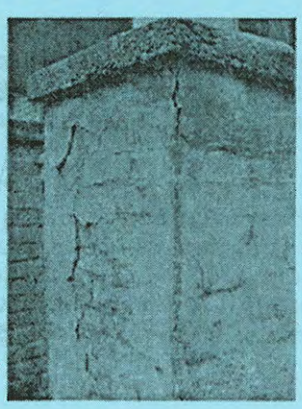
View of piers. Notice parging on right pier.



Interior view of piers looking up from porch level at bottom of concrete cap.



View at left of brick loss where porch and chimney meet. Notice hollow core. Picture above of this core taken from this hole.



View at right of parging on chimney and subsequent flaking as water accumulates below

Pier Rehabilitation

The brick piers are failing due to design flaw.

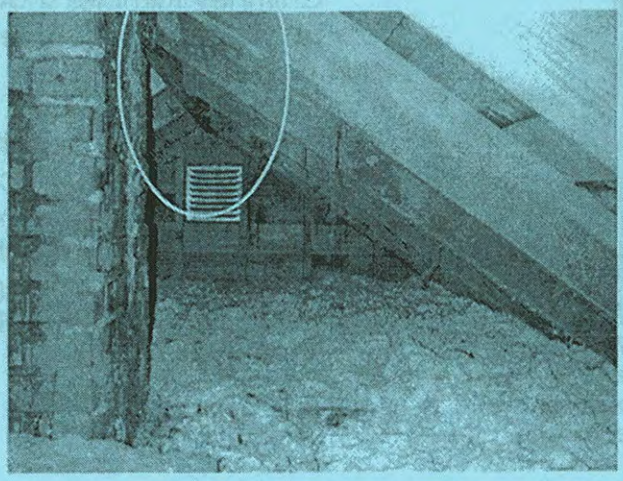
The porch roof should be shored up at the soffit level. The brick piers and boxed wood columns could then be dismantled, salvaging the brick and wood for reuse. A rectangular concrete pier matching original pier height could then be installed. This concrete pier would support the corners of the porch substructure. Reinstall brick as veneer.

If work described (new concrete pier) cannot be performed in the near future, the existing condition of the brickwork warrants additional temporary support beneath the outer corners of the porch deck. A recommended support may be stacked concrete masonry units or similar cribbing material.

Re-pointing work would be relatively ineffective due to the single wythe (thickness) configuration of the piers. Removal of existing parging (cementitous coating meant to act as a waterproofing layer) prior to installation of a concrete core is not recommended. The existing coating may be reinforcing deteriorated brickwork.

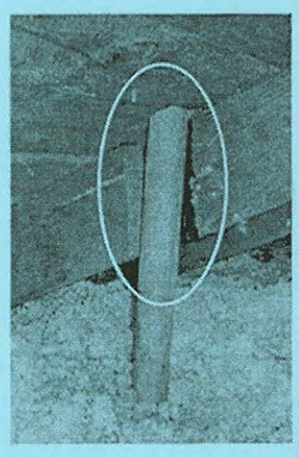
Separation of the porch roof from the exterior wall may be occurring due to the listing piers. If so, this condition would likely be remedied concurrent with action taken to pier reinforcing.

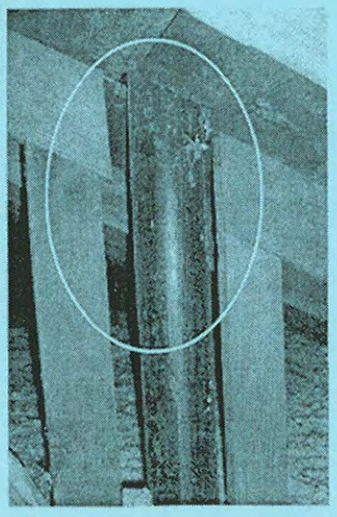
Stabilization



Interior view showing moisture penetration around roof-chimney joint.

Detail of water stain.





Examples showing cuts in rafters to accomodate vertical pipe vents.

Chimney Recommendations

Determine future use of chimney, whether or not it will be used. If not used then determine if chimney will be kept in place or removed.

If used, and with metal liner, then return structural integrity, and seismically retrofit the base as determined necessary. Installation of appropriate flashing around the roof-chimney joint should coincide with roof repairs.

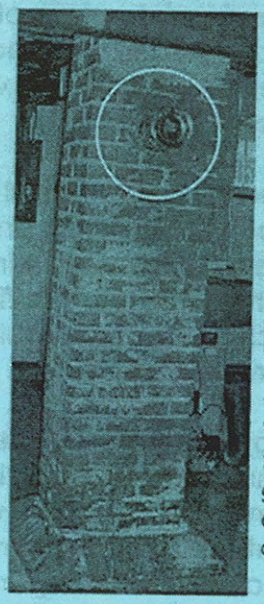
If kept but not used, there is an immediate concern of moisture, both building up in chimney from lack of use and penetrating at the roof-chimney joint. The chimney and surrounding materials would benefit from a cap and flashing installed at the roof-chimney joint.

If upper portions of chimneys are to be removed then photograph and document exterior and interior views of each chimney for archival purposes prior to removal.

House No. 40 has partially cut roof rafters and ceiling joists at areas where vertical pipe vents are located.

Determine if this condition occurs elsewhere and at each location sister matching wood member to existing framing.

Stabilization

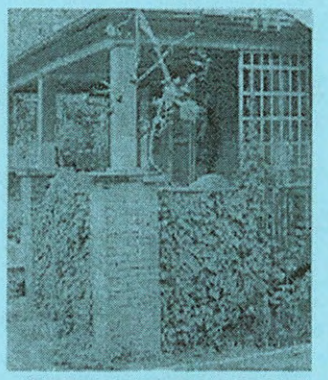


View at left of chimney thimble as seen in basement. View above of chimney thimble as seen on the ground floor. Notice moisture entry and damage to wall covering at the ground floor..

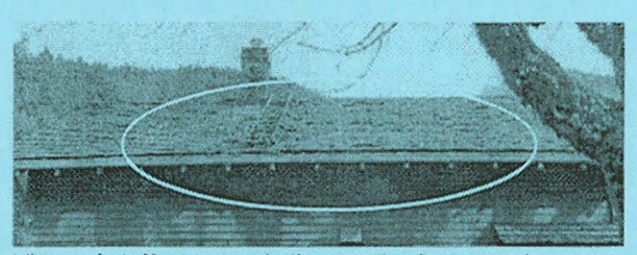
Chimney thimbles show signs of moisture build up and movement within the chimney.

Determine if this condition occurs elsewhere and at each location replace thimbles in basement with vents and those on the ground floor with lightweight metal plates, replaster surrounding area. The vent in the basement will allow air movement through chimney.

Stabilization



Examples of vegetation growing into and adjacent to house.



View of duff accumulation and subsequent vegatative growth on roof.

Planting Recommendations

Roots: If affecting foundation then they are a serious issue. Remove the tree and all accompanying roots. Prevent by monitoring all new and existing plantings, and determine minimum planting distance from building.

Dangerous Limbs: Cut, if possible during spring. Keep growth balanced if possible to mitigate toppling in heavy wind. Prevent by keeping pruned.

Foundation plantings: Any plants that are close to the foundation should be pruned so that a 12-inch space exists between the house and the plant. If this is not possible then the plant should be removed. (This is necessary to reduce moisture and bug infestation into the structure.)

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The Seismic Retrofit of Historic Buildings

Keeping Preservation in the Forefront

David W. Look, AIA, Terry Wong, PE, and Sylvia Rose Augustus

»Introduction
»Balancing Seismic Retrofit and Preservation
»Earthquake Damage to Historic Buildings
»Putting a Team Together
»Planning for Seismic Retrofit
»Assessing the Cost of Seismic Retrofit
»Seismic Strengthening Approaches
»Post-Earthquake Issues
»Questions to Ask
»Conclusion

Violent, swift, and unpredictable, earthquakes result from sudden movements of the geological plates that form the earth's crust, generally along cracks or fractures known as "faults." If a building has not been designed and constructed to absorb these swaying ground motions, then major structural damage, or outright collapse, can result, with grave risk to human life. Historic buildings are especially vulnerable in this regard. As a result, more and more communities are beginning to adopt stringent requirements for seismic retrofit of existing buildings. And despite popular misconceptions, the risks of earthquakes are not limited to the West Coast.

Although historic and other older buildings can be retrofitted to survive earthquakes, many retrofit practices damage or destroy the very features that make such buildings significant. Life-safety issues are foremost and, fortunately, there are various approaches which can save historic buildings both from the devastation caused by earthquakes and from the damage inflicted by well-intentioned but insensitive retrofit procedures. Building owners, managers, consultants, and communities need to be actively involved in preparing documents and readying irreplaceable historic resources from these threats.

This Preservation Brief provides essential information on how earthquakes affect historic buildings, how a historic preservation ethic can guide responsible decisions, and how various methods of seismic retrofit can protect human lives *and* historic structures. Because many of the terms used in this Brief are technical, a glossary is provided at the end. The Brief focuses on unreinforced masonry buildings because these are the most vulnerable of our older resources, but the guidance is appropriate for all historic buildings. Damage to non-structural elements such as furnishings and collections is beyond the scope of this Brief, but consideration should be given to securing and

protecting these cultural resources as well.

Planning the retrofit of historic buildings *before* an earthquake strikes is a process that requires teamwork on the part of engineers, architects, code officials, and agency administrators. Accordingly, this Brief also presents guidance on assembling a professional team and ensuring its successful interaction. Project personnel working together can ensure that the architectural, engineering, financial, cultural, and social values of historic buildings are preserved, while rendering them safe for continued use.

Balancing Seismic Retrofit and Preservation

Reinforcing a historic building to meet new construction requirements, as prescribed by many building codes, can destroy much of a historic building's appearance and integrity. This is because the most expedient ways to reinforce a building according to such codes are to impose structural members and to fill irregularities or large openings, regardless of the placement of architectural detail. The results can be quite intrusive. However, structural reinforcement can be introduced sensitively. In such cases, its design, placement, patterning, and detailing respect the historic character of the building, even when the reinforcement itself is visible.

Before

Before

After

After

Both exteriors and interiors can be severely damaged in an earthquake. This Craftsman Style bungalow was successfully rehabilitated and seismically upgraded after the Northridge earthquake in California.

Photos: Courtesy, Historic Preservation Partners in Earthquake Response.

Three important preservation principles should be kept in mind when undertaking seismic retrofit projects:

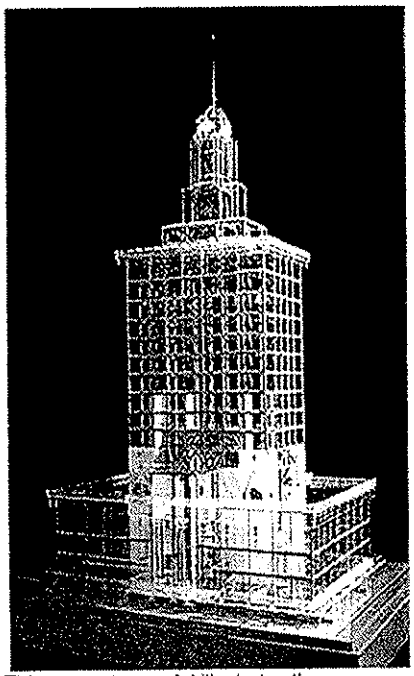
- *Historic materials should be preserved and retained to the greatest extent possible and not replaced wholesale in the process of seismic strengthening;*
- *New seismic retrofit systems, whether hidden or exposed, should respect the character and integrity of the historic building and be visually compatible with it in design; and,*

- *Seismic work should be "reversible" to the greatest extent possible to allow removal for future use of improved systems and traditional repair of remaining historic materials.*

It is strongly advised that all owners of historically significant buildings contemplating seismic retrofit become familiar with *The Secretary of the Interior's Standards for the Treatment of Historic Properties*, which are published by the National Park Service and cited in the bibliography of this publication. These standards identify approaches for working with historic buildings, including preservation, rehabilitation, and restoration. Code-required work to make buildings functional and safe is an integral component of each approach identified in the *Standards*. While some seismic upgrading work is more permanent than reversible, care must be taken to preserve historic materials to the greatest extent possible and for new work to have a minimal visual impact on the historic appearance of the building.

Earthquake Damage to Historic Buildings: Assessing Principal Risk Factors

Typical earthquake damage to most older and historic buildings results from poor ductility--or flexibility--of the building and, specifically, poor structural connections between walls, floors, and foundations combined with the very heavy weight and mass of historic materials that are moved by seismic forces and must be resisted. In buildings that have not been seismically upgraded, particularly unreinforced masonry buildings, parapets, chimneys, and gable ends may dislodge and fall to the ground during a moderate to severe earthquake. Walls, floors, roofs, skylights, porches, and stairs which rely on tied connections may simply fail. Interior structural supports may partially or totally collapse. Unreinforced masonry walls between openings often exhibit shear (or diagonal) cracking. Upper stories may collapse onto under-reinforced lower floors with large perimeter openings or atriums. Unbraced infill material between structural or rigid frame supports may dislodge. Adjacent buildings with separate foundations may move differently in an earthquake creating damage between them. Poorly anchored wood frame buildings tend to slide off their foundations. Ruptured gas and water lines often cause fire and water damage. Many of these vulnerabilities can be mitigated by understanding how the forces unleashed in an earthquake affect the building, then planning and implementing appropriate remedial treatments.



This computer model illustrates the comprehensive methods used to fully reinforce a building for the future. Oakland City Hall, CA. Computer Model ©Douglas Symes, San Francisco.

Six principal factors influence how and why historic buildings are damaged in an earthquake:

(1) depth of the earthquake and subsequent strength of earthquake waves reaching the surface

(2) duration of the earthquake, including after-shock tremors

(3) proximity of the building to the earthquake epicenter, although distance is not necessarily a direct relationship

(4) geological and soil conditions

(5) building construction details, including materials, structural systems, and plan configuration; and

(6) existing building condition, including maintenance level.

The first three factors--**the depth, duration, and proximity to the fault**--are beyond human control. Recent earthquakes have shown the fourth factor, geological soil conditions, to be as important as any of the other factors because loose, soft soils tend to amplify ground motion, thereby increasing damage. Further, there is the tendency of soft, unstable soils to "liquefy" as the ground vibrates, causing the building foundations to sink unevenly. This fourth factor, geological and soil conditions, is difficult to address in a retrofit situation, although it can be planned for in new construction. The last two factors--**the building's construction type and its existing physical condition**--are the two factors over which building owners and managers have control and can ultimately affect how the historic property performs in an earthquake.

Although historic buildings present problems, the way they were constructed often has intrinsic benefits that should not be overlooked. Diagonal subflooring under tongue-and-groove nailed flooring can provide a diaphragm, or horizontal membrane, that ties the building together. Interior masonry walls employing wire lath with plaster also add strength that binds materials together. The typical construction of older buildings with partition walls that extend from floor to ceiling (instead of just to the underside of a dropped ceiling) also provides additional support and load transfer during an earthquake that keeps shifting floors from collapsing. Moreover, buildings constructed of unreinforced masonry with a wall thickness to height ratio that does not exceed code requirements can often survive shaking without serious damage. The stability of unreinforced masonry walls should not be underestimated; while the masonry may crack, it often does not shift out of plumb enough to collapse.

Type of Building and Construction

A historic building's construction and materials determine its behavior during an earthquake. Some buildings, such as wooden frame structures, are quite ductile and, thus, able to absorb substantial movements. Others, such as unreinforced brick or adobe buildings comprised of heavy individual load-bearing units, are more susceptible to damage from shaking. If an earthquake is strong, or continues for a long time, building elements that are poorly attached or unreinforced may collapse. Most historic buildings still standing in earthquake zones have survived some shaking, but may be structurally weakened.

Buildings of more rigid construction techniques may also have seismic deficiencies. Masonry infill-wall buildings are generally built of steel or concrete structural frames with unreinforced masonry sections or panels set within the frame. While the structural frames may survive an earthquake, the masonry infill can crack and, in some cases, dislodge. The reaction of concrete buildings and concrete frame structures is largely dependent upon the extent and configuration of iron or steel reinforcement. Early

buildings constructed of concrete are often inadequately reinforced, inadequately tied, or both, and are thus susceptible to damage during earthquakes.

Recognition of the configuration of the historic structure and inherent areas of weakness are essential to addressing appropriate alternatives for seismic retrofit. For example, the plan and elevation may be as important as building materials and structural systems in determining a historic building's survival in an earthquake. Small round, square, or rectangular buildings generally survive an earthquake because their geometry allows for equal resistance of lateral forces in all directions. The more complex and irregular the plan, however, the more likely the building will be damaged during an earthquake because of its uneven strength and stiffness in different directions. Structures having an "L," "T," "H," "U," or "E" shape have unequal resistance, with the stress concentrated at corners and intersections. This is of particular concern if the buildings have flexible structural systems and/or an irregular layout of shear walls which may cause portions of the building to pull apart.

Similarly, the more complex and irregular a building elevation, the more susceptible it is to damage, especially in tall structures. Large or multiple openings around the building on the ground level, such as storefronts or garage openings, or floors with columns and walls running in only one direction are commonly known as "soft stories" and are prone to structural damage.

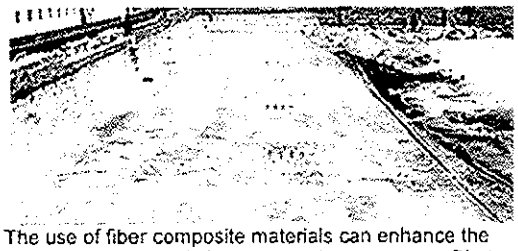
Building Condition

Much of the damage that occurs during an earthquake is directly related to the building's existing condition and maintenance history. Well maintained buildings, even without added reinforcement, survive better than buildings weakened by lack of maintenance. The capacity of the structural system to resist earthquakes may be severely reduced if previous alterations or earthquakes have weakened structural connections or if materials have deteriorated from moisture, termite, or other damage. Furthermore, in unreinforced historic masonry buildings, deteriorated mortar joints can weaken entire walls. Cyclical maintenance, which reduces moisture penetration and erosion of materials, is therefore essential. Because damage can be cumulative, it is important to analyze the structural capacity of the building.

Over time, structural members can become loose and pose a major liability. Unreinforced historic masonry buildings typically have a friction-fit connection between horizontal and vertical structural members, and the shaking caused by an earthquake pulls them apart. With insufficient bearing surface for beams, joists, and rafters against the load bearing walls or support columns, they fail. The resulting structural inadequacy may cause a partial or complete building collapse, depending on the severity of the earthquake and the internal wall configuration. Tying the building together by making a positive anchored or braced connection between walls, columns, and framing members, is key to the seismic retrofit of historic buildings.

Putting a Team Together

The two goals of the seismic retrofit in historic buildings are life safety and the protection of older and historic buildings during and after an earthquake. Because rehabilitation should be



The use of fiber composite materials can enhance the shear capacity of existing structural components. Photo: The Crosby Group.

sensitive to historic materials and the building's historic character, it is important to put together a team experienced in both seismic requirements and historic preservation. Team members should be selected for their experience with similar projects, and may include architects, engineers, code specialists, contractors, and preservation consultants. Because the typical seismic codes are written for new construction, it is important that both the architect and structural engineer be knowledgeable about historic buildings and about meeting building code equivalencies and using alternative solutions. Local and state building officials can identify regulatory requirements, alternative approaches to meeting these requirements, and if the jurisdiction uses a historic preservation or building conservation code. Even on small projects that cannot support a full professional team, consultants should be familiar with historic preservation goals. The State Historic Preservation Office and the local historic preservation office or commission may be able to identify consultants who have been successful in preserving historic buildings during seismic retrofit work. Once the team has been assembled, their tasks include:

Compiling documentation. The team should review all available documentation on the historic building, including any previous documentation assembled to nominate the structure to the National Register of Historic Places, and any previous Historic Structures Reports. Original plans and specifications as well as those showing alterations through time often detail structural connections. Early real estate or insurance plans, such as the *Sanborn Maps,* note changes over time. Historic photographs of the building under construction or before and after previous earthquakes are invaluable. Base maps for geological or seismic studies and utility maps showing the location of water, gas, and electric lines should be also identified. The municipal or state office of emergency preparedness can provide data on earthquake hazard plans for the community.

Evaluating significant features and spaces. The team must also identify areas of a historic building and its site that exhibit design integrity or historical significance which must be preserved. It is critical, and a great challenge, to protect these major features, such as domes, atriums, and vaulted spaces or highly decorative elements, such as mosaics, murals, and frescoes. In some cases, secondary areas of the building can provide spaces for additional reinforcement behind these major features, thus saving them from damage during seismic retrofit work. Both primary and secondary spaces, features, and finishes should, thus, be identified.

Assessing the condition of the building and the risk hazards. The team then assesses the general physical condition of the building's interior and exterior, and identifies areas vulnerable to seismic damage. This often requires a structural engineer or testing firm to determine the strength and durability of materials and connections. A sliding scale of potential damage is established, based on the probability of hazard by locale and building use. This helps the owner distinguish between areas in which repairable damage, such as cracking, may occur and those in which life-threatening problems may arise. These findings help guide cost-benefit decisions, especially when budgets are limited.

Evaluating local and state codes and requirements. Few codes consider historic buildings, but the California State Historical Code and the Uniform Code for Building Conservation provide excellent models for jurisdictions to adopt. Code officials should always be asked where alternative approaches can be taken to provide life safety if the specified requirements of a code would destroy significant historic materials and features. Some jurisdictions require the removal of parapets, chimneys, or projecting

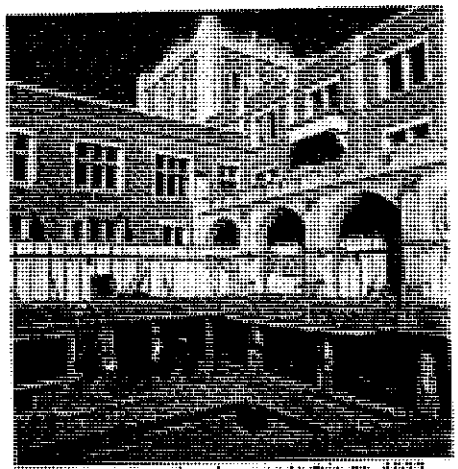
decoration from unreinforced masonry buildings which is not a preservation approach. Professionals on the team should be prepared with alternatives that allow for mitigating potential damage to such features while retaining them through reattachment or strengthening.

Developing a retrofit plan. The final task of the project team is to develop a retrofit plan. The plan may require multiple treatments, each more comprehensive than the last. Treating life-safety issues as well as providing a safe route of exit should be evaluated for all buildings. Developing more comprehensive plans, often combined with future rehabilitation, is reasonable. Long-term restoration solutions phased in over time as funding is available should also be considered. In every case, owners and their planning teams should consider options that keep preservation goals in mind.

There are significant advantages of completing a seismic survey and analysis even if resources for implementing a retrofit are not yet available. Once the retrofit plan is finished, the project team will have a document by which to assess future damage and proceed with emergency repairs. If construction is phased, its impact to the whole building should be understood. Some partially completed retrofit measures have left buildings more rigid in one area than in others, thereby contributing to more extensive damage during an ensuing earthquake.

Planning for Seismic Retrofit: How Much and Where?

The integrity and significance of the historic building, paired with the cost and benefit of seismic upgrading, need to be weighed by the owner and the consulting team. Buildings in less active seismic areas may need little or no further bracing or tying. Buildings in more active seismic zones, however, may need more extensive intervention. Options for the level of seismic retrofit generally fall into four classifications, depending on the expected seismic activity and the desired level of performance. Realistically, for historic buildings, only the first three categories apply.



Upon completion, the changes to this ca. 1852 Gothic Revival building to add base isolation at the foundation were not visually apparent. Photo: © Jonathan Farrer

1) *Basic Life Safety.* This addresses the most serious life-safety concerns by correcting those deficiencies that could lead to serious human injury or total building collapse. Upgrades may include bracing and tying the most vulnerable elements of the building, such as parapets, chimneys, and projecting ornamentation or reinforcing routes of exit. It is expected that if an earthquake were to occur, the building would not collapse but would be seriously damaged requiring major repairs.

2) *Enhanced Life Safety.* In this approach, the building is upgraded using a flexible approach to the building codes for moderate earthquakes. Inherent deficiencies found in older buildings, such as poor floor to wall framing connections and unbraced masonry walls would be corrected. After a design level earthquake, some structural damage is anticipated, such as masonry cracking, and the building would be temporarily unusable.

3) *Enhanced Damage Control.* Historic buildings are substantially rehabilitated to meet, to the extent possible, the proscribed building code provision. Some minor repairable damage would be expected after a major earthquake.

4) *Immediate Occupancy.* This approach is intended for designated hospitals and emergency preparedness centers remaining open and operational after a major earthquake. Even most modern buildings do not meet this level of construction, and so for a historic building to meet this requirement, it would have to be almost totally reconstructed of new materials which, philosophically, does not reflect preservation criteria.

Devising the most appropriate approach for a particular historic building will depend on a variety of factors, including the building's use, whether it remains occupied during construction, applicable codes, budgetary constraints, and projected risk of damage. From a design perspective, the vast majority of historic buildings can tolerate a well-planned hidden system of reinforcement. Utilitarian structures, such as warehouses, may be able to receive fairly visible reinforcement systems without undue damage to their historic character. Other more architecturally detailed buildings or those with more finished interior surfaces, however, will benefit from more hidden systems; installation of such systems may even require the temporary removal of significant features to assure their protection. Most buildings, particularly commercial rehabilitations, can incorporate seismic strengthening during other construction work in a way that ensures a high degree of retention of historic materials in place.

Assessing the Cost of Seismic Retrofit

Cost plays a critical role in selecting the most appropriate retrofit measure. It is always best to undertake retrofit measures before an earthquake occurs, when options are available for strengthening existing members. Once damage is done, the cost will be substantially higher and finding engineers, architects, and contractors available to do the work on a constricted schedule will be more difficult.

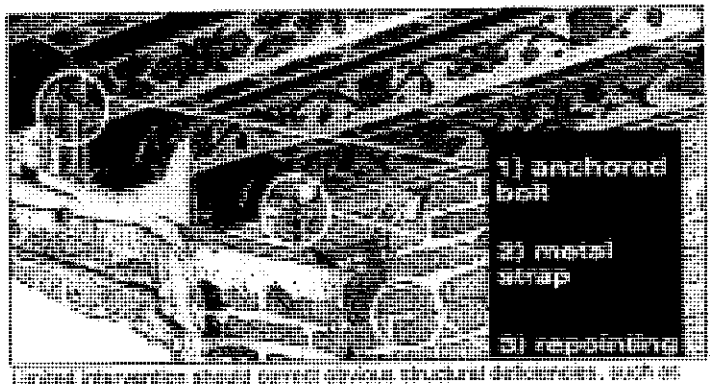
Planned seismic retrofit work may add between $10 and $100 per square foot to the cost of rehabilitation work depending on the level of intervention, the condition of the building, and whether work will be undertaken while the building is occupied. Costs can exceed several hundred dollars a square foot for combined restoration and seismic upgrade costs in major public buildings, in order to provide a level of structural reinforcement that would require only minor repairs after a major earthquake. But maintenance and incremental improvements to eliminate life-safety risks are within the cost realm of responsible upkeep.

Each property owner has to weigh the costs and benefits of undertaking seismic retrofit in a timely manner. Owners may find that an extended engineering study evaluating a wide range of options is worthwhile. Not only can such a study consider the most sensitive historic preservation solution, but the most cost-effective one as well. In many cases, actual retrofit expenses have been lower than anticipated because a careful analysis of the existing building was made that took the durability and performance of existing historic materials into consideration. Most seismic retrofit is done incrementally or incorporated into other rehabilitation work. In large public buildings, seemingly expensive "high-tech" solution such as installing foundation base isolators can turn out

to be justified because significant historic materials do not have to be removed, replaced, or replicated. The cost for a fully retrofitted building can offset the potential loss of income, relocation, and rebuilding after an earthquake. Without careful study, these solutions often are not evaluated.

Some municipalities and states provide low-interest loans, tax relief, municipal bonds, or funding grants targeted to seismic retrofit. Federal tax incentives for the rehabilitation of income-producing historic buildings include seismic strengthening as an allowable expense. Information on these incentives is available from the State Historic Preservation Office. It is also in the best interest of business communities to support the retrofit of buildings in seismically active areas to reduce the loss of sales and property taxes, should an earthquake occur.

Seismic Strengthening Approaches



Limited intervention should correct obvious structural deficiencies, such as tying vulnerable elements together and repointing masonry. Upon replastering and painting these reinforcements will not be visible. Photo: Courtesy, Historic Preservation Partners for Earthquake Response.

Seismic strength within buildings is achieved through the reinforcement of structural elements. Such reinforcement can include anchored ties, reinforced mortar joints, braced frames, bond beams, moment-resisting frames, shear walls, and horizontal diaphragms. Most historic buildings can use these standard, traditional methods of strengthening successfully, if properly designed to conform to the historic character of the building. In addition, there are new technologies and better designs for traditional connection devices as well as a greater acceptance of alternative approaches to meeting seismic requirements. While some technologies may still be new for retrofit, the key preservation principles previously outlined should be applied, to ensure that historic buildings will not be damaged by them.

There are varying levels of intervention for seismically retrofitting historic buildings based on the owner's program, the recommendations of the team, applicable codes, and the availability of funds.

Maintenance/Preparedness

Adequate maintenance ensures that existing historic materials remain in good condition and are not weakened by rot, rust, decay or other moisture problems. Without exception, historic buildings should be well maintained and an evacuation plan developed. Expectation that an earthquake will occur sometime in the future should prepare the owner to have emergency information and supplies on hand.

- Check roofs, gutters, and foundations for moisture problems, and for corrosion of metal ties for parapets and chimneys. Make repairs and keep metal painted and in good condition.

- Inspect and keep termite and wood boring insects away from wooden structural members. Check exit steps and porches to ensure that they are tightly connected and will not collapse during an emergency exit.

- Check masonry for deteriorating mortar, and never defer repairs. Repoint, matching the historic mortar in composition and detailing.

- Contact utility companies for information on flexible connectors for gas and water lines, and earthquake activated gas shut-off valves. Strap oil tanks down and anchor water heaters to wall framing.

- Collect local emergency material for reference and implement simple household or office mitigation measures, such as installing latches to keep cabinets from flying open or braces to attach tall bookcases to walls. Keep drinking water, tarpaulins, and other emergency supplies on hand.

Basic/Traditional Measures

This is not an exhaustive list, but illustrates that most measures to reduce life-safety risks rely on using mechanical fasteners to tie a building together. Incorporating these measures can be done incrementally without waiting for extensive rehabilitation. An architectural or engineering survey should identify what is needed. Care should be taken to integrate these changes with the visual appearance of the building.

- Bolt sill plates to foundations and add plywood stiffeners to cripple wall framing around wood frame buildings. Keep reinforcement behind decorative crawlspace lattice or other historic features.

- Reinforce floor and roof framing connections to walls using joist hangers, metal straps, threaded bolts, or other means of mechanical fasteners. Tie columns to beams; reinforce porch and stair connections as well.

- Repair weakened wooden structural systems by adding, pairing, or bracing existing members. Consider adding non-ferrous metal straps in alternating mortar joints if extensive repointing is done in masonry walls.

- Reinforce projecting parapets and tie parapets, chimneys, balconies, and unsecured decorative elements to structural framing. Make the connections as unobtrusive as possible. In some cases, concrete bond beams can be added to reinforce the top of unreinforced masonry or adobe walls.

- Properly install and anchor new diaphragms, such as roof sheathing or subflooring, to the walls of a structure prior to installing finish materials.

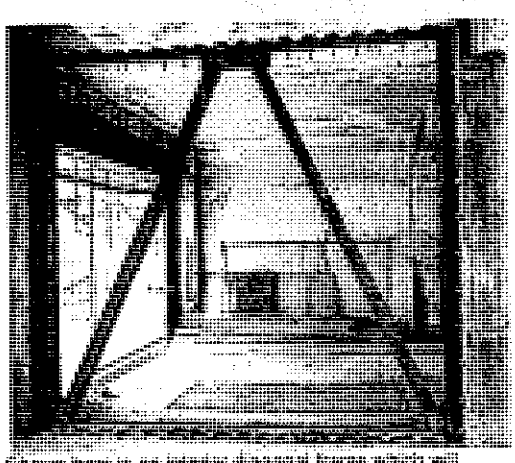
- Avoid awkwardly placed exposed metal plates or rosettes when using threaded bolts through masonry walls. When exposed plates will interfere with the decorative elements of the facade, use less visible grouted bolts or plates that can be set underneath exposed finished materials.

- Use sensitively designed metal bracing along building exteriors to tie the unsupported face of long exterior walls to the floor framing. This is often seen

along side or party walls in commercial or industrial buildings.

Rehabilitation

When buildings are being rehabilitated, it is generally the most cost effective time to make major upgrades that affect the structural performance of the building. New elements, such as concrete shear walls or fiber reinforcing systems can be added while the structure is exposed for other rehabilitation or code compliance work.



dampen and transfer seismic loads in a designed path from foundation to roof. Photo: David Look, AIA.

- Inspect and improve all lateral tie connections and diaphragms.

- Reinforce walls and large openings to improve shear strength in locations of doors, windows, and storefront openings. Carefully locate "X" and "K" bracing to avoid visual intrusion, or use moment frames, which are a hidden perimeter bracing in large openings. From a preservation perspective, the use of a more hidden system in finished spaces is generally preferable.

- Strengthen masonry walls or columns with new concrete reinforcement or fiber wrap systems. Avoid the use of heavy spray concrete or projecting reinforced walls that seriously alter the historic relationship of the wall to windows, trim, and other architectural moldings or details.

- Selectively locate new shear walls constructed to assist the continuous transfer of loads from the foundation to the roof. If these walls cannot be set behind historic finishes, they should be located in secondary spaces in conjunction with other types of reinforcement of the primary spaces or features.

- Consider the internal grouting of rubble masonry walls using an injected grout mixture that is compatible in composition with existing mortar. Ensure that exposed areas are repaired and that the mortar matches all visual qualities of the historic mortar joints in tooling, width, color and texture.

- Evaluate odd-shaped buildings and consider the reinforcement of corners and connections instead of infilling openings with new construction. Altering the basic configuration and appearance of primary facades of buildings is damaging to those qualities that make the building architecturally significant.

Specialized Technologies

New technologies, being developed all the time, may have applicability to historic preservation projects. These specialized technologies include: vertical and center core drilling systems for unreinforced masonry buildings, base isolation at the foundations, superstructure damping systems, bonded resin coatings, and reproducing

The new base isolator allows the structural support members at the foundation to move horizontally as it absorbs the earthquake forces. Photo: ©Jonathan Farrer.

lost elements in lighter materials. However, many new technologies may also be non-reversible treatments resulting in difficulties of repair after an earthquake. The reinforcement of historic materials with special resins, or the use of core drilling to provide a reinforced vertical connection from foundation to roof may not be as repairable after an earthquake as would more traditional means of wall reinforcement. New technologies should be carefully evaluated by the design team for both their benefits as well as their shortcomings.

Using computer modeling of how historic buildings may act in an earthquake suggests options for seismic upgrade using a combination of traditional methods and new technologies. While most projects involving base isolation and other complex damping systems constitute only a small percentage of the projects nationwide that are seismically reinforced, they may be appropriate for buildings with significant interior spaces that should not be disturbed or removed during the retrofit. Each building will needs its own survey and evaluation to determine the most appropriate seismic reinforcement.

Post-Earthquake Issues

New structural steel and restoration of the historic stucco and decorative tile work and a repaired tile roof reinstated this earthquake damaged building as a major element of the historic district. Northridge, CA. Photo: Courtesy of Historic Preservation Partners for Earthquake Response.

Should a historic building suffer damage during an earthquake, it is the owner *who has a plan in place* who will be able to play a critical role in determining its ultimate fate. If the owner has previously assembled a team for the purpose of seismic upgrading, there is a greater chance for the building to be evaluated in a timely fashion and for independent emergency stabilization to occur. In most municipalities, a survey, often by trained volunteers, will be conducted as soon as possible after an earthquake, and buildings will be tagged on the front with a posted notice according to their ability to be entered. Typically red, yellow, and green tags are used to indicate varying levels of damage--*no entry, limited entry, and useable*--to warn citizens of their relative safety. Heavily damaged areas are often secured off-limits and many red tagged, but repairable, buildings have been torn down unnecessarily because owners were unable to evaluate and present a stabilization plan in time. Owners or members of the preservation community may engage their own engineers with specialized knowledge to challenge a demolition order. Because seismic retrofit is complex and many jurisdictions are

involved, the coordination between various regulatory bodies needs to be accomplished *before* an earthquake.

During times of emergencies, many communities, banks, and insurance agencies will not be in a position to evaluate alternative approaches to dealing with damaged historic buildings, and so they often require full compliance with codes for new construction for the major rehabilitation work required. Because seismic after-shocks often create more damage to a weakened building, the inability to act quickly--even to shore up the structure on a temporary basis--can result in the building's demolition. Penetrating rain, uneven settlement, vandalism, and continuing after-shocks can easily undermine a building's remaining structural integrity. Moreover, the longer a building is unoccupied and non-income-producing, the sooner it will be torn down in a negotiated settlement with the insurance company. All of these factors work against saving buildings damaged in earthquakes, and make having an action plan essential.

Having an emergency plan in place, complete with access to plywood, tarpaulins, bracing timbers, and equipment, will allow quick action to save a building following an earthquake. Knowing how the community evaluates buildings and the steps taken to secure an area will give the owner the ability to be a helpful resource to the community in a time of need.

If the federal government is asked to intervene after a natural disaster, technical assistance programs are available. Often after a disaster, grant funds or low-cost loans from federal, state, and congressional special appropriations are targeted to qualified properties, which can help underwrite the high cost of rehabilitation (see information about FEMA)

Conclusion

Recent earthquakes have shown that historic buildings retrofitted to withstand earthquakes survive better than those that have not been upgraded. Even simple efforts, such as bracing parapets, tying buildings to foundations, and anchoring brick walls at the highest, or roof level, have been extremely effective. It has also been proven that well maintained buildings have faired better than those in poor condition during and after an earthquake. Thus, maintenance and seismic retrofit are two critical components for the protection of historic buildings in areas of seismic activity. It makes no sense to retrofit a building, then leave the improvements, such as braced parapets or metal bolts with plates, to deteriorate due to lack of maintenance.

Damage to historic buildings *after* an earthquake can be as great as the initial damage from the earthquake itself. The ability to act quickly to shore up and stabilize a building and to begin its sensitive rehabilitation is imperative. Communities without earthquake hazard reduction plans in place put their historic buildings--as well as the safety and economic well-being of their residents -- at risk.

Having the right team in place is important. Seismic strengthening of existing historic buildings and knowledge of community planning for earthquake response makes the professional opinions of the team members that much more important when obtaining permits to do the work. Local code enforcement officials can only implement the provisions of the model or historic preservation codes if the data and calculations work to ensure public safety. Buildings do not need to be over-retrofitted. A cost-effective

balance between protecting the public and the building recognizes that planned for repairable damage can be addressed after an earthquake. Engineers and architects, *who specialize in historic buildings* and who have a working knowledge of alternative options and expected performance for historic structures, are critical to the process.

It is clear that historic and older buildings can be seismically upgraded in a cost-effective manner while retaining or restoring important historic character-defining qualities. Seismic upgrading measures exist that preserve the historic character and materials of a buildings. However, it takes a multi-disciplined team to plan and to execute sensitive seismic retrofit. It also takes commitment on the part of city, state, and federal leaders to ensure that historic districts are protected from needless demolition after an earthquake so that historic buildings and their communities are preserved for the future.

SEISMIC RISK ZONES

Most local jurisdictions measure seismic risk based on seismic zones established by code, such as the Uniform Building Code with its 4 risk zones [1=low to 4=high]. There are also maps, such as this one, which identify the Effective Peak Acceleration (EPA) which further reflect the light, moderate, and severe shaking risks as a percentage of the acceleration of gravity that can be expected in an area.

In the United States, the greatest activity areas are the western states, Alaska, and some volcanic island areas. However, noted historical earthquakes occurred in Massachusetts (1755), Missouri (1811), South Carolina (1886), and Alaska (1964). The Caribbean Islands and Puerto Rico have been sites of severe earthquakes. The history of earthquakes in the United States has been recorded for over 200 years and new areas of concern include moderate risk areas in southern and mid-western states.

The Richter Magnitude Scale, first published in 1935, records the size of an earthquake at its source, as measured on a seismograph. Magnitudes are expressed in whole numbers and decimals between 1 and 9. An earthquake of a magnitude of 6 or more will cause moderate damage, while one of over 7 will be considered a major earthquake. It is important to remember that an increase of one whole number on the Richter Scale is a tenfold increase in the size of the earthquake.

The Federal Emergency Management Agency

The Federal Emergency Management Agency -- FEMA -- is an independent agency of the federal government, reporting to the President. Since its founding in 1979, FEMA's mission has been to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program. FEMA works with the state and local governments and the private sector to stimulate increased participation in emergency preparedness, mitigation, response and recovery programs related to natural disasters. To minimize damage-repair-damage cycles, FEMA carries out and encourages preventive activities

referred to as hazard mitigation.

The FEMA Hazard Mitigation Program, established in 1988 with the passage of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, offers a framework for protecting historic structures from natural disasters. In the event of a federally declared disaster, state and local governments as well as eligible non-profit applicants may receive financial and technical assistance to identify and carry out cost-effective hazard mitigation activities.

FEMA encourages hazard mitigation projects, including the restoration of buildings, by providing technical assistance and funding through the Hazard Mitigation Grant Program (HMPG), which can underwrite up to 50% of the cost of the project.

FEMA's public-assistance program provides financial and other assistance to rebuild disaster-damaged facilities that serve a public purpose, such as schools, hospitals, government buildings and public utilities.

In terms of technical assistance, FEMA, under a cooperative agreement with the Building Seismic Safety Council has produced two volumes of comprehensive material dealing with the seismic retrofit of existing buildings (see Further Reading). In addition an ongoing project ATC-43 involves earthquake analysis procedures for Unreinforced Masonry Buildings and Reinforced Concrete Buildings. These documents contain nationally applicable technical criteria intended to ensure that buildings will withstand earthquakes better than before. There is a great deal of information that is applicable to historic buildings, although historic buildings are not necessarily identified as a category. Write for FEMA publications at:

FEMA, PO Box 70274, Washington, DC 20024

For current information about emergency activities, federally declared disaster areas, or how to contact regional offices see the FEMA website: http://www.fema.gov/

Questions To Ask When Planning Seismic Retrofit:

These questions should be asked with the assistance of the team to determine acceptable alternatives. Since there is never a single right answer, the design team and code officials should work together to determine the appropriate level of seismic retrofit with the lowest visual impact on the significant spaces, features, and finishes of both the interior and exterior of historic buildings.

As with the illustrations above, this guide is not intended to proscribe how seismic retrofit should be done, but rather, to illustrate that every physical change to a building will have some consequence. By asking how impacts can be reduced, the owner will have several options from which to choose.

» Can bracing be installed without damaging decorative details or appearance of parapets, chimneys, or balconies?

»Are the visible features of the reinforcement, such as anchor washers or exterior buttresses adequately designed to blend with the historic building?

»Can hidden or grouted bolts be set on an angle to tie floors and walls together, instead of using traditional bolts and exposed washers or rosettes on ornamental exteriors?

»Are diagonal frames, such as X, K, or struts located to have a minimal impact on the primary facade? Are they set back and painted a receding color if visible through windows or storefronts?

»Can moment frames or reinforced bracing be added around historic storefronts in order to avoid unsightly exposed reinforcement, such as X braces, within the immediate viewing range of the public?

»Can shorter sections of reinforcement be "stitched" into the existing building to avoid removal of large sections of historic materials? This is particularly true for the insertion of roof framing supports.

»Can shear walls be located in utilitarian interior spaces to reduce the impact on finishes in the primary areas?

»Are there situations where thinner applied fiber reinforced coating would adequately strenghten walls or supports without the need for heavier reinforced concrete?

»Can diaphragms be added to non-significant floors in order to protect highly decorated ceilings below, or the reverse if the floor is more ornamental than the ceiling?

»Are there adequate funds to retain, repair, or reinstall ornamental finishes once structural reinforcements have been installed?

»Should base isolation, wall damping systems, or core drilling be considered? Are they protecting significant materials by reducing the amount of intervention?

»Are the seismic treatments being considered "reversible" in a way that allows the most amount of historic materials to be retained and allows future repair and restoration?

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Glossary

Anchor Ties or bolts: Generally threaded rods or bolt which connect walls to floor and roof framing. Washers, plates, or rosettes anchor the bolt in place.

Base isolation: the ability to isolate the structures from the damaging effects of

earthquakes by providing a flexible layer between the foundations and vertical supports.

Diagonal Braces: the use of diagonal, chevron or other type of bracing (X or K) to provide lateral resistance to adjacent walls.

Core drilling: a type of vertical reinforcement of masonry walls that relies on drilling a continuous vertical core that is filled with steel reinforcing rods and grouting to resist in-plane shear and out-of-plane bending.

Cripple wall: A frame wall between a building's first floor and foundation.

Diaphragm: A floor, roof, or continuous membrane that provides for the transfer of earthquake loading to the exterior or interior shear walls of the structure.

Fiber wrap reinforcement: A synthetic compound of filaments that increase the shear capacity of structural members.

Grouted bolts: anchor bolts set, generally on an angle, in a concrete grout mixture, avoid the problem of using an exposed washer. Requires a greater diameter hole than an anchor bolt with washer.

Lateral forces: Generally the horizontal forces transferred to the building from the dynamic effects of wind or seismic forces.

Life-safety: providing a level of assurance that risk of loss of life is kept to minimal levels. For buildings, this includes strengthening to reduce 1)structural collapse, 2) falling debris, 3)blocking exits or emergency routes, and 4) prevention of consequential fire.

Moment-resisting frame: A steel frame designed to provide in-plane resistance to lateral loads particularly by reinforcing the joint connection between column and beams without adding a diagonal brace. Often used as a perimeter frame around storefronts or large door and window openings.

Seismic retrofit: All measures that improve the earthquake performance of a building especially those that affect structural stability and reduce the potential for heavy structural damage or collapse.

Shear stress: A concept in physics where forces act on a body in opposite directions, but not in the same line. Horizontal forces applied to a wall that is insufficient to move with these forces will crack, often in a diagonal or X pattern. Connections at beams and walls will also crack from shear stress.

Shear wall: A wall deliberately designed to transfer the building's loads from the roof and floors to the foundation thereby preventing a building from collapse from wind or earthquake forces.

Unreinforced Masonry (URM): This designation refers to traditional brick, block,and adobe construction that relies on the weight of the masonry and the bonding capacity of mortar to provide structural stability.

Acknowledgments

David W. Look, AIA, is the Chief, Cultural Resource Team, Pacific Great Basin Support Office, National Park Service. **Terry Wong, PE,** is the Chief, Structural Engineering, Denver Service Center, National Park Service. **Sylvia Rose Augustus**, is the Historical Architect, Yosemite National Park

The authors wish to thank their collaborator, **Sharon C. Park, FAIA**, Senior Historical Architect, Heritage Preservation Services, NPS, who undertook the technical editing of the publication and took the authors' original manuscript and developed it into the Preservation Brief complete with compiling information from other sources and selecting the photographs. **Kay D. Weeks** and **Michael J. Auer,** Heritage Preservation Services, NPS, contributed substantially to the published manuscript by revising the draft with an eye to articulation of policy, organizational structure, and cohesiveness of language.

The authors also wish to thank the following for providing information for the publication and/or reviewing the final draft: Steade R. Craigo, AIA, Senior Restoration Architect, State of California; Randolph Langenbach, Architect, FEMA; Bruce Judd, FAIA, Architectural Resources Group; Melvyn Green & Associates; Cassandra Mettling-Davis and Carey & Co. Inc. Architecture; Curt Ginther, Architect, the University of California, Los Angeles (UCLA) Capital Program; The Crosby Group; American Institute of Architects, San Francisco Chapter; Jeffrey L. Eichenfield, California Preservation Foundation; Michael Jackson, Illinois Historic Preservation Agency; George Siekkinen, the National Trust for Historic Preservation; and colleagues at Heritage Preservation Services, NPS, including: deTeel Patterson Tiller, Chief; Charles E. Fisher, Anne E. Grimmer, John Sandor, and Jason Fenwick.

Washington DC October 1997

Home page logo: Earthquake damaged building. Photo: NPS files.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

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KDW

ParkNet
National Park Service

Building # _____

Date _____

Performed by _____

Initial 'One Time Only' Maintenance List

- [ ] Make all windows operable
- [ ] Properly plug all chimney thimbles
- [ ] Install monitors in foundation cracks
- [ ] Replace attic insulation
- [ ] Clean out attics (remove animals, waste, etc.)
- [ ] Inspect all stairs, interior and exterior, for stability
- [ ] Remove moss from roof shingles & take action to prevent growth
- [ ] Clean all chimneys/flues
- [ ] Remove roof top ladders (bldg. 7, 8 & 9)
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Building # _____

Date _____

Performed by _____

Yearly Maintenance Schedule

- [ ] Clean out basement fuel bin
- [ ] General housekeeping (dust, sweep, clean fixtures, etc.)
- [ ] HVAC - clean ducts & register, change filter, oil motor, clean strainer
- [ ] Inspect attic & chimney for water penetration & other deterioration
- [ ] Record foundation crack conditions & changes
- [ ] Clean dirt & blockage from all exterior vents (attic, basement & wall vents)
- [ ] Inspect wiring, plumbing & drainage
- [ ] Inspect basement walls & overhead floor members
- [ ] Monitor walkways for safety & stability
- [ ] Inspect siding for deterioration & repair/replace
- [ ] Inspect, repair & touch up paint or completely repaint
- [ ] Monitor interior plaster cracks (as indicators of larger problems)
- [ ] Inspect & clean chimney flues of blockage (bird nests, foliage, etc.)
- [ ] Clean & check window operability
- [ ] Inspect porches for structural stability (remove debris from underneath)
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Building # _____

Date _____

Performed by _____

Seasonal Maintenance Schedule (fall/spring)

- [ ] Clean out gutters (leaves, etc.)
- [ ] Clear vegetation away from foundations (foliage, etc.)
- [ ] Install/remove storm windows & screens
- [ ] Trim trees & clean up leaves
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Building # _____

Date _____

Performed by _____

Monthly Maintenance Schedule

- [ ] Record crack monitor findings

FOUNDATION

Original specs for Aladdin Homes, circa 1929:
8" thick concrete foundation, purchaser to supply cement, sand, and gravel
2/3 basement, 22' x 26'

Character Defining Features:
Board Formed, Poured Concrete Foundation, unfinished
Daylight Basement
Chamfered Corners

Typical in 2001:
Board Formed Poured Concrete Foundation, Metal Ties Clinched on the outside
Chamfered corners
Windows set into form before concrete poured.
Traditional Cottages had a wooden water detail above the join between walls and foundation

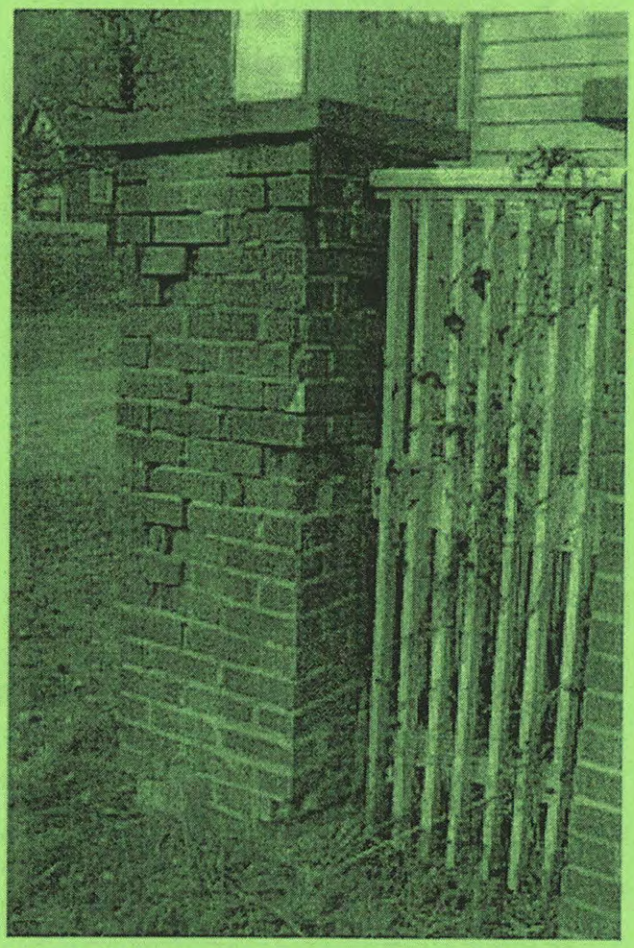
Special Cases:
Cottage #4's North foundation wall was formed at an angle. Buttresses were added to the southeast corner kickout of cottage #5.

Condition:
Settlement of foundations has occurred, causing cracks. Most foundations showed small cracks along one of the longer walls. Previous parging of cracks for repair may be trapping moisture.
Spray painting of houses has leaked paint on to the foundation.
Foundation windows are generally in poor condition, due in part to conditions of their construction. Fuel windows have been semi-sealed on most houses.
No ties exist between the concrete foundation and the house frame, which may be a seismic concern.

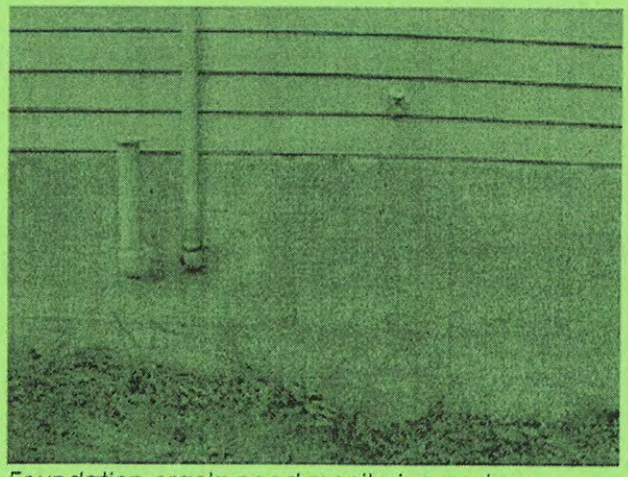
In this Section:
Crack Monitoring

See also:
Attic & Basement
Systems
Stabilization Section
Brief #41: The Seismic Retrofit of Historic Buildings, in the Stabilization section

Operations



Vegetation growing on piers and rails can cause damage including rot from moisure.



Foundation cracks need monitoring and any changes recorded.

Foundation

Vegetation

See the Stabilization section for initial concerns and changes to existing vegetation.

Seasonally clear vegetation from cottage to prevent damage from moisture being trapped against surfaces. This includes weeds and new growth in spring, as well as dead vegetation and leaves in fall and winter.

Windows

The foundation windows were constructed with the rough opening and wood frame built into the concrete form. Because of this, some air infiltration and wood deterioration problems may occur.

Due to house to house variations, proper ways to seal these windows should be discussed and implemented.

All hardware should be kept in working order, and all panes properly glazed.

Replacement instructions can be found in the Rehabilitation windows section.

Venting

See Basement, venting.

Cracks

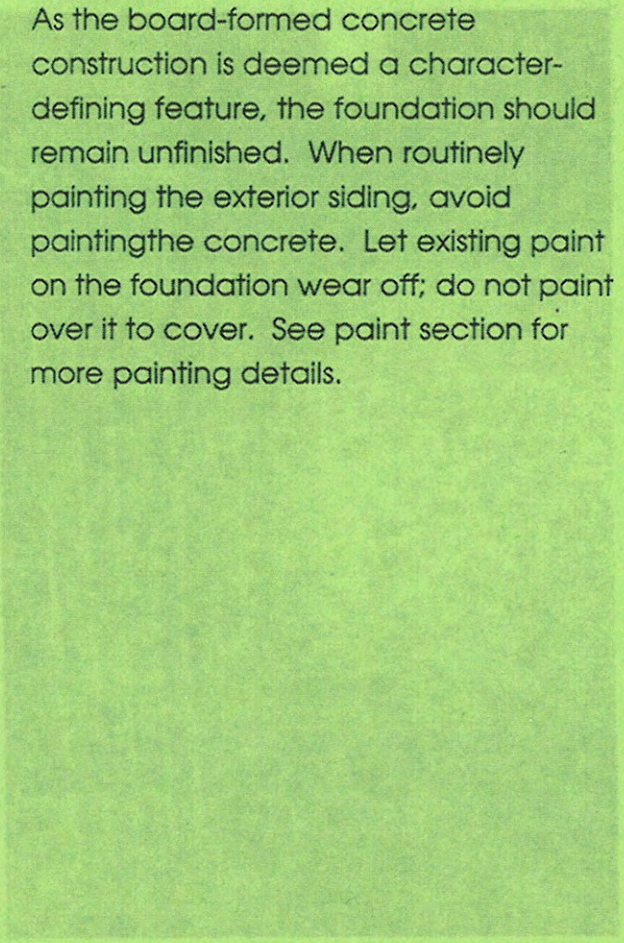
Crack monitors should be installed. See Stabilization directive

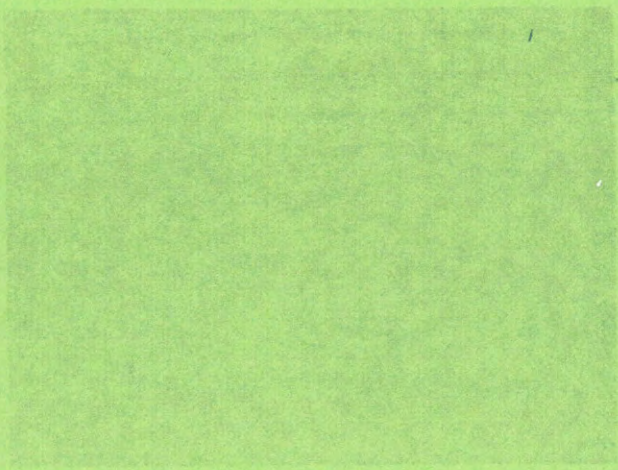
All cottage foundations should be inspected yearly to monitor existing cracks and record new conditions.

Operations

Finishes

As the board-formed concrete construction is deemed a character-defining feature, the foundation should remain unfinished. When routinely painting the exterior siding, avoid paintingthe concrete. Let existing paint on the foundation wear off; do not paint over it to cover. See paint section for more painting details.





EXTERIOR WALLS

Original specs for Aladdin Homes, circa 1929:
Clear grain 6" bevel siding
Exterior Paint – Ivory with light gray trim and reverse, one coat primer, two coats paint
All nails

Character Defining Features:
4.5" to weather horizontal lap siding
Corner boards
Traditional
Crown Molding above Windows
Water Table Detail

Typical in 2001:
4.5" to weather horizontal lap siding, face nailed, painted (variety of colors)

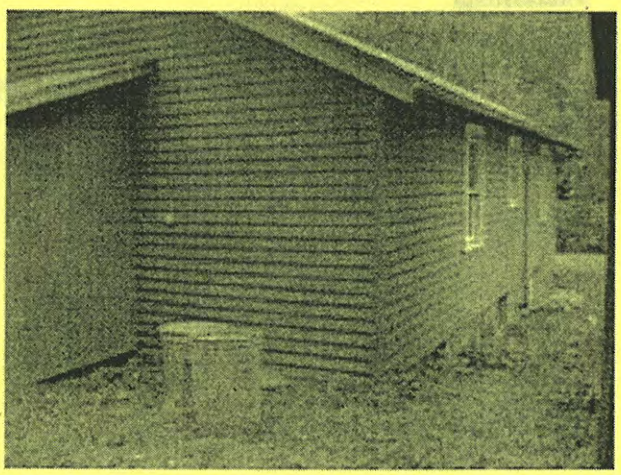
Special Cases:
Half-dollar sized vents beneath windows on the north side of cottage 40
Some siding seems to have been replaced on cottage 44
Window surrounds on the left side of cottage 5 are stripped of paint

Condition:
Overall, siding is intact. Paint integrity is poor. In many places, paint is peeling or chipped, which may be the cause of moisture damage. Some houses have loose or broken boards. Some houses show evidence of wood damage from high pressure paint removal prior to the current coat, which could explain the poor quality of this coat of paint.
The water table details on the traditional cottages are generally in good condition, with paint loss being the primary concern.

In this Section:
Siding
Vents
Trim
Insulation
Brief # 10: Exterior Paint Problems on Historic Woodwork

See also:
Paint Section

Rehabilitation



Wood horizontal lap siding with corner boards on Aladdin cottage.

Exterior Walls

Siding

The horizontal lap siding is a character-defining feature of the Three Lynx houses. As a very visible feature it is desirable for the siding to maintain its design attributes. One exception to the horizontal siding is found on the rear porches of the one-and-a-half story houses which have vertical bead board siding. The bead board siding should be maintained on these porches.

When repair or replacement occurs, use hardwood, horzontal lap siding wtih 4.5" exposure to assure proper function of the weather envelope. In the event that large areas of siding are replaced install building paper beneath siding.

Paint

When painting, first locate any damaged siding or repair and replace in kind. Scrape and paint using two coats of oil-based primer with a one coat latex finish. After initial priming coat apply oil based caulk to holes. Care should be taken when painting to maintain the flow of air in the various vents located in the siding. These instructions apply also to trim.

Watertable

If parts are replaced, all new members should receive one coat of oil-based primer on every side and joints should be caulked with oil-based caulking during assembly.

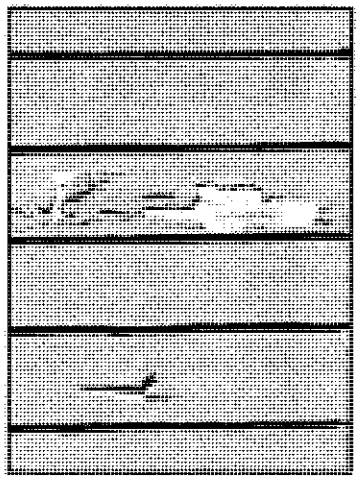
Rehabilitation

Flashing

When siding above a window or door is replaced, it is recommended that flashing be installed. The existence of flashing currently is not known, but it was in the original specs.

10 Preservation Briefs
Technical Preservation Services
HPS
National Park Service

Exterior Paint Problems on Historic Woodwork



Kay D. Weeks and David W. Look, AIA

»Purposes of Exterior Paint
»Treating Paint Problems
»Justification for Paint Removal
»Paint Removal Precautions
»Repainting Historic Buildings for Cosmetic Reasons
»Conditions/Recommended Treatments
»Selecting the Safest Method to Remove Paint
»General Paint Type Recommendations
»Conclusion
»Reading List

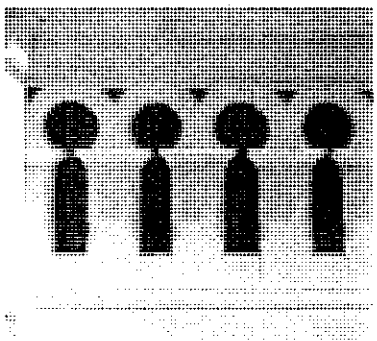
A cautionary approach to paint removal is included in the guidelines to the *Secretary of the Interior Standards for Rehabilitation.* Removing paints down to bare wood surfaces using harsh methods can permanently damage those surfaces; therefore such methods are not recommended. Also, total removal obliterates evidence of the historical paints and their sequence and architectural context.

This Brief expands on that advice for the architect, building manager, contractor, or homeowner by identifying and describing common types of paint surface conditions and failures, then recommending appropriate treatments for preparing exterior wood surfaces for repainting to assure the best adhesion and greatest durability of the new paint.

Although the Brief focuses on responsible methods of "paint removal," several paint surface conditions will be described which do not require any paint removal, and still others which can be successfully handled by limited paint removal. In all cases, the information is intended to address the concerns related to exterior wood. It will also be generally assumed that, because houses built before 1950 involve one or more layers of lead-based paint, the majority of conditions warranting paint removal will mean dealing with this toxic substance along with the dangers of the paint removal tools and chemical strippers themselves.

Purposes of Exterior Paint

Paint applied to exterior wood must withstand yearly extremes of both temperature and humidity. While never expected to be more than a temporary physical shield--requiring reapplication every 58 years--its importance should not be minimized. Because one of the main causes of wood deterioration is moisture penetration, a primary purpose for painting wood is to exclude such moisture, thereby slowing deterioration not only of a building's exterior siding and decorative features but, ultimately, its underlying structural members. Another important



The paint on this exterior decorative feature is sound. Photo: NPS files.

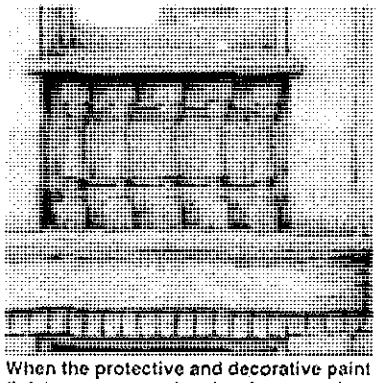
purpose for painting wood is, of course, to define and accent architectural features and to improve appearance.

Treating Paint Problems in Historic Buildings

Exterior paint is constantly deteriorating through the processes of weathering, but in a program of regular maintenance--assuming all other building systems are functioning properly--surfaces can be cleaned, lightly scraped, and hand sanded in preparation for a new finish coat. Unfortunately, these are ideal conditions. More often, complex maintenance problems are inherited by owners of historic buildings, including areas of paint that have failed beyond the point of mere cleaning, scraping, and hand sanding (although much so-called "paint failure" is attributable to interior or exterior moisture problems or surface preparation and application mistakes with previous coats).

Although paint problems are by no means unique to historic buildings, treating multiple layers of hardened, brittle paint on complex, ornamental--and possibly fragile--exterior wood surfaces necessarily requires an extremely cautious approach. In the case of recent construction, this level of concern is not needed because the wood is generally less detailed and, in addition, retention of the sequence of paint layers as a partial record of the building's history is not an issue.

When historic buildings are involved, however, a special set of problems arises--varying in complexity depending upon their age, architectural style, historical importance, and physical soundness of the wood--which must be carefully evaluated so that decisions can be made that are sensitive to the longevity of the resource.



When the protective and decorative paint finish was removed and an inappropriate clear finish applied, the exterior character of the building was altered. Photo: NPS files.

Justification for Paint Removal

At the outset of this Brief, it must be emphasized that removing paint from historic buildings--with the exception of cleaning, light scraping, and hand sanding as part of routine maintenance--should be avoided unless absolutely essential. ***Once conditions warranting removal have been identified the general approach should be to remove paint to the next sound layer using the gentlest means possible, then to repaint.*** Practically speaking as well, paint can adhere just as effectively to existing paint as to bare wood, providing the previous coats of paint are also adhering uniformly and tightly to the wood and the surface is properly prepared for repainting--cleaned of dirt and chalk and dulled by sanding.

But, if painted exterior wood surfaces display continuous patterns of deep cracks or if they are extensively blistering and peeling so that bare wood is visible, then the old paint should be completely removed before repainting. The only other justification for removing all previous layers of paint is if doors, shutters, or windows have literally been "painted shut," or if new wood is being pieced-in adjacent to old painted wood and a smooth transition is desired.

Paint Removal Precautions

Because paint removal is a difficult and painstaking process, a number of costly, regrettable experiences have occurred--and continue to occur--for both the historic building and the building owner. Historic buildings have been set on fire with blow torches; wood irreversibly scarred by sandblasting or by harsh mechanical devices such as rotary sanders and rotary wire strippers; and layers of historic paint inadvertently and unnecessarily removed. In addition, property owners, using techniques that substitute speed for safety, have been injured by toxic lead vapors or dust from the paint they were trying to remove or by misuse of the paint removers themselves.

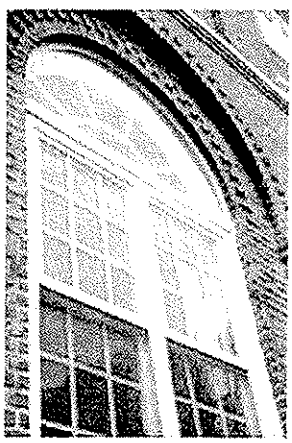
Owners of historic properties considering paint removal should also be aware of the amount of time and labor involved. While removing damaged layers of paint from a door or porch railing might be readily accomplished within a reasonable period of time by one or two people, removing paint from larger areas of a building can, without professional assistance, easily become unmanageable and produce less than satisfactory results. The amount of work involved in any paint removal project must therefore be analyzed on a case-by-case basis. Hiring qualified professionals will often be a cost-effective decision due to the expense of materials, the special equipment required, and the amount of time involved. Further, paint removal companies experienced in dealing with the inherent health and safety dangers of paint removal should have purchased such protective devices as are needed to mitigate any dangers and should also be aware of State or local environmental and/or health regulations for hazardous waste disposal.

All in all, paint removal is a messy, expensive, and potentially dangerous aspect of rehabilitating or restoring historic buildings and should not be undertaken without careful thought concerning first, its necessity, and second, which of the available recommended methods is the safest and most appropriate for the job at hand.

Re-painting Historic Buildings for Cosmetic Reasons

If existing exterior paint on wood siding, eaves, window sills, sash, and shutters, doors, and decorative features shows no evidence of paint deterioration such as chalking, blistering, peeling, or cracking, then there is no physical reason to repaint, much less remove paint! Nor is color fading, of itself, sufficient justification to repaint a historic building.

The decision to repaint may not be based altogether on paint failure. Where there is a new owner, or even where ownership has remained constant through the years, taste in colors often changes. Therefore, if repainting is primarily to alter a building's primary and accent colors, a technical factor of paint accumulation should be taken into consideration.



When the paint on the wood windows became too thick, it was removed and the window repainted. Photo: NPS files.

When paint builds up to a thickness of approximately 1/16" (approximately 16 to 30 layers), one or more extra coats of paint may be enough to trigger cracking and peeling in limited or even widespread areas of the building's surface. This results because excessively thick paint is less able to withstand the shrinkage or pull of an additional coat as it dries and is also less able to tolerate thermal stresses. Thick paint invariably fails at the weakest point of adhesion--the oldest layers next to the wood. Cracking and peeling follow. Therefore, if there are no signs of paint failure, it may be somewhat risky to add still another layer of unneeded paint simply for color's sake (extreme changes in color may also require more than one coat to provide proper hiding power and full color). When paint appears to be nearing the critical thickness, a change of accent colors (that is, just to limited portions of the trim) might be an acceptable compromise without chancing cracking and peeling of paint on wooden siding.

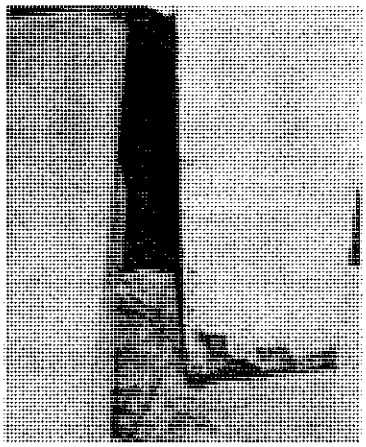
If the decision to repaint is nonetheless made, the "new" color or colors should, at a minimum, be appropriate to the style and setting of the building. On the other hand, where the intent is to restore or accurately reproduce the colors originally used or those from a significant period in the building's evolution,

they should be based on the results of a paint analysis.

Identification of Exterior Paint Surface Conditions/Recommended Treatments

It is assumed that a preliminary check will already have been made to determine, first, that the painted exterior surfaces are indeed wood--and not stucco, metal, or other wood substitutes--and second, that the wood has not decayed so that repainting would be superfluous. For example, if any area of bare wood such as window sills has been exposed for a long period of time to standing water, wood rot is a strong possibility. Repair or replacement of deteriorated wood should take place before repainting. After these two basic issues have been resolved, the surface condition identification process may commence.

The historic building will undoubtedly exhibit a variety of exterior paint surface conditions. For example, paint on the wooden siding and doors may be adhering firmly; paint on the eaves peeling; and paint on the porch balusters and window sills cracking and alligatoring. The accurate identification of each paint problem is therefore the first step in planning an appropriate overall solution.



The problem evidenced here by mossy growth and deteriorated wood must be resolved and the wood allowed to dry out before the wood is repainted. Photo: NPS files.

Paint surface conditions can be grouped according to their relative severity: CLASS I conditions include minor blemishes or dirt collection and generally require no paint removal; CLASS II conditions include failure of the top layer or layers of paint and generally require limited paint removal; and CLASS III conditions include substantial or multiple-layer failure and generally require total paint removal. It is precisely because conditions will vary at different points on the building that a careful inspection is critical. Each item of painted exterior woodwork (i.e., siding, doors, windows, eaves, shutters, and decorative elements) should be examined early in the planning phase and surface conditions noted.

CLASS I Exterior Surface Conditions Generally Requiring No Paint Removal

Dirt, Soot, Pollution, Cobwebs, Insect Cocoons, etc.

Cause of Condition

Environmental "grime" or organic matter that tends to cling to painted exterior surfaces and, in particular, protected surfaces such as eaves, do not constitute a paint problem unless painted over rather than removed prior to repainting. If not removed, the surface deposits can be a barrier to proper adhesion and cause peeling.

Recommended Treatment

Most surface matter can be loosened by a strong, direct stream of water from the nozzle of a garden hose. Stubborn dirt and soot will need to be scrubbed off using 1/2 cup of household detergent in a gallon of water with a medium soft bristle brush. The cleaned surface should then be rinsed thoroughly, and permitted to dry before further inspection to determine if repainting is necessary. Quite often, cleaning provides a satisfactory enough result to postpone repainting.

Mildew

Cause of Condition

Mildew is caused by fungi feeding on nutrients contained in the paint film or on dirt adhering to any surface. Because moisture is the single most important factor in its growth, mildew tends to thrive in areas where dampness and lack of sunshine are problems such as window sills, under eaves, around gutters and downspouts, on the north side of buildings, or in shaded areas near shrubbery. It may sometimes be difficult to distinguish mildew from dirt, but there is a simple test to differentiate: if a drop of household bleach is placed on the suspected surface, mildew will immediately turn white whereas dirt will continue to look like dirt.

Recommended Treatment

Because mildew can only exist in shady, warm, moist areas, attention should be given to altering the environment that is conducive to fungal growth. The area in question may be shaded by trees which need to be pruned back to allow sunlight to strike the building; or may lack rain gutters or proper drainage at the base of the building. If the shady or moist conditions can be altered, the mildew is less likely to reappear. A recommend solution for removing mildew consists of one cup non-ammoniated detergent, one quart household bleach, and one gallon water: When the surface is scrubbed with this solution using a medium soft brush, the mildew should disappear; however, for particularly stubborn spots, an additional quart of bleach may be added. After the area is mildew-free, it should then be rinsed with a direct stream of water from the nozzle of a garden hose, and permitted to dry thoroughly. When repainting, specially formulated "mildew-resistant" primer and finish coats should be used.

Excessive Chalking

Cause of Condition

Chalking--or powdering of the paint surface--is caused by the gradual disintegration of the resin in the paint film. (The amount of chalking is determined both by the formulation of the paint and the amount of ultraviolet light to which the paint is exposed.) In moderation, chalking is the ideal way for a paint to "age," because the chalk, when rinsed by rainwater, carries discoloration and dirt away with it and thus provides an ideal surface for repainting. In excess, however, it is not desirable because the chalk can wash down onto a surface of a different color beneath the painted area and cause streaking as well as rapid disintegration of the paint film itself. Also, if a paint contains too much pigment for the amount of binder (as the old white lead carbonate/oil paints often did), excessive chalking can result.

Recommended Treatment

The chalk should be cleaned off with a solution of l/2 cup household detergent to one gallon water, using a medium soft bristle brush. After scrubbing to remove the chalk, the surface should be rinsed with a direct stream of water from the nozzle of a garden hose, allowed to dry thoroughly, (but not long enough for the chalking process to recur) and repainted, using a non-chalking paint.

Staining

Cause of Condition

Staining of paint coatings usually results from excess moisture reacting with materials within the wood substrate. There are two common types of staining, neither of which requires paint removal. The most prevalent type of stain is due to the oxidation or rusting of iron nails or metal (iron, steel, or copper) anchorage devices. A second type of stain is caused by a chemical reaction between moisture and natural extractives in certain woods (red cedar or redwood) which results in a surface deposit of colored matter. This is most apt to occur in new replacement wood within the first 10-15 years.

Recommended Treatment

In both cases, the source of the stain should first be located and the moisture problem corrected.

When stains are caused by rusting of the heads of nails used to attach shingles or siding to an exterior wall or by rusting or oxidizing iron, steel, or copper anchorage devices adjacent to a painted surface, the metal objects themselves should be hand sanded and coated with a rust-inhibitive primer followed by two finish coats. (Exposed nail heads should ideally be countersunk, spot primed, and the holes filled with a high quality wood filler except where exposure of the nail head was part of the original construction system or the wood is too fragile to withstand the countersinking procedure.)

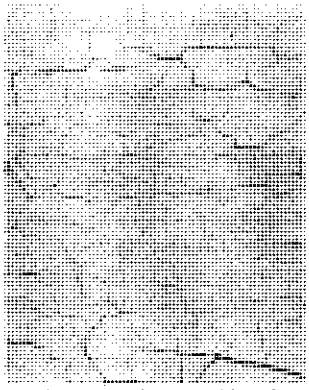
Discoloration due to color extractives in replacement wood can usually be cleaned with a solution of equal parts denatured alcohol and water. After the affected area has been rinsed and permitted to dry, a "stainblocking primer" especially developed for preventing this type of stain should be applied (two primer coats are recommended for severe cases of bleeding prior to the finish coat). Each primer coat should be allowed to dry at least 48 hours.

CLASS II Exterior Surface Conditions Generally Requiring Limited Paint Removal

Crazing

Cause of Condition

Crazing--fine, jagged interconnected breaks in the top layer of paint--results when paint that is several layers thick becomes excessively hard and brittle with age and is consequently no longer able to expand and contract with the wood in response to changes in temperature and humidity. As the wood swells, the bond between paint layers is broken and hairline cracks appear. Although somewhat more difficult to detect as opposed to other more obvious paint problems, it is well worth the time to scrutinize all surfaces for crazing. If not corrected, exterior moisture will enter the crazed surface, resulting in further swelling of the wood and, eventually, deep cracking and alligatoring, a Class III condition which requires total paint removal.



Crazing--or surface cracking--is an exterior surface condition which can be successfully treated by sanding and painting. Photo: Courtesy, National Decorating Products Assocation.

Recommended Treatment

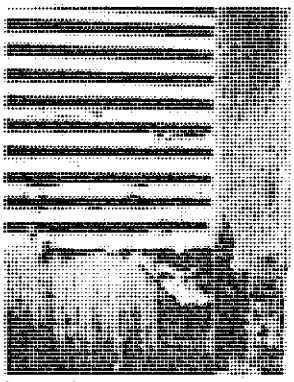
Crazing can be treated by hand or mechanically sanding the surface, then repainting. Although the hairline cracks may tend to show through the new paint, the surface will be protected against exterior moisture penetration.

Intercoat Peeling

Cause of Condition

Intercoat peeling can be the result of improper surface preparation prior to the last repainting. This most often occurs in protected areas such as eaves and covered porches because these surfaces do not receive a regular rinsing from rainfall, and salts from airborne pollutants thus accumulate on the surface. If not cleaned off, the new paint coat will not adhere properly and that layer will peel.

Another common cause of intercoat peeling is incompatibility between paint types. For example, if oil paint is applied over latex paint, peeling of the top coat can sometimes result since, upon aging, the oil paint becomes harder and less elastic than the latex paint. If latex paint is applied over old, chalking oil paint, peeling can also occur because the latex paint is unable to penetrate the chalky surface and adhere.



Here, a latex top coat was applied directly over old oil paint, resulting in intercoat peeling. The latex was unable to adhere. If latex is used over oil, an oil-base primer should be applied first. Photo: Mary L. Oehrlein, AIA.

Recommended Treatment

First, where salts or impurities have caused the peeling, the affected area should be washed down thoroughly after scraping, then wiped dry. Finally, the surface should be hand or mechanically sanded, then repainted.

Where peeling was the result of using incompatible paints, the peeling top coat should be scraped and hand or mechanically sanded. Application of a high quality oil type exterior primer will provide a surface over which either an oil or a latex topcoat can be successfully used.

Solvent Blistering

Cause of Condition

Solvent blistering, the result of a less common application error, is not caused by moisture, but by the action of ambient heat on paint solvent or thinners in the paint film. If solventrich paint is applied in direct sunlight, the top surface can dry too quickly and, as a result, solvents become trapped beneath the dried paint film. When the solvent vaporizes, it forces its way through the paint film, resulting in surface blisters. This problem occurs more often with dark colored paints because darker colors absorb more heat than lighter ones. To distinguish between solvent blistering and blistering caused by moisture, a blister should be cut open. If another layer of paint is visible, then solvent blistering is likely the problem whereas if bare wood is revealed, moisture is probably to blame. Solvent blisters are generally small.

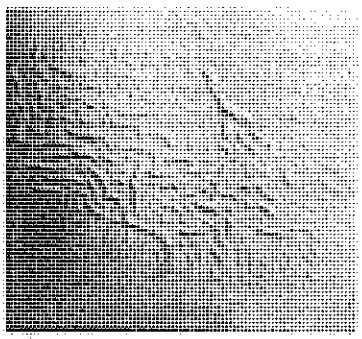
Recommended Treatment

Solvent-blistered areas can be scraped, hand or mechanically sanded to the next sound layer, then repainted. In order to prevent blistering of painted surfaces, paint should not be applied in direct sunlight.

Wrinkling

Cause of Condition

Another error in application that can easily be avoided is wrinkling. This occurs when the top layer of paint dries before the layer underneath. The top layer of paint actually moves as the paint underneath (a primer, for example) is drying. Specific causes of wrinkling include: (1) applying paint too thick; (2) applying a second coat before the first one dries; (3) inadequate brushing out; and (4) painting in temperatures higher than recommended by the manufacturer.



Wrinkled layers can generally be removed by scraping and sanding as opposed to total paint removal. Photo: Courtesy, National Decorating Products Association.

Recommended Treatment

The wrinkled layer can be removed by scraping followed by hand or mechanical sanding to provide as even a surface as possible, then repainted following manufacturer's application instructions.

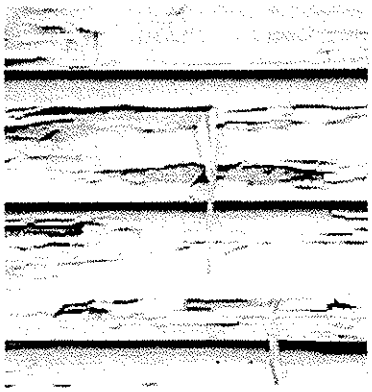
CLASS III Exterior Surface Conditions Generally Requiring Total Paint Removal

If surface conditions are such that the majority of paint will have to be removed prior to repainting, it is suggested that a small sample of intact paint be left in an inconspicuous area

either by covering the area with a metal plate, or by marking the area and identifying it in some way. (When repainting does take place, the sample should not be painted over). This will enable future investigators to have a record of the building's paint history.

Peeling

Cause of Condition



Extensively deteriorated paint needs to be removed to bare wood, then primed and re-painted. Photo: NPS files.

Peeling to bare wood is most often caused by excess interior or exterior moisture that collects behind the paint film, thus impairing adhesion. Generally beginning as blisters, cracking and peeling occur as moisture causes the wood to swell, breaking the adhesion of the bottom layer.

Recommended Treatment

There is no sense in repainting before dealing with the moisture problems because new paint will simply fail. Therefore, the first step in treating peeling is to locate and remove the source or sources of the moisture, not only because moisture will jeopardize the protective coating of paint but because, if left unattended, it can ultimately cause permanent damage to the wood. Excess interior moisture should be removed from the building through installation of exhaust fans and vents. Exterior moisture should be eliminated by correcting the following conditions prior to repainting: faulty flashing; leaking gutters; defective roof shingles; cracks and holes in siding and trim; deteriorated caulking in joints and seams; and shrubbery growing too close to painted wood. After the moisture problems have been solved, the wood must be permitted to dry out thoroughly. The damaged paint can then be scraped off with a putty knife, hand or mechanically sanded, primed, and repainted.

Cracking/Alligatoring

Cause of Condition

Cracking and alligatoring are advanced stages of crazing. Once the bond between layers has been broken due to intercoat paint failure, exterior moisture is able to penetrate the surface cracks, causing the wood to swell and deeper cracking to take place.

This process continues until cracking, which forms parallel to grain, extends to bare wood. Ultimately, the cracking becomes an overall pattern of horizontal and vertical breaks in the paint layers that looks like reptile skin; hence, "alligatoring." In advanced stages of cracking and alligatoring, the surfaces will also flake badly.

Recommended Treatment

If cracking and alligatoring are present only in the top layers they can probably be scraped, hand or mechanically sanded to the next sound layer, then repainted. However, if cracking and/or alligatoring have progressed to bare wood and the paint has begun to flake, it will need to be totally removed. Methods include scraping or paint removal with the electric heat plate, electric heat gun, or chemical strippers, depending on the particular area involved. Bare wood should be primed within 48 hours then repainted.

Selecting the Appropriate/Safest Method to Remove Paint

After having presented the "hierarchy" of exterior paint surface conditions--from a mild condition

such as mildewing which simply requires cleaning prior to repainting to serious conditions such as peeling and alligatoring which require total paint removal--one important thought bears repeating: if a paint problem has been identified that warrants either limited or total paint removal, the gentlest method possible for the particular wooden element of the historic building should be selected from the many available methods.

The treatments recommended--based upon field testing as well as onsite monitoring of Department of Interior grant-in-aid and certification of rehabilitation projects--are therefore those which take three overriding issues into consideration (1) the continued protection and preservation of the historic exterior woodwork; (2) the retention of the sequence of historic paint layers; and (3) the health and safety of those individuals performing the paint removal. By applying these criteria, it will be seen that no paint removal method is without its drawbacks and all recommendations are qualified in varying degrees.

Methods for Removing Paint

After a particular exterior paint surface condition has been identified, the next step in planning for repainting--if paint removal is required--is selecting an appropriate method for such removal.

The method or methods selected should be suitable for the specific paint problem as well as the particular wooden element of the building. Methods for paint removal can be divided into three categories (frequently, however, a combination of the three methods is used). Each method is defined below, then discussed further and specific recommendations made:

Abrasive--"Abrading" the painted surface by manual and/or mechanical means such as scraping and sanding. Generally used for surface preparation and limited paint removal.

Thermal--Softening and raising the paint layers by applying heat followed by scraping and sanding. Generally used for total paint removal.

Chemical--Softening of the paint layers with chemical strippers followed by scraping and sanding. Generally used for total paint removal.

Abrasive Methods (Manual)

If conditions have been identified that require limited paint removal such as crazing, intercoat peeling, solvent blistering, and wrinkling, scraping and hand sanding should be the first methods employed before using mechanical means. Even in the case of more serious conditions such as peeling--where the damaged paint is weak and already sufficiently loosened from the wood surface --scraping and hand sanding may be all that is needed prior to repainting.

Recommended Abrasive Methods (Manual)

Putty Knife/Paint Scraper: Scraping is usually accomplished with either a putty knife or a paint scraper, or both. Putty knives range in width from one to six inches and have a beveled edge. A putty knife is used in a pushing motion going under the paint and working from an area of loose paint toward the edge where the paint is still firmly adhered and, in effect,"beveling" the remaining layers so that as smooth a transition as possible is made between damaged and undamaged areas.

Paint scrapers are commonly available in 1-5/16, 2-1/2, and 3-1/2 inch widths and have replaceable blades. In addition, profiled scrapers can be made specifically for use on moldings. As opposed to the putty knife, the paint scraper is used in a pulling motion and works by raking the damaged areas of paint away.

The obvious goal in using the putty knife or the paint scraper is to selectively remove the affected layer or layers of paint; however, both of these tools, particularly the paint scraper with its hooked edge, must be used with care to properly prepare the surface and to avoid gouging the

wood.

Sandpaper/Sanding Block/Sanding sponge: After manually removing the damaged layer or layers by scraping, the uneven surface (due to the almost inevitable removal of varying numbers of paint layers in a given area) will need to be smoothed or "feathered out" prior to repainting. As stated before, hand sanding, as opposed to harsher mechanical sanding, is recommended if the area is relatively limited. A coarse grit, open-coat flint sandpaper--the least expensive kind--is useful for this purpose because, as the sandpaper clogs with paint it must be discarded and this process repeated until all layers adhere uniformly.

Blocks made of wood or hard rubber and covered with sandpaper are useful for handsanding flat surfaces. Sanding sponges--rectangular sponges with an abrasive aggregate on their surfaces--are also available for detail work that requires reaching into grooves because the sponge easily conforms to curves and irregular surfaces. All sanding should be done with the grain.

Summary of Abrasive Methods (Manual)

Recommended: Putty knife, paint scraper, sandpaper, sanding block, sanding sponge.

Applicable areas of building: All areas. For use on: Class I, Class II, and Class III conditions.

Health/Safety factors: Take precautions against lead dust, eye damage; dispose of lead paint residue properly.

Abrasive Methods (Mechanical)

If hand sanding for purposes of surface preparation has not been productive or if the affected area is too large to consider hand sanding by itself, mechanical abrasive methods, i.e., power-operated tools may need to be employed; however, it should be noted that the majority of tools available for paint removal can cause damage to fragile wood and must be used with great care.

Recommended Abrasive Methods (Mechanical)

Orbital sander: Designed as a finishing or smoothing tool--not for the removal of multiple layers of paint--the orbital sander is thus recommended when limited paint removal is required prior to repainting. Because it sands in a small diameter circular motion (some models can also be switched to a back-and-forth vibrating action), this tool is particularly effective for "feathering" areas where paint has first been scraped. The abrasive surface varies from about 3x7 inches to 4x9 inches and sandpaper is attached either by clamps or sliding clips. A medium grit, open-coat aluminum oxide sandpaper should be used; fine sandpaper clogs up so quickly that it is ineffective for smoothing paint.

Belt sander: A second type of power tool--the belt sander--can also be used for removing limited layers of paint but, in this case, the abrasive surface is a continuous belt of sandpaper that travels at high speeds and consequently offers much less control than the orbital sander. Because of the potential for more damage to the paint or the wood, use of the belt sander (also with a medium grit sandpaper) should be limited to flat surfaces and only skilled operators should be permitted to operate it within a historic preservation project.

Not Recommended

Rotary Drill Attachments: Rotary drill attachments such as the rotary sanding disc and the rotary wire stripper should be avoided. The disc sander--usually a disc of sandpaper about 5 inches in diameter secured to a rubber based attachment which is in turn connected to an electric drill or other motorized housing--can easily leave visible circular depressions in the wood which are difficult to hide, even with repainting. The rotary wire stripper--clusters of metals wires similarly attached to an electric drill-type unit--can actually shred a wooden surface and is thus to be used exclusively for removing corrosion and paint from metals.

Waterblasting: Waterblasting above 600 p.s.i. to remove paint is not recommended because it can force water into the woodwork rather than cleaning loose paint and grime from the surface; at worst, high pressure waterblasting causes the water to penetrate exterior sheathing and damages interior finishes. A detergent solution, a medium soft bristle brush, and a garden hose for purposes of rinsing, is the gentlest method involving water and is recommended when cleaning exterior surfaces prior to repainting.

Sandblasting: Finally--and undoubtedly most vehemently "not recommended"--sandblasting painted exterior woodwork will indeed remove paint, but at the same time can scar wooden elements beyond recognition. As with rotary wire strippers, sandblasting erodes the soft porous fibers (spring wood) faster than the hard, dense fibers (summer wood), leaving a pitted surface with ridges and valleys. Sandblasting will also erode projecting areas of carvings and moldings before it removes paint from concave areas. Hence, this abrasive method is potentially the most damaging of all possibilities, even if a contractor promises that blast pressure can be controlled so that the paint is removed without harming the historic exterior woodwork. (For Additional Information, See Preservation Briefs 6, "Dangers of Abrasive Cleaning to Historic Buildings".)

Summary of Abrasive Methods (Mechanical)

Recommended: Orbital sander, belt sander (skilled operator only).

Applicable areas of building: Flat surfaces, i.e., siding, eaves, doors, window sills.

For use on: Class II and Class III conditions.

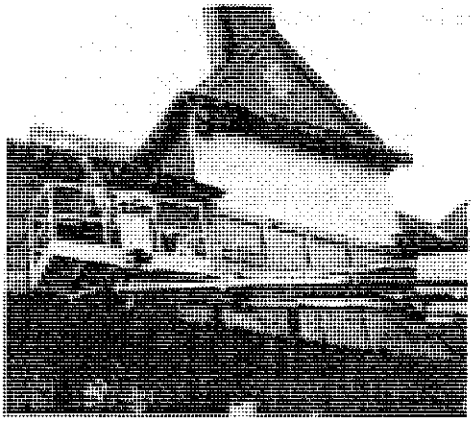
Health/Safety factors: Take precautions against lead dust and eye damage; dispose of lead paint residue properly.

Not Recommended: Rotary drill attachments, high pressure waterblasting, sandblasting.

Thermal Methods

Where exterior surface conditions have been identified that warrant total paint removal such as peeling, cracking, or alligatoring, two thermal devices--the electric heat plate and the electric heat gun--have proven to be quite successful for use on different wooden elements of the historic building. One thermal method--the blow torch--is not recommended because it can scorch the wood or even burn the building down!

Recommended Thermal Methods

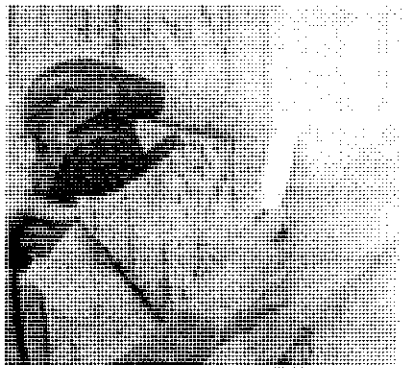


A heat plate was used on the cornice to remove paint. Photo: NPS files.

Electric heat plate: The electric heat plate operates between 500 and 800 degrees Fahrenheit (not hot enough to vaporize lead paint), using about 15 amps of power. The plate is held close to the painted exterior surface until the layers of paint begin to soften and blister, then moved to an adjacent location on the wood while the softened paint is scraped off with a putty knife (it should be noted that the heat plate is most successful when the paint is very thick!). With practice, the operator can successfully move the heat plate evenly across a flat surface such as wooden siding or a window sill or door in a continuous motion, thus lessening the risk of scorching the wood in an attempt to reheat the edge of the paint sufficiently for effective removal. Since the electric heat plate's coil is "red hot," extreme caution should be taken to avoid igniting clothing or burning the skin. If an extension cord is used, it should be a heavy-duty cord (with 3-prong grounded plugs). A heat plate could overload a circuit or, even worse, cause an electrical fire; therefore, it is

recommended that this implement be used with a single circuit and that a fire extinguisher always be kept close at hand.

Electric heat gun: The electric heat gun (electric hot-air gun) looks like a hand-held hairdryer with a heavy-duty metal case. It has an electrical resistance coil that typically heats between 500 and 750 degrees Fahrenheit and, again, uses about 15 amps of power which requires a heavy-duty extension cord. There are some heat guns that operate at higher temperatures but they should not be purchased for removing old paint because of the danger of lead paint vapors. The temperature is controlled by a vent on the side of the heat gun. When the vent is closed, the heat increases. A fan forces a stream of hot air against the painted woodwork, causing a blister to form. At that point, the softened paint can be peeled back with a putty knife. It can be used to best advantage when a paneled door was originally varnished, then painted a number of times. In this case, the paint will come off quite easily, often leaving an almost pristine varnished surface behind. Like the heat plate, the heat gun works best on a heavy paint buildup. (It is, however, not very successful on only one or two layers of paint or on surfaces that have only been varnished. The varnish simply becomes sticky and the wood scorches.)



The nozzle on the electric heat gun permits hot air to be aimed into cavities on solid decorative surfaces, such as this carriage house door. After the paint has been sufficiently softened, it can be carefully removed with a scraper. Photo: NPS files.

Although the heat gun is heavier and more tiring to use than the heat plate, it is particularly effective for removing paint from detail work because the nozzle can be directed at curved and intricate surfaces. Its use is thus more limited than the heat plate, and most successfully used in conjunction with the heat plate. For example, it takes about two to three hours to strip a paneled door with a heat gun, but if used in combination with a heat plate for the large, flat area, the time can usually be cut in half. Although a heat gun seldom scorches wood, it can cause fires (like the blow torch) if aimed at the dusty cavity between the exterior sheathing and siding and interior lath and plaster. A fire may smolder for hours before flames break through to the surface. Therefore, this thermal device is best suited for use on solid decorative elements, such as molding, balusters, fretwork, or "gingerbread."

Not Recommended

Blow Torch: Blow torches, such as hand-held propane or butane torches, were widely used in the past for paint removal because other thermal devices were not available. With this technique, the flame is directed toward the paint until it begins to bubble and loosen from the surface. Then the paint is scraped off with a putty knife. Although this is a relatively fast process, at temperatures between 3200 and 3800 degrees Fahrenheit the open flame is not only capable of burning a careless operator and causing severe damage to eyes or skin, it can easily scorch or ignite the wood. The other fire hazard is more insidious. Most frame buildings have an air space between the exterior sheathing and siding and interior lath and plaster. This cavity usually has an accumulation of dust which is also easily ignited by the open flame of a blow torch. Finally, leadbase paints will vaporize at high temperatures, releasing toxic fumes that can be unknowingly inhaled. Therefore, because both the heat plate and the heat gun are generally safer to use--that is, the risks are much more controllable--the blow torch should definitely be avoided!

Summary of Thermal Methods

Recommended: Electric heat plate, electric heat gun.

Applicable areas of building: Electric heat plate--flat surfaces such as siding, eaves, sash, sills, doors. Electric heat gun--solid decorative molding, balusters, fretwork, or "gingerbread."

For use on: Class III conditions.

Health/Safety factors: Take precautions against eye damage and fire. Dispose of lead paint residue properly.

Not Recommended: Blow torch.

Chemical Methods

With the availability of effective thermal methods for total paint removal, the need for chemical methods--in the context of preparing historic exterior woodwork for repainting--becomes quite limited. Solvent-base or caustic strippers may, however, play a supplemental role in a number of situations, including:

- Removing paint residue from intricate decorative features, or in cracks or hard to reach areas if a heat gun has not been completely effective;
- Removing paint on window muntins because heat devices can easily break the glass;
- Removing varnish on exterior doors after all layers of paint have been removed by a heat plate/heat gun if the original varnish finish is being restored;
- Removing paint from detachable wooden elements such as exterior shutters, balusters, columns, and doors by dip stripping when other methods are too laborious.

Recommended Chemical Methods

(Use With Extreme Caution)

Because all chemical paint removers can involve potential health and safety hazards, no wholehearted recommendations can be made from that standpoint. Commonly known as "paint removers" or "strippers," both solvent-base or caustic products are commercially available that, when poured, brushed, or sprayed on painted exterior woodwork are capable of softening several layers of paint at a time so that the resulting "sludge"--which should be remembered is nothing less than the sequence of historic paint layers--can be removed with a putty knife. Detachable wood elements such as exterior shutters can also be "dip-stripped."

Solvent-base Strippers: The formulas tend to vary, but generally consist of combinations of organic solvents such as methylene chloride, isopropanol, toluol, xylol, and methanol; thickeners such as methyl cellulose; and various additives such as paraffin wax used to prevent the volatile solvents from evaporating before they have time to soak through multiple layers of paint. Thus, while some solvent-base strippers are quite thin and therefore unsuitable for use on vertical surfaces, others, called "semi-paste" strippers, are formulated for use on vertical surfaces or the underside of horizontal surfaces.

However, whether liquid or semi-paste, there are two important points to stress when using any solvent-base stripper: First, the vapors from the organic chemicals can be highly toxic if inhaled; skin contact is equally dangerous because the solvents can be absorbed; second, many solvent-base strippers are flammable. Even though application out-of-doors may somewhat mitigate health and safety hazards, a respirator with special filters for organic solvents is recommended and, of course, solvent-base strippers should never be used around open flames, lighted cigarettes, or with steel wool around electrical outlets.

Although appearing to be the simplest for exterior use, a particular type of solvent-base stripper needs to be mentioned here because it can actually cause the most problems. Known as "water-rinsable," such products have a high proportion of methylene chloride together with emulsifiers. Although the dissolved paint can be rinsed off with water with a minimum of scraping, this ultimately creates more of a problem in cleaning up and properly disposing of the sludge. In addition, these strippers can leave a gummy residue on the wood that requires removal with solvents. Finally, water-rinsable strippers tend to raise the grain of the wood more than regular

strippers.

On balance, then, the regular strippers would seem to work just as well for exterior purposes and are perhaps even better from the standpoint of proper lead sludge disposal because they must be hand 'scraped as opposed to rinsed off (a coffee-can with a wire stretched across the top is one effective way to collect the sludge; when the putty knife is run across the wire, the sludge simply falls into the can. Then, when the can is filled, the wire is removed, the can capped, and the lead paint sludge disposed of according to local health regulations).

Caustic strippers: Until the advent of solvent-base strippers, caustic strippers were used exclusively when a chemical method was deemed appropriate for total paint removal prior to repainting or refinishing. Now, it is more difficult to find commercially prepared caustic solutions in hardware and paint stores for homeowner use with the exception of lye (caustic soda) because solvent-base strippers packaged in small quantities tend to dominate the market.

Most commercial dip stripping companies, however, continue to use variations of the caustic bath process because it is still the cheapest method available for removing paint. Generally, dip stripping should be left to professional companies because caustic solutions can dissolve skin and permanently damage eyes as well as present serious disposal problems in large quantities.

If exterior shutters or other detachable elements are being sent out for stripping in a caustic solution, it is wise to see samples of the company's finished work. While some companies do a first-rate job, others can leave a residue of paint in carvings and grooves. Wooden elements may also be soaked too long so that the wood grain is raised and roughened, requiring extensive hand sanding later. In addition, assurances should be given by these companies that caustic paint removers will be neutralized with a mild acid solution or at least thoroughly rinsed with water after dipping (a caustic residue makes the wood feel slippery). If this is not done, the lye residue will cause new paint to fail.

Summary of Chemical Methods

Recommended, with extreme caution: Solvent-base strippers, caustic strippers.

Applicable areas of buildings: decorative features, window muntins, doors, exterior shutters, columns, balusters, and railings.

For use on: Class III Conditions.

Health/Safety factors: Take precautions against inhaling toxic vapors; fire; eye damage; and chemical poisoning from skin contact. Dispose of lead residue properly

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General Paint Type Recommendations

Based on the assumption that the exterior wood has been painted with oil paint many times in the past and the existing top coat is therefore also an oil paint, it is recommended that for CLASS I and CLASS II paint surface conditions, a top coat of high quality oil paint be applied when repainting. The reason for recommending oil rather than latex paints is that a coat of latex paint applied directly over old oil paint is more apt to fail. The considerations are twofold. First, because oil paints continue to harden with age, the old surface is sensitive to the added stress of shrinkage which occurs as a new coat of paint dries. Oil paints shrink less upon drying than latex paints and thus do not have as great a tendency to

Decorative features were painted with a traditional oil-based paint as a part of the rehabilitation. Photo: NPS files.

pull the old paint loose. Second, when exterior oil paints age, the binder releases pigment particles, causing a chalky surface. Although for best results, the chalk (or dirt, etc.) should always be cleaned off prior to repainting, a coat of new oil paint is more able to penetrate a chalky residue and adhere than is latex paint. Therefore, unless it is possible to thoroughly clean a heavily chalked surface, oil paints--on balance--give better adhesion.

If however, a latex top coat is going to be applied over several layers of old oil paint, an oil primer should be applied first (the oil primer creates a flat, porous surface to which the latex can adhere). After the primer has thoroughly dried, a latex top coat may be applied. In the long run, changing paint types is more time consuming and expensive. An application of a new oil-type top coat on the old oil paint is, thus, the preferred course of action.

If CLASS III conditions have necessitated total paint removal, there are two options, both of which assure protection of the exterior wood: (1) an oil primer may be applied followed by an oil-type top coat, preferably by the same manufacturer; or (2) an oil primer may be applied followed by a latex top coat, again using the same brand of paint. It should also be noted that primers were never intended to withstand the effects of weathering; therefore, the top coat should be applied as soon as possible after the primer has dried.

CONCLUSION

The recommendations outlined in this Brief are cautious because at present there is no completely safe and effective method of removing old paint from exterior woodwork. This has necessarily eliminated descriptions of several methods still in a developmental or experimental stage, which can therefore neither be recommended nor precluded from future recommendation. With the ever-increasing number of buildings being rehabilitated, however, paint removal technology should be stimulated and, in consequence, existing methods refined and new methods developed which will respect both the historic wood and the health and safety of the operator.

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Acknowledgements

Special thanks go to Baird M. Smith, AIA (formerly Chief, Preservation Technology Branch, TPS) for providing general direction in the development of the manuscript. In addition, the following individuals are to be thanked for their contributions as technical experts in the field: Royal T. Brown, National Paint and Coatings Association, Washington, D.C.; Dr. Judith E. Selwyn, Preservation Technology Associates, Boston, Massachusetts; and Dennis R. Vacca, Pratt & Lambert Co., Carlstadt, New Jersey. Finally, thanks go to several National Park Service staff members whose valuable comments were incorporated into the text and who contributed to the production of the brief: James A. Caufield, Anne E. Grimmer, Jean E. Travers, David G. Battle, Sharon C. Park, AIA, Charles E. Fisher III, Sara K. Blumenthal, and Martha A. Gutrick. The peeling paint photo used as the logo is provided, courtesy, John Leeke, Preservation Consultant, 2001, and is copyrighted.

Washington, D.C. September, 1982

Home page logo: Peeling paint on historic wood siding. Photo: ©John Leeke, 2001.

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ROOF

Original specs for Aladdin Homes, circa 1929:
Dark Red Hexagonal-butt Asphalt strip shingles

Character Defining Features:
Aladdin
Gable Roof, Main House; Entry at Gable Ends
2 x 8 Verge Boards at Gable End
Exposed Rafter Tails
Corbelled Brick Chimney
Beadboard Soffitt
Traditional
Gable Roof, Main House, Entry at Gable Ends
Gable Roofed Porch
Brackets at Gable Overhang
Projecting Girders at Porch Gable
Decorative Verge Tie
Wide Verge Board at gable end of Porch
Exposed Rafter Tails, notched for gutter system
Centered, Corbelled Brick Chimney

Typical in 2001:
Composition shingle roofs, 8:12 pitch tradtional cottage, 6:12 pitch Aladdin
Vents at both gable ends, into attic
Wide verge boards, painted
Decorative verge tie on Traditional cottages
Exposed Rafter tails
Gable roof on house, hip roof on front porch, shed roof on projections and most rear porches
Beadboard soffit

Special Cases:
Wood shake roofs on cottages 7, 8, 9
Cottage 44 has a steeper than normal pitch for the Aladdin cottages
Cottage 36 has two extra vents into the attic, over the back porch roof
Cottage 44 has one additional vent in the front of the house over the porch roof

Condition:
Shingles seem to be in good condition overall. Cottage #35 appears to have been reroofed. The front porch roofs on cottages 36 and 38 are sagging and/or bowing. The roof on #44 bulges upwards to the chimney on both sides. Rafter ends have poor paint integrity and some deterioration due to this. Moss appears to be a problem on cottages 3 & 8. Metal ladders have been permanently affixed to the roofs of cottages 7-9, near the chimney.

Turn over for More

GUTTERS/DOWNS

Original specs for Aladdin Homes, circa 1929:
None
Differences in 1930s Kit
Eave Troughing and Down Spouts

Character Defining Features:
Traditional
Exposed Roof Rafter Tails are Notched to Accept Gutters

Typical in 2001:
2" metal downs on most houses.
Metal (modern, some galvanized) gutters on most cottages
Wood gutters on cottages 3 (north wall only), 37, 38
Gutters are notched into rafter tails on traditional cottages

Special Cases:
Square downs on cottage 44

Condition:
Generally, the gutters seem to be in workable condition, but in need of cleaning. There is some decay evident on cottage 5. The support pieces at the ends of the gutters on cottage 38 are missing, and gutters on cottage 41 are falling. The southwest corner down is missing on cottage 38, and the metal flashing is not directed into the gutter. The condition of the downs, and where they drain was difficult to determine, and should be checked to make sure that downs are draining away from the house.
Problem downs, cottages 9, 39, 40, 42

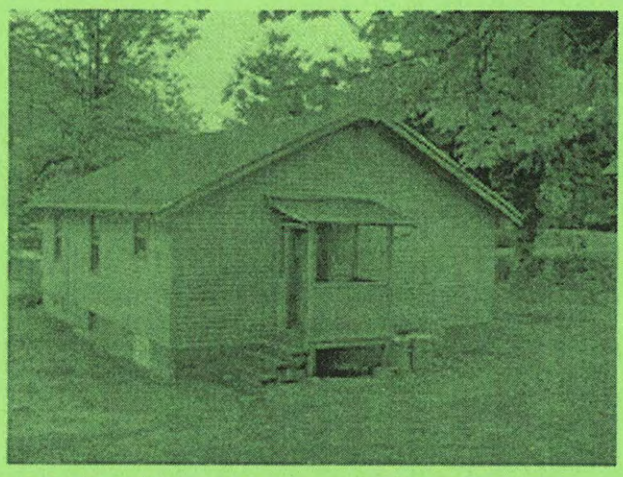
In this Section:
Shingles
Flashing
Moss
Verge Boards
Gutters and downs
Selections from Brief #4: Roofing for Historic Buildings

See Also:
Chimney
Attic

Turn over for More

Operations

Aladdin gable roofs typically include a hip roof front porch.



A shed roof is common on many Aladdin back porches.

Original wooden gutter detail shows exposed rafter tails withsigns of debris buildup.

Roof

Shingling

Loose shingles should be reattached or replaced, making sure fasterners are not visible. When roof needs replacement, see Rehabilitation section.

Flashing

Flashing should be maintained if in place, and installed if not. Maintenance should include paint upkeep and inspection of mortar connection into brick. See Rehabilitation for instructions on installation.

Moss

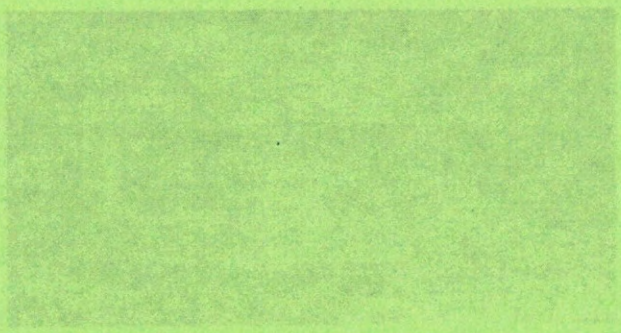
Moss should be chemically treated as needed with potassium salts, zinc and copper sulfate, or bleach; refer to appendix for moss control products and specifications. If moss is a major problem, a zinc ridge is recommended.

Verge boards

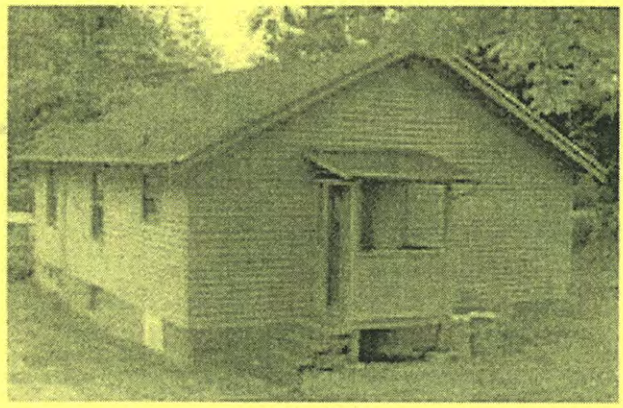
The verge boards on the traditional style cottages are considered character-defining features, which warrant special care during maintenance. The boards should be kept painted and monitored for signs of deterioration, to prevent damage. End boards in particular should be inspected for signs of decay; paint as needed.

Gutters/downspouts

Clean seasonally, with monthly cleaning during critical times. Install leaf screens at downspouts. See Rehabilitation if damaged.



Rehabilitation



Aladdin front gabled roof with composition shingling.

Traditional front gabled roof with

Roofing

Overall the roofs are in good condition and have performed well. There is no need to drastically change the roofing system. It is important to note that the roofs are a highly visible feature of the houses and integral to their character. It is desirable to keep the material and style as close as possible to that of the original. Rehabilitation is intended to take place at a time when re-roofing is necessary.

Shingles

When re-roofing of the Aladdins is necessary, existing shingles and roofing material should be removed to the existing sheathing. Any damaged wood members should be replaced in kind. Roofing material should, if possible, be returned to the original red hexagonal patterned asphalt shingles. If this is not possible, regular asphalt shingles may be used.

When re-roofing, proper metal flashing should be installed at all roof plane joints and wall intersections.

Original roofing material of Traditional cottages is unknown.

Chimney

See Chimney section

Gutters

It is recommended that metal gutters be used that are similar in profile and color of the original wood gutters. Original gutters can be seen on cottage 3, on the north wall, and cottages 37 and 38. The downspouts should also be of metal and of a 2" diameter and also painted to match the body color of the house.

SELECTIONS FROM PRESERVATION BRIEF #4: ROOFING FOR HISTORIC BUILDINGS, Sarah M. Sweetser

www2.cr.nps.gov/tps/briefs/brief04.htm Accessed 20 February 2002

Significance of the Roof

A weather-tight roof is basic in the preservation of a structure, regardless of its age, size, or design. In the system that allows a building to work as a shelter, the roof sheds the rain, shades from the sun, and buffers the weather.

During some periods in the history of architecture, the roof imparts much of the architectural character. It defines the style and contributes to the building's aesthetics. The hipped roofs of Georgian architecture, the turrets of Queen Anne, the Mansard roofs, and the graceful slopes of the Shingle Style and Bungalow designs are examples of the use of roofing as a major design feature.

But no matter how decorative the patterning or how compelling the form, the roof is a highly vulnerable element of a shelter that will inevitably fail. A poor roof will permit the accelerated deterioration of historic building materials--masonry, wood, plaster, paint--and will cause general disintegration of the basic structure. Furthermore, there is an urgency involved in repairing a leaky roof since such repair costs will quickly become prohibitive. Although such action is desirable as soon as a failure is discovered, temporary patching methods should be carefully chosen to prevent inadvertent damage to sound or historic roofing materials and related features. Before any repair work is performed, the historic value of the materials used on the roof should be understood. Then a complete internal and external inspection of the roof should be planned to determine all the causes of failure and to identify the alternatives for repair or replacement of the roofing.

Locating the Problem

Failures of Surface Materials

When trouble occurs, it is important to contact a professional, either an architect, a reputable roofing contractor, or a craftsman familiar with the inherent characteristics of the particular historic roofing system involved. These professionals may be able to advise on immediate patching procedures and help plan more permanent repairs. A thorough examination of the roof should start with an appraisal of the existing condition and quality of the roofing material itself. Particular attention should be given to any southern slope because year-round exposure to direct sun may cause it to break down first.

Failures of Support Systems

Once the condition of the roofing material has been determined, the related features and support systems should be examined on the exterior and on the interior of the roof. The gutters and downspouts need periodic cleaning and maintenance since a variety of debris fill them, causing water to back up and seep under roofing units. Water will eventually cause fasteners, sheathing, and roofing structure to deteriorate. During winter, the daily freeze-thaw cycles can cause ice floes to develop under the roof surface. The pressure from these ice floes will dislodge the roofing material, especially slates, shingles, or tiles.

Moreover, the buildup of ice dams above the gutters can trap enough moisture to rot the sheathing or the structural members.

Many large public buildings have built-in gutters set within the perimeter of the roof. The downspouts for these gutters may run within the walls of the building, or drainage may be through the roof surface or through a parapet to exterior downspouts. These systems can be effective if properly maintained; however, if the roof slope is inadequate for good runoff, or if the traps are allowed to clog, rainwater will form pools on the roof surface. Interior downspouts can collect debris and thus back up, perhaps leaking water into the surrounding walls. Exterior downspouts may fill with water, which in cold weather may freeze and crack the pipes. Conduits from the built-in gutter to the exterior downspout may also leak water into the surrounding roof structure or walls.

Failure of the flashing system is usually a major cause of roof deterioration. Flashing should be carefully inspected for failure caused by either poor workmanship, thermal stress, or metal deterioration (both of flashing material itself and of the fasteners). With many roofing materials, the replacement of flashing on an existing roof is a major operation, which may require taking up large sections of the roof surface. Therefore, the installation of top quality flashing material on a new or replaced roof should be a primary consideration. Remember, some roofing and flashing materials are not compatible.

Roof fasteners and clips should also be made of a material compatible with all other materials used, or coated to prevent rust. For example, the tannic acid in oak will corrode iron nails. Some roofs such as slate and sheet metals may fail if nailed too rigidly.

If the roof structure appears sound and nothing indicates recent movement, the area to be examined most closely is the roof substrate--the sheathing or the battens. The danger spots would be near the roof plates, under any exterior patches, at the intersections of the roof planes, or at vertical surfaces such as dormers. Water penetration, indicating a breach in the roofing surface or flashing, should be readily apparent, usually as a damp spot or stain. Probing with a small penknife may reveal any rot which may indicate previously undetected damage to the roofing membrane. Insect infestation evident by small exit holes and frass (a sawdust like debris) should also be noted. Condensation on the underside of the roofing is undesirable and indicates improper ventilation. Moisture will have an adverse effect on any roofing material; a good roof stays dry inside and out.

Repair or Replace

Understanding potential weaknesses of roofing material also requires knowledge of repair difficulties. Individual slates can be replaced normally without major disruption to the rest of the roof, but replacing flashing on a slate roof can require substantial removal of surrounding slates. If it is the substrate or a support material that has deteriorated, many surface materials such as slate or tile can be reused if handled care fully during the repair. Such problems should be evaluated at the outset of any project to determine if the roof can be effectively patched, or if it should be completely replaced. Will the repairs be effective? Maintenance costs tend to multiply once trouble starts. As the cost of labor escalates, repeated repairs could soon equal the cost of a new roof.

The more durable the surface is initially, the easier it will be to maintain. Some roofing materials such as slate are expensive to install, but if top quality slate and flashing are used, it will last 40-60 years with minimal maintenance. Although the installation cost of the roof will be high, low maintenance needs will make the lifetime cost of the roof less expensive.

Replacing the Historic Roofing Material

Professional advice will be needed to assess the various aspects of replacing a historic roof. With some exceptions, most historic roofing materials are available today. If not, an architect or preservation group who has previously worked with the same type material may be able to recommend suppliers. Special roofing materials, such as tile or embossed metal shingles, can be produced by manufacturers of related products that are commonly used elsewhere, either on the exterior or interior of a structure. With some creative thinking and research, the historic materials usually can be found.

Temporary Stabilization

It may be necessary to carry out an immediate and temporary stabilization to prevent further deterioration until research can determine how the roof should be restored or rehabilitated, or until funding can be provided to do a proper job. A simple covering of exterior plywood or roll roofing might provide adequate protection, but any temporary covering should be applied with caution. One should be careful not to overload the roof structure, or to damage or destroy historic evidence or fabric that might be incorporated into a new roof at a later date. In this sense, repairs with caulking or bituminous patching compounds should be recognized as potentially harmful, since they are difficult to remove, and at their best, are very temporary.

Precautions

The architect or contractor should warn the owner of any precautions to be taken against the specific hazards in installing the roofing material. Soldering of sheet metals, for instance, can be a fire hazard, either from the open flame or from overheating and undetected smoldering of the wooden substrate materials.

Thought should be given to the design and placement of any modern roof appurtenances such as plumbing stacks, air vents, or TV antennas. Consideration should begin with the placement of modern plumbing on the interior of the building; otherwise a series of vent stacks may pierce the roof membrane at various spots creating maintenance problems as well as aesthetic ones. Air handling units placed in the attic space will require vents which, in turn, require sensitive design. Incorporating these in unused chimneys has been very successful in the past.

Whenever gutters and downspouts are needed that were not on the building historically, the additions should be made as unobtrusively as possible, perhaps by painting them out with a color compatible with the nearby wall or trim.

Maintenance

Although a new roof can be an object of beauty, it will not be protective for long without proper maintenance. At least twice a year, the roof should be inspected against a checklist. All changes should be recorded and reported. Guidelines should be established for any foot traffic that may be required for the maintenance of the roof. Many roofing materials should not be walked on at all. For some--slate, asbestos, and clay tile—a self-supporting ladder might be hung over the ridge of the roof, or planks might be spanned across the roof surface. Such items should be specifically designed and kept in a storage space accessible to the roof. If exterior work ever requires hanging scaffolding, use caution to insure that the anchors do not penetrate, break, or wear the roofing surface, gutters, or flashing.

Any roofing system should be recognized as a membrane that is designed to be self-sustaining, but that can be easily damaged by intrusions such as pedestrian traffic or fallen tree branches. Certain items should be checked at specific times. For example, gutters tend to accumulate leaves and debris during the spring and fall and after heavy rain. Hidden gutter screening both at downspouts and over the full length of the gutter could help keep them clean. The surface material would require checking after a storm as well. Periodic checking of the underside of the roof from the attic after a storm or winter freezing may give early warning of any leaks. Generally, damage from water or ice is less likely on a roof that has good flashing on the outside and is well ventilated and insulated on the inside. Specific instructions for the maintenance of the different roof materials should be available from the architect or contractor.

Summary

The essential ingredients for replacing and maintaining a historic roof are:
Understanding the historic character of the building and being sympathetic to it.
Careful examination and recording of the existing roof and any evidence of earlier roofs.
Consideration of the historic craftsmanship and detailing and implementing them in the renewal wherever visible.
Supervision of the roofers or maintenance personnel to assure preservation of historic fabric and proper understanding of the scope and detailing of the project.
Consideration of alternative materials where the original cannot be used.
Cyclical maintenance program to assure that the staff understands how to take care of the roof and of the particular trouble spots to safeguard.
With these points in mind, it will be possible to preserve the architectural character and maintain the physical integrity of the roofing on a historic building.

CHIMNEY

Original Spec, circa 1929:
8"x12" flue, with 6" thimble for kitchen and 8" thimble for furnace
plaster inside flue, lime and cement mortar and brick exterior (lime, cement, and brick NOT supplied by Aladdin)
flashed and counter flashed *(can we explain "counter flashed?)*
metals to be painted with one coat of red lead and two coats of white lead paint

Character Defining Features:
Corbeled brick courses on the Aladdin

Typical Chimney, circa 2001:
20" sq. , 1.5-4 ft. tall brick with 2 course corbel detail the 2nd and 3rd courses from the top
metal flue, cottages 2-5, 7-9, 39, 41
mastic caulking material at base of chimney (possibly over original flashing)

Special Cases:
Missing corbel detail/truncated chimney top: cottages 9, 35
No chimney above roof line: cottage 36
Metal structural ties between chimney and roof: cottage 44

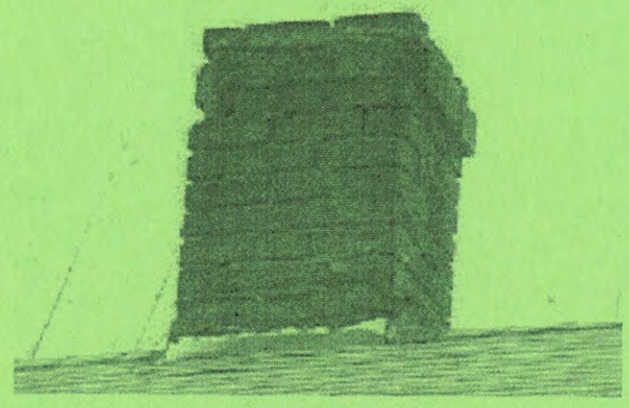
Condition:
Overall, the chimneys seem to be a weak point in the cottage construction, especially in the Aladdin cottages. In many cases, it appears from a ground survey that the **mortar is weak**. Some of the attic inspections revealed that the chimney may be a main **source of moisture infiltration** in the cottages. Some chimneys have been truncated below the corbel detail. Not all of the unused thimbles have been correctly plugged, causing further moisture problems in some houses (for example, cottages 35 & 38). The joint between the roof and chimney has been inappropriately repaired with caulk or like materials. This is a probable cause of the moisture issues associated with the chimney.

In this section:
Thimbles
Flue
Flashing
Selections from Brief #2: Repointing Mortar Joints in Historic Masonry

See also:
Roof
HVAC heating systems

Operations

Chimney



A typical Aladdin chimney features a single wythe corbel and metal flashing.

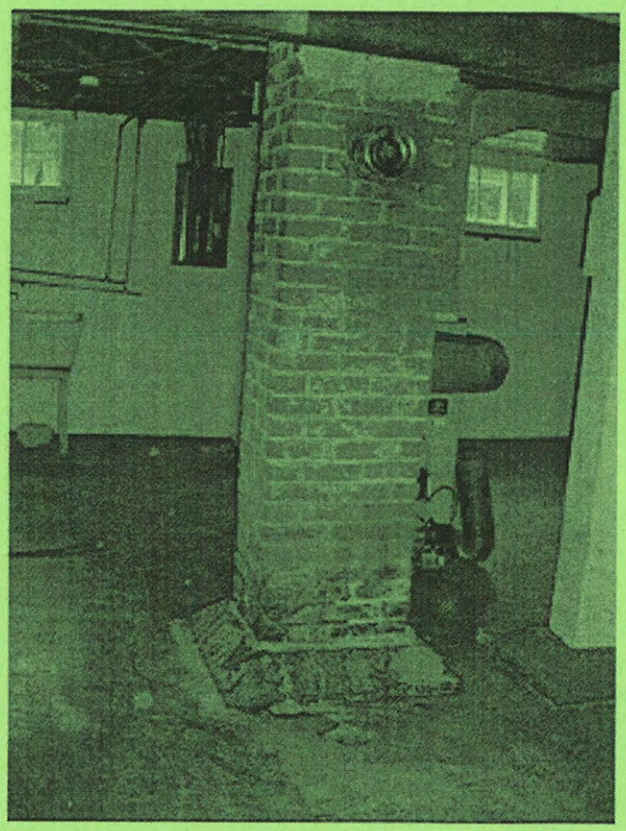
Before any stabilization efforts are made at Three Lynx, chimneys need monitoring to assess individual conditions. Levels of urgency will vary due to continued use of some chimneys while others remain inactive.

Flue

After initial cleaning by a professional, flues should be inspected annually, and be professionally cleaned at least every five years. Inspect seasonally for water leaks.

Flashing

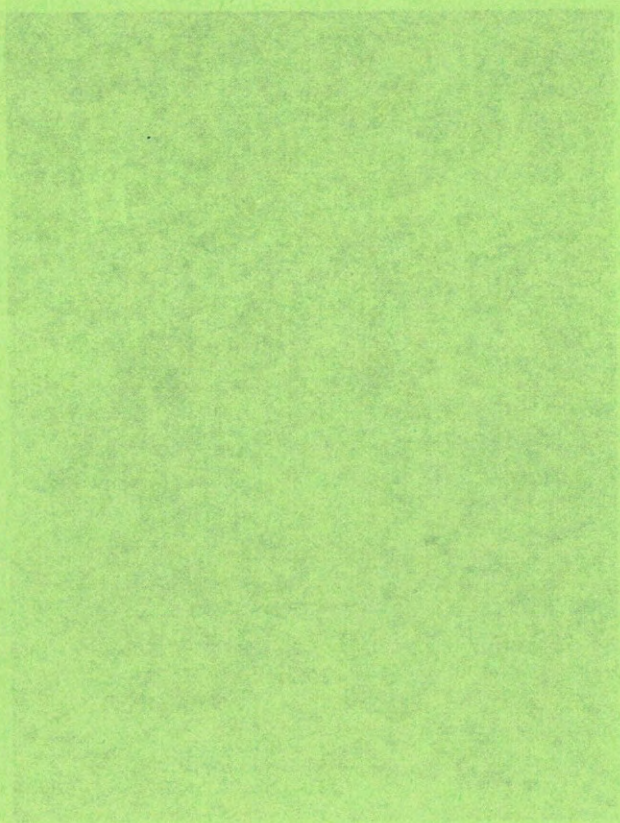
Inspect seasonally for water leakage into attic. Repair as indicated in Rehabilitation directive.



A chimney base in basement shows an improperly plugged thimble opening.

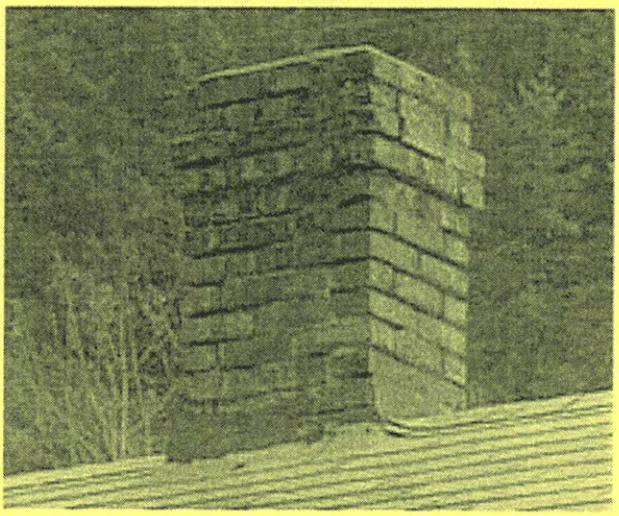
Thimbles

Check all chimney thimbles for tightness and insulation, making sure holes are properly plugged where not used. Replace as needed with manufactured models. Refer to Stabilization for more information.



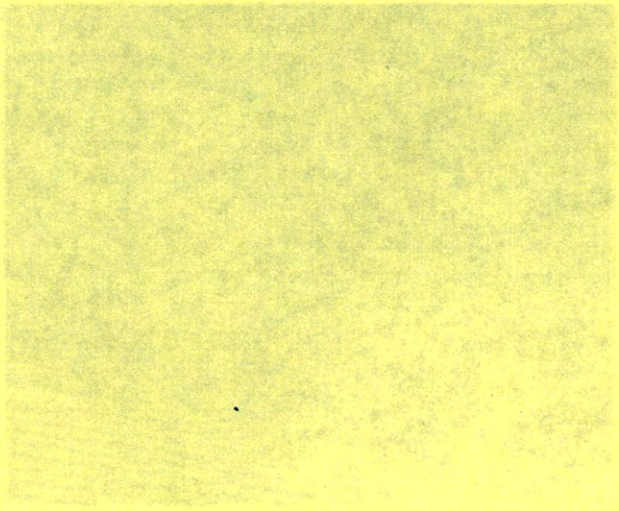
Rehabilitation

Chimney



Aladdin chimney with corbelling detail.

Re-point chimney, keeping original corbel detail. If corbel detail is missing rebuild using existing detail as a guide. Install proper step flashing at roof and chimney joint. When damage is too extensive for repairs, rebuild chimney using as much original material as possible. Chimney repair should coincide with replacement of roofing for efficiency. If in use, it is recommended that the chimney be fitted with a metal flue and lining at the time of chimney work.



SELECTIONS FROM PRESERVATION BRIEF 2: REPOINTING MORTAR JOINTS IN HISTORIC MASONRY BUILDINGS, Robert C. Mack, FAIA, and John P. Speweik
www2.cr.nps.gov/tps/briefs/brief02.htm

Identifying the Problem Before Repointing

The decision to repoint is most often related to some obvious sign of deterioration, such as disintegrating mortar, cracks in mortar joints, loose bricks or stones, damp walls, or damaged plasterwork. It is, however, erroneous to assume that repointing alone will solve deficiencies that result from other problems. The root cause of the deterioration--leaking roofs or gutters, differential settlement of the building, capillary action causing rising damp, or extreme weather exposure--should always be dealt with prior to beginning work. Without appropriate repairs to eliminate the source of the problem, mortar deterioration will continue and any repointing will have been a waste of time and money.

Use of Consultants

Because there are so many possible causes for deterioration in historic buildings, it may be desirable to retain a consultant, such as a historic architect or architectural conservator, to analyze the building. In addition to determining the most appropriate solutions to the problems, a consultant can prepare specifications which reflect the particular requirements of each job and can provide oversight of the work in progress. Referrals to preservation consultants frequently can be obtained from State Historic Preservation Offices, the American Institute for Conservation of Historic and Artistic Works (AIC), the Association for Preservation Technology (APT), and local chapters of the American Institute of Architects (AIA).

Finding an Appropriate Mortar Match

Preliminary research is necessary to ensure that the proposed repointing work is both physically and visually appropriate to the building. Analysis of unweathered portions of the historic mortar to which the new mortar will be matched can suggest appropriate mixes for the repointing mortar so that it will not damage the building because it is excessively strong or vapor impermeable. Examination and analysis of the masonry units--brick, stone or terra cotta--and the techniques used in the original construction will assist in maintaining the building's historic appearance. A simple, non-technical, evaluation of the masonry units and mortar can provide information concerning the relative strength and permeability of each--critical factors in selecting the repointing mortar--while a visual analysis of the historic mortar can provide the information necessary for developing the new mortar mix and application techniques.

Although not crucial to a successful repointing project, for projects involving properties of special historic significance, a mortar analysis by a qualified laboratory can be useful by providing information on the original ingredients. However, there are limitations with such an analysis, and replacement mortar specifications should not be based solely on laboratory analysis. Analysis requires interpretation, and there are important factors which affect the condition and performance of the mortar that cannot be established through laboratory analysis. These may include: the original water content, rate

of curing, weather conditions during original construction, the method of mixing and placing the mortar, and the cleanliness and condition of the sand. The most useful information that can come out of laboratory analysis is the identification of sand by gradation and color. This allows the color and the texture of the mortar to be matched with some accuracy because sand is the largest ingredient by volume.

In creating a repointing mortar that is compatible with the masonry units, the objective is to achieve one that matches the historic mortar as closely as possible, so that the new material can coexist with the old in a sympathetic, supportive and, if necessary, sacrificial capacity. The exact physical and chemical properties of the historic mortar are not of major significance as long as the new mortar conforms to the following criteria:

The new mortar must match the historic mortar in color, texture and tooling. (If a laboratory analysis is undertaken, it may be possible to match the binder components and their proportions with the historic mortar, if those materials are available.)

The sand must match the sand in the historic mortar. (The color and texture of the new mortar will usually fall into place if the sand is matched successfully.)

The new mortar must have greater vapor permeability and be softer (measured in compressive strength) than the masonry units.

The new mortar must be as vapor permeable and as soft or softer (measured in compressive strength) than the historic mortar. (Softness or hardness is not necessarily an indication of permeability; old, hard lime mortars can still retain high permeability.)

Properties of Mortar

Mortars for repointing should be softer or more permeable than the masonry units and no harder or more impermeable than the historic mortar to prevent damage to the masonry units. It is a common error to assume that hardness or high strength is a measure of appropriateness, particularly for lime-based historic mortars. Stresses within a wall caused by expansion, contraction, moisture migration, or settlement must be accommodated in some manner; in a masonry wall, these stresses should be relieved by the mortar rather than by the masonry units. A mortar that is stronger in compressive strength than the masonry units will not "give," thus causing stresses to be relieved through the masonry units--resulting in permanent damage to the masonry, such as cracking and spalling, that cannot be repaired easily.

While stresses can also break the bond between the mortar and the masonry units, permitting water to penetrate the resulting hairline cracks, this is easier to correct in the joint through repointing than if the break occurs in the masonry units.

Permeability, or rate of vapor transmission, is also critical. High lime mortars are more permeable than denser cement mortars. Historically, mortar acted as a bedding material--not unlike an expansion joint--rather than a "glue" for the masonry units, and moisture was able to migrate through the mortar joints rather than the masonry units. When moisture evaporates from the masonry it deposits any soluble salts either on the surface as efflorescence or below the surface as

subflorescence. While salts deposited on the surface of masonry units are usually relatively harmless, salt crystallization within a masonry unit creates pressure that can cause parts of the outer surface to spall off or delaminate. If the mortar does not permit moisture or moisture vapor to migrate out of the wall and evaporate, the result will be damage to the masonry units.

Budgeting and Scheduling

Repointing is both expensive and time consuming due to the extent of handwork and special materials required. It is preferable to repoint only those areas that require work rather than an entire wall, as is often specified. But, if 25 to 50 per cent or more of a wall needs to be repointed, repointing the entire wall may be more cost effective than spot repointing. Total repointing may also be more sensible when access is difficult, requiring the erection of expensive scaffolding (unless the majority of the mortar is sound and unlikely to require replacement in the foreseeable future). Each project requires judgement based on a variety of factors. Recognizing this at the outset will help to prevent many jobs from becoming prohibitively expensive.

In scheduling, seasonal aspects need to be considered first. Generally speaking, wall temperatures between 40 and 95 degrees F (8 and 38 degrees C) will prevent freezing or excessive evaporation of the water in the mortar. Ideally, repointing should be done in shade, away from strong sunlight in order to slow the drying process, especially during hot weather. If necessary, shade can be provided for large-scale projects with appropriate modifications to scaffolding.

The relationship of repointing to other work proposed on the building must also be recognized. For example, if paint removal or cleaning is anticipated, and if the mortar joints are basically sound and need only selective repointing, it is generally better to postpone repointing until after completion of these activities. However, if the mortar has eroded badly, allowing moisture to penetrate deeply into the wall, repointing should be accomplished before cleaning. Related work, such as structural or roof repairs, should be scheduled so that they do not interfere with repointing and so that all work can take maximum advantage of erected scaffolding.

Building managers also must recognize the difficulties that a repointing project can create. The process is time consuming, and scaffolding may need to remain in place for an extended period of time. The joint preparation process can be quite noisy and can generate large quantities of dust which must be controlled, especially at air intakes to protect human health, and also where it might damage operating machinery. Entrances may be blocked from time to time making access difficult for both building tenants and visitors. Clearly, building managers will need to coordinate the repointing work with other events at the site.

Execution of the Work

Test Panels. These panels are prepared by the contractor using the same techniques that will be used on the remainder of the project. Several panel locations--preferably not on the front or other highly visible location of the building--may be necessary to include all types of masonry, joint styles, mortar colors, and other problems likely to be encountered on the job. If cleaning tests,

for example, are also to be undertaken, they should be carried out in the same location. Usually a 3 foot by 3 foot area is sufficient for brickwork, while a somewhat larger area may be required for stonework. These panels establish an acceptable standard of work and serve as a benchmark for evaluating and accepting subsequent work on the building.

Joint Preparation. Old mortar should be removed to a minimum depth of 2 to 2-1/2 times the width of the joint to ensure an adequate bond and to prevent mortar "popouts." For most brick joints, this will require removal of the mortar to a depth of approximately * to 1 inch; for stone masonry with wide joints, mortar may need to be removed to a depth of several inches. Any loose or disintegrated mortar beyond this minimum depth also should be removed.

Although some damage may be inevitable, careful joint preparation can help limit damage to masonry units. The traditional manner of removing old mortar is through the use of hand chisels and mash hammers. Though labor-intensive, in most instances this method poses the least threat for damage to historic masonry units and produces the best final product.

The most common method of removing mortar, however, is through the use of power saws or grinders. The use of power tools by unskilled masons can be disastrous for historic masonry, particularly soft brick. Using power saws on walls with thin joints, such as most brick walls, almost always will result in damage to the masonry units by breaking the edges and by overcutting on the head, or vertical joints.

However, small pneumatically-powered chisels generally can be used safely and effectively to remove mortar on historic buildings as long as the masons maintain appropriate control over the equipment. Under certain circumstances, thin diamond-bladed grinders may be used to cut out horizontal joints only on hard portland cement mortar common to most early-20th century masonry buildings. Usually, automatic tools most successfully remove old mortar without damaging the masonry units when they are used in combination with hand tools in preparation for repointing. Where horizontal joints are uniform and fairly wide, it may be possible to use a power masonry saw to assist the removal of mortar, such as by cutting along the middle of the joint; final mortar removal from the sides of the joints still should be done with a hand chisel and hammer. Caulking cutters with diamond blades can sometimes be used successfully to cut out joints without damaging the masonry. Caulking cutters are slow; they do not rotate, but vibrate at very high speeds, thus minimizing the possibility of damage to masonry units. Although mechanical tools may be safely used in limited circumstances to cut out horizontal joints in preparation for repointing, they should never be used on vertical joints because of the danger of slipping and cutting into the brick above or below the vertical joint. Using power tools to remove mortar without damaging the surrounding masonry units also necessitates highly skilled masons experienced in working on historic masonry buildings. Contractors should demonstrate proficiency with power tools before their use is approved.

Using any of these power tools may also be more acceptable on hard stone, such as quartzite or granite, than on terra cotta with its glass-like glaze, or on soft brick or stone. The test panel should determine the acceptability of power tools. If power tools are to be permitted, the contractor should establish a

quality control program to account for worker fatigue and similar variables. Mortar should be removed cleanly from the masonry units, leaving square corners at the back of the cut. Before filling, the joints should be rinsed with a jet of water to remove all loose particles and dust. At the time of filling, the joints should be damp, but with no standing water present. For masonry walls--limestone, sandstone and common brick--that are extremely absorbent, it is recommended that a continual mist of water be applied for a few hours before repointing begins.

Mortar Preparation. Mortar components should be measured and mixed carefully to assure the uniformity of visual and physical characteristics. Dry ingredients are measured by volume and thoroughly mixed before the addition of any water. Sand must be added in a damp, loose condition to avoid over sanding. Repointing mortar is typically pre-hydrated by adding water so it will just hold together, thus allowing it to stand for a period of time before the final water is added. Half the water should be added, followed by mixing for approximately 5 minutes. The remaining water should then be added in small portions until a mortar of the desired consistency is reached. The total volume of water necessary may vary from batch to batch, depending on weather conditions. It is important to keep the water to a minimum for two reasons: first, a drier mortar is cleaner to work with, and it can be compacted tightly into the joints; second, with no excess water to evaporate, the mortar cures without shrinkage cracks. Mortar should be used within approximately 30 minutes of final mixing, and "retempering," or adding more water, should not be permitted.

Filling the Joint. Where existing mortar has been removed to a depth of greater than 1 inch, these deeper areas should be filled first, compacting the new mortar in several layers. The back of the entire joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners. This application may extend along the wall for several feet. As soon as the mortar has reached thumb-print hardness, another 1/4 inch layer of mortar--approximately the same thickness--may be applied. Several layers will be needed to fill the joint flush with the outer surface of the masonry. It is important to allow each layer time to harden before the next layer is applied; most of the mortar shrinkage occurs during the hardening process and layering thus minimizes overall shrinkage.

When the final layer of mortar is thumb-print hard, the joint should be tooled to match the historic joint. Proper timing of the tooling is important for uniform color and appearance. If tooled when too soft, the color will be lighter than expected, and hairline cracks may occur; if tooled when too hard, there may be dark streaks called "tool burning," and good closure of the mortar against the masonry units will not be achieved.

If the old bricks or stones have worn, rounded edges, it is best to recess the final mortar slightly from the face of the masonry. This treatment will help avoid a joint which is visually wider than the actual joint; it also will avoid creation of a large, thin featheredge which is easily damaged, thus admitting water. After tooling, excess mortar can be removed from the edge of the joint by brushing with a natural bristle or nylon brush. Metal bristle brushes should never be used on historic masonry.

Curing Conditions. The preliminary hardening of high-lime content mortars--those mortars that contain more lime by volume than portland cement, i.e., Type O (1:2:9), Type K (1:3:11), and straight lime/sand, Type "L" (0:1:3)--takes place fairly rapidly as water in the mix is lost to the porous surface of the masonry and through evaporation. A high lime mortar (especially Type "L") left to dry out too rapidly can result in chalking, poor adhesion, and poor durability. Periodic wetting of the repointed area after the mortar joints are thumb-print hard and have been finish tooled may significantly accelerate the carbonation process. When feasible, misting using a hand sprayer with a fine nozzle can be simple to do for a day or two after repointing. Local conditions will dictate the frequency of wetting, but initially it may be as often as every hour and gradually reduced to every three or four hours. Walls should be covered with burlap for the first three days after repointing. (Plastic may be used, but it should be tented out and not placed directly against the wall.) This helps keep the walls damp and protects them from direct sunlight. Once carbonation of the lime has begun, it will continue for many years and the lime will gain strength as it reverts back to calcium carbonate within the wall.

Cleaning the Repointed Masonry

If repointing work is carefully executed, there will be little need for cleaning other than to remove the small amount of mortar from the edge of the joint following tooling. This can be done with a stiff natural bristle or nylon brush after the mortar has dried, but before it is initially set (1-2 hours). Mortar that has hardened can usually be removed with a wooden paddle or, if necessary, a chisel.

Further cleaning is best accomplished with plain water and natural bristle or nylon brushes. If chemicals must be used, they should be selected with extreme caution. Improper cleaning can lead to deterioration of the masonry units, deterioration of the mortar, mortar smear, and efflorescence. New mortar joints are especially susceptible to damage because they do not become fully cured for several months. Chemical cleaners, particularly acids, should never be used on dry masonry. The masonry should always be completely soaked once with water before chemicals are applied. After cleaning, the walls should be flushed again with plain water to remove all traces of the chemicals.

Several precautions should be taken if a freshly repointed masonry wall is to be cleaned. First, the mortar should be fully hardened before cleaning. Thirty days is usually sufficient, depending on weather and exposure; as mentioned previously, the mortar will continue to cure even after it has hardened. Test panels should be prepared to evaluate the effects of different cleaning methods. Generally, on newly repointed masonry walls, only very low pressure (100 psi) water washing supplemented by stiff natural bristle or nylon brushes should be used, except on glazed or polished surfaces, where only soft cloths should be used.**

New construction "bloom" or efflorescence occasionally appears within the first few months of repointing and usually disappears through the normal process of weathering. If the efflorescence is not removed by natural processes, the safest way to remove it is by dry brushing with stiff natural or nylon bristle brushes followed by wet brushing. Hydrochloric (muriatic) acid, is generally

ineffective, and it should not be used to remove efflorescence. It may liberate additional salts, which, in turn, can lead to more efflorescence.

Summary

For the Owner/Administrator. The owner or administrator of a historic building should remember that repointing is likely to be a lengthy and expensive process. First, there must be adequate time for evaluation of the building and investigation into the cause of problems. Then, there will be time needed for preparation of the contract documents. The work itself is precise, time-consuming and noisy, and scaffolding may cover the face of the building for some time. Therefore, the owner must carefully plan the work to avoid problems. Schedules for both repointing and other activities will thus require careful coordination to avoid unanticipated conflicts. The owner must avoid the tendency to rush the work or cut corners if the historic building is to retain its visual integrity and the job is to be durable.

For the Architect/Consultant. Because the primary role of the consultant is to ensure the life of the building, a knowledge of historic construction techniques and the special problems found in older buildings is essential. The consultant must assist the owner in planning for logistical problems relating to research and construction. It is the consultant's responsibility to determine the cause of the mortar deterioration and ensure that it is corrected before the masonry is repointed. The consultant must also be prepared to spend more time in project inspections than is customary in modern construction.

For the Masons. Successful repointing depends on the masons themselves. Experienced masons understand the special requirements for work on historic buildings and the added time and expense they require. The entire masonry crew must be willing and able to perform the work in conformance with the specifications, even when the specifications may not be in conformance with standard practice. At the same time, the masons should not hesitate to question the specifications if it appears that the work specified would damage the building.

Conclusion

A good repointing job is meant to last, at least 30 years, and preferably 50- 100 years. Shortcuts and poor craftsmanship result not only in diminishing the historic character of a building, but also in a job that looks bad, and will require future repointing sooner than if the work had been done correctly. The mortar joint in a historic masonry building has often been called a wall's "first line of defense." Good repointing practices guarantee the long life of the mortar joint, the wall, and the historic structure. Although careful maintenance will help preserve the freshly repointed mortar joints, it is important to remember that mortar joints are intended to be sacrificial and will probably require repointing some time in the future. Nevertheless, if the historic mortar joints proved durable for many years, then careful repointing should have an equally long life, ultimately contributing to the preservation of the entire building.

Useful Addresses

Brick Institute of America
11490 Commerce Park Drive
Reston, VA 22091

National Lime Association
200 N. Glebe Road, Suite 800
Arlington, VA 22203

Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077

FRONT PORCH

Original specs for Aladdin Homes, circa 1929:
Purchaser to supply cement, sand, gravel, lime, and brick

Character Defining Features:
Traditional
Wood Porch Skirt, Solid (vs. Slatted)
Tongue and Groove Flooring
Wood Railing
Gable Roofed, with Wide Verge Board and Decorative Verge Tie
Girders Project from Gable
Aladdin
Hip Roof
Beadboard Ceiling
Tongue and Groove Floor
Slatted Porch Rail and Contiguous Skirt
Serrated Brick Piers, with Concrete Caps and Wood Box Columns
Double tread stair system

Typical in 2001:
24" - 32" rail height
Tongue and Groove flooring, 3 1/8", runs perpendicular to house body, angled down
Beadboard Ceiling
Contiguous Rail and Skirt, slatted, Aladdin
Slatted Rail and Solid Skirt, Traditional
Aladdin columns: hollow, serrated brick piers, concrete caps, hollow wooden box columns
Non-original steps to porch: Single tread replacement steps, made of treated wood, with asphalt shingles tacked on for traction
Original light fixtures
Single tread stairs have replaced the double tread configuration

Special Cases:
Plywood decks on cottages 2, 3, 7, 35, 36, 41
T-111 skirt, cottage 4
New unfinished wood porch, cottage 6, 44. The rebuilt porch on cottage 6 is vaguely in the manner of the traditional porch, but not quite matching.
T&G decking runs parallel to building on cottages 8, 9
Parged brick piers on cottages 35, 38
Some front rail slats are missing on cottage 42

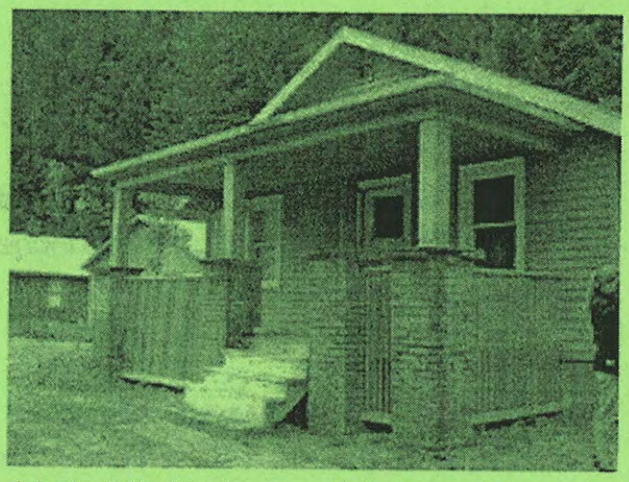
Condition:
The porches have been much altered. The brick piers have severely deteriorated mortar. The parged piers are spalling. The hollow construction of the piers may be structurally unsure. The wood box columns are separating and the trim has deteriorated in many places and been replaced in others. The

plywood decking is historically inappropriate. Peeling paint may lead to further deterioration of the wood underneath, especially on railings. Foliage encroachment may also be causing moisture damage. Steps are generally in good condition, but asphalt shingles may be trapping moisture against the wood which would accelerate decay.

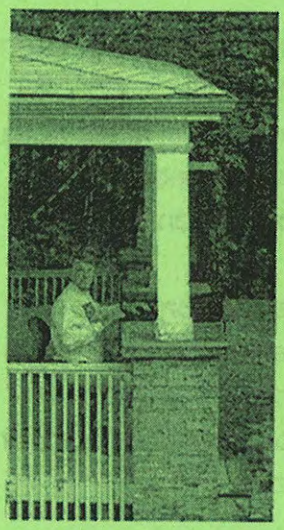
In this Section:
Stairs
Support systems
Railing and Skirt
Floor
Ceiling and Roof
Lighting Fixtures

See also:
Back Porch
Paint
Landscape

Operations



A typical Aladdin front porch includes steps and brick piers that need annual inspections..



Box columns on piers support the porch hip roof.

Removal of pier cap revealed formwork.

Front Porch

Stairs

Steps should be kept painted, for protection from wear and from the elements. For traction, sand painting should be used, rather than an asphalt layer that may trap moisture against the wood and lead to deterioration.

Stair treads should be monitored for standing water or other signs of moisture, which may indicate deterioration or problems elsewhere.

Steps should be inspected annually for rot, loose boards, and paint integrity. If treads need to be replaced, see Rehabilitation.

Supports (piers & columns)

See Stabilization for the initial repair for the brick piers and wood box columns.

Brick piers should not be painted, plastered, stuccoed, parged or otherwise sealed. They should be checked annually for mortar integrity, and repointed if necessary. See Brief #2 in the appendix for details on repointing.

Wood box columns should be kept painted for protection from the elements. Joints should be neatly caulked to provide a weather seal. All trim pieces serve a protective function and should be maintained where intact, and replaced in kind where missing.

Operations

A continuous rail and skirt is a character-defining feature of the Aladdin cottages at Three Lynx.

Crawl space beneath a front porch.

A traditional front porch shows decorative verge boards, a character-defining feature that.

Railing/skirt

Railings are original, character-defining features that should be retained. Keep rails painted.

Keep foliage off rails, as it contributes to deterioration by holding moisture against wood surfaces. Keep soil at least 6 inches from structures.

Floor

Keep watch for signs of poor drainage, such as pooling water from settlement or warped pieces. Identify the cause of such problems and repair.

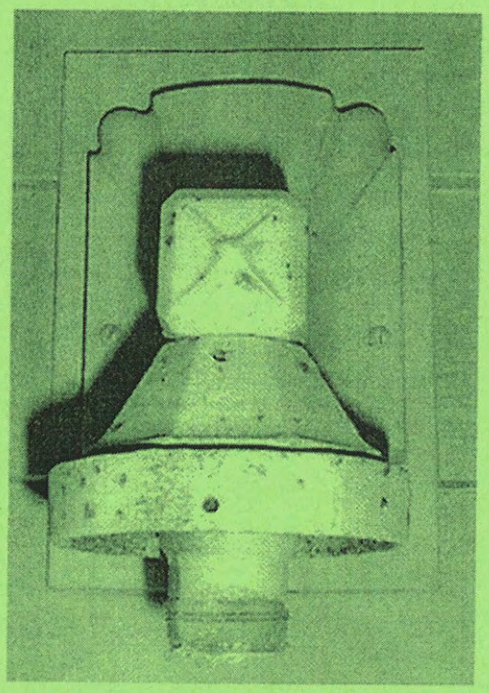
Keep decking painted for protection from the elements and from deterioration. If traction is a problem on painted surfaces, sand paint for traction. For more information, see Rehabilitation.

End grains of wood need monitoring for deterioration because moisture damage can easily move deeper. If wood is damaged, see Rehabilitation for repair or replacement instructions.

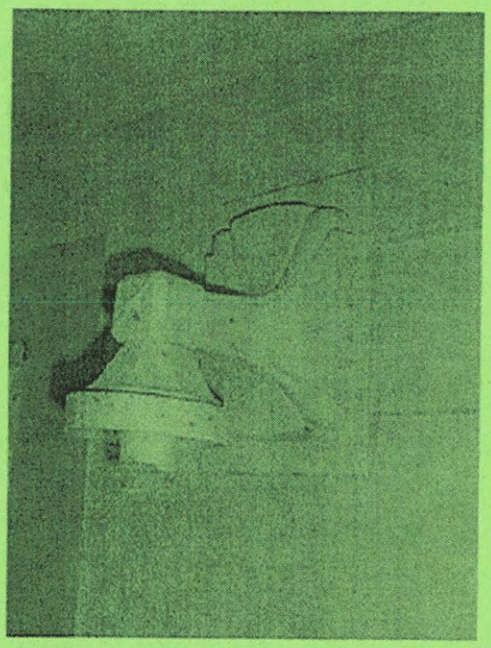
Ceiling/roof

Sagging wood or blistering paint should be noted, as these may be signs of moisture infiltration. Ceiling should be kept painted, and cleaned of cobwebs and insect nests at least once a year.

Operations



Front porch lamps on all Aladdin cottages are the original models and should be retained.



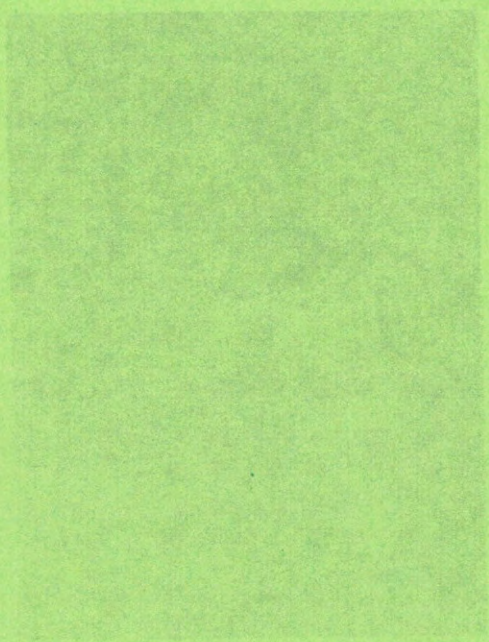
Missing globesin the porch lamps should be replaced.

Light fixture

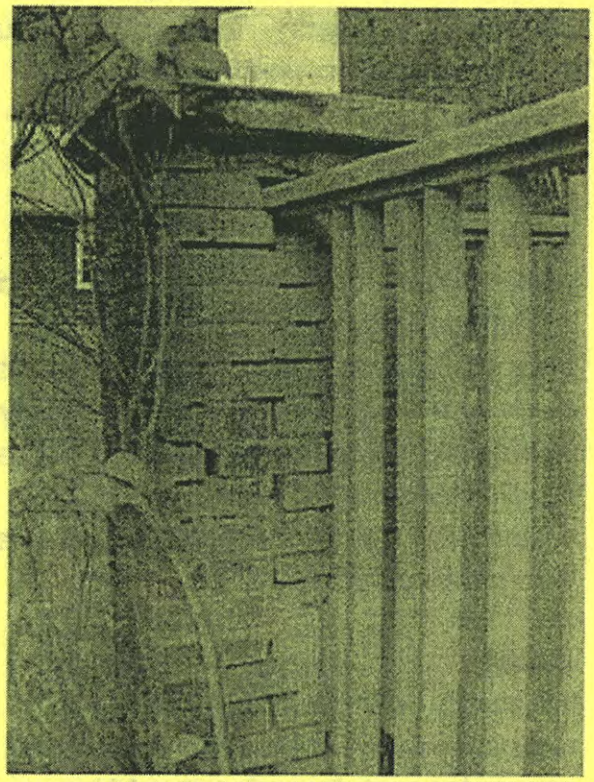
The Aladdin cottages have wall-mounted porch lights with original brackets. The traditional cottages have centrally located ceiling fixtures.

Many glass lanterns are missing. Replacement globes should be of uniform shape and size.

Lighting fixtures should be kept in good repair, cleaned occasionally, and kept painted.



Rehabilitation



Deterioration of railing/skirt and brick piers; immediate mitigation is required.

Wooden stairs have been rebuilt on many cottages in a manner not original and problematic for water drainage. Parging of the brick piers has also occured on two Aladdin cottages.

Porches

The porches have shown the much wear and change over the course of time. Due to the use and exposure of the porch it is imperative that the repair and replacement of material and features be both functional and historically accurate. As a very visible feature it is necessary for the porches to maintain their unique design attributes.

Railing/Skirt

When rehabilitating existing railing, care should be taken to reuse as much of the original material as possible. It may be possible to chemically consolidate deteriorated wood material. Paint should be thoroughly removed by a non-destructive technique, and reapplied. See paint section for more details.

Stairs

Stairs have been more frequently replaced than any other house part due to their exposure and use. Currently they are being replaced with a single board tread. Research shows that the original Aladdin stair treads were two boards, allowing for better drainage. See stair design on the next page for more details. Material for stair should not have visible incising marks (from pressure treating). Paint using two coats of oil-based primer with latex finish coat. If additional traction is needed on the treads two methods are recommended. Method 1: Mix sand into paint to be applied to the stair treads. Method 2: Apply self-adhesive strips to the treads which are textured and similar in color to the stair paint.

Rehabilitation

Historic beadboard detail.

Wooden box column rests on top of concrete cap over brick piers. Little historic trim remains, most has been replaced with less decorative pieces.

It is recommended that a low profile metal handrail be utilized only if absolutely necessary. The handrail should be painted to match the color of the stairs.

Floor/Decking

When porch deck is in need of replacement tongue and groove boards 3 &1/8 inch wide should be used. T&g floor should run perpendicular to the main body of the house and be sloped slighly down, away from the body of the house for drainage.

Paint using two coats of oil-based primer with a one coat latex finish.

Ceiling

If a porch ceiling is in need of replacement beadboard of the original character and dimension should be used. Paint using two coats of oil-based primer with a one coat latex finish.

Posts

If porch posts seams are separating, disassemble and clean boards at joints. Then reassemble. Joints should be caulked neatly with an oil-based product. Scrape and paint using two coats of oil-based primer covering all wood surfaces followed with one coat of latex finish.

Post and Column Trim

An original trim configuration should be determined, if possible. If not, a design should be worked out with historical consideration and used as standard. Replacement trim should be backpainted and joints should be caulked with and oil-based material. Trim should then be painted.

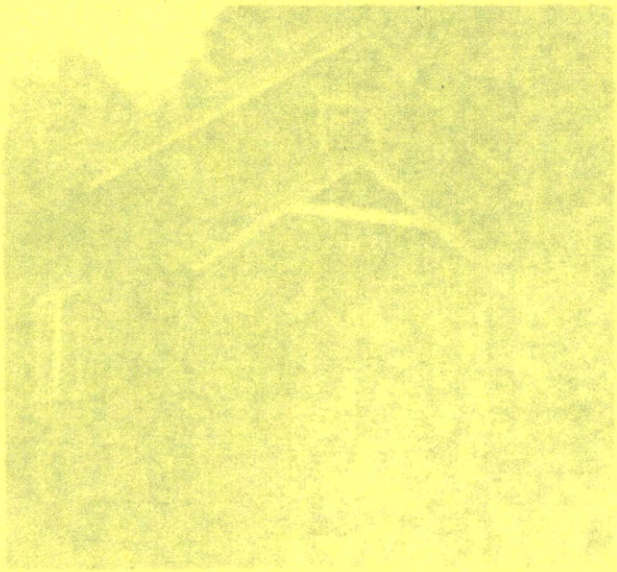
Rehabilitation

Traditional front porch.

Skirting

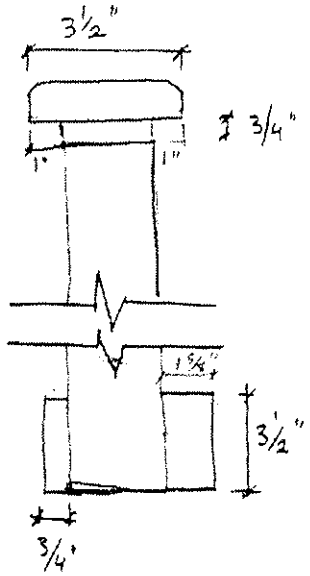
It is recommended that skirting surrounding the porches on the Aladdin houses be maintained in their original configuration, with the handrail pickets extending down to act as both picket and skirt.

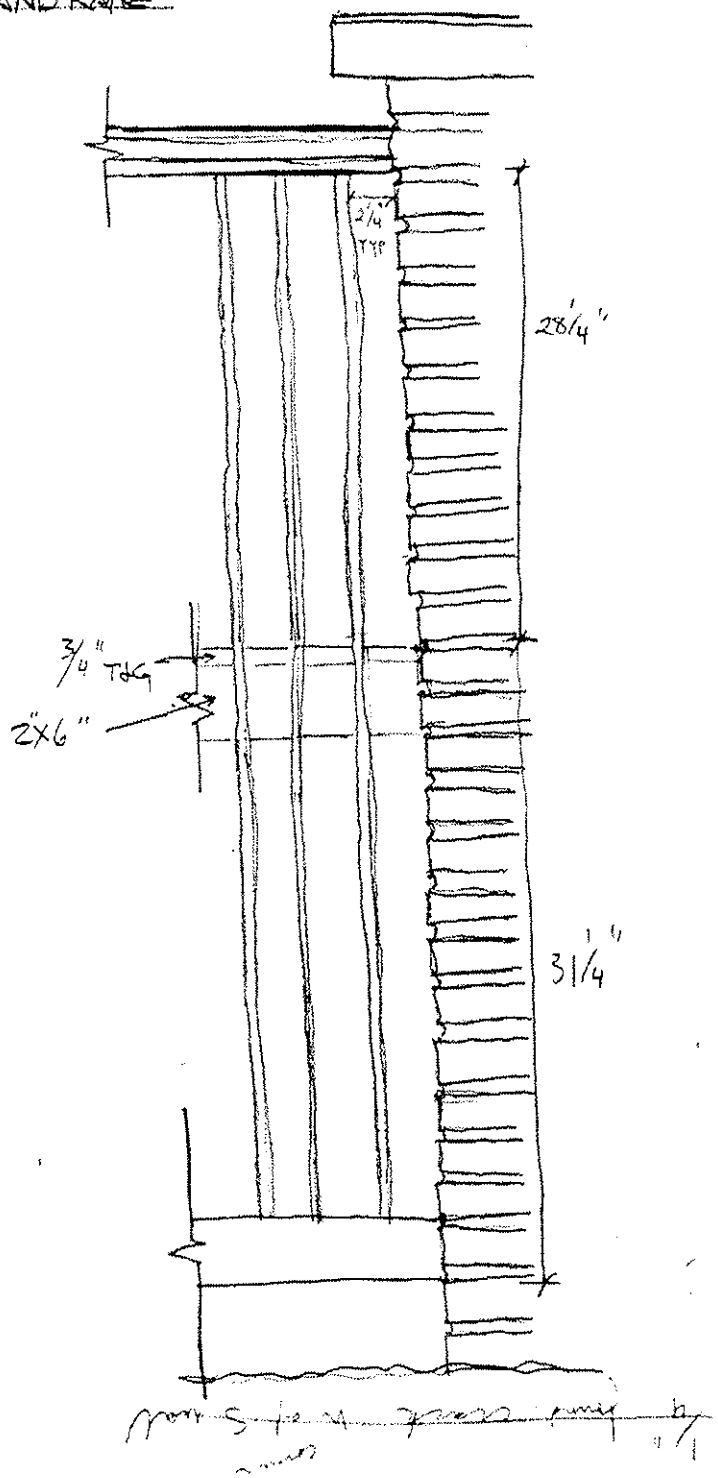
On the one and a half story houses it is recommended that vertical tongue and groove bead board be used as skirting of a dimension approximately three inches in width.

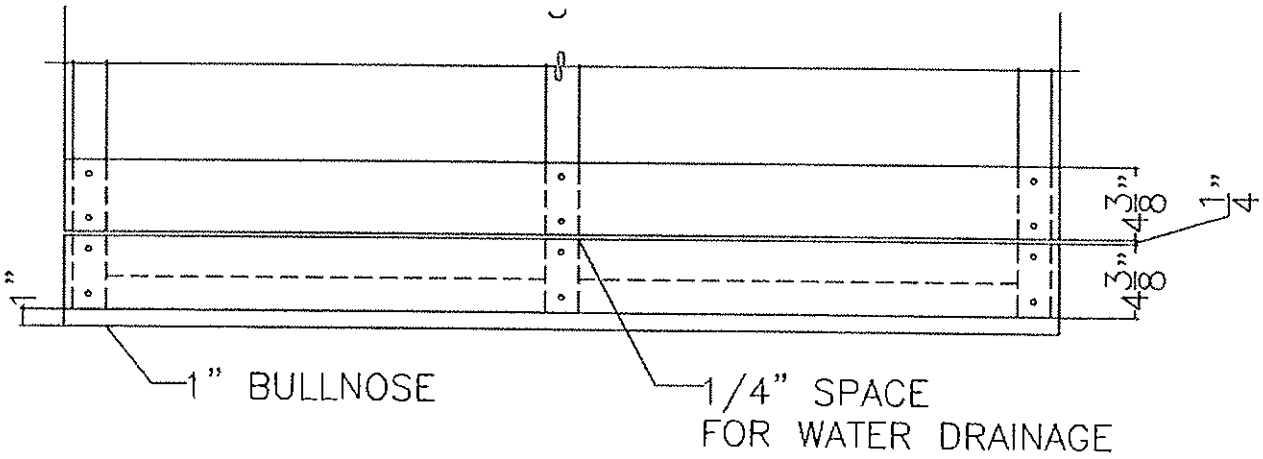


#39
TYPICAL

TYPICAL ALUMINUM HAND RAIL

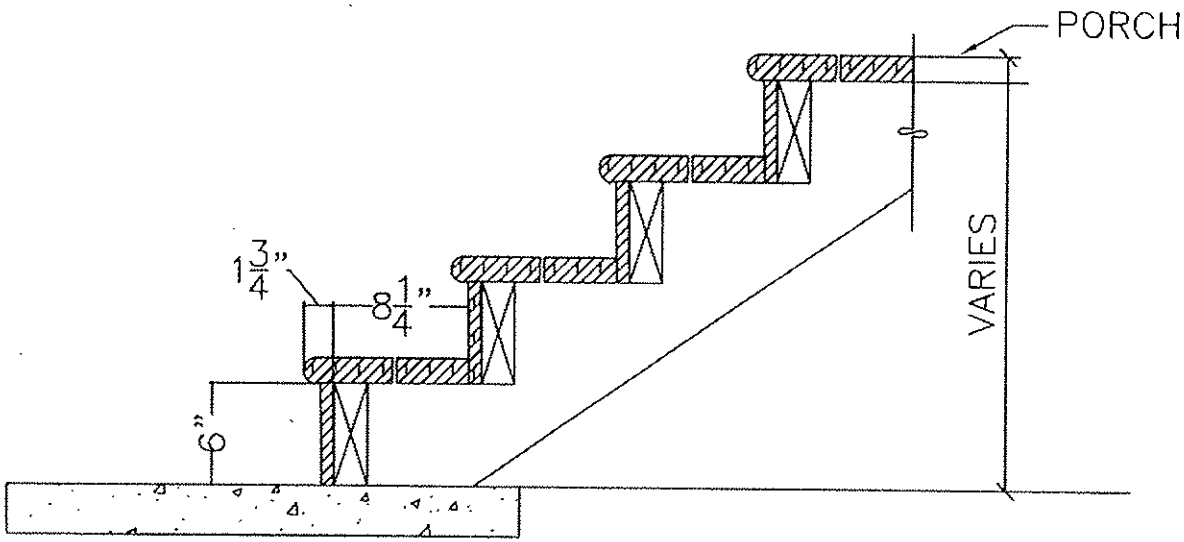






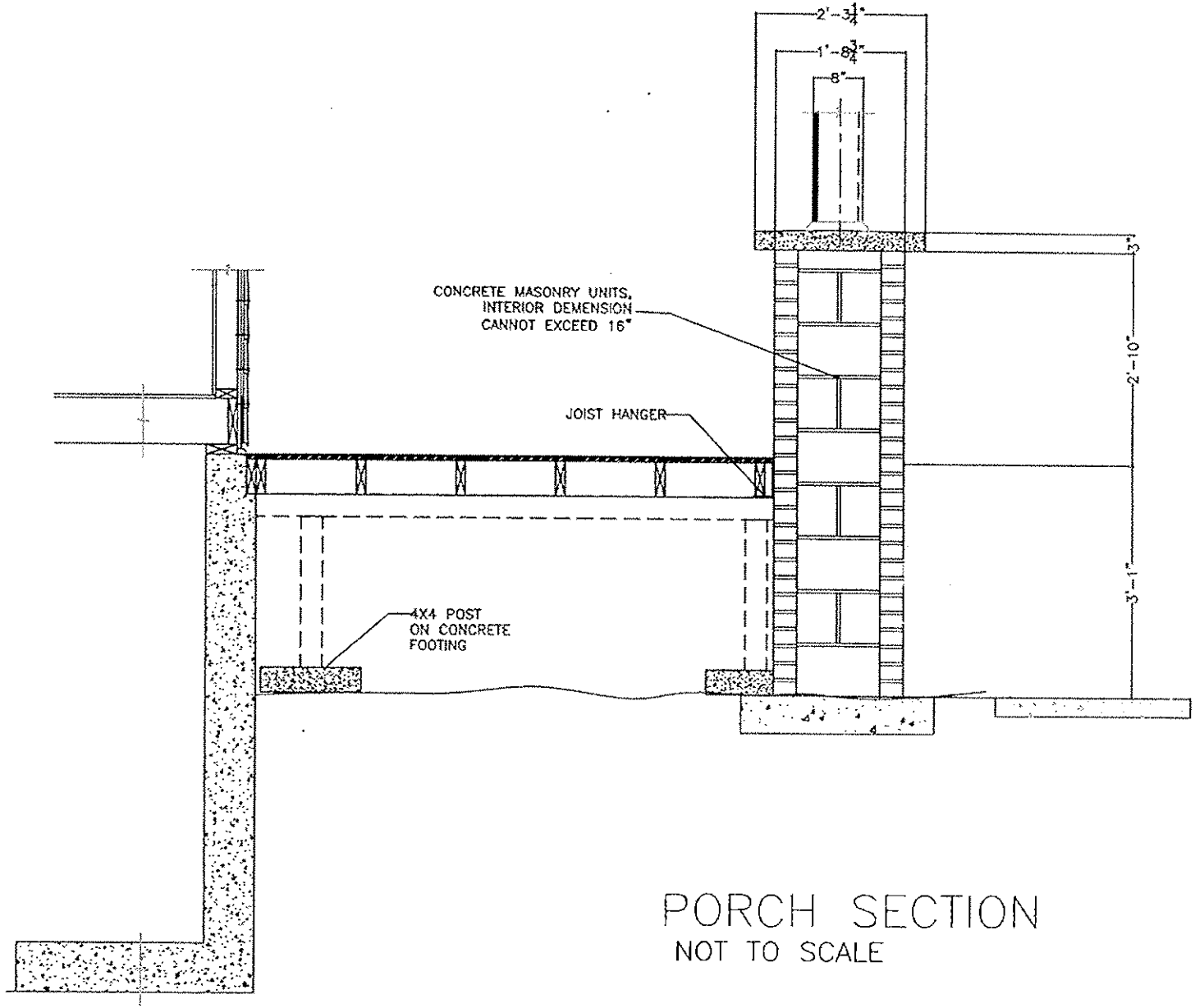
STAIR PLAN

1-1/2" = 1'-0"



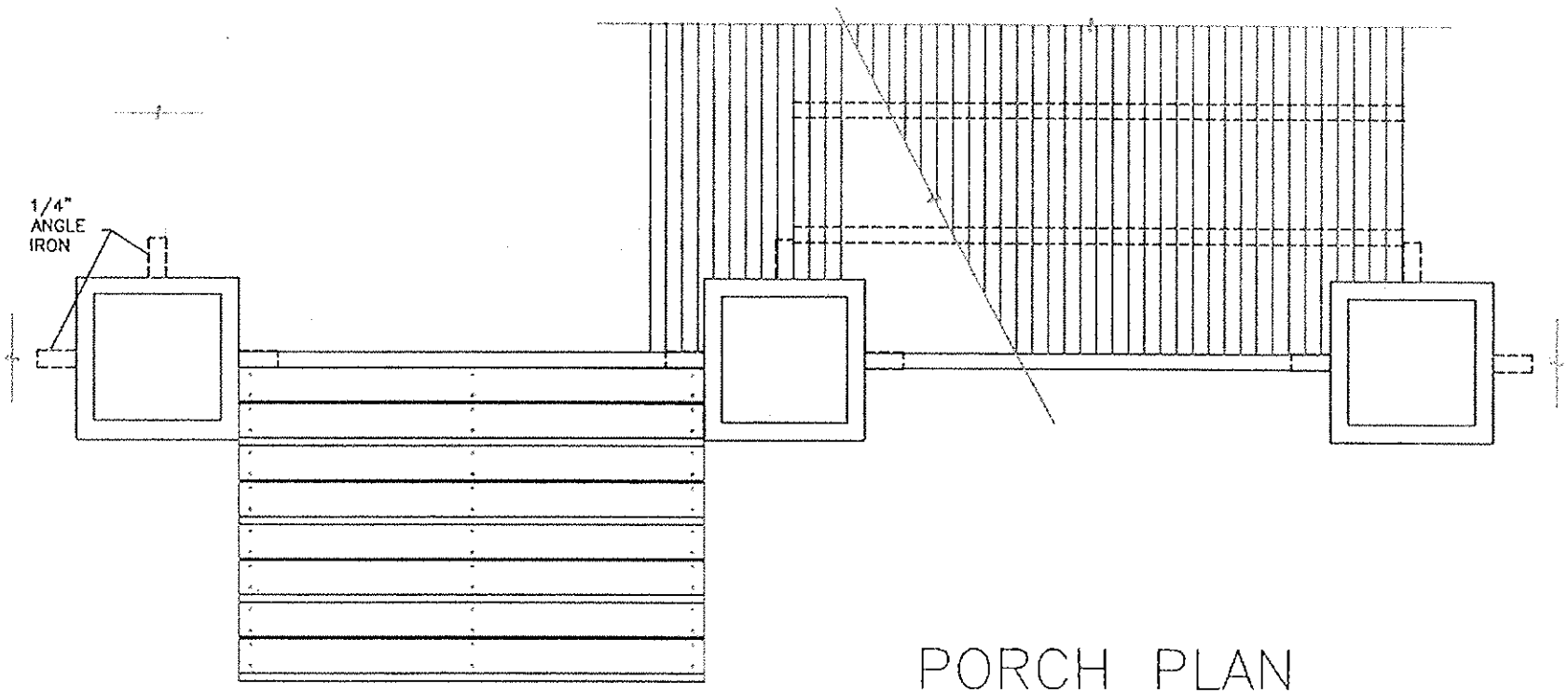
STAIR PLAN AND SECTION

1-1/2" = 1'-0"



PORCH SECTION

NOT TO SCALE



PORCH PLAN

NOT TO SCALE

BACK PORCH

Original specs for Aladdin Homes, circa 1929:
Small Back Porch with Steps to grade line, Hand Railing, and Roof

Character Defining Features:
Traditional
Enclosed Rear Porch with Fire Escape Ladder to second story

Typical in 2001:
There is no typical rear porch type. The back porch on cottage 35 is thought to be close to the original Aladdin porch.

Special Cases:
For a review of a variety of porch types, see the Operations page.

Condition:
Varied, depending on the construction of the porch.

In this Section:
Design consideration and analysis

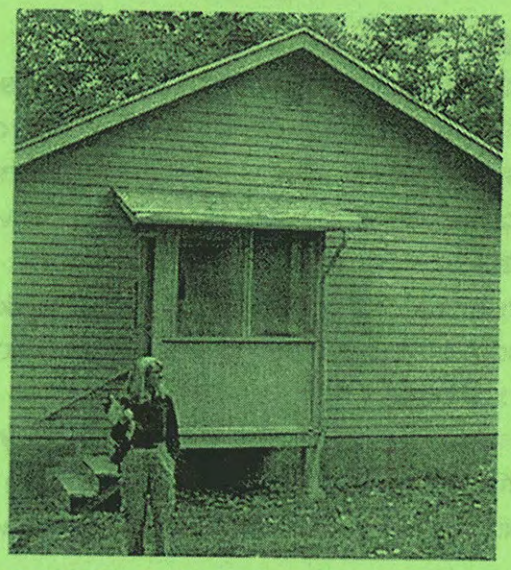
See also:
Front Porch

Operations

Back Porch

Back porches vary from cottage to cottage. In general, they should be maintained in a similar manner to front porches.

Back Porch - Aladdin

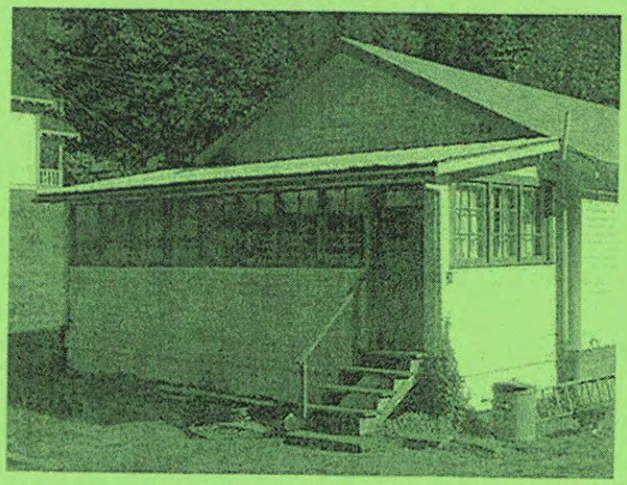


The rear porch on Aladdin cottage #35 is a good example of the original design.

Cottage #35 appears to be an original Aladdin model back porch. The enclosure is screen at the top and wood at the bottom, with a shed roof.

The rear porch of Aladdin cottage #40 shows a partially modified design.

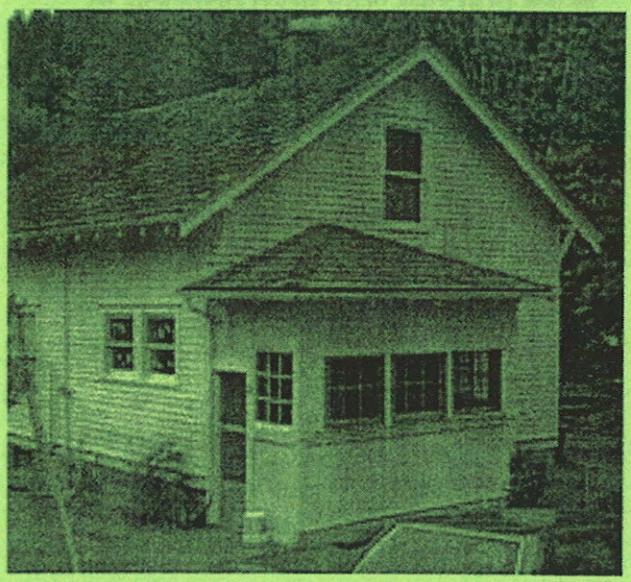
Cottage #40 has a slightly modified Aladdin porch. The top half of the porch has been enclosed with fixed six-light sash. An addition has been made to the rear, a 20 inch deep cabinet. Although altered, this porch preserves the character of the original by glazing the top half of the enclosure, keeping it visually open.



Aladdin cottage #36's rear porch extends the full house width (cook house kitchen).

Like the back porch on cottage #40, the porch on #36 is in keeping with the original, having glazing on the top half beneath a shed roof. The porch extends too far to the sides. The roof planes of the porch interrupt the roof plane of the main house block in an awkward fashion. If the porch had been made just slightly smaller, this could have been avoided.

Operations



Traditional cottage back porch with side entry and 3/3 fixed windows.

Back Porch - Traditional

Traditional cottage back porches are all of similar design with a dropped hip roof, asymetrical placement, side door, and upper half glazing. Few changes have been made to their overall form and structure. Future changes to proportion should be avoided. Many of the windows have been changed presumably for maintainance and/or function. Every attempt should be made to maintain the existing 3/3 fixed wood frame windows.

WINDOWS

Original specs for Aladdin Homes, circa 1929:
Windows and Hardware Included in Kit
Metal Flashing for heads of all Windows
Paints and Varnishes

Character Defining Features:
1:1 Single-Hung Windows
Traditional
Crown Molding above Windows (exterior)

Typical in 2001:
A variety of dimensions of 1:1 single-hung wood window sash are hung with weights. Basement windows casements were set into the framework of the foundation before the concrete was poured; many of the glass lights are broken. Back porch windows are mostly wood sash, with fixed lights. On the traditional cottages, a crown mold exists above the windows.

Special Cases:
Storm Hooks are found on ALL cottages, EXCEPT 3, 6, 36, 37, 39
Plastic Storm windows are found on cottage 39, attached with screws
Plastic insulating sheets were attached to windows on cottages 8 & 9
Metal Screens are found on cottages 2, 4, 5, 8, 42, 44
Wood Screens are found on cottages 38 (2), and 41 (kitchen window), as well as several stored inside cottage 6

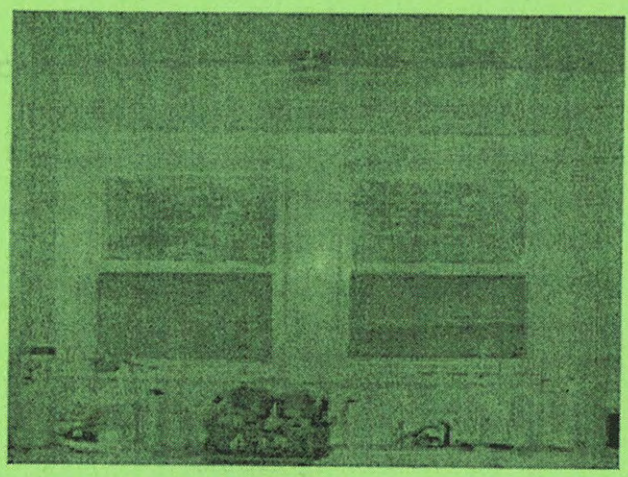
Condition:
Most windows seem to be in good condition. Many have been painted shut or nailed shut. In these cases, usually the hardware is missing. The glass is fully intact in most of the windows, but the glazing putty needs to be replaced. In general, the wood of the sash and sill are intact, but the paint seal is questionable. Plastic storm seals on some houses could be causing moisture-related damage. Original wood storms and screens are, in most cases, missing. In some cases, aluminum storms or screens have been used as replacements.

In this Section:
Sash
Glazing
Paint
Weatherization
Brief #9: The Repair of Historic Wooden Windows

See also:
Paint
Interior Finishes – Trim
Brief #3: Conserving Energy in Historic Buildings, in appendix

Operations

An Aladdin side window shows use of storm clips to hold a screen.



Interior view of kitchen windows in a Traditional cottage (#2).

Windows

All windows should be maintained in an operable state. Windows should be cleaned and checked for operability annally.

Frame

Interior wood frames should be kept painted to protect from damage, or returned to their original varnished state. For instructions on refinishing, see Rehabilitation.
Exterior frames should be kept painted.

Sash

Wood should be kept painted to protect from damage. For repair or replacement instructions, see Rehabilitation.

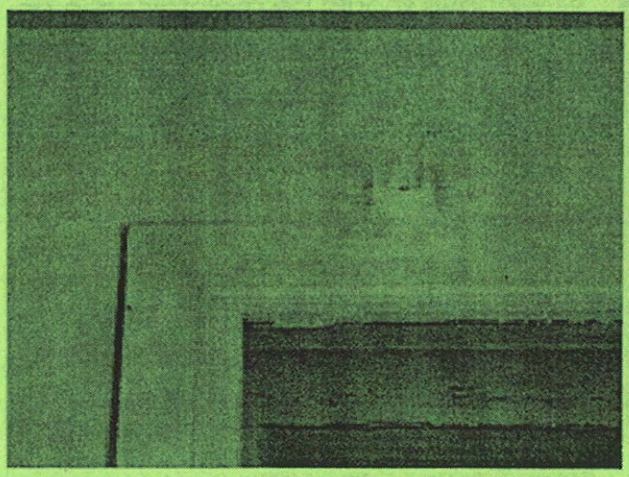
Glazing

Chipped or cracked glazing compound compromises the weather seal and safety of a window pane. Reglaze windows if damaged. See Rehabilitation for instructions.

Paint

For paint details, see Paint section.

Operations



A storm clip in action, holding a wooden storm window.

Weatherization/Energy Efficiency

All information in this section is taken from Preservation Brief #3, "Conserving Energy in Historic Buildings."

Weather stripping options should be considered. Soft-pile weather stripping is recommended where lead paint is present, to prevent airborne lead dust. Weather stripping should be non-intrusive and mostly invisible, damaging neither the visual nor actual fabric. Do not caulk or seal windows from inside, as that will interfere with breathability.

For energy efficiency, window sash should be made operable. The most significant increase in efficiency and comfort would be to re-create a storm window/screen system. Adding a storm window will double the R-factor by decreasing air infiltration.

Interior storm "windows" (usually plastic attached to a frame) are not recommended, as they can trap moisture against the window sash and cause deterioration.

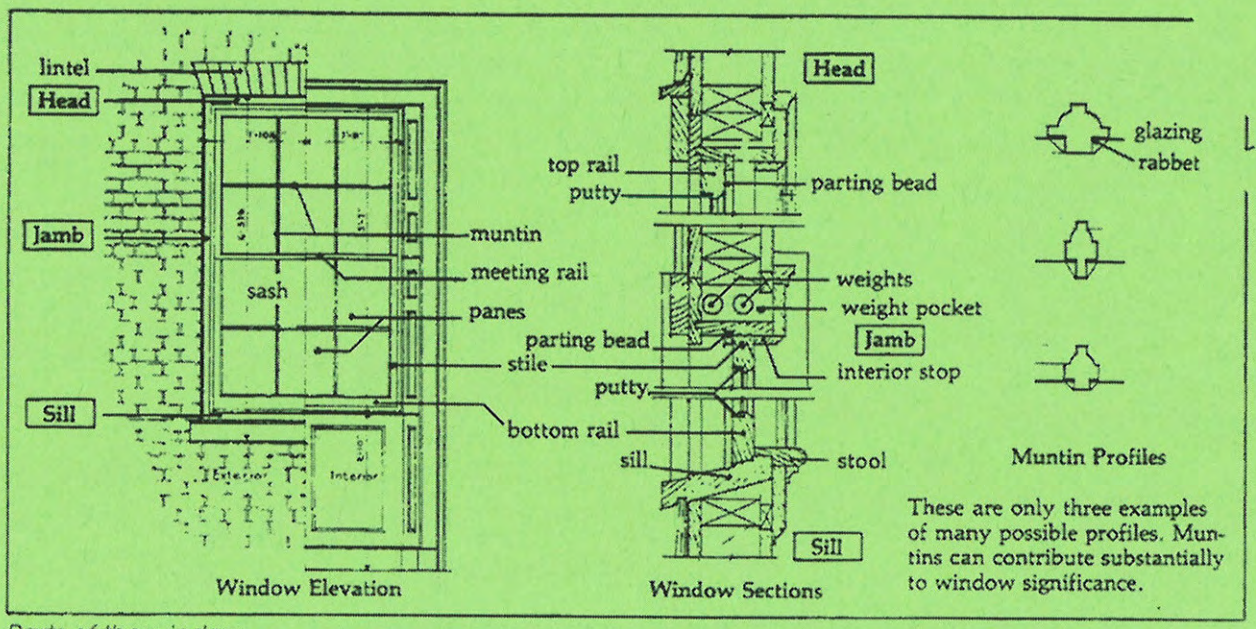
Operations

Hardware

Securely locking hardware should be installed where missing and maintained where existing. Nails should not be used. Hardware should NOT be painted. Where paint has covered the hardware and inhibits use, it should be removed in the gentlest possible way to prevent damage.

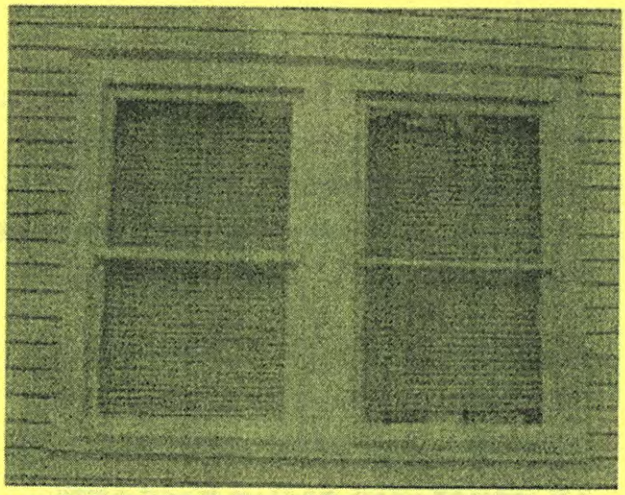
Treatments (curtains, blinds, etc.)

Hardware for window treatments should be installed either outside the frame (into the plaster wall) or inside the frame to minimize damage to interior trim work. Thermal blinds are recommended for energy efficiency and tenant comfort, but any window treatment will reduce air infiltration and add to the comfort of the cottage.

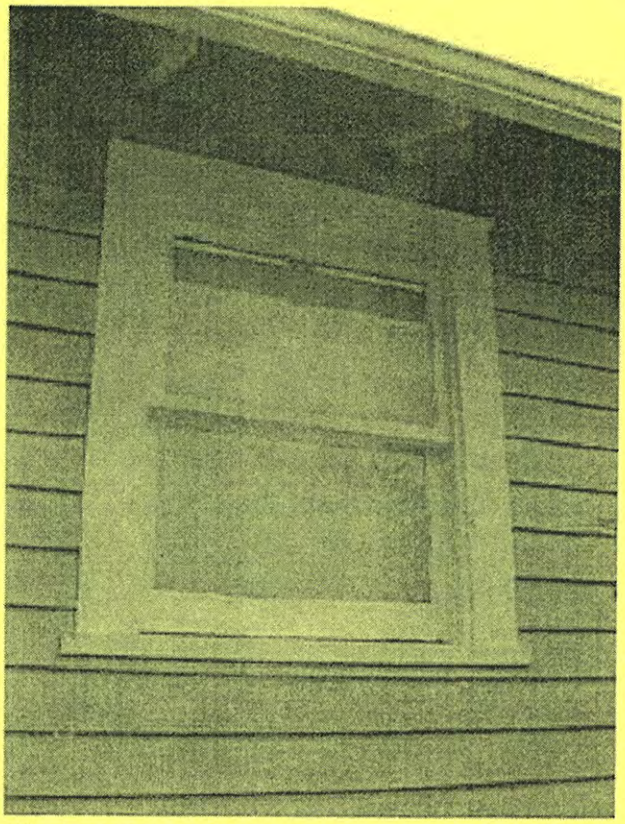


Parts of the window

Rehabilitation



Pair of windows on a Traditional cottage; 1/1 double hung.



Window on an Aladdin cottage; 1/1 single hung.

Windows

The appearance and functionality of windows is integral to the character of a building. Windows can almost always be rehabilitated and re-used. Due to the fact that the windows are wood, replacement parts can be made easily. The windows are an important aspect to the ventilation of the house, so their proper function will make residing in the house more amenable.

Storms and Screens

It is recommended that storm windows and screens, preferrably of wood, as is thought to be historically correct, be used on the houses.

When possible locate and install original storms and screens. In cases where storms and screens are not found new wood ones should be purchased or fabricated. The screen material should be light gray in color and of metal or vinyl.

The hardware for storm and screen installation should NOT be removed.

If aluminum stroms or screens must be used, it is recommended that they be installed with this original hardware. In no case should storm screens be screwed into the frame of the window.

Sash

If a window has deteriorated beyond repair, it should be replaced in kind. Otherwise, it should be repaired. Use Preservation Brief #9, Repair of Historic Wooden Windows to determine the level of repair needed, as well. This brief can

be found at the end of this section.

Sash Cord

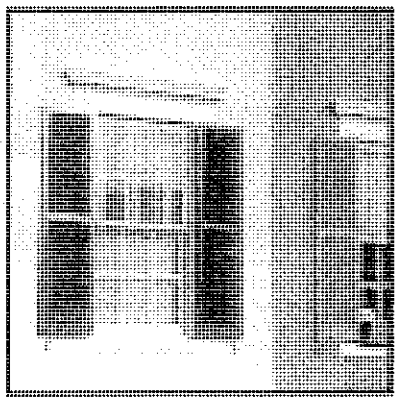
Windows need to be rendered operable. Where sash cord needs to be replaced, an appropriate historical material and diameter should be determined and used consistently.

Lites/Panes

Broken panes should be replaced with glass containing similar characteristics of the original glass, such as single sheet, non-reflective.

9 Preservation Briefs
Technical Preservation Services
HPS
National Park Service

The Repair of Historic Wooden Windows



John H. Myers

»Architectural or Historical Significance
»Physical Evaluation
»Repair Class I: Routine Maintenance
»Repair Class II: Stabilization
»Repair Class III: Splices and Parts Replacement
»Weatherization
»Window Replacement
»Conclusion
»Additional Reading

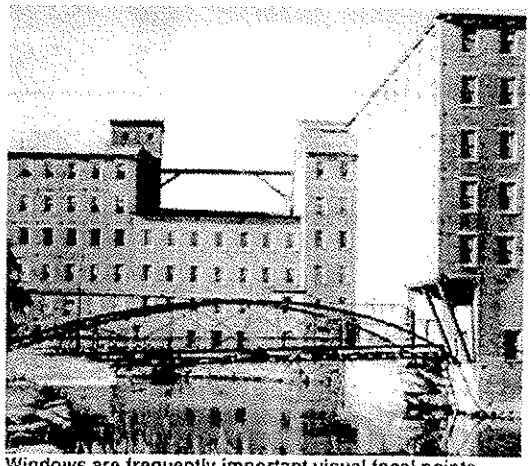
The windows on many historic buildings are an important aspect of the architectural character of those buildings. Their design, craftsmanship, or other qualities may make them worthy of preservation. This is self-evident for ornamental windows, but it can be equally true for warehouses or factories where the windows may be the most dominant visual element of an otherwise plain building. Evaluating the significance of these windows and planning for their repair or replacement can be a complex process involving both objective and subjective considerations. *The Secretary of the Interior's Standards for Rehabilitation* and the accompanying guidelines, call for respecting the significance of original materials and features, repairing and retaining them wherever possible, and when necessary, replacing them in kind. This Brief is based on the issues of significance and repair which are implicit in the standards, but the primary emphasis is on the technical issues of planning for the repair of windows including evaluation of their physical condition, techniques of repair, and design considerations when replacement is necessary.

Much of the technical section presents repair techniques as an instructional guide for the do-it-yourselfer. The information will be useful, however, for the architect, contractor, or developer on large-scale projects. It presents a methodology for approaching the evaluation and repair of existing windows, and considerations for replacement, from which the professional can develop alternatives and specify appropriate materials and procedures.

Architectural or Historical Significance

Evaluating the architectural or historical significance of windows is the first step in planning for window treatments, and a general understanding of the function and history of windows is vital to making a proper evaluation. As a part of this evaluation, one must consider four basic window functions: admitting light to the interior spaces, providing fresh air and ventilation to the interior, providing a visual link to the outside world, and enhancing the appearance of a building. No single factor can be disregarded when planning window treatments; for example, attempting to conserve energy by closing up or reducing the size of window openings may result in the use of *more* energy by increasing electric lighting loads and decreasing passive solar heat gains.

Historically, the first windows in early American houses were casement windows; that is, they were



Windows are frequently important visual focal points, especially on simple facades such as this mill building. Replacement of the multi-pane windows with larger panes could dramatically alter the appearance of the building. Photo: NPS files.

hinged at the side and opened outward. In the beginning of the eighteenth century single- and double-hung windows were introduced. Subsequently many styles of these vertical sliding sash windows have come to be associated with specific building periods or architectural styles, and this is an important consideration in determining the significance of windows, especially on a local or regional basis. Site-specific, regionally oriented architectural comparisons should be made to determine the significance of windows in question. Although such comparisons may focus on specific window types and their details, the ultimate determination of significance should be made within the context of the whole building, wherein the windows are one architectural element.

After all of the factors have been evaluated, **windows should be considered significant to a building if they: 1)** are original, **2)** reflect the original design intent for the building, **3)** reflect period or regional styles or building practices, **4)** reflect changes to the building resulting from major periods or events, or **5)** are examples of exceptional craftsmanship or design. Once this evaluation of significance has been completed, it is possible to proceed with planning appropriate treatments, beginning with an investigation of the physical condition of the windows.

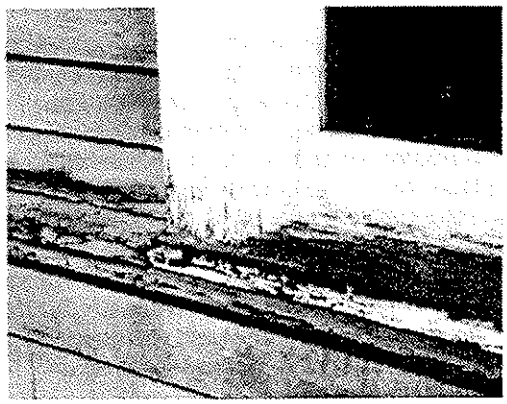
Physical Evaluation

The key to successful planning for window treatments is a careful evaluation of existing physical conditions on a unit-by-unit basis. A graphic or photographic system may be devised to record existing conditions and illustrate the scope of any necessary repairs. Another effective tool is a window schedule which lists all of the parts of each window unit. Spaces by each part allow notes on existing conditions and repair instructions. When such a schedule is completed, it indicates the precise tasks to be performed in the repair of each unit and becomes a part of the specifications. In any evaluation, one should note at a minimum:

- **1)** window location
- **2)** condition of the paint
- **3)** condition of the frame and sill
- **4)** condition of the sash (rails, stiles and muntins)
- **5)** glazing problems
- **6)** hardware, and
- **7)** the overall condition of the window (excellent, fair, poor, and so forth)

Many factors such as poor design, moisture, vandalism, insect attack, and lack of maintenance can contribute to window deterioration, but moisture is the primary contributing factor in wooden window decay. All window units should be inspected to see if water is entering around the edges of the frame and, if so, the joints or seams should be caulked to eliminate this danger. The glazing putty should be checked for cracked, loose, or missing sections which allow water to saturate the wood, especially at the joints. The back putty on the interior side of the pane should also be inspected, because it creates a seal which prevents condensation from running down into the joinery. The sill should be examined to insure that it slopes downward away from the building and allows water to drain off. In addition, it may be advisable to cut a dripline along the underside of the sill. This almost invisible treatment will insure proper water runoff, particularly if the bottom of the sill is flat. Any conditions, including poor original design, which permit water to come in contact with the wood or to puddle on the sill must be corrected as they contribute to deterioration of the window.

One clue to the location of areas of excessive moisture is the condition of the paint; therefore, each window should be examined for areas of paint failure. Since excessive moisture is detrimental to the paint bond, areas of paint blistering, cracking, flaking, and peeling usually identify points of water penetration, moisture saturation, and potential deterioration. Failure of the paint should not, however, be mistakenly interpreted as a sign that the wood is in poor condition and hence, irreparable. Wood is frequently in sound physical condition beneath unsightly paint. After noting areas of paint failure, the next step is to inspect the condition of the wood, particularly at the points identified during the paint examination.



Deterioration of poorly maintained windows usually begins on horizontal surfaces and at joints, where water can collect and saturate the wood. Photo: NPS files.

Each window should be examined for operational soundness beginning with the lower portions of the frame and sash. Exterior rainwater and interior condensation can flow downward along the window, entering and collecting at points where the flow is blocked. The sill, joints between the sill and jamb, corners of the bottom rails and muntin joints are typical points where water collects and deterioration begins. The operation of the window (continuous opening and closing over the years and seasonal temperature changes) weakens the joints, causing movement and slight separation. This process makes the joints more vulnerable to water which is readily absorbed into the endgrain of the wood. If severe deterioration exists in these areas, it will usually be apparent on visual inspection, but other less severely deteriorated areas of the wood may be tested by two traditional methods using a small ice pick.

An ice pick or an awl may be used to test wood for soundness. The technique is simply to jab the pick into a wetted wood surface at an angle and pry up a small section of the wood. Sound wood will separate in long fibrous splinters, but decayed wood will lift up in short irregular pieces due to the breakdown of fiber strength.

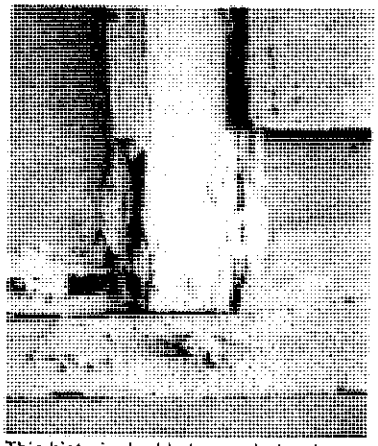
Another method of testing for soundness consists of pushing a sharp object into the wood, perpendicular to the surface. If deterioration has begun from the hidden side of a member and the core is badly decayed, the visible surface may appear to be sound wood. Pressure on the probe can force it through an apparently sound skin to penetrate deeply into decayed wood. This technique is especially useful for checking sills where visual access to the underside is restricted.

Following the inspection and analysis of the results, the scope of the necessary repairs will be evident and a plan for the rehabilitation can be formulated. Generally the actions necessary to return a window to "like new" condition will fall into three broad categories: ***1) routine maintenance procedures***, ***2) structural stabilization***, and ***3) parts replacement***. These categories will be discussed in the following sections and will be referred to respectively as **Repair Class I**, **Repair Class II**, and **Repair Class III.** Each successive repair class represents an increasing level of difficulty, expense, and work time. Note that most of the points mentioned in Repair Class I are routine maintenance items and should be provided in a regular maintenance program for any building. The neglect of these routine items can contribute to many common window problems.

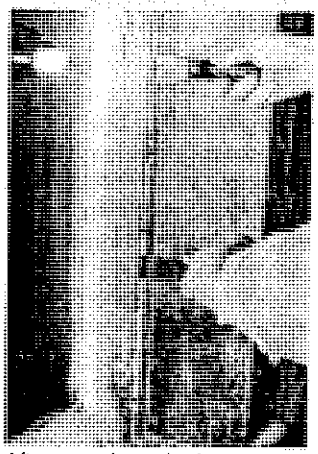
Before undertaking any of the repairs mentioned in the following sections all sources of moisture penetration should be identified and eliminated, and all existing decay fungi destroyed in order to arrest the deterioration process. Many commercially available fungicides and wood preservatives are toxic, so it is extremely important to follow the manufacturer's recommendations for application, and store all chemical materials away from children and animals. After fungicidal and preservative treatment the windows may be stabilized, retained, and restored with every expectation for a long service life.

Repair Class I: Routine Maintenance

Repairs to wooden windows are usually labor intensive and relatively uncomplicated. On small scale projects this allows the do-it-yourselfer to save money by repairing all or part of the windows. On larger projects it presents the opportunity for time and money which might otherwise be spent on the removal and replacement of existing windows, to be spent on repairs, subsequently saving all or part of the material cost of new window units. Regardless of the actual costs, or who performs the work, the evaluation process described earlier will provide the knowledge from which to specify an appropriate work program, establish the work element priorities, and identify the level of skill needed by the labor force.



This historic double-hung window has many layers of paint, some cracked and missing putty, slight separation at the joints, broken sash cords, and one cracked pane. Photo: NPS files.

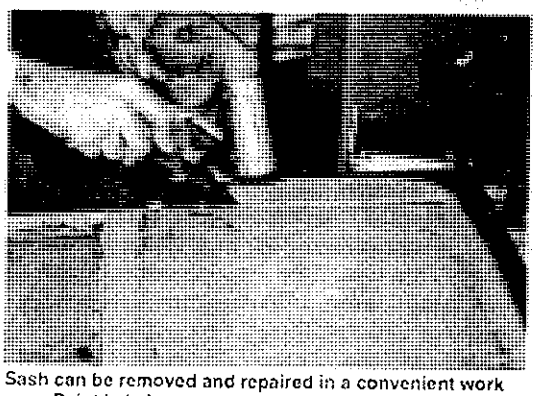


After removing paint from the seam between the interior stop and the jamb, the stop can be pried out and gradually worked loose using a pair of putty knives as shown. Photo: NPS files.

The routine maintenance required to upgrade a window to "like new" condition normally includes the following steps: 1) some degree of interior and exterior paint removal, 2) removal and repair of sash (including reglazing where necessary), 3) repairs to the frame, 4) weatherstripping and reinstallation of the sash, and 5) repainting. These operations are illustrated for a typical double-hung wooden window, but they may be adapted to other window types and styles as applicable.

Historic windows have usually acquired many layers of paint over time. Removal of excess layers or peeling and flaking paint will facilitate operation of the window and restore the clarity of the original detailing. Some degree of paint removal is also necessary as a first step in the proper surface preparation for subsequent refinishing (if paint color analysis is desired, it should be conducted prior to the onset of the paint removal). There are several safe and effective techniques for removing paint from wood, depending on the amount of paint to be removed.

Paint removal should begin on the interior frames, being careful to remove the paint from the interior stop and the parting bead, particularly along the seam where these stops meet the jamb. This can be accomplished by running a utility knife along the length of the seam, breaking the paint bond. It will then be much easier to remove the stop, the parting bead and the sash. The interior stop may be initially loosened from the sash side to avoid visible scarring of the wood and then gradually pried loose using a pair of putty knives, working up and down the stop in small increments. With the stop removed, the lower or interior sash may be withdrawn. The sash cords should be detached from the sides of the sash and their ends may be pinned with a nail or tied in a knot to prevent them from falling into the weight pocket.



Sash can be removed and repaired in a convenient work area. Paint is being removed from this sash with a hot air gun. Photo: NPS files.

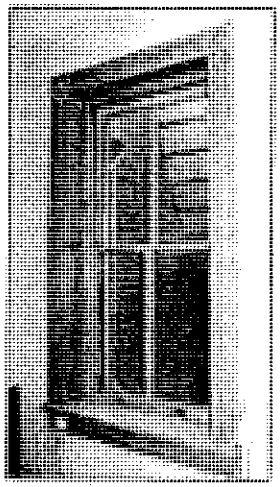
Removal of the upper sash on double-hung units is similar but the parting bead which holds it in place is set into a groove in the center of the stile and is thinner and more delicate than the interior stop. After removing any paint along the seam, the parting bead should be carefully pried out and worked free in the same manner as the interior stop. The upper sash can be removed in the same manner as the lower one and both sash taken to a convenient work area (in order to remove the sash the interior stop and parting bead need only be removed from one side of the

window). Window openings can be covered with polyethylene sheets or plywood sheathing while the sash are out for repair.

The sash can be stripped of paint using appropriate techniques, but if any heat treatment is used, the glass should be removed or protected from the sudden temperature change which can cause breakage. An overlay of aluminum foil on gypsum board or asbestos can protect the glass from such rapid temperature change. It is important to protect the glass because it may be historic and often adds character to the window. Deteriorated putty should be removed manually, taking care not to damage the wood along the rabbet. If the glass is to be removed, the glazing points which hold the glass in place can be extracted and the panes numbered and removed for cleaning and reuse in the same openings. With the glass panes out, the remaining putty can be removed and the sash can be sanded, patched, and primed with a preservative primer. Hardened putty in the rabbets may be softened by heating with a soldering iron at the point of removal. Putty remaining on the glass may be softened by soaking the panes in linseed oil, and then removed with less risk of breaking the glass. Before reinstalling the glass, a bead of glazing compound or linseed oil putty should be laid around the rabbet to cushion and seal the glass. Glazing compound should only be used on wood which has been brushed with linseed oil and primed with an oil based primer or paint. The pane is then pressed into place and the glazing points are pushed into the wood around the perimeter of the pane.

The final glazing compound or putty is applied and beveled to complete the seal. The sash can be refinished as desired on the inside and painted on the outside as soon as a "skin" has formed on the putty, usually in 2 or 3 days. Exterior paint should cover the beveled glazing compound or putty and lap over onto the glass slightly to complete a weather-tight seal. After the proper curing times have elapsed for paint and putty, the sash will be ready for reinstallation.

While the sash are out of the frame, the condition of the wood in the jamb and sill can be evaluated. Repair and refinishing of the frame may proceed concurrently with repairs to the sash, taking advantage of the curing times for the paints and putty used on the sash. One of the most common work items is the replacement of the sash cords with new rope cords or with chains. The weight pocket is frequently accessible through a door on the face of the frame near the sill, but if no door exists, the trim on the interior face may be removed for access. Sash weights may be increased for easier window operation by elderly or handicapped persons. Additional repairs to the frame and sash may include consolidation or replacement of deteriorated wood. Techniques for these repairs are discussed in the following sections.



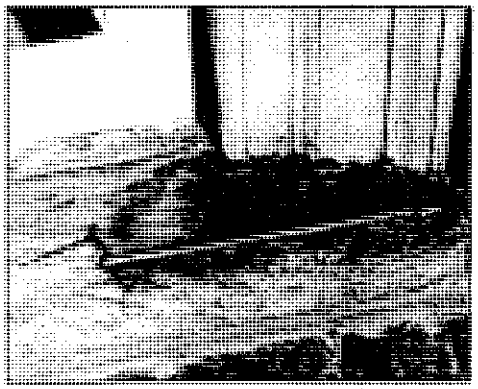
Following the relatively simple repairs, the window is weathertight, like new in appearance, and serviceable for many years to come.Photo: NPS files.

The operations just discussed summarize the efforts necessary to restore a window with minor deterioration to "like new" condition. The techniques can be applied by an unskilled person with minimal training and experience. To demonstrate the practicality of this approach, and photograph it, a Technical Preservation Services staff member repaired a wooden double-hung, two over two window which had been in service over ninety years. The wood was structurally sound but the window had one broken pane, many layers of paint, broken sash cords and inadequate, worn-out weatherstripping. The staff member found that the frame could be stripped of paint and the sash removed quite easily. Paint, putty and glass removal required about one hour for each sash, and the reglazing of both sash was accomplished in about one hour. Weatherstripping of the sash and frame, replacement of the sash cords and reinstallation of the sash, parting bead, and stop required an hour and a half. These times refer only to individual operations; the entire process took several days due to the drying and curing times for putty, primer, and paint, however, work on other window units could have been in progress during these lag times.

Repair Class II: Stabilization

The preceding description of a window repair job focused on a unit which was operationally sound. Many windows will show some additional degree of physical deterioration, especially in the vulnerable areas mentioned earlier, but even badly damaged windows can be repaired using simple processes. Partially decayed wood can be waterproofed, patched, built-up, or consolidated and then painted to achieve a sound condition, good appearance, and greatly extended life. Three techniques for repairing partially decayed or weathered wood are discussed in this section, and all three can be accomplished using products available at most hardware stores.

One established technique for repairing wood which is split, checked or shows signs of rot, is to: **1)** dry the wood, **2)** treat decayed areas with a fungicide, **3)** waterproof with two or three applications of boiled linseed oil (applications every 24 hours), **4)** fill cracks and holes with putty, and **5)** after a "skin" forms on the putty, paint the surface. Care should be taken with the use of fungicide which is toxic. Follow the manufacturers' directions and use only on areas which will be painted. When using any technique of building up or patching a flat surface, the finished surface should be sloped slightly to carry water away from the window and not allow it to puddle. Caulking of the joints between the sill and the jamb will help reduce further water penetration.



This illustrates a two-part expoxy patching compound used to fill the surface of a weathered sill and rebuild the missing edge. When the epoxy cures, it can be sanded smooth and painted to achieve a durable and waterproof repair. Photo: NPS files.

When sills or other members exhibit surface weathering they may also be built-up using wood putties or homemade mixtures such as sawdust and resorcinol glue, or whiting and varnish. These mixtures can be built up in successive layers, then sanded, primed, and painted. The same caution about proper slope for flat surfaces applies to this technique.

Wood may also be strengthened and stabilized by consolidation, using semirigid epoxies which saturate the porous decayed wood and then harden. The surface of the consolidated wood can then be filled with a semirigid epoxy patching compound, sanded and painted. Epoxy patching compounds can be used to build up missing sections or decayed ends of members. Profiles can be duplicated using hand molds, which are created by pressing a ball of patching compound over a sound section of the profile which has been rubbed with butcher's wax. This can be a very efficient technique where there are many typical repairs to be done. The process has been widely used and proven in marine applications; and proprietary products are available at hardware and marine supply stores. Although epoxy materials may be comparatively expensive, they hold the promise of being among the most durable and long lasting materials available for wood repair. More information on epoxies can be found in the publication "Epoxies for Wood Repairs in Historic Buildings," cited in the bibliography.

Any of the three techniques discussed can stabilize and restore the appearance of the window unit. There are times, however, when the degree of deterioration is so advanced that stabilization is impractical, and the only way to retain some of the original fabric is to replace damaged parts.

Repair Class III: Splices and Parts Replacement

When parts of the frame or sash are so badly deteriorated that they cannot be stabilized there are methods which permit the retention of some of the existing or original fabric. These methods involve replacing the deteriorated parts with new matching pieces, or splicing new wood into existing members. The techniques require more skill and are more expensive than any of the previously discussed alternatives. It is necessary to remove the sash and/or the affected parts of the frame and have a carpenter or woodworking mill reproduce the damaged or missing parts. Most millwork firms can duplicate parts, such as muntins, bottom rails, or sills, which can then be incorporated into the existing window, but it may be necessary to shop around because there are several factors controlling the practicality of this approach. Some woodworking mills do not like to

repair old sash because nails or other foreign objects in the sash can damage expensive knives (which cost far more than their profits on small repair jobs); others do not have cutting knives to duplicate muntin profiles. Some firms prefer to concentrate on larger jobs with more profit potential, and some may not have a craftsman who can duplicate the parts. A little searching should locate a firm which will do the job, and at a reasonable price. If such a firm does not exist locally, there are firms which undertake this kind of repair and ship nationwide. It is possible, however, for the advanced do-it-yourselfer or craftsman with a table saw to duplicate moulding profiles using techniques discussed by Gordie Whittington in "Simplified Methods for Reproducing Wood Mouldings," *Bulletin* of the Association for Preservation Technology, Vol. III, No. 4, 1971, or illustrated more recently in *The Old House*, Time-Life Books, Alexandria, Virginia, 1979.

The repairs discussed in this section involve window frames which may be in very deteriorated condition, possibly requiring removal; therefore, caution is in order. The actual construction of wooden window frames and sash is not complicated. Pegged mortise and tenon units can be disassembled easily, if the units are out of the building. The installation or connection of some frames to the surrounding structure, especially masonry walls, can complicate the work immeasurably, and may even require dismantling of the wall. It may be useful, therefore, to take the following approach to frame repair: **1)** conduct regular maintenance of sound frames to achieve the longest life possible, **2)** make necessary repairs in place, wherever possible, using stabilization and splicing techniques, and **3)** if removal is necessary, thoroughly investigate the structural detailing and seek appropriate professional consultation.

Another alternative may be considered if parts replacement is required, and that is sash replacement. If extensive replacement of parts is necessary and the job becomes prohibitively expensive it may be more practical to purchase new sash which can be installed into the existing frames. Such sash are available as exact custom reproductions, reasonable facsimiles (custom windows with similar profiles), and contemporary wooden sash which are similar in appearance. There are companies which still manufacture high quality wooden sash which would duplicate most historic sash. A few calls to local building suppliers may provide a source of appropriate replacement sash, but if not, check with local historical associations, the state historic preservation office, or preservation related magazines and supply catalogs for information.

If a rehabilitation project has a large number of windows such as a commercial building or an industrial complex, there may be less of a problem arriving at a solution. Once the evaluation of the windows is completed and the scope of the work is known, there may be a potential economy of scale. Woodworking mills may be interested in the work from a large project; new sash in volume may be considerably less expensive per unit; crews can be assembled and trained on site to perform all of the window repairs; and a few extensive repairs can be absorbed (without undue burden) into the total budget for a large number of sound windows. While it may be expensive for the average historic home owner to pay seventy dollars or more for a mill to grind a custom knife to duplicate four or five bad muntins, that cost becomes negligible on large commercial projects which may have several hundred windows.

Most windows should not require the extensive repairs discussed in this section. The ones which do are usually in buildings which have been abandoned for long periods or have totally lacked maintenance for years. It is necessary to thoroughly investigate the alternatives for windows which do require extensive repairs to arrive at a solution which retains historic significance and is also economically feasible. Even for projects requiring repairs identified in this section, if the percentage of parts replacement per window is low, or the number of windows requiring repair is small, repair can still be a cost effective solution.

Weatherization

A window which is repaired should be made as energy efficient as possible by the use of appropriate weatherstripping to reduce air infiltration. A wide variety of products are available to assist in this task. Felt may be fastened to the top, bottom, and meeting rails, but may have the disadvantage of absorbing and holding moisture, particularly at the bottom rail. Rolled vinyl strips

may also be tacked into place in appropriate locations to reduce infiltration. Metal strips or new plastic spring strips may be used on the rails and, if space permits, in the channels between the sash and jamb. Weatherstripping is a historic treatment, but old weatherstripping (felt) is not likely to perform very satisfactorily. Appropriate contemporary weatherstripping should be considered an integral part of the repair process for windows. The use of sash locks installed on the meeting rail will insure that the sash are kept tightly closed so that the weatherstripping will function more effectively to reduce infiltration. Although such locks will not always be historically accurate, they will usually be viewed as an acceptable contemporary modification in the interest of improved thermal performance.

Many styles of storm windows are available to improve the thermal performance of existing windows. The use of exterior storm windows should be investigated whenever feasible because they are thermally efficient, cost-effective, reversible, and allow the retention of original windows (see "Preservation Briefs: 3"). Storm window frames may be made of wood, aluminum, vinyl, or plastic; however, the use of unfinished aluminum storms should be avoided. The visual impact of storms may be minimized by selecting colors which match existing trim color. Arched top storms are available for windows with special shapes. Although interior storm windows appear to offer an attractive option for achieving double glazing with minimal visual impact, the potential for damaging condensation problems must be addressed. Moisture which becomes trapped between the layers of glazing can condense on the colder, outer prime window, potentially leading to deterioration. The correct approach to using interior storms is to create a seal on the interior storm while allowing some ventilation around the prime window. In actual practice, the creation of such a durable, airtight seal is difficult.

Window Replacement

Although the retention of original or existing windows is always desirable and this Brief is intended to encourage that goal, there is a point when the condition of a window may clearly indicate replacement. The decision process for selecting replacement windows should not begin with a survey of contemporary window products which are available as replacements, but should begin with a look at the windows which are being replaced. Attempt to understand the contribution of the window(s) to the appearance of the facade including: **1)** the pattern of the openings and their size; **2)** proportions of the frame and sash; **3)** configuration of window panes; **4)** muntin profiles; **5)** type of wood; **6)** paint color; **7)** characteristics of the glass; and **8)** associated details such as arched tops, hoods, or other decorative elements. Develop an understanding of how the window reflects the period, style, or regional characteristics of the building, or represents technological development.

Armed with an awareness of the significance of the existing window, begin to search for a replacement which retains as much of the character of the historic window as possible. There are many sources of suitable new windows. Continue looking until an acceptable replacement can be found. Check building supply firms, local woodworking mills, carpenters, preservation oriented magazines, or catalogs or suppliers of old building materials, for product information. Local historical associations and state historic preservation offices may be good sources of information on products which have been used successfully in preservation projects.

Consider energy efficiency as one of the factors for replacements, but do not let it dominate the issue. Energy conservation is no excuse for the wholesale destruction of historic windows which can be made thermally efficient by historically and aesthetically acceptable means. In fact, a historic wooden window with a high quality storm window added should thermally outperform a new double-glazed metal window which does not have thermal breaks (insulation between the inner and outer frames intended to break the path of heat flow). This occurs because the wood has far better insulating value than the metal, and in addition many historic windows have high ratios of wood to glass, thus reducing the area of highest heat transfer. One measure of heat transfer is the U-value, the number of Btu's per hour transferred through a square foot of material. When comparing thermal performance, the lower the U-value the better the performance. According to ASHRAE 1977 Fundamentals, the U-values for single glazed wooden windows range from 0.88 to 0.99. The addition of a storm window should reduce these figures to a

range of 0.44 to 0.49. A non-thermal break, double-glazed metal window has a U-value of about 0.6.

Conclusion

Technical Preservation Services recommends the retention and repair of original windows whenever possible. We believe that the repair and weatherization of existing wooden windows is more practical than most people realize, and that many windows are unfortunately replaced because of a lack of awareness of techniques for evaluation, repair, and weatherization. Wooden windows which are repaired and properly maintained will have greatly extended service lives while contributing to the historic character of the building. Thus, an important element of a building's significance will have been preserved for the future.

Additional Reading

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Washington, D.C. 1981

Home page logo: Historic six-over-six windows--preserved. Photo: NPS files.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

DOORS

Originals specs for Aladdin homes, circa 1929:
All interior and exterior doors with light oak oil stain and varnish for the interiors hardware and lock sets, and metal flashing at top of exterior doors

Character Defining Features:
1/3 glazed entry door

Typical in 2001:
Exterior: 1/3 glazed, 2/3 wood panel doors, painted (Interior may have originally been varnished?)
All the traditional cottages had metal screens in the rear. Most of the Aladdins had either rear or front screens; some had both. See below for list.
Interior: painted wood panel doors showing evidence in many places of original varnish finish underneath, but darker than the light oak stain specified (see Interiors for more)

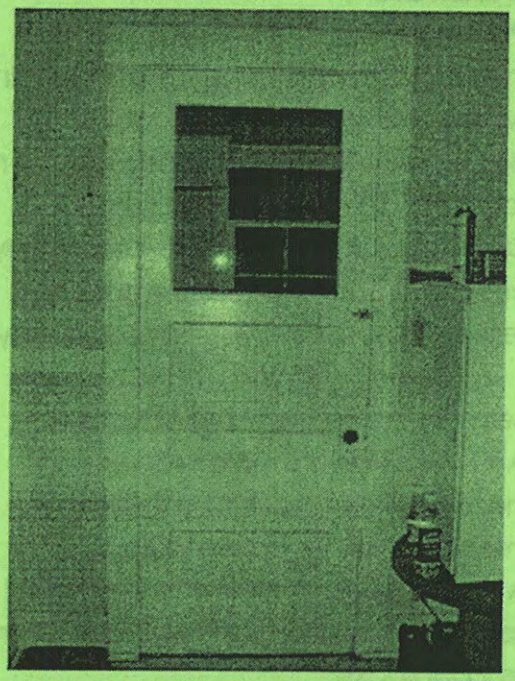
Special Cases:
Metal screens with scroll details: rear on cottages 2, 3, 5, 8
front on cottages 36, 41, 42
Metal screens, modern: rear on 4, 6, 7, 9
front on 5, 7, 8, 39, 40, 44
Wood screens: rear on 35, 38, 39, 40
Original varnished finish on the interior doors: cottage 36, bedrooms

Condition:
The doors are mostly in good condition, with few showing signs of deterioration in the wood. The glazing compound is somewhat deteriorated due to age on a majority of the doors, but not to the point that it has compromised the integrity of the door. Paint integrity is poor on most front doors. Much of the hardware has been painted or replaced with non-historic hardware.

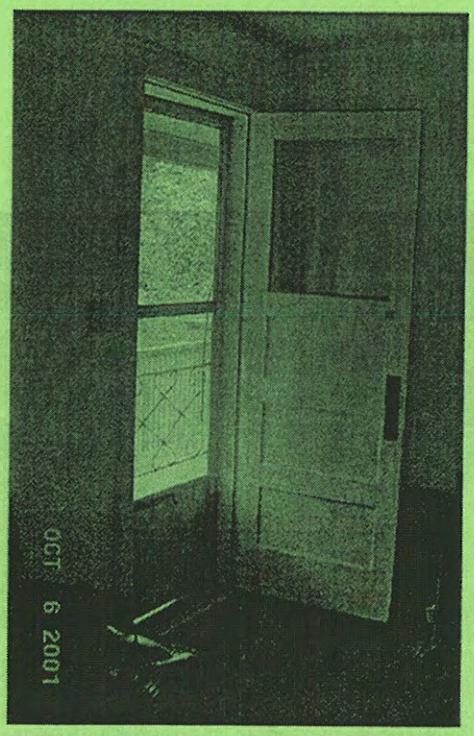
In this section:
Screens
Glazing
Paint
Weatherization

See also:
Interiors, Doors
Interior Finishes
Paint

Operations



A one-third glazed panel door separates kitchen from the back porch. The door retains its original knob hardware; the lock was added later.



A one-third glazed panel door opens intoa typical metal screen door.

Doors

Frame

Maintain paint.

Glazing

Chipped or cracked glazing compound seriously compromises the weatherseal and safety of a window pane. Glazing compound should be repaired if damaged. See Rehabilitation for instructions.

Paint

For paint details, see paint section.

Weatherization

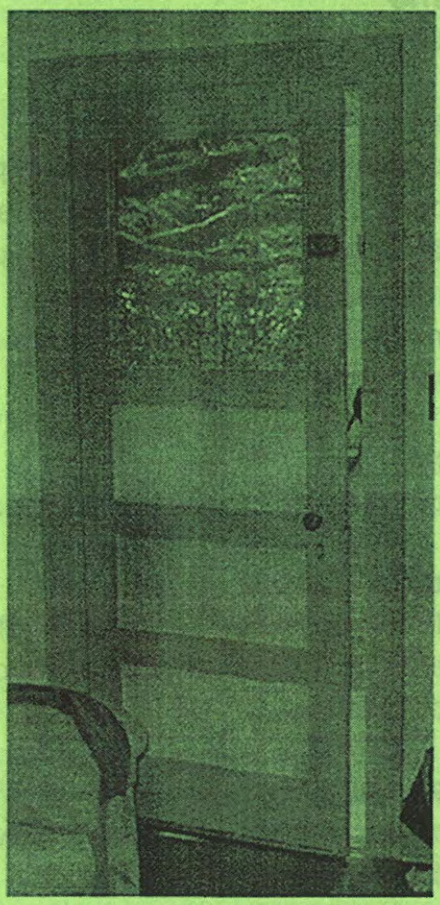
Add metal weather stripping, if not existing. This was called for in the original specifications.

Screen doors

Clean and maintain screen doors where existing.

If screen is ripped or torn, replace only the screen. Screen should be replaced in kind. If whole door must be replaced, an attempt to replace with wood screen doors would be appropriate.

Operations



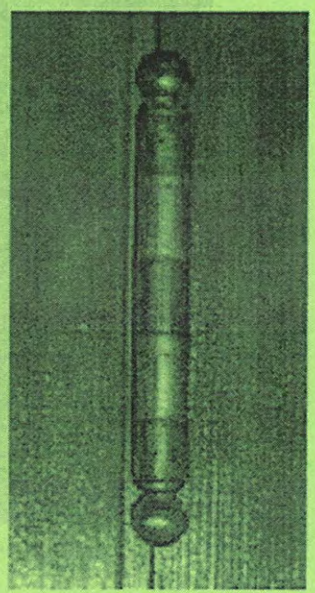
The paint on this panel front door highlights the construction.

Hardware

Proper locking hardware should be installed where missing, and maintained where existing. When replacing hardware, every attempt should be made to match the original hardware.
Do not paint hardware. Where hardware has been painted, paint should be removed in the gentlest possible way.

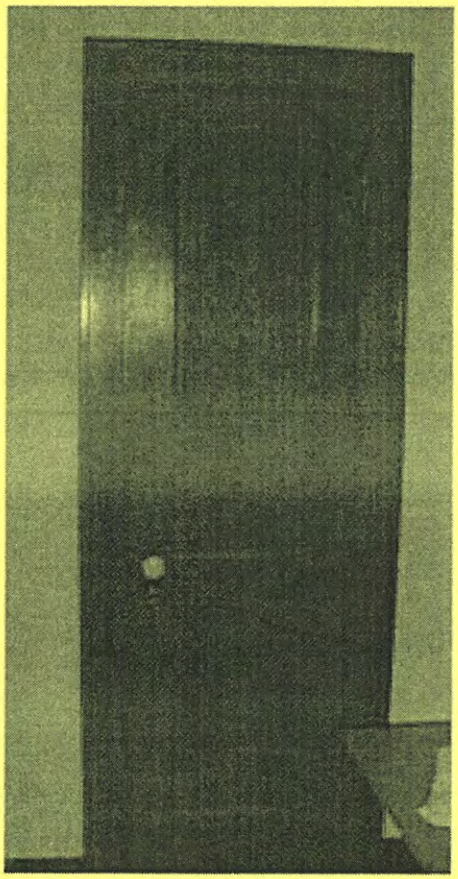
Security measures may include:
A 1" throw deadbolt offers security inexpensively and with a minimum intrusion into the historic fabric.
A break-resistant plastic panel could be used to reinforce glass on doors. Do not use padlocks.

A door knob in storage is presumed to be original.



Detail of original door knob with key lock and an original door hinge.

Rehabilitation



Aladdin interior varnished panel door.

Traditional interior door surround; painted over varnish.

Doors

There are several different styles of doors found in the houses. While the styles have subtle differences, they are all solid wood paneled and any future replacement should be in keeping with this type.

Exterior door

It is recommended that the exterior doors be maintained as wood with the upper panel glazed and the lower portion paneled. When needed, scrape and paint with two coats of oil-based primer and one coat latex finish.

Interior Door

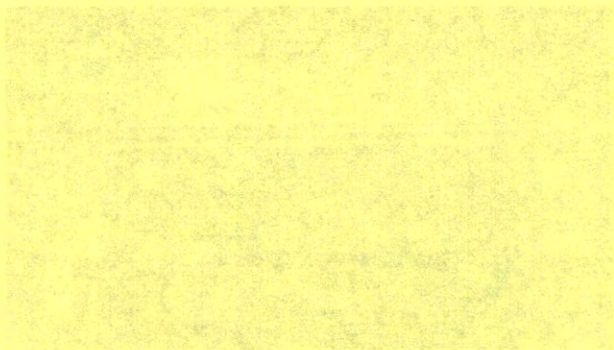
The interior doors are solid wood and multi-paneled. It is recommended that any paint be removed and original varnish finish be restored, except the bathroom and kitchen sides of the doors, which should be painted.

Exterior Trim

See paint section.

Interior trim

It is recommended that the trim in all rooms except the kitchen and bathroom be scraped removing paint and returning to original varnished finish. Paint is recommended for the trim in the bathroom and kitchen areas.
Do Not Paint Woodwork which is unpainted.



INTERIOR FINISHES

Original specs for Aladdin Homes, circa 1929:
One coat of light oak oil stain and one coat of varnish for woodwork
Two coat plaster interior, sand finished surfaces (contractor supplies plaster and sand)
Aladdin supplied all nails, paints, and enamels

Character Defining Features:
Stain and Varnish Finished Wood Trim
Painted Plaster Walls

Typical in 2001:
Painted plaster walls and ceilings. Some paint seems to have been applied over wallpaper.
Both tongue and groove hardwood flooring and carpet were noted in the building. In most, hardwood is presumably still beneath the carpet. The kitchen and bathroom floors in the cottages entered were all linoleum.

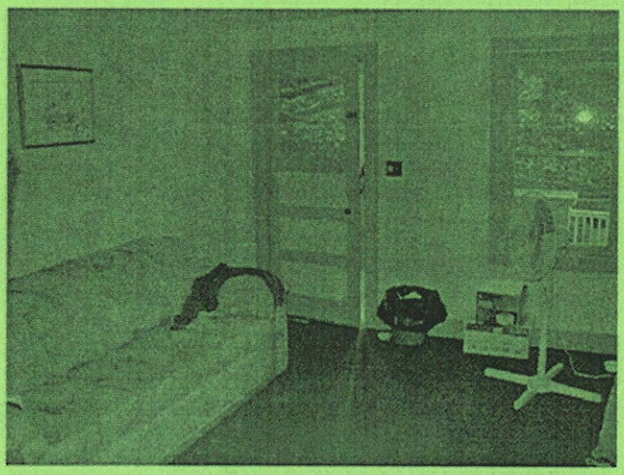
Special Cases:
The bedrooms on cottage 36 have what appears to be original varnished woodwork and doors. Some original varnished doors exist in cottage 35 as well.
In cottage # 36, the living room and dining room floors were linoleum.
Uncovered hardwood floors were noted in cottage 6, 35, 36 (bedrooms), 38, 40 (living and dining rooms)

Condition:
Most of the trimwork and doors inside the cottages has been painted.
Minimal cracking was observed in some houses, but plaster was overall in good condition. Special attention should be paid to bathroom ceilings because of possible moisture issues.

In this Section:
Millwork/Trim
Walls: Plaster/Paint
Ceilings
Floors
Selections from Brief # 18:Rehabilitation Interiors in Historic Buildings
Selections from Brief # 21: Repairing Historic Flat Plaster
Brief # 28: Painting Historic Interiors

See also:
Paint
Kitchen & Bath
Windows
Doors
Systemss

Operations



A typical Aladdin living room looks onto a shaded porch..

Cottage #36 features original, varnished closet and bedroom doors with original hardware.

Interiors

Floors

If lead paint may be an issue, floors should be wet mopped, rather than swept, as airborne lead is a hazard.
For replacement and/or refinishing instructions, see Rehabilitation.

Plaster

Keep painted. Inspect for signs of moisture problems. For repairs, see Rehabilitation.

Millwork/trim

If trim is varnished, avoid painting. If paint exists, and is in good condition, maintain it. Do not drill through or fasten objects to millwork.

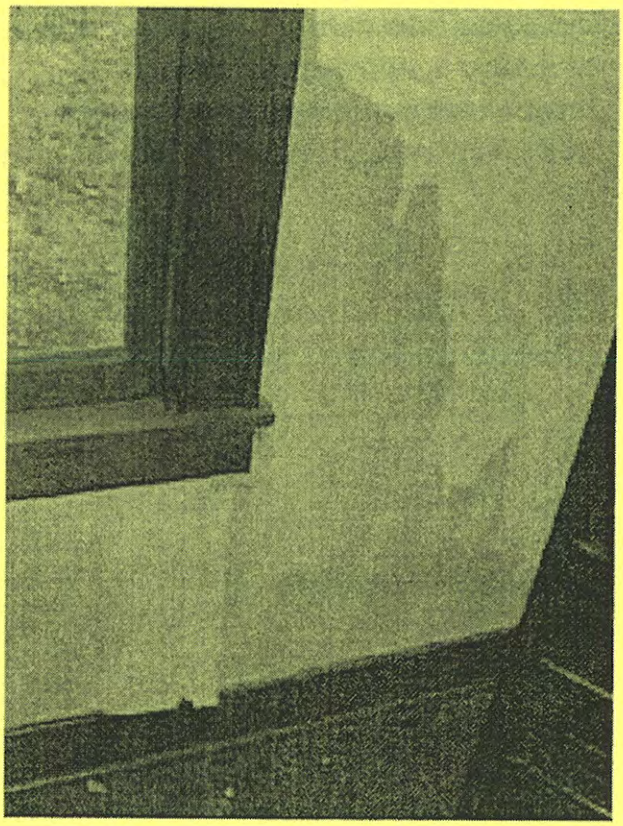
Rehabilitation

Interiors

Floors

Originally the floors were exposed wood. Over the life of the houses, many of the wood floors have been covered with wall-to-wall carpeting. One of the truly unique features of these houses is the intact wood flooring. It is recommended that wood floors be maintained in all rooms except for the kitchen and bathroom which are best suited for a vinyl floor covering or tile. The original aesthetic can be reclaimed, and daily maintenance can be minimized.

To expose the original wood floor, carpets must be removed. The floors should then be refinished. Refinishing here involves varying degrees of sanding and varnishing the floor. Use of a professional floor refinisher is recommended. Area rugs and high traffic rugs are recommended.



Deterioration of plaster wall due to water leakage through window. Window surround and floorboard are varnished.

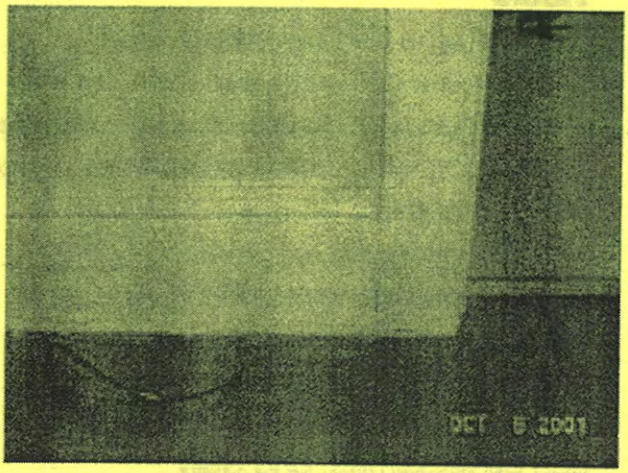
Interior walls and ceiling

The interior walls are still plaster on lath and predominantly painted. Although wall-paper is historically common, it is recommended for the longevity of the plaster that the wall finishes be limited to painting.

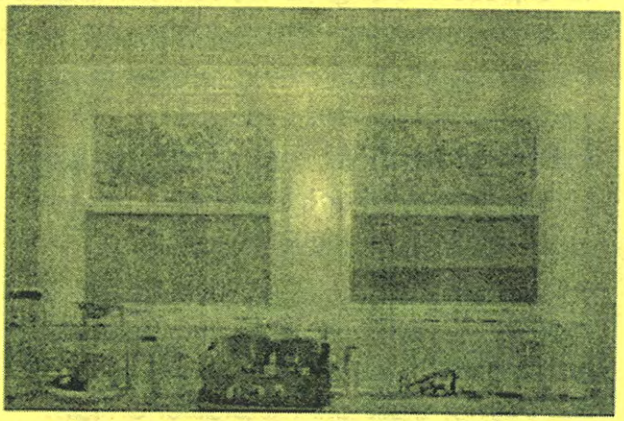
Plaster

Investigate and mitigate moisture problems. It is uncertain at the time of this report as to the exact make-up of the wall finish material. Repair of damaged sections should be of plaster mix and application matching historic laster as close as possible. nish Painting
When choosing paint for interior walls it is

Rehabilitation



Detail of Aladdin baseboard (painted) and exposed flooring; baseboard was originally varnished.



Painted kitchen windows and trim in Traditional cottage.

recommended that colors of universal appeal be used.

Baseboard

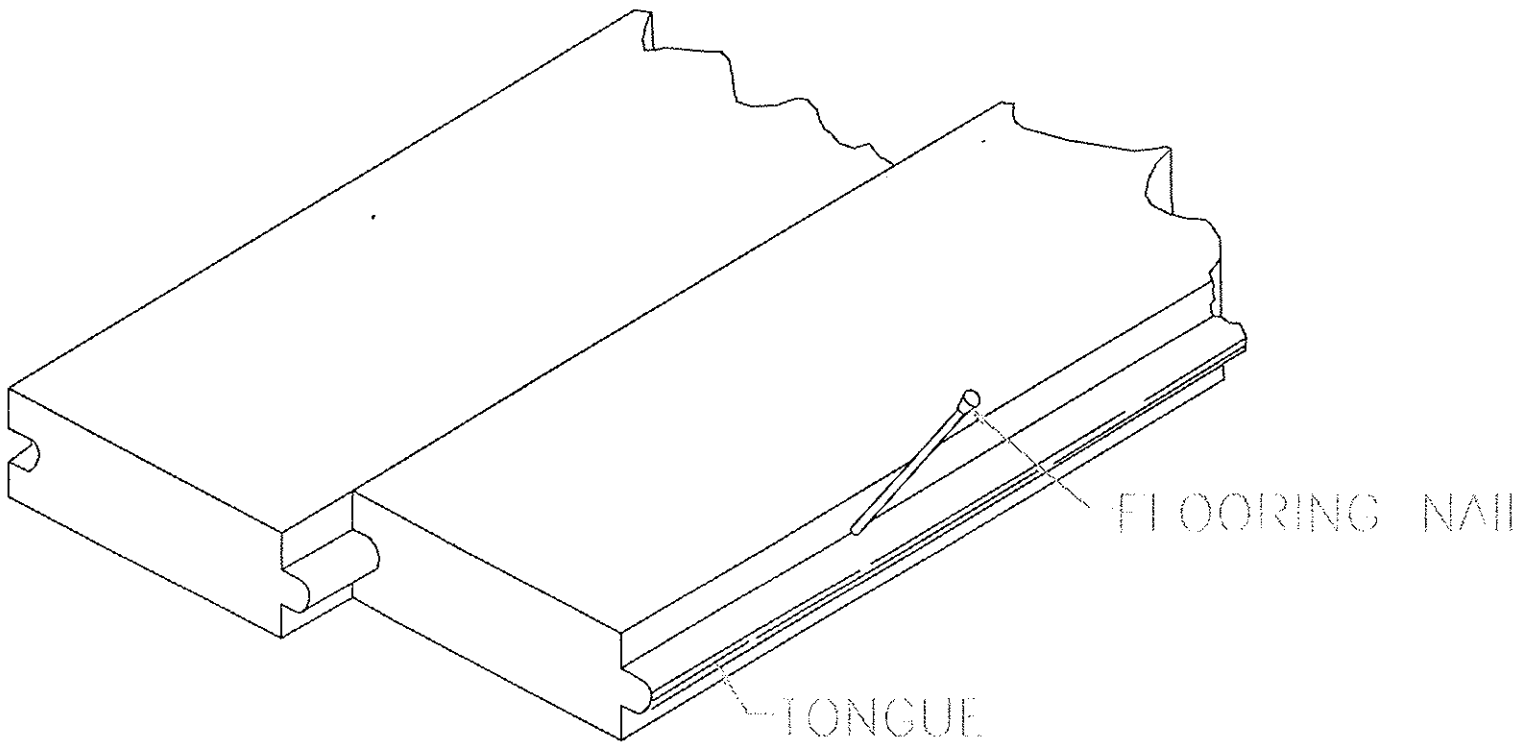
Scrape and remove paint from baseboard and return to original varnished finish in all rooms except the kitchen and bathroom. The baseboard in the kitchen and bathroom are to be painted.

Do Not Paint Woodwork which is unpainted.

Interior Window Trim

Determine standard blind, curtain or window treatment appropriate to house character in order to mitigate repeated drilling and nailing into trim. Hardware should be attached either inside the trim, or outside it, into the plaster walls.

Scrape and remove paint from windows and return trim to original varnished finish.


FLOORING NAIL
TONGUE

SELECTIONS FROM PRESERVATION BRIEF # 18: REHABILITATING INTERIORS IN HISTORIC BUILDINGS, H. Ward Jandl
www2.cr.nps.gov/tps/briefs/brief18.htm Accessed 20 February, 2002

Recommended Approaches for Rehabilitating Historic Interiors

1. Retain and preserve floor plans and interior spaces that are important in defining the overall historic character of the building. This includes the size, configuration, proportion, and relationship of rooms and corridors; the relationship of features to spaces; and the spaces themselves such as lobbies, reception halls, entrance halls, double parlors, theaters, auditoriums, and important industrial or commercial use spaces. Put service functions required by the building's new use, such as bathrooms, mechanical equipment, and office machines, in secondary spaces.

2. Avoid subdividing spaces that are characteristic of a building type or style or that are directly associated with specific persons or patterns of events. Space may be subdivided both vertically through the insertion of new partitions or horizontally through insertion of new floors or mezzanines. The insertion of new additional floors should be considered only when they will not damage or destroy the structural system or obscure, damage, or destroy character-defining spaces, features, or finishes. If rooms have already been subdivided through an earlier insensitive renovation, consider removing the partitions and restoring the room to its original proportions and size.

3. Avoid making new cuts in floors and ceilings where such cuts would change character-defining spaces and the historic configuration of such spaces.

(4. Not applicable to Three Lynx.)

5. Retain and preserve interior features and finishes that are important in defining the overall historic character of the building. This might include columns, doors, cornices, baseboards, fireplaces and mantels, paneling, light fixtures, elevator cabs, hardware, and flooring; and wallpaper, plaster, paint, and finishes such as stenciling, marbleizing, and graining; and other decorative materials that accent interior features and provide color, texture, and patterning to walls,floors, and ceilings.

6. Retain stairs in their historic configuration and to location. If a second means of egress is required, consider constructing new stairs in secondary spaces. The application of fire-retardant coatings, such as intumescent paints; the installation of fire suppression systems, such as sprinklers; and the construction of glass enclosures can in many cases permit retention of stairs and other character-defining features.

7. Retain and preserve visible features of early mechanical systems that are important in defining the overall historic character of the building, such as radiators, vents, fans, grilles, plumbing fixtures, switchplates, and lights. If new

heating, air conditioning, lighting and plumbing systems are installed, they should be done in a way that does not destroy character-defining spaces, features and finishes. Ducts, pipes, and wiring should be installed as inconspicuously as possible: in secondary spaces, in the attic or basement if possible, or in closets.

8. Avoid "furring out" perimeter walls for insulation purposes. This requires unnecessary removal of window trim and can change a room's proportions. Consider alternative means of improving thermal performance, such as installing insulation in attics and basements and adding storm windows.

9. Avoid removing paint and plaster from traditionally finished surfaces, to expose masonry and wood. Conversely, avoid painting previously unpainted millwork. Repairing deteriorated plasterwork is encouraged. If the plaster is too deteriorated to save, and the walls and ceilings are not highly ornamented, gypsum board may be an acceptable replacement material. The use of paint colors appropriate to the period of the building's construction is encouraged.

10. Avoid using destructive methods--propane and butane torches or sandblasting--to remove paint or other coatings from historic features. Avoid harsh cleaning agents that can change the appearance of wood.

Meeting Building, Life Safety and Fire Codes

Buildings undergoing rehabilitation must comply with existing building, life safety and fire codes. The application of codes to specific projects varies from building to building, and town to town. Code requirements may make some reuse proposals impractical; in other cases, only minor changes may be needed to bring the project into compliance. In some situations, it may be possible to obtain a code variance to preserve distinctive interior features. (It should be noted that the Secretary's Standards for Rehabilitation take precedence over other regulations and codes in determining whether a rehabilitation project qualifies for Federal tax benefits.) A thorough understanding of the applicable regulations and close coordination with code officials, building inspectors, and fire marshals can prevent the alteration of significant historic interiors.

SELECTIONS FROM PRESERVATION BRIEF # 21: REPAIRING HISTORIC FLAT PLASTER - WALLS AND CEILINGS, Mary Lee MacDonald
www2.cr.nps.gov/tps/briefs/brief21.htm Accessed 20 February, 2002

Common Plaster Problems

When plaster dries, it is a relatively rigid material which should last almost indefinitely. However, there are conditions that cause plaster to crack, effloresce, separate, or become detached from its lath framework. These include:

Structural Problems
Poor Workmanship
Improper Curing
Moisture

Structural Problems

Overloading. Stresses within a wall, or acting on the house as a whole, can create stress cracks. Appearing as diagonal lines in a wall, stress cracks usually start at a door or window frame, but they can appear anywhere in the wall, with seemingly random starting points.

Builders of now-historic houses had no codes to help them size the structural members of buildings. The weight of the roof, the second and third stories, the furniture, and the occupants could impose a heavy burden on beams, joists, and studs. Even when houses were built properly, later remodeling efforts may have cut in a doorway or window without adding a structural beam or "header" across the top of the opening. Occasionally, load-bearing members were simply too small to carry the loads above them. Deflection or wood "creep" (deflection that occurs over time) can create cracks in plaster.

Overloading and structural movement (especially when combined with rotting lath, rusted nails, or poor quality plaster) can cause plaster to detach from the lath. The plaster loses its key. When the mechanical bond with the lath is broken, plaster becomes loose or bowed. If repairs are not made, especially to ceilings, gravity will simply cause chunks of plaster to fall to the floor.

Settlement/Vibration. Cracks in walls can also result when houses settle. Houses built on clay soils are especially vulnerable. Many types of clay (such as montmorillonite) are highly expansive. In the dry season, water evaporates from the clay particles, causing them to contract. During the rainy season, the clay swells. Thus a building can be riding on an unstable footing. Diagonal cracks running in opposite directions suggest that house settling and soil conditions may be at fault. Similar symptoms occur when there is a nearby source of vibration-blasting, a train line, busy highway, or repeated sonic booms.

Lath movement. Horizontal cracks are often caused by lath movement. Because it absorbs moisture from the air, wood lath expands and contracts as humidity rises and falls. This can cause cracks to appear year after year. Cracks can also appear between rock lath panels. A nail holding the edge of a piece of lath

may rust or loosen, or structural movement in the wood framing behind the lath may cause a seam to open. Heavy loads in a storage area above a rock-lath ceiling can also cause ceiling cracks.

Errors in initial building construction such as improper bracing, poor corner construction, faulty framing of doors and windows, and undersized beams and floor joists eventually "telegraph" through to the plaster surface.

Poor Workmanship. In addition to problems caused by movement or weakness in the structural framework plaster durability can be affected by poor materials or workmanship. Poorly proportioned mix. The proper proportioning and mixing of materials are vital to the quality of the plaster job. A bad mix can cause problems that appear years later in a plaster wall. Until recently, proportions of aggregate and lime were mixed on the job. A plasterer may have skimped on the amount of cementing material (lime or gypsum) because sand was the cheaper material. Over sanding can cause the plaster to weaken or crumble. Plaster made from a poorly proportioned mix may be more difficult to repair.

Incompatible base coats and finish coats. Use of perlite as an aggregate also presented problems. Perlite is a lightweight aggregate used in the base coat instead of sand. It performs well in cold weather and has a slightly better insulating value. But if a smooth lime finish coat was applied over perlited base coats on wood or rock lath, cracks would appear in the finish coat and the entire job would have to be redone. To prevent this, a plasterer had to add fine silica sand or finely crushed perlite to the finish coat to compensate for the dramatically differing shrinkage rates between the base coat and the finish coat.

Improper plaster application. The finish coat is subject to "chip cracking" if it was applied over an excessively dry base coat, or was insufficiently troweled, or if too little gauging plaster was used. Chip cracking looks very much like an alligatored paint surface. Another common problem is called map cracking--fine, irregular cracks that occur when the finish coat has been applied to an over sanded base coat or a very thin base coat.

Too much retardant. Retarding agents are added to slow down the rate at which plaster sets, and thus inhibit hardening. They have traditionally included ammonia, glue, gelatin, starch, molasses, or vegetable oil. If the plasterer has used too much retardant, however, a gypsum plaster will not set within a normal 20 to 30minute time period. As a result, the surface becomes soft and powdery.

Inadequate plaster thickness. Plaster is applied in three coats over wood lath and metal lath--the scratch, brown, and finish coats. In three-coat work, the scratch coat and brown coat were sometimes applied on successive days to make up the required wall thickness. Using rock lath allowed the plasterer to apply one base coat and the finish coat--a two-coat job.

If a plasterer skimped on materials, the wall may not have sufficient plaster thickness to withstand the normal stresses within a building. The minimum total thickness for plaster on gypsum board (rock lath) is 1/2 inch. On metal lath the minimum thickness is 5/8 inch; and for wood lath it is about 3/4 to 7/8 inch. This

minimum plaster thickness may affect the thickness of trim projecting from the wall's plane.

Improper Curing. Proper temperature and air circulation during curing are key factors in a durable plaster job. The ideal temperature for plaster to cure is between 55 to 70 degrees Fahrenheit. However, historic houses were sometimes plastered before window sashes were put in. There was no way to control temperature and humidity.

Dry outs, freezing, and sweat-outs. When temperatures were too hot, the plaster would return to its original condition before it was mixed with water, that is, calcined gypsum. A plasterer would have to spray the wall with alum water to reset the plaster. If freezing occurred before the plaster had set, the job would simply have to be redone. If the windows were shut so that air could not circulate, the plaster was subject to sweat-out or rot. Since there is no cure for rotted plaster, the affected area had to be removed and replastered.

Moisture. Plaster applied to a masonry wall is vulnerable to water damage if the wall is constantly wet. When salts from the masonry substrate come in contact with water, they migrate to the surface of the plaster, appearing as dry bubbles or efflorescence. The source of the moisture must be eliminated before replastering the damaged area.

Sources of Water Damage. Moisture problems occur for several reasons. Interior plumbing leaks in older houses are common. Roofs may leak, causing ceiling damage. Gutters and downspouts may also leak, pouring rain water next to the building foundation. In brick buildings, dampness at the foundation level can wick up into the above-grade walls. Another common source of moisture is splashback. When there is a paved area next to a masonry building, rainwater splashing up from the paving can dampen masonry walls. In both cases water travels through the masonry and damages interior plaster. Coatings applied to the interior are not effective over the long run. The moisture problem must be stopped on the outside of the wall.

Repairing Historic Plaster

Many of the prablems described above may not be easy to remedy. If major structural problems are found to be the source of the plaster problem, the structural problem should be corrected. Some repairs can be made by removing only small sections of plaster to gain access. Minor structural problems that will not endanger the building can generally be ignored. Cosmetic damages from minor building movement, holes, or bowed areas can be repaired without the need for wholesale demolition. However, it may be necessary to remove deteriorated plaster caused by rising damp in order for masonry walls to dry out. Repairs made to a wet base will fail again.

Canvassing Uneven Wall Surfaces

Uneven wall surfaces, caused by previous patching or by partial wallpaper removal, are common in old houses. As long as the plaster is generally sound, cosmetically unattractive plaster walls can be "wallpapered" with strips of a canvas or fabric-like material. Historically, canvassing covered imperfections in the plaster and provided a stable base for decorative painting or wallpaper.

Filling Cracks

Hairline cracks in wall and ceiling plaster are not a serious cause for concern as long as the underlying plaster is in good condition. They may be filled easily with a patching material. For cracks that reopen with seasonal humidity change, a slightly different method is used. First the crack is widened slightly with a sharp, pointed tool such as a crack widener or a triangular can opener. Then the crack is filled. For more persistent cracks, it may be necessary to bridge the crack with tape. In this instance, a fiberglass mesh tape is pressed into the patching material.

After the first application of a quick setting joint compound dries, a second coat is used to cover the tape, feathering it at the edges. A third coat is applied to even out the surface, followed by light sanding. The area is cleaned off with a damp sponge, then dried to remove any leftover plaster residue or dust.

When cracks are larger and due to structural movement, repairs need to be made to the structural system before repairing the plaster. Then, the plaster on each side of the crack should be removed to a width of about 6 inches down to the lath. The debris is cleaned out, and metal lath applied to the cleared area, leaving the existing wood lath in place. The metal lath usually prevents further cracking. The crack is patched with an appropriate plaster in three layers (i.e., base coats and finish coat). If a crack seems to be expanding, a structural engineer should be consulted.

Replacing Delaminated Areas of the Finish Coat

Sometimes the finish coat of plaster comes loose from the base coat. In making this type of repair, the plasterer paints a liquid plaster-bonding agent onto the areas of base-coat plaster that will be replastered with a new lime finish coat. A homeowner wishing to repair small areas of delaminated finish coat can use the methods described in "Patching Materials."

Patching Holes in Walls

For small holes (less than 4 inches in diameter) that involve loss of the brown and finish coats, the repair is made in two applications. First, a layer of base coat plaster is troweled in place and scraped back below the level of the existing plaster. When the base coat has set but not dried, more plaster is applied to create a smooth, level surface. One-coat patching is not generally recommended by plasterers because it tends to produce concave surfaces that show up when the work is painted. Of course, if the lath only had one coat of plaster originally, then a one-coat patch is appropriate.

For larger holes where all three coats of plaster are damaged or missing down to the wood lath, plasterers generally proceed along these lines. First, all

the old plaster is cleaned out and any loose lath is re-nailed. Next, a water mist is sprayed on the old lath to keep it from twisting when the new, wet plaster is applied, or better still, a bonding agent is used. To provide more reliable keying and to strengthen the patch, expanded metal lath (diamond mesh) should be attached to the wood lath with tie wires or nailed over the wood lath with lath nails. The plaster is then applied in three layers over the metal lath, lapping each new layer of plaster over the old plaster so that old and new are evenly joined. This stepping is recommended to produce a strong, invisible patch. Also, if a patch is made in a plaster wall that is slightly wavy, the contour of the patch should be made to conform to the irregularities of the existing work. A flat patch will stand out from the rest of the wall.

Patching Holes in Ceilings

Hairline cracks and holes may be unsightly, but when portions of the ceiling come loose, a more serious problem exists. The keys holding the plaster to the ceiling have probably broken. First, the plaster around the loose plaster should be examined.

Keys may have deteriorated because of a localized moisture problem, poor quality plaster, or structural overloading; yet, the surrounding system may be intact. If the areas surrounding the loose area are in reasonably good condition, the loose plaster can be reattached to the lath using flathead wood screws and plaster washers. To patch a hole in the ceiling plaster, metal lath is fastened over the wood lath; then the hole is filled with successive layers of plaster, as described above.

Establishing New Plaster Keys

If the back of the ceiling lath is accessible (usually from the attic or after removing floor boards), small areas of bowed-out plaster can be pushed back against the lath. A padded piece of plywood and braces are used to secure the loose plaster. After dampening the old lath and coating the damaged area with a bonding agent, a fairly liquid plaster mix (with a glue size retardant added) is applied to the backs of the lath, and worked into the voids between the faces of the lath and the back of the plaster. While this first layer is still damp, plaster-soaked strips of jute scrim are laid across the backs of the lath and pressed firmly into the first layer as reinforcement. The original lath must be secure; otherwise the weight of the patching plaster may loosen it.

Loose, damaged plaster can also be re-keyed when the goal is to conserve decorative surfaces or wallpaper. Large areas of ceilings and walls can be saved. This method requires the assistance of a skilled conservator--it is not a repair technique used by most plasterers.

The conservator injects an acrylic adhesive mixture through holes drilled in the face of the plaster (or through the lath from behind, when accessible). The loose plaster is held firm with plywood bracing until the adhesive bonding mixture sets. When complete, gaps between the plaster and lath are filled, and the loose plaster is secure.

Replastering Over the Old Ceiling

If a historic ceiling is too cracked to patch or is sagging (but not damaged from moisture), plasterers routinely keep the old ceiling and simply relath and replaster over it. This repair technique can be used if lowering the ceiling slightly does not affect other ornamental features. The existing ceiling is covered with 1x3-inch wood furring strips, one to each joist, and fastened completely through the old lath and plaster using a screw gun. Expanded metal lath or gypsum board lath is nailed over the furring strips. Finally, two or three coats are applied according to traditional methods. Replastering over the old ceiling saves time, creates much less dust than demolition, and gives added fire protection.

When Damaged Plaster Cannot be Repaired--Replacement Options

Partial or complete removal may be necessary if plaster is badly damaged, particularly if the damage was caused by long-term moisture problems. Workers undertaking demolition should wear OSHA-approved masks because the plaster dust that flies into the air may contain decades of coal soot. Lead, from lead based paint, is another danger. Long-sleeved clothing and head-and-eye protection should be worn. Asbestos, used in the mid-twentieth century as an insulating and fireproofing additive, may also be present and OSHA-recommended precautions should be taken. If plaster in adjacent rooms is still in good condition, walls should not be pounded--a small trowel or pry bar is worked behind the plaster carefully in order to pry loose pieces off the wall.

When the damaged plaster has been removed, the owner must decide whether to replaster over the existing lath or use a different system. This decision should be based in part on the thickness of the original plaster and the condition of the original lath. Economy and time are also valid considerations. It is important to ensure that the wood trim around the windows and doors will have the same "reveal" as before. (The "reveal" is the projection of the wood trim from the surface of the plastered wall). A lath and plaster system that will give this required depth should be selected.

Replastering--Alternative Lath Systems for New Plaster. Replastering old wood lath. When plasterers work with old lath, each lath strip is re-nailed and the chunks of old plaster are cleaned out. Because the old lath is dry, it must be thoroughly soaked before applying the base coats of plaster, or it will warp and buckle; furthermore, because the water is drawn out, the plaster will fail to set properly. As noted earlier, if new metal lath is installed over old wood lath as the base for new plaster, many of these problems can be avoided and the historic lath can be retained. The ceiling should still be sprayed unless a vapor barrier is placed behind the metal lath.

Replastering over new metal lath. An alternative to reusing the old wood lath is to install a different lathing system. Galvanized metal lath is the most expensive, but also the most reliable in terms of longevity, stability, and proper keying. When lathing over open joists, the plasterer should cover the joists with kraft paper or a polyethylene vapor barrier. Three coats of wet plaster are applied consecutively

to form a solid, monolithic unit with the lath. The scratch coat keys into the metal lath; the second, or brown, coat bonds to the scratch coat and builds the thickness; the third, or finish coat, consists of lime putty and gauging plaster.

Replastering over new rock lath. It is also possible to use rock lath as a plaster base. Plasterers may need to remove the existing wood lath to maintain the woodwork's reveal. Rock lath is a 16x36-inch, 1/2-inch thick, gypsum-core panel covered with absorbent paper with gypsum crystals in the paper. The crystals in the paper bond the wet plaster and anchor it securely. This type of lath requires two coats of new plaster--the brown coat and the finish coat. The gypsum lath itself takes the place of the first, or scratch, coat of plaster.

Painting New Plaster

The key to a successful paint job is proper drying of the plaster. Historically, lime plasters were allowed to cure for at least a year before the walls were painted or papered. With modern ventilation, plaster cures in a shorter time; however, fresh gypsum plaster with a lime finish coat should still be perfectly dry before paint is applied--or the paint may peel. (Plasterers traditionally used the "match test" on new plaster. If a match would light by striking it on the new plaster surface, the plaster was considered dry.) Today it is best to allow new plaster to cure two to three weeks. A good alkaline-resistant primer, specifically formulated for new plaster, should then be used. A compatible latex or oil-based paint can be used for the final coat.

A Modern Replacement System

Veneer Plaster. Using one of the traditional lath and plaster systems provides the highest quality plaster job. However, in some cases, budget and time considerations may lead the owner to consider a less expensive replacement alternative. Designed to reduce the cost of materials, a more recent lath and plaster system is less expensive than a two-or-three coat plaster job, but only slightly more expensive than drywall. This plaster system is called veneer plaster.

The system uses gypsum-core panels that are the same size as drywall (4x8 feet), and specially made for veneer plaster. They can be installed over furring channels to masonry walls or over old wood lath walls and ceilings. Known most commonly as "blue board," the panels are covered with a special paper compatible with veneer plaster. Joints between the 4-foot wide sheets are taped with fiberglass mesh, which is bedded in the veneer plaster. After the tape is bedded, a thin, 1/16-inch coat of high-strength veneer plaster is applied to the entire wall surface. A second veneer layer can be used as the "finish" coat, or the veneer plaster can be covered with a gauged lime finish-coat--the same coat that covers ordinary plaster.

Although extremely thin, a two-coat veneer plaster system has a 1,500 psi rating and is thus able to withstand structural movements in a building or surface abrasion. With either a veneer finish or a gauged lime putty finish coat, the room will be ready for painting almost immediately. When complete, the troweled or textured wall surface looks more like traditional plaster than drywall.

The thin profile of the veneer system has an added benefit, especially for owners of uninsulated masonry buildings. Insulation can be installed between the pieces of furring channel used to attach blue board to masonry walls. This can be done without having to fur out the window and door jambs. The insulation plus the veneer system will result in the same thickness as the original plaster. Occupants in the rooms will be more comfortable because they will not be losing heat to cold wall surfaces.

Patching Materials

Plasterers generally use ready-mix base-coat plaster for patching, especially where large holes need to be filled. The ready-mix plaster contains gypsum and aggregate in proper proportions. The plasterer only needs to add water.

Another mix plasterers use to patch cracks or small holes, or for finish-coat repair, is a "high gauge" lime putty (50 percent lime; 50 percent gauging plaster). This material will produce a white, smooth patch. It is especially suitable for surface repairs.

Although property owners cannot duplicate the years of accumulated knowledge and craft skills of a professional plasterer, there are materials that can be used for do-it-yourself repairs. For example, fine cracks can be filled with an all-purpose drywall joint compound. For bridging larger cracks using fiberglass tape, a homeowner can use a "quicksetting" joint compound. This compound has a fast drying time--60, 90, or 120 minutes. Quick-setting joint compound dries because of a chemical reaction, not because of water evaporation. It shrinks less than all-purpose joint compound and has much the same workability as ready-mix base-coat plaster. However, because quick-set joint compounds are hard to sand, they should only be used to bed tape or to fill large holes. All-purpose point compound should be used as the final coat prior to sanding.

Homeowners may also want to try using a ready-mix perlited base-coat plaster for scratch and brown coat repair. The plaster can be hand-mixed in small quantities, but bagged ready-mix should be protected from ambient moisture. A "millmixed pre-gauged" lime finish coat plaster can also be used by homeowners. A base coat utilizing perlite or other lightweight aggregates should only be used for making small repairs (less than 4 ft. patches). For large-scale repairs and entire room replastering, see the precautions in Table 1 for using perlite.

Homeowners may see a material sold as "patching plaster" or "plaster of Paris" in hardware stores. This dry powder cannot be used by itself for plaster repairs. It must be combined with lime to create a successful patching mixture.

When using a lime finish coat for any repair, wait longer to paint, or use an alkaline-resistant primer.

Summary

The National Park Service recommends retaining historic plaster if at all possible. Plaster is a significant part of the "fabric" of the building. Much of the building's history is documented in the layers of paint and paper found covering old plaster. For buildings with decorative painting, conservation of historic flat

plaster is even more important. Consultation with the National Park Service, with State Historic Preservation Officers, local preservation organizations, historic preservation consultants, or with the Association for Preservation Technology is recommended. Where plaster cannot be repaired or conserved using one of the approaches outlined in this Brief, documentation of the layers of wallpaper and paint should be undertaken before removing the historic plaster. This information may be needed to complete a restoration plan.

Plaster Terms

Scratch coat. The first base coat put on wood or metal lath. The wet plaster is "scratched" with a scarifier or comb to provide a rough surface so the next layer of base coat will stick to it.

Brown coat. The brown coat is the second application of wet, base-coat plaster with wood lath or metal systems. With gypsum board lath (rock lath, plasterboard), it is the only base coat needed.

Finish coat. Pure lime, mixed with about 35 percent gauging plaster to help it harden, is used for the very thin surface finish of the plaster wall. Fine sand can be added for a sanded finish coat.

Casing Bead. Early casing bead was made of wood. In the 19th century, metal casing beads were sometimes used around fireplace projections, and door and window openings. Like a wood ground, they indicate the proper thickness for the plaster.

Corner Bead. Wire mesh with a rigid metal spline used on outside corners. Installing the corner bead plumb is important.

Cornerite. Wire mesh used on inside corners of adjoining walls and ceilings. It keeps corners from cracking.

Ground. Plasterers use metal or wood strips around the edges of doors and windows and at the bottom of walls. These grounds help keep the plaster the same thickness and provide a stopping edge for the plaster. Early plasterwork, however, did not use grounds. On early buildings, the woodwork was installed and primed before plastering began. Some time in the early 19th century, a transition occurred, and plasterers applied their wall finish before woadwork was installed.

Gypsum. Once mined from large gypsum quarries near Paris (thus the name plaster of Paris), gypsum in its natural form is calcium sulfate. When calcined (or heated), one-and-a-half water molecules are driven off, leaving a hemi-hydrate of calcium sulfate. When mixed with water, it becomes calcium sulfate again. While gypsum was used in base-coat plaster from the 1890s on, it has always been used in finish coat and decorative plaster. For finish coats, gauging plaster was added to lime putty; it causes the lime to harden. Gypsum is also the ingredient in moulding plaster, a finer plaster used to create decorative moldings in ornamental plasterwork.

Lime. Found in limestone formations or shell mounds, naturally occurring lime is calcium carbonate. When heated, it becomes calcium oxide. After water has been added, it becomes calcium hydroxide. This calcium hydroxide reacts with carbon dioxide in the air to recreate the original calcium carbonate.

Screed. Screeds are strips of plaster run vertically or horizontally on walls or ceilings. They are used to plumb and straighten uneven walls and level ceilings. Metal screeds are used to separate different types of plaster finishes or to separate lime and cement plasters.

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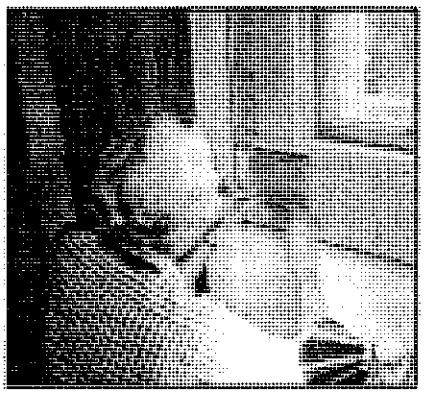
Painting Historic Interiors



Sara B. Chase

»Constituents of Historic Paint
»Oil-Based and Water-Based Paints
»Pre-1875 Paints
»Factory-Made Paints after 1875
»20th Century Paints
»Paint Investigation
»Choosing a Treatment
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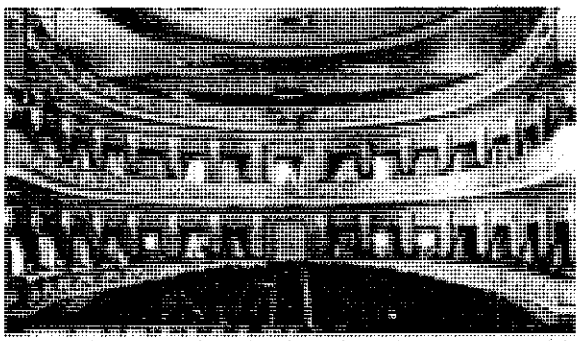
The paint Americans used in the past is undeniably part of a technological and commercial record. But beyond that, the colors we have chosen and continue to select for our interior living and working spaces--bright and exuberant, purposefully somber, or a combination of hues--reflect our nation's cultural influences and our individual and collective spirit. Paint color is a simple, direct expression of the time, and of taste, values, and mood. To consider paint only as a protective coating is to misunderstand its meaning as an important aspect of America's heritage.



Researching the interior paint history is the key to a successful preservation or restoration project. The decorative detailing can be appreciated in this Puerto Rico Theater primarily because of appropriate paint color and paint placement. Photo: Max Toro.

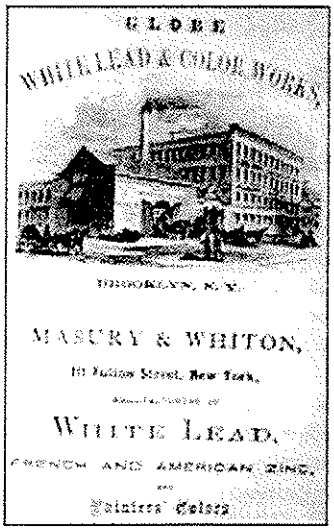
This Brief is about historic interior paints and choosing new paints for historic interiors if repainting is necessary or desirable. It addresses a variety of materials and features: plaster walls and ceilings; wooden doors, molding, and trim; and metal items such as radiators and railings. It provides background information about some of the types of paint which were used in the past, discusses the more common causes and effects of interior paint failure, and explains the principal factors guiding decisions about repainting, including what level of paint investigation may be appropriate. Careful thought should be given to each interior paint project, depending on the history of the building and its painted surfaces. Treatments may range from protecting extant decorative surfaces, to ordering custommade paint that replicates the original paint color, to using today's paint straight off the shelf and out of the can.

Finally, stripping old paints or applying new oil/alkyd paints poses serious health and safety concerns; the State Historic Preservation Officer should be contacted for current legal and technical information on removal, disposal, and health and safety precautions.

Constituents of Historic Paint: Pigment, Binder, and Vehicle

Paint is a dispersion of small solid particles, usually crystalline, in a liquid medium. Applied to a surface, this liquid has the special quality of becoming a solid, protective film when it dries. Paint also enhances the appearance of surfaces. A late Victorian writer observed that the coming of a painter to a house was cause for celebration. Indeed, these statements not only indicate the chemical and physical complexity of paint, but also its emotional impact.

Pigment. Pigment made the paint opaque, thus preventing deterioration of the substrate caused by ultraviolet light, and added color, thus making the paint attractive. White lead, a whitish corrosion product of lead, was most often used to provide opacity. The white pigment in a colored paint is often called the "hiding" pigment. In addition to preventing the sun's damaging rays from hitting the surface of the substrate, the white lead also helped prevent the growth of mold and mildew. Not until early in the 20th century was a successful substitute, titanium dioxide (TiO_2), patented, and even then, it did not come into prevalent use by itself until the mid-20th century (earlier in the century, titanium oxide and white lead were often mixed). Zinc oxide was used briefly as a hiding pigment after 1850.



There were numerous companies producing white lead in the United States by mid-19th century. Shown is one manufacturer's flyer. Photo: NPS files.

Early tinting pigments for house paints consisted of the earth pigments--ochres, siennas, umbers made from iron-oxide containing clay--and a few synthesized colorants such as Prussian blue, or mercuric sulfide (crimson). From the early 1800s on more pigments were developed and used to offer a wider and brighter variety of hues.

Binder. The most common binder in interior paints was, and still is, oil. Chalk was sometimes added to waterbased paints to help bind the pigment particles together. Other common binders included hide glue and gelatin.

Vehicle. The fluid component was termed the vehicle, or medium, because it carried the pigment. Historically, vehicles included turpentine in oil paints and water in waterbased paints, but other vehicles were sometimes used, such as milk in casein paints.

Oil-Based and Water-Based Paints

The two major types of paint are termed oil-based and water-based. For oilbased paints, linseed oil was frequently chosen because it is a drying oil. When thinned with an organic solvent such as turpentine for easier spreading, its drying speed was enhanced. To make the drying even faster, drying agents such as cobalt compounds were frequently added. Because the addition of driers was most successfully done in hot or boiling oil, boiled linseed oil was preferable. The drying rate of linseed oil paints was relatively rapid at first, for several days immediately after application, and paint soon felt dry to the touch; it is important to remember, however, that linseed oil paint continues to dry--or more precisely, to crosslink--over decades and thus continues to a point of brittleness as the paint ages. Strong and durable with a surface sheen, oil-based paints were mainly used for wood trim and metal.

Whitewashes and distemper paints differed from oil paints in appearance primarily because the vehicle was water. Waterbased paints were always flat, having no gloss of their own. Because the paint film dried to the touch as soon as the water evaporated, driers were not needed. Waterbase paints were fairly strong, with the pigments well bound as in hide glue distempers, but they did not hold up to abrasion. Wood trim, therefore, was rarely painted with these types of paint historically, though interior plaster surfaces were frequently coated with whitewash and calcimine. Distemper paints were commonly used for decorative work.

Recent Changes to Paint Constituents. Until the mid-20th century, almost all paints used in

Theater in Sacramento, California (1931) features painted plaster columns and cornices which have been finished in gold and silver leaf. Photo: Gabriel Moulin Studios.

Often decorated with simple molded plaster designs of the Art Deco and Art Moderne styles, interiors of the 1930s and 1940s were frequently accented with metal flake paints in a full range of metallic colors, from copper to bronze. And enamels, deep but subdued hues, became popular. Paint technology had progressed and varying degrees of gloss were also available, including the mid-range enamels, variously called satin, semigloss, or eggshell. In contrast to Victorian paint treatments, this period was characterized by simplicity. To some extent, the Bauhaus aesthetic influenced taste in the 1950s; interior paints were frequently chosen from a palette limited to a few "earth" colors and a "nearly neutral" palette of off-whites and pale greys.

While the trend in colors and decorative treatments was defined by its simplicity, paint chemists were developing paints of increasing complexity. Experimentation had started early in the 20th century and accelerated greatly after World War II. Of greatest significance was the manufacture of the latex paints for consumer use. Synthetic resin emulsions carried in water offered advantages over the traditional oil paints, and even over the oil/alkyd paints: they did not yellow; they permitted water cleanup until dried; and they emitted no toxic or hazardous fumes from solvent evaporation.

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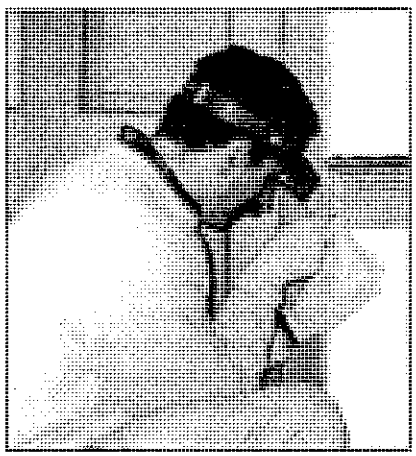
Paint Investigation

Understanding each project's historic preservation goal and knowing what level of information needs to be collected to achieve that goal is an important responsibility of the purchaser of the service. Before someone is hired, the owner or manager needs to decide if a thorough investigation of painted surfaces is actually needed, and *how* to use the results when one is done.



This conservator is shown collecting paint samples onsite. Then, in a laboratory, an ultra violet light microscope will be used to identify pigment and binding media. Photo: Courtesy, Matt Mosca.

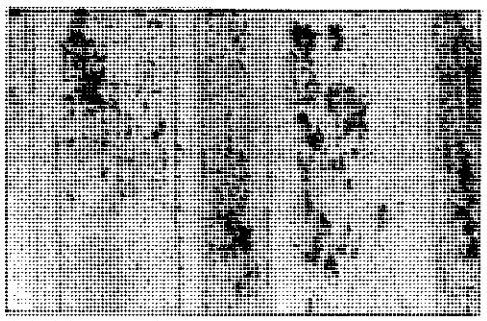
Specialists with both training and field experience conduct paint investigations. These experts use sophisticated instruments and procedures such as field sampling, cross-section analysis, and fluorescent and chemical staining to learn about the components and behaviors of historic paints. In addition, they utilize written documentation, verbal research, and visual information about past painting in the building in conjunction with findings in the field.

Paint investigation can make several contributions to a project. A complete analysis of the paint layers on surfaces within a structure can tell a great deal about the sequence of alterations that have occurred within a building, as well as potentially providing ranges of dates for some of these changes. By establishing a full sequence of paint layers (termed a chromochronology), together with other research, alterations of various building spaces and features can be associated with specific paint layers. It is by establishing this association that the correct layer is identified; when the correct layer has been identified, the color may be matched.

- In addition to its archeological value, paint analysis can determine the types and colors of paint on a given surface (identification of thin glazes, decorative paint schemes, binders and pigments). Beyond color identification, then, paint analysis is also recommended to diagnose causes of paint failure. Knowing a paint binder can often explain causes as well as guide appropriate preservation or conservation treatments.

Owners and managers should identify all of these needs

before deciding on the extent of analysis. For example, a complete paint investigation is usually recommended as part of an historic structure report. For buildings with little documentation, additions and alterations can often be identified, and possibly dated, through analysis. Often the use of such seemingly expensive techniques can save money in the long run when determining the history of building change.



A dark layer can be seen beneath the flaking paint on these raised field panels. Depending on the project work goal and the period of the building's history being interpreted, any one of the paint layers could be duplicated in repainting. Photo: NPS files.

It is possible to do some analysis on site; this is a much simpler process that can be undertaken for less cost than the complex laboratory procedures described above. However, the usefulness of onsite analysis is limited and the results will not be as precise as results from samples that are analyzed in a laboratory with a good microscope. Any shortcut approaches to paint analysis that do not follow scientific procedures are generally not worth the expense. In summary, if preservation and restoration treatments are being undertaken, a complete investigation is recommended; for a rehabilitation project, onsite analysis and color matching may provide an adequate palette.

Choosing a Treatment

Most projects involve repainting. It is the historic appearance of the interior and the visual impression that will be created by new paint treatments that must be considered before choosing a particular course of action. The type and colors of paint obviously depend on the type of building and the use and interpretation of its interior spaces. A consistent approach is best.

Preservation. When the treatment goal is preservation, a building's existing historic features and finishes are maintained and repaired, saving as much of the historic paint as possible. Sometimes, cleaning and washing of painted surfaces is all that is needed. Or a coating may be applied to protect important examples of history or art. If repainting is

required, the new paint is matched to existing paint colors using the safer, modern formulations. Recreating earlier surface colors and treatments is not an objective.

Interior spaces that are being rehabilitated for a new use can benefit from being repainted in historic period colors rather than a neutral off-white. Photo: NPS files.

Rehabilitation. In a typical rehabilitation, more latitude exists in choosing both the kind of new paint as well as color because the goal is the efficient reuse of interior spaces. Decisions about new paint often weigh factors such as economy and durability--use of a high quality standard paint from a local or national company and application by a qualified contractor. Color choices may be based on paint research reports prepared for interior rooms of comparable date and style. More often, though, current color values and taste are taken into account. Again, the safer paint formulations are used.

Interiors of institutional buildings, such as university buildings, city halls, libraries, and churches often contain rich decorative detailing. During rehabilitation, careful choices should be made to retain or restore selected portions of the decorative work as well as match some of the earlier colors to evoke the historic sense of time and place. At the least, it is important to use periodtypical paint color and paint placement.

Restoration. In a restoration project, the goal is to depict the property as it appeared during its period of greatest

significance. This may or may not be the time of its original construction. For example, if a building dated from 1900 but historians deemed its significance to be the 1920s, the appropriate paint color match would be the 1920s layer, not the original 1900 layer.

Based on historical research, onsite collection of paint samples, and laboratory analysis, surface colors and treatments can be recreated to reflect the property at a particular period of time. It should be noted that scholarly findings may yield a color scheme that is not suited to the taste of the contemporary owner, but is nonetheless historically accurate. In restoration, personal taste in color is not at issue; the evidence should be strictly followed.

In the restoration process, colors are custom-matched by professionals to give an accurate representation. If an artist or artisan can be found, the historically replicated paint may be applied using techniques appropriate to the period of the restoration. Although custom paint manufacture is seldom undertaken, color and glazing are capable of being customized. In some projects, paint may be custom-made using linseed oil and, if building code variances allow it, white lead. For example, the repainting of a number of rooms at Mount Vernon demonstrates that it is possible to replicate historic paints and applications in all aspects; however, as noted, replication of historic paint formulation is not practical for the majority of projects.

Identifying Deteriorated and Damaged Paint Surfaces

Because painted surfaces are subject to abrasion, soiling, water damage, sunlight, and application of incompatible paints they generally need to be repainted or at least reglazed appropriately from time to time.

Abrasion. From the baseboards up to a level of about six feet off the floor, wood trim is constantly subjected to wear from being touched and inadvertently kicked, and from having furniture pushed against it. Chair rails were in fact intended to take the wear of having chairs pushed back against them instead of against the more delicate plaster wall or expensive wallpaper. Doors in particular, sometimes beautifully grained, receive extensive handling. Baseboards get scraped by various cleaning devices, and the lower rails of windows, as well as window seats, take abuse. The paint in all of these areas tends to become abraded. Two things are important to bear in mind about areas of abraded paint. Samples taken to determine original paint colors and layer sequences will not be accurate except at undamaged edges. Also, dirt and oil or grease need to be removed before applying any new paint because new paint will not adhere to dirty, greasy surfaces.

Dirt. Soiling is another problem of interior paint. Fireplaces smoked; early coalfired furnaces put out oily black soot; gas lights and candles left dark smudges. Sometimes the dirt got deposited on plaster walls or ceilings in a way that makes the pattern of the lath behind the plaster quite clear. Another source of dirt was polluted outside air, from factories or other industries, infiltrating houses and other nearby buildings. Until smokestacks became very high, most air pollution was caused by nearby sources.

In paint investigation, dirt on the surface of paint layers; as seen under the microscope, can be very useful in suggesting the length of time a given paint layer remained exposed, and in distinguishing a finish layer from a prime or undercoat layer. This kind of soiling can happen on any painted surface in a room, but may be slightly heavier in the recesses of moldings and on upwardfacing horizontal edges. Using dirt as a sole measure, however, may be misleading if the surfaces have been cleaned. The fracture or bonding between paint layers is often used by professionals as a better means of indicating time differences between layers as well as indicating those layers that are part of a single decoration or painting.

Water. Water, the usual source of deterioration for many kinds of material, is also a prime cause of interior paint failure. As a liquid, it can come from roof leaks, from faulty plumbing or steam heating systems, or from firesuppression systems that have misfired. As a vapor, it may come from such human activities as breathing, showering, or cooking. Plaster walls sealed with

unpigmented hideglue are notably susceptible to water damage because it forms a watersoluble layer between the plaster and the paint. This can cause the paint to lose adhesion when even small amounts of moisture come into contact with the watersoluble sealer.

Age/Sunlight. Finally, in historic interiors, especially where there is heavy paint buildup, paint can weaken and fail due to chemical or mechanical reasons. For example, the older linseed oil is, the more brittle it is. It also darkens when it is covered and gets no ultraviolet exposure. In rooms where there is more sunlight on one area than on others, the oil or even oil/alkyd paint will get discernibly darker in the less exposed areas in as short a time as six months. Painted over, the oil medium in older paints gets quite yellowbrown, thus changing the color of the paint. Prussian blue is one of the tinting pigments that is particularly vulnerable to fading.

Incompatible Paints. Understanding some basic differences in the strength of various paints helps to explain certain paint problems. Paints that dry to a stronger film are incompatible with those which are weaker. Acrylic latex paints are stronger than oil/alkyd paints. Oil or oil/alkyd paint is stronger than waterbased paint such as calcimine. When a stronger paint is applied over a weaker paint, it will tend to pull off any weaker paint which may have begun to lose its bond with its substrate. Thus, on many ceilings of older buildings where oil/alkyd paints have been applied over old calcimine, large strips of paint may be peeling.

Oil or varnish glazes over older paints become brittle with age, and can make removal of later paints rather easy. Sometimes it is possible to take advantage of this characteristic to reveal an earlier decorative treatment such as graining or marbleizing. Getting under the edge of the glaze with a scalpel blade can make the removal of later paints relatively simple, and relatively harmless to the fancier paint treatment. Sometimes, paints separate from each other simply due to poor surface preparation in the past or the hardening of the earlier surface paint. Use of alkaline paint strippers can cause paint to lose adhesion. When insufficiently neutralized, they leave salts in wood which cause oil or oil/alkyd paints to fail to adhere to the surface. If dirt or oily residues are not cleaned from the surfaces to be painted, new paint will not remain well adhered.

Surface Preparation

First, it is important to note that the earlier, linseed oil-based paints were penetrating type paints, forming a bond by absorption into the substrate. Often these thin oil coatings were slightly tinted with an ironoxide pigment so coverage could be seen; the next coating applied would adhere to this first oil layer. Modern paints, on the other hand, are primarily bonding paints with little ability to penetrate a substrate. For this reason, surface preparation is extremely important for today's paints.

Before preparing the interior for repainting, all moisture penetration from failing roofs or gutters or from faulty plumbing or interior heating elements should be identified and corrected. A paint job is only as good as the preparation that goes before it. The surface to be painted, old or new, wood, plaster, masonry, or metal must be made sound and capable of taking the paint to be applied.

Scraping and Sanding. The first step in preparing interior wood and plaster surfaces which are coherent and sound is to remove any loose paint (see Paint Hazards sidebar). Careful hand scraping is always advisable for historic surfaces. Use of mechanical sanders usually leaves traces of the sander's edges, visible through the new paint film. Hand sanding is also necessary to feather the edges of the firmly adhering layers down to the bare areas so that shadow lines are avoided. Preparing previously painted interior masonry for new paint is basically similar to preparing plaster. Metals elements, such as radiators, valences, or firebacks are somewhat different. In order to get a sound paint job on metal items, the work is primarily that of sanding to remove any rust before repainting. If the existing paint is well adhered over the entire metal surface, then it may be necessary only to sand lightly to roughen the existing paint, thus providing some "tooth" for the primer and new paint layer. On wood, garnet sanding papers work well. Aluminum oxide and silicon carbide sandpapers are effective on other surfaces as well as wood; emery papers should be used on metals.

Paint Removal. When should surfaces be completely stripped? Obviously, new paint is wasted when applied on old paint which is loose, that is, extensively damaged and deteriorated. Sometimes paint on an architectural feature needs to be removed if it obscures delicate detailing. For the most part, however, if the surface is intact--and the presence of lead paint has been shown to present no health dangers to building occupants--the existing paint can be overpainted.

Well-adhered, intact paint layers (in at least one area of each room) should be covered with a sturdy protective tape, then painted over with the new paint and left in place to inform future research. The next owner may be interested in the building's past history, and methods of gleaning information from old paints grow more sophisticated all the time.

Heat/Scraping. Propane torches should never be used because they can damage historic wood features. Also, charred areas of wood will not hold the new paint. Use of a heat gun or heat plate may be relatively fast, but has both health and safety drawbacks. Heat oxidizes lead paint, causing poisonous fumes. And old walls may contain fine debris which acts like tinder and smolders when heated, bursting into flame hours after the stripping. (Heat methods are best limited to those interior elements that can be safely removed from the building for stripping and reinstalled). Finally, scraping to remove heatloosened paint may gouge and scar the wood or plaster substrate if not done carefully. Rotary wire brushes cut into wood and should be avoided altogether.

Chemical stripping. Removing paint from wood and plaster features can be done with either caustic strippers (potassium or sodium hydroxide) or solvent strippers (organic compounds such as methylene chloride, methanol, or toluol). Caustic strippers are fairly fast acting, but can weaken wood fibers if left on too long, causing them to raise and separate. They also leave alkaline residues which must be neutralized by an acidic wash (usually white vinegar which contains 4% acetic acid). It is difficult to make the neutralizing 100% effective and, when it is not, chemical reactions between the alkaline residues and the new paint may cause the paint to lose adhesion.

Methylene chloride and other organic compounds are as effective as caustic strippers, but their fumes may be both flammable and toxic. While they may leave wood and plaster surfaces free from harmful residue, the newly cleaned surface must be washed down with mineral spirits or denatured alcohol before priming in order to remove additives, such as wax, that were put in the stripper to retard its drying. All hazard warnings on the labels of chemical strippers should be heeded.

Detergent or vinegar and water. Waterbased paints can usually be scrubbed off with hot water with a detergent added. Calcimine and whitewash are difficult to remove; because of the lime or whiting content (calcium carbonate), however, they can be broken down with acids. While strong acids may work quickly, they are very dangerous. Acetic acid in its most common form, vinegar, (4% acetic acid) is often used instead. In areas where any calcimine remains and is evident as chalk, the area can be coated with white shellac, which provides a stable surface for the new paint.

Air pressure. Air pressure of 200-500 psi is effective for flat surfaces if there is a weak substrate surface bond. A flat nozzle is inserted between the paint layer and substrate, and the air pressure simply lifts the loose paint up for easy removal. When used carefully, this method is fast and causes little damage.

Patching and Repair. Once the substrate and its surface are sound and clean, free from crumbling, loose material or dust, the next step is to undercut and fill any cracks in plaster surfaces. Plaster which has lost its key and is sagging should be reattached or replaced. Friable plaster and punky wood need to be consolidated. Wood surfaces should be made as smooth as they were historically so that the paint film will cover a relatively uniform surface. Rotted wood must be removed and new wood carefully spliced in. Finally, gypsum plaster finishes can be painted as soon as the water has evaporated; a lime putty coat or traditional finish plaster can be primed almost immediately after drying as well, using alkaliresistant primers such as acrylic latex.

Priming. The importance of a primer can hardly be overstated. It is the intermediary material between the immediate substrate, which may be an old paint layer or may be bare wood, plaster, or metal (rarely stone, as around a fireplace opening), and the fresh paint itself. The primer must be capable of being absorbed to some extent by the material underneath while being compatible and cohesive with the paint to be applied on top. Most paint manufacturers will provide explicit instructions about which primers are most compatible with their paints. Those instructions should be followed.

The question of a primer for latex paint continues to be debated. Traditionalists recommend that the primer between an old oil paint and a new latex paint be an oil primer, but the improvements to latex paint in recent years have led many experts to the conclusion that today's top grade latex primers are best for latex finish paints. If a latex primer is selected, the label on the can should specify clearly that it is one which can bond to an older oil or oil/alkyd paint.

The most important general rule to remember is that softer or weaker paints should always go over harder and stronger paints. For instance, because latex is stronger than oil, an oil or oil/alkyd paint can go over a well adhered latex, but the reverse will run the risk of failure. Using primer and finish paints by a single company is a good way to guarantee compatibility.

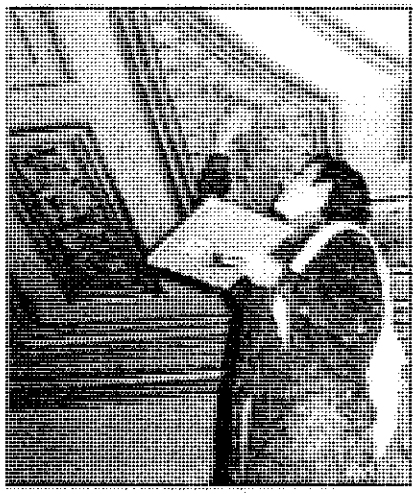
Choosing Modern Paint Types/Finish Coats

Most frequently today, the project goal is preservation or rehabilitation. Because of the impracticality of replicating historic paints, restoration is least often undertaken. Given current laws restricting the use of toxic ingredients, such as lead, solvents, and thinners, contemporary substitute paints using safer ingredients need to be used. Many paint companies make latex paints in colors that are close to historic colors as well as appropriate gloss levels, but contain no white lead and no hazardous volatile organic compounds.

Work on historic properties generally requires the services of a qualified paint contractor who has had at least five years of experience and who can list comparable jobs that a potential client can see. Then, too, getting a sample or a mockup of any special work may be advisable before the job starts. While less experienced workers may be acceptable for preparing and priming, it is wise to have the most experienced painters on the finish work.

Oil-based/alkyd paints. Today's version of oil paint has a binder that usually contains some linseed oil (read the paint can label), but also has one of the improved synthesized oils, frequently soybased, known as alkyds. They dry hard, have flexibility, and discolor far less than linseed oil. They can also be manufactured to dry with a high sheen, and can take enough tinting pigment to create even the very deep Victorian period colors. However, they all contain volatile organic compounds, and thus are forbidden by law in some parts of the United States. They are also less simple and more dangerous to use, as cleaning up involves mineral spirits.

Acrylic waterborne paints (latex). Latex paints are synthetic resins carried in water. Before the paint dries or crosslinks, it can be cleaned up with water. Early in the history of latex paints, some contained styrene/butadiene resins. Now nearly all topgrade latex paints contain acrylic resins, which are superior. Also, until fairly recently, the latex paints, while offering great strength, quick drying, and water cleanup, had some disadvantages for jobs which needed to have an historic look. Today, there are latex product lines with better gloss characteristics and more historic colors from which to choose. In addition, latex paints often have excellent color retention with very little fading. Still, it is always a good idea to buy a quart and "test paint" the color chosen for the job on site before making a total commitment.



Traditional water-based paint and artists' brushes are being used to reproduce historic finishes within a restoration project. Photo: Courtesy, Alexis Elza.

Calcimine/whitewash. Modern waterbased paints such as calcimine can be purchased today and have much the same appearance as the early ones. The same is true of modern whitewash, although today's whitewashes do not leave the same ropy surface texture as the early ones.

Glazes. Glazes were often part of historic paint treatments. Traditionally oil and turpentine, sometimes with a scant amount of pigment, today's glazes can be formulated with a water base and are relatively simple to apply by brush. An experienced decorative painter should be consulted before deciding whether to use a glaze coat rather than a high-gloss enamel. The glaze is capable of providing protection as well as a more accurate historic appearance that includes a greater depth to the finish.

Epoxies/Urethane. These were not available until relatively recently and thus are not appropriate for replication of traditional finishes.

Applying Interior Paints

Because flat wall surfaces generally dominate an interior painting job, some flexibility in applicators is suggested below:

Brushes. Natural bristle brushes now have competition from synthetic brushes made of nylon or polyester which work well for applying either oil/alkyd or latex paints. Being harder than natural bristles, they tend to last longer. Since brushes come in a wide and very specific variety of types suited to different types of work, it is important to have a painter who will use the appropriate brush for the paint selected and for each portion of the job. One strong advantage of brushing paint on is that the paint is forced onto the surface and into all of its imperfections. Thus a good brushedon paint job may last longer if the substrate is sound and the primer and finish coats are compatible and of top quality.

Rollers. There is no harm in using a roller, or even an airless sprayer, to apply a prime coat to a large flat area. Since all contemporary commercial paints dry with a smooth surface anyway, use of a roller or sprayer is acceptable for priming, and even for a first finish coat. However, to get paint well pushed into articulated surfaces and to add some texture to larger flat surfaces, a brush is best.

Types of Modern Paint

Oilbased/alkyd: Nonvolatile oils and resins, with thinners. (Alkyds are synthetic, gelatinous resins compounded from acids and alcohol.) Accept almost any type of coloring/hiding pigments. For use on interior wood and metal.

Acrylic waterborne paints (latex): Suspension of acrylic or polyvinyl resins in water, with other resins, plus hiding and coloring pigments and extenders. Dries by evaporation. Commercially produced acrylic or latex enamels are also available in a complete range of gloss levels which are produced with the addition of various acrylic polymers. Use on interior plaster especially.

Enamels: Modern alkyd paints are adjusted with the addition of synthetic varnishes to produce a complete range of gloss levels.

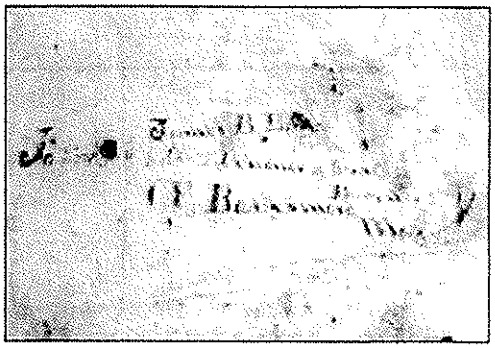
Metal finishes: Paints marketed for use on metals, can either be alkyd, latex, or epoxy based, or combinations. The primers used for metals are formulated with rustinhibiting ingredients.

Special finishes: finishes such as urethane and epoxy-based paints, marketed for very high gloss surface treatments.

Finally, decorative paint work in an historic interior-- whether simple or highstyle--is well worth preserving or restoring, and when such fancy work is being undertaken, traditional tools should always be used. To simplify by using shortcut methods or rejecting painted decoration is indeed to dismiss or skew history as well as to lose the enjoyment of a true historic finish.

Summary

First, it is most important to understand the range of approaches and treatments and to make choices with as much knowledge of the original and subsequent historic paints as possible, using the ***Secretary of the Interior's Standards for the Treatment of Historic Properties*** as a framework.



When discovered, important examples of history, such as this pencilled Civil War graffiti, should be preserved. Photo: Kaye Ellen Simonson.

A paint's patina of age expresses decades or centuries of endurance in the face of changing climate and conditions. Documenting the sequence of interior paint layers and protecting this information for future investigation should be an integral part of any historic preservation project.

Except for the rare, scholarly restorations of historic interiors, most repainting jobs done today will employ modern paint formulations. Modern paints can recreate the appearance of historic colors, gloss and texture in varying degrees, but eliminate earlier toxic components such as white lead and volatile organic compounds.

CAUTION: Before Painting Know Paint Hazards and Take Action

Before undertaking any project involving paint removal, applicable State and Federal laws on lead paint abatement and disposal must be taken into account and carefully followed. State and Federal requirements may affect options available to owners on both paint removal and repainting. These laws, as well as any requirements prohibiting volatile organic compounds (VOCs), should be requested from the State Historic Preservation Officer in each State.

Below is a summary of the health hazards that owners, managers, and workers need to be aware of before removing paint and repainting:

Lead and other heavy metal compounds. In virtually all paints made before 1950, the white or "hiding" pigment was a lead compound, or more rarely, zinc oxide. Work to remove lead paint such as scraping and dry sanding releases the lead--a highly damaging heavy metal--in dust. Lead dust then enters the human system through pores of the skin and through the lungs. The use of heat for stripping also creates toxic lead fumes which can be inhaled.

To mitigate the hazards of lead paint ingestion, inhalation, or contact, it is extremely important to prevent the dust from circulating by masking room openings and removing all curtains, carpeting, and upholstered furniture. Drop cloths and masking containing lead dust should be carefully enclosed in tight plastic bags before removal. Workers and others in the room should wear High Efficiency Particulate Air (HEPA) filters for lead dust (fume filters if heat stripping is being used), change clothing just outside the room leaving the work clothes inside, and avoid any contact between bare skin (hands) and the paint being removed. Workers should also not eat, drink, or smoke where lead dust is present. Finally, anyone involved in lead paint removal should undergo

periodic blood testing. After work, ordinary vacuuming is not enough to remove lead dust; special HEPA vacuums are essential. The surfaces of the room must also be given a final wash with a solution of trisodium phosphate and water, changing the washing solution often and rinsing well.

In addition to lead, early oil paints also had cobalt or other heavy metal compounds in them to accelerate drying. A small amount of mercury is also included in some latex paints to help prevent mildew and mold formation.

Volatile organic compounds (VOCs). Organic paint strippers, such as methylene chloride, and oil/alkyd paints have VOCs as their solvent base. Inhaling these fumes can lead to respiratory and other illnesses, and to cancer. Especially in closed spaces (but in the outdoor environment as well) these compounds pollute the air and can damage health.

Additional Reading

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Organizations

National Paint and Coatings Association
1500 Rhode Island Ave. N.W.
Washington, D.C. 20005

Painting and Decorating Contractors of America
3913 Old Lee Highway, Suite 33B
Fairfax, VA 22030

Federation of Societies for Coatings Technology
492 Norristown Rd.
Blue Bell, PA 19422-2350

Acknowledgements

Thanks go to the technical experts in the field who reviewed the draft manuscript and made substantive contributions: Andrea M. Gilmore (Director, Architectural Services, Society for the Preservation of New England Antiquities), Andy Ladygo (Jefferson's Poplar Forest), and Matthew J. Mosca, Historic Paint Research. Insightful comments were also offered by E. Blaine Cliver, Chief, Preservation Assistance Division. In addition, Technical Preservation Services Branch staff members (H. Ward Jandl, Chief) and the NPS Regions provided valuable suggestions on both content and organization.

Kay D. Weeks, Preservation Assistance Division, served as director of this cooperative publication project and general editor.

Washington, D.C. June, 1992

Home page logo: Restoration of decorative paint finishes. Photo: Sara B. Chase.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

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KITCHEN/BATHROOM

Original specs for Aladdin Homes, circa 1929:
"Metropolitan" Plumbing Fixtures set
Bathroom Medicine Cabinet and Bath Wall Fixture
Kitchen Sink #2, Kitchen Cabinet
Ivory Enamel Finish, one coat primer, two coats white lead and oil, one coat enamel

Character Defining Features:
None intact, except for fixtures listed under "Special Cases"

Typical in 2001:
Linoleum floors, flat paint, mix of appliances and fixtures

Special Cases:
Cottage 40 has a possibly original toilet
Cottage 6 has an original bath tub which has been painted brown, as well as an unusual corner sink fixture that may be historic. The kitchen cabinets may also be original.
Cottage 36, also known as the Cookhouse, has some interesting appliances in the kitchen that, while not original to the house, may be significant historically.

Condition:
Cottage 7 has moisture issues around the bathroom. Typically, showers have been installed in the original bathtub, some with new tubs. The window above this tub has presented some issues with relation to privacy and moisture. In cottage 7, paint bubbles under the bathroom window indicate moisture damage, possibly from the shower leaking out of the window. In cottage 35, a plastic tub unit replaced the original bath, and the window has been sided over. Cottage 35 is also missing the toilet and sink fixtures.

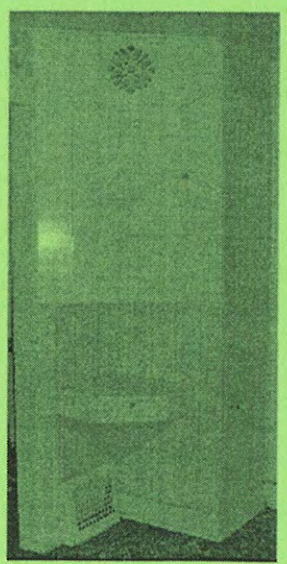
In this Section:
Fixtures
Flooring
Ceiling
Paint
Cabinets and Millwork

See also:
Interior Finishes
Systems

Operations

The bathroom in Cottage #36 appears to have the original tub and sink.

Cottage #36 features an altered kitchen for group meals.



Cottage #40 sppears to have the original corner kitchen cabinet and HVAC grate.

Kitchen/Bath

Fixtures/amenities

Retain historic sinks, tubs, toilets and medicine cabinets where found. See individual cottage assessments for items thought to be original.

Flooring

Inspect floor in plumbed areas for signs of moisture. Repair as needed.

Ceiling

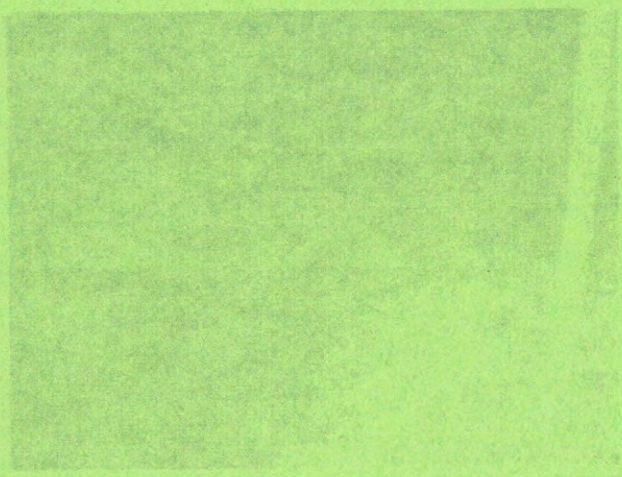
Inspect for signs of moisture. Repair and paint as needed.

Paint

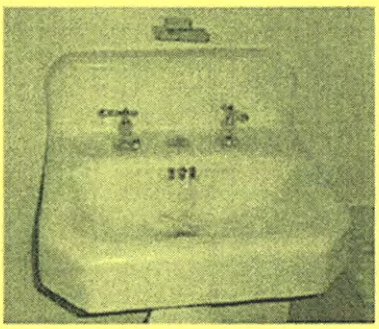
Ivory enamel finish was used originally in kitchen and bath. Enamel should be maintained for resistance to moisture and abrasion from cleaning. See paint section.

Cabinets/millwork

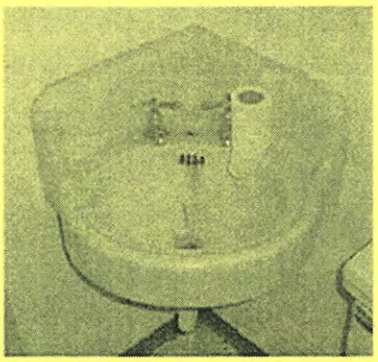
Retain historic pieces where present. See individual cottage assessments for items thought to be original.



Rehabilitation



Original "Metropolitan" set Aladdin bathroom sink.



Presumably original Traditional cottage bathroom sink

Detail of original claw-foot porcelain bath tub still existing in several cottages.

Bathrooms

Fixtures/Amenities

It is recommended that the houses which have original fixtures maintain those fixtures. In all other cases, attention to the historical nature of the buildings should influence the choices of new fixtures. Also see History section for details of original Aladdin fixtures.

Showers

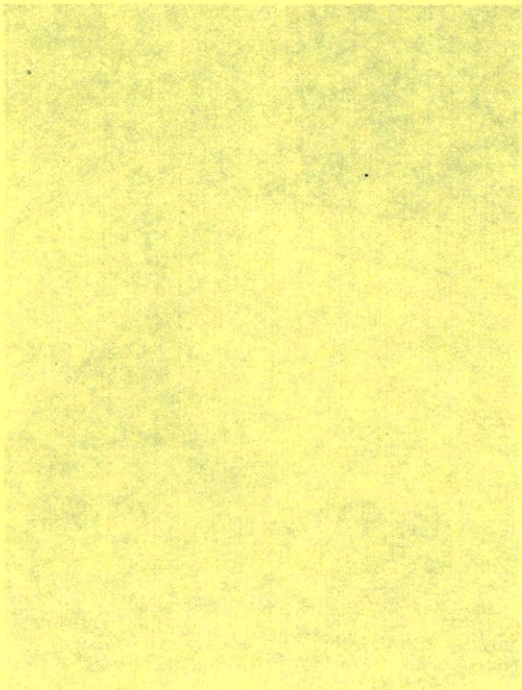
When showers are installed over a standing bath tub, it is recommend that shower curtains which encircle the tub be installed to keep water spray off the surrounding area.

Windows

Windows in the bath should not be sided over, made inoperable, or made impermeable, as this will interfere with the ventilation in the bath. It is recommended that shower curtains not be hung against the window, as this would trap moisture and cause mold.

Flooring

Sheet vinyl or tile is recommended for the floor. Originally, the floors would likely have been the same wood as the rest of the house, but it is impractical to consider this course of action today.



ATTIC/BASEMENT

Original specs for Aladdin Homes, circa 1929:
2/3 Basement, 22' x 26' (8" thick concrete foundation) Contractor supplies cement, sand, gravel, and lime
No specs for attic

Character Defining Features:
Board Formed Concrete Foundation

Typical in 2001:
2/3 basement, poured concrete. Mostly in good condition, but some evidence of exterior cracking is visible.
Blown wool insulation was consistent in all attics viewed.

Special Cases:
Cottages 7 & 8 have problem foundation windows
Cottage 35 has 4 boarded up foundation holes that look to be approximately window-size
Cottage 38 also has boarded up foundation windows

Condition:
Basement is generally in good condition. Many insect webs and nests were noted in the floor structures. The fuel bins are in need of cleaning. Most of the window hardware is missing, making these windows unlatchable.

Attic is mostly in good condition. Some moisture problems arising from chimney issues were apparent. In some places, roof joists have been compromised by improper installation of pipes into the bathroom. Some of the attic vents may not be impervious to animal infiltration. In cottage 40, the only attic assessed in depth, no vapor barrier was found under the insulation. The wool insulation was approximately 5 inches deep in between the 2x4 rafters. No efflorescence was found on the chimney. Many dead birds were found, with a possible entry location in a knot hole above the rear porch roof.

In this Section:
Venting
Structural Members
Stairs
Crawl space
Wiring

See also:
Systems
Chimney
Roof
Foundation

Operations

Structural roof members illustrate chimney penetration.

Blown rock wool insulation covers the attic floor.

Attic

Attic should be inspected yearly for leaks, deterioration and pest control.

Venting

All attics should be vented. To assure proper air flow, vents should never be covered or clogged with paint and should be cleaned yearly to remove debris.

Structural members

Inspect yearly for deterioration from pests and moisture. When installing pipes, vents or wiring that penetrate the attic and/or roof, do not ever alter, cut or remove structural roof members. Where this alteration has taken place, the structural integrity may be compromised. Refer to Stabilization and Rehabilitation for mitigation.

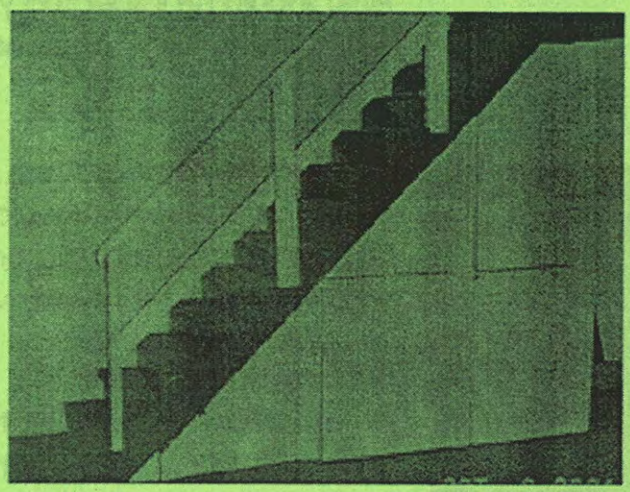
Insulation

All attic insulation should be replaced with Fiberglas blown mineral wool equal to R38, probably 10".
Do not compress insulation.
Do not store boxes on top of insulation.
Do not walk on insulation.
Keep levels even, and keep fluffy.

Chimney

Where the chimney penetrates the roof in the attic, inpsect carefully for signs of water infiltration. For repair, see Rehabilitation directive on chimney flashing. Inspect for effluorescence and seal if needed. Animal infiltration As birds have been found in cottages' attics, inspect annually and close off any entry points.

Operations



Cabinets beneath basement stairs utilize otherwise empty space.

A fuel bin, showing the fuel door, is a character-defining feature of these board-formed concrete foundations.

Basement

Stairs

An initial inspection should be made of all stairs for safety and stability. Repair and replace damaged parts in kind as necessary; see Rehabilitation for instructions.

Cabinetry

Basement cabinetry exists in most basements. Its historic integrity is unknown.

Crawlspace/wood storage

An initial cleaning of all wood storage areas is needed to remove buildup of waste, pests and vegetation.
Inspect seasonally for pests and/or moisture problems.

Structural members

Yearly inspections should check all wood members for deterioration from water and pests. Overhead floor support members should not be compromised and weakened by installation of pipes, ducts, wiring, etc. Wood members should also be kept clean of webs and pests.

Wiring

Inspect yearly for unsafe conditions such as water hazards and damage from pests. When rewiring, attempt to use existing paths and avoid drilling new holes in wood floors, trim and millwork.
f new holes must be created, drill through plaster, rather than wood work, on the interior. Monitor exterior holes for signs of moisture damage.

SYSTEMS

Original specs for Aladdin Homes, circa 1929:
22" fire pot hot-air Pipe Furnace with necessary floor grills, individual side registers for rooms, hot and cold air pipes, smoke piep, oak cold air grills, asbestos pipe covering (from Marshall-Wells Co., Portland, OR)
??"Hartford" type #922
Plumbing Fixtures – "Metropolitan" set (contractor supplied all plumbing materials and fittings)
Electric Fixtures – "Favorite" set, wired, without bulbs

House Kit Difference, 1930, cottages #35-38??
#23 Montag oval firepot, hot-air pipe furnace, with same as above (from Montag Stove Works, Portland, OR)

Contractor to Supply: Laundry Trays, Hot Water Tanks, Sewer Piping

Character Defining Features:
None

Typical in 2001:
There is no typical fixture or system at this time.

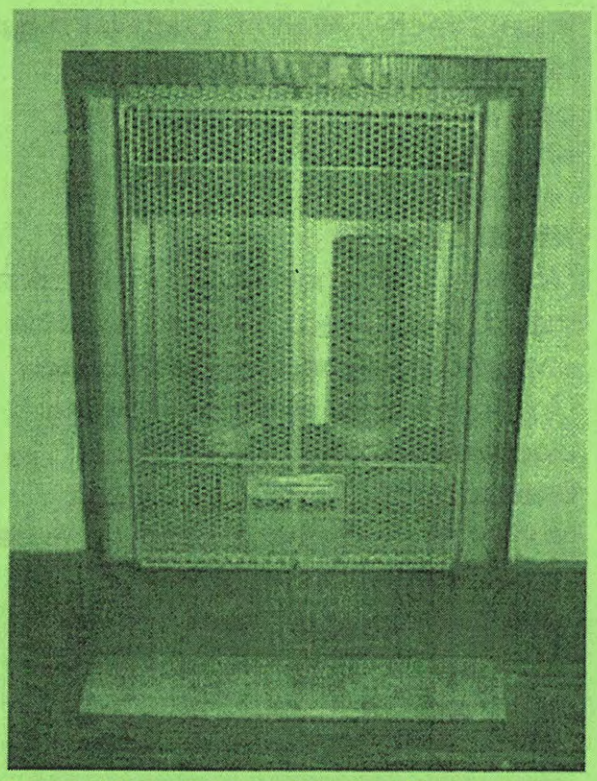
Special Cases:
None

Condition:
Ducts, Pipes and Hot Water Heaters were found to be uninsulated in houses assessed

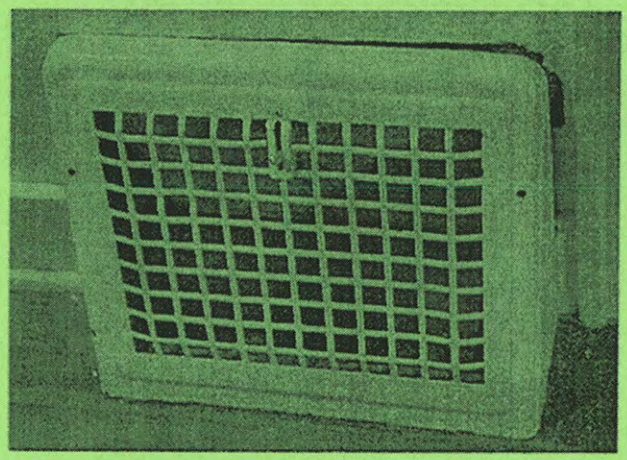
In this Section:
Fixtures
HVAC
Wiring
Brief #24: Heating, Ventilating, and Cooling Historic Buildings

See also:
Basement
Attic
Chimney
Interior Finishes

Operations



Some buildings feature this Singer Electromode three-coil electric wall heater; some with varnished trim.



Several of the cottages include HVAC grates that appear to be original.

Systems

Electrical/fixtures

Where present, historic fixtures should be maintained. Wiring should be inspected for unsafe conditions and fire hazards. If upgrades are made to comply with modern codes, care should be taken to retain visual historic features.

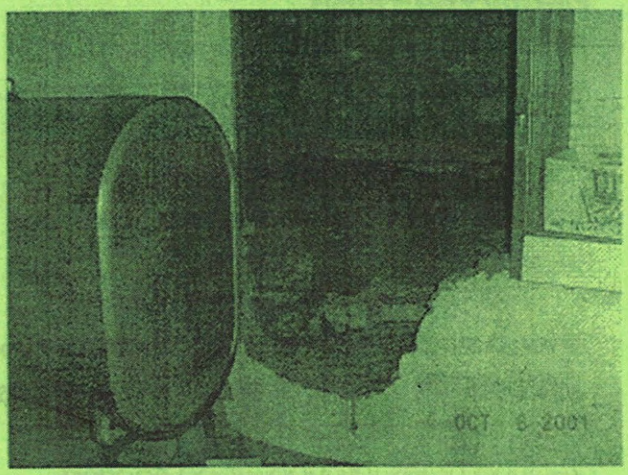
When running new electrical wires, cable and antenna connections, ducts or pipes, every attempt should be made to avoid creating holes through wood flooring, wood trim and millwork. If holes must be drilled, they should be made through the plaster wall.

HVAC registers

Registers and trim that appear to be historic should be maintained. All registers should be cleaned yearly to prevent buildup and blockage and to promote proper air flow and human health.

Cottage temperatures should be maintained at no less than 50 degrees Farenheit year-round. This keeps the cottages warm enough to prevent moisture deterioration, and helps to keep the HVAC system in order.

Operations



A fuel oil tank stands beside the entry to the basement fuel bin.

Ductwork

Inspect yearly. All HVAC ductwork should be cleaned yearly to assure proper performance and improve energy efficiency.

HVAC/systems

Manufacturer's maintenance instructions should be followed. Air filters should be changed yearly when system is in use. Motors should be oiled and strainers cleaned yearly.

Drainage

Monitor for problems. For initial issues, see Stabilization.

24 Preservation Briefs
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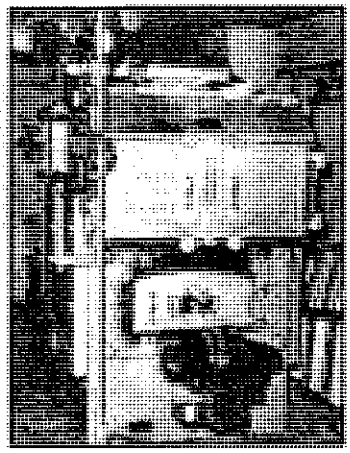
Heating, Ventilating, and Cooling Historic Buildings

Problems and Recommended Approaches

Sharon C. Park, AIA



»History of Mechanical Systems
»Climate Control and Preservation
»Planning the New System
»Overview of HVAC Systems
» Designing the new system
»Systems Performance and Maintenance
»HVAC Do's and Don'ts
»Conclusion
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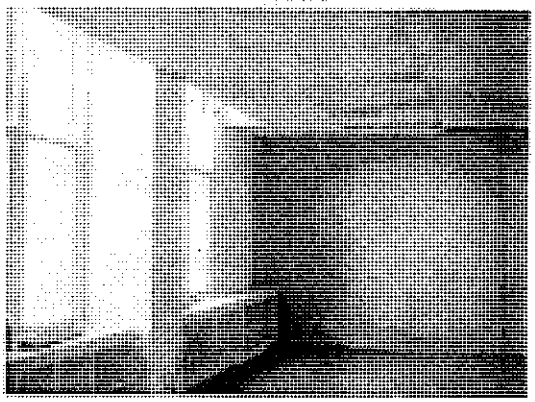
The need for modern mechanical systems is one of the most common reasons to undertake work on historic buildings. Such work includes upgrading older mechanical systems, improving the energy efficiency of existing buildings, installing new heating, ventilation or air conditioning (HVAC) systems, or--particularly for museums--installing a climate control system with humidification and dehumidification capabilities. Decisions to install new HVAC or climate control systems often result from concern for occupant health and comfort, the desire to make older buildings marketable, or the need to provide specialized environments for operating computers, storing artifacts, or displaying museum collections. Unfortunately, occupant comfort and concerns for the objects within the building are sometimes given greater consideration than the building itself. In too many cases, applying modern standards of interior climate comfort to historic buildings has proven detrimental to historic materials and decorative finishes.

This Preservation Brief underscores the importance of careful planning in order to balance the preservation objectives with interior climate needs of the building. It is not intended as a technical guide to calculate tonnage or to size piping or ductwork. Rather, this Brief identifies some of the problems associated with installing mechanical systems in historic buildings and recommends approaches to minimizing the physical and visual damage associated with installing and maintaining these new or upgraded systems.

Historic buildings are not easily adapted to house modern precision mechanical systems. Careful planning must be provided early on to ensure that decisions made during the design and installation phases of a new system are appropriate. Since new mechanical and other related systems, such as electrical and fire suppression, can use up to 10% of a building's square footage and 30%-40% of an overall rehabilitation budget, decisions must be made in a systematic and coordinated manner. The installation of inappropriate mechanical systems may result in any or all of the following:

- large sections of historic materials are removed to install or house new systems.
- historic structural systems are weakened by carrying the weight of, and sustaining vibrations from, large equipment.

- moisture introduced into the building as part of a new system migrates into historic materials and causes damage, including biodegradation, freeze/thaw action, and surface staining.
- exterior cladding or interior finishes are stripped to install new vapor barriers and insulation.
- historic finishes, features, and spaces are altered by dropped ceilings and boxed chases or by poorly located grilles, registers, and equipment.
- systems that are too large or too small are installed before there is a clearly planned use or a new tenant.



The dropped ceilings covering an air conditioning system also cover the historic windows, altering their proportion and resulting in loss of the historic character. Photo: NPS files.

For historic properties it is critical to understand what spaces, features, and finishes are historic in the building, what should be retained, and what the realistic heating, ventilating, and cooling needs are for the building, its occupants, and its contents. A systematic approach, involving preservation planning, preservation design, and a follow-up program of monitoring and maintenance, can ensure that new systems are successfully added--or existing systems are suitably upgraded--while preserving the historic integrity of the building.

No set formula exists for determining what type of mechanical system is best for a specific building. Each building and its needs must be evaluated separately. Some buildings will be so significant that every effort must be made to protect the historic materials and systems in place with minimal intrusion from new systems. Some buildings will have museum collections that need special climate control. In such cases, curatorial needs must be considered--but not to the ultimate detriment of the historic building resource. Other buildings will be rehabilitated for commercial use. For them, a variety of systems might be acceptable, as long as significant spaces, features, and finishes are retained.

Most mechanical systems require upgrading or replacement within 15-30 years due to wear and tear or the availability of improved technology. Therefore, historic buildings should not be greatly altered or otherwise sacrificed in an effort to meet short-term systems objectives.

History of Mechanical Systems

The history of mechanical systems in buildings involves a study of inventions and ingenuity as building owners, architects, and engineers devised ways to improve the interior climate of their buildings. Following are highlights in the evolution of heating, ventilating, and cooling systems in historic buildings.

Eighteenth Century. Early heating and ventilation in America relied upon common sense methods of managing the environment. Builders purposely sited houses to capture winter sun and prevailing summer cross breezes; they chose materials that could help protect the inhabitants from the elements, and took precautions against precipitation and damaging drainage patterns. The location and sizes of windows, doors, porches, and the floor plan itself often evolved to maximize ventilation. Heating was primarily from fireplaces or stoves and, therefore, was at the source of delivery. In 1744, Benjamin Franklin designed his "Pennsylvania stove" with a fresh air intake in order to maximize the heat radiated into the room and to minimize annoying smoke.

Thermal insulation was rudimentary--often wattle and daub, brick and wood nogging. The comfort level for occupants was low, but the relatively small difference between internal and external temperatures and relative humidity allowed building materials to expand and contract with the seasons.

Regional styles and architectural features reflected regional climates. In warm, dry and sunny climates, thick adobe walls offered shelter from the sun and kept the inside temperatures cool. Verandas, courtyards, porches, and high ceilings also reduced the impact of the sun. Hot and humid climates called for elevated living floors, louvered grilles and shutters, balconies, and interior courtyards to help circulate air.

Nineteenth Century. The industrial revolution provided the technological means for controlling the environment for the first time. The dual developments of steam energy from coal and industrial mass production made possible early central heating systems with distribution of heated air or steam using metal ducts or pipes. Improvements were made to early wrought iron boilers and by late century, steam and low pressure hot water radiator systems were in common use, both in offices and residences. Some large institutional buildings heated air in furnaces and distributed it throughout the building in brick flues with a network of metal pipes delivering heated air to individual rooms. Residential designs of the period often used gravity hot air systems utilizing decorative floor and ceiling grilles.

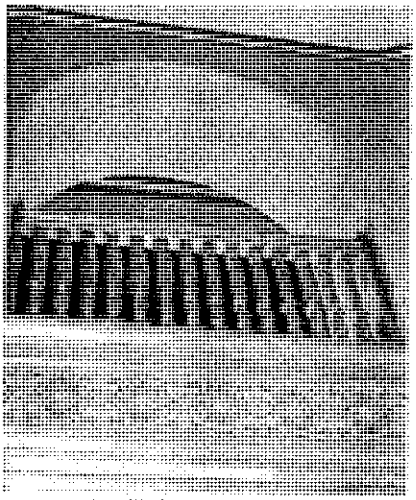
Ventilation became more scientific and the introduction of fresh air into buildings became an important component of heating and cooling. Improved forced air ventilation became possible in mid-century with the introduction of power-driven fans. Architectural features such as porches, awnings, window and door transoms, large openwork iron roof trusses, roof monitors, cupolas, skylights and clerestory windows helped to dissipate heat and provide healthy ventilation.

Cavity wall construction, popular in masonry structures, improved the insulating qualities of a building and also provided a natural cavity for the dissipation of moisture produced on the interior of the building. In some buildings, cinder chips and broken masonry filler between structural iron beams and jack arch floor vaults provided thermal insulation as well as fireproofing. Mineral wool and cork were new sources of lightweight insulation and were forerunners of contemporary batt and blanket insulation.

The technology of the age, however, was not sufficient to produce "tight" buildings. There was still only a moderate difference between internal and external temperatures. This was due, in part, to the limitations of early insulation, the almost exclusive use of single glazed windows, and the absence of airtight construction. The presence of ventilating fans and the reliance on architectural features, such as operable windows, cupolas and transoms, allowed sufficient air movement to keep buildings well ventilated. Building materials could behave in a fairly traditional way, expanding and contracting with the seasons.

Twentieth Century. The twentieth century saw intensive development of new technologies and the notion of fully integrating mechanical systems. Oil and gas furnaces developed in the nineteenth century were improved and made more efficient, with electricity becoming the critical source of power for building systems in the latter half of the century. Forced air heating systems with ducts and registers became popular for all types of buildings and allowed architects to experiment with architectural forms free from mechanical encumbrances. In the 1920s large-scale theaters and auditoriums introduced central air conditioning, and by mid-century forced air systems which combined heating and air conditioning in the same ductwork set a new standard for comfort and convenience. The combination and coordination of a variety of systems came together in the post-World War II high-rise buildings; complex heating and air conditioning plants, electric elevators, mechanical towers, ventilation fans, and full service electric lighting were integrated into the building's design.

The insulating qualities of building materials improved. Synthetic materials, such as spun fiberglass batt insulation, were fully developed by mid-century. Prototypes of insulated thermal glazing and integral storm window systems were promoted in construction journals. Caulking to seal out perimeter air around window and door openings became a



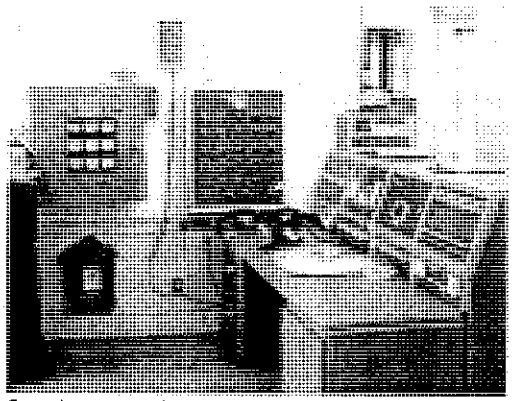
A return air grille is successfully screened behind the arch. Photo: NPS files.

standard construction detail.

The last quarter of the twentieth century has seen making HVAC systems more energy efficient and better integrated. The use of vapor barriers to control moisture migration, thermally efficient windows, caulking and gaskets, compressed thin wall insulation, has become standard practice. New integrated systems now combine interior climate control with fire suppression, lighting, air filtration, temperature and humidity control, and security detection. Computers regulate the performance of these integrated systems based on the time of day, day of the week, occupancy, and outside ambient temperature.

Climate Control and Preservation

Although twentieth century mechanical systems technology has had a tremendous impact on making historic buildings comfortable, the introduction of these new systems in older buildings is not without problems. The attempt to meet and maintain modern climate control standards may in fact be damaging to historic resources. Modern systems are often over-designed to compensate for inherent inefficiencies of some historic buildings materials and plan layouts. Energy retrofit measures, such as installing exterior wall insulation and vapor barriers or the sealing of operable window and vents, ultimately affect the performance and can reduce the life of aging historic materials.



Complex mechanical systems for institutional buildings may require a central control room. Photo: NPS files.

In general, the greater the differential between the interior and exterior temperature and humidity levels, the greater the potential for damage. As natural vapor pressure moves moisture from a warm area to a colder, dryer area, condensation will occur on or in building materials in the colder area. Too little humidity in winter, for example, can dry and crack historic wooden or painted surfaces. Too much humidity in winter causes moisture to collect on cold surfaces, such as windows, or to migrate into walls. As a result, this condensation deteriorates wooden or metal windows and causes rotting of walls and wooden structural elements, dampening insulation and holding moisture against exterior surfaces. Moisture migration through walls can cause the corrosion of metal anchors, angles, nails or wire lath, can blister and peel exterior paint, or can leave efflorescence and salt deposits on exterior masonry. In cold climates, freeze-thaw damage can result from excessive moisture in external walls.

To avoid these types of damage to a historic building, is important to understand how building components work together as a system. Methods for controlling interior temperature and humidity and improving venation must be considered in any new or upgraded HVAC or climate control system. While certain energy retrofit measures will have a positive effect on the overall building, installing effective vapor barriers in historic walls is difficult and often results in destruction of significant historic materials.

Planning the New System

temperature: air, water, or a combination of both. The complexity of choices facing a building owner or manager means that a systematic approach is critical in determining the most suitable system for a building, its contents, and its occupants. No matter which system is installed, a change in the interior climate will result. This physical change will in turn affect how the building materials perform. New registers, grilles, cabinets, or other accessories associated with the new mechanical system will also visually change the interior (and sometimes the exterior) appearance of the building. Regardless of the type or extent of a mechanical system, the owner of a historic building should know before a system is installed what it will look like and what problems can be anticipated during the life of that system. The potential harm to a building and costs to an owner of selecting the wrong mechanical system are very great.

The use of a building and its contents will largely determine the best type of mechanical system. The historic building materials and construction technology as well as the size and availability of secondary spaces within the historic structure will affect the choice of a system. It may be necessary to investigate a combination of systems. In each case, the needs of the user, the needs of the building, and the needs of a collection or equipment must be considered. It may not be necessary to have a comprehensive climate control system if climate-sensitive objects can be accommodated in special areas or climate-controlled display cases. It may not be necessary to have central air conditioning in a mild climate if natural ventilation systems can be improved through the use of operable windows, awnings, exhaust fans, and other "lowtech" means. Modern standards for climate control developed for new construction may not be achievable or desirable for historic buildings. In each case, the lowest level of intervention needed to successfully accomplish the job should be selected.

Before a system is chosen, the following planning steps are recommended:

1. Determine the use of the building. The proposed use of the building (museum, commercial, residential, retail) will influence the type of system that should be installed. The number of people and functions to be housed in a building will establish the level of comfort and service that must be provided. Avoid uses that require major modifications to significant architectural spaces. What is the intensity of use of the building: intermittent or constant use, special events or seasonal events? Will the use of the building require major new services such as restaurants, laundries, kitchens, locker rooms, or other areas that generate moisture that may exacerbate climate control within the historic space? In the context of historic preservation, uses that require radical reconfigurations of historic spaces are inappropriate for the building.

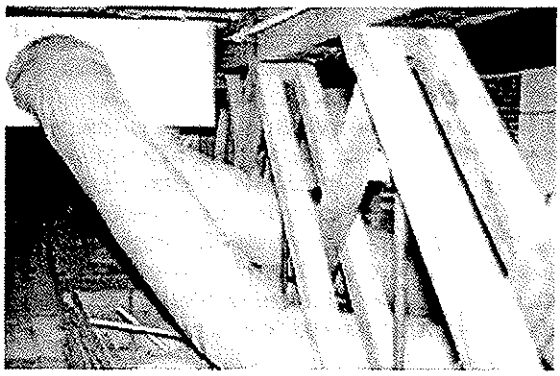
2. Assemble a qualified team. This team ideally should consist of a preservation architect, mechanical engineer, electrical engineer, structural engineer, and preservation consultants, each knowledgeable in codes and local requirements. If a special use (church, museum, art studio) or a collection is involved, a specialist familiar with the mechanical requirements of that building type or collection should also be hired.

Team members should be familiar with the needs of historic buildings and be able to balance complex factors: the preservation of the historic architecture (aesthetics and conservation), requirements imposed by mechanical systems (quantified heating and cooling loads), building codes (health and safety), tenant requirements (quality of comfort, ease of operation), access (maintenance and future replacement), and the overall cost to the owner.

3. Undertake a condition assessment of the existing building and its systems. What are the existing construction materials and mechanical systems? What condition are they in and are they reusable? Where are existing chillers, boilers, air handlers, or cooling towers located? Look at the condition of all other services that may benefit from being integrated into a new system, such as electrical and fire suppression systems. Where can energy efficiency be improved to help downsize any new equipment added, and which of the historic features, e.g. shutters, awnings, skylights, can be reused? Evaluate air infiltration through the exterior envelope; monitor the interior for temperature and humidity levels with hygrothermographs for at least a year. Identify building, site, or equipment deficiencies or the presence of asbestos that must be corrected prior to the installation or upgrading of mechanical systems.

4. Prioritize architecturally significant spaces, finishes, and features to be preserved.

Significant architectural spaces, finishes and features should be identified and evaluated at the outset to ensure their preservation. This includes significant existing mechanical systems or elements such as hot water radiators decorative grilles, elaborate switch-plates, and nonmechanical architectural features such as cupolas, transoms, or porches. Identify nonsignificant spaces where mechanical equipment can be placed and secondary spaces where equipment and distribution runs on both a horizontal and vertical basis can be located. Appropriate secondary spaces for housing equipment might include attics, basements, penthouses, mezzanines, false ceiling or floor cavities, vertical chases, stair towers, closets, or exterior below-grade vaults.



The flexible duct work, seen here, can be used to advantage in tight attic spaces. Photo: NPS files.

5. Become familiar with local building and fire codes. Owners or their representatives should meet early and often with local officials. Legal requirements should be checked; for example, can existing ductwork be reused or modified with dampers? Is asbestos abatement required? What are the energy, fire, and safety codes and standards in place, and how can they be met while maintaining the historic character of the building? How are fire separation walls and rated mechanical systems to be handled between multiple tenants? Is there a requirement for fresh air intake for stair towers that will affect the exterior appearance of the building? Many of the health, energy, and safety code requirements will influence decisions made for mechanical equipment for climate control. It is importance to know what they are before the design phase begins.

6. Evaluate options for the type and size of systems. A matrix or feasibility studies should be developed to balance the benefits and drawbacks of various systems. Factors to consider include heating and/or cooling, fuel type, distribution system, control devices, generating equipment and accessories such as filtration, and humidification. What are the initial installation costs, projected fuel costs, long-term maintenance, and life-cycle costs of these components and systems? Are parts of an existing system being reused and upgraded? The benefits of added ventilation should not be overlooked. What are the tradeoffs between one large central system and multiple smaller systems? Should there be a forced air ducted system, a two-pipe fan coil system, or a combined water and air system? What space is available for the equipment and distribution system? Assess the fire risk levels of various fuels. Understand the advantages and disadvantages of the various types of mechanical systems available. Then evaluate each of these systems in light of the preservation objectives established during the design phase of planning.

Overview of HVAC Systems

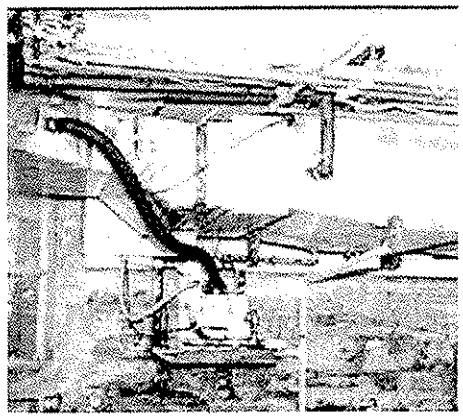
WATER SYSTEMS: Hydronic radiators, Fan coil, or radiant pipes

Water systems are generally called hydronic and use a network of pipes to deliver water to hot water radiators, radiant pipes set in floors or fan coil cabinets which can give both heating and cooling. Boilers produce hot water or steam; chillers produce chilled water for use with fan coil units. Thermostats control the temperature by zone for radiators and radiant floors.

Fan coil units have individual controls. Radiant floors provide quiet, even heat, but are not common.

Advantages: Piped systems are generally easier to install in historic buildings because the pipes are smaller than ductwork.

Disadvantages: There is the risk, however, of hidden leaks in the wall or burst pipes in winter if boilers fail. Fan coil condensate pans can overflow if not properly maintained. Fan coils may be noisy.



A fan coil unit in the basement is feeding controlled air to a primary space upstairs. Photo: Courtesy, Karen Sweeney, Frank Lloyd Wright Home & Studio.

Hydronic Radiators: Radiators or baseboard radiators are looped together and are usually set under windows or along perimeter walls. New boilers and circulating pumps can upgrade older systems. Most piping was cast iron although copper systems can be used if separately zoned. Modern cast iron baseboards and copper fin-tubes are available. Historic radiators can be reconditioned.

Fan Coil Units: Fan coil systems use terminal cabinets in each room serviced by 2, 3, or 4 pipes approximately 11/2" each in diameter. A fan blows air over the coils which are serviced by hot or chilled water. Each fan coil cabinet can be individually controlled. Four-pipe fan coils can provide both heating and cooling all year long. Most piping is steel. Non-cabinet units may be concealed in closets or custom cabinetry, such as benches, can be built.

CENTRAL AIR SYSTEMS

The basic heating, ventilation and air conditioning (HVAC) system is all-air, single zone fan driven designed for low, medium or high pressure distribution. The system is composed of compressor drives, chillers, condensers, and furnace depending on whether the air is heated, chilled or both. Condensers, generally air cooled, are located outside. The ducts are sheet metal or flexible plastic and can be insulated. Fresh air can be circulated. Registers can be designed for ceilings, floors and walls. The system is controlled by thermostats; one per zone.

Advantages: Ducted systems offer a high level of control of interior temperature, humidity, and filtration. Zoned units can be relatively small and well concealed.

Disadvantages: The damage from installing a ducted system without adequate space can be serious for a historic building. Systems need constant balancing and can be noisy.

Basic HVAC: Most residential or small commercial systems will consist of a basic furnace with a cooling coil set in the unit and a refrigerant compressor or condenser located outside the building. Heating and cooling ductwork is usually shared. If sophisticated humidification and dehumidification is added to the basic HVAC system, a full climate control system results. This can often double the size of the equipment.

Basic Heat Pump/Air System: The heat pump is a basic HVAC system as described above except for the method of generating hot and cold air. The system operates on the basic

refrigeration cycle where latent heat is extracted from the ambient air and is used to evaporate refrigerant vapor under pressure. Functions of the condenser and evaporator switch when heating is needed. Heat pumps, somewhat less efficient in cold climates, can be fitted with electric resistance coil.

COMBINED AIR AND WATER SYSTEMS

These systems are popular for restoration work because they combine the ease of installation for the piped system with the performance and control of the ducted system. Smaller air handling units, not unlike fan coils, may be located throughout a building with service from a central boiler and chiller. In many cases the water is delivered from a central plant which services a complex of buildings.

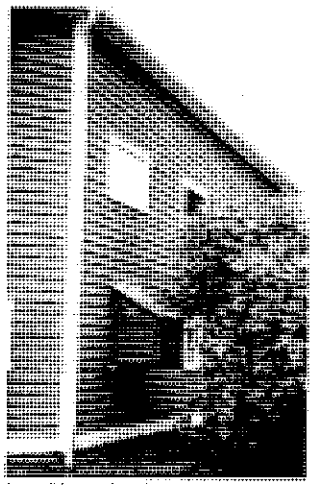
This system overcomes the disadvantages of a central ducted system where there is not adequate horizontal or vertical runs for the ductwork. The equipment, being smaller, may also be quieter and cause less vibration. If only one air handler is being utilized for the building, it is possible to house all the equipment in a vault outside the building and send only conditioned air into the structure.

Advantages: flexibility for installation using greater piping runs with shorter ducted runs; Air handlers can fit into small spaces.

Disadvantages: piping areas may have undetected leaks; air handlers may be noisy.

OTHER SYSTEM COMPONENTS

Non-systems components should not be overlooked if they can make a building more comfortable without causing damage to the historic resource or its collection.



Installing a fan (successfully concealed here) for increased ventilation can be a successful low-tech substitute for air conditioning. Photo: Courtesy, Shelburne Village.

Advantages: components may provide acceptable levels of comfort without the need for an entire system.

Disadvantages: Spot heating, cooling and fluxuations in humidity may harm sensitive collections or furnishings. If an integrated system is desirable, components may provide only a temporary solution.

Portable Air Conditioning:

Most individual air conditioners are set in windows or through exterior walls which can be visually as well as physically damaging to historic buildings. Newer portable air conditioners are available which sit in a room and exhaust directly to the exterior through a small slot created by a raised window sash.

Fans: Fans should be considered in most properties to improve ventilation. Fans can be located in attics, at the top of stairs, or in individual rooms. In moderate climates, fans may eliminate the need to install central air systems.

Dehumidifiers: For houses without central air handling systems, a dehumidifier can resolve problems in humid climates. Seasonal use of dehumidifiers can remove moisture from damp basements and reduce fungal growth.

Heaters: Portable radiant heaters, such as those with water and glycol, may provide temporary heat in buildings used infrequently or during systems breakdowns. Care should be taken not to create a fire hazard with improperly wired units.

Designing the new system

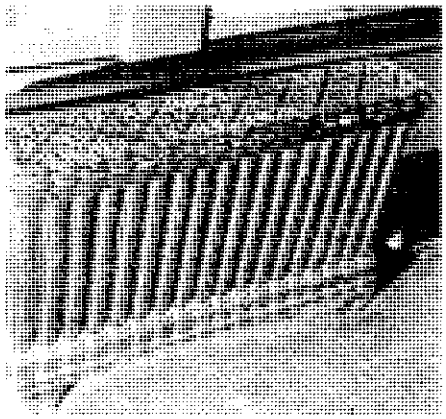
In designing a system, it is important to anticipate how it will be installed, how damage to historic materials can be minimized, and how visible the new mechanical system will be within the restored or rehabilitated spaces. Mechanical equipment space needs are often overwhelming; in some cases, it may be advantageous to look for locations outside of the building, including ground vaults, to house some of the equipment but only if it there is no adverse impact to the historic landscape or adjacent archeological resources. Various means for reducing the heating and cooling loads (and thereby the size of the equipment) should be investigated. This might mean reducing slightly the comfort levels of the interior, increasing the number of climate control zones, or improving the energy efficiency of the building.

The following activities are suggested during the design phase of the new system:

1. Establish specific criteria for the new or upgraded mechanical system. New systems should be installed with a minimum of damage to the resource and should be visually compatible with the architecture of the building. They should be installed in a way that is easy to service, maintain, and upgrade in the future. There should be safety and backup monitors in place if buildings have collections, computer rooms, storage vaults or special conditions that need monitoring. The new systems should work within the structural limits of the historic building. They should produce no undue vibration, no undue noise, no dust or mold, and no excess moisture that could damage the historic building materials. If any equipment is to be located outside of the building, there should be no impact to the historic appearance of building or site, and there should be no impact on archeological resources.

2. Prioritize the requirements for the new climate control system. The use of the building will determine the level of interior comfort and climate control. Sometimes, various temperature zones may safely be created within a historic building. This zoned approach may be appropriate for buildings with specialized collections storage, for buildings with mixed uses, or for large buildings with different external exposures, occupancy patterns, and delivery schedules for controlled air. Special archives, storage vaults or computer rooms may need a completely different climate control from the rest of the building. Determine temperature and humidity levels for occupants and collections and ventilation requirements between differing zones. Establish if the system is to run 24 hours a day or only during operating or business hours. Determine what controls are optimum (manual, computer, preset automatic, or other). The size and location of the equipment to handle these different situations will ultimately affect the design of the overall system as well.

3. Minimize the impact of the new HVAC on the existing architecture. Design criteria for the new system should be based on the type of architecture of the historic resource. Consideration should be given as to whether or not the delivery system is visible or hidden. Utilitarian and industrial spaces may be capable of accepting a more visible and functional system. More formal, ornate spaces which may be part of an interpretive program may require a less visible or disguised system. A ducted system should be installed without ripping into or boxing out large sections of floors, walls, or ceilings. A wet pipe system should be installed so that hidden leaks will not damage important decorative finishes. In each case, not only the type of system (air, water, combination), but its distribution (duct, pipe) and delivery appearance (grilles, cabinets, or registers) must be evaluated. It may be necessary to use a combination of different systems in order to preserve the historic building. Existing chases should be reused whenever possible.

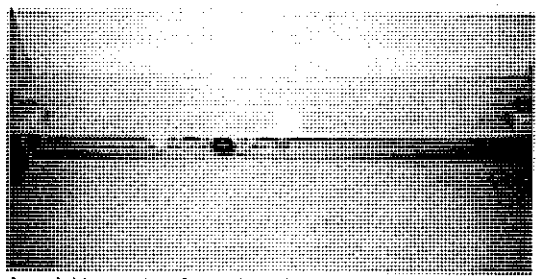


This radiator would be identified as a significant element of the interior. In any work to upgrade the mechanical system, it would be retained and preserved, even if non-functioning. Photo: NPS files.

4. Balance quantitative requirements and preservation objectives. The ideal system may not be achievable for each historic resource due to cost, space limitations, code requirements, or other factors beyond the owner's control. However, significant historic spaces, finishes, and features can be preserved in almost every case, even given these limitations. For example, if some ceiling areas must be slightly lowered to accommodate ductwork or piping, these should be in secondary areas away from decorative ceilings or tall windows. If modern fan coil terminal units are to be visible in historic spaces, consideration should be given to custom designing the cabinets or to using smaller units in more locations to diminish their impact. If grilles and registers are to be located in significant spaces, they should be designed to work within the geometry or placement of decorative elements. All new elements, such as ducts, registers, pipe-runs, and mechanical equipment should be installed in a reversible manner to be removed in the future without further damage to the building.

Systems Performance and Maintenance

Once the system is installed, it will require routine maintenance and balancing to ensure that the proper performance levels are achieved. In some cases, extremely sophisticated, computerized systems have been developed to control interior climates, but these still need monitoring by trained staff. If collection exhibits and archival storage are important to the resource, the climate control system will require constant monitoring and tuning. Backup systems are also needed to prevent damage when the main system is not working. The owner, manager, or chief of maintenance should be aware of all aspects of the new climate control system and have a plan of action before it is installed.



A sprinkler system is unobtrusively placed behind a false cornice at the end of a corridor. Photo: NPS files.

Regular training sessions on operating, monitoring, and maintaining the new system should be held for both curatorial and building maintenance staff. If there are curatorial reasons to maintain constant temperature or humidity levels, only individuals thoroughly trained in how the HVAC systems operates should be able to adjust thermostats. Ill-informed and haphazard attempts to adjust comfort levels, or to save energy over weekends and holidays, can cause great damage.

HVAC Do's and Don'ts

DO's:

- Use shutters, operable windows, porches, curtains, awnings, shade trees and other historically appropriate nonmechanical features of historic buildings to reduce the heating and cooling loads. Consider adding sensitively designed storm windows to existing historic windows.
- Retain or upgrade existing mechanical systems whenever possible: for example, reuse radiator systems with new boilers, upgrade ventilation within the building, install proper thermostats or humidistats.
- Improve energy efficiency of existing buildings by installing insulation in attics and basements. Add insulation and vapor barriers to exterior walls only when it can be done without further damage to the resource.
- In major spaces, retain decorative elements of the historic system whenever possible. This includes switch-plates, grilles and radiators. Be creative in adapting these features to work within the new or upgraded system.
- Use space in existing chases, closets or shafts for new distribution systems.
- Design climate control systems that are compatible with the architecture of the building: hidden system for formal spaces, more exposed systems possible in industrial or secondary spaces. In formal areas, avoid standard commercial registers and use custom slot registers or other less intrusive grilles.
- Size the system to work within the physical constraints of the building. Use multi-zoned smaller units in conjunction with existing vertical shafts, such as stacked closets, or consider locating equipment in vaults underground, if possible.
- Provide adequate ventilation to the mechanical rooms as well as to the entire building.

Selectively install air intake grilles in less visible basement, attic, or rear areas.

- Maintain appropriate temperature and humidity levels to meet requirements without accelerating the deterioration of the historic building materials. Set up regular monitoring schedules.
- Design the system for maintenance access and for future systems replacement.
- For highly significant buildings, install safety monitors and backup features, such as double pans, moisture detectors, lined chases, and battery packs to avoid or detect leaks and other damage from system failures.
- Have a regular maintenance program to extend equipment life and to ensure proper performance.
- Train staff to monitor the operation of equipment and to act knowledgeably in emergencies or breakdowns.
- Have an emergency plan for both the building and any curatorial collections in case of serious malfunctions or breakdowns.

DON'TS:

- Don't install a new system if you don't need it.
- Don't switch to a new type of system (e.g. forced air) unless there is sufficient space for the new system or an appropriate place to put it.
- Don't over-design a new system. Don't add air conditioning or climate control if they are not absolutely necessary.
- Don't cut exterior historic building walls to add through-wall heating and air conditioning units. These are visually disfiguring, they destroy historic fabric, and condensation runoff from such units can further damage historic materials.
- Don't damage historic finishes, mask historic features, or alter historic spaces when installing new systems.
- Don't drop ceilings or bulkheads across window openings.
- Don't remove repairable historic windows or replace them with inappropriately designed thermal windows.
- Don't seal operable windows, unless part of a museum where air pollutants and dust are being controlled.
- Don't place condensers, solar panels, chimney stacks, vents or other equipment on visible portions of roofs or at significant locations on the site.
- Don't overload the building structure with the weight of new equipment, particularly in the attic.
- Don't place stress on historic building materials through the vibrations of the new equipment.

- Don't allow condensation on windows or within walls to rot or spall adjacent historic building materials.

Maintenance staff should learn how to operate, monitor, and maintain the mechanical equipment. They must know where the maintenance manuals are kept. Routine maintenance schedules must be developed for changing and cleaning filters, vents, and condensate pans to control fungus, mold, and other organisms that are dangerous to health. Such growths can harm both inhabitants and equipment. (In piped systems, for example, molds in condensate pans can block drainage lines and cause an overflow to leak onto finished surfaces). Maintenance staff should also be able to monitor the appropriate gauges, dials, and thermographs. Staff must be trained to intervene in emergencies, to know where the master controls are, and whom to call in an emergency. As new personnel are hired, they will also require maintenance training.

In addition to regular cyclical maintenance, thorough inspections should be undertaken from time to time to evaluate the continued performance of the climate control system. As the system ages, parts are likely to fail, and signs of trouble may appear. Inadequately ventilated areas may smell musty. Wall surfaces may show staining, wet patches, bubbling or other signs of moisture damage. Routine tests for air quality, humidity, and temperature should indicate if the system is performing properly. If there is damage as a result of the new system, it should be repaired immediately and then closely monitored to ensure complete repair.

Equipment must be accessible for maintenance and should be visible for easy inspection. Moreover, since mechanical systems last only 15-30 years, the system itself must be "reversible." That is, the system must be installed in such a way that later removal will not damage the building. In addition to servicing, the backup monitors that signal malfunctioning equipment must be routinely checked, adjusted, and maintained. Checklists should be developed to ensure that all aspects of routine maintenance are completed and that data is reported to the building manager.

Conclusion

The successful integration of new systems in historic buildings can be challenging. Meeting modern HVAC requirements for human comfort or installing controlled climates for museum collections or for the operation of complex computer equipment can result in both visual and physical damage to historic resources. Owners of historic buildings must be aware that the final result will involve balancing multiple needs; no perfect heating, ventilating, and air conditioning system exists. In undertaking changes to historic buildings, it is best to have the advice and input of trained professionals who can:

- assess the condition of the historic building,
- evaluate the significant elements that should be preserved or reused,
- prioritize the preservation objectives,
- understand the impact of new interior climate conditions on historic materials
- integrate preservation with mechanical and code requirements,
- maximize the advantages of various new or upgraded mechanical systems,
- understand the visual and physical impact of various installations,
- identify maintenance and monitoring requirements for new or upgraded systems, and
- plan for the future removal or replacement of the system.

Too often the presumed climate needs of the occupants or collections can be detrimental to the long-term preservation of the building. With a careful balance between the preservation needs of the building and the interior temperature and humidity needs of the occupants, a successful project can result.

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Acknowledgements

The author gratefully acknowledges the invaluable assistance of Michael C. Henry, P.E., AIA, in the development and technical editing of this Preservation Brief. Technical review was also provided by Ernest A. Conrad, P.E. Thanks is also given to staff members of the National Park Service Cultural Resources Programs, including Tom Keohan and Catherine Colby, Rocky Mountain Region; Michael Crowe, Western Region; Mark Chavez, Midwest Region; Randall J. Biallas, AIA, Chief, Park Historic Architecture Division, and George A. Thorsen, Historical Architect, Denver Service Center. Special thanks is also given to Michael J. Auer of Technical Preservation Services for his editorial assistance in preparing this paper and Tim Buehner for his assistance with the illustrations.

Washington, D.C. October, 1991

Home page logo: Historic boiler in functioning condition. Photo: NPS files.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments to a broad public.

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PAINT

Original specs for Aladdin Homes, circa 1929:
Aladdin supplied ivory and grey paint for the cottages' exterior

Character Defining Features:
None

Typical in 2001:
Variety of colours, sprayed on to the exterior. Various paints and embellishments on the interiors. Paint covers much of the originally varnished trim.

Special Cases:
Each house has different existing conditions and should be assessed separately.

Condition:
Paint is one of the more important elements in the preservation of these cottages, especially on the exteriors. Its condition directly affects the amount of weathering on the building.

In this Section:
Dealing with Lead Paint Hazards
Paint's Importance
Brief #37: Appropriate Methods for Reducing Lead-Paint Hazards in Historic Housing

See also:
Exterior Walls
Porches
Interior Finishes

Rehabilitation

Assessment for lead paint

A risk assessment program determines where lead-containing materials exist on a property and which areas warrant mitigation. A specialist will be required to perform either on-site or laboratory testing of paint, dust, soil, and domestic water (due to piping and solder) to identify the presence of lead. Testing is generally performed using X-ray fluorescence, spot chemical tests, and laboratory chemical tests.

Lead-Based Paint

Lead-based paint was used on exterior wood, interior woodwork, window and door assemblies, and on high-gloss wall surfaces found in kitchens and bathrooms. Most painted metals were primed with red lead, as were structural steel members. The existence of lead-containing paint can only be determined through laboratory analysis. Since building surfaces are periodically repainted, over time the surface paint layer may not contain lead, which could very well be present in the underlying paint layers. Identifying these paint layers not only determines the presence of lead, but can also provide an important record of the original paint colors and decorative treatments, such as graining, stenciling or marbling, and may also be a useful record to date alterattions. When a significant amount of the original material and treatment is uncovered during paint analysis, it may be worth considering mitigation treatments that will stabilze and preserve the painted finish. In the event the paint must be removed, careful paint analysis and documentation are recommended.

Lead Abatement Options

Lead paint abatement options include encapsulation of the painted surface, paint removal, and removal of the painted element. Due to cost considerations as well as historic preservation concerns, wholesale removal of paint or painted elements may not be appropriate. THe alternative is to develop a strategy to control and manage the hazardous condition. Methods to achieve a balanced approach include removal of loose material, proper surface preparation, and encapsulation with a fresh coat of paint.

Encapsulation

Encapsulation involves encasing the hazardous lead-painted surface so that it is inaccessible. Encapsulation methods include covering the element with new building materials such as wallboard or paneling. This technique obscures original historic elements including any significant details. Another method involves sealing the surface with an acrylic or epoxy coating, covered by a fresh coat of paint. Installation of wall covering can also be used to achieve similar results.

Paint Removal

Paint removal methods vary widely and

Rehabilitation

continue to be developed with the key goal of capturing the lead-tainted residue. Removal of lead-based paint should be performed only by qualified contractors. Improper performance of paint removal will greatly increase the risk of exposure to lead residue.

Lead paint can be removed mechanically or with chemical strippers. Mechanical methods include scraping, sanding, and abrasive- or water-blasting. These methods may ultimately increase the hazard by introducing airboarne lead dust, and must be used with HEPA filter vacuum cleaners or with water in order to control airborne dust. These methods may also damage historic materials if they are applied too vigorously.

Solvent-based and caustic strippers are effective chemicals for paint removal. However, the chemicals themselves may be toxic and damaging. Other state-of-the art methods use micro-abrasive blasting systems in conjunction with chemical solvents. The solvent loosens the paint so that micro-abrasive blasting can remove the residue at a very low pressure, t hereby preventing damage to the historic material. This method also minimizes the amount of water generated, thus reducing the amount of contaminated waste produced.

Removal of lead-based paint with torches or heat guns is no longer an acceptable method for abatement. The risk of fire (in addition to generating lead fumes) puts both the historic property and workers at risk.

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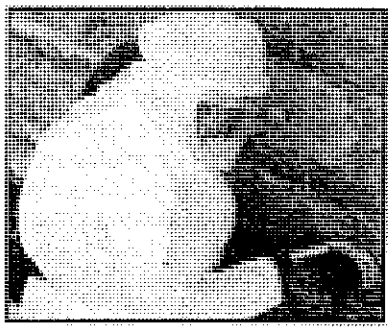
Appropriate Methods for Reducing Lead-Paint Hazards in Historic Housing



Sharon C. Park, AIA, and Douglas C. Hicks

»Lead in Historic Paints
»Planning for Lead Hazard Reduction in Historic Housing
»Appropriate Methods for Controlling Lead Hazards
»Maintenance after Hazard Control Treatment
»LEAD-BASED PAINT LEGISLATION
»Worker Safety
»Further Reading
»Glossary of Terms

Lead-based paint, a toxic material, was widely used in North America on both the exteriors and interiors of buildings until well into the second half of the twentieth century. If a "historic" place is broadly defined in terms of time as having attained an age of fifty years, this means that almost every historic house contains some lead-based paint. In its deteriorated form, it produces paint chips and lead-laden dust particles that are a known health hazard to both children and adults.

Children are particularly at risk when they ingest lead paint dust through direct hand-to-mouth contact and from toys or pacifiers. They are also at risk when they chew lead-painted surfaces in accessible locations. In addition to its presence in houses, leaded paint chips, lead dust, or lead-contaminated soil in play areas can elevate a child's blood lead level to a degree that measures to reduce and control the hazard should be undertaken (see Action Level Chart.

Residential housing is shown prior to rehabilitation and lead abatement. Photo: NPS files.

The premise of this Preservation Brief is that historic housing can be made lead-safe for children without removing significant decorative features and finishes, or architectural trimwork that may contribute to the building's historic character. *Historic housing*--encompassing private dwellings and all types of rental units--is necessarily the focus of this Brief because federal and state laws primarily address the hazards of lead and lead-based paint in housing and day-care centers to protect the health of children under six years of age. Rarely are there mandated requirements for the removal of lead-based paint from non-residential buildings.

Ideally, most owners and managers should understand the health hazards created by lead-based paint and voluntarily control these hazards to protect young children. A stricter approach has been taken by some state and federal funding programs which have compliance requirements for identifying the problem, notifying tenants, and, in some cases,

remedying lead hazards in housing (see Lead-based Paint Legislation). With new rules being written, and new products and approaches being developed, it is often difficult to find systematic and balanced methodologies for dealing with lead-based paint in historic properties.

This Preservation Brief is intended to serve as an introduction to the complex issue of historic lead-based paint and its management. It explains how to plan and implement lead-hazard control measures to strike a balance between preserving a historic building's significant materials and features and protecting human health and safety, as well as the environment. It is not meant to be a "how-to guide" for undertaking the work. Such a short-cut approach could easily result in creating a greater health risk, if proper precautions were not taken. Home renovators and construction workers should be aware that serious health problems can be caused by coming into contact with lead. For this reason, there are also laws to protect workers on the job site (see Worker Safety). Controlling the amount of waste containing lead-based paint residue will also reduce the impact on the environment. All of these considerations must be weighed against the goal of providing housing that is safe for children.

Lead in Historic Paints

Lead compounds were an important component of many historic paints. Lead, in the forms of lead carbonate and lead oxides, had excellent adhesion, drying, and covering abilities. White lead, linseed oil, and inorganic pigments were the basic components for paint in the 18th, 19th, and early 20th centuries. Lead-based paint was used extensively on wooden exteriors and interior trimwork, window sash, window frames, baseboards, wainscoting, doors, frames, and high gloss wall surfaces such as those found in kitchens and bathrooms. Almost all painted metals were primed with red lead or painted with lead-based paints. Even milk (casein) and water-based paints (distemper and calcimines) could contain some lead, usually in the form of hiding agents or pigments. Varnishes sometimes contained lead. Lead compounds were also used as driers in paint and window glazing putty.

Significant architectural finishes should not be removed during a project incorporating lead hazard controls. Clear protective coatings may be added by conservators to areas subject to impact or abrasion. Photo: NPS files.

In 1978, the use of lead-based paint in residential housing was banned by the federal government. Because the hazards have been known for some time, many lead components of paint were replaced by titanium and other less toxic elements earlier in the 20th century. Since houses are periodically repainted, the most recent layer of paint will most likely ***not*** contain lead, but the older layers underneath probably will. Therefore, the only way to accurately determine the amount of lead present in older paint is to have it analyzed.

It is important that owners of historic properties be aware that layers of older paint can reveal a great deal about the history of a building and that paint chronology is often used to date alterations or to document decorative period colors. Highly significant decorative finishes, such as graining, marbleizing, stenciling, polychrome decoration, and murals should be evaluated by a painting conservator to develop the appropriate preservation treatment that will stabilize the paint and eliminate the need to remove it. If such finishes must be removed in the process of controlling lead hazards, then research, paint analysis, and documentation are advisable as a record for future research and treatment.

Planning for Lead Hazard Reduction in Historic Housing

Typical health department guidelines call for removing as much of the surfaces that contain lead-

based paint as possible. **This results in extensive loss or modification of architectural features and finishes and is not appropriate for most historic properties.** A great number of federally-assisted housing programs are moving away from this approach as too expensive and too dangerous to the immediate work environment. A preferred approach, consistent with *The Secretary of the Interior's Standards for the Treatment of Historic Properties*, calls for removing, controlling, or managing the hazards rather than wholesale-or even partial-removal of the historic features and finishes. This is generally achieved through careful cleaning and treatment of deteriorating paint, friction surfaces, surfaces accessible to young children, and lead in soil. Lead-based paint that it not causing a hazard is thus permitted to remain, and, in consequence, the amount of historic finishes, features and trimwork removed from a property is minimized.

Because the hazard of lead poisoning is tied to the risk of ingesting lead, careful planning can help to determine how much risk is present and how best to allocate available financial resources. An owner, with professional assistance, can protect a historic resource and make it lead-safe using this three-step planning process:

I. Identify the historical significance of the building and architectural character of its features and finishes;

II. Undertake a risk assessment of interior and exterior surfaces to determine the hazards from lead and lead-based paint; and,

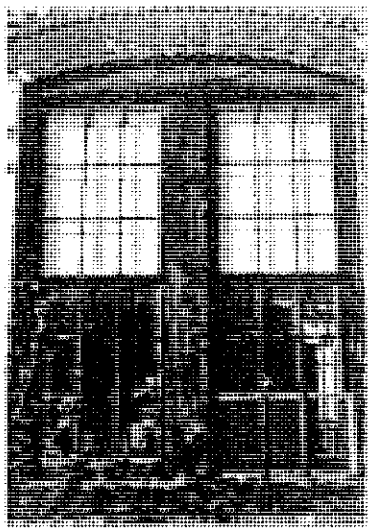
III. Evaluate the options for lead hazard control in the context of historic preservation standards.

I. Identify the historical significance of the building and architectural character of its features and finishes

The historical significance, integrity, and architectural character of the building always need to be assessed before work is undertaken that might adversely affect them. An owner may need to enlist the help of a preservation architect, building conservator or historian. The State Historic Preservation Office (SHPO) may be able to provide a list of knowledgeable preservation professionals who could assist with this evaluation.

Features and finishes of a historic building that exhibit distinctive characteristics of an architectural style; represent work by specialized craftsmen; or possess high artistic value should be identified so they can be protected and preserved during treatment.

When it is absolutely necessary to remove a significant architectural feature or finish-as noted in the first two priorities listed below-it should be replaced with a new feature and finish that matches in design, detail, color, texture, and, in most cases, material.



Deteriorating operable windows often contribute to lead dust in a house. In homes with small children, floors and other surfaces should be kept as clean as possible to avoid lead contamination.

Finally, features and finishes that characterize simple, vernacular buildings should be retained and preserved; in the process of removing hazards, there are usually reasonable options for their protection. Wholesale removal of historic trim, and other seemingly less important historic material, undermines a building's overall character and integrity and, thus, is never recommended.

For each historic property, features will vary in significance. As part of a survey of each historic property, a list of priorities should be made, in this order:

- Highly significant features and finishes that should always be protected and preserved;

- Significant features and finishes that should be carefully repaired or, if necessary, replaced in-kind or to match all visual qualities; and
- Non-significant or altered areas where removal, rigid enclosure, or replacement could occur.

This hierarchy gives an owner a working guide for making decisions about appropriate methods of removing lead paint.

II. Undertake a risk assessment of interior and exterior surfaces to determine hazards from lead and lead-based paint.

A licensed professional uses an x-ray fluorescence scanner to determine--without disturbing the surface--whether lead is present in underlying layers of paint. Photo: NPS files.

While it can be assumed that most historic housing contains lead-based paint, it cannot be assumed that it is causing a health risk and should be removed. The purpose of a risk assessment is to determine, through testing and evaluation, where hazards from lead warrant remedial action. Testing by a specialist can be done on paint, soil, or lead dust either on-site or in a laboratory using methods such as x-ray fluorescence (XRF) analyzers, chemicals, dust wipe tests, and atomic absorption spectroscopy. Risk assessments can be fairly low cost investigations of the location, condition, and severity of lead hazards found in house dust, soil, water, and deteriorating paint. Risk assessments will also address other sources of lead from hobbies, crockery, water, and the parents' work environment. A public health office should be able to provide names of certified risk assessors, paint inspectors, and testing laboratories. These services are critical when owners are seeking to implement measures to reduce suspected lead hazards in housing, day-care centers, or when extensive rehabilitations are planned.

The risk assessment should record:

- the paint's location
- the paint's condition
- lead content of paint and soil
- the type of surface
- (friction; accessible to children for chewing; impact)
- how much lead dust is actively present
- how the family uses and cares for the house
- the age of the occupants who might come into contact with lead paint.

It is important from a health standpoint that future tenants, painters, and construction workers know that lead-based paint is present, even under treated surfaces, in order to take precautions when work is undertaken in areas that will generate lead dust. Whenever mitigation work is completed, it is important to have a clearance test using the *dust wipe method* to ensure that lead-laden dust generated during the work does not remain at levels above those established by the Environmental Protection Agency (EPA) and the Department of Housing and Urban Development (HUD) (see Action Levels Chart). A building file should be maintained and updated whenever any additional lead hazard control work is completed.

Hazards should be removed, mitigated, or managed in the order of their health threat, as identified in a risk assessment (with 1. the greatest risk and 8. the least dangerous):

1. **Peeling, chipping, flaking, and chewed** interior lead-based paint and surfaces

2. **Lead dust** on interior surfaces

3. **High lead in soil levels** around the house and in play areas (check state requirements)

4. **Deteriorated exterior painted surfaces** and features

5. **Friction surfaces subject to abrasion** (windows, doors, painted floors)

6. **Accessible, chewable surfaces** (sills, rails) if small children are present

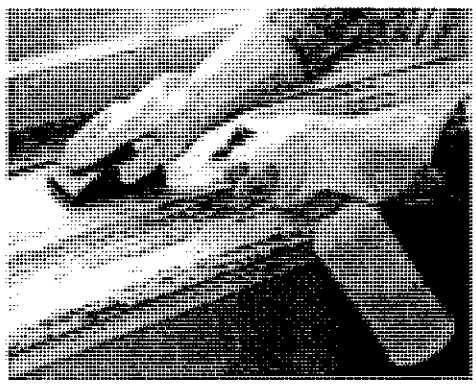
7. **Impact surfaces** (baseboards and door jambs)

8. **Other interior surfaces showing age or deterioration** (walls and ceilings).

III. Evaluate options for hazard control in the context of historic preservation standards.

The Secretary of the Interior's Standards for the Treatment of Historic Properties-established principles used to evaluate work that may impact the integrity and significance of National Register properties-can help guide suitable health control methods. The preservation standards call for the protection of historic materials and historic character of buildings through stabilization, conservation, maintenance, and repair. The rehabilitation standards call for the repair of historic materials with replacement of a character-defining feature appropriate only when its deterioration or damage is so extensive that repair is infeasible. From a preservation standpoint, selecting a hazard control method that removes *only* the deteriorating paint, or that involves some degree of repair, is always preferable to the total replacement of a historic feature.

By tying the remedial work to the areas of risk, it is possible to limit the amount of intrusive work on delicate or aging features of a building without jeopardizing the health and safety of the occupants. To make historic housing lead-safe, the gentlest method possible should be used to remove the offending substance-lead-laden dust, visible paint chips, lead in soil, or extensively deteriorated paint. Overly aggressive abatement may damage or destroy much more historic material than is necessary to remove lead paint, such as abrading historic surfaces. Another reason for targeting paint removal is to limit the amount of lead dust on the work site. This, in turn, helps avoid expensive worker protection, cleanup, and disposal of larger amounts of hazardous waste.



Wet sanding of interior surfaces will keep lead dust levels down, reduce the need for workers' protection, and provide a sound surface for repainting. Photo: NPS files.

Whenever extensive amounts of lead must be removed from a property, or when methods of removing toxic substances will impact the environment, it is extremely important that the owner be aware of the issues surrounding worker safety, environmental controls, and proper disposal. Appropriate architectural, engineering and environmental professionals should be consulted when lead hazard projects are complex.

Following are brief explanations of the two approaches for controlling lead hazards, once they have been identified as a risk. These controls are recommended by the Department of Housing and Urban Development in *Guidelines for the Evaluation and Control of Lead-Paint Hazards in Housing*, and are summarized here to focus on the special considerations for historic housing:

Interim Controls: Short-term solutions include thorough dust removal; thorough washdown and clean-up of exposed surfaces; paint film stabilization and repainting; covering of lead-contaminated soil; and making tenants aware of lead hazards. Interim controls require ongoing maintenance and evaluation.

Hazard Abatement: Long-term solutions are defined as having an expected life of 20 years or more, and involve permanent removal of hazardous paint through chemicals, heat guns or controlled sanding/abrasive methods; permanent removal of deteriorated painted features through replacement; the removal or permanent covering of contaminated soil; and the use of enclosures (such as drywall) to isolate painted surfaces. The use of specialized elastomeric encapsulant paints and coatings can be considered as permanent containment of lead-based paint if they receive a 20-year manufacturer's warranty or are approved by a certified risk assessor. One should be aware of their advantages and drawbacks for use in historic housing.

Within the context of the historic preservation standards, the most appropriate method will always be the least invasive. More invasive approaches are considered only under the special circumstances outlined in the three-step process. An inverted triangle shows the greatest number of residential projects fall well within the "interim controls" section. Most housing can be made safe for children using these sensitive treatments, particularly if no renovation work is anticipated. Next, where owners may have less control over the care and upkeep of housing and rental units, more aggressive means of removing hazards may be needed. Finally, large-scale projects to rehabilitate housing or convert non-residential buildings to housing may successfully incorporate "hazard abatement" as a part of the overall work.

Appropriate Methods for Controlling Lead Hazards

In selecting appropriate methods for controlling lead hazards, it is important to refer to Step I. of the survey where architecturally significant features and finishes are identified and need to be preserved. Work activities will vary according to hazard abatement needs; for example, while an interim control would be used to stabilize paint on most trimwork, an accessible window sill might need to be stripped prior to repainting. Since paint on a window sill is usually not a significant finish, such work would be appropriate.

The method selected for removing or controlling the hazards has a direct bearing on the type of worker protection as well as the type of disposal needed, if waste is determined to be hazardous. Following are examples of appropriate methods to use to control lead hazards within an historic preservation context.

Historic Interiors (deteriorating paint and chewed surfaces). Whenever lead-based paint (or lead-free paint covering older painted surfaces) begins to peel, chip, craze, or otherwise comes loose, it should be removed to a sound substrate and the surface repainted. If children are present and there is evidence of painted surfaces that have been chewed, such as a window sill, then these surfaces should be stripped to bare wood and repainted. The removal of peeling, flaking, chalking, and deteriorating paint may be of a small scale and undertaken by the owner, or may be extensive enough to require a paint contractor. In either case, care must be taken to avoid spreading lead dust throughout the dwelling unit. If the paint failure is extensive and the dwelling unit requires more permanent hazard removal, then an abatement contractor should be considered. Many states are now requiring that this work be undertaken by specially trained and certified workers.

If an owner undertakes interim controls, it would be advisable to receive specialized training in handling lead-based paint. Such training emphasizes isolating the area, putting plastic sheeting down to catch debris, turning off mechanical systems, taping registers closed, and taking precautions to clean up prior to handling food. Work clothes should be washed separately from regular family laundry. The preferred method for removing flaking paint is the wet sanding of surfaces because it is gentle to the substrate and controls lead dust. The key to reducing lead hazards while stabilizing flaking paint is to keep the surfaces slightly damp to avoid ingesting lead dust. Wet sanding uses special flexible sanding blocks or papers that can be rinsed in water or used along with a bottle mister. This method will generally not create enough debris to constitute hazardous waste.

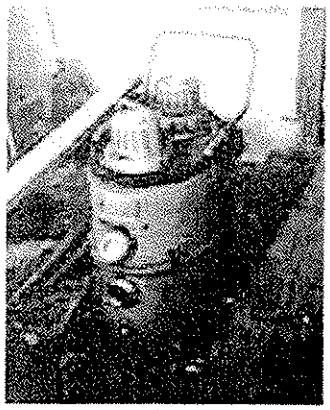
Other methods for selectively removing more deteriorated paint in historic housing include

controlled sanding, using low-temperature heat guns, or chemical strippers. Standard safety precautions and appropriate worker protection should be used. Methods to *avoid* include uncontrolled dry abrasive methods, high heat removal (lead vaporizes at 1100 degrees F), uncontrolled water blasting, and some chemicals considered carcinogenic (methylene chloride). When possible and practicable, painted elements, such as radiators, doors, shutters, or other easily removable items, can be taken to an off site location for paint removal.

In most cases, when interior surfaces are repainted, good quality interior latex or oil/alkyd paints may be used. The paint and primer system must be compatible with the substrate, as well as any remaining, well-bonded, paint.

Encapsulant paints and coatings, developed to contain lead-based paint, rely on an adhesive bonding of the new paint through the layers of the existing paint. The advantages of these special paint coatings is that they allow the historic substrate to remain in-place; reduce the amount of existing paint removed; can generally be applied without extensive worker protection; and are a durable finish. (They cannot, however, be used on friction surfaces.) The drawbacks include their ability to obscure carved details, unless thinly applied in several applications, and difficulty in future removal. If a specialized paint, such as an elastomeric encapsulant paint, is considered, the manufacturer should be contacted for specific instructions for its application. Unless these specialized paint systems are warranted for 20 years, they are considered as less permanent interim controls.

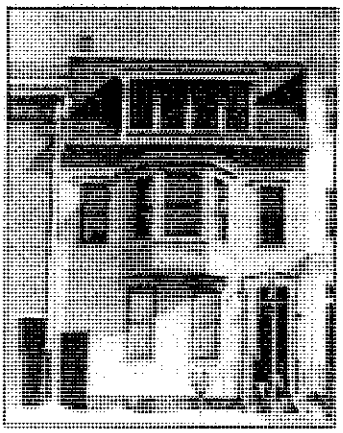
Lead-dust on interior finishes. Maintaining and washing painted surfaces is one of the most effective measures to prevent lead poisoning. Houses kept in a clean condition, with paint film intact and topcoated with lead-free paint or varnish, may not even pose a health risk. Dust wipe tests, which are sent to a laboratory for processing, can identify the level of lead dust present on floors, window sills, and window troughs. If lead dust is above acceptable levels, then specially modified maintenance procedures can be undertaken to reduce it. All paints deteriorate over time, so maintenance must be ongoing to control fine lead dust. The periodic washing of surfaces with a surfactant, such as tri-sodium phosphate (TSP) or its equivalent, loosens dirt and removes lead dust prior to a water rinse and touch-up painting, if necessary. This interim treatment can be extremely beneficial in controlling lead dust that is posing a hazard.



A HEPA vacuum is used as a method of dust control to manage or remove lead-based paint in historic buildings. Photo: NPS files.

Soil/landscape. Soil around building foundations may contain a high level of lead from years of chalking and peeling exterior paint. This dirt can be brought indoors on shoes or by pets and small children if they play outside a house. Lead in the soil is generally found in a narrow band directly adjacent to the foundation. If the bare soil tests high in lead (see Action Levels Chart), it should be replaced to a depth of several inches or covered with new sod or plantings. Care should be taken to protect historic plantings on the building site and, in particular, historic landscapes, while mitigation work is underway. If an area has become contaminated due to a variety of environmental conditions (for example, a smelter nearby or water tanks that have been sandblasted in the past), then an environmental specialist as well as a landscape preservation architect should be consulted on appropriate site protection and remedial treatments. It is inappropriate to place hard surfaces, such as concrete or macadam, over historically designed landscaped areas, which is often the recommendation of typical abatement guidelines.

Deteriorating paint on exteriors. Deteriorating exterior paint will settle onto window ledges and be blown into the dwelling, and will also contaminate soil at the foundation, as previously discussed. Painted exteriors may include wall surfaces, porches, roof trim and brackets, cornices, dormers, and window surrounds. Most exteriors need repainting every 5-10 years due to the cumulative effect of sun, wind, and rain or lack of maintenance. Methods of paint removal that do not abrade or damage the exterior materials should



In this successful residential rehabilitation, deteriorated wood siding was removed from the foundation to the top of the first floor windows and replaced with matching wood siding. The building was repainted. Photo: Courtesy, Crispus Attucks Community Development Corporation.

be evaluated. Because there is often more than one material (for example, painted brick and galvanized roof ornaments), the types of paint removal or paint stabilization systems need to be compatible with each material. If paint has failed down to the substrate, it should be removed using either controlled sanding/scraping, controlled light abrasives for cast iron and durable metals, chemicals, or low heat. If chemicals are used, it may be necessary to have the contractor contain, filter, or otherwise treat any residue or rinse water. Environmental regulations must be checked prior to work, particularly if a large amount of lead waste will be generated or public water systems affected.

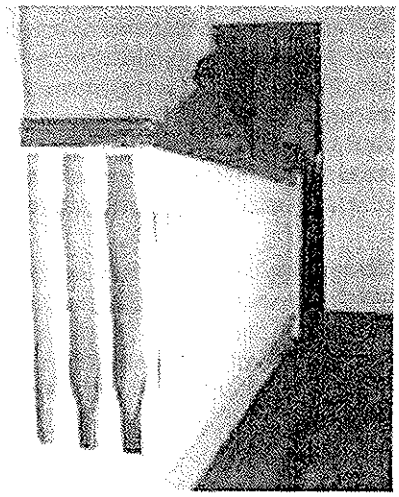
A cost analysis may show that, in the long run, repair and maintenance of historic materials or in-kind replacement can be cost effective. Due to the physical condition and location of wood siding, together with the cost of paint removal, a decision may be made to remove and replace these materials on some historic frame buildings. If the repair or replacement of historic cladding on a primary elevation is being undertaken, such replacement materials should match the historic cladding in material, size, configuration, and detail. The use of an artificial siding or aluminum coil stock panning systems over wooden trimwork or sills and lintels (as recommended in some abatement guidelines) is not appropriate, particularly on principal facades of historic buildings because they change the profile appearance of the exterior trimwork and may damage historic materials and detailing during installation. Unless the siding is too deteriorated to warrant repair and the cost is too prohibitive to use matching replacement materials (i.e., wood for wood), substitute materials are not recommended.

The use of specialized encapsulant paint coatings on exteriors-in particular, moist or humid climates, and, to some extent, cold climates-is discouraged because such coatings may serve to impede the movement of moisture that naturally migrates through other paints or mask leaks that may be causing substrate decay. Thus, a carefully applied exterior paint system (either oil/alkyd or latex) with periodic repainting can be very effective.

Friction Surfaces. Interior features with surfaces that functionally rub together such as windows and doors, or are subject to human wear and tear, such as floor and steps, are known as friction surfaces. It is unclear how much lead dust is created when friction surfaces that contain lead-based paint, but are top-coated with lead-free paint, rub together because much of the earlier paint may have worn away. For example, if lead dust levels around windows or on painted floors are consistently above acceptable levels, treating nearby friction surfaces should be considered. If surfaces, such as operable windows, operable doors, painted porch decks, painted floors and painted steps appear to be generating lead dust, they should be controlled through isolating or removing the lead-based paint. Window and door edges can be stripped or planed, or the units stripped on or off site to remove paint prior to repainting. Simple wooden stops and parting beads for windows, which often split upon removal, can be replaced. If window sash are severely deteriorated, it is possible to replace them; and vinyl jamb liners can effectively isolate remaining painted window jambs. When windows are being treated within rehabilitation projects, their repair and upgrading are always recommended. In the event that part or all of a window needs to be replaced, the new work should match in size, configuration, detail, and, whenever possible, material.

Painted floors often present a difficult problem because walking on them abrades the surface, releasing small particles of lead-based paint. It is difficult to remove lead dust between the cracks in previously painted strip flooring even after sanding and vacuuming using special High Efficiency Particulate Air (HEPA) filters to control the lead dust. If painted floors are not highly significant in material, design, or craftsmanship, and they cannot be adequately cleaned and refinished, then replacing or covering them with new flooring may be considered. Stair treads can be easily fitted with rubber or vinyl covers.

Accessible, projecting, mouthable surfaces. Accessible, chewable surfaces that can be mouthed by small children need not be removed entirely, as some health guidelines recommend. These accessible surfaces are listed as projecting surfaces within a child's reach, including window sills, banister railings, chair rails, and door edges. In many cases, the projecting edges can have all paint removed using wet sanding, a heat gun or chemical strippers, prior to repainting the feature. If the homeowner feels that there is no evidence of unsupervised mouthing of surfaces, a regular paint may be adequate once painted surfaces have been stabilized. An encapsulant paint that adhesively bonds existing paint layers onto the substrate extends durability. While encapsulant paint systems are difficult to remove from a surface in the future, they permit retention of the historic feature itself. If encapsulant paint is used on molded or decorative woodwork, it should be applied in several thin coats to prevent the architectural detail from being obscured by the heavy paint.



This recently completed housing, which is now lead-safe, could become re-contaminated from lead if safe conditions are not maintained. Damp mopping floor surfaces and regular dusting to keep the house clean will ensure its continuing safety. Photo: NPS files.

Impact Surfaces. Painted surfaces near doorways and along corridors tend to become chipped and scraped simply because of their location. This is particularly true of baseboards, which were designed to protect wall surfaces, and also for doorjambs. Owners should avoid hitting painted impact surfaces with vacuums, brooms, baby carriages, or wheeled toys. Adding new shoe moldings can give greater protection to some baseboards. In most cases, stabilizing loose paint and repainting with a high quality interior paint will provide a durable surface. Clear panels or shields can be installed at narrow doorways, if abrasion continues, or these areas can be stripped of paint and repainted. Features in poor condition may need to be replaced with new, matching materials.

Other surfaces showing age or deterioration/ walls and ceilings. Many flat wall surfaces and ceilings were not painted with lead-based paint, so will need to be tested for its presence prior to any treatment. Flat surfaces that contain deteriorating lead-based paint should be repaired following the responsible approach previously cited (i.e., removing loose paint to a sound substrate, then repairing damaged plaster using a skim coat or wet plaster repair. Drywall is used *only* when deterioration is too great to warrant plaster repair. If walls and ceilings have a high lead content, and extensive paint removal is not feasible, there are systems available that use elastomeric paints with special fabric liners to stabilize older, though intact, wall surfaces.

If a new drywall surface needs to be applied, care should be taken that the historic relationship of wall to trim is not lost. Also, if there are significant features, such as crown moldings or ceiling medallions, they should always be retained and repaired.

Maintenance after Hazard Control Treatment

Following treatment, particularly where interim controls have been used, ongoing maintenance and re-evaluation become critical. In urban areas, even fully lead-safe houses can be re-contaminated within a year from lead or dirt outside the immediate property. Thus, housing interiors must be kept clean, once lead hazard control measures have been implemented. Dust levels should be kept down by wet sweeping porch steps and entrances on a regular basis. Vacuum cleaning and dusting should be repeated inside on a weekly basis or even more often. Vinyl, tile, and wood floor surfaces should be similarly damp mopped. Damp washing of window troughs and sills to remove new dust should be encouraged several times a year, particularly in the spring and fall when windows will be open. Carpets and area rugs should be steam cleaned or washed periodically if they appear to hold outside dirt.

Housing should be inspected frequently for signs of deterioration by both owner and occupant.

Tenants need to be made aware of the location of lead-based paint under lead-free top coats and instructed to contact the owners or property managers when the paint film becomes disturbed. Any leaks, peeling paint, or evidence of conditions that may generate lead-dust should be identified and corrected immediately. Occupants must be notified prior to any major dust-producing project. Dry sanding, burning, compressed air cleaning or blasting should be not be used. Repairs, repainting, or remodeling activities that have the potential of raising significant amounts of lead dust should be undertaken in ways that isolate the area, reduce lead-laden dust as much as possible, and protect the occupants.

Yearly dust wipe tests are recommended to ensure that dust levels remain below actionable levels. Houses or dwelling units that fail the dust-wipe test should be thoroughly re-cleaned with TSP, or its equivalent, washed down, wet vacuumed and followed by HEPA vacuuming, if necessary, until a clearance dust wipe test shows the area to be under actionable levels (see Action Levels chart). Spaces that are thoroughly cleaned and maintained in good condition are not a health risk.

Conclusion

The three-step planning process outlined in this Brief provides owners and managers of historic housing with responsible methods for protecting historic paint layers and architectural elements, such as windows, trimwork, and decorative finishes. Exposed decorative finishes, such as painted murals or grained doors can be stabilized by a paint conservator with a glazed or varnished layer without destroying their significance.

Reducing and controlling lead hazards can be successfully accomplished without destroying the character-defining features and finishes of historic buildings. Federal and state laws generally support the reasonable control of lead-based paint hazards through a variety of treatments, ranging from modified maintenance to selective substrate removal. The key to protecting children, workers, and the environment is to be informed about the hazards of lead, to control exposure to lead dust and lead in soil, and to follow existing regulations. In all cases, methods that control lead hazards should be selected that minimize the impact to historic resources while ensuring that housing is lead-safe for children.

ACTION LEVELS

Readers should become familiar with terminology and basic levels that trigger concern and/or action. Check with the appropriate authorities if you have questions and to verify applicable action levels which may change over time.

Blood lead levels: Generally from drawn blood and not a finger stick test which can be unreliable. Units are measured in micrograms per deciliter (*ug*/dl) and reflect the 1995 standards from the Centers of Disease Control:

Children:

10 *ug*/dl; level of concern; find source of lead

15 *ug*/dl and above; intervention, counseling, medical monitoring.

20 *ug*/dl and above; medical treatment

Adults:

25 *ug*/dl; level of concern; find source of lead

50 *ug*/dl ; OSHA standard for medical removal from the worksite

Lead in paint: Differing methods report results in differing units. Lead is considered a potential hazard if *above the following levels*, but can be a hazard at lower levels, if improperly handled. These are the current numbers as identified by the Department of Housing and Urban Development (1995):

Lab analysis of samples:

5,000 milligram per kilogram (mg/kg) or 5,000 parts per million (ppm), or

0.5% lead by weight.

XRF reading: in milligram per centimeter squared

1 mg/cm2

Lead dust wipe test: in micrograms per square foot

Floors 100 *ug*/ft2;

Window sills 500 *ug*/ft2;

Window troughs 800 *ug*/ft2

Lead in soil: ***high contact bare play areas, listed as parts per million (ppm)***

concern: 400 ppm

interim control 2,000 ppm

hazard abatement 5,000 ppm

LEAD-BASED PAINT LEGISLATION

The following summarizes several important regulations that affect lead-hazard reduction projects. Owners should be aware that regulations change and they have a responsibility to check state and local ordinances as well.

Federal Legislation

Title X (Ten) Residential Lead-Based Paint Hazard Reduction Act of 1992 is part of the Housing and Community Development Act of 1992 (Public Law 102-550). It established that HUD issue "The Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing" (1995) to outline risk assessments, interim controls, and abatement of lead-based paint hazards in *housing*. Title X calls for the reduction of lead in housing that is *federally supported* and outlines the federal responsibility towards its own residential units and the need for disclosure of lead in residences, even private residences, prior to sale.

Interim Final Regulations of Lead in Construction Standards (29CFR 1926.62). Issued by the Department of Labor, Occupational Safety and Health Administration (OSHA), these regulations address worker safety, training, and protective measures. It is based in part on environmental air sampling to determine the amount of lead dust generated by various activities.

Toxic Substance Control Act; Title IV. The Environment Protective Agency (EPA) has

jurisdiction for setting standards for lead abatement. Also, EPA controls the handling and disposal of hazardous waste generated during an abatement project. EPA will develop standards to establish lead hazards, to certify abatement contractors, and to establish work practice standards for abatement activity. EPA Regional Offices can provide guidance on the appropriate regulatory agency for states within their region.

State Laws: States generally have the authority to regulate the removal and transportation of lead based paint and the generated waste generally through the appropriate state environmental and public health agencies. Most requirements are for mitigation in the case of a lead-poisoned child, or for protection of children, or for oversight to ensure the safe handling and disposal of lead waste. When undertaking a lead-based paint reduction program, it is important to determine which laws are in place that may affect your project. Call the appropriate officials.

Local Ordinances: Check with local health departments, Poison Control Centers, and offices of housing and community development to determine if there are laws that require compliance by building owners. Rarely are owners required to remove lead-based paint and most laws are to ensure safety if a project is undertaken as part of a larger rehabilitation. Special use permits may be required when an environmental impact may occur due to a cleaning treatment that could contaminate water or affect water treatment. Determine whether projects are considered abatements and will require special contractors and permits.

Owner's Responsibility: Owners are ultimately responsible for ensuring that hazardous waste is properly disposed of when it is generated on their own sites. Owners should check with their state office to determine if the abatement project requires a certified contractor. (National certification requirements are not yet in place.) Owners should establish that the contractor is responsible for the safety of the crew and that all applicable laws are followed, and that transporters and disposers of hazardous waste have liability insurance as a protection for the owner. If an interim treatment is being used to reduce lead hazards, the owner should notify the contractor that lead-based paint is present and that it is the contractor's responsibility to follow appropriate work practices to protect workers and to complete a thorough clean-up to ensure that lead-laden dust is not present after the work is completed.

Worker Safety

Current worker safety standards were established by OSHA's 29 CFR Part 1926, Lead Exposure in Construction; Interim Final Rule, which became effective June 3, 1993. These standards base levels of worker protection on exposure to airborne lead dust. They are primarily targeted to persons working within the construction industry, but apply to any workers who are exposed to lead dust for longer than a specific amount of time and duration. The Interim Final Rule establishes an action level of 30 micrograms of lead dust per cubic meter of air (30 *u*g/m3) based on an eight hour, time-weighted average, as the level at which employers must initiate compliance activities; and it also establishes 50 *u*g/m3 of lead dust as the permitted exposure level (PEL) for workers.

The standard identifies responsibilities before, during, and after the actual abatement activity necessary to protect the worker. Before the project begins, it requires an exposure assessment, a written compliance plan, initial medical surveillance, and training. The exposure assessment determines whether a worker may be exposed to lead. OSHA has identified a number of work tasks expected to produce dust levels between 50 and 500 *u*g/m3 of air, including manual demolition, manual scraping, manual sanding, heat gun applications, general cleanup, and power tool use when the power tool is equipped with a dust collection system. It is an OSHA requirement that, at a minimum, a HEPA filtered half-face respirator with a protection factor of 10 be used for these operations. Initial blood lead level (BLL) base lines are established for each worker. Actual dust levels are monitored by air sampling of representative work activities, generally by an industrial hygienist or an environmental monitoring firm. Protective equipment is determined by the dust level. For all workers exposed at, or above, the action level for over 30 days in a 12-month period, BLLs are tested on a regular basis of every 2 months for the first 6 months and

every 6 months thereafter. After completing a project, maintenance, medical surveillance, and recordkeeping responsibilities continue.

HEPA vacuums, HEPA respirators, and HEPA filters, which substantially reduce exposure to lead dust, are available through laboratory safety and supply catalogs and vendors.

Copies of 29 CFR Part 1926, Lead Exposure in Construction: Interim Final Rule, are available from the Department of Labor, Occupational Safety and Health Administration, or may be found in any library with a current edition of the Code of Federal Regulation (CFR).

Further Reading

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Glossary of Terms

Deteriorated Lead-Based Paint: Paint known to contain lead that shows signs of peeling, chipping, chalking, blistering, alligatoring or otherwise separating from its substrate.

Dust Removal: The process of removing dust to avoid creating a greater problem of spreading lead particles; usually through wet or damp collection or through the use of special HEPA vacuums.

Hazard Abatement: Long-term measures to remove the hazards of lead-based paint through selective paint stripping of deteriorated areas; or, in some cases, replacement of deteriorated features.

Hazard Control: Measures to reduce lead hazards to make housing safe for young children. Can be accomplished with interim (short-term) or hazard abatement (long-term) controls.

Interim Control: Short-term methods to remove lead dust, stabilize deteriorating surfaces, and repaint surfaces. Maintenance can ensure that housing remains lead-safe.

Lead-based Paint: Any existing paint, varnish, shellac or other coating that is in excess of 1.0 mg/cm2 as measured by an XRF detector or greater than 0.5% by weight from laboratory analysis (5,000 ppm, 5,000 *ug*/g, or 5,000 mg/kg). For new products, the Consumer Safety Act notes 0.06% as the maximum amount of lead allowed in paint.

Lead-safe: The act of making a property safe from contamination by lead-based paint, lead-dust, and lead in soil generally through short and long-term methods to remove it, or to isolate it from small children.

Risk Assessment: An on-site investigation to determine the presence and condition of lead-based paint, including limited test samples, and an evaluation of the age, condition, housekeeping practices, and uses of a residence.

Acknowledgements

Sharon C. Park, AIA, is the Senior Historical Architect for the Preservation Assistance Division of the National Park Service. **Douglas C. Hicks** is the Deputy Chief of the Williamsport Preservation Training Center of the National Park Service. Both authors served on the National Park Service Housing Task Force addressing lead-safe employee housing and on various national panels to discuss combining lead-safe housing, worker safety, and historic preservation concerns.

Kay D. Weeks was technical editor for this publication project. The project was completed under the direction of H. Ward Jandl, Deputy Chief, Preservation Assistance Division. The authors also wish to thank the following individuals for providing technical information or for supplying case study projects: Claudia Kavenagh, Building Conservation Associates, Inc; David E. Jacobs, Armand C. Magnelli, National Center for Lead-Safe Housing; Ellis Goldman, William Wisner, and Catherine Hillard, HUD Office of Lead-Based Paint Abatement; Ellis Schmidlapp, Landmarks Design Associates (Pittsburg, PA); Crispus Attucks Community Development Corporation (York, PA); Charlene Dwin Vaughn and Rebecca

Rogers, the Advisory Council on Historic Preservation; George Siekkinen, National Trust for Historic Preservation; Deborah Birch, Einhorn Yaffee Prescott Architects; Baird M. Smith and Quinn Evans Architects; Jack Waite, Messick Cohen Waite Architects; Jim Caufield, Pennsylvania Historical and Museum Commission; Mike Jackson, Illinois Historic Preservation; Martha Raymond, Ohio Historic Preservation Division; Susan Chandler, Connecticut Historic Commission; Steade Craigo, California Office of Historic Preservation; Christopher Jones, Rocky Mountain Regional Office, NPS; Rebecca Shiffer and Kathleen Catalano Milley, Mid-Atlantic Regional Office, NPS; Peggy Albee, North Atlantic Regional Office, Cultural Resources Center, NPS; Victoria Jacobson, AIA, Mt. Rainier National Park; E. Blaine Cliver, Anne E. Grimmer, Thomas C. Jester, Michael J. Auer,

Charles A. Birnbaum, ASLA, and Charles E. Fisher of the Preservation Assistance Division, the National Park Service, and Thomas McGrath, Williamsport Preservation Training Center.

Washington, D.C. April, 1995

Home page logo: Appropriate lead paint abatement in progress. Photo: NPS files.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

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MOTHBALLING AND VACANT HOUSES

Original specs for Aladdin Homes, circa 1929:
N/A

Character Defining Features:
N/A

Typical in 2001:
Many houses are unoccupied, or occupied only part time.

Special Cases:
Cottage #37 is currently boarded up and deteriorating.

Condition:
Unoccupied cottages are more prone to damage from moisture and neglect. It is recommended that these houses be occupied if at all possible, as this is the best way to preserve and maintain them. If occupancy is not possible, it is recommended that the houses be mothballed, or that some of the steps of mothballing be taken in order to preserve the cottages until they can again be put to use. It is recommended that cottage #37 be dismantled by professionals and used for parts for the remaining Aladdin cottages. If this course of action is undesirable, it is recommended that the cottage be mothballed.

In this Section:
Recommendations on mothballing
Brief #31: Mothballing Historic Buildings

See also:

Rehabilitation

Mothballing

Mothballing is a process of temporarily closing a building to protect it from weather and vandalism. It gives the owners time to discuss, plan, and finance the future use of the building. This course of action is a possible choice for some of the unused buildings at Three Lynx. Preservation Brief #31: Mothballing Historic Buildings, is included after this section and can be used to determine if mothballing is an appropriate course of action for individual houses in Three Lynx. Besides criteria, it includes a checklist for mothballing, and a maintenance chart, both of which may be helpful, even if mothballing is not determined necessary for the buildings.

Building #37

It is recommended that cottage #37 be dismantled by professional salvagers. The stored assembly of house parts could then be used for spare parts on the extant Aladdin houses.

If the disassembly is not the desired course of action, it is recommended that the house be mothballed.

Rehabilitation

Mothballing

Building #37

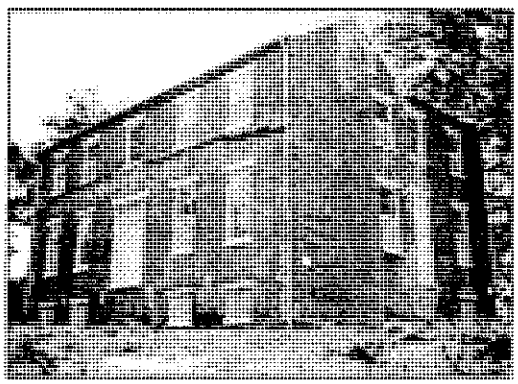
31 Preservation Briefs
Technical Preservation Services
HPS
National Park Service

Mothballing Historic Buildings

Sharon C. Park, AIA

»Documentation
»Stabilization
»Mothballing
»Mothballing Checklist
»Maintenance Chart
»Conclusion

When all means of finding a productive use for a historic building have been exhausted or when funds are not currently available to put a deteriorating structure into a useable condition, it may be necessary to close up the building temporarily to protect it from the weather as well as to secure it from vandalism. This process, known as mothballing, can be a necessary and effective means of protecting the building while planning the property's future, or raising money for a preservation, rehabilitation or restoration project. If a vacant property has been declared unsafe by building officials, stabilization and mothballing may be the only way to protect it from demolition.



This building has been successfully mothballed for 10 years because the roof and walls were repaired and structurally stabilized, ventilation louvers added, and the property maintained. Photo: NPS files.

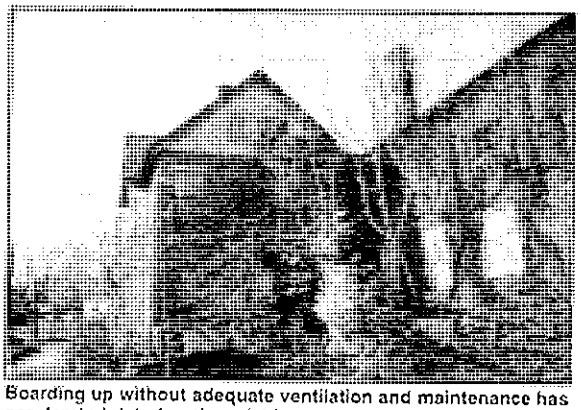
This Preservation Brief focuses on the steps needed to "de-activate" a property for an extended period of time. The project team will usually consist of an architect, historian, preservation specialist, sometimes a structural engineer, and a contractor. Mothballing should not be done without careful planning to ensure that needed physical repairs are made prior to securing the building. The steps discussed in this Brief can protect buildings for periods of up to ten years; long-term success will also depend on continued, although somewhat limited, monitoring and maintenance. For all but the simplest projects, hiring a team of preservation specialists is recommended to assess the specific needs of the structure and to develop an effective mothballing program.

A vacant historic building cannot survive indefinitely in a boarded-up condition, and so even marginal interim uses where there is regular activity and monitoring, such as a caretaker residence or non-flammable storage, are generally preferable to mothballing. In a few limited cases when the vacant building is in good condition and in a location where it can be watched and checked regularly, closing and locking the door, setting heat levels at just above freezing, and securing the windows may provide sufficient protection for a period of a few years.

But if long-term mothballing is the only remaining option, it must be done properly. This will require stabilization of the exterior, properly designed security protection, generally

some form of interior ventilation--either through mechanical or natural air exchange systems--and continued maintenance and surveillance monitoring.

Comprehensive mothballing programs are generally expensive and may cost 10% or more of a modest rehabilitation budget. However, the money spent on well-planned protective measures will seem small when amortized over the life of the resource. Regardless of the location and condition of the property or the funding available, the following 9 steps are involved in properly mothballing a building:



Boarding up without adequate ventilation and maintenance has accelerated deterioration of this property. Photo: NPS files.

Documentation

1. Document the architectural and historical significance of the building.
2. Prepare a condition assessment of the building.

Stabilization

3. Structurally stabilize the building, based on a professional condition assessment.
4. Exterminate or control pests, including termites and rodents.
5. Protect the exterior from moisture penetration.

Mothballing

6. Secure the building and its component features to reduce vandalism or break-ins. 7. Provide adequate ventilation to the interior.
8. Secure or modify utilities and mechanical systems.
9. Develop and implement a maintenance and monitoring plan for protection.

These steps will be discussed in sequence below. Documentation and stabilization are critical components of the process and should not be skipped over. Mothballing measures should not result in permanent damage, and so each treatment should be weighed in terms of its reversibility and its overall benefit.

Documentation

Documenting the historical significance and physical condition of the property will provide information necessary for setting priorities and allocating funds. The project team should be cautious when first entering the structure if it has been vacant or is deteriorated. It may be advisable to shore temporarily areas appearing to be structurally unsound until the condition of the structure can be fully assessed. If pigeon or bat droppings, friable asbestos or other health hazards are present, precautions must be taken to wear the appropriate safety equipment when first inspecting the building. Consideration should be given to hiring a firm specializing in hazardous waste removal if these highly toxic elements are found in the building.

Documenting and recording the building

Documenting a building's history is important because evidence of its true age and architectural significance may not be readily evident. The owner should check with the State Historic Preservation Office or local preservation commission for assistance in researching the building. If the building has never been researched for listing in the National Register of Historic Places or other historic registers, then, at a minimum, the following should be determined:

The overall historical significance of the property and dates of construction;

The chronology of alterations or additions and their approximate dates; and,

Types of building materials, construction techniques, and any unusual detailing or regional variations of craftsmanship.

Old photographs can be helpful in identifying early or original features that might be hidden under modern materials. On a walk-through, the architect, historian, or preservation specialist should identify the architecturally significant elements of the building, both inside and out.

Documenting a building's history and assessing its condition provide information to set priorities for stabilization and repair, prior to mothballing. Photo: NPS files.

By understanding the history of the resource, significant elements, even though deteriorated, may be spared the trash pile. For that reason alone, any materials removed from the building or site as part of the stabilization effort should be carefully scrutinized and, if appearing historic, should be photographed, tagged with a number, inventoried, and safely stored, preferably in the building, for later retrieval.

A site plan and schematic building floor plans can be used to note important information for use when the building is eventually preserved, restored, or rehabilitated. Each room should be given a number and notations added to the plans regarding the removal of important features to storage or recording physical treatments undertaken as part of the stabilization or repair.

Because a mothballing project may extend over a long period of time, with many different people involved, clear records should be kept and a building file established. Copies of all important data, plans, photographs, and lists of consultants or contractors who have worked on the property should be added to the file as the job progresses. Recording actions taken on the building and identifying where elements that have been removed are stored will be helpful in the future.

The project coordinator should keep the building file updated and give duplicate copies to the owner. A list of emergency numbers, including the number of the key holder, should be kept at the entrance to the building or on a security gate, in a transparent vinyl sleeve.

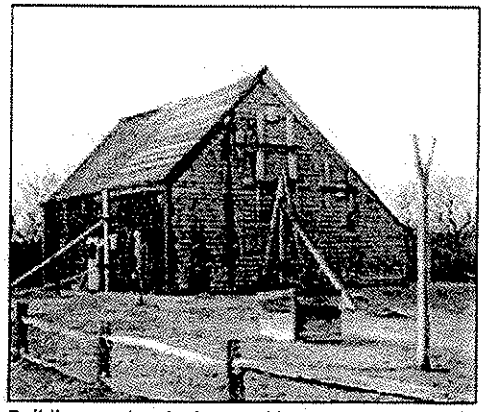
Preparing a condition assessment of the building

A condition assessment can provide the owner with an accurate overview of the current condition of the property. If the building is deteriorated or if there are significant interior architectural elements that will need special protection during the mothballing years, undertaking a condition assessment is highly recommended, but it need not be exhaustive.

A modified condition assessment, prepared by an architect or preservation specialist, and in some case a structural engineer, will help set priorities for repairs necessary to stabilize the property for both the short and long-term. It will evaluate the age and condition of the following major elements: foundations; structural systems; exterior materials; roofs and gutters; exterior porches and steps; interior finishes; staircases; plumbing, electrical, mechanical systems; special features such as chimneys; and site drainage.

To record existing conditions of the building and site, it will be necessary to clean debris from the building and to remove unwanted or overgrown vegetation to expose foundations. The interior should be emptied of its furnishing (unless provisions are made for mothballing

these as well), all debris removed, and the interior swept with a broom. Building materials too deteriorated to repair, or which have come detached, such as moldings, balusters, and decorative plaster, and which can be used to guide later preservation work, should be tagged, labeled and saved.



Buildings seriously damaged by storms or deterioration may need to be braced before architectural evaluations can be made. Photo: John Milner Architects. Photo: NPS files

Photographs or a videotape of the exterior and all interior spaces of the resource will provide an invaluable record of "as is" conditions. If a videotape is made, oral commentary can be provided on the significance of each space and architectural feature. If 35mm photographic prints or slides are made, they should be numbered, dated, and appropriately identified. Photographs should be cross-referenced with the room numbers on the schematic plans. A systematic method for photographing should be developed; for example, photograph each wall in a room and then take a corner shot to get floor and ceiling portions in the picture. Photograph any unusual details as well as examples of each window and door type.

Loose or detached elements should be identified, tagged and stored, preferably on site. Photo: NPS files

For historic buildings, the great advantage of a condition assessment is that architectural features, both on the exterior as well as the interior, can be rated on a scale of their importance to the integrity and significance of the building. Those features of the highest priority should receive preference when repairs or protection measures are outlined as part of the mothballing process. Potential problems with protecting these features should be identified so that appropriate interim solutions can be selected. For example, if a building has always been heated and if murals, decorative plaster walls, or examples of patterned wall paper are identified as highly significant, then special care should be taken to regulate the interior climate and to monitor it adequately during the mothballing years. This might require retaining electrical service to provide minimal heat in winter, fan exhaust in summer, and humidity controls for the interior.

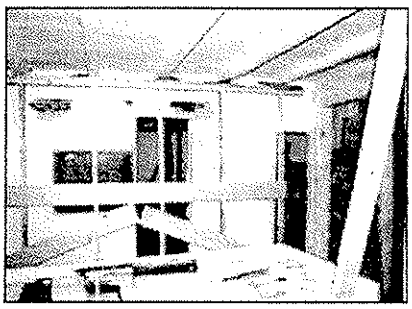
Stabilization

Stabilization as part of a mothballing project involves correcting deficiencies to slow down the deterioration of the building while it is vacant. Weakened structural members that might fail altogether in the forthcoming years must be braced or reinforced; insects and other pests removed and discouraged from returning; and the building protected from moisture damage both by weatherizing the exterior envelope and by handling water run-off on the site. Even if a modified use or caretaker services can eventually be found for the building, the following steps should be addressed.

Structurally stabilizing the building

While bracing may have been required to make the building temporarily safe for inspection, the condition assessment may reveal areas of hidden structural damage. Roofs, foundations, walls, interior framing, porches and dormers all have structural components that may need added reinforcement.

Structural stabilization by a qualified contractor should be


Interior bracing which will last the duration of the mothballing will protect weakened structural members. Photo: John Milner Architects.

done under the direction of a structural engineer or a preservation specialist to ensure that the added weight of the reinforcement can be sustained by the building and that the new members do not harm historic finishes. Any major vertical post added during the stabilization should be properly supported and, if necessary, taken to the ground and underpinned.

If the building is in a northern climate, then the roof framing must be able to hold substantial snow loads. Bracing the roof at the ridge and mid-points should be considered if sagging is apparent. Likewise, interior framing around stair openings or under long ceiling spans should be investigated. Underpinning or bracing structural piers weakened by poor drainage patterns may be a good precaution as well. Damage caused by insects, moisture, or from other causes should be repaired or reinforced and, if possible, the source of the damage removed. If features such as porches and dormers are so severely deteriorated that they must be removed, they should be documented, photographed, and portions salvaged for storage prior to removal.

If the building is in a southern or humid climate and termites or other insects are a particular problem, the foundation and floor framing should be inspected to ensure that there are no major structural weaknesses. This can usually be done by observation from the crawl space or basement. For those structures where this is not possible, it may be advisable to lift selective floor boards to expose the floor framing. If there is evidence of pest damage, particularly termites, active colonies should be treated and the structural members reinforced or replaced, if necessary.

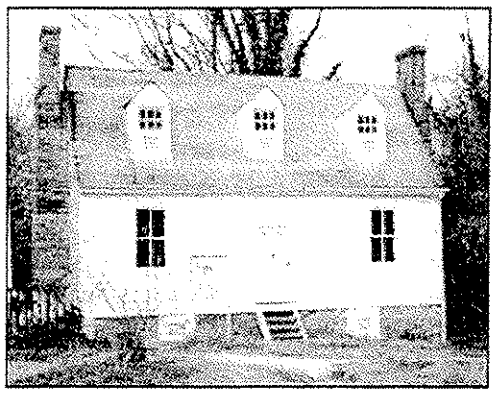
Controlling pests

Pests can be numerous and include squirrels, raccoons, bats, mice, rats, snakes, termites, moths, beetles, ants, bees and wasps, pigeons, and other birds. Termites, beetles, and carpenter ants destroy wood. Mice, too, gnaw wood as well as plaster, insulation, and electrical wires. Pigeon and bat droppings not only damage wood finishes but create a serious and sometimes deadly health hazard.

If the property is infested with animals or insects, it is important to get them out and to seal off their access to the building. If necessary, exterminate and remove any nests or hatching colonies. Chimney flues may be closed off with exterior grade plywood caps, properly ventilated, or protected with framed wire screens. Existing vents, grills, and louvers in attics and crawl spaces should be screened with bug mesh or heavy duty wire, depending on the type of pest being controlled. It may be advantageous to have damp or infected wood treated with insecticides (as permitted by each state) or preservatives, such as borate, to slow the rate of deterioration during the time that the building is not in use.

Securing the exterior envelope from moisture penetration

It is important to protect the exterior envelope from moisture penetration before securing the building. Leaks from deteriorated or damaged roofing, from around windows and doors, or through deteriorated materials, as well as ground moisture from improper site run-off or rising damp at foundations, can cause long-term damage to interior finishes and structural systems. Any serious deficiencies on the exterior, identified in the condition assessment, should be addressed.


Regrading has protected this masonry foundation wall

from excessive damp during its 10-year mothballing. Note the attic and basement vents, temporary stairs, and interpretive sign. Photo: NPS files.

To the greatest extent possible, these weatherization efforts should not harm historic materials. The project budget may not allow deteriorated features to be fully repaired or replaced in-kind. Non-historic or modern materials may be used to cover historic surfaces temporarily, but these treatments should not destroy valuable evidence necessary for future preservation work. Temporary modifications should be as visually compatible as possible with the historic building.

Roofs are often the most vulnerable elements on the building exterior and yet in some ways they are the easiest element to stabilize for the long term, if done correctly. "Quick fix" solutions, such as tar patches on slate roofs, should be avoided as they will generally fail within a year or so and may accelerate damage by trapping moisture. They are difficult to undo later when more permanent repairs are undertaken. Use of a tarpaulin over a leaking roof should be thought of only as a very temporary emergency repair because it is often blown off by the wind in a subsequent storm.

If the existing historic roof needs moderate repairs to make it last an additional ten years, then these repairs should be undertaken as a first priority. Replacing cracked or missing shingles and tiles, securing loose flashing, and reanchoring gutters and downspouts can often be done by a local roofing contractor. If the roof is in poor condition, but the historic materials and configuration are important, a new temporary roof, such as a lightweight aluminum channel system over the existing, might be considered. If the roofing is so deteriorated that it must be replaced and a lightweight aluminum system is not affordable, various inexpensive options might be considered. These include covering the existing deteriorated roof with galvanized corrugated metal roofing panels, or 90 lb. rolled roofing, or a rubberized membrane (refer back to cover photo). These alternatives should leave as much of the historic sheathing and roofing in place as evidence for later preservation treatments.

Urban buildings often need additional protection from unwanted entry and graffiti. This commercial building uses painted plywood panels to cover its glass storefronts. The upper windows on the street sides have been painted to resemble 19th century sash. Photo: NPS files.

For masonry repairs, appropriate preservation approaches are essential. For example, if repointing deteriorated brick chimneys or walls is necessary to prevent serious moisture penetration while the building is mothballed, the mortar should match the historic mortar in composition, color, and tooling. The use of hard portland cement mortars or vapor-impermeable waterproof coatings are not appropriate solutions as they can cause extensive damage and are not reversible treatments.

For wood siding that is deteriorated, repairs necessary to keep out moisture should be made; repainting is generally warranted. Cracks around windows and doors can be beneficial in providing ventilation to the interior and so should only be caulked if needed to keep out bugs and moisture. For very deteriorated wall surfaces on wooden frame structures, it may be necessary to sheathe in plywood panels, but care should be taken to minimize installation damage by planning the location of the nailing or screw patterns or by installing panels over a frame of battens. Generally, however, it is better to repair deteriorated features than to cover them over.

Foundation damage may occur if water does not drain away from the building. Run-off from gutters and downspouts should be directed far away from the foundation wall by using long flexible extender pipes equal in length to twice the depth of the basement or crawl space. If underground drains are susceptible to clogging, it is recommended that the downspouts be disconnected from the drain boot and attached to flexible piping. If gutters and downspouts are in bad condition, replace them with inexpensive aluminum units.

If there are no significant landscape or exposed archeological elements around the foundation, consideration should be given to regrading the site if there is a documented drainage problem. If

building up the grade, use a fiber mesh membrane to separate the new soil from the old and slope the new soil 6 to 8 feet (200 cm-266 cm) away from the foundation making sure not to cover up the dampcourse layer or come into contact with skirting boards. To keep vegetation under control, put down a layer of 6 mil black polyethylene sheeting or fiber mesh matting covered with a 2"-4" (5-10 cm.) of washed gravel. If the building suffers a serious rising damp problem, it may be advisable to eliminate the plastic sheeting to avoid trapping ground moisture against foundations.

Mothballing

The actual mothballing effort involves controlling the long-term deterioration of the building while it is unoccupied as well as finding methods to protect it from sudden loss by fire or vandalism. This requires securing the building from unwanted entry, providing adequate ventilation to the interior, and shutting down or modifying existing utilities. Once the building is de-activated or secured, the long-term success will depend on periodic maintenance and surveillance monitoring.

Securing the building from vandals, break-ins, and natural disasters

Securing the building from sudden loss is a critical aspect of mothballing. Because historic buildings are irreplaceable, it is vital that vulnerable entry points are sealed. If the building is located where fire and security service is available then it is highly recommended that some form of monitoring or alarm devices be used.

To protect decorative features, such as mantels, lighting fixtures, copper downspouts, iron roof cresting, or stained glass windows from theft or vandalism, it may be advisable to temporarily remove them to a more secure location if they cannot be adequately protected within the structure.

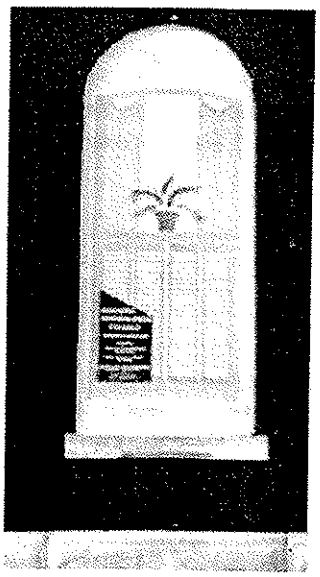
The first floor openings of this historic building have been filled with cinder blocks and the doors, window sash, and frames removed for safe keeping. The security metal door features heavy duty locks. Photo: NPS files.

Mothballed buildings are usually boarded up, particularly on the first floor and basement, to protect fragile glass windows from breaking and to reinforce entry points. Infill materials for closing door and window openings include plywood, corrugated panels, metal grates, chain fencing, metal grills, and cinder or cement blocks. The method of installation should not result in the destruction of the opening and all associated sash, doors, and frames should be protected or stored for future reuse.

Generally exterior doors are reinforced and provided with strong locks, but if weak historic doors would be damaged or disfigured by adding reinforcement or new locks, they may be removed temporarily and replaced with secure modern doors. Alternatively, security gates in an new metal frame can be installed within existing door openings, much like a storm door, leaving the historic door in place. If plywood panels are installed over door openings, they should be screwed in place, as opposed to nailed, to avoid crowbar damage each time the panel is removed. This also reduces pounding vibrations from hammers and eliminates new nail holes each time the panel is replaced.

For windows, the most common security feature is the closure of the openings; this may be achieved with wooden or pre-formed panels or, as needed, with metal sheets or concrete blocks. Plywood panels, properly installed to protect wooden frames and properly ventilated, are the preferred treatment from a preservation standpoint.

There are a number of ways to set insert plywood panels into



This painted trompe l'eoil scene on plywood panels is a neighborhood-friendly device. Photo: NPS files.

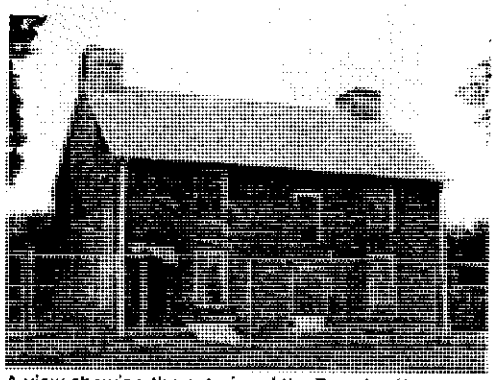
windows openings to avoid damage to frame and sash. One common method is to bring the upper and lower sash of a double hung unit to the mid-point of the opening and then to install pre-cut plywood panels using long carriage bolts anchored into horizontal wooden bracing, or strong backs, on the inside face of the window. Another means is to build new wooden blocking frames set into deeply recessed openings, for example in an industrial mill or warehouse, and then to affix the plywood panel to the blocking frame. If sash must be removed prior to installing panels, they should be labeled and stored safely within the building.

Plywood panels are usually 1/2"-3/4" (1.25-1.875 cm.) thick and made of exterior grade stock, such as CDX, or marine grade plywood. They should be painted to protect them from delamination and to provide a neater appearance.

These panels may be painted to resemble operable windows or treated decoratively. With extra attention to detail, the plywood panels can be trimmed out with muntin strips to give a shadow line simulating multi-lite windows. This level of detail is a good indication that the building is protected and valued by the community.

If the building has shutters simply close the shutters and secure them from the interior. If the building had shutters historically, but they are missing, it may be appropriate to install new shutters, even in a modern material, and secure them in the closed position. Louvered shutters will help with interior ventilation if the sash are propped open behind the shutters.

There is some benefit from keeping windows unboarded if security is not a problem. The building will appear to be occupied, and the natural air leakage around the windows will assist in ventilating the interior. The presence of natural light will also help when periodic inspections are made. Rigid polycarbonate clear storm glazing panels may be placed on the window exterior to protect against glass breakage. Because the sun's ultraviolet rays can cause fading of floor finishes and wall surfaces, filtering pull shades or inexpensive curtains may be options for reducing this type of deterioration for significant interiors. Some acrylic sheeting comes with built-in ultraviolet filters.



A view showing the exterior of the Brearley House, New Jersey, in its mothballed condition Photo: Michael Mills, Ford Farewell Mills Gatsch, Architects.

Securing the building from catastrophic destruction from fire, lightning, or arson will require additional security devices. Lightning rods properly grounded should be a first consideration if the building is in an area susceptible to lightning storms. A high security fence should also be installed if the property cannot be monitored closely. These interventions do not require a power source for operation. Since many buildings will not maintain electrical power, there are some devices available using battery packs, such as intrusion alarms, security lighting, and smoke detectors which through audible horn alarms can alert nearby neighbors. These battery packs must be replaced every 3 months to 2 years, depending on type and use. In combination with a cellular phone, they can also provide some level of direct communication with police and fire departments.

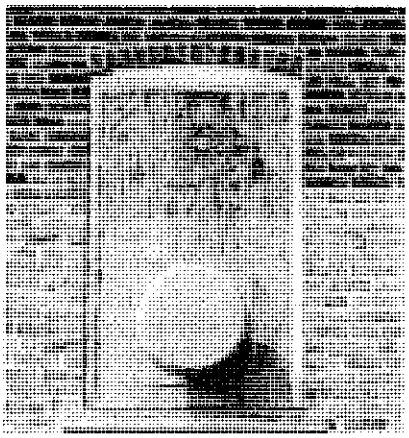
If at all possible, new temporary electric service should be provided to the building. Generally a telephone line is needed as well. A hard wired security system for intrusion and a combination rate-of-rise and smoke detector can send an immediate signal for help directly to the fire department and security service. Depending on whether or not heat will be maintained in the building, the security system should be designed accordingly. Some systems cannot work below 32°F (0°C). Exterior lighting set on a timer, photo electric sensor, or a motion/infra-red detection

device provides additional security.

Providing adequate ventilation to the interior

Once the exterior has been made weathertight and secure, it is essential to provide adequate air exchange throughout the building. Without adequate air exchange, humidity may rise to unsafe levels, and mold, rot, and insect infestation are likely to thrive. The needs of each historic resource must be individually evaluated because there are so many variables that affect the performance of each interior space once the building has been secured.

A mechanical engineer or a specialist in interior climates should be consulted, particularly for buildings with intact and significant interiors. In some circumstances, providing heat during the winter, even at a minimal 45° F (7°C), and utilizing forced-fan ventilation in summer will be recommended and will require retaining electrical service. For masonry buildings it is often helpful to keep the interior temperature above the spring dew point to avoid damaging condensation. In most buildings it is the need for summer ventilation that outweighs the winter requirements.


This exhaust fan has tamper-proof housing. Photo: Michael Mills. Ford Farewell Mills Gatsch, Architects.

Many old buildings are inherently leaky due to loose-fitting windows and floorboards and the lack of insulation. The level of air exchange needed for each building, however, will vary according to geographic location, the building's construction, and its general size and configuration.

There are four critical climate zones when looking at the type and amount of interior ventilation needed for a closed up building: hot and dry (southwestern states); cold and damp (Pacific northwest and northeastern states); temperate and humid (Mid-Atlantic states, coastal areas); and hot and humid (southern states and the tropics).

Once closed up, a building interior will still be affected by the temperature and humidity of the exterior. Without proper ventilation, moisture from condensation may occur and cause damage by wetting plaster, peeling paint, staining woodwork, warping floors, and in some cases even causing freeze thaw damage to plaster. If moist conditions persist in a property, structural damage can result from rot or returning insects attracted to moist conditions. Poorly mothballed masonry buildings, particularly in damp and humid zones have been so damaged on the interior with just one year of unventilated closure that none of the interior finishes were salvageable when the buildings were rehabilitated.

Portable monitors are used to record temperature and humidity conditions in historic buildings during mothballing. Photo: NPS files.

The absolute minimum air exchange for most mothballed buildings consists of one to four air exchanges every hour; one or two air exchanges per hour in winter and twice that amount in summer. Even this minimal exchange may foster mold and mildew in damp climates, and so monitoring the property during the stabilization period and after the building has been secured will provide useful information on the effectiveness of the ventilation solution.

There is no exact science for how much ventilation should be provided for each building. There are, however, some general rules of thumb. Buildings, such as adobe structures, located in hot and arid climates may need no additional ventilation if they have been well weatherized and no moisture is penetrating the interior. Also frame buildings with natural cracks and fissures for air infiltration may have a natural air exchange rate of 3 or 4 per hour, and so in arid as well as temperate climates may

need no additional ventilation once secured. The most difficult buildings to adequately ventilate without resorting to extensive louvering and/or mechanical exhaust fan systems are masonry buildings in humid climates. Even with basement and attic vent grills, a masonry building many not have more than one air exchange an hour. This is generally unacceptable for summer conditions. For these buildings, almost every window opening will need to be fitted out with some type of passive, louvered ventilation.

Depending on the size, plan configuration, and ceiling heights of a building, it is often necessary to have louvered opening equivalent to 5%-10% of the square footage of each floor. For example, in a hot humid climate, a typical 20'x30' (6.1m x 9.1m) brick residence with 600 sq. ft. (55.5 sq.m) of floor space and a typical number of windows, may need 30-60 sq. ft.(2.75sq.m-5.5 sq. m) of louvered openings per floor. With each window measuring 3'x5'(.9m x 1.5 m) or 15 sq. ft. (1.3 sq.m), the equivalent of 2 to 4 windows per floor will need full window louvers.

Small pre-formed louvers set into a plywood panel or small slit-type registers at the base of inset panels generally cannot provide enough ventilation in most moist climates to offset condensation, but this approach is certainly better than no louvers at all. Louvers should be located to give cross ventilation, interior doors should be fixed ajar at least 4" (10cm) to allow air to circulate, and hatches to the attic should be left open.

Monitoring devices which can record internal temperature and humidity levels can be invaluable in determining if the internal climate is remaining stable. These units can be powered by portable battery packs or can be wired into electric service with data downloaded into laptop computers periodically. This can also give long-term information throughout the mothballing years. If it is determined that there are inadequate air exchanges to keep interior moisture levels under control, additional passive ventilation can be increased, or, if there is electric service, mechanical exhaust fans can be installed. One fan in a small to medium sized building can reduce the amount of louvering substantially.

If electric fans are used, study the environmental conditions of each property and determine if the fans should be controlled by thermostats or automatic timers. Humidistats, designed for enclosed climate control systems, generally are difficult to adapt for open mothballing conditions. How the system will draw in or exhaust air is also important. It may be determined that it is best to bring dry air in from the attic or upper levels and force it out through lower basement windows. If the basement is damp, it may be best to zone it from the rest of the building and exhaust its air separately. Additionally, less humid day air is preferred over damper night air, and this can be controlled with a timer switch mounted to the fan.

The type of ventilation should not undermine the security of the building. The most secure installations use custom-made grills well anchored to the window frame, often set in plywood security panels. Some vents are formed using heavy millwork louvers set into existing window openings. For buildings where security is not a primary issue, where the interior is modest, and where there has been no heat for a long time, it may be possible to use lightweight galvanized metal grills in the window openings. A cost effective grill can be made from the expanded metal mesh lath used by plasterers and installed so that the mesh fins shed rainwater to the exterior.

Securing mechanical systems and utilities

At the outset, it is important to determine which utilities and services, such as electrical or telephone lines, are kept and which are cut off. As long as these services will not constitute a fire hazard, it is advisable to retain those which will help protect the property. Since the electrical needs will be limited in a vacant building, it is best to install a new temporary electric line and panel (100 amp) so that all the wiring is new and exposed. This will be much safer for the building, and allows easy access for reading the meter.

Most heating systems are shut down in long term mothballing. For furnaces fueled by oil, there are two choices for dealing with the tank. Either it must be filled to the top with oil to eliminate condensation or it should be drained. If it remains empty for more than a year, it will likely rust and not be reusable. Most tanks are drained if a newer type of system is envisioned when the

building is put back into service. Gas systems with open flames should be turned off unless there is regular maintenance and frequent surveillance of the property. Gas lines are shut off by the utility company.

If a hot water radiator system is retained for low levels of heat, it generally must be modified to be a self-contained system and the water supply is capped at the meter. This recirculating system protects the property from extensive damage from burst pipes. Water is replaced with a water/glycol mix and the reserve tank must also be filled with this mixture. This keeps the modified system from freezing, if there is a power failure. If water service is cut off, pipes should be drained. Sewerage systems will require special care as sewer gas is explosive. Either the traps must be filled with glycol or the sewer line should be capped off at the building line.

Developing a maintenance and monitoring plan

While every effort may have been made to stabilize the property and to slow the deterioration of materials, natural disasters, storms, undetected leaks, and unwanted intrusion can still occur. A regular schedule for surveillance, maintenance, and monitoring should be established. The fire and police departments should be notified that the property will be vacant. A walk-through visit to familiarize these officials with the building's location, construction materials, and overall plan may be invaluable if they are called on in the future.

The optimum schedule for surveillance visits to the property will depend on the location of the property and the number of people who can assist with these activities. The more frequent the visits to check the property, the sooner that water leaks or break-ins will be noticed. Also, the more frequently the building is entered, the better the air exchange. By keeping the site clear and the building in good repair, the community will know that the building has not been abandoned. The involvement of neighbors and community groups in caring for the property can ensure its protection from a variety of catastrophic circumstances.

The owner may utilize volunteers and service companies to undertake the work outlined in the maintenance chart. Service companies on a maintenance contract can provide yard, maintenance, and inspection services, and their reports or itemized bills reflecting work undertaken should be added to update the building file.

Sidebar

Mothballing Checklist

In reviewing mothballing plans, the following checklist may help to ensure that work items are not inadvertently omitted.

Moisture

- Is the roof watertight?
- Do the gutters retain their proper pitch and are they clean?
- Are downspout joints intact?
- Are drains unobstructed?
- Are windows and doors and their frames in good condition?
- Are masonry walls in good condition to seal out moisture?
- Is wood siding in good condition?
- Is site properly graded for water run-off?
- Is vegetation cleared from around the building foundation to avoid trapping moisture?

Pests

- Have nests/pests been removed from the building's interior and eaves?
- Are adequate screens in place to guard against pests?
- Has the building been inspected and treated for termites, carpenter ants, rodents, etc.?

- If toxic droppings from bats and pigeons are present, has a special company been brought in for its disposal?

Housekeeping

- Have the following been removed from the interior: trash, hazardous materials such as inflammable liquids, poisons, and paints and canned goods that could freeze and burst?
- Is the interior broom-clean?
- Have furnishings been removed to a safe location?
- If furnishings are remaining in the building, are they properly protected from dust, pests, ultraviolet light, and other potentially harmful problems?
- Have significant architectural elements that have become detached from the building been labeled and stored in a safe place?
- Is there a building file?

Security

- Have fire and police departments been notified that the building will be mothballed?
- Are smoke and fire detectors in working order?
- Are the exterior doors and windows securely fastened?
- Are plans in place to monitor the building on a regular basis?
- Are the keys to the building in a secure but accessible location?
- Are the grounds being kept from becoming overgrown?

Utilities

- Have utility companies disconnected/shut off or fully inspected water, gas, and electric lines?
- If the building will not remain heated, have water pipes been drained and glycol added?
- If the electricity is to be left on, is the wiring in safe condition?

Ventilation

- Have steps been taken to ensure proper ventilation of the building?
- Have interior doors been left open for ventilation purposes?
- Has the secured building been checked within the last 3 months for interior dampness or excessive humidity?

Maintenance Chart

1-3 months; periodic

- regular drive by surveillance
- check attic during storms if possible
- monthly walk arounds
- check entrances
- check window panes for breakage
- mowing as required
- check for graffiti or vandalism

- enter every 3 months to air out
- check for musty air
- check for moisture damage
- check battery packs and monitoring equipment
- check light bulbs

- check for evidence of pest intrusion

every 6 months; spring and fall

- site clean-up; pruning and trimming
- gutter and downspout check
- check crawlspace for pests
- clean out storm drains

every 12 months

- maintenance contract inspections for equipment/utilities
- check roof for loose or missing shingles
- termite and pest inspection/treatment
- exterior materials spot repair and touch up painting
- remove bird droppings or other stains from exterior
- check and update building file

Conclusion

Providing temporary protection and stabilization for vacant historic buildings can arrest deterioration and buy the owner valuable time to raise money for preservation or to find a compatible use for the property. A well planned mothballing project involves documenting the history and condition of the building, stabilizing the structure to slow down its deterioration, and finally, mothballing the structure to secure it. The three highest priorities for a mothballed building are 1) to protect the building from sudden loss, 2) to weatherize and maintain the property to stop moisture penetration, and 3) to control the humidity levels inside once the building has been secured.

While issues regarding mothballing may seem simple, the variables and intricacies of possible solutions make the decision-making process very important. Each building must be individually evaluated prior to mothballing. In addition, a variety of professional services as well as volunteer assistance is needed for careful planning and repair, sensitively designed protection measures, follow-up security surveillance, and cyclical maintenance.

In planning for the future of the building, complete and systematic records must be kept and generous funds allocated for mothballing. This will ensure that the historic property will be in stable condition for its eventual preservation, rehabilitation, or restoration.

Further Reading

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"Mothballing Vacant Buildings," An Anti-Arson Kit for Preservation and Neighborhood Action. Washington, DC: Federal Emergency Management Agency, 1982.

Solon, Thomas E. "Security Panels for the Foster-Armstrong House." Association for Preservation Technology Bulletin. Vol XVI no. 3 & 4, 1984. (note the design of the panels, but be aware that additional louvering may be needed on other projects).

Acknowledgements

The author, Sharon C. Park, Senior Historical Architect, Heritage Preservation Services Division, National Park Service, would like to acknowledge the assistance of the following individuals in the preparation and review of this publication. H. Ward Jandl served as the technical editor and assisted with producing this Preservation Brief. In addition the following persons have provided invaluable information and illustrations: Ernest A. Conrad, PE; Doug Hicks, NPS Williamsport Preservation Training Center; Thomas C. Taylor, Colonial Williamsburg; Karen Gordon, Seattle Urban Conservation Office; Kevin B. Stoops, Seattle Department of Parks and Recreation; Michael Mills, AIA; Christina Henry, architect, Mary Beth Hirsch, Ohio Historical Society. Thanks also to Heritage Preservation Services Division staff members Michael J. Auer, Anne E. Grimmer, Kay D. Weeks, Tim Buehner, and Jean Travers, and to the numerous staff members of the NPS Regional offices who submitted comments. All photographs and drawings are by the author unless otherwise noted.

Washington, D.C. September, 1993

Home page logo: Appropriately mothballed historic building. Photo: NPS files.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments to a broad public.

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Last Modified: Tue, Oct 2 2001 11:17:16 am EDT

KDW

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LANDSCAPE/PLANTINGS

Original specs for Aladdin Homes, circa 1929:
Aladdin supplied no landscaping materials. Purchaser supplied soil and sand as needed.

Character Defining Features:
All planting appear to have been tenant-cultivated.

Typical in 2001:
See the landscape plan for identification of all major plantings.

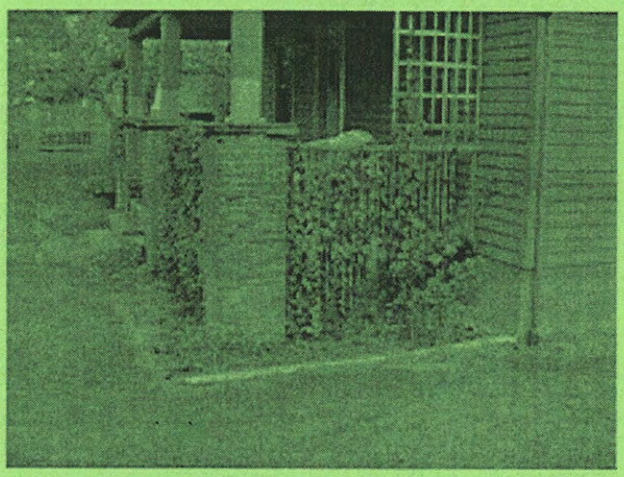
Special Cases:
Intrusive porch vegetation on cottages 2, 36, 37, 41
Possibly intrusive trees on cottages 2, 3, 5, 8, 9

Condition:
Most of the vegetation seems to be healthy. In certain cases (see above), vegetation may be contributing to deterioration of the building, as it holds moisture against the wood. Some trees overhanging the roof of the building can contribute to mold growth. See the section on Roofs for more information on this.

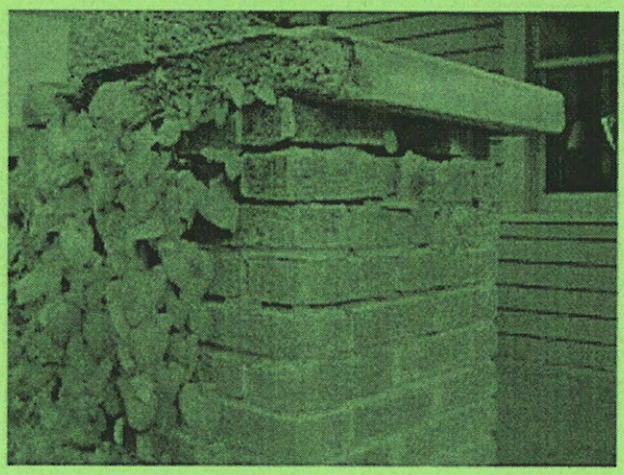
In this Section:
Trees/Plantings
Walkways

See also:
Site analysis in Section One
Stabilization Section

Operations



Vines growing on the porch rails can hold moisture against the wood surface and cause decay.



Vines growing up a brick pier can accelerate mortar deterioration.

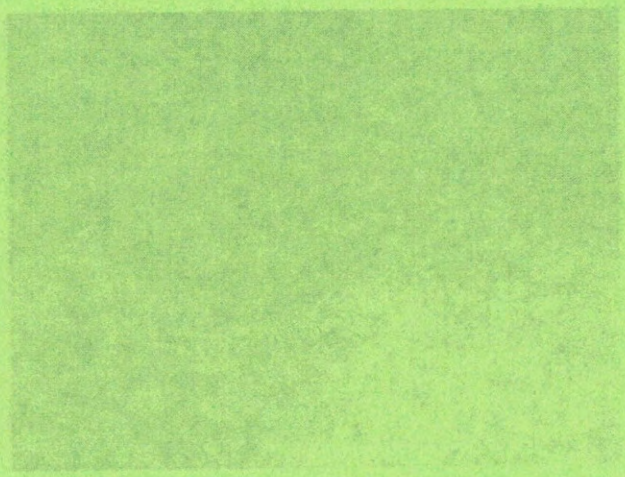
Landscape

Trees/plantings

See Stabilization for initial trimming.Seasonal trimming should take place to remove foliage encroaching on buildings, especially at the roof and foundation levels and on porches. Clean up deciduous tree debris in fall. Foliage should be kept 12" from the structure.

Walkways

Inspect annually for cracks.Keep walkways clean. Repair as needed.



CONCLUSION

Three Lynx is a great resource for Portland General Electric, both as an architectural treasure trove, and a source of company history. The rightful pride that the employees we spoke with evidenced about this village demonstrates the importance Three Lynx has had in the lives of those who have lived there. Besides its beautiful setting, it is unique in its continued existence as a company town, with a history of more than 70 years. The unique Aladdin Company kit houses are historically significant because of their period and method of construction. PGE chose houses from Aladdin that complemented the existing building stock on the site.

The cottages at Three Lynx are overall in good condition. No major structural problems seem to exist. We suggest that the foundation cracks be monitored to affirm that they were caused by settling and are no longer active. We suggest as well that foundation and roof ties be installed, as they will prevent major damage in the event of a strong storm or an earthquake.

The most immediate concern besides this is the fact that several of the cottages are unoccupied. Preservation is best achieved through sensitive and informed utilization. We highly recommend that a plan be worked out that would increase the occupancy of the cottages, as well as educate occupants as to the history of the buildings and appropriate care. We recommend mothballing cottages not in use, to avoid further deterioration.

We hope that PGE will continue its maintenance of Three Lynx, and attempt to revive the village. Full occupancy cannot be stressed enough. To restore the community it is necessary to create a draw, perhaps by restoring those elements that once contributed to the overall sense of community, such as the pool and shared-use buildings including the school.

We sincerely hope that the strategies suggested in this project be helpfully implemented by PGE's maintenance crews and tenants.

THREE LYNX ASSESSMENT PROJECT
UNIVERSITY OF OREGON HISTORIC PRESERVATION PROGRAM

APPENDIX

APPENDIX
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Moss Information Sheets

FEMA Earthquake Information

Preservation Briefs:

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39 Holding the Line: Controlling Unwanted Moisture in Historic Buildings

STUDENT CONTRIBUTOR BIOGRAPHIES

Stewart Crosby, graduate student in landscape architecture, has a B.S. in International Affairs from Lewis and Clark College and a B.L.A. from the University of Oregon. His master's project is a rehabilitation plan for Terwilliger Boulevard in Portland, Oregon.

Christy Fockler, graduate student in historic preservation, has a B.S. in interior design from Colorado State University. Her interests include historic masonry, adaptive reuse projects, and downtown urban renewal.

Marti Gerdes, graduate student in historic preservation and landscape architecture, has a M.S. in journalism from the University of Oregon.

Spencer J. Howard, graduate student in historic preservation, has a B.A. in Spanish and German from the University of Oregon. His thesis work is on the Stimson-Green Mansion in Seattle.

Carin Petersen, graduate student in historic preservation, has a B.Arch from California Polytechnic State University, San Luis Obispo. Her interests include the integration of new construction with historic architecture, adaptive reuse, and the seismic retrofit of masonry buildings.

Mary Kate Ryan, graduate student in art history, has a B.A. in art history and English literature. Her thesis work explores the role of the family in the design of early post-WWII suburbs in Portland, Oregon.

David Steele, graduate student in historic preservation, has a B.Arch from Andrews University. His thesis work is lighthouse preservation.

Anita Washko, graduate student in architecture with an emphasis in historic preservation, has a B.A. in Architecture from the University of Washington. Upon completion of her degree she will return to work for an engineering and architecture consulting firm in Seattle.

Philip Waugh, graduate student in historic preservation, has a B.A. in literature from Skidmore College. His interests include rural vernacular architecture, and the technologies of wood and stone preservation.

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Sweetser, Sarah M. Preservation *Brief #4: Roofing for Historic Buildings*. Accessed 20 February 2002 at www2.cr.nps.gov/tps/briefs/brief04.htm.

All other Preservation Briefs are included in their entirety, and can be accessed at www2.cr.nps.gov/tps/briefs/

Original Assessment Forms

Site Visit One

&

Notes from Site Visit Two

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
10.6.01	CHRISTY

Address/ Bldg. #: 2

Style: STORY & 1/2 — SITE BUILT — painted lt. green (mint) w/ white trim

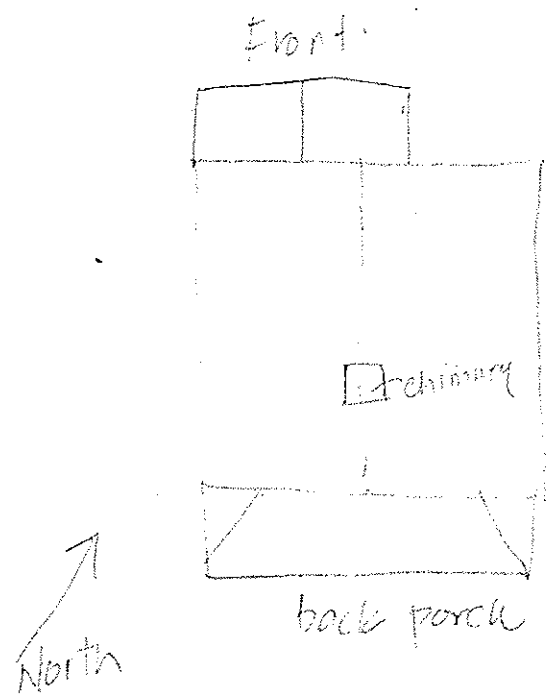
Date of Construction: ? T.B.D. early 1920's

Moved: NO

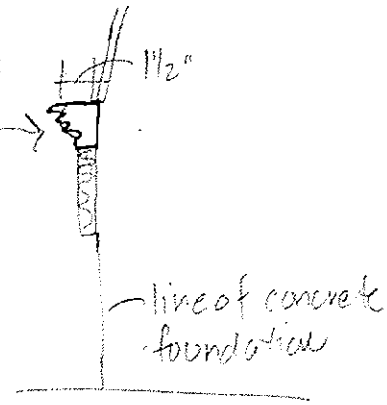
# of stories 1 1/2 - 2 levels & basement

PHOTO

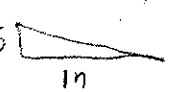
Roof Configuration



Address/ Bldg. #: 2

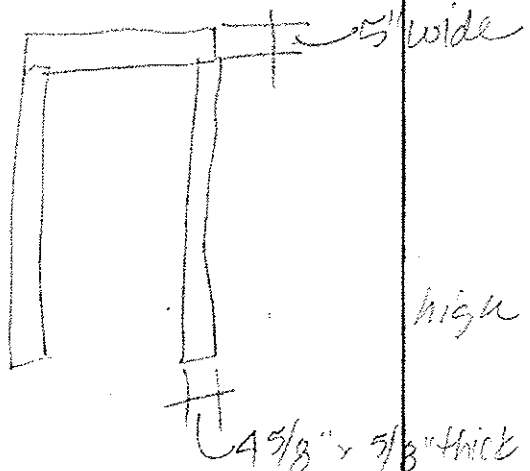
EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness, Pier Sizes/ Spacing, Cracking/ Damage, Header material	board frmd conc. w/ daylight bsmt. crack on west side - middle		
Exterior Wall	**Issues to Consider:** Insulation, Bulging / leaning	4½" exposure siding water table detail @ 3' approx ~~[illegible]~~ above ground		
Windows	1/1 wood ~~dbl~~ SINGLE hung windows. some have perm. fixed alum storms crown mold above windows. see sketch			
Doors	See sketch	1/3 glazed panel door (wood)		
Decks/Porch	**Issues to Consider:** Railing height, Floor material	Front: 25-27" rail ht. Floor: +BG 3¼ x ¾ thick — modern decking — after WW2 porch gabel end is shingled - painted.		
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	gutter let-into rafter tail - once a wood gutter - now metal. 2" downspouts appears to go to perimeter drainage. Both porches have similar gutter details.		
Chimney	**Issues to Consider:** Height above roof, Flue size, Structural problems	20" sq. chimney w/ corbel top. bad connection to roof w/ flashing & goopous caulking material s. steel flu at top.		
Roof	**Issues to Consider:** Pitch 8:12 pitch, Flashing type, ~~Skylights~~	comp. shingle roof bad flashing detail — loops over shingles at rake verge bd. is only visual detail - not structural		
Additions and Changes (on back)				

2

back porch: 5  2x4 rafters add-on

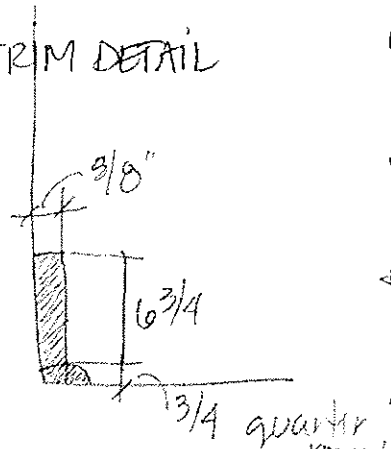
Address/ Bldg. #: 2

INTERIOR	Material	Condition	Integrity
Issues to Consider: Dimensions Ceiling Height 8'-5 1/4 ~~Closets / sizes~~ Trim wainscot 3 1/2" x 1" @ [illegible]	3'6 1/2" btm to floor		
Number of outlets / voltage 4-110 / 1-220 Heat source 1 vent Location of rm (1st) / 2nd fl) Skylights ~~Ventilation source~~ ~~Fireplace size~~			
Kitchen			
Ceiling	PAINTED ptd lath/plastr	good	high
Floor	sheet vinyl		
Wall	wallpaper/lath/plaster		
Window above sink	SINGLE HUNG WINDOW 1/1 7'6 3/4 across	x 3'8 1/4	
Door 32" to porch (back) archway btwn dining & kitchen			
Cabinet/Millwork	base & upper cabs. w/ lam. c. top.	laminate countertops	
~~**Fireplace**~~ none			
Appliances / Fixtures	sink / stove / 1/2 fridge		



12'-8" x 9'11" room dim

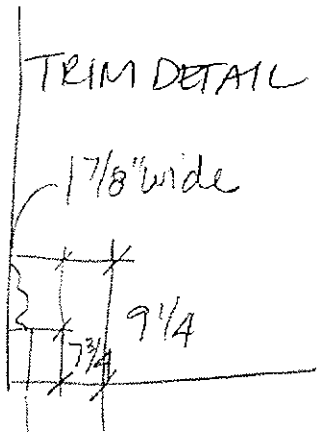
TRIM DETAIL



Address/ Bldg. #: 2

Living Room		Material	Condition	Integrity
	Ceiling	PAINTED ptd lath/plastr		
Issues to Consider:				
Dimensions				
Ceiling Height 8'5 typ	Floor	wood / varnished	3¼ wide tongue & groove	
~~Closets / sizes~~				
Trim base board				
Number of outlets / voltage — 4-110 1-220		PAINTED		
Heat source 2 floor	Wall	ptd lath/plastr		
Location of rm (1st/ 2nd fl)				
Skylights				
Ventilation source				
Fireplace size	Window	3 typ. windows	1:1 single hung windows	
	Door typ.	to front porch ½3 glazed wood panel door		
ROOM DIMENSIONS: 17'11" x 12'-8"	~~Cabinet/Millwork~~			
	~~Fireplace~~			

TRIM DETAIL



→ used to have quarter round – no removed.

Address/ Bldg. #: 2

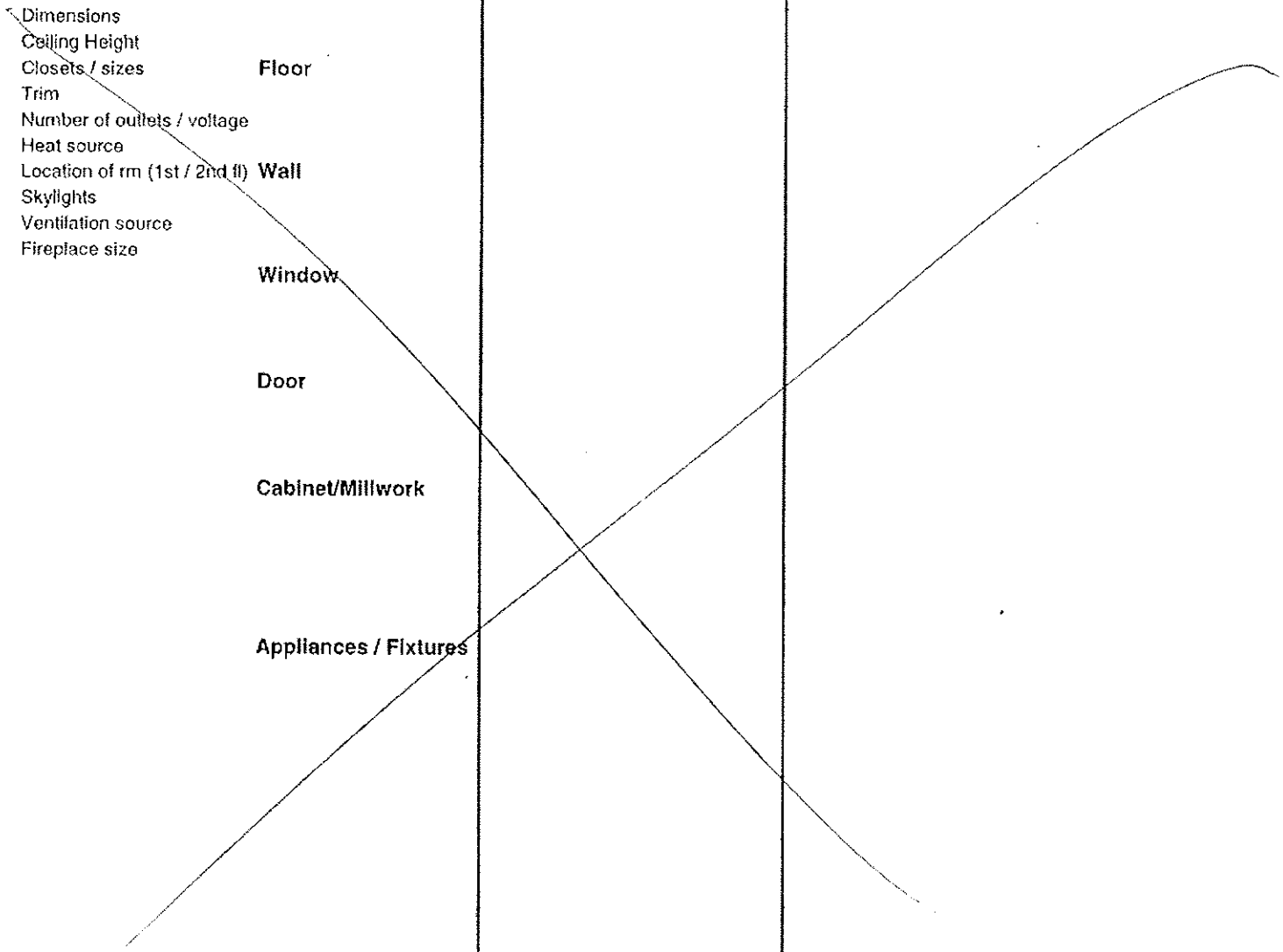
Dining Room		Material	Condition	Integrity
	Ceiling	PAINTED ptd lath/plaster		
Issues to Consider:				
Dimensions	Floor	sheet vinyl		
Ceiling Height 8'-5 1/4				
~~Closets / sizes~~				
Trim base board				
2-110 — Number of outlets / voltage	Wall	ptd lath/plaster w/ wallpaper trim at ceiling line		
Heat source — heat				
Location of rm (1st) / 2nd fl)				
~~Skylights~~				
~~Ventilation source~~	Window one typ.	~~[illegible]~~	1/1 SINGLE HUNG WINDOW	
~~Fireplace size~~				
	Door to upstairs			
	Cabinet/Millwork —	corner upper from ceiling 41" wide total x 5' 5 1/4" 3 3/4" trim		
	~~Fireplace~~			
9'11" x 10' 2 1/2" room dim				

Address/ Bldg. #: 2

Bathroom		Material	Condition	Integrity
	Ceiling	PAINTED ptd plaster		
Issues to Consider:				
Dimensions				
Ceiling Height typ.				
Closets / sizes	Floor	plaster/ptd w/ c.tile wainscot — vinyl trim		
Trim typ. at door/window		CERAMIC		
Number of outlets / voltage 1-110				
Heat source				
Location of rm (1st / 2nd fl)	Wall	sheet vinyl		
~~Skylights~~				
~~Ventilation source~~				
~~Fireplace size~~				
	Window	1 typ.		
	Door	27 3/4		
	Cabinet/Millwork	one shower cabinet - hanging 2 minor cab's.		
4'-11" x 6' 9½" room size	Appliances / Fixtures	corner sink/ toilet / modern tub.		

Address/ Bldg. #: 2

Bathroom	Material	Condition	Integrity
Ceiling **Issues to Consider:** Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size **Floor** **Wall** **Window** **Door** **Cabinet/Millwork** **Appliances / Fixtures**			



Address/ Bldg. #: 2

Bedroom		Material	Condition	Integrity
Master	**Ceiling**	plastr/paint		
Issues to Consider:				
Dimensions				
Ceiling Height tup	**Floor**	wood/varnish		
~~Closets / sizes~~				
Trim base bd. tup.				
Number of outlets / voltage 2-110				
~~Heat source~~ 1 floor vent				
Location of rm (1st) 2nd fl)	**Wall**	paint/plastr		
~~Skylights~~				
~~Ventilation source~~				
~~Fireplace size~~				
	Window	2-tup.		
	Door 30"			
	Cabinet/Millwork	2'4 1/2 d x 4'4 1/2 wide sliding part. bd. doors		
9'5 1/4 x 10'-3" room dim.		trim is 3 1/2 v. x 4 1/2 h. ↳ VERTICAL ↳ HORIZONTAL		
	~~**Fireplace**~~			

Address/ Bldg. #: 2

Bedroom		Material	Condition	Integrity
Front	Ceiling	PAINTED pt. plaster		
Issues to Consider:				
Dimensions				
Ceiling Height 7'3 1/4"	Floor	wood / varnish		
Closets / sizes — attic				
Trim b. board BEADBOARD				
Number of outlets / voltage 3 - 110				
Heat source none		PAINTED		
Location of rm (1st / 2nd fl)	Wall	pt. plaster & wood paneling		
~~Skylights~~				
~~Ventilation source~~				
~~Fireplace size~~				
	Window	one - typ.		
	Door 5½ x 5½ trim			
	Cabinet/Millwork 5½ x 4" trim at closet door — 30" — 2 closets			
	Fireplace			

12' 8" x 12' 7 1/4"

Address/ Bldg. #: 2

Bedroom	Material	Condition	Integrity
Back **Ceiling** **Issues to Consider:** Dimensions Ceiling Height 7'-4 1/2 Closets / sizes attic **Floor** Trim b.board Number of outlets / voltage 1-110 Heat source none Location of rm (1st / 2nd fl) **Wall** ~~Skylights~~ ~~Ventilation source~~ ~~Fireplace size~~ **Window** **Door** 29 7/8" trim typ. of front bedroom ~~**Cabinet/Millwork**~~ 12'-9 1/2 x 10'1 1/2 ~~**Fireplace**~~ 57" closets West side runs whole length east side is broken up by stair well.	paint/plaster wood/varnish paint/plaster one typ.		

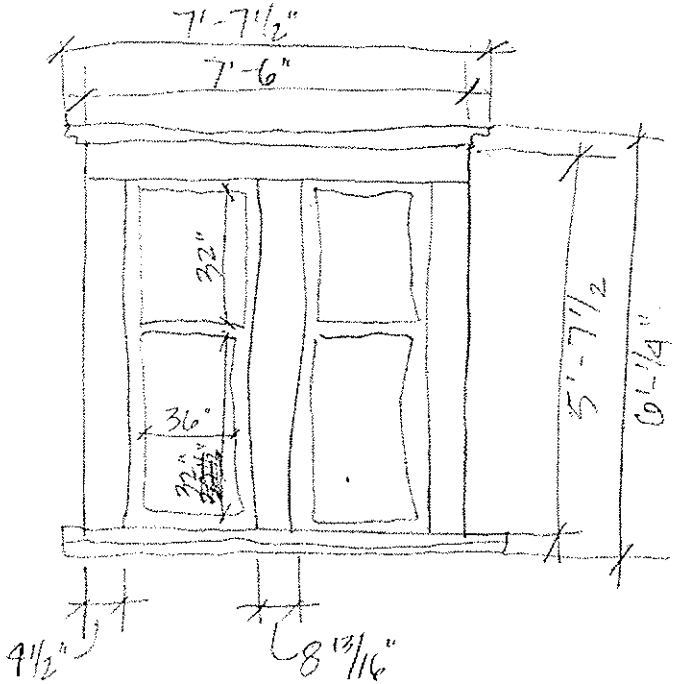
Address/ Bldg. #: 2

Basement		Material	Condition	Integrity
	Issues to Consider:			
	Insulation	none		
	Floor material	concrete		
	Floor to ceiling height	90"		
		chimney - fair cond.		
Attic				
	Issues to Consider:			
	Ceiling members	5½ x 1 5/8 @ 24" O.C.		
	Roof members	skip sheathing w/ shingles on top.		
	Roof substrate	7/8 x 5 7/8		
	Deflection/ warping			
	Signs of fungal and insect	Floor joists 3 7/8 x 1 5/8		
	Fire damage	ridge board 7 5/8 x 1 3/4		
	Insulation	rockwool insulation		
	Peak height — 42 1/4			
	Means of access hatch			
	Ventilation	not to take wiring		
	Leakage water			
Stairs				
to upstairs	**Issues to Consider:**			
	Handrail height	32"		
5½ substrate at 2nd floor finish floor is top.	Tread / riser dimensions	tread = 8½ rise = 8 bullnose of 1"		
	Stair width	29 3/4		
	Headroom	lots		
wood stairs				
Utility Room				
	Issues to Consider:			
	Plumbing connections			
	Floor drain			
back porch 6' 5½ wide x 23' 7 1/2" 7' 2½" ceiling ht.				

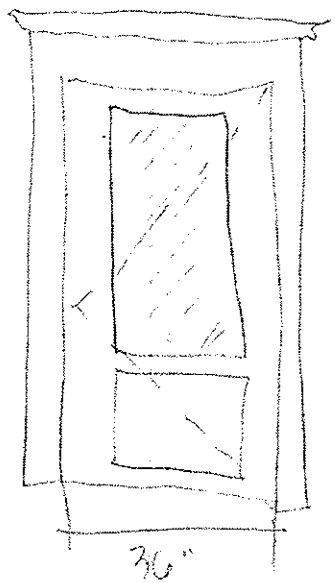
Address/ Bldg. #: 2

SYSTEMS		Material	Condition	Integrity
Mechanical/HVAC				
	Issues to Consider:			
	System type	oil - forced air		
Electrical				
	Issues to Consider:			
	System type	modern / ~~knob~~ knob & tube combo		
	Elec. Entry point	west side by back porch		
Plumbing				
	Issues to Consider:			
	Pipe size / material	cast iron / 4" stack		
	Waste disposal system			
	Water source	galvanized / copper	pipes	
Structure				
	Issues to Consider:			
	Framing type	Balloon & platform	combo	
	Floor members	2x8 16" o.c.		
	Floor substrate →	diag. shrath. 1x8		
	Wall members	2x4 16" o.c.		
	Wall substrate	horiz. shrathing		
	Deflection/ warping			
	Signs of fungal and insect			
	Fire damage n/A			
Character defining features:				

Bldg. #2



WINDOW ELEVATION

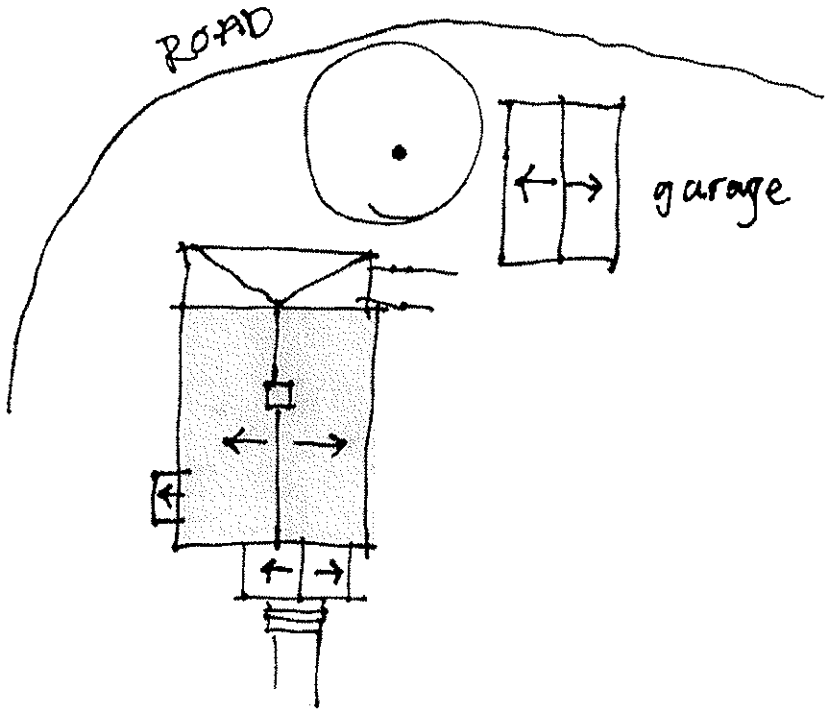


DOOR (FRONT)

PROJECT : 3 LYNX

SITE ID: 2
RECORDER: ~~CHRISTY~~ CARIN
DATE: 10.7.01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK

F B

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

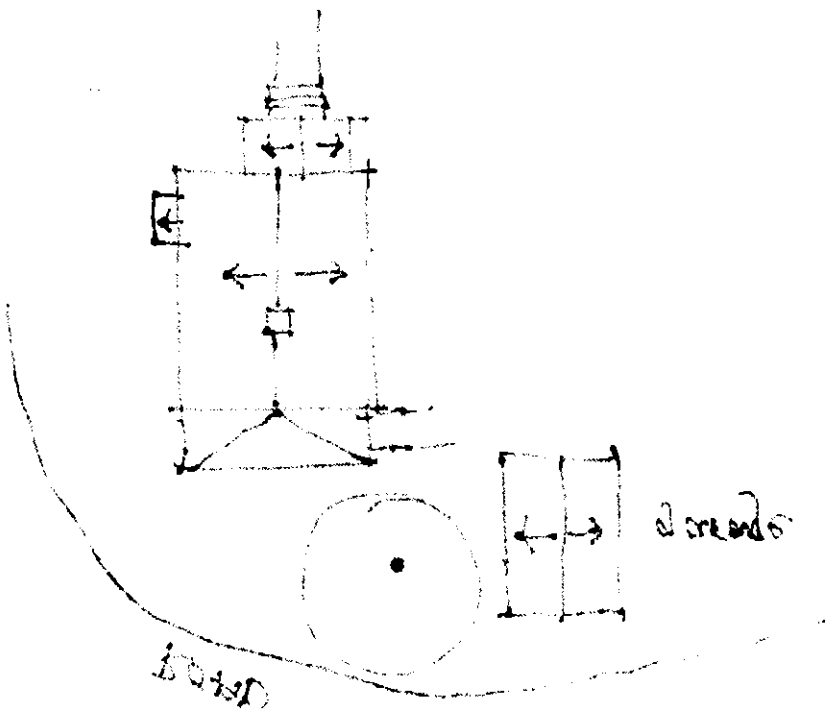
TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS


d cuerdo

FIELD ASSESMENT FORM: THREE LYNX

Date: 10.7.01 Name of Recorder: Christy

Address/ Bldg. #: 3

Style: ~~craftsman~~ 1½ story painted ~~g~~ mustard yellow w/ brown trim

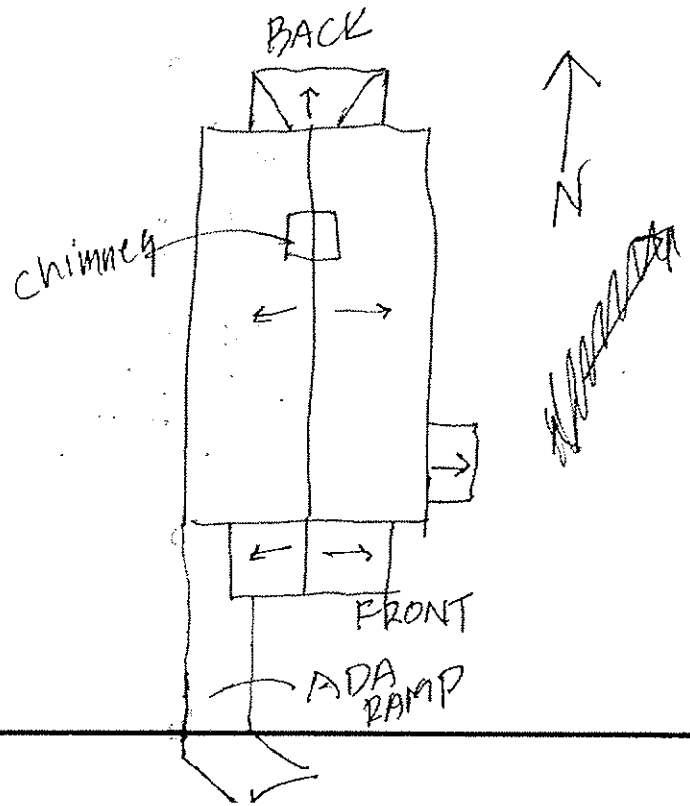
Date of Construction: 1920's

Moved: NO.

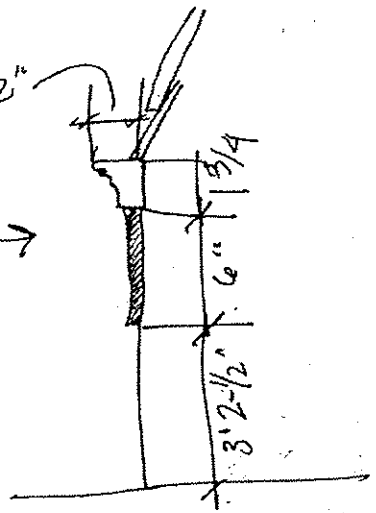
# of stories 1½ - 2 levels & basement.

PHOTO

Roof Configuration



Address/ Bldg. #: 3

EXTERIOR	Material	Condition	Integrity
Foundation **Issues to Consider:** Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material	Board formed concrete Daylight Bsmt.		
Exterior Wall **Issues to Consider:** Insulation Bulging / leaning	4 1/2" exposure wood siding - HORIZONTAL LAP water table detail. → i.e. see sketch		
back shed - see sketch. **Windows** 1/1 wood dbl. hung. crown mold above windows.			
Doors see sketch from bldg #2	1/3 GLAZED PANEL DOOR		
Decks/Porch **Issues to Consider:** Railing height 29" Floor material	ptd plywood new steps - not painted	gable end is comp. shingle - painted.	
Drainage System **Issues to Consider:** Gutter/ downspout sizes	wood gutter still in place w/ notched rafter tails, on N side NORTH metal downspout & metal gutter on south west side of bldg.		N side - yes elsewhere - no
Chimney **Issues to Consider:** Height above roof Flue size Structural problems	corbel chimney 20" - w/ lots of goop at base & flue at top of chimney		
Roof **Issues to Consider:** Pitch Flashing type Skylights	8 / 12 pitch comp. shingle roof, verge bd. painted.		
Additions and Changes (on back)			

Address/ Bldg. #: 3

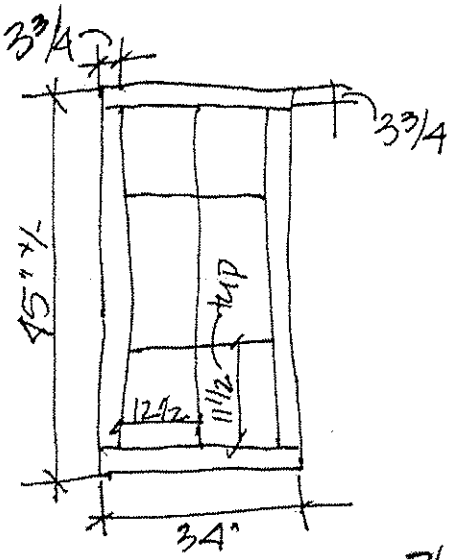
DID NOT GET INSIDE

Basement	Material	Condition	Integrity
Issues to Consider: Insulation Floor material Floor to ceiling height			
Attic			
Issues to Consider: Ceiling members Roof members Roof substrate Deflection/ warping Signs of fungal and insect Fire damage Insulation Peak height Means of access Ventilation Leakage			
Stairs			
Issues to Consider: Handrail height Tread / riser dimensions Stair width Headroom			
Utility Room			
Issues to Consider: Plumbing connections Floor drain			

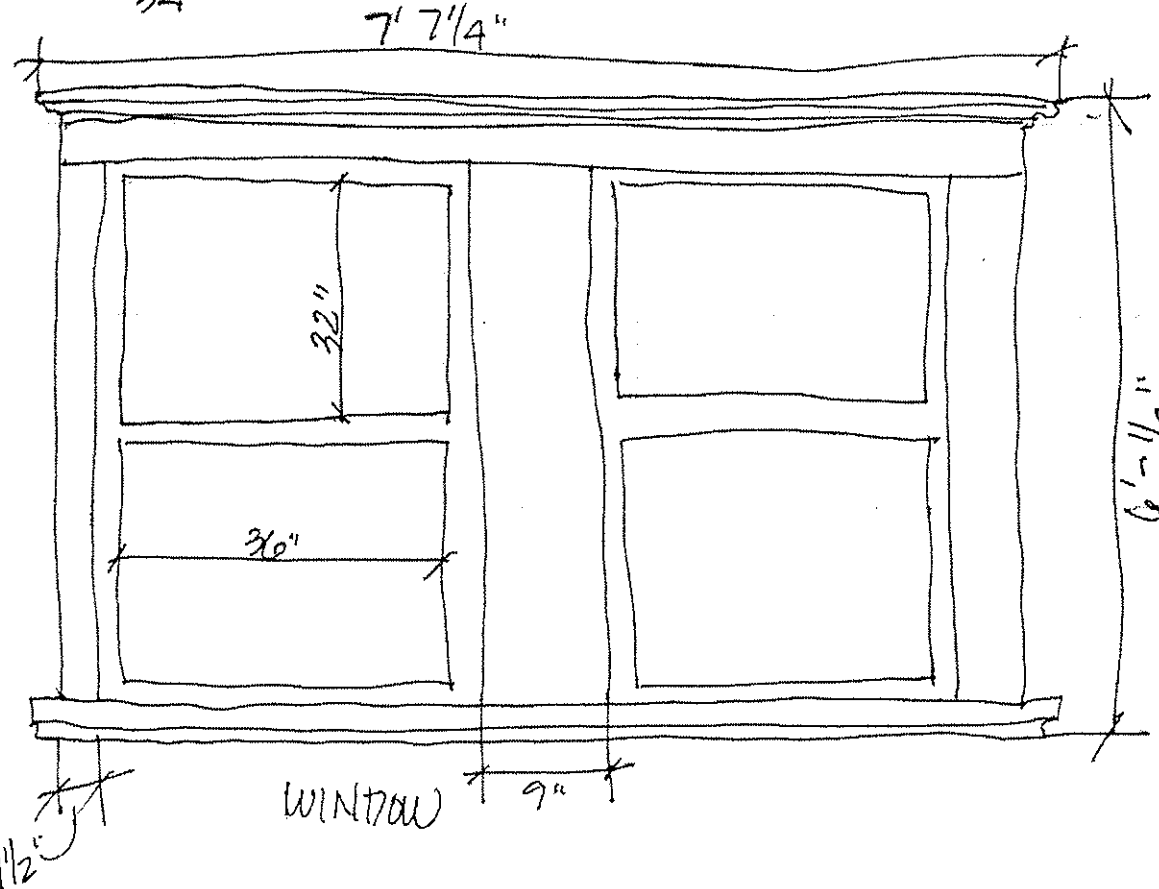
Address/ Bldg. #: 3

SYSTEMS	Material	Condition	Integrity
Mechanical/HVAC **Issues to Consider:** System type **Electrical** **Issues to Consider:** System type Elec. Entry point **Plumbing** **Issues to Consider:** Pipe size / material Waste disposal system Water source **Structure** **Issues to Consider:** Framing type Floor members Floor substrate Wall members Wall substrate Deflection/ warping Signs of fungal and insect Fire damage			
Character defining features: On next page			

Building #3



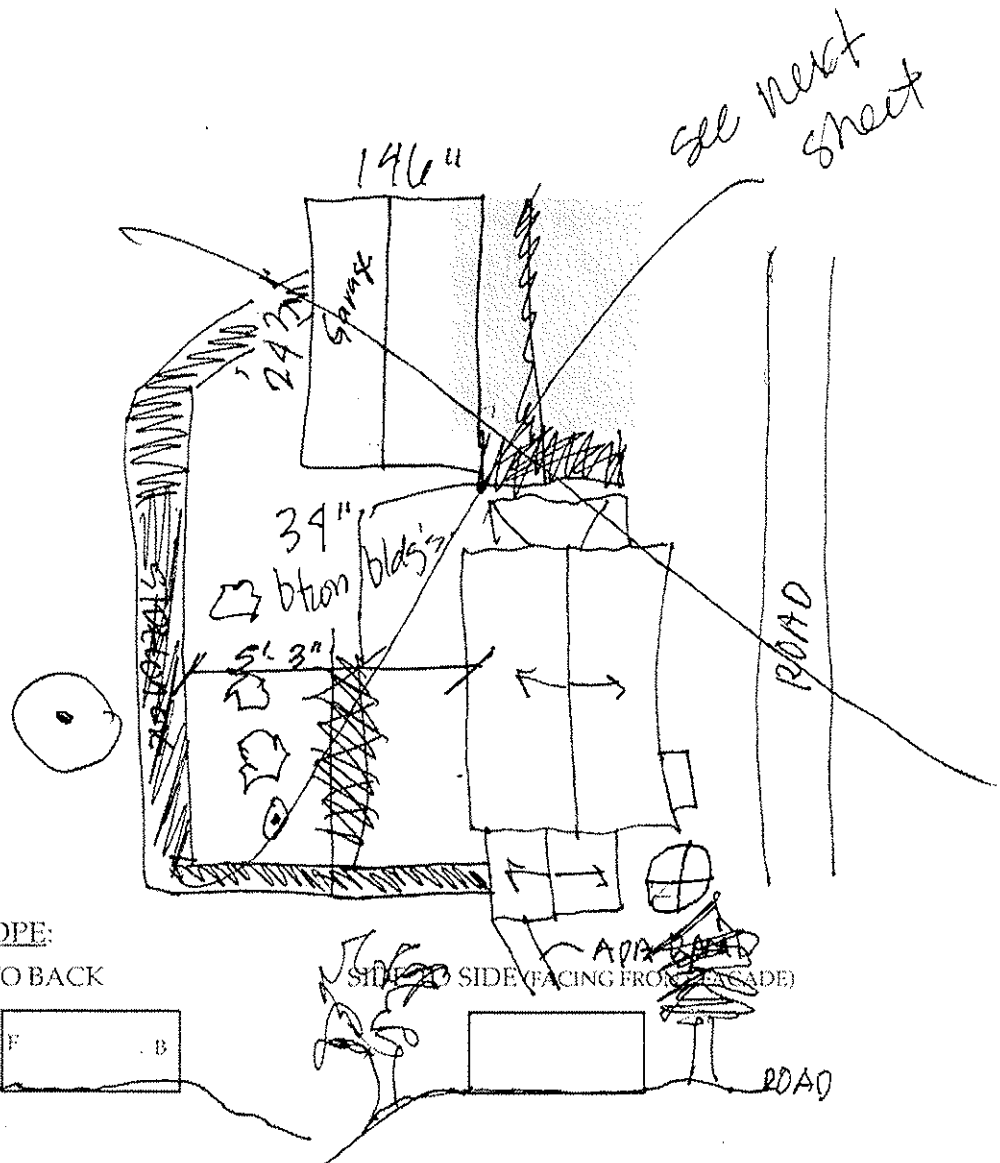
shed window.
REAR PORCH



PROJECT : 3 LYNX

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 3
RECORDER: Christy
DATE: 10·7·01



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS		FEATURES	ASSOCIATED STRUCTURES
TREES, DECIDUOUS	⊙	WALKWAY	GARAGE/CARPORT
TREES, EVERGREEN	⊕	DRIVEWAY	SHEDS
		FENCE/WALLS	
SHRUBS		ROAD	

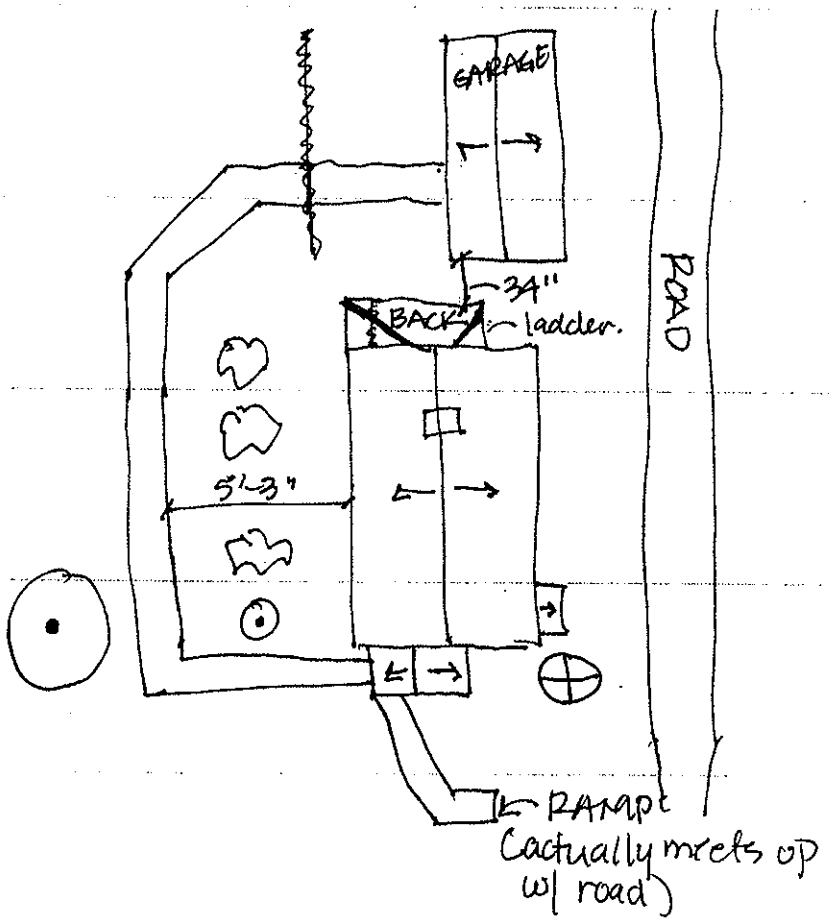
CHARACTER DEFINING FEATURES – FOR A TRADITIONAL COTTAGE #

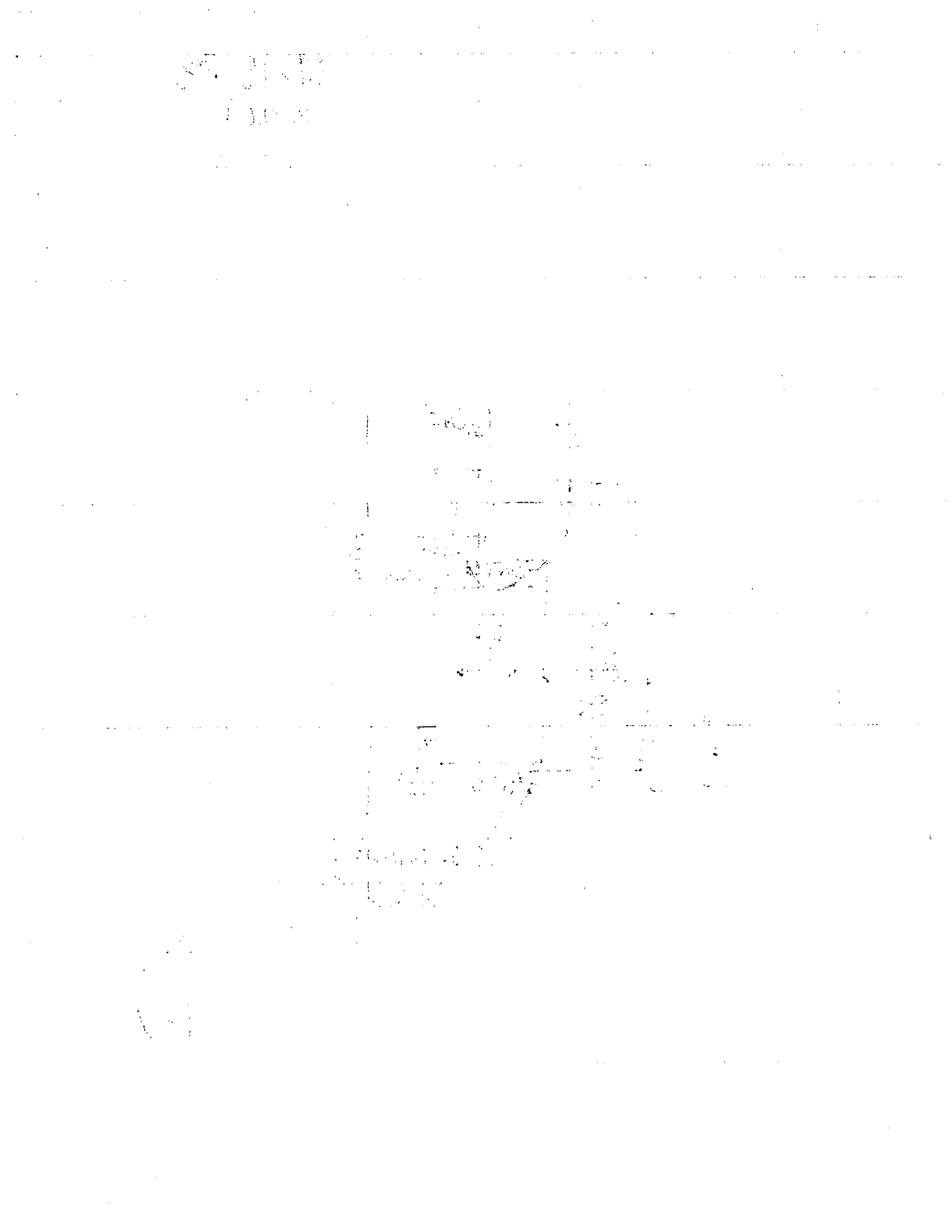
9-9 1½ stories

✓projecting girders that hold rafters of front porch
✓gabel roof
wood gutter on North side
✓water table
✓crown mould above windows.
✓projecting closet extension w/ shed roof – possible add on
✓gabel roof on porch
✓shingle on gabel end of porch
✓verge tie – decorative material – wide verge bds at gabel end
brackets on overhang of roof at gabel end
✓crown mould on verge bd. btwn projecting shingle & verge board.

✓exposed rafter tails.
✓cantered, corbeled chimney
✓siding – horizontal.
"Industrial-vernacular-craftsman" style or "IVC"
✓1/1 double hung windows
parged foundation on North side of bldg.
✓notched rafter tails for gutter
fire ladder (escape) at back porch.

Site ID #3
10.7.01





FIELD ASSESMENT FORM: THREE LYNX

Date: 10/2/01 Name of Recorder: DAVID STEELE

Address/ Bldg. #: 4 (BLUE W/ WHITE TRIM)

Style: TRADITIONAL COTTAGE

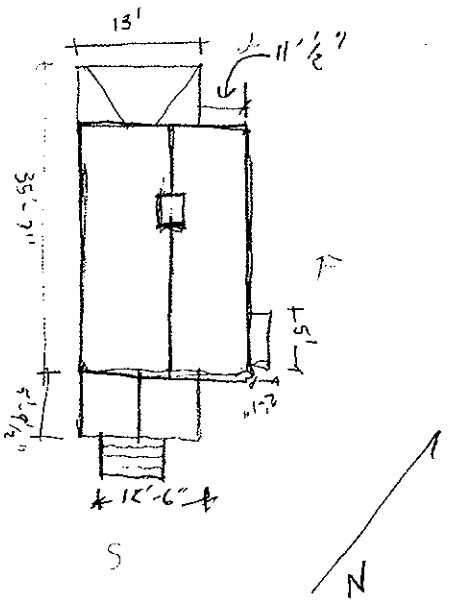
Date of Construction: EARLY 1920S

Moved: NO

# of STORIES 1.5 stories

PHOTO

Roof Configuration



Address/ Bldg. #: 4

EXTERIOR		Material	Condition	Integrity
Foundation		W side	- hair line cracks at bottom of windows	
	Issues to Consider:	pour in place conc.	2 - wd frame 3 lite windows	
various places around found. appear to have been poured on top of existing rough conc. walls! N found wall form was @ an angle	Wall Thickness		- hose bib in center of wall	
	Pier Sizes/ Spacing		- dryer vent beside	
	Cracking/ Damage	S side	1 - wd frame 3 lite win.	
	Header material		SE corner seems to have been parged	
Exterior Wall		E side		
	Issues to Consider:		2 - wd frame 3 lite windows, rear boarded over	
	Insulation	wood clap board		
	Bulging / leaning		Some damage on E side over rear win. opening to found. band of siding	
Windows	E side: 2 - standard; 1 - short standard	S side: 2 - standard 1ST FL; 1 - standard 2ND FL		
Doors	N side: 1 - standard 2ND FL	1 standard front (no screen)		
Decks/Porch	W side: 1 - dk short stand.; 1 - dk stand ← w/ storm win. alum.			
	Issues to Consider:	porch		
	Railing height	rail ht. 28 3/4"		
	Floor material	T-111 skirt		appears to have been rebuilt
		Treated steps + handrail		
		wd shingles porch gable		
Drainage System				
	Issues to Consider:			
	Gutter/ downspout sizes	Standard	SE porch gutter down empties on ground	replacement
		cut into rafter tails		
Chimney				
	Issues to Consider:	brick with metal flue	52" (approx.) above roof	
	Height above roof			
	Flue size			
	Structural problems			
Roof				
	Issues to Consider:			
	Pitch	12" x 14" vent in gables	has knee brace @ each corner	
	Flashing type	comp asp. shingles	exposed rafter tails	
	Skylights		exposed head board decking	addition
			closet bump out on SE corner	
Additions and Changes (on back)	rear porch	vertical wd boards + T-111	3 1/4" below win, 2 1/4 above win	add on

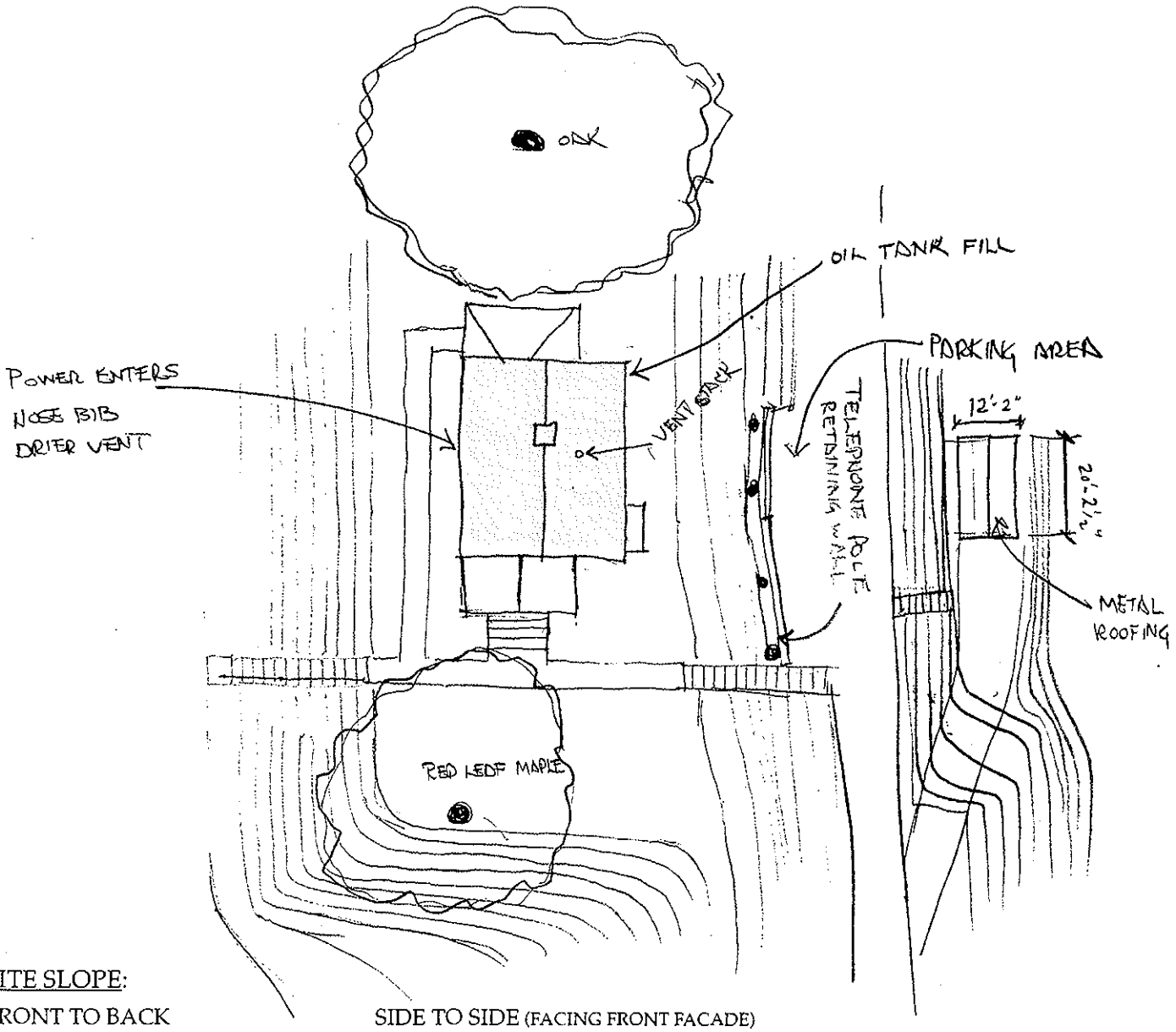
pic ladder

3 lite win. → 4 on N side + 1 on E + W
1 - storm dr
T-111 [illegible]

PROJECT : 3 LYNX

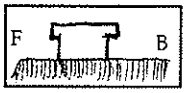
PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 4 BLUE w/WHITE TRIM
RECORDER: D. STEELE
DATE: 10/7/01

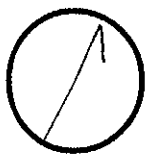


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
8/oct/01	Christy Spencer

PALE YELLOW W / BROWN TRIM

Address/ Bldg. #: Bldg #5

Style: ~~STYLE BA~~, TRADITIONAL

Date of Construction:

Moved: N/C

OF STORIES 1 1/2

PHOTO	Roof Configuration
See INDEX	See Landscape

Address/ Bldg. #: 5

EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material	BOARD FORMED CONCRETE	S WALL, CRACK MIDWAY, 1/16" @SW CORNER 1/8"-3/16" w/spalling @CORNER, CONCRETE DECAY UNDER SW WINDOW	ADDED BUTRESS UNDER KICKOUT @SE CORNER OF ON E WALL 12"x12" BOARD FORMED W/ CHAMFERED CORNER MAIN HOUSE CORNER NOT CHAMFERED
Exterior Wall	**Issues to Consider:** Insulation Bulging / leaning	4½" HORIZONTAL LAP SIDING, WOOD	SIDING - S SIDE - WATER DAMAGE, PAINT LOSS	PARGING ALONG E WALL
PAINT - POOR, PEELING		BLDG 6		
Windows		1:1 SINGLE HUNG W/ WOOD WINDOWS	SIZES TYP, ALUMINUM STORM WINDOWS PERMANENTLY AFFIXED, SURROUNDS - PAINT LOSS	
Doors		½ GLAZED PANEL DOOR	S WINDOW BROKEN	
Decks/Porch	**Issues to Consider:** Railing height Floor material	ADDITION		
Drainage System	**Issues to Consider:** Gutter/ downspout sizes			
Chimney	**Issues to Consider:** Height above roof Flue size Structural problems	BRICK WHITE CORBEL DETAIL	CORBEL CUT OFF TRUNCATED, W/ METAL FLU PROJECTING	some
Roof	**Issues to Consider:** Pitch 4:12 Flashing type Skylights	COMPOSITION SHINGLE	GUTTER DECAY	
Additions and Changes (on back)				

Address/ Bldg. #: 5 DID NOT ENTER HOUSE #

Basement		Material	Condition	Integrity
	Issues to Consider: Insulation Floor material Floor to ceiling height			
Attic				
	Issues to Consider: Ceiling members Roof members Roof substrate Deflection/ warping Signs of fungal and insect Fire damage Insulation Peak height Means of access Ventilation Leakage			
Stairs				
	Issues to Consider: Handrail height Tread / riser dimensions Stair width Headroom	DAVE		
Utility Room				
	Issues to Consider: Plumbing connections Floor drain			

Address/ Bldg. #: 5

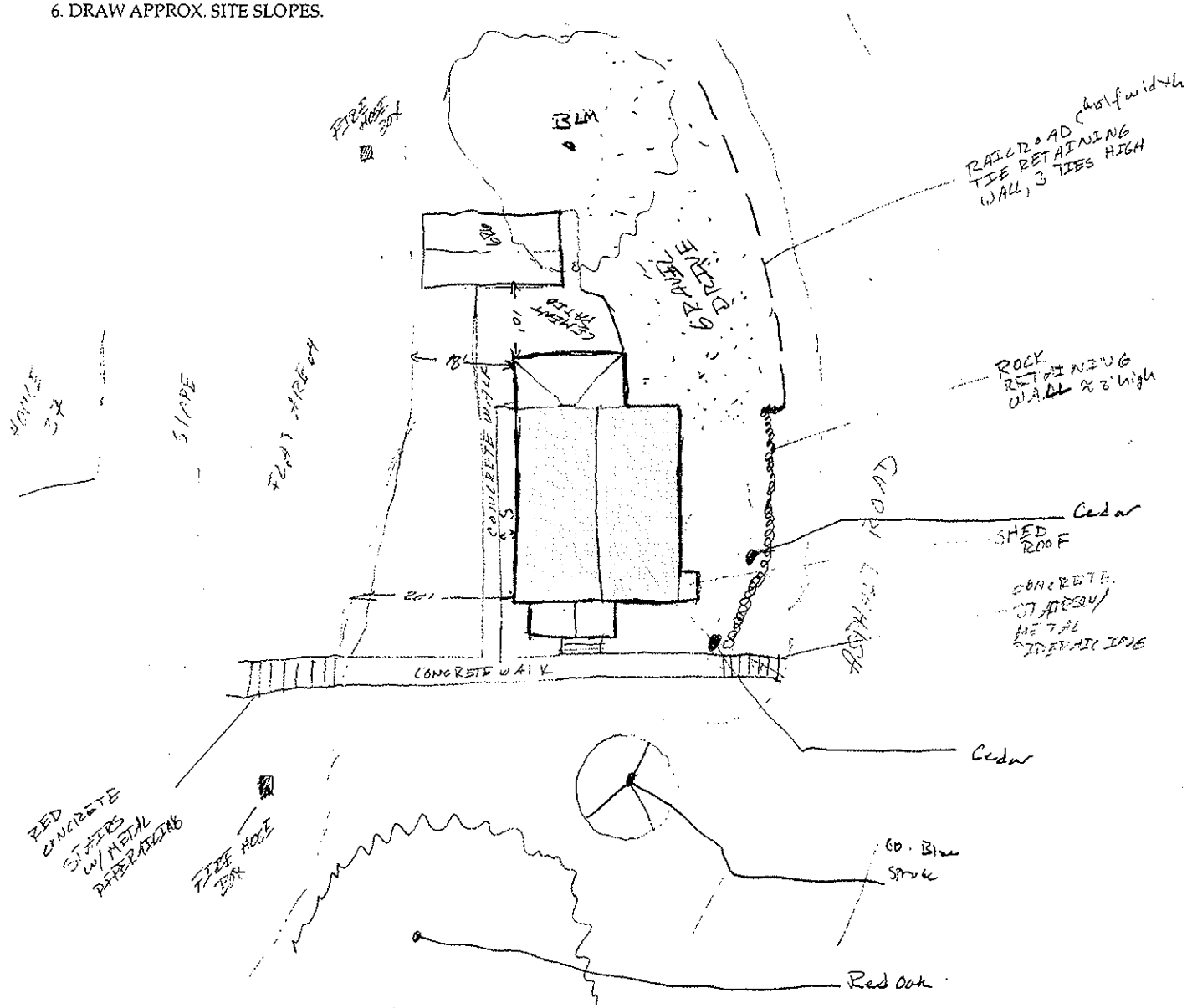
SYSTEMS	Material	Condition	Integrity
Mechanical/HVAC **Issues to Consider:** System type **Electrical** **Issues to Consider:** System type Elec. Entry point **Plumbing** **Issues to Consider:** Pipe size / material Waste disposal system Water source **Structure** **Issues to Consider:** Framing type Floor members Floor substrate Wall members Wall substrate Deflection/ warping Signs of fungal and insect Fire damage	DNE SAME AS BLDG #2		
Character defining features:			

PROJECT : 3 LYNX

SITE ID: Bldg #5
RECORDER: Spencer Howard
DATE: Oct 8 2011

PROCEDURE

1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

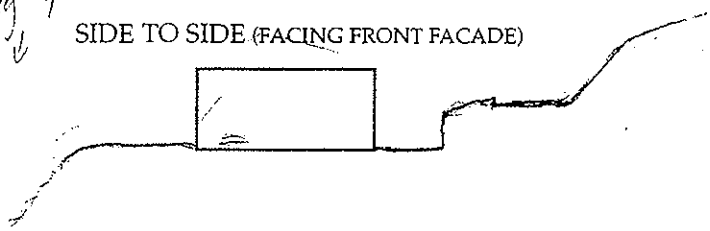


SITE SLOPE:

FRONT TO BACK

Bldg #4

SIDE TO SIDE (FACING FRONT FACADE)



PLANTS		FEATURES	ASSOCIATED STRUCTURES
TREES, DECIDUOUS	⊙	WALKWAY	GARAGE/CARPORT
TREES, EVERGREEN	⊕	DRIVEWAY	SHEDS
		FENCE/WALLS	
SHRUBS		ROAD	

FIELD ASSESMENT FORM: THREE LYNX

Date 8/oct/01 Name of Recorder

Color - YELLOW w/ white TRIM

Spencer HOWARD

INT: Christy

Address/ Bldg. #: 6

Style: 1½ story, ~~site built~~ TRADITIONAL

Date of Construction: EARLY 1920S

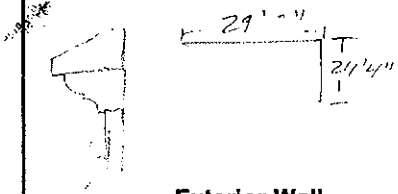
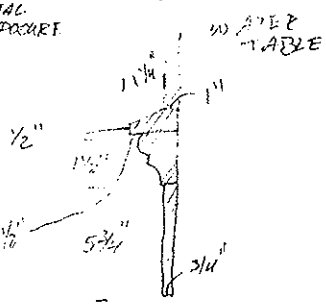
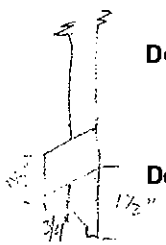
Moved: NO

OF STORIES 1½

PHOTO	Roof Configuration
SEE ENDEX	See landscape

Address/ Bldg. #: 6

CRACK @ SE CORNER 1/16" WIDE

EXTERIOR		Material	Condition	Integrity
Foundation 	**Issues to Consider:** Wall Thickness, Pier Sizes/ Spacing, Cracking/ Damage, Header material	BOARD FORMED CONCRETE BOARD WIDTH 7" WALL - 6" THICK	NO VISIBLE SIGNS OF CRACKING, NE CORNER, ALONG 1/2 OF E WALL & 2' SECTION OF NE CORNER SHOW SIGNS OF RUBBING + REPAIR TO CORNER, WOOD WINDOW FRAMES; LOSS OF PAINT, 1 BOARDED OVER, DECAY, NO SIGN OF HIGH MOIST, CONTENT IN FOUND. WALL.	HIGH
Exterior Wall NOTE: KICKOUT; PLY WOOD SUBFLOOR 8 3/8" WIDE BASE BRD 5 1/2" WIDE CORNER BRDS } TOTAL EXPOSURE	**Issues to Consider:** Insulation, Bulging / leaning	HORIZONTAL WOOD SIDING, 4" EXPOSURE 5 1/2" CORNER BOARDS W/ WOOD BRACKETS @ TOP UNDER EAVES, WOOD SHEATHING BELOW	GOOD, TYP	HIGH
Windows 				
Doors 				
Decks/Porch	**Issues to Consider:** Railing height, Floor material	NEW, WOOD UNFINISHED		
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	METAL W/ NOTCHED RAFTER TAILS		
Chimney	**Issues to Consider:** Height above roof, Flue size, Structural problems	CORBELED, BRICK, MASTIC SEALANT	POOR	HIGH
Roof	**Issues to Consider:** Pitch 9:12, Flashing type, Skylights	COMPOSITE SHINGLE	FAIR	
Additions and Changes (on back)				

#6

Address/ Bldg. #: 6

INTERIOR	Material	Condition	Integrity
Issues to Consider: Dimensions TYPICAL Ceiling Height " Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size **Kitchen**		Overall board Vent to chimney, Partitioned & cracking	~~Good~~ LIGHT
Ceiling	TYP PLASTER ON LATH, PAINTED		
WOOD CHAIR RAIL 43-44" from fl, 3 1/2" ~~high~~ wide, aligns under window above sink.			
Floor	Sheet vinyl flooring		
Wall	TYP PLASTER ON LATH, PAINTED		
Window	2 windows over sink - TYP		
VINYL BASE 3" high, cove wood Base Board			
Door	TYP WOOD PANEL DOOR		
Cabinet/Millwork	TYP. BASE/UPPER CBNTS w/ LAMINATE COUNTER TOP & BACKSPLASH	VARNISHED WOOD	
~~Fireplace~~			
Appliances / Fixtures			

TYP = TYPICAL OF RMS 1-2

Address/ Bldg. #: 6

Living Room		Material	Condition	Integrity
12'11¼" / 12'9¾"	**Ceiling** height 8'6"	PLASTER TEXTURED, PAINTED	GOOD	HIGH
Issues to Consider:				
Dimensions ~~TYP~~				
Ceiling Height ~~TYP~~	**Floor**	HARDWOOD, 3¼" WIDE		
Closets / sizes				
Trim TYP 9¼ height overall				
Number of outlets / voltage				
Heat source	**Wall**	PLASTER, PAINTED		
Location of rm (1st) 2nd fl)				
~~Skylights~~				
Ventilation source				
~~Fireplace size~~	**Window**	TYP		
	Door	TYP		
	Cabinet/Millwork	NONE		
	~~**Fireplace**~~			

Address/ Bldg. #: 6

#6

Dining Room	Material	Condition	Integrity
9'-11" × 10'-2 3/4" **Ceiling**	LATH PLASTER, PAINTED	GOOD	HIGH
Issues to Consider:			
Dimensions **Floor**	TYP		
Ceiling Height			
Closets / sizes			
Trim TYP			
Number of outlets / voltage **Wall**	L/P/PTD		
Heat source			
Location of rm (1st / 2nd fl)			
Skylights			
Ventilation source **Window**	N		
Fireplace size			
Door			
~~**Cabinet/Millwork**~~			
Fireplace			
NOTE: SQUARED OPENING Between Kitchen & Dining Rm.			
Door to Stair 28" wide			

Address/ Bldg. #: 6

Bathroom		Material	Condition	Integrity
Issues to Consider:	**Ceiling** VP HEIGHT	TYP	GOOD	HIGH
Dimensions				
Ceiling Height				
Closets / sizes	**Floor**	SHEET VINYL W/ TYPICAL WD BASE +3" VINYL BASE		
Trim				
Number of outlets / voltage				
Heat source				
Location of rm (1st / 2nd fl)	**Wall**	TYP		
Skylights				
Ventilation source				
Fireplace size				
	Window	1		
CHAIR RAIL 43-1/4" high 3 1/2" wide	**Door**	TYP (28")		
	Cabinet/Millwork	MIRRORED MED. CAB, OVER SINK, CAB W/ OPEN ENDS SHELVES NEXT TO SHOWER/TUB)		
	Appliances / Fixtures	CORNER, HANGING SINK, TOILET, CLAW FOOT BATH		
DOOR				

#6

Address/ Bldg. #: 6

Bathroom	Material	Condition	Integrity
Ceiling **Issues to Consider:** Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size **Floor** **Wall** **Window** **Door** **Cabinet/Millwork** **Appliances / Fixtures**			

Address/ Bldg. #: 6 1ST FLR SE

Bedroom		Material	Condition	Integrity
Issues to Consider: Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) ~~Skylights~~ Ventilation source ~~Fireplace size~~	**Ceiling** TYP		GOOD	HIGH - except closet
	Floor TYP		DAMAGED, PAINTED, COVING PAINT	
	Wall TYP			
	Window TYP	2		
PICTURE MOLDING 1½-2¾" high 88½" ABOVE FLR ALIGNS (TOP EDGES) W/ TOP EDGE OF WINDOW SURROUND	**Door** TYP	1 / 30" wide		
	Cabinet/Millwork			
	~~**Fireplace**~~			
	CLOSET	PLYWOOD SLIDING DRS - UNFINISHED MDF WALLS PLYWOOD FLR		NONE

#6

Address/ Bldg. #: 6 2nd FLR BACK

Bedroom		Material	Condition	Integrity
Issues to Consider: Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size	**Ceiling** 91" height	~~STEEL SIDE~~/PLASTER BOARD, PAINTED	FAIR	HIGH
	Floor	~~TYP~~ PAINTED WOOD DIMENSIONS TYP		
	Wall	SAME AS CEILING		
10-1½" 15 13'-6"	**Window** TYP	1		
	Door	30" VARNISHED SURROUND VARNISHED		
CLOSETS, ATTIC - 2		INSULATION ON INSIDE OF ATTIC DOOR (FIBER GLASS)		
	~~**Cabinet/Millwork**~~			
BASE BOARD 7¼" height, no ornament	~~**Fireplace**~~			
BUILT IN SHELF along E WALL (ABOVE BED)				

Address/ Bldg. #: 6 2nd FL @ FRNT

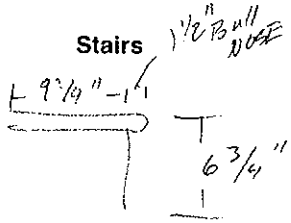
Bedroom		Material	Condition	Integrity
Issues to Consider: Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size	**Ceiling** height same	SAME AS OTHER BDRM	CRACKED, PLASTERBOARD 1/16" front & backing gup. plaster total dim. is.	cardtrd. w/ type infill 1/4"
	Floor	WOOD, VARNISH.		
	Wall	SAME	Hole in W wall	
	Window	SAME		
	Door	~~#~~ 30" WIDE INSULATION ON ATTIC CLOSET DOORS (SAME)		
	~~**Cabinet/Millwork**~~			
	~~**Fireplace**~~			
ATTIC CLOSETS, 2				

F 0

HARDWARE— ORIGINAL

#6

Address/ Bldg. #: 6

Basement		Material	Condition	Integrity
PORCH: CLOSER TO ORIG. DETAILING & SIZE THAN BLDG 2	**Issues to Consider:** Insulation Floor material Floor to ceiling height	NONE CONCRETE WALLS PAINTED BOARD FORMED CONCRETE		
Attic	**Issues to Consider:** Ceiling members Roof members Roof substrate Deflection/ warping Signs of fungal and insect Fire damage Insulation Peak height Means of access Ventilation Leakage	 typ. of #2 skip sheathing w/ shingles. fiberglass insul. around chimney	fiberglass insulation at walls at each bedroom upstairs rockwool insulation at floor in attic closets.	
Stairs  	**Issues to Consider:** Handrail height Tread / riser dimensions Stair width Headroom	CARPETED 30" wide stairs	FAIR	HIGH
Utility Room	**Issues to Consider:** Plumbing connections Floor drain			
LINEN CLOSET @ TOP OF STAIRS				

Address/ Bldg. #: 6

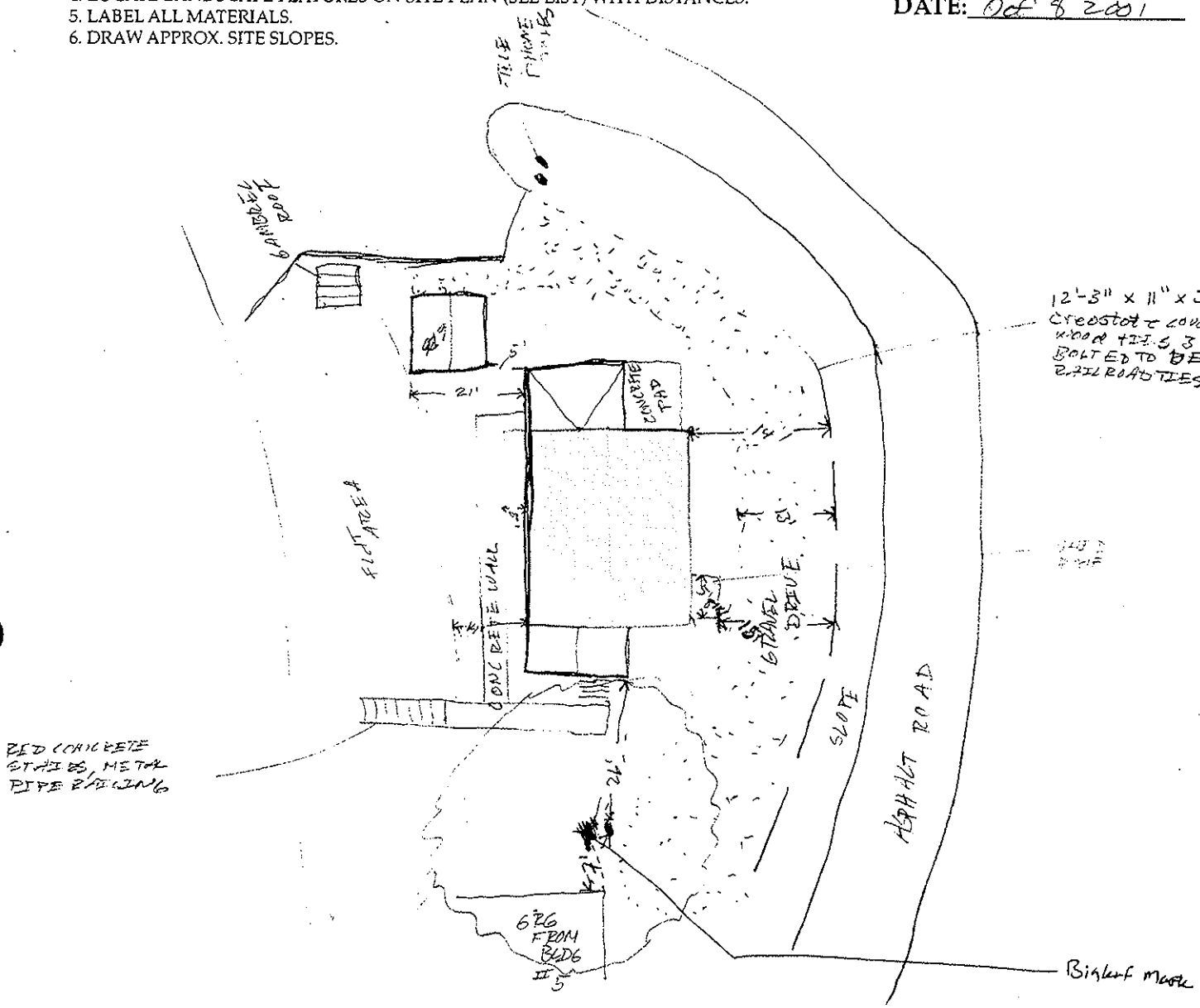
SYSTEMS	Material	Condition	Integrity
Mechanical/HVAC **Issues to Consider:** System type **Electrical** **Issues to Consider:** System type Elec. Entry point **Plumbing** **Issues to Consider:** Pipe size / material Waste disposal system Water source **Structure** **Issues to Consider:** Framing type Floor members Floor substrate Wall members Wall substrate Deflection/ warping Signs of fungal and insect Fire damage			
Character defining features:			

5 & 6 outside
Inside if Pass.

PROJECT : 3 LYNX

SITE ID: Bldg #6
RECORDER: Spencer Howard
DATE: Oct 8 2001

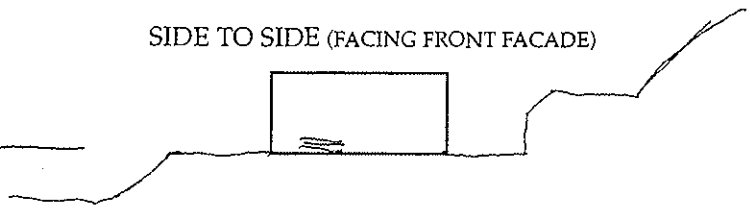
PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)



PLANTS		FEATURES	ASSOCIATED STRUCTURES
TREES, DECIDUOUS	⊙	WALKWAY	GARAGE/CARPORT
TREES, EVERGREEN	⊕	DRIVEWAY	SHEDS
		FENCE/WALLS	
SHRUBS	✡	ROAD	

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
10/7	Phil

Address/ Bldg. #: 7

Style: Vern. w/ craftmans details
site Built TRADITIONAL

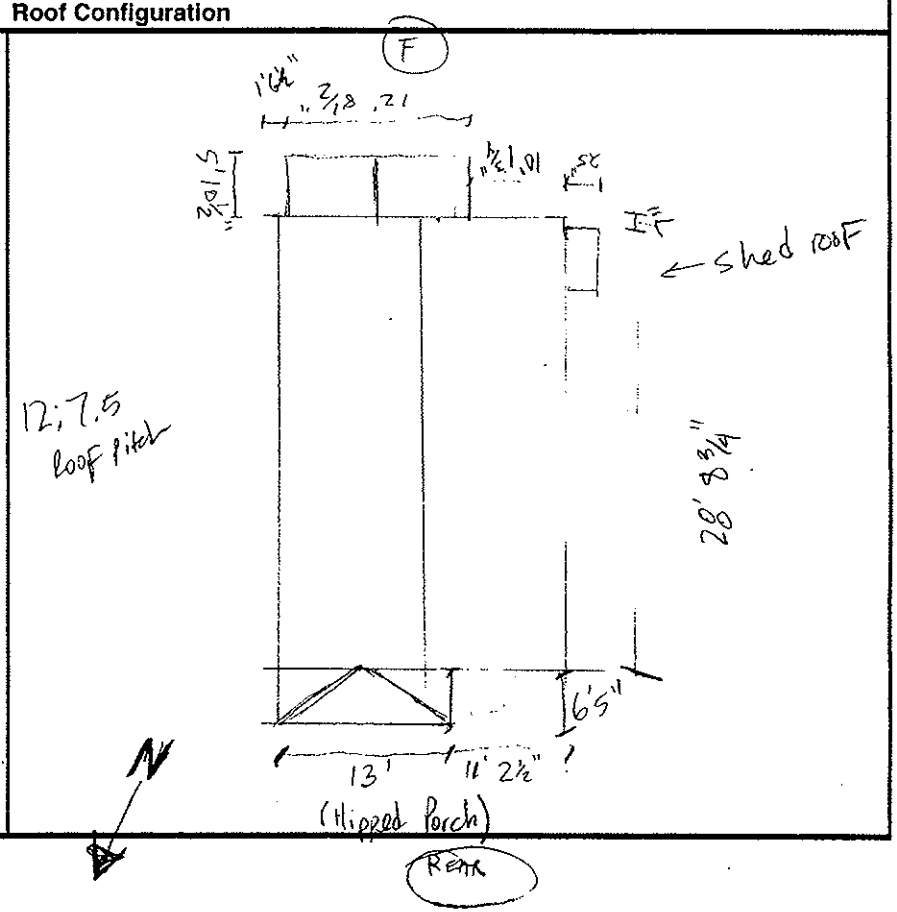
Date of Construction: early 1920's

Moved: No

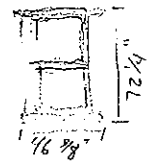
# of stories: 1.5 stories

PHOTO

Roof Configuration



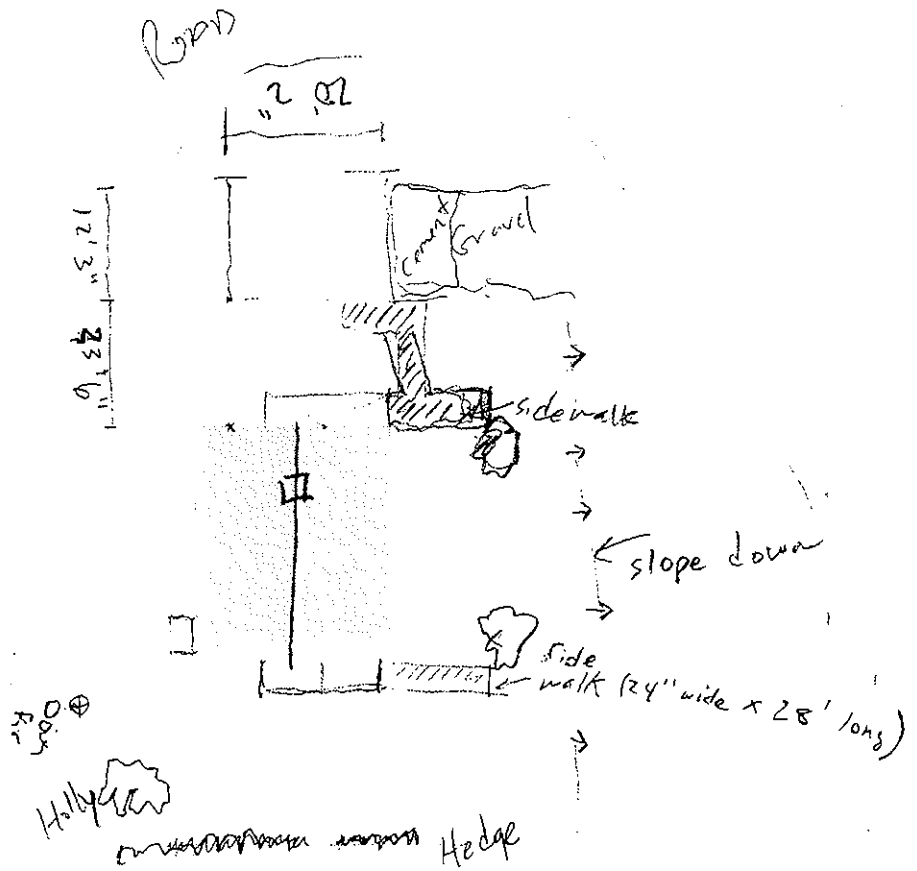
Address/ Bldg. #: 7

EXTERIOR		Material	Condition	Integrity
Foundation **Issues to Consider:** Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material		Board Formed Concrete 7" Boards	Slight crack at SW corner Otherwise Fair/Good	Y/ High - original
Exterior Wall **Issues to Consider:** Insulation Bulging / leaning		4.5½ lap horizontal Siding - WOOD Corner boards: 5½" water table detail = See House #2 for detail	some warping under kitchen window Broken board at NW Face = 3 rows up	Y/ High - original / High - original
Windows	SINGLE HUNG (typical) 1/1 DH 36 x 32 sash		- SW Face - Broken light - hooks for storms - No storms seen	
Doors	FRONT: 35" x 81" 2/3 light Panel Blank bottom Panel	WOOD metal screen door - permanently affixed	Broken light/glazing	/ high orig / low - not orig
Decks/Porch **Issues to Consider:** Railing height 25"–26½" Floor material plywood	FRONT Rear is Utility (enclosed) room has fire ladder attached Rear has 9 light fixed sashwin	WOOD - porch is 3'6" off ground Bead board soffits Shingle at Gable		
Drainage System **Issues to Consider:** Gutter/ downspout sizes		Gutter System	metal - GOOD condition	not original
Chimney **Issues to Consider:** Height above roof 3-4' Flue size Structural problems		Brick	Poor condition	high - original w/metal flu
Roof **Issues to Consider:** Pitch Flashing type ~~Skylights~~		(Garage is comp. shingle) WOOD shake - Fair condition 7.5:12" metal Gable Main + Front Porch Hipped Rear Porch Shed projection for closet		High - original NO INTEGRITY
Additions and Changes (on back)				

PROJECT : 3 LYNX

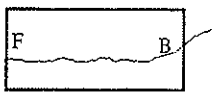
SITE ID: #7
RECORDER: PHIL
DATE: 10/7/01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
~~FENCE/WALLS~~
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
~~SHEDS~~

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
10/7	PHIL

Address/ Bldg. #: 8

Style: Vernacular w/ Craftsman elements (Brown w/ tan trim)

Date of Construction: Early 1920's

Moved: NO

# of Stories 1.5

PHOTO

Roof Configuration

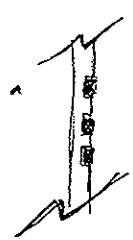
See landscape plan

Address/ Bldg. #: 8

EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness, Pier Sizes/ Spacing, Cracking/ Damage, Header material	Board Formed Concrete w/ 5½" boards	Good Condition / But painted/stained light brown	
Exterior Wall	**Issues to Consider:** Insulation, Bulging / leaning; Water table - See photo (21 & 22 p.w.)	Wood 4½" Lap	(broken siding on W side closed ext.)	Good
Windows	typical sash 32 x 35	WOOD 1:1 SINGLE HUNG	1 x original storm window on W face - aluminum storm perm. affixed on most others - surround is typical - Bath window on W side is filled in w/ siding	
Doors	Typical 35" 2/3 light 1/3 panel			
Decks/Porch (See end notes)	Front: 35" ground to top of decking; Rear Porch (Rear porch height ground to roof 11')	Decking: Decking painted wood 2" x 5 5/8" is a true 2". Porch has shingle in gable - Enclosed w/ bead board - 3 single light windows - Awning style	Does not appear to be original though it is original	(T111 on bottom of front porch)
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	metal Gutters		not original
Chimney	**Issues to Consider:** Height above roof, Flue size, Structural problems	2-4' has corbel detailing	Fair condition metal Flu	
Roof	**Issues to Consider:** Pitch, Flashing type, ~~Skylights~~	WOOD shake (Garage is comp. shingle) 8:12 metal Decorative molding on Verge Board (crown molding?) Exposed Rafter tails		NO INTEGRITY - REPLACEMENT ROOF
Additions and Changes (on back)		Daylight basement	missing windows on W Facade	

- Front Porch) Decking is running N/S - traditionally should run E/W IF ~~use~~ ~~[illegible]~~ not using T + G.

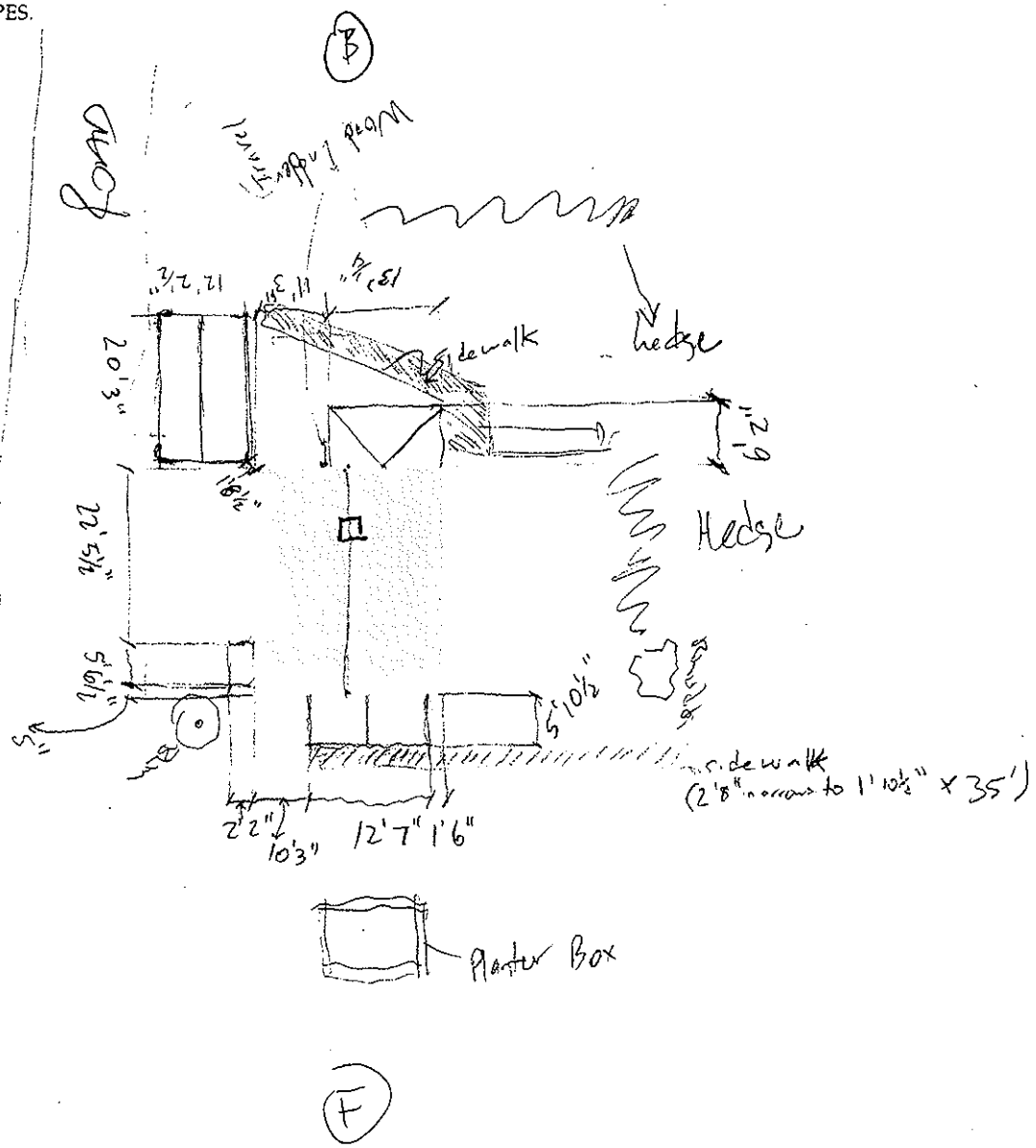
Character Defining Features: Units 7, 8, 9

- offset Front Porch - ✓ Decorative verge trim + oversized verge board itself
  - ✓ Gable w/ Shingle Siding
  - ✓ decorative Verge tie
- closet Extension on left (w) side (raised like oriel) w/ Shed
- Shake Roofing
- 1/1 DH window + trim + window Surrounds
  Storm windows (though not seen would be good to bring back)
- ✓ Exposed Rafter ends (on Porches as well)
- Board Formed Foundation
- Horizontal lap siding - w 4½" lap
- ✓ Gutter hanging system built into Rafter tail ends
- ✓ Watertable detail
- ✓ chimney corbel
- Fire ladder on Rear - Notched construction 
- Brackets at Corners.
- Enclosed rear Porch w/ high ceiling

PROJECT : 3 LYNX

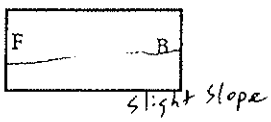
SITE ID: 8
RECORDER: PHC
DATE: 10/7/2021

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3: SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

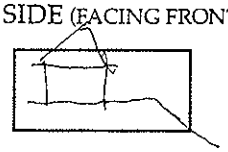


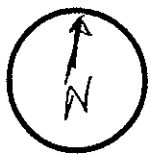
SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)





PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/~~CARPORT~~
SHEDS

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
10/7	PHIL

Address/ Bldg. #: 9

Style: Site built Vernacular w/ craftsman Lite Green w/ Forest Green trim
TRADITIONAL

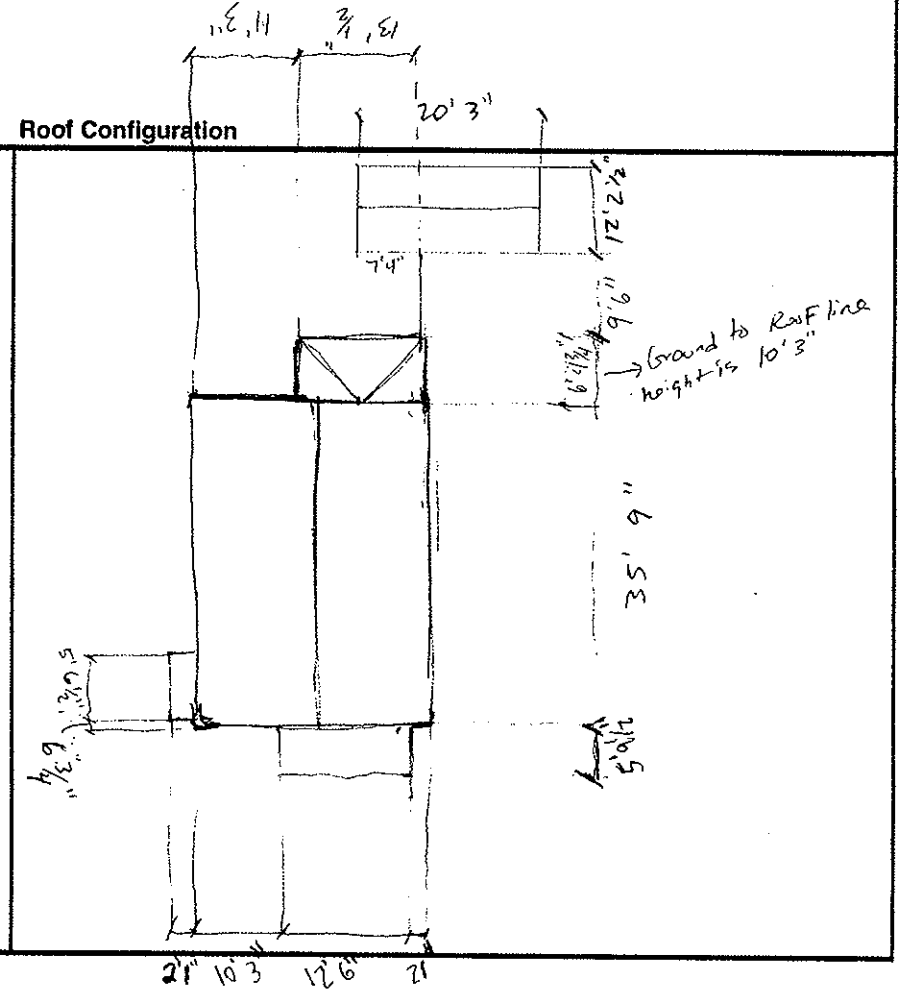
Date of Construction: Early 1920's

Moved: NO

OF STORIES: 1.5

PHOTO

Roof Configuration



Address/ Bldg. #: 9

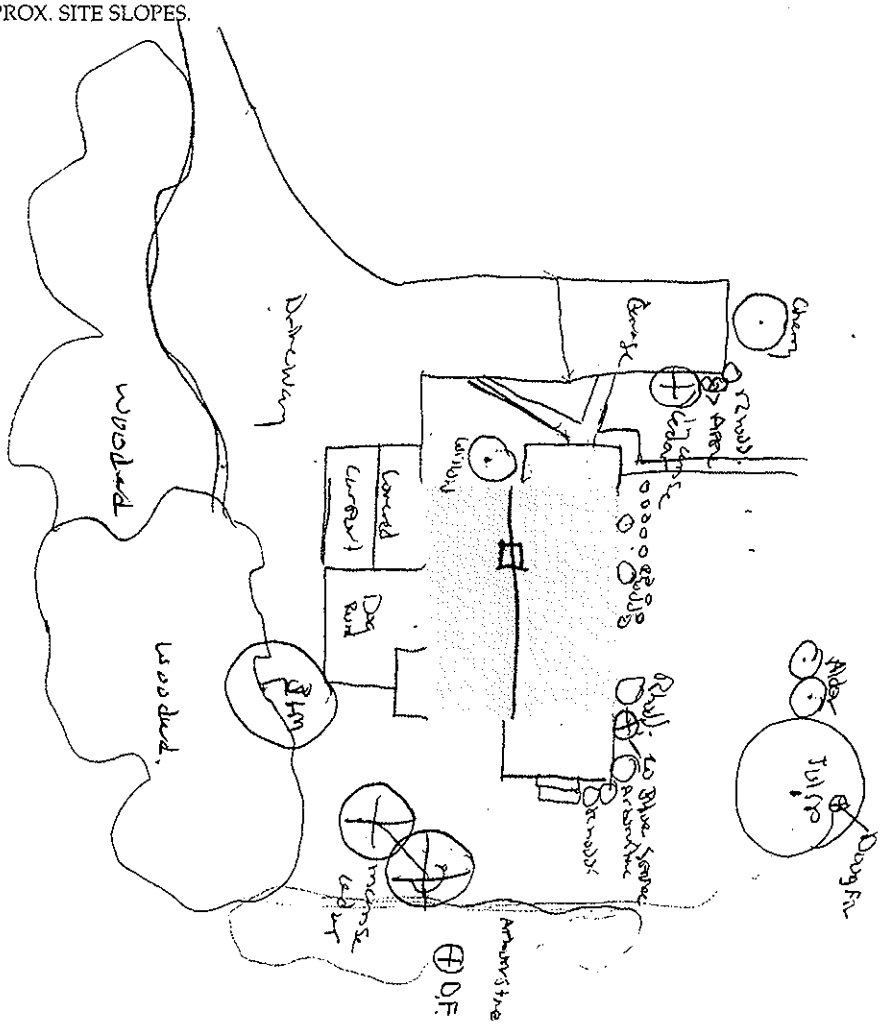
EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material	board Formed 4" crack W of S wall FDN window has crack East wall small crack + N Face near W corner		
Exterior Wall	**Issues to Consider:** Insulation Bulging / leaning	4½" lap wood Paint peeling — "ONLY ON WEST SIDE" — wood water table		high
Windows	Sash 36x32 —	Wood 1/1 ~~DH~~ SINGLE HUNG Trim is typical	- New storm handers	high
Doors Front	2/3 light 1/3 Panel blank			
Decks/Porch	Front: 37¾" Ground to top of Flooring: Flooring is 2 x 8 wood running N-S **Issues to Consider:** Railing height 28½" Floor material Rear has single light 3 windows			Fair/Good
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	Gutter metal		
Chimney	**Issues to Consider:** Height above roof → 3-4' Flue size Structural problems		Fair condition - NO Corbel. Possibly truncated	[illegible]
Roof	**Issues to Consider:** Pitch Flashing type metal Skylights	Wood shake on House (Comp. on Garage) Fair/Poor condition		~~High~~ NO INTEGRITY
Additions and Changes (on back)		Daylight basement		

PROJECT : 3 LYNX

PROCEDURE

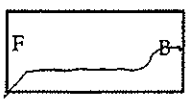
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 9
RECORDER: PHIL
DATE: 10/7/01

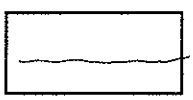


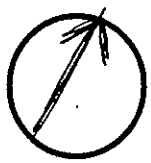
SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)





PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

FIELD ASSESMENT FORM: THREE LYNX | **Date** | **Name of Recorder**

MARTI

Address/ Bldg. #: #35

Style: ALADDIN VICTORY, Z-TYPE, VERNACULAR

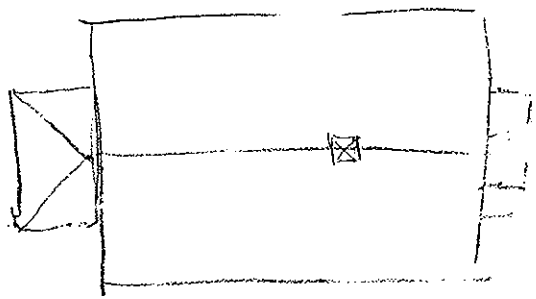
Date of Construction: MID-1970s

Moved: N/A

# of Stories ONE

PHOTO

Roof Configuration



Address/ Bldg. #: 35

Rear porch
rear porch steps

foundation – [illegible] on pier [illegible]
bead board vertical siding
plywood floor, beadboard roof w/ composite shingles
wood screen door
2x8 (five) wood steps

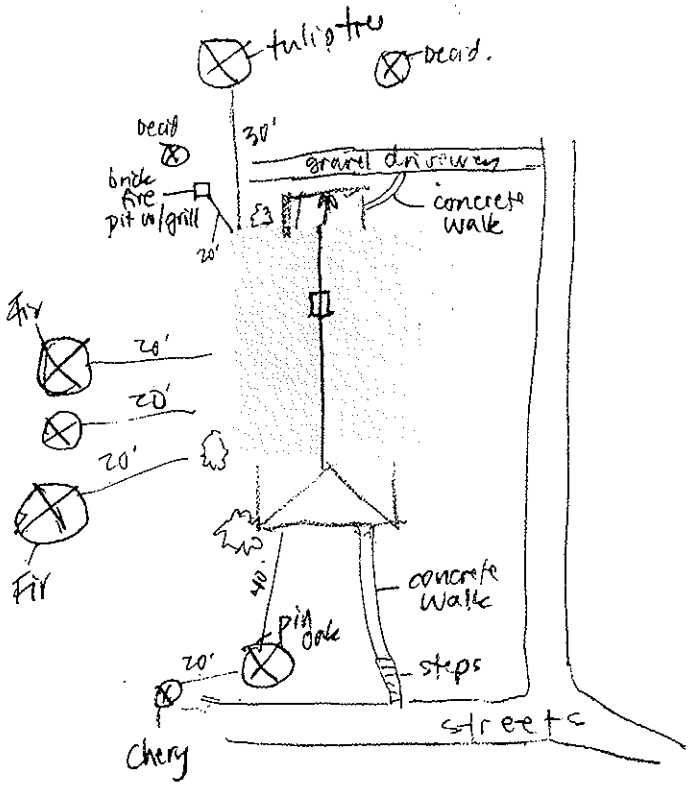
probably

EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness, Pier Sizes/ Spacing, Cracking/ Damage, Header material	Board formed concrete Chamfered corners	Crack east + west walls 10' north from s. side. patched east wall s. basement vent hole. " west " " " west basement windows boarded over. east basement north window boarded over.	yes
Exterior Wall	**Issues to Consider:** Insulation, Bulging / leaning	4½" wood siding		
Windows		1:1 dbl hung wood	porch windows painted shut	
Doors	rear	½ glazed wood panel	one panel shows evidence water damage.	yes
	front	"	wood panels show some evidence of moisture, but most likely salvageable. Door sill paint chipped + peeling.	yes
Decks/Porch	**Issues to Consider:** Railing height 25-26", Floor material	7/8" x 2¼ T+G flooring, brick columns – east + west parged, 3 new PT steps. Plywood ~~transom~~, worn-off paint.	dry rot on western most joist. floorboards solid; worn paint, railing ~~paint~~ paint chipped near ground (weath.) parging slats chipped + peeling. Bricks need repointing.	yes
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	2" downspouts, metal painted galvanized gutters (4")	good good	downspout – possibly gutters – no
Chimney	**Issues to Consider:** Height above roof, Flue size, Structural problems	Brick; not corbeled.	deteriorated mortar, some missing bricks	
Roof	**Issues to Consider:** Pitch, Flashing type, Skylights	composite over plywood assume 6:12 pitch. beadboard soffitt on North + South ends only.	good	No (except orig. soffit sections N+S)
Additions and Changes (on back)				

PROJECT : 3 LYNX

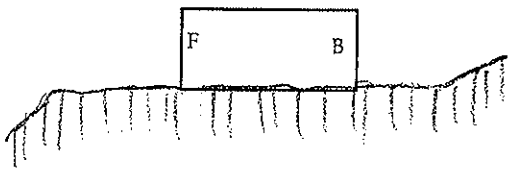
SITE ID: #35
RECORDER: MARTI
DATE: 7 OCT 01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

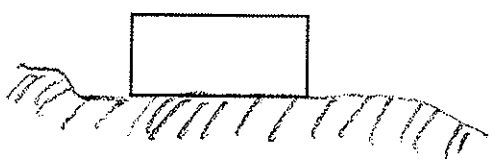


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

FIELD ASSESMENT FORM: THREE LYNX

Date: 10/6/01

Name of Recorder: Carin

Address/ Bldg. #: 36

Style: Aladdin Victory Z
vernacular/craftsman

Date of Construction: mid 1920's

Moved: No

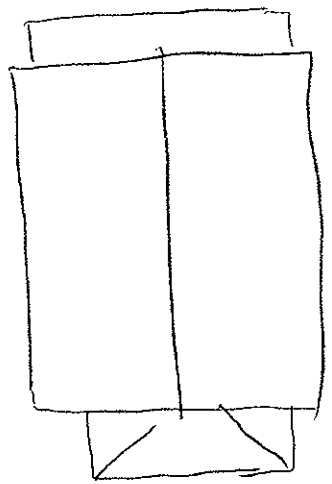
# of stories 1 w/ basement

PHOTO

disk 4 photos 1-10

Bright sunshiney yellow

Roof Configuration



Address/ Bldg. #: 36

EXTERIOR		Material	Condition	Integrity
Foundation				
	Issues to Consider:			
	Wall Thickness	board formed concrete w/ chamfered edges	tiny crack on SW side & SE side	yes
	Pier Sizes/ Spacing		crack from basement window on W side (diagonal crack)	
	Cracking/ Damage		vent covered, seems recently patched	
	Header material			
Exterior Wall				
	Issues to Consider:	4½" to weather horizontal siding	fair, weathering on lower boards	yes
	Insulation			
	Bulging / leaning			
Windows		double hung single pane sash	W side middle window sill badly damaged, covered w/ metal plate	yes
Doors				
Decks/Porch				
	Issues to Consider:			
	Railing height 2'-0" approx.	wood	good, bottom board missing SE corner and touching ground all others	
	Floor materiel 3/4"	plywood	paint gone, weathering	original decking gone
Drainage System				
	Issues to Consider:			
	Gutter/ downspout sizes. 2"	metal gutters	good	no
Chimney				
	Issues to Consider:			
	Height above roof	missing		
	Flue size			
	Structural problems			
Roof				
	Issues to Consider:	composite shingles	good	
	Pitch			
	Flashing type			
	Skylights			
Additions and Changes (on back)				

See pg 10 for shed Addition Ext

Address/ Bldg. #: 36

INTERIOR		Material	Condition	Integrity
Issues to Consider:				
Dimensions				
Ceiling Height				
Closets / sizes				
Trim				
Number of outlets / voltage				
Heat source	Electromode wall radiator		electric wall radiator, works	
Location of rm (1st / 2nd fl)				
Skylights				
Ventilation source				
Fireplace size	countertop	formica? turquoise, metal trim	good	none
Kitchen				
	Ceiling	textured plaster painted	fair w/ cracks	good
	Floor	appears to be linoleum	good	?
	Wall	plaster covered by painted particle board	good (behind particle board unknown)	
	Window	double hung 1-1 sash	trim cut into & replaced presumable w/ installation of existing cabinetry	sash yes surround no
	Door to basement	panel door	possibly original hardware	not sure, look orig!
	Cabinet/Millwork	shellacked particle and plywood	good	none
		rubber baseboards	door surrounds not original	
	~~**Fireplace**~~			
	Appliances / Fixtures	Griswold griddle	30x19 electric	
		3 Westinghouse 2 burner ranges	electric	
		2 Stanthony hoods	models 360 & 400	
		2 GE ovens	1 broken	
		electric clock	still working	

Address/ Bldg. #: 36

Living Room		Material	Condition	Integrity
	Ceiling	plaster, painted	many cracks - fair to poor	yes
Issues to Consider:				
Dimensions				
Ceiling Height	**Floor**	vinyl/linoleum	fair. seam down center of room is splitting. shows slat marks - poss. from wood beneath	no - maybe underneath
Closets / sizes				
Trim				
Number of outlets / voltage				
Heat source	**Wall**	painted plaster	fair to poor - many cracks damage above wall heat unit	
Location of rm (1st / 2nd fl)				
Skylights				
Ventilation source			crack in left side of bottom sash of W window taped.	
Fireplace size	**Window**	1:1 dbl hung sash wood & glass inoperable top sash	bottom sash of W & S windows have been "weather-sealed" with duct tape. Tape on meeting rail of W window has UV damage. Hardware is old, but presumably replacement	yes No, for hardware
	Door	½ glazed wood panel w/ original hardware	painted - presumably varnished underneath. Good cond. Damage on ext from padlock clamp. curtain rod over window	yes
	Cabinet/Millwork	wood baseboard trim window & door surrounds	intact - mostly undamaged curtain rod over S window	
	~~Fireplace~~ HVAC	3 coil Electromode wall heater on N wall	works great	questionable
		2 baseboard heaters W of front door (S wall) Cavalier	unknown - presumed to work	
	Fixtures	one central 2 bulb ceiling fixture w/ glass cover	works	no
	Electrical	3 120V grounded plugs	all upside down	no
		standard 2 switch face plate	for int LR & porch lights - works	no

MMM

Address/ Bldg. #: 36

Dining Room		Material	Condition	Integrity
	Ceiling	textured plaster	fair, some cracking	yes
Issues to Consider:				
Dimensions	**Floor**	vinyl? rolled out in 2 pieces	fair, chipped & scratched presumable glued to wood floor	no
Ceiling Height				
Closets / sizes				
Trim				
Number of outlets / voltage	**Wall**	plaster	some cracking worse damage above wall heaters	yes
Heat source				
Location of rm (1st / 2nd fl)				
Skylights				
Ventilation source	**Window**	double hung single pane sash	hardware intact good condition, paint peeling to reveal varnish	
Fireplace size				
	Door	no doors door trim	good, paint peeling	yes
		clamps, metal	screwed into door frames 3 each side	
	Cabinet/Millwork	floor trim	good condition, paint peeling missing under heater in NE corner	yes
	Fireplace			

Address/ Bldg. #: 36

Bathroom		Material	Condition	Integrity
	Ceiling	plaster, textured	water damage throughout ceiling	
Issues to Consider:				
Dimensions				
Ceiling Height				
Closets / sizes	**Floor**	linoleum	good condition	
Trim			seems to be of different time than vynil in dining/livingrm	
Number of outlets / voltage				
Heat source				
Location of rm (1st / 2nd fl)	**Wall**	plaster	cracked	
Skylights				
Ventilation source				
Fireplace size				
	Window	single pane double hung	fair condition, peeling paint	yes
	Door	panel door	original hardware, varnished on out side painted inside	yes
	Cabinet/Millwork	wood cabinet	all intact	
		trim, wood	all painted white	yes
	Appliances / Fixtures	porcelain sink	separate Hot & cold ~~ref~~ faucets	?
		modern toilet	good	
		porcelain bath tub	with claw feet	
			Shower (handheld) added later	yes

depends on pd of Sig cance

Address, _dg. #: 36

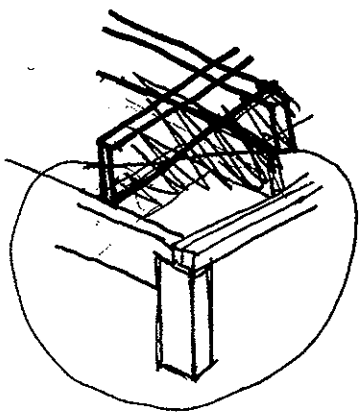
~~Bathroom~~ SHED ADDITION		Material	Condition	Integrity
	Ceiling	plywood-painted	bowing downward / inward @ North end damage @ N.W ends (damage runs down window) - bugs	
Issues to Consider:				
Dimensions				
Ceiling Height				
Closets / sizes	**Floor**	Linoleum-esque stuff over ... ?	good	
Trim				
Number of outlets / voltage				
Heat source				
Location of rm (1st / 2nd fl)	**Wall**	very thin wood product (¼")	fair	
Skylights				
Ventilation source			(E) 3 (N) 8 (W) 3 - peeling paint	
Fireplace size				
	Window	6 pane wood & glass sash		
	Door to kitchen	orig frame facing but w/o trim	fair. hardware - some original, hinges, handle & lock additional new locks	some of door may be original '20s.
	to exterior	wood panel, ½ glazed painted w/ metal weatherstrip		
	Cabinet/Millwork		much reused trim found throughout	
		varnished plywood sliding door cabinetry & hinged	usable - good?	
	Appliances / Fixtures	Electromode (by Singer) heaters	newer - dated 1960s	
		Dishwasher Hobart (OH)	not orig. to addition (space beneath)	
		2 sinks on int. wall	30x20 porcelain? fair w/ working hardware (differs) E sink leaks	
		2 GE combination Fridges	freezer on bottom w/ pedal. latch 4 ½ circle rotating shelves, 2 fold up bottle racks, 2 adjustable & 1 fixed door racks butter compartment w/ hard & soft settings Rt has 2 crisper drawers	
		1 lg chest freezer		

Address/ Bldg. #: 36

Bedroom - SOUTH		Material	Condition	Integrity
	Ceiling	painted textured plaster	good	yes
Issues to Consider:				
Dimensions				
Ceiling Height				
Closets / sizes	**Floor**	2 3/8" hardwood, runs E/W	some aesthetic damage, some dents, but overall, good	yes
Trim				
Number of outlets / voltage				
Heat source				
Location of rm (1st / 2nd fl)	**Wall**	painted plaster	good except for unexplained peeling beneath E window	yes
Skylights				
Ventilation source				
Fireplace size				
	Window	dbl hung 1:1 wood & glass sash, varnished inoperable top sash	presumably original varnish operable hardware	yes
	Door	varnished wood panel door - to room & to closet	excellent	yes
	Cabinet/Millwork	varnished wood door surrounds, window surrounds & baseboard	excellent. damage to window surrounds from curtain rod attachments.	yes
NOTE: attic access through closet	**Fireplace**	2 coil Electromode wall heater	unknown	?
	Electric	2 120V grounded dbl plugs	upside down	no
		1 flip switch for 2 bulb ceiling fixture	works. No cover for fixture	no

Address/ Bldg. #: 36 EXTERIOR SHED ADDITION

Bedroom		Material	Condition	Integrity
Issues to Consider:	~~Ceiling~~ FOUNDATION	raised foundation wood piers 8x8 2x6 joists notched	2x8 joists See drawing	questionable
Dimensions				
Ceiling Height				
Closets / sizes	~~Floor~~ EXTWALL	horizontal wood siding vertical to cover wood frame foundation	beveled siding variety of sizes fair condition. some peeling/damage beneath current paint	
Trim				
Number of outlets / voltage				
Heat source				
Location of rm (1st / 2nd fl)	**Wall**			
Skylights				
Ventilation source				
Fireplace size				
	Window	8N, 3W, 3E 6 pane windows	some broken/cracked panes S most of N E side smaller than rest, same configuration – N most trim ~~door~~ is cut off	
	Door	½ glazed panel	orig to house not to current location. Aed locks – damage	maybe
	~~Cabinet/Millwork~~ DRAIN SYS	Mod metal gutter	good	no.
	~~Fireplace~~ ROOF	2.5x5.75 2x4 & ~~2x6~~ or 2x8 rafters 1x8 sheathing wood shingle composite shingle on top metal flashing		uncertain



ignore cross out

ignore cross out

Address/ Bldg. #: 36

Bedroom North		Material	Condition	Integrity
Issues to Consider: Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size	**Ceiling**	plaster, textured	separating from outer wall some water damage on W wall	yes
	Floor	2 3/8 t&g wood	dented but in decent condition no other flooring material	yes
	Wall	plaster underneath	plaster was papered over &, appears to have been painted white over the paper cracking through paper paper peeled off near window	?
	Window	single pane, double hung	varnished wood, original sill has been stripped	yes, excellent example
	Door	panel door	excellent, varnished, orig hardware	yes
		22" closet panel door	" " "	yes
	Cabinet/Millwork	base boards & all wood trim	varnished and intact	yes
	~~**Fireplace**~~ #	Electromode heater	with varnished wood surround intact	yes

Address/ Bldg. #: 30

Basement		Material	Condition	Integrity
house width 23'6" (kitchen to just inside living rm.	**Issues to Consider:** Insulation Floor material Floor to ceiling height	painted wood ceiling painted concrete floor 3 pane windows	good - most bridging intact fair - some signs of H_2O damage can see cut made for kitchen & dining rm heaters - plywood used to set	yes
Attic not very accessible	**Issues to Consider:** Ceiling members Roof members Roof substrate Deflection/ warping Signs of fungal and insect Fire damage Insulation Peak height Means of access Ventilation Leakage	access thru S bedrm - wood insulation - no ~~pres~~ evident damage. ~~No evidence~~ chimney to peak	H_2O damage to E wall beneath open window newer hardware on windows SW wall plywood over concrete SE top ½ plywood. Shelves over doors on SW side Singer rm htr - doesn't work Florescent lighting tubes	no yes
Stairs	**Issues to Consider:** Handrail height Tread / riser dimensions Stair width Headroom	headroom 5'-7" rail height 34"-39" basement stairs 6½" riser 9" tread 35½" wide		
Utility Room	**Issues to Consider:** Plumbing connections Floor drain	In BASEMENT washer - Kelvinator dryer - older Maytag 2 basin wash tub.	2 speed - doesn't seem to work (one dial) - works w/ electric burn stench	no

Address/ Bldg. #: 36

SYSTEMS		Material	Condition	Integrity
Mechanical/HVAC		room heaters		
	Issues to Consider:	chimney bolted shut - brick		
	System type			
Electrical				
	Issues to Consider:			
	System type			
	Elec. Entry point – see	site plan		
Plumbing				
	Issues to Consider:	hot H_2O heater	looks very new	no
	Pipe size / material	connected to automatic electric H_2O htr – LectroSpeed (Seattle) looks old		
	Waste disposal system	toilet pipe is corroded		
	Water source			
Structure				
	Issues to Consider:			
	Framing type			
	Floor members			
	Floor substrate			
	Wall members			
	Wall substrate			
	Deflection/ warping			
	Signs of fungal and insect			
	Fire damage			
Character defining features:		original varnished trim in hall, 2 bedrooms		

#36

FRONT PORCH (con't)

bead board	good condition	good integrity
masonry columns	deteriorating brick & mortar appears to be some repointing	fair
wood columns	box columns, missing lower trim	fair
stairs	not original, not in particularly good condition	none
roof	saggy	

Maintenance Suggestions

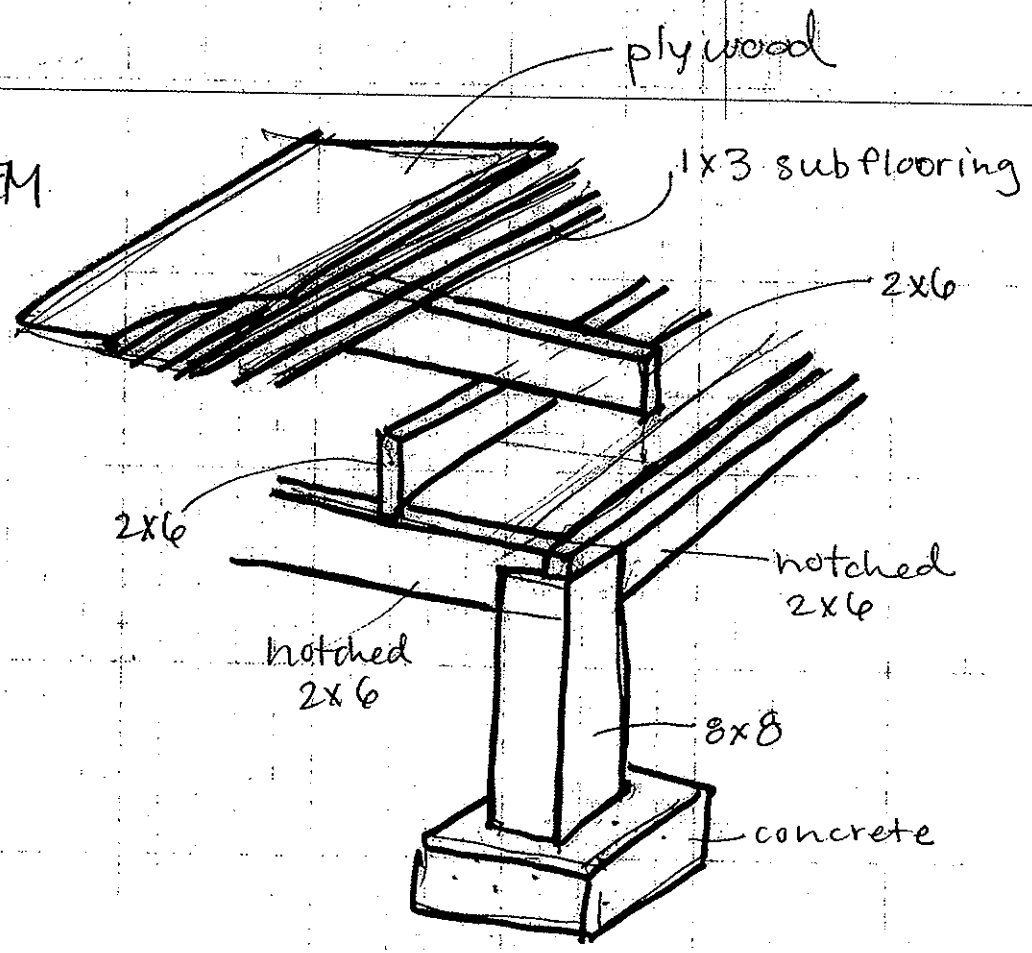
As this is the ONLY house we found with originally varnished trim, care should be taken with it.

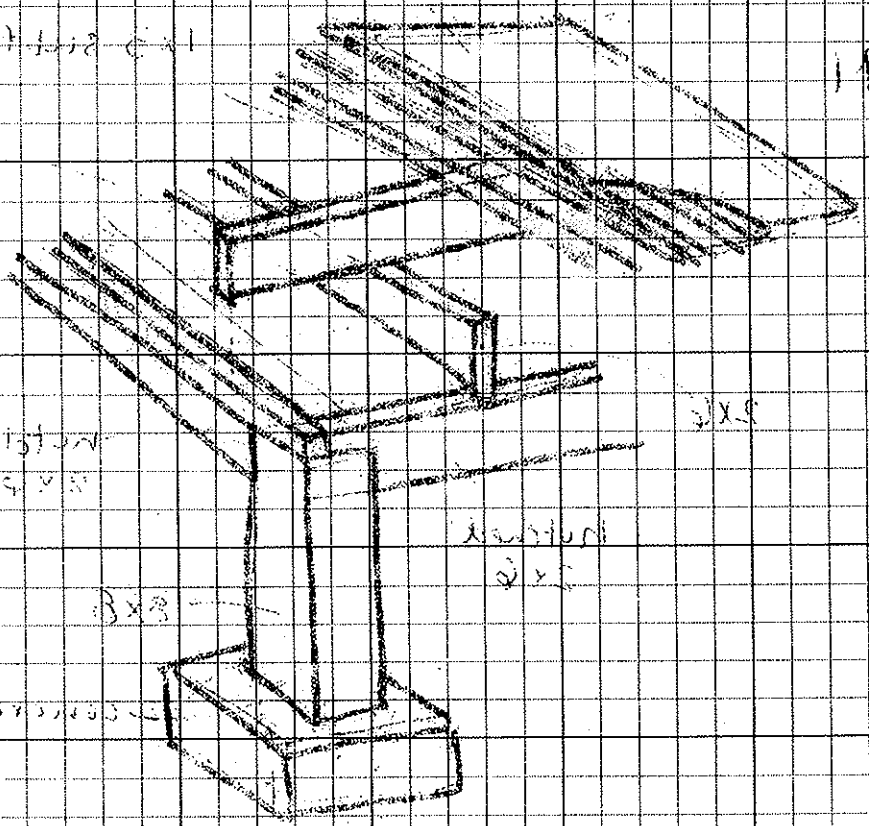
The kitchen appliances are unique, if not original to the house and their significance should be considered in light of the function of house #36 within the community.

Wood floors should be cared for

Plaster in the living room - walls & ceiling - should be assessed for soundness.

KITCHEN
ADDITION
FLOOR SYSTEM
#36





PROJECT : 3 LYNX

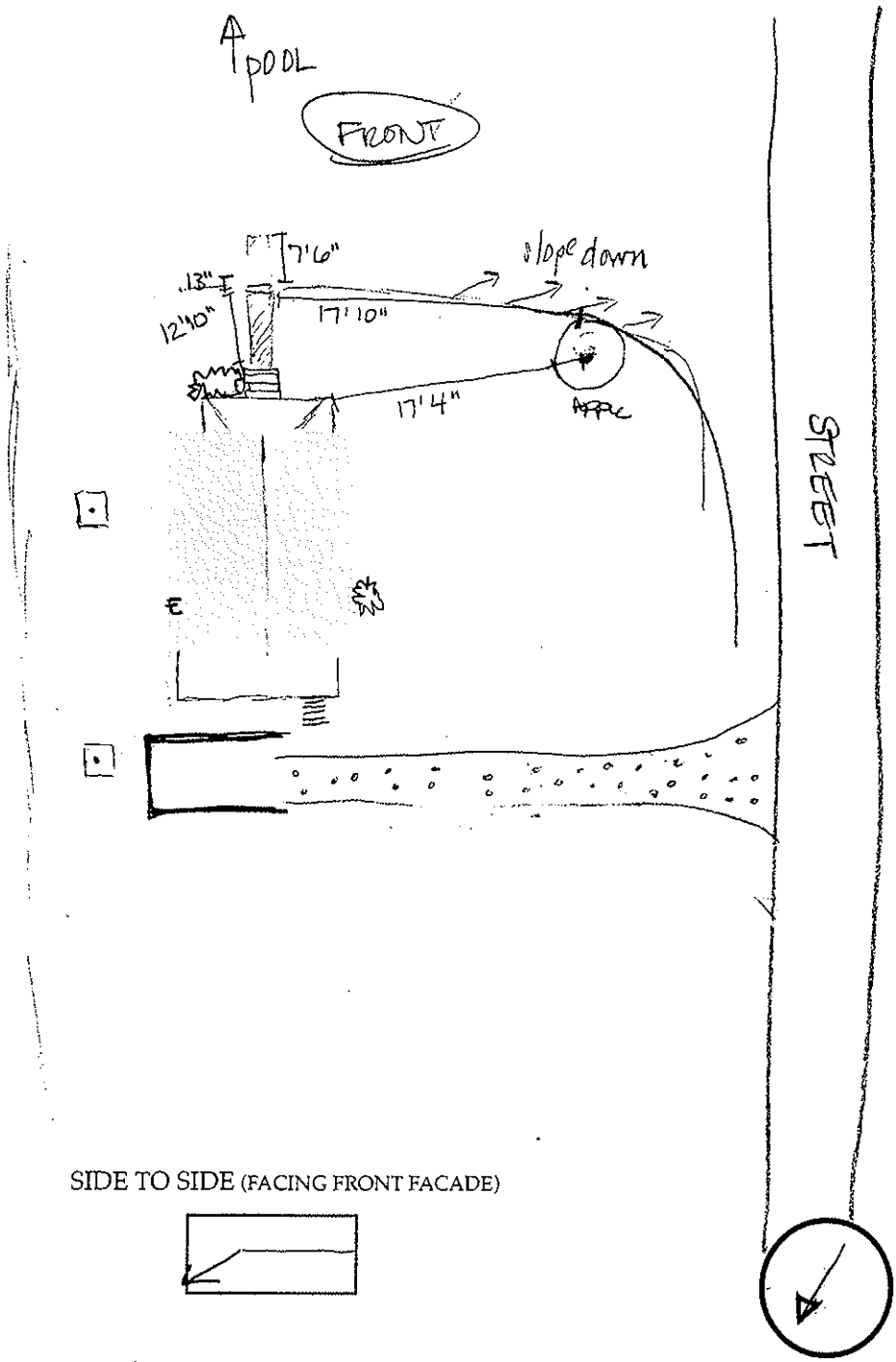
SITE ID: 36
RECORDER: ~~[redacted]~~ Kate
DATE: 6 OCT 2001

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

Horseshoe game to NE side, iron poles (?) in sand

E = electric cnxn

NOTE: This house has NO chimney on the ext.



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY concrete
DRIVEWAY gravel
FENCE/WALLS none
ROAD labelled street

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS
concrete foundation (for garage, presumably) @ rear of house

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
10.6.07	phil, christy, Spencer

Address/ Bldg. #: 37

Style: Victory -

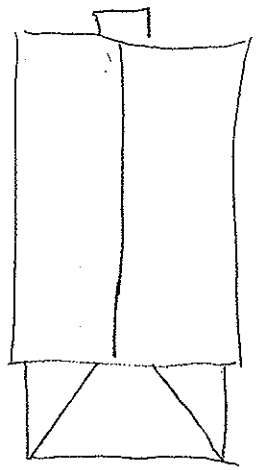
Date of Construction: 1920's

Moved: No

# of Stories 1

PHOTO

Roof Configuration



Address/ Bldg. #: 37

EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material	BOARD FORMED POURED CONCRETE	—	YES
Exterior Wall	**Issues to Consider:** Insulation Bulging / leaning	4.5" TO WEATHER HORIZONTAL LAP SIDING	NOT GOOD – PEELING PAINT AND MOISTURE DAMAGE. ACTUAL SIDING IS MISSING ON REAR OF BUILDING – EXPOSED BUILDING PAPER HAS BEEN REVEALED	YES
Windows		BOARDED UP	—	UNKNOWN
Doors		BOARDED UP	—	UNKNOWN
Decks/Porch	**Issues to Consider:** Railing height Floor material	REAR PORCH	MISSING ROOF – BUT MAY BE ORIGINAL	MAYBE
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	SOME WOOD GUTTERS		YES
Chimney	**Issues to Consider:** Height above roof Flue size Structural problems	DOES NOT APPEAR ABOVE ROOFLINE		
Roof	**Issues to Consider:** Pitch Flashing type Skylights	8:12 – NOT SHINGLED		NO
Additions and Changes (on back)				

HAS BEEN ABANDONED AND BARDED UP

Address/ Bldg. #: 37

INTERIOR		Material	Condition	Integrity
Issues to Consider: Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size **Kitchen**			very, very bad	
	Ceiling			
	Floor			
	Wall			
	Window			
	Door			
	Cabinet/Millwork			
	Fireplace			
	Appliances / Fixtures	sink		

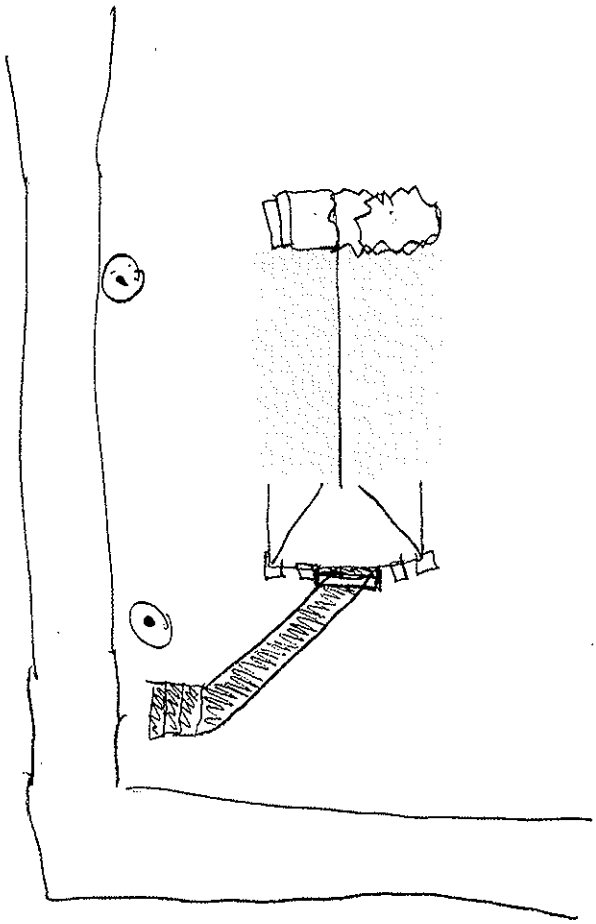
Address/ Bldg. #: 37

Living Room	Material	Condition	Integrity
Ceiling			
Issues to Consider: Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size			
Floor			
Wall			
Window			
Door			
Cabinet/Millwork			
Fireplace			

PROJECT : 3 LYNX

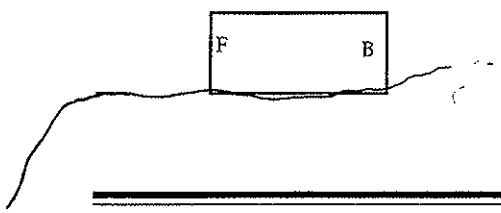
PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 37
RECORDER: CHRISTY
DATE: 10.6.01



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

Oct 7, 2001 RIN

FIELD ASSESMENT FORM: THREE LYNX | **Date** | **Name of Recorder**

Address/ Bldg. #: 38

Style: Aladdin Z
vernacular/craftsman

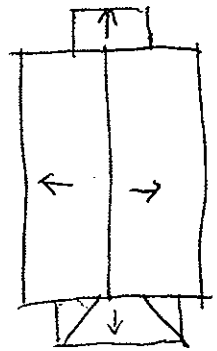
Date of Construction: mid 1920s

Moved: no

# of stories: 1

PHOTO

Roof Configuration



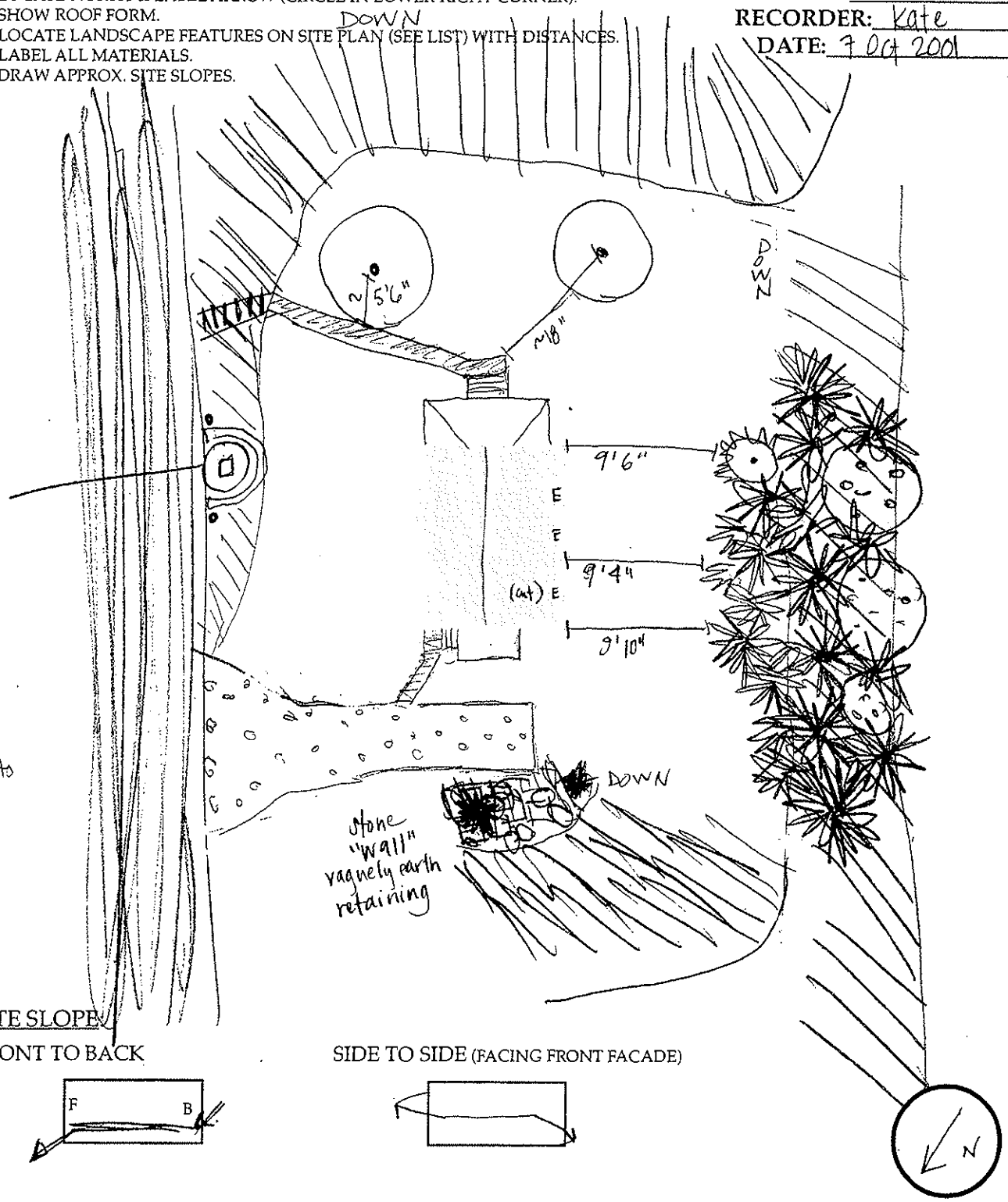
Address/ Bldg. #: 38

EXTERIOR		Material	Condition	Integrity
Foundation				
	Issues to Consider: Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material	board formed concrete	good, no cracking	yes
Exterior Wall				
	Issues to Consider: Insulation Bulging / leaning	horizontal wood siding redwood	extremely weathered loose boards on SE corner	yes
Windows		storm windows wood trim/ frame sashes basement sashes	hook above windows intact, some screens weathered need some repair, paint peeling missing on east side & 1 SW glass missing from NW	yes
Doors		~~Single~~ wood panel door half glazed	good condition, original hardware	yes
Decks/Porch				
	Issues to Consider: Railing height Floor material	3 1/8" t&g decking approx. 2' rail height brick columns wood box columns	fair, presumably not original (size difference) loose verticles on west side 2 outer-plastered over, 2 inner-some repointing	?
Drainage System				
	Issues to Consider: Gutter/ downspout sizes 2"	bead board ceiling wood gutters	trim in bad condition, piece missing from SW side (lower) good good condition, no support pieces at rafter ends	?
Chimney				
	Issues to Consider: Height above roof Flue size Structural problems	brick chimney	corbelling severely deteriorated lots of goop	fair
Roof				
	Issues to Consider: Pitch Flashing type Skylights	composition shingle porch roof	good condition slight bow	yes
Additions and Changes (on back)	Back porch	decking	fair condition, some misshaping partial enclosure w/ screen	

PROJECT : 3 LYNX

SITE ID: 30
RECORDER: Kate
DATE: 7 Oct 2001

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



concrete "manhole?" w/ warning reflectors

E = cables connecting to house

SITE SLOPE

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY concrete
DRIVEWAY = gravel
FENCE/WALLS stone
ROAD asphalt

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

FIELD ASSESMENT FORM: THREE LYNX

6 OCT 2001
Date

Name of Recorder:
Kate Ryan
Stewart Crosby
Marti Gerdes
Carin Peterson

Address/ Bldg. #: 39

Style: ALADDIN VICTORY Z
VERNACULAR - CRAFTSMAN

Date of Construction:
MID 1920S

Moved: NO

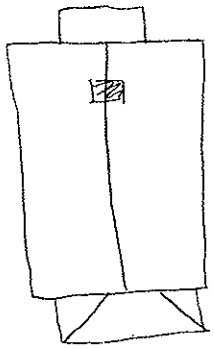
# of Stories 1 + FULL HEIGHT DAYLIGHT BASEMENT

PHOTO

SEE WALKING TOUR DISK #1
DISK #2 PHOTOS # 14 -

tan house

Roof Configuration



FRONT

Address/ Bldg. #: 39

EXTERIOR		Material	Condition	Integrity
Foundation		BOARD FORMED CONCRETE 29.5" ABOVE GROUND (N) CHAMFERED CORNERS MANY METAL TIES	(N) CRACK NORTH WALL TOWARDS WEST (FRONT) E OF SMALL VENT - PATCHED SECOND CRACK 5 FT E OF FIRST, ALSO PATCHED - PUTTY-LIKE (E) CRACK 1 FT S OF PORCH - PATCHED LG PATCHED SQ 1.5 FT N OF S END - PATCHED (VENT?) (S)(W) OKAY.	LOOKS ORIGINAL
	Issues to Consider: Wall Thickness, Pier Sizes/ Spacing, Cracking/ Damage, Header material			
Exterior Wall		WOOD SIDING - 4.5" TO WEATHER FACE NAILED	(N) LG CHIPS OF MISSING PAINT (E) PATCHES OF WOOD DAMAGE, ESP N OF PORCH PAINT SEALED (S) BEAT-UP SIDING	
	Issues to Consider: Insulation, Bulging / leaning			
Windows		1:1 DBL HUNG SASH W/ WEIGHTS INOPERABLE TOP SASH PLASTIC STORM WINDOW IN KITCHEN & BATHROOM	PEELING PAINT (EXT) CRACKING GLAZING COMPOUND PARTING BEADS WEATHERED KIT (S) UV DAMAGE TO BOTTOM RAIL & SILL BOTTOM SASH OF BATHROOM HAS REPLACEMENT GLASS	ORIGINAL WOOD GLASS - ?
Doors		½ GLAZED WOOD PANEL DOOR	BATH STYLES & RAILS DAMAGED	
Decks/Porch		RAILING 29.75" - 31" HEIGHT ABOVE FLOOR 23/8" T&G FLOOR SLOPED OUT 1:20 BEAD BOARD CEILING BRICK (SERRATED) PIERS W/ CONCRETE TOPS & 3 WOOD POSTS GLASS METAL LIGHT FIXTURE	DAMAGE TO TOP OF RAIL - PEELED PAINT, SAGGING & RAIL SLATS HAVE PULLED AWAY IN CENTER BRICK POSTS NO LONGER STRAIGHT - MORTAR CRACKING, N MOST WEATHER DAMAGE TO POST BASE TRIM 4 STEPS UP, CONCRETE BOTTOM, NEW WOOD 2ND OLD WOOD 3RD - 4TH CONCRETE PATCHES SPALLING POSSIBLE SETTLING OF PORCH	GOOD - QUESTION OF RAILING DATES, CAULKED! STABILIZATION => Δ TO STRUCTURE UNDER PORCH. NEWER LIGHT FIX
	Issues to Consider: Railing height, Floor material			
Drainage System		GALVANIZED METAL GUTTER DOWNSPOUTS - 2" - INTO GROUND	GOOD CONDITION	NOT ALADDIN
	Issues to Consider: Gutter/ downspout sizes			
Chimney		CORBELED BRICK 16" FROM PEAK, 24" FROM SLOPE	WEAK MORTAR	YES, PIPE NEW, ON TOP OF BRICK (FMC)
	Issues to Consider: Height above roof, Flue size, Structural problems			
Roof		BEAD BOARD SOFFIT EXPOSED END ROOF RAFTERS (6:12 ASSUMED) COMPOSITE SHINGLE	RAFTER ENDS UNPAINTED - WEATHERING SOFFITS HAVE PEELING PAINT GOOD COND SHINGLE	NEW SHINGLE, INTEG GOOD FOR REST
	Issues to Consider: Pitch, Flashing type, Skylights			
Additions and Changes (on back)				

Address/ Bldg. #: 39

INTERIOR		Material	Condition	Integrity
Issues to Consider: door to basement Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size		wood panel	painted hardware - orig, working, painted over	yes.
Kitchen				
	Ceiling	textured plaster, painted	good.	presumably
	Floor	Linoleum, poss. wood beneath	good	questionable
	Wall	painted plaster wallpaper border	good. SW corner, above fridge bulges	good.
	Window 29" wide	dbl hung 1:1 wood sash w/ ext storm window	show signs of water damage on bottom rail. intact lock on meeting rail	yes
	Door	1/2 glazed panel door painted. screen & wood	~~brass~~ hardware newer metal weatherstripping top bottom & sides Frame damaged by hardware removal screen - poor condition	screen - no door - yes orig hinges
	Cabinet/Millwork	wood baseboard mod (70s?) woodlike cabinets SW corner cabinet (photo?)	painted - s&se wall diff from rest of house - painted. workable - corner cabinet, counter & cabinet, grate	maybe cab - none. yes, not counter top new hardware
	~~**Fireplace**~~			
	Appliances / Fixtures	fridge range 2 microwaves	all new	no.

Address/ Bldg. #: 39

Living Room		Material	Condition	Integrity
	Ceiling	TEXTURED plaster	Damage to paint layers in NE corner of room one central 3 bulb fixture in center	good. Fixture not orig.
Issues to Consider: Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size	**Floor**	carpet w/ hardwood beneath	Newer carpet - good cond. hardwood looks good	hardwood prob orig.
	Wall	painted plaster		
	Windows - 2	one N > dbl hung 1:1 one W > inoperable top wood & glass (fir)	4.3/4" molding - painted, prob orig glazed	yes
160" x 159 1/4" (wxh)	**Door**	to front porch - 1/2 glazed wood panel	painted - prob orig glazed surrounded by molding	Yes
	Cabinet/Millwork	4.75" molding around 65" x 80" (wxh) opening to dining rm same around windows / doors Floor / baseboard molding.	orig varnish shows through some paint All painted, fair to poor condition	Yes
	~~Fireplace~~			
	Electric	one central ceiling light 3 bulb.	grounded plug (w wall), E ungrounded plug N wall grounded plug dbl switch - dimmer int, ext switch	none
	Ventilation	Modern metal floor grate beneath W window	good - - - - -	no
		wall grate to S of dining rm opening - metal	good - same paint as trim	yes

Address/ Bldg. #: 39

Dining Room		Material	Condition	Integrity
	Ceiling	plaster, painted ~~over~~	good; cracks around light	yes
Issues to Consider:				
Dimensions 13'7 x 16'0	**Floor**	carpet over h.w. s	suspected to be good	under carpet
Ceiling Height				
Closets / sizes				
Trim				
Number of outlets / voltage	**Wall**	plaster, painted	good	yes
Heat source Forced air; New thermo-stat				
Location of rm (1st / 2nd fl)				
Skylights				
Ventilation source	**Window**		good	yes
Fireplace size				
	Door	N/A		
	Cabinet/Millwork	baseboard & trim on openings to hall & kitchen & living rm. - painted, plob once varnished		
	Fireplace	N/A		
		110V 3 outlets and 1 220 outlet		

Address/ Bldg. #: 39

Bathroom		Material	Condition	Integrity
	Ceiling	painted plaster	good	yes
Issues to Consider:				
Dimensions 65" x 90"				
Ceiling Height 92 1/2"				
Closets / sizes N/A	**Floor**	vinyl	good	NO
Trim				
Number of outlets / voltage one - light on				
Heat source NONE				
Location of rm (1st / 2nd fl)	**Wall**			
Skylights				
Ventilation source NONE				
Fireplace size				
	Window 36" x 30"	wood + glass	good, but painted shut	new bottom glazing
	Door	2-panel plywood	good	yes
	Cabinet/Millwork	medicine chest - wood	good	yes
	Appliances / Fixtures	toilet		NO
		sink		
		tub/shower	constant faucet leak	
		Countertop - possibly masonite	good	questionable

Address/ Bldg. #: 39

Bathroom ~~#1~~ #4 BEDROOM	Material	Condition	Integrity
Ceiling **Issues to Consider:** Dimensions 14'4 1/2 X 13'5 1/2 Ceiling Height 9'2 1/2 Closets / sizes 3'5 D, 4'9 1/2 E **Floor** Trim 4 3/8 Paint over Varnish Number of outlets / voltage 2 elec Heat source Forced air vent Location of rm (1st / 2nd fl) **Wall** Skylights No Ventilation source No Fireplace size N/A 1st FL, SE corner	Painted plaster	Good - No cracks	No
	Carpet over wood	Carpet is in Good condition	No
	Painted Plaster	Good Condition	Yes
Window - 1	2 Pane, Painted trim	Good working condition	Yes
Door	2 Panel Plywood	Good. Paint not peeling	Yes
Cabinet/Millwork	baseboard window trim	missing bottom mast member on SW - painted, prob once varnished	Yes
Appliances / Fixtures	2 bulb Ceiling light fixture	Good	No

Address/ Bldg. #: 39

Bedroom	Material	Condition	Integrity
Ceiling	Painted Plaster	Good. Textured	No
Issues to Consider:			
Dimensions 135 x 167			
Ceiling Height 92 1/2			
22 1/4 x 11 1/2 Closets / sizes 52 1/2 x 19 1/4 **Floor** — 3 shelves	Carpet over hardwood	Good - Carpet Not Stained.	No
Trim 4 3/8 — Chip board sliding doors-2			
Number of outlets / voltage 2 @ 120			
Heat source Forced air vent			
Location of rm (1st / 2nd fl) **Wall**	Painted Plaster	Good. No Chipping	Yes
Skylights No — 1st fl SW corner			
Ventilation source No			
Fireplace size No			
Window 2	2 Pane Painted Trim	Good working condition	Yes
Door	2 Panel Plywood	Good	Yes
Cabinet/Millwork	N/A		
Fireplace	N/A		

Address/ Bldg. #: 39

Bedroom	Material	Condition	Integrity
Ceiling **Issues to Consider:** Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size			
Floor			
Wall			
Window			
Door			
Cabinet/Millwork			
Fireplace			

Address/ Bldg. #: 39

Bedroom	Material	Condition	Integrity
Ceiling			
Issues to Consider:			
Dimensions			
Ceiling Height			
Closets / sizes **Floor**			
Trim			
Number of outlets / voltage			
Heat source			
Location of rm (1st / 2nd fl) **Wall**			
Skylights			
Ventilation source			
Fireplace size			
Window			
Door			
Cabinet/Millwork			
Fireplace			

Address/ Bldg. #: 39

Basement		Material	Condition	Integrity
	Issues to Consider:	board formed concrete	good - can see W most foundation crack.	yes.
	Insulation	3 light sash windows	some replacement panels - seams around frame have been hot glued.	some
	Floor material		New latch on NW side	
	Floor to ceiling height			
Attic				
	Issues to Consider:			
	Ceiling members			
	Roof members	wood - good cond.		
	Roof substrate	can't see		
	Deflection/ warping	no		
	Signs of fungal and insect	- fogger cans		
	Fire damage	no		
	Insulation	yes - wool & pink		
	Peak height			
	Means of access	hallway b/t bedrms - bead	board panel was varnished, is painted	yes.
	Ventilation	yes to west		
	Leakage	no		
Stairs				
	Issues to Consider:	understair cabinet		
	Handrail height - none	wood - painted	solid	maybe
	Tread / riser dimensions - 9x6"			
	Stair width - 3ft.			
	Headroom			
	- 6ft 2in			
Utility Room NONE				
	Issues to Consider:			
	Plumbing connections			
	Floor drain			

Address/ Bldg. #: 37

SYSTEMS		Material	Condition	Integrity
Mechanical/HVAC	**Issues to Consider:** System type	oil furnace oil tank in basement	dated 9/2000 - attaches to existing duct sys.	no
Electrical	**Issues to Consider:** System type Elec. Entry point	Hot H_2O htr. 220V plug on E wall 4 120V outlets	well insulated	no
Plumbing	**Issues to Consider:** Pipe size / material Waste disposal system Water source	basement wash basin		
Structure	**Issues to Consider:** Framing type Floor members Floor substrate Wall members Wall substrate Deflection/ warping Signs of fungal and insect Fire damage	Wood platform wood	stacked joist E-W center 2X8 members floor 1X8 substrate - some X bracing missing - some replaced near pipe sys w/ horiz bracing	
Character defining features:				

#37

MAINTENANCE SUGGESTIONS

SCRAPE AND PAINT WINDOWS AND FRAMES

REGLAZE, ESP BASEMENT

USE HOOKS OR LATCHES INSTEAD OF SCREWS FOR STORM WINDOWS - LESS DAMAGE TO HISTORIC FABRIC

STUDY OF PORCH HISTORY SHOULD BE MADE - POSSIBLE RESTORATION?

REMORTAR & POSSIBLY STRENGTHEN BRICK PIERS. REPLACE OR CONSOLIDATE BRICK

REPAINT, ESP. PORCH FLOOR - SAND PAINT STAIRS

REMOVE CAULK

REMOVE EXCESS BOLTS, NAILS, FILL

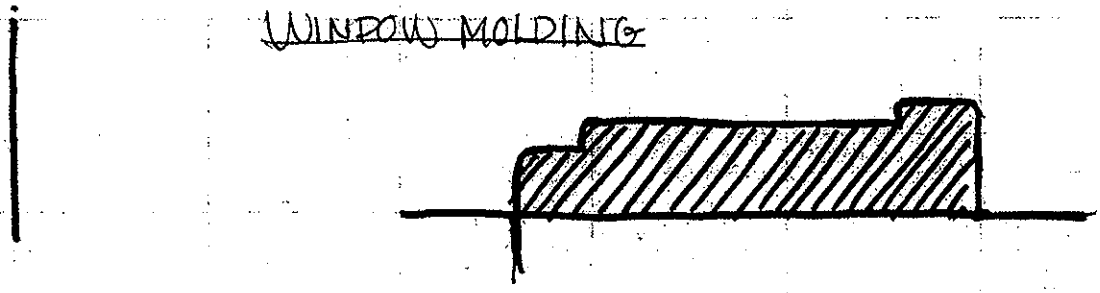
KEEP ORIGINAL HARDWARE & VENT GRATES WHERE POSSIBLE

Scale = 1/2

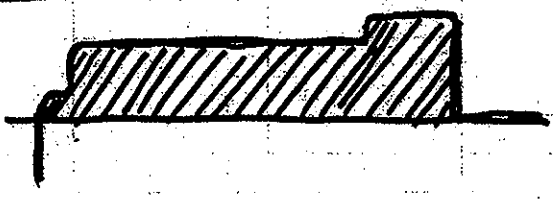
Bldg 54
10/6/01

Carin

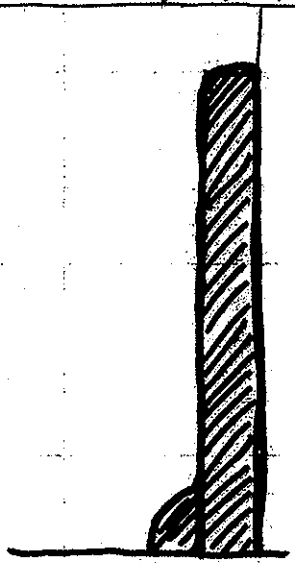
WINDOW MOLDING

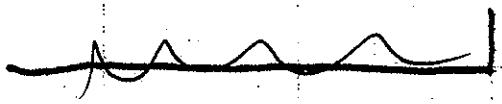


DOOR MOLDING

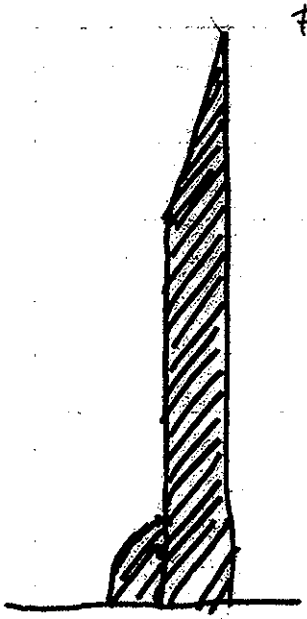


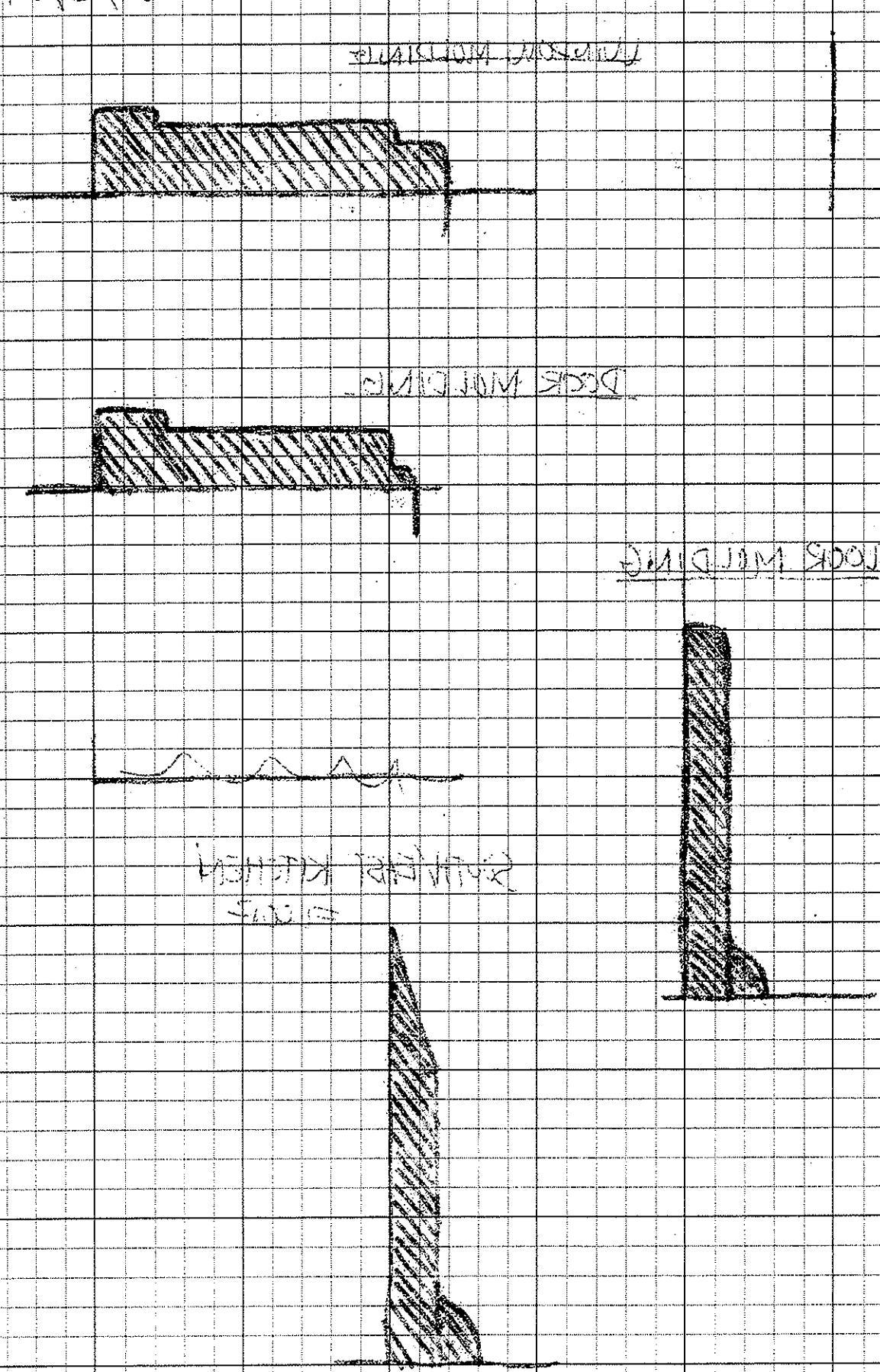
FLOOR MOLDING





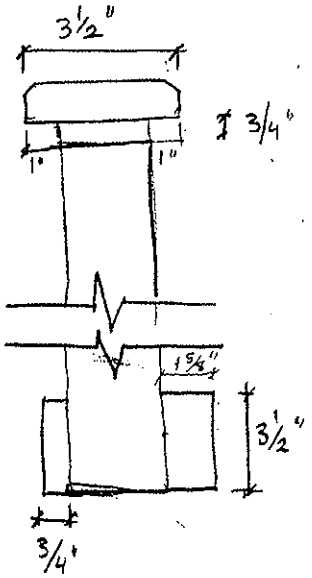
SOUTH/EAST KITCHEN FLOOR

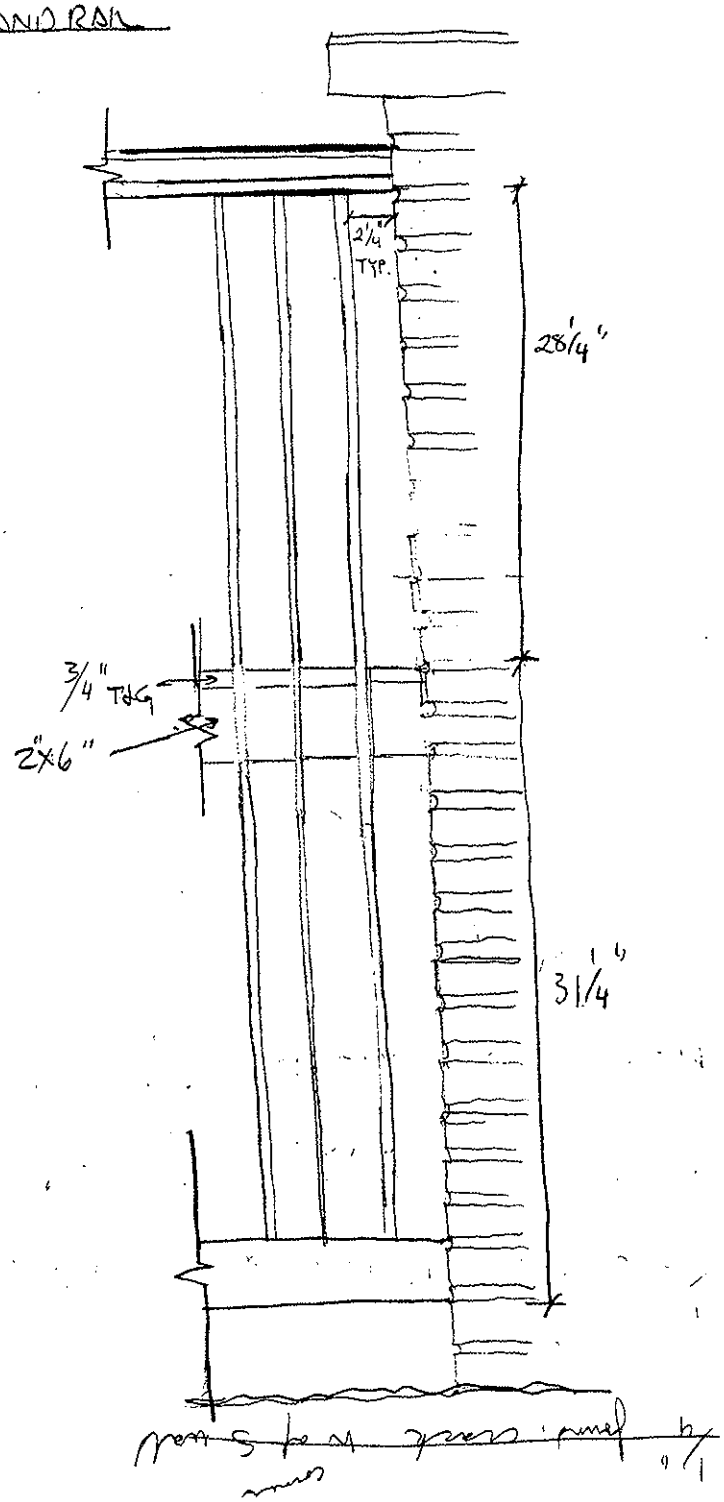




#39
TYPICAL

TYPICAL ALADDIN HANDRAIL

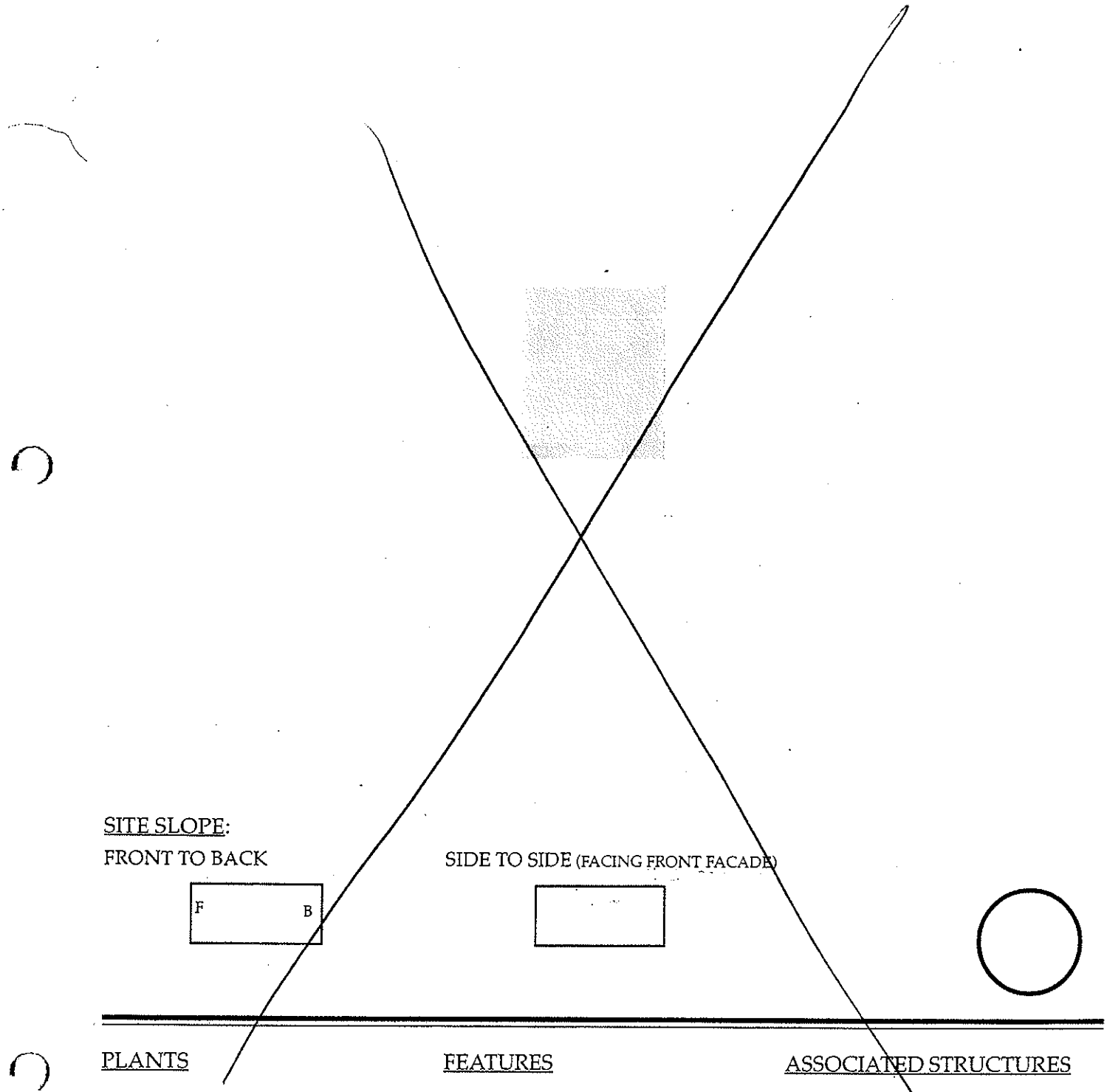




PROJECT : 3 LYNX

SITE ID:_____
RECORDER:_____
DATE:_____

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK

SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

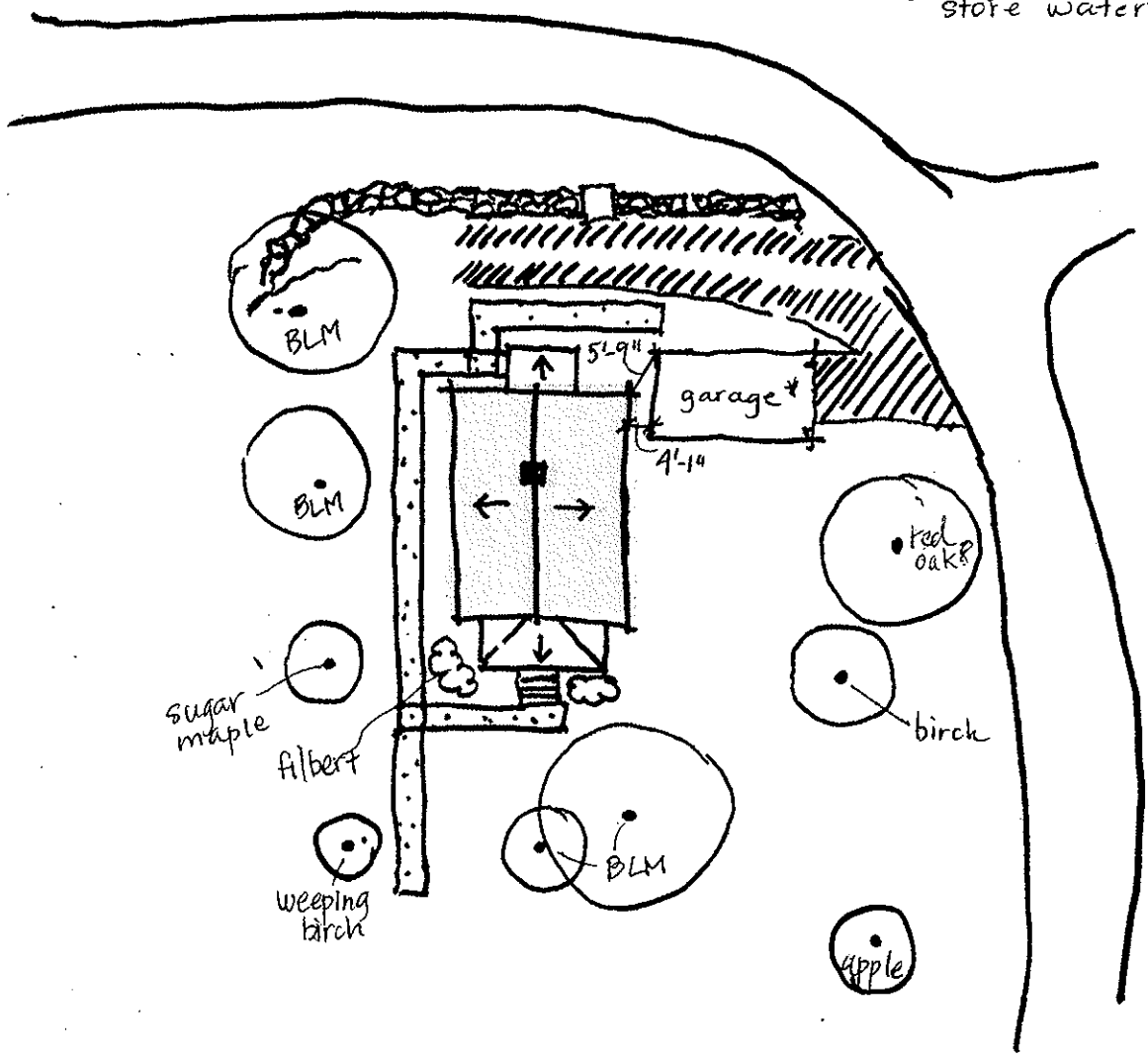
GARAGE/CARPORT
SHEDS

PROJECT : 3 LYNX

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

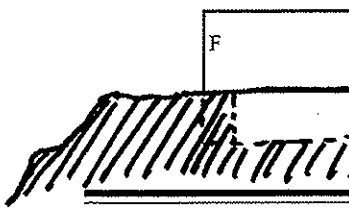
SITE ID: 39
RECORDER: CARIN
DATE: 10/6/01

* garage used to store water tanks

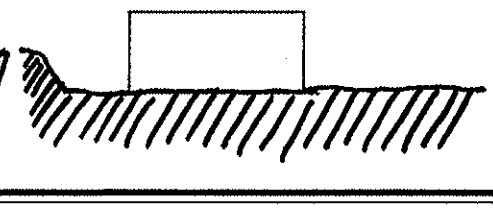


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

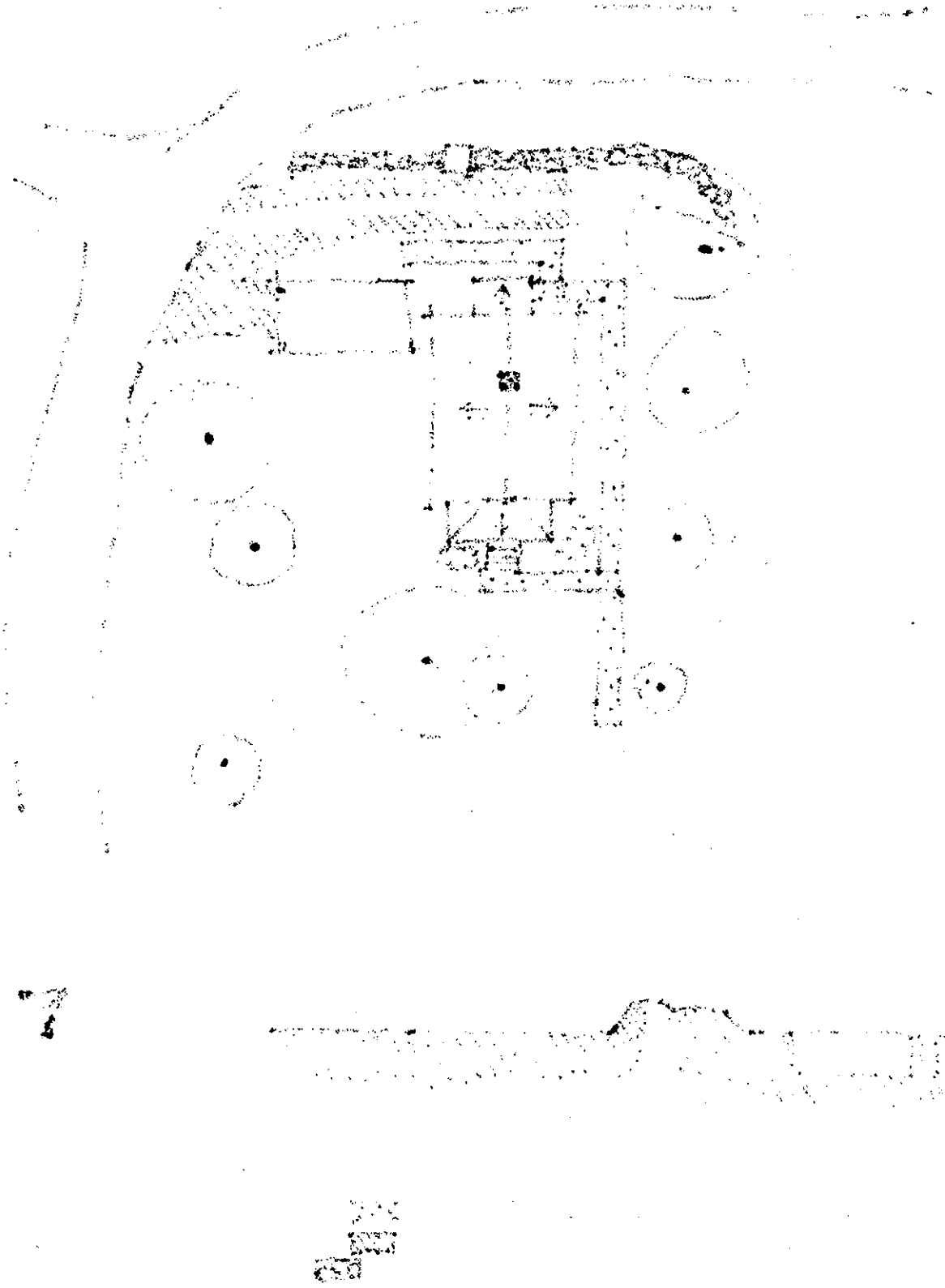
TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY - concrete
DRIVEWAY - gravel
FENCE/WALLS - basalt
ROAD - asphalt

ASSOCIATED STRUCTURES

GARAGE/CARPORT not original
SHEDS



FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
10-6-01	CLASS — MARTI / CHRISTY

Address/ Bldg. #: 40

Style: VICTORY, Z-TYPE, VERNACULAR / CRAFTSMAN

Date of Construction: MID-1920s

Moved: NO

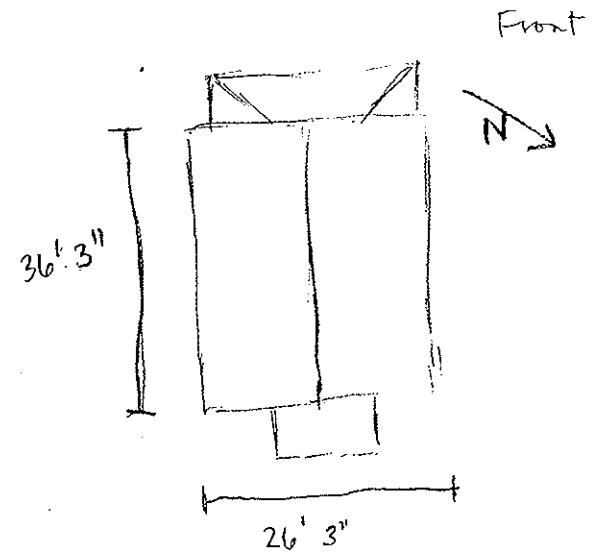
# of Stories ONE, W/BASEMENT

PHOTO

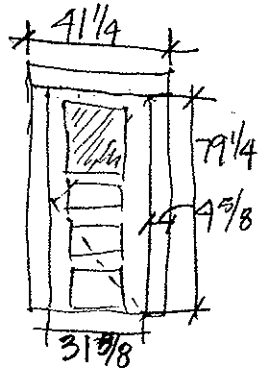
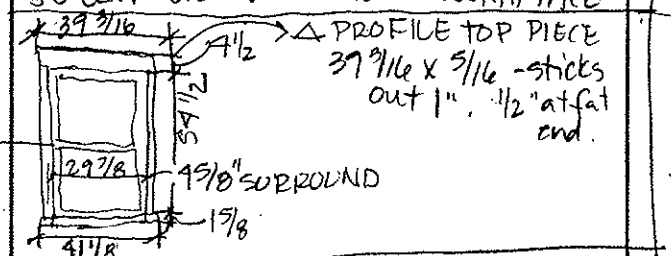
blue

Roof Configuration GABLE W/HIP FRONT PORCH, SHED-REAR PORCH

PITCH 6:12

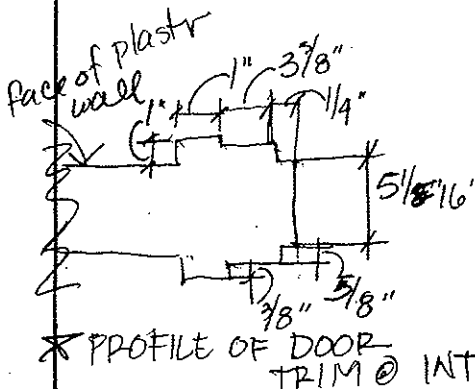


Address/ Bldg. #: 40

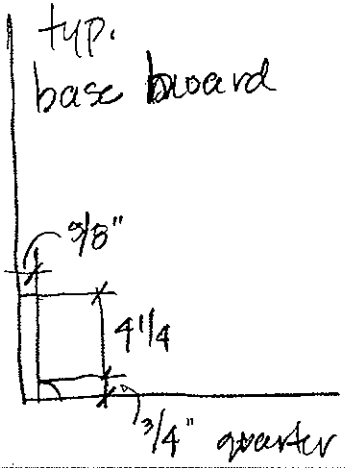
EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness, Pier Sizes/ Spacing, Cracking/ Damage, Header material	ALSO 10' SOUTH SIDE 10' IN, NW CORNER - PATCHED / INTERIOR, INTERRUPTED FOOTING DUE TO EXISTING STONE	Board Formed w/ 7" boards TIES LEFT EXPOSED; CLINCHED REAR PORCH - NOT ORIG (SIDE ENCLOSURES)	NO FOUNDATION BOLTS - RECOMMEND ADDING
Exterior Wall	**Issues to Consider:** Insulation, Bulging / leaning	NO SIDING	50-CENT SIZE VENTS ADDED NORTH FACE	
Windows				61 1/8 x 39 total typ. window
Doors	DOOR SURROUNDS ON REAR & FRONT SAME DIM.			
Decks/Porch	SEE PORCH PLAN	**Issues to Consider:** Railing height, Floor material 30-31" / WOOD T+G	PORCH COLUMN: FOUR; BRICK PIER TO JIST ABOVE RAILING HEIGHT - WOOD THEREAFTER. BRICK SUPPORTS PORCH FLOOR. SOFT MORTAR. FLOORING: 2 7/16" x 7/8"	MAIN STRUCTURAL PIECES OK;
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	GUTTER - ADDED		
Chimney	**Issues to Consider:** Height above roof, Flue size, Structural problems	CORBEL DETAIL		
Roof	**Issues to Consider:** Pitch, Flashing type, Skylights	6:12 ZINC COATED METAL NONE		
Additions and Changes (on back)				

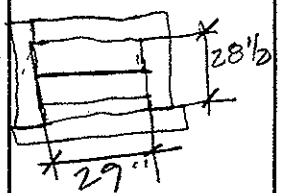
Address/ Bldg. #: 40

INTERIOR	Material	Condition	Integrity
Issues to Consider:			
Dimensions 7'9 1/2" typ. through out			
Ceiling Height		9'-5 1/2 x 13'-6" room dim	
Closets / sizes			
Trim			
Number of outlets / voltage 1-220	2-110		
Heat source FORCED AIR	— 1 VENT		
Location of rm (1st) 2nd fl)			
Skylights			
Ventilation source			
~~Fireplace size~~			
Kitchen			
Ceiling	plaster/Lath	Good	High
Floor	sheet Vinyl Linole. not original	Fine	Not original.
Wall	plaster/Lath/wallpaper	Good	High
Window	DOUBLE HUNG ONE-OVER-ONE. UPPER PART FIXED.		
Door	to outside back porch - typ.		
	to basement - homemade cutéa door 31 3/4 w x 79"h 4 3/8" w x 84 3/8 h surround		
Cabinet/Millwork	wood base & upper cab's. Laminated Counter U shaped corner built out unit w/ shelf & upper cab.		
~~Fireplace~~	1/1 window over sink — 4 1/4" SURROUND 29"w x 28 1/2h		
Appliances / Fixtures	SINK — not orig.		



* PROFILE OF DOOR TRIM @ INTERIOR





Address/ Bldg. #: 40

Living Room		Material	Condition	Integrity
	Ceiling	PAINTED PLASTER ON LATH E-W	good	high
Issues to Consider: Dimensions Ceiling Height 7'9½" typ Closets / sizes N/A Trim see typ. detail Number of outlets / voltage — 3 - 110 1 vent Heat source F-AIR Location of rm (1st / 2nd fl) ~~Skylights~~ Ventilation source ~~Fireplace size~~	**Floor**	VARNISHED 2 3/8"	EXPOSED HARDWOOD (MAPLE?), E-W. good	high
	Wall	PLASTER/LATH - PAINTED	- good	high
	Window	2 - TYP. SIZE	LOCKS GONE, PAINTED SHUT. TRIM ORIGINAL. SASH CORDS GONE. SCREENS + STORMS MISSING. good	high
	Door	1 - DOOR TO PORCH - SEE EXTERIOR FOR DIM's.	good	high
	~~**Cabinet/Millwork**~~	N/A		
	~~**Fireplace**~~	N/A		
13' 5½", x 13' - 6"				
passage living-dining		6' 1⅜" wide incl. surround		

Address/ Bldg. #: 40

Dining Room		Material	Condition	Integrity
	Ceiling	plaster / lath - painted	good	high
Issues to Consider:				
Dimensions	Floor	23/8" wide hardwood	- varnished good	high
Ceiling Height tup. 7'-9 1/2"				
Closets / sizes none				
Trim see detail				
Number of outlets / voltage 3 - 110	Wall	lath/plaster - painted good		high
Heat source f. air - vent shared w/ kitchen				
Location of rm (1st / 2nd fl)				
~~Skylights~~ -				
Ventilation source -	Window	typical - sash (weighted) window		high
~~Fireplace size~~ -				
	Door	2 doorways w/ tup. trim & base door btwn kitchen & dining is 3'-5 1/2" wide incl. trim		
	Cabinet/Millwork	none	door btwn dining & hall is 3' 5 3/8" wide	
	Fireplace	none		

13' 5 3/4" x 11' 7 1/4" room dim.

Address/ Bldg. #: 40

Bathroom	Material	Condition	Integrity
Ceiling	ptd. plaster/ lath	good — patch over shower.	
Issues to Consider:			
Dimensions			
Ceiling Height 7'-9½" twp. **Floor**	sheet vinyl	good	not orig.
Closets / sizes			
Trim			
Number of outlets / voltage 1 – 110			
Heat source – none			
Location of rm (1st / 2nd fl) **Wall**	plaster – wallpaper	– formica backsplash 18½" Above counter.	
~~Skylights~~	1x4 trim above backsplash – on 3 walls.		
~~Ventilation source~~			
~~Fireplace size~~			
Window	→ 1 – by shower	– trim typ. 36¾h x 29¼w interior dim.	
Door	~~typ~~. 3'1½" wide	incl. trim	
Cabinet/Millwork	base cab. w/ p. lam ctr. top. at sink. closet by toilet → full ht of 93" x 30½w x 11⅞ deep.		→ low
Appliances / Fixtures	toilet, tub/shower – sink. → encased in laminet.		TOILET MAY BE ORIGINAL
7'5" x 5'5¼" room dim.			

Address/ Bldg. #: 40

Bathroom	Material	Condition	Integrity
Ceiling **Issues to Consider:** Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size			
Floor			
Wall			
Window			
Door			
Cabinet/Millwork			
Appliances / Fixtures			

Address/ Bldg. #: 40

Bedroom	Material	Condition	Integrity
Master - at front of house			
Ceiling	ptd - lath/plaster	good	high
Issues to Consider:			
Dimensions			
Ceiling Height 7'-9 1/2 typ			
~~Closets / sizes~~ **Floor**	carpet	fair	low
Trim			
Number of outlets / voltage 2 - 110			
Heat source - 1 vent			
Location of rm (1st) 2nd fl) **Wall**	ptd - lath/plaster	good	high
~~Skylights~~			
~~Ventilation source~~			
~~Fireplace size~~			
Window	2 - typ. size sash w/ wts.	good	high
Door	typ. - see detail for trim 4 1 3/8" wide	good	high
Cabinet/Millwork	closet - interior dims. 7'6 1/4 x 1'7 1/2"	no doors. evidence of sliding doors.	
~~**Fireplace**~~			
11'-6" x 13'-5 3/4 room dim.			

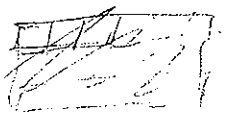
Address/ Bldg. #: 40

Bedroom		Material	Condition	Integrity
#2 at back of house	**Ceiling**	ptd - lath/ plaster	good	high
Issues to Consider:				
Dimensions				
Ceiling Height 7'-9½" tap.				
Closets / sizes	**Floor**	wood - tap.	good	high
Trim src base bd. detail				
Number of outlets / voltage 2 - 110				
Heat source 1 vent				
Location of rm (1st / 2nd fl)	**Wall**	ptd' lath/ plaster	good	high
~~Skylights~~				
~~Ventilation source~~				
~~Fireplace size~~				
	Window	1- typical		
	Door	- typical trim 41 3/8 wide		
	Cabinet/Millwork CLOSET →	43 3/4w x 35"d interior dim.	w/ 1 light.	
		door - 31½ total x	85¼ incl. surround	
	~~**Fireplace**~~			
11'-5¼ x 12'-1¼ room dim.				

Address/ Bldg. #: 40

Bedroom	Material	Condition	Integrity
Ceiling			
Issues to Consider:			
Dimensions			
Ceiling Height			
Closets / sizes **Floor**			
Trim			
Number of outlets / voltage			
Heat source			
Location of rm (1st / 2nd fl) **Wall**			
Skylights			
Ventilation source			
Fireplace size			
Window			
Door			
Cabinet/Millwork			
Fireplace			

Address/ Bldg. #: 40

Basement		Material	Condition	Integrity
	Issues to Consider: Insulation Floor material Floor to ceiling height	FULL HEIGHT (7'2"), CONCRETE FLOOR, FLOOR DRAINAGE (CURRENTLY COVERED). FUEL STORAGE ON WEST SIDE WITH DIRT FLOOR. ALL SERVICES EXPOSED. ptd. conc. walls		
Attic				
	**Issues to Consider:** Ceiling members Roof members Roof substrate Deflection/ warping Signs of fungal and insect Fire damage Insulation → Peak height → 82" Means of access Ventilation ~~Leakage~~	ROOF TRUSS: @ TOP. SPACING BTWN RAFTER 24". 2x6 RAFTER w/ 1" RIDGE. 2x4 CEILING JOISTS. @ to @ 24" ROCK WOOL - BLOWN IN 4" SOLID SUBSTRATE SHEATHING	WELL VENTED - EVIDENCE OF H2O DAMAGE AT CHIMNEY NOT WET Appears to NEVER HAVE WOOD SHINGLES	
HATCH IN HALLWAY — VENTED ON ENDS		NO FIRE DAMAGE		
Stairs				
	Issues to Consider: Handrail height → Tread / riser dimensions Stair width → Headroom	31" tread = 7 1/4 riser = 7" — 1 1/4 nosing 36" 6'-2" tread of stair to lowest pt. of ceiling		
Utility Room				
	Issues to Consider: Plumbing connections Floor drain			

Address/ Bldg. #: 40

SYSTEMS		Material	Condition	Integrity
Mechanical/HVAC				
	Issues to Consider:			
	System type	Forced Air Furnace Evidence of oil furnace.		
Electrical				
	Issues to Consider:			
	System type	evidence of mast & tube - now disconnected. Currently modern 2 wire sheathed cable		
	Elec. Entry point	South East corner of structure.		
Plumbing				
	Issues to Consider:			
	Pipe size / material	cast iron - 2" drain off sink to 4" main drain & thats all.		
	Waste disposal system	sewage system		
	Water source	re: plans from PG&E		
Structure				
	Issues to Consider:			
	Framing type	WESTERN PLATFORM		
	Floor members	FRAME 16" O.C. JOISTS w/ cross bridging.		
	Floor substrate	1x8		
	Wall members	studs		
	Wall substrate	bldg. paper & horiz.	1x ?	
	Deflection/ warping			
	Signs of fungal and insect	N/A		
	Fire damage	N/A.		

Character defining features:

2x8 verge bd. on gabel
Corbel chimney
Exposed rafter tails
Gabel form
Horiz. siding 4 1/2"+/- exposure
Double hung windows 1 over 1
Board form-ed foundation
Daylight basement
Entries at gabel ends
Bead bd. soffit
Chamfered corners at foundation at entries

PORCH
hip roof porch
pier supports - brick
t & g floor
bead bd. ceiling
serrated brick at piers.
slatted railing - not original to kit. 6'1/2 total ht. 3'0 1/2 above floor to top of railing

Board corner at siding

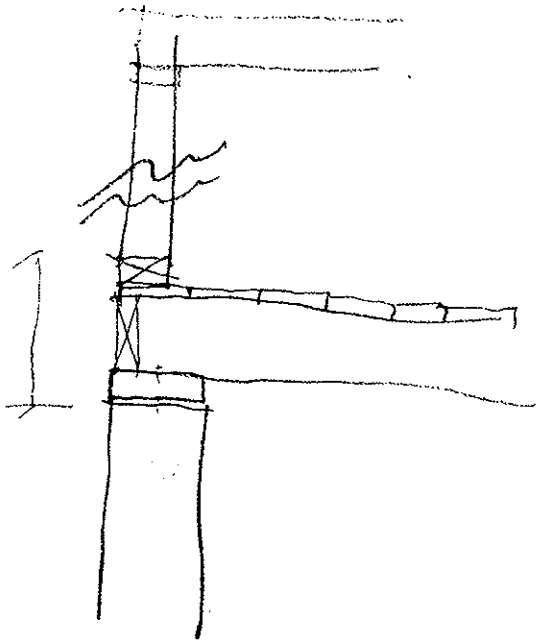
GLAZED (1/2) ENTRY DOOR

#40

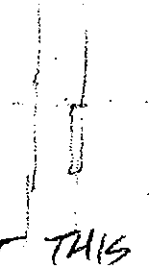
Maintenance Issues:

Interior — provide a std. window shade & repair sash

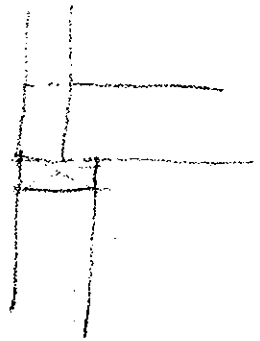
#40



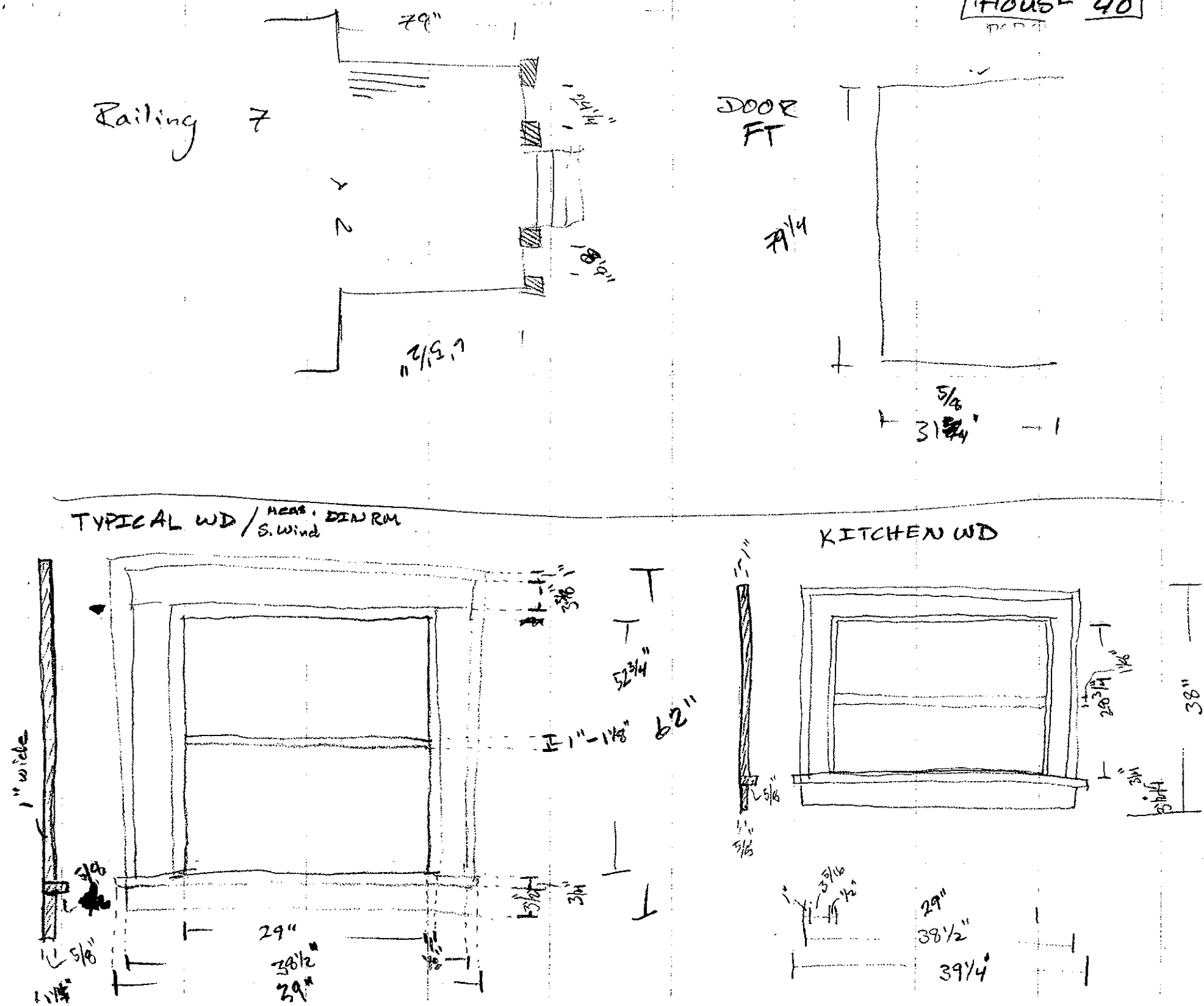
WESTERN OR PLATFORM



NOT THIS



HOUSE #40

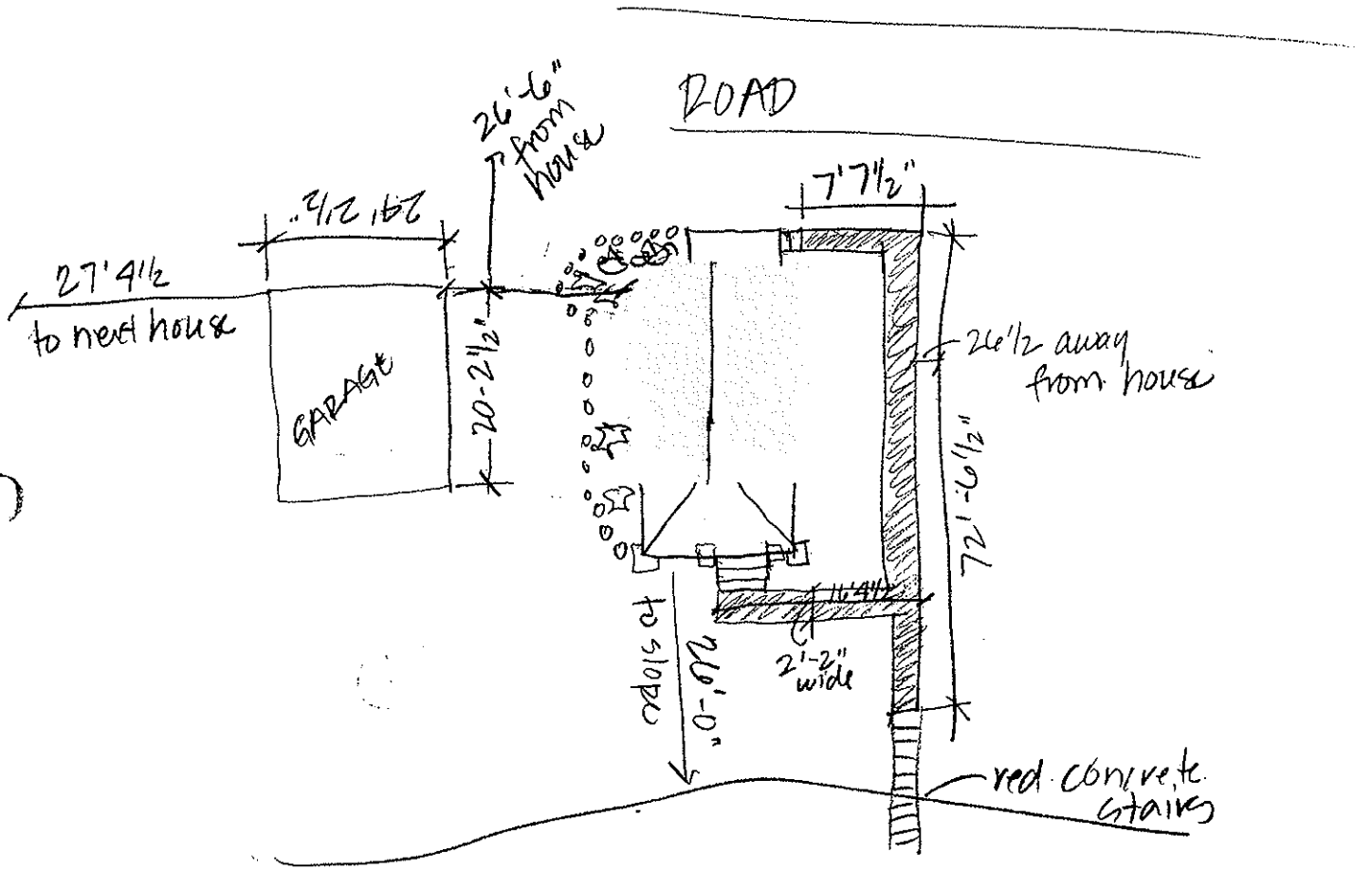


Railing 7
79"
24 1/4"
8'9"
DOOR FT
79 1/4
5/8
31 3/4"
TYPICAL WD / MEAS. DIN RM
S. Wind
1" wide
52 3/4"
1'-1 1/8"
62"
29"
38 1/2"
39"
5/8"
KITCHEN WD
38"
29"
38 1/2"
39 1/4"

PROJECT : 3 LYNX

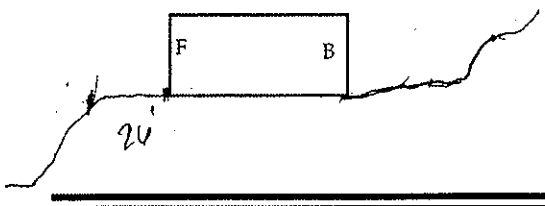
SITE ID: 90
RECORDER: CHRISTY
DATE: 10/10/01

PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS		FEATURES	ASSOCIATED STRUCTURES
TREES, DECIDUOUS	⊙	WALKWAY	GARAGE/CARPORT
TREES, EVERGREEN	⊕	DRIVEWAY	SHEDS
		FENCE/WALLS	
SHRUBS	✿	ROAD	

FIELD ASSESMENT FORM: THREE LYNX

Date

Name of Recorder

Marta

Address/ Bldg. #: 41

Style: VICTORY, 2-TYPE, VERNACULAR

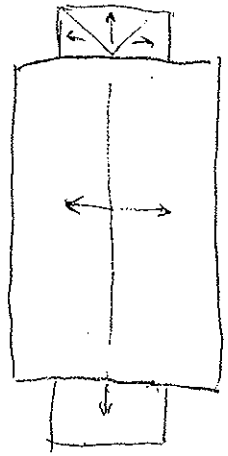
Date of Construction: 1920s

Moved: N/A

OF STORIES ONE

PHOTO

Roof Configuration



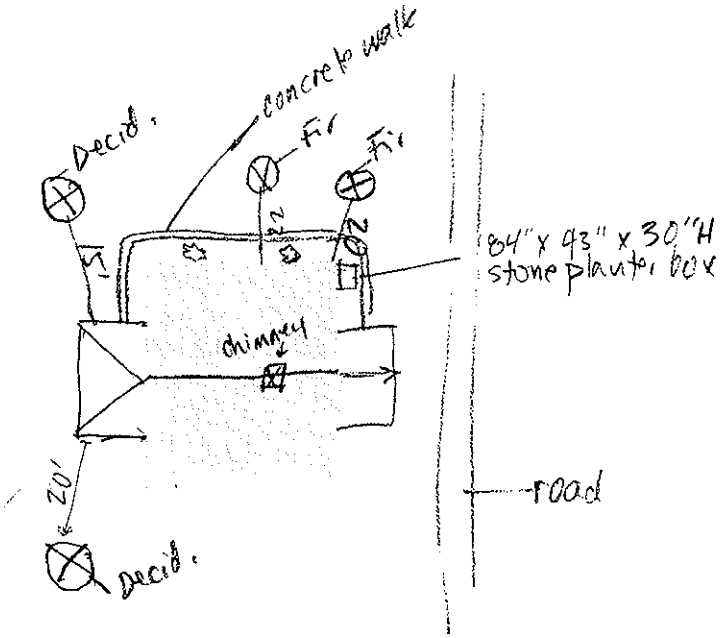
Address/ Bldg. #: 41

EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness, Pier Sizes/ Spacing, Cracking/ Damage, Header material	board-formed concrete, 29"-31" approx. chamfered corners	Crack – S. side & N. side (10' east) board-formed concrete. 29"-31" approx. SW basement window framing needs patch. NW basement patched.	yes
Exterior Wall	**Issues to Consider:** Insulation, Bulging / leaning	47/16" wood siding. Beadboard soffit all around except ~~East~~ side southern half is plywood. East side shed T1-11.	Siding split near faucet S. side, and near west downspout. Soffit peeling paint unif~~orm~~ly.	yes
Windows			SW window painted shut. Basement windows need scraping/repainting, new glazing compound. (Middle one needs new bottom sash rail.)	yes
Doors		1:1 double hung sash w/ weights, 1 screen, in kitchen.	good	
		1/2 glazed wood panel		
Decks/Porch	**Issues to Consider:** Railing height, Floor material	Beadboard soffit	good cond; morning glory has overtaken.	yes
		29-32", wood railing.	some separation of top rail from subtop rail	yes
		unpainted plywood floor,	sagging; evidence of water damage	no
		wood steps, worn off paint	need paint	no
		brick columns	cement caps all deteriorated. Brick needs repointing.	yes
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	painted metal, 4" 2" downspouts	SW downspout rusted through.	
Chimney	**Issues to Consider:** Height above roof, Flue size, Structural problems	corbeled brick	Corbeling chipped	yes
Roof	**Issues to Consider:** Pitch, Flashing type, Skylights	composite shingle appears 6/12 assumed 4 roof vent N. side	good	no
Additions and Changes (on back)				

PROJECT : 3 LYNX

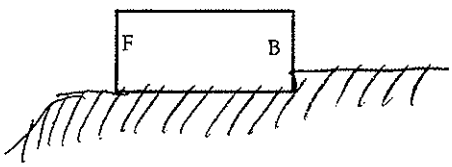
PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: #41
RECORDER: MARTI
DATE: 7 OCT 2001

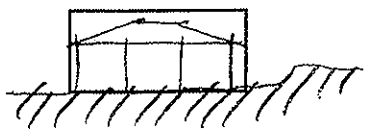


SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)



PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
10/7/01	DAVID STEELE

Address/ Bldg. #: 42 (BEIGE W/ WHITE TRIM)

Style: ALADDIN

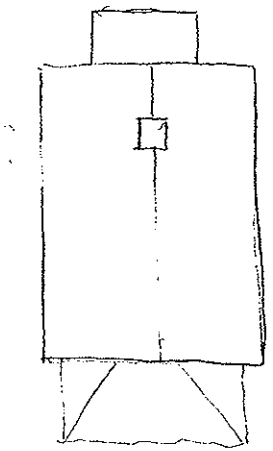
Date of Construction: LATE 1920S

Moved: NO

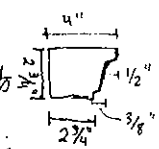
 # OF STORIES 1

PHOTO

Roof Configuration



Address/ Bldg. #: 42

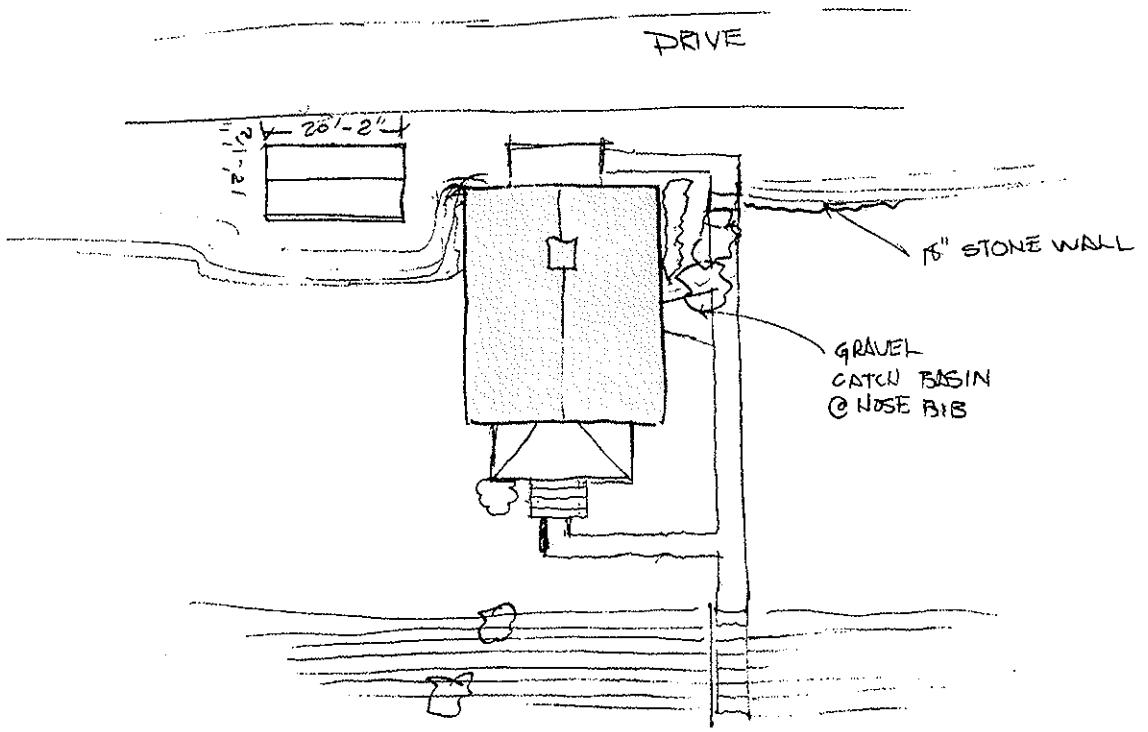
EXTERIOR		Material	Condition	Integrity
Foundation	**Issues to Consider:** Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material	- poured concrete - hose bib on S side	- south wall 1/8" crack 8' back from front corner - dripping - N. wall crack 1/4" 9' back	- 8"X14" vent add 6' from front corner on S wall framed in 2X material
Exterior Wall	**Issues to Consider:** Insulation Bulging / leaning	- clap board w/ 4½" exposure	- good condition, some siding is loose, slight pressure washer damage - on N side over front basement win. siding damage	
Windows	N. wall 2 - 1/1 dbl hng. standard 1 - 1/1 dbl hng 30"x38" 3 - 3'x2' foundation opening, only 2 windows - other boarded up	S wall - 2 - 3'x2' foundation windows wd frame - 2 - 1/1 dbl hung 30" wd x 54" tall - 1 - 1/1 dbl hng. 30"x30" W wall - 2 1/1 dbl hng standard	- vertical 3 lite, framed in 2X material - standard trim - standard trim - N. foundation win. need paint & putty	- recently glazed
Doors		- standard front door		- left win. has nailed on screen - has screen door
Decks/Porch	**Issues to Consider:** Railing height Floor material	- access to under side porch on N side - plywd porch deck - steps wd - four brick piers - pier caps 27½"x27½"	- porch columns base trim missing, except 3/4 of center pier - fair condition - railing ht. tappers from 31" - 30" - left pier is twisting - all piers in poor condition - pier caps chamfered only @ corner piers - porch light @ rt of dr.	- decking is replacement - poor condition railing rotting sagging pickets missing
Drainage System	**Issues to Consider:** Gutter/ downspout sizes	metal gutter 2" down spouts - NW corner down drains to a pipe 	attached w/ nails	- steps are replacement - some repointing on 3 rt piers
Chimney	**Issues to Consider:** Height above roof Flue size Structural problems	brick chimney w/ corbel 2 cons @ top	- approx. 3' above roof	
Roof	**Issues to Consider:** Pitch Flashing type Skylights	comp. rep shings exposed rafter tails exposed bead board decking (same as porch ceiling)	- vent at rear gable approx. 12"x16" - bead board 3¼" wide w/ groove in center	
Additions and Changes (on back)	6'x10' back porch add.	T-111	- 31¾" wide screen door only - light @ rt side - 2 - 6 lite windows - vent @ [illegible]	- added - windows & screen dr [illegible]

PROJECT : 3 LYNX

PROCEDURE

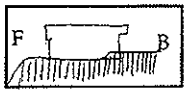
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 42 (BEIGE W/ WHITE TRIM)
RECORDER: D. STEELE
DATE: 10/7/01



SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)

PLANTS

TREES, DECIDUOUS
TREES, EVERGREEN
SHRUBS

FEATURES

WALKWAY
DRIVEWAY
FENCE/WALLS
ROAD

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

FIELD ASSESMENT FORM: THREE LYNX

Date	Name of Recorder
7 OCT 2001	Kate

Address/ Bldg. #: 44

Style: Aladdin Victory, plan 2 - vernacular — Later info reveals that this was a version of the Aladdin built by the contractor without a kit - supposedly for the same cost.

Date of Construction: Mid - 1920s + additions | changes

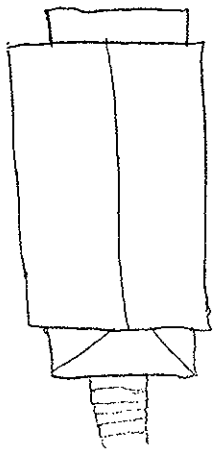
Moved: NO

# of stories: 1.5 + daylight basement

PHOTO

barn red w/ white trim

Roof Configuration



Address/ Bldg. #: 44

EXTERIOR		Material	Condition	Integrity
Foundation **Issues to Consider:** Wall Thickness Pier Sizes/ Spacing Cracking/ Damage Header material		Board formed concrete	good. chamferred corners except on back porch	yes
Exterior Wall **Issues to Consider:** Insulation Bulging / leening		4.5 in to weather painted wood siding horiz.	some peeling paint - S&N walls - shows mint green beneath	probable
Windows		1:1 dbl hung wood & glass sash		yes
	basement	6 pane singk hung		
Doors	front —	½ glazed (4 pane) wood w/ mod metal screen	unknown	unknown
Decks/Porch **Issues to Consider:** Railing height Floor material		brand new reddish lumber porch w/ older roof	porch deck looks to be sloped outward. lattice work beneath. Rail height ≈ 4' slat spacing ≈ 4'	none
Drainage System **Issues to Consider:** Gutter/ downspout sizes		2" down	looks newer - sq. downs on front	doubtful
Chimney **Issues to Consider:** Height above roof Flue size Structural problems		1.5 - 2' brick w/ metal ties surrounding	fair- has weathered poorly ties denote structural probs	doubtful
Roof **Issues to Consider:** Pitch Flashing type Skylights		steeper than norm gable composite shingle galvanized metal gutter & verge board flashing	overall good. ridgeline bulges upward to chimney on both sides exposed rafter ends beneath covered roof substructure 6" or 8" by 1" or 2"	highly unlikely
Additions and Changes (on back)				

Address/ Bldg. #: 44

Living Room	Material	Condition	Integrity
Ceiling			
Issues to Consider: Dimensions Ceiling Height **Floor** Closets / sizes Trim Number of outlets / voltage Heat source **Wall** Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size **Window**			
Door			
Cabinet/Millwork			
Fireplace			

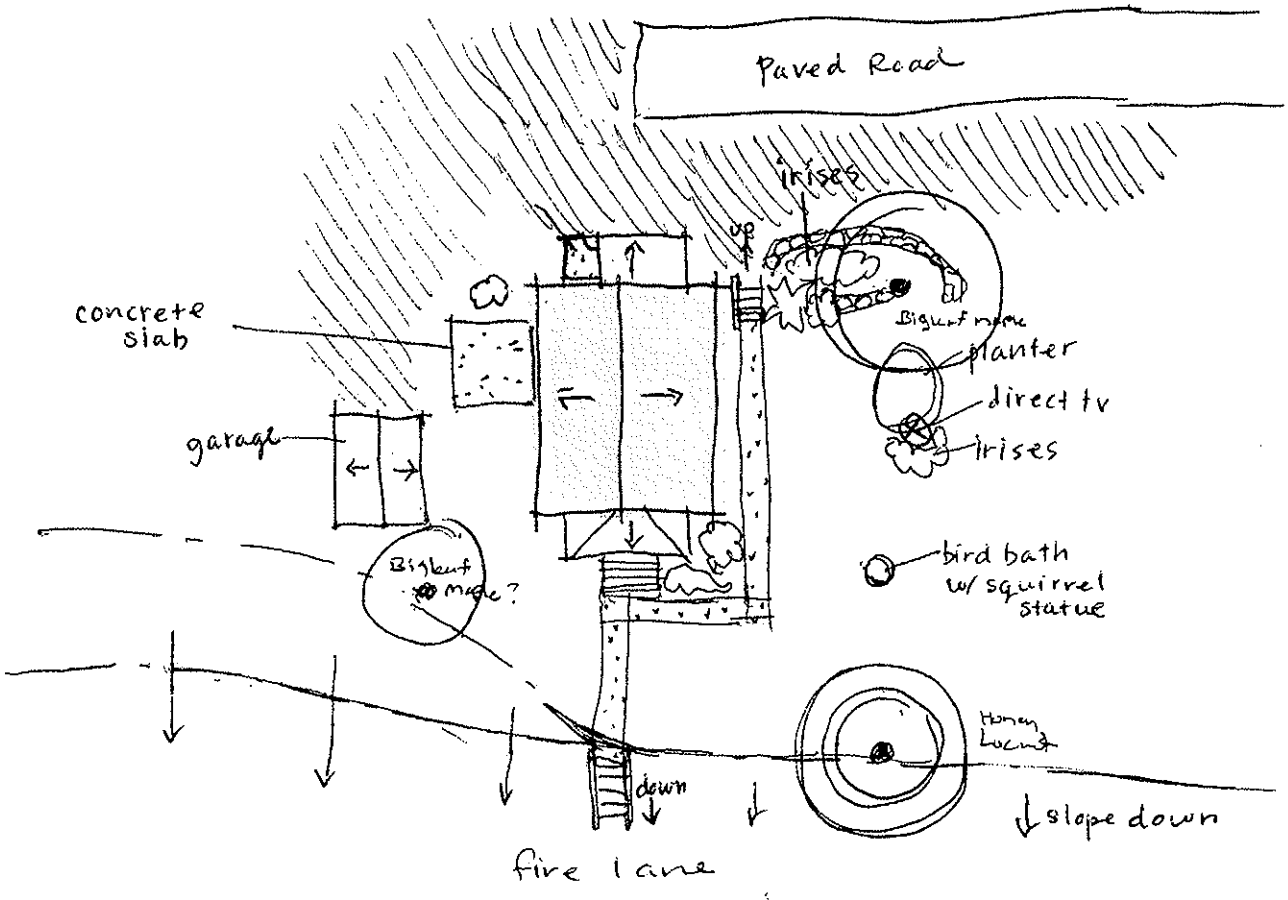
Address/ Bldg. #: 44

INTERIOR	Material	Condition	Integrity
Issues to Consider: EXT Δ Dimensions Ceiling Height Closets / sizes Trim Number of outlets / voltage Heat source Location of rm (1st / 2nd fl) Skylights Ventilation source Fireplace size **Kitchen**	rear porch add-	has vert. wood siding concrete foundation	no
Ceiling			
Floor			
Wall			
Window			
Door			
Cabinet/Millwork			
Fireplace			
Appliances / Fixtures			

PROJECT : 3 LYNX

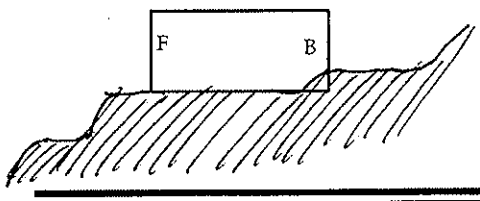
PROCEDURE
1. FILL OUT PROJECT INFO.
2. LOCATE NORTH & LABEL ARROW (CIRCLE IN LOWER RIGHT CORNER).
3. SHOW ROOF FORM.
4. LOCATE LANDSCAPE FEATURES ON SITE PLAN (SEE LIST) WITH DISTANCES.
5. LABEL ALL MATERIALS.
6. DRAW APPROX. SITE SLOPES.

SITE ID: 44
RECORDER: CARIN
DATE: 1 OCT 2001

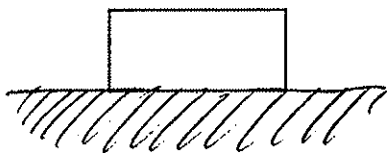


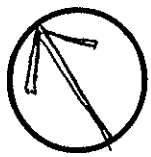
SITE SLOPE:

FRONT TO BACK



SIDE TO SIDE (FACING FRONT FACADE)





PLANTS

TREES, DECIDUOUS ⊙
TREES, EVERGREEN ⊕
SHRUBS

FEATURES

WALKWAY concrete
DRIVEWAY gravel
FENCE/WALLS basalt
ROAD asphalt

ASSOCIATED STRUCTURES

GARAGE/CARPORT
SHEDS

Appendix

Look up dates for Maddins

3 Lynx Visit
10 November 2001
Kate Ryan, Carin Peterson, Anita Washko
(mkr)

On the 10th of November, 2001, we again visited the 3 Lynx site to do additional onsite assessment. Carin and Kate had been on the original trip; Anita had not.

We did a house by house survey, with a list of certain things to assess, but also making note of things we found to be significant. What follows is a summary of this survey. All notations of Right or Left are referenced from the point of view of an observer looking at the front facade of the house.

(POSSIBLY) INTRUSIVE VEGETATION

#2: Ivy on the back porch
Trees close to the right side of the house
#3: Small trees on the left
Tree on the right corner
#4: None
#5: 2 trees close to the right side of the front facade
#6: Garden planted around the sides (non-intrusive)
#7: None
#8: Tree on the left side of the front
#9: Trees close to the front of the house
Shrubs on the right side of the front

#35: Bushes to the left of the porch
#36: Vines on the porch rails
#37: Vines up the back porch
#38: None
#39: None
#40: Bushes along the left side
#41: Porch vines (intrusive but cultivated...)
Small shrubs
#42: Vines on the sides of the house
#44: None

VENTILATION-- LOCATION OF VENTS

#2 Roof- rear and front
#3 Roof- rear and front
#4 Roof- rear and front
#5 Roof- rear and front

Dryer vent - left

#6 Roof- rear and front

#7 Roof- rear and front
Wall vents under window on the right
Dryer vent on the right
Porch skirt - drilled holes

#8 Roof- rear and front
Above boarded up bathroom window, left side

#9 Roof- rear and front

#35 Roof- rear and front

#36 Roof- rear and front
Dryer vent - left
Pipe left of peak roof vent in rear of house
2 vents on the right, directly above the back porch shed roof

#37 Roof- rear and front

#38 Roof- rear and front

#39 Roof- rear and front
Dryer vent - left

#40 Roof- rear and front
Wall vents, left and right sides

#41 Roof- rear and front
Modern square vent near foundation on left side, rear corner

#42 Roof- rear and front

#44 Roof- rear and front
To right of gable end, front

STORMS/SCREENS/HOOKS (WINDOWS)

#2 some metal inset screens
hooks

#3 no

#4 hooks
some metal inset screens

#5 some metal inset screens
hooks - right

#6 no

#7 hooks

#8 some metal inset screens
hooks

#9 new hooks

#35 hooks
#36 no
#37 windows boarded up
#38 hooks
original screens: bath, right side front window
#39 plastic screwed in storms on kitchen and bath
#40 wingnut hooks
#41 hooks
kitchen screen - orig?
#42 wooden tabs - right
screen on porch
#44 screens
bracket hooks

DOOR SCREENS

#2 rear: metal (alum?) w/ scroll details
#3 rear: metal (alum?) w/ scroll details
#4 rear: metal (alum?)
#5 front: metal (alum?) w/ scroll details
rear: metal (alum?)
#6 rear: metal (alum?)
#7 rear: metal
front: metal
#8 rear: metal (alum?) w/ scroll details
front: metal (alum?) w/ scroll details
#9 rear: metal

Rear screens - all trads, metal
scroll 2, 3, 5, 8
non 4, 6, 7, 9
front - 5, 7, 8

#35 rear: wood
#36 front: metal (alum?) w/ scroll details
#37 boarded up
#38 rear: wood
#39 rear: wood
front: metal
#40 rear: wood
front: metal
#41 front: metal (alum?) w/ scroll details
#42 front: metal (alum?) w/ scroll details
#44 front: metal

Rear - wood 35, 38, 39, 40
metal scroll] none
non
Front metal scroll 36, 41, 42
non 39, 40, 44

BARE WOODEN FLOORS?

#2 occupied
#3 occupied
#4 occupied
#5 occupied
#6 storage: yes (kitchen linol.)
#7 occupied
#8 occupied
#9 occupied

#35 some
#36 no
#37 boarded up
#38 yes
#39 no
#40 dining and living rooms
#41 occupied
#42 blinds on windows - occupied?
#44 unknown occupied.

ORIGINAL PORCH LIGHTING FIXTURES
(note: Aladdin houses have wall bracket next to door. Traditional houses have ceiling fixtures)

#35 maybe original bracket?
#36 maybe original bracket?
#37 maybe original bracket?
#38 maybe original bracket?
#39 maybe original bracket?
#40 maybe original bracket?
#41 maybe original bracket?
#42 maybe original bracket?
#44 maybe original bracket?

CHIMNEY FLUE (METAL)

#2 yes
#3 yes
#4 yes
#5 yes
#6 no

#7 yes
#8 yes
#9 yes

#35 no
#36 no chimney above roofline
#37 no
#38 no
#39 yes
#40 no
#41 yes
#42 no
#44 did not record

OTHER NOTES BY HOUSE NUMBER: (note: not in numerical order)

39 HOUSE WE STAYED IN
Down has leak at bend
Gutters need to be cleaned

40 BLUE HOUSE WE STAYED IN
possibly original toilet
jerry-rigged back porch - enclosed - 2, 6-pane sash side by side.
cabinets opposite screen door. 67.5" x 44", not including 20" deep cabinets
one thermostat
BASEMENT:
no hooks on basement windows
posted furnace directions - westco - clean air filter
oil motor
clean strainer
ducts, pipes and hot water heater are uninsulated
many webs in basement ceiling
left side crawl space under front porch
missing piece on back porch down -- drains to ground
ATTIC
no vapor barrier
wool insulation approx. 5 in deep
2x4 rafters
no musty scent
no efflorescence on chimney
many recently dead birds in attic

hole in rear wall above porch - knot - possible bird entry to attic

41 gutter falling
plywood deck
enclosed back porch

42 corroded down on right side, front
all trim missing from wood porch columns
plywood deck
deck missing front rail slats
has door to porch crawl space
back porch like #40

44 CONTRACTOR ALADDIN
siding - some replaced? different paint colours

3 ACCESSIBLE HOUSE
much moss on roof

5 surrounds on left side windows are stripped of paint

37 FALLING DOWN HOUSE
missing siding shows proof of building paper use
NO back porch
roof material -- asphalt? but not shingles

7 signs of moisture issues in and around bathroom - right side
paint bubbles under bathroom window
shower dripping out window down exterior wall
trash bag "storm" on foundation window - left side rear
ladder attached to left side of roof, front of chimney

8 moss on roof
ladder attached to left side of roof, front of chimney
completely missing foundation window, left side rear (frame gone)
plastic on right porch window, all right side windows

9 plastic on porch windows, right side front window
gutters need to be cleaned
discontinuous down on left side of front window

6 STORE HOUSE__ TRAD
some wooden screens upstairs (inside house)

musty smell in back porch and downstairs in general
bath - corner sink (orig?), original tub, painted brown
bumpout closet in front right bedroom -- recent plywood interior, doors
original kitchen cabinets?
PORCH
redone porch - untreated/paint/stain/etc -
vaguely in manner of typical traditional porch, but not quite
constructed with screws??

35 STORE HOUSE _ ALADDIN
four boarded up foundation holes - window sized
original back porch?
musty smelling
shag carpet - yellow in living room
green in bedrooms
stove pipe cover in kitchen - moisture damage to wall along chimney
no bathroom window -- plastic tub unit - sided over on ext
no sink or toilet
mildew on walls in living room and kitchen
efflorescence on chimney in basement
contains some orig. varnished doors - no hardware
some hardware, medicine cabinet
some possible storms

38
water damage in kitchen - chimney/stovepipe
boarded up basement windows
wood column damage
metal flashing on roof edge not pointed into wooden gutter

36 COOK HOUSE
musty smell in porch - chemicals??

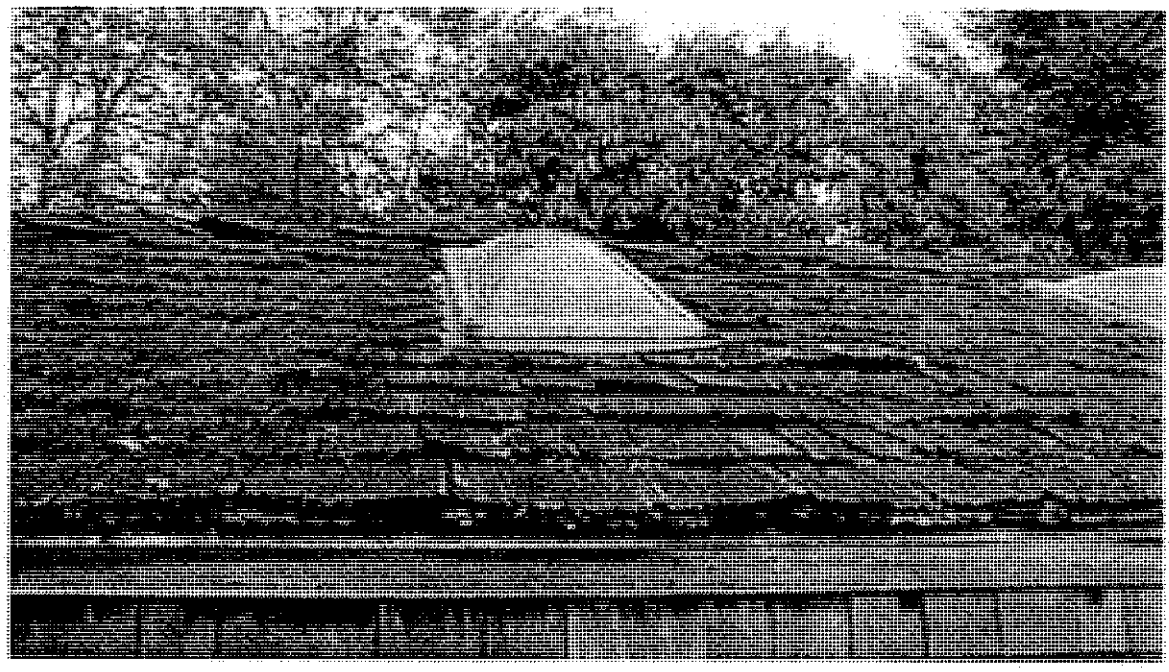
ISSUES TO ADDRESS FOR ALL HOUSES

satellite dish placement
gutter cleaning
seal around wood bin cover
leaves along foundation
moss on roof

Chemical Moss Control for Roofs, Decks, and Sidewalks

Zinc strips | Potassium salts | zinc sulfate | zinc chloride | zinc-copper | bleach

Zinc Strips



General Information: Zinc strips are usually considered the long-term solution to controlling mosses (see photo at right: skylights are surrounded by galvanized flashing that has suppressed the growth of mosses below the skylights. The remaining parts of this cedar shake roof are covered mainly with the moss *Dicranoweisia*.). Zinc strips are relatively safe and inexpensive. They effectively kill or retard the growth of mosses and fungi and appear to have effect up to 15 feet below the zinc flashing along the length of the flashing. To use: apply the rolled zinc to each side of ridge caps along the roof peaks. Place a nail down each foot of the zinc strip. With each rain zinc is released from the strip and kills the mosses below the strip. For best results remove the existing mosses prior to treatment. Active ingredients include pure metallic zinc. Zinc is the most common product used, however, any galvanized metal (zinc plated) can be used in moss control. One brand is Lilly-Miller Moss - Kil roof strip.

Effectiveness: Zinc strips are considered to be effective for up to one year for most brands. The effect of galvanized flashing (example above) can persist for decades. Success rates vary with severity of moss infection and weather in areas where the moss killer is used. Zinc strips or flashing are most effectively used before mosses are well developed. Physical removal of existing moss followed by installation of zinc strips or flashing is an effective long-term strategy for suppressing moss growth.

Negative Side Effects: If runoff occurs from the zinc flashing to surrounding vegetation and or water supplies contamination may occur. Zinc strips should not be used with strong acids or bases.

ossible Alternatives: Consider physical control.

Potassium salts of fatty acids

General Information: This product is non-staining on most surfaces and is for use on decks, fences, roofs and lawns. This product will not harm bordering plants. This kind of moss killer is formed from naturally occurring, biodegradable fatty acids. It is water based non-corrosive to metals and contains no zinc or iron. This product is available in liquid form in several brands. One brand is Safer Brand for moss and algae. To apply this product, attach bottle to hose and spray liberally over infected area.

Effectiveness: Many people have reported varying degrees of success with the use of potassium salt products. Experimental trials on *Racomitrium* on old asphalt resulted in very little kill, even at concentrations well above the recommended dose (Ash 1999).

Negative Side Effects: Because this product occurs naturally in the environment and is biodegradable the environmental side effects are small. This product is toxic to aquatic invertebrates. Potassium should not be applied directly to water and should not come into contact with water sources.

Possible Alternatives: Before treating mosses one should consider whether it is necessary to treat the mosses or not. Please see our site on whether or not to control mosses as well as the page related to applying bleach to mosses.

Zinc Sulfate

General Information: The active ingredient for some moss killers is zinc sulfate monohydrate usually at concentrations of 99%. One brand name is Moss B Ware. Zinc sulfate will not stain roofs or corrode aluminum and galvanized gutters. To use zinc sulfate one can apply powder directly to moss areas. Powder should be applied thoroughly - up to three pounds for every 600 square feet. For spraying combine three pounds to five gallons of water and apply to 600 square feet. This product needs to be applied on a calm day.

Effectiveness: Powder application has been known to control mosses for two years and spraying application may need to be applied annually. Some roofing companies will guarantee no mosses for up to five years after using this product while treating roofs.

Negative Side Effects: This product is toxic both to fishes and aquatic invertebrates. Zinc sulfate should not be applied to water. If zinc sulfate comes into contact with neighboring plants -harm will occur. Plants and shrubbery should be draped when this chemical is being used.

Possible Alternatives: Though this product is effective in controlling mosses, it is not entirely environmentally safe or smart. Considering the need to control and/or organic chemicals can solve your moss problem without polluting the environment.

Zinc Chloride

General Information: Zinc chloride comes in two different concentrations, 13% and 62%. The 13% concentration can be applied directly to moss without mixing with water. Spray

directly from nozzle six to ten inches away from target. Make sure to wet the area thoroughly. The 62% concentration needs to be mixed with water before applying to an affected area. Mix one pint of concentration to three gallons of water. Using a backpack sprayer, use one gallon for every 100 sq ft. Zinc chloride should be applied just prior to fall rains or in the early spring.

Effectiveness: Zinc chloride is effective in controlling mosses from one year up to five years. Increased application concentrations may be needed in areas of higher moss concentration.

Negative Side Effects: Avoid drift and runoff when using this product. Zinc chloride will effect other plants and lawns. Application should only take place when air is still and when no rain is expected within 24 hours. Zinc chloride is corrosive and should not be used when copper fixtures are present. This product is toxic to fishes and aquatic invertebrates. Avoid contaminating water sources with zinc chloride. If zinc chloride comes into contact with a painted area damage is possible.

Possible Alternatives: Considering the toxicity of this chemical, it may be possible to use a less corrosive; dangerous product on your moss infected area. Please see other chemicals on this web site as well as our reasons to control or not site.

Zinc - Copper sulfate mix

General Information: Zinc and Copper sulfate comes dry, but can be applied as a powder or mixed with water. This product reacts electrolytically with water to stimulate a slow release reaction. Zinc and copper sulfate will not stain patios, decks, walls, walkways, buildings or roofs. However, zinc and copper sulfate may react with red bricks. This product is not harmful to lawns, ornamental shrubs, trees, turf or other vegetation such as flowers and vegetation. To apply simply sprinkle areas thoroughly with powder when it is wet, either after a rain or when early morning dew is present. Do not use this product in high wind. For spray application a wet applicator may need to be purchased one brand is Security brand. Apply one pound of moss killer to 1000 sq ft. This product may be applied anytime during the year, but should not be applied while it is raining. Since this product specializes in the slow release reaction; allow plenty of time for the chemical to act. This product is corrosive and should not be used if copper fixtures are present.

Effectiveness: Applications of zinc and copper sulfate usually last for up to one year depending on the concentrations of moss. Annual application is generally needed.

Negative Side Effects: Though this product is generally safe for surrounding plants, it is toxic to fishes and aquatic invertebrates. Do not apply this product to water or let the product come into contact with water sources. When applying this product or any product to rooftops it is essential to avoid runoff. Collecting the runoff in a fashioned trap would greatly reduce the negative effects on the environment.

Possible Alternatives: This chemical is one of the better chemicals to use when considering

the environment; however, deciding to control is still a good question to consider.

Bleach

General Information: Chlorine bleach (sodium hypochlorite) can be used on a number of surfaces contaminated with mosses including decks, patios, walks and roofs. When used to proper concentrations bleach is non corrosive to metals and will not stain treated areas. One should, however, avoid contact with clothing. Brand names of bleach especially for mosses can be found in the moss control area in garden centers - one brand is 30seconds brand. To apply bleach mix one part water with one part concentrate. Use a backpack sprayer and spray liquid to dry area infected with mosses. Keep surface wet for at lease 30 seconds. After finishing application rinse thoroughly with water. If applying to wood keep wet for at least 15 minutes. An alternative to this concentration is to use four times the water. When applying one will need to keep the surface wet for four times as long. This concentration will cover 600 sq ft on porous surfaces or 1800 sq ft on non-porous surfaces.

Effectiveness: Bleach applications remain effective for up to one year, but annual applications are usually necessary.

Negative Side Effects: Bleach at these concentrations will be toxic to plants if left on for more than ten minutes. After ten minutes, burning to plant will occur. Since this product is toxic to fishes and aquatic invertebrates contact with water sources should be avoided.

Possible Alternatives: Bleach is a good alternative to some of the other chemicals listed at this site. Bleach is less toxic to plants and aquatic ecosystems than other chemicals listed. Additionally, one could consider not controlling the mosses at all.

Federal Emergency Management Agency

MITIGATION

REDUCING RISK THROUGH MITIGATION

Protecting Your Property from Earthquake...

Are You At Risk?

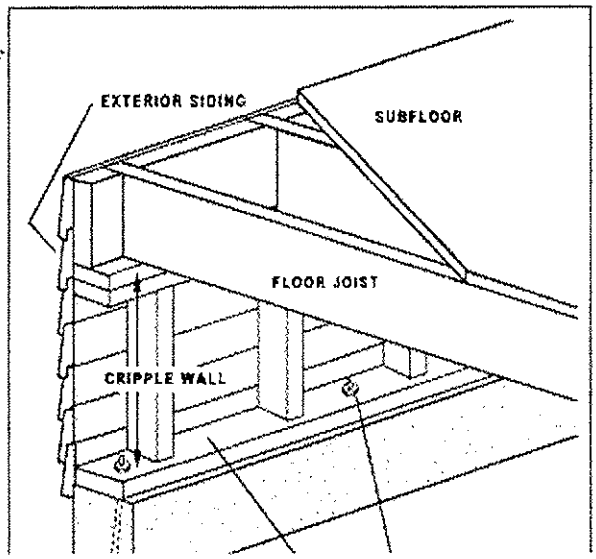
If you aren't sure whether your house is at risk from earthquakes, check with your local building official, city engineer, or planning and zoning administrator. They can tell you whether you are in an earthquake hazard area. Also, they usually can tell you how to protect yourself and your house and property from earthquakes.

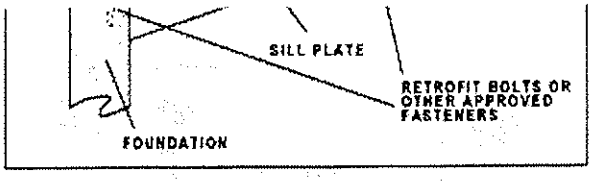
What You Can Do

Earthquake protection can involve a variety of changes to your house and property -- changes that can vary in complexity and cost. You may be able to make some types of changes yourself. But complicated or large-scale changes and those that affect the structure of your house or its electrical wiring and plumbing should be carried out only by a professional contractor licensed to work in your state, county, or city. One example of earthquake protection is bolting the sill plates of your house to its foundation to increase structural stability. This is something that only a licensed contractor should do.

Bolt Sill Plates to Foundation

As shown in the figure, the sill plate of a house rests directly on top of the foundation. (This figure shows the sill plate for a house built on a cripple wall and crawl space foundation, a type of construction that is especially susceptible to earthquake damage.) If the sill plate is not securely





anchored, an earthquake can cause it to shift on the foundation. When this occurs, there is a greater potential for severe damage as well as injury to you and members of your family.

One way to increase the stability of your house and reduce earthquake damage is to have the sill plate bolted or otherwise anchored to the foundation. In the method shown in the figure, bolts long enough to pass through the sill plate and penetrate several inches into the foundation are installed every few feet along the base of the exterior walls. This method is not limited to cripple wall construction; it can also be used for a house built on a basement or slab-on-grade foundation or on another type of crawl space foundation.

Tips

Keep these points in mind when you have the sill plates bolted to the foundation:

- Modifications to the foundation of your house must be done by a licensed contractor, who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.
- Bolts are usually installed no more than 6 feet apart. The work involved is likely to be extensive and may require that portions of the walls or floor be cut away temporarily.
- Your contractor may be able to recommend an alternative anchoring method based on other approved fasteners or connectors that can be installed with fewer changes to your house and less work.
- If your house is built on cripple walls, you should consider bracing them after the sill plates are bolted. For more information, refer to the separate earthquake protection fact sheet titled Brace Cripple Walls.

Estimated Cost

Having a contractor bolt the sill plates to the foundation will cost you about $50 to $75 per bolt, depending on the type of foundation you have. For example, a house measuring 60 feet by 30 feet, will have a perimeter of 180 feet and would therefore require a minimum of 30 bolts (if the bolts are placed no more than 6 feet

apart). So the cost for that house would be about $1,500 to $2,250.

Other Sources of Information

Seismic Retrofit Training for Building Contractors and Building Inspectors: Participant Handbook, FEMA, 1995

Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide, FEMA-74, 1994

Protecting Your Home and Business from Nonstructural Earthquake Damage, FEMA, 1994

To obtain copies of these and other FEMA documents, call FEMA Publications at **1-800-480-2520**. Information is also available on the World Wide Web at http://www.fema.gov.

Updated: July 17, 2001

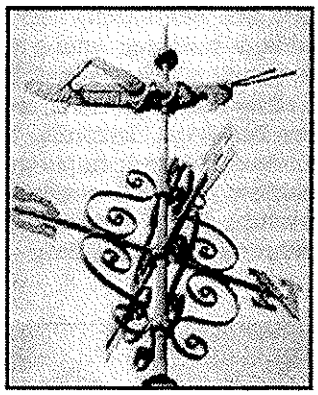
Federal Emergency Management Agency

3 **Preservation Briefs**

Technical Preservation Services

HPS
National Park Service

Conserving Energy in Historic Buildings



Baird M. Smith, AIA

»Inherent Energy Saving Characteristics
»Passive Measures
»Preservation Retrofitting
»Retrofitting Measures
»Mechanical Equipment
»Summary
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With the dwindling supply of energy resources and new efficiency demands placed on the existing building stock, many owners of historic buildings and their architects are assessing the ability of these buildings to conserve energy with an eye to improving thermal performance. This brief has been developed to assist those persons attempting energy conservation measures and weatherization improvements such as adding insulation and storm windows or caulking of exterior building joints. In historic buildings, many measures can result in the inappropriate alteration of important architectural features, or, perhaps even worse, cause serious damage to the historic building materials through unwanted chemical reactions or moisture caused deterioration. This brief recommends measures that will achieve the greatest energy savings with the least alteration to the historic buildings, while using materials that do not cause damage and that represent sound economic investments.

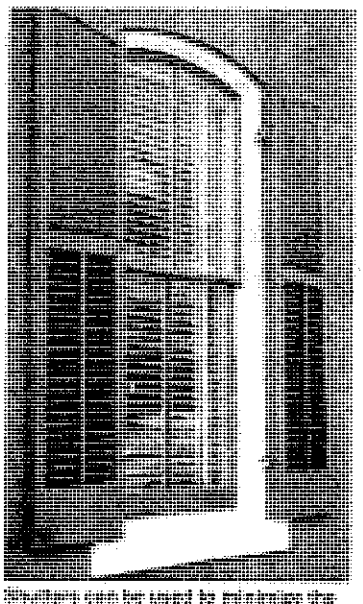
Inherent Energy Saving Characteristics of Historic Buildings

Many historic buildings have energy saving physical features and devices that contribute to good thermal performance. Studies by the Energy Research and Development Administration (see bibliography) show that the buildings with the poorest energy efficiency are actually those built between 1940 and 1975.

Older buildings were found to use less energy for heating and cooling and hence probably require fewer weatherization improvements. They use less energy because they were built with a well-developed sense of physical comfort and because they maximized the natural sources of heating, lighting and ventilation. The historic building owner should understand these inherent energy-saving qualities.

The most obvious (and almost universal) inherent energy saving characteristic was the use of operable windows to provide natural ventilation and light. In addition, historic commercial and public buildings often include interior light/ventilation courts, rooftop ventilators, clerestories or skylights. These features provide energy efficient fresh air and light, assuring that energy consuming mechanical devices may be needed only to supplement

the natural energy sources. Any time the mechanical heating and air conditioning equipment can be turned off and the windows opened, energy will be saved.



Shutters can be used to minimize the problem of summer heat gain by shading the windows. Photo: NPS files.

Early builders and architects dealt with the poor thermal properties of windows in two ways. First, the number of windows in a building was kept to only those necessary to provide adequate light and ventilation. This differs from the approach in many modern buildings where the percentage of windows in a wall can be nearly 100%. Historic buildings where the ratio of glass to wall is often less than 20%, are better energy conservers than most new buildings. Secondly, to minimize the heat gain or loss from windows, historic buildings often include interior or exterior shutters, interior venetian blinds, curtains and drapes, or exterior awnings. Thus, a historic window could remain an energy efficient component of a building.

This 19th c. building in Massachusetts employed several energy-conserving features in its historic design, including shade trees, roof overhangs, awnings and shutters. Photo: HABS collection, NPS.

There are other physical characteristics that enable historic buildings to be energy efficient. For instance, in the warmer climates of the United States, buildings were often built to minimize the heat gain from the summer sun. This was accomplished by introducing exterior balconies, porches, wide roof overhangs, awnings and shade trees. In addition, many of these buildings were designed with the living spaces on the second floor to catch breezes and to escape the radiant heat from the earth's surface. Also, exterior walls were often painted light colors to reflect the hot summer sun, resulting in cooler interior living spaces.

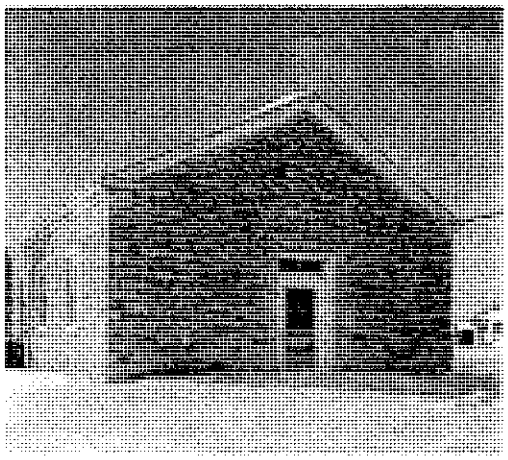
Winter heat loss from buildings in the northern climates was reduced by using heavy masonry walls, minimizing the number and size of windows, and often using dark paint colors for the exterior walls. The heavy masonry walls used so typically in the late 19th century and early 20th century, exhibit characteristics that improve their thermal performance beyond that formerly recognized. It has been determined that walls of large mass and weight (thick brick or stone) have the advantage of high thermal inertia, also known as the "M factor." This inertia modifies the thermal resistance (R factor) (1) of the wall by lengthening the time scale of heat transmission. For instance, a wall with high thermal inertia, subjected to solar radiation for an hour, will absorb the heat at its outside surface, but transfer it to the interior over a period as long as 6 hours. Conversely, a wall having the same R factor, but low thermal inertia, will transfer the heat in perhaps 2 hours.

High thermal inertia is the reason many older public and commercial buildings, without modern air conditioning, still feel cool on the inside throughout the summer. The heat from the midday sun does not penetrate the buildings until late afternoon and evening, when it is unoccupied.

Although these characteristics may not typify all historic buildings, the point is that historic buildings often have thermal properties that need little improvement. One must understand the inherent energy saving qualities of a building, and assure, by

reopening the windows for instance, that the building functions as it was intended.

To reduce heating and cooling expenditures there are two broad courses of action that may be taken. First, begin passive measures to assure that a building and its existing components function as efficiently as possible without the necessity of making alterations or adding new materials. The second course of action is preservation retrofitting, which includes altering the building by making appropriate weatherization measures to improve thermal performance. Undertaking the passive measures and the preservation retrofitting recommended here could result in a 50% decrease in energy expenditures in historic buildings.



Heavy masonry walls and few windows serve to maximize warmth inside. Photo: HABS collection, NPS.

Passive Measures

The first passive measures to utilize are operational controls; that is, controlling how and when a building is used. These controls incorporate programmatic planning and scheduling efforts by the owner to minimize usage of energy-consuming equipment. A building should survey and quantify all aspects of energy usage, by evaluating the monies expended for electricity, gas, and fuel oil for a year and by surveying how and when each room is used. This will identify ways of conserving energy by initiating operational controls such as:

- lowering the thermostat in the winter, raising it in the summer
- controlling the temperature in those rooms actually used
- reducing the level of illumination and number of lights (maximize natural light)
- using operable windows, shutters, awnings and vents as originally intended to control interior environment (maximize fresh air)
- having mechanical equipment serviced regularly to ensure maximum efficiency
- cleaning radiators and forced air registers to ensure proper operation

The passive measures outlined above can save as much as 30% of the energy used in a building. They should be the first undertakings to save energy in any existing building and are particularly appropriate for historic buildings because they do not necessitate building alterations or the introduction of new materials that may cause damage. Passive measures make energy sense, common sense, and preservation sense!

Preservation Retrofitting

In addition to passive measures, building owners may undertake certain retrofitting measures that will not jeopardize the historic character of the building and can be accomplished at a reasonable cost. Preservation retrofitting improves the thermal performance of the building, resulting in another 20%30% reduction in energy.

When considering retrofitting measures, historic building owners should keep in mind that there are no permanent solutions. One can only meet the standards being applied today with today's materials and techniques. In the future, it is likely that the standards and the technologies will change and a whole new retrofitting plan may be necessary. Thus, owners of historic buildings should limit retrofitting measures to those that achieve reasonable energy savings, at reasonable costs, with the least intrusion or impact on the character of the building. Overzealous retrofitting, which introduces the risk of damage to historic building materials, should not be undertaken.

The preservation retrofitting measures presented here, were developed to address the three most common problems in historic structures caused by some retrofitting actions. The first problem concerns retrofitting actions that necessitated inappropriate building alterations, such as the wholesale removal of historic windows, or the addition of insulating aluminum siding, or installing dropped ceilings in significant interior spaces. To avoid such alterations, refer to the Secretary of the Interior's "Standards for Historic Preservation Projects" which provide the philosophical and practical basis for all preservation retrofitting measures (see last page).

The second problem area is to assure that retrofitting measures do not create moisturerelated deterioration problems. One must recognize that large quantities of moisture are present on the interior of buildings.

In northern climates, the moisture may be a problem during the winter when it condenses on cold surfaces such as windows. As the moisture passes through the walls and roof it may condense within these materials, creating the potential for deterioration. The problem is avoided if a vapor barrier is added facing in.

In southern climates, insulation and vapor barriers are handled quite differently because moisture problems occur in the summer when the moist outside air is migrating to the interior of the building. In these cases, the insulation is installed with the vapor barrier facing out (opposite the treatment of northern climates). Expert advice should be sought to avoid moisture-related problems to insulation and building materials in southern climates.

The third problem area involves the avoidance of those materials that are chemically or physically incompatible with existing materials, or that are improperly installed. A serious problem exists with certain cellulose insulations that use ammonium or aluminum sulfate as a fire retardant, rather than boric acid which causes no problems. The sulfates react with moisture in the air forming sulfuric acid which can cause damage to most metals (including plumbing and wiring), building stones, brick and wood. In one instance, a metal building insulated with cellulose of this type collapsed when the sulfuric acid weakened the structural connections! To avoid problems such as these, refer to the recommendations provided here, and consult with local officials, such as a building inspector, the better business bureau, or a consumer protection agency.

Before a building owner or architect can plan retrofitting measures, some of the existing physical conditions of the building should be investigated. The basic building components (attic, roof, walls and basement) should be checked to determine the methods of construction used and the presence of insulation. Check the insulation for full coverage and whether there is a vapor barrier. This inspection will aid in determining the need for additional insulation, what type of insulation to use (batt, blownin, or poured), and where to install it. In addition, sources of air infiltration should be checked at doors, windows, or where floor and ceiling systems meet the walls. Last, it is important to check the condition of the exterior wall materials, such as painted wooden siding or brick, and the condition of the roof, to determine the weather tightness of the building. A building owner must assure that rain and snow are kept out of the building before expending money for weatherization improvements.

Retrofitting Measures

The following listing includes the most common retrofitting measures; some measures are highly recommended for a preservation retrofitting plan, but, as will be explained, others are less beneficial or even harmful to the historic building:

- Air Infiltration
- Attic Insulation
- Storm Windows
- Basement and Crawl Space Insulation
- Duct and Pipe Insulation
- Awnings and Shading Devices

- Doors and Storm Doors
- Vestibules
- Replacement Windows
- Wall Insulation--Wood Frame
- Wall Insulation--Masonry Cavity Walls
- Wall Insulation--Installed on the Inside
- Wall Insulation--Installed on the Outside
- Waterproof Coatings for Masonry

The recommended measures to preservation retrofitting begin with those at the top of the list. The first ones are the simplest, least expensive, and offer the highest potential for saving energy. The remaining measures are not recommended for general use either because of potential technical and preservation problems, or because of the costs outweighing the anticipated energy savings. Specific solutions must be determined based on the facts and circumstances of the particular problem; therefore, advice from professionals experienced in historic preservation, such as, architects, engineers and mechanical contractors should be solicited.

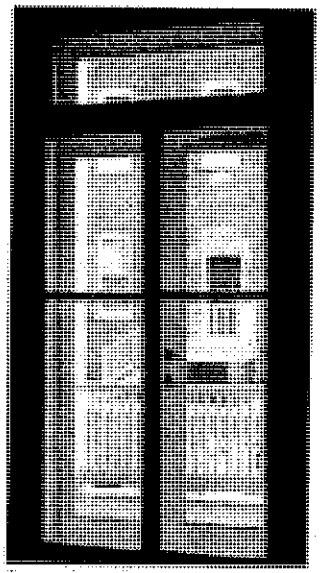
Air Infiltration: Substantial heat loss occurs because cold outside air infiltrates the building through loose windows, doors, and cracks in the outside shell of the building. Adding weatherstripping to doors and windows, and caulking of open cracks and joints will substantially reduce this infiltration. Care should be taken not to reduce infiltration to the point where the building is completely sealed and moisture migration is prevented. Without some infiltration, condensation problems could occur throughout the building. Avoid caulking and weatherstripping materials that, when applied, introduce inappropriate colors or otherwise visually impair the architectural character of the building. Reducing air infiltration should be the first priority of a preservation retrofitting plan. The cost is low, little skill is required, and the benefits are substantial.

Attic Insulation: Heat rising through the attic and roof is a major source of heat loss, and reducing this heat loss should be one of the highest priorities in preservation retrofitting. Adding insulation in accessible attic spaces is very effective in saving energy and is generally accomplished at a reasonable cost, requiring little skill to install. The most common attic insulations include blankets of fiberglass and mineral wool, blownin cellulose (treated with boric acid only), blowing wool, vermiculite, and blown fiberglass. If the attic is unheated (not used for habitation), then the insulation is placed between the floor joists with the vapor barrier facing down. If flooring is present, or if the attic is heated, the insulation is generally placed between the roof rafters with the vapor barrier facing in. All should be installed according to the manufacturer's recommendations. A weatherization manual entitled, "In the Bank . . . or Up the Chimney" (see the bibliography) provides detailed descriptions about a variety of installation methods used for attic insulation. The manual also recommends the amount of attic insulation used in various parts of the country. If the attic has some insulation, add more (but without a vapor barrier) to reach the total depth recommended.

Problems occur if the attic space is not properly ventilated. This lack of ventilation will cause the insulation to become saturated and lose its thermal effectiveness. The attic is adequately ventilated when the net area of ventilation (free area of a louver or vent) equals approximately 1/300 of the attic floor area. With adequate attic ventilation, the addition of attic insulation should be one of the highest priorities of a preservation retrofitting plan.

If the attic floor is inaccessible, or if it is impossible to add insulation along the roof rafters, consider attaching insulation to the ceilings of the rooms immediately below the attic. Some insulations are manufactured specifically for these cases and include a durable surface which becomes the new ceiling. This option should not be considered if it causes irreparable damage to historic or architectural spaces or features; however, in other cases, it could be a recommended measure of a preservation retrofitting plan.

Storm Windows: Windows are a primary source of heat loss because they are both a poor thermal barrier (R factor of only 0.89)



Storm sash have been added on the inside of this historic building as an energy-conserving device. Photo: NPS files.

and often a source of air infiltration. Adding storm windows greatly improves these poor characteristics. If a building has existing storm windows (either wood or metal framed), they should be retained. Assure they are tight fitting and in good working condition. If they are not in place, it is a recommended measure of a preservation retrofitting plan to add new metal framed windows on the exterior. This will result in a window assembly (historic window plus storm window) with an R factor of 1.79 which outperforms a double paned window assembly (with an air space up to 1/2") that only has an R factor of 1.72. When installing the storm windows, be careful not to damage the historic window frame. If the metal frames visually impair the appearance of the building, it may be necessary to paint them to match the color of the historic frame.

Triple-track metal storm windows are recommended because they are readily available, in numerous sizes, and at a reasonable cost. If a preassembled storm window is not available for a particular window size, and a custommade storm window is required, the cost can be very high. In this case, compare the cost of manufacture and installation with the expected cost savings resulting from the increased thermal efficiency. Generally, custom-made storm windows, of either wood or metal frames, are not cost effective, and would not be recommended in a preservation retrofitting plan.

Interior storm window installations can be as thermally effective as exterior storm windows; however, there is high potential for damage to the historic window and sill from condensation. With storm windows on the interior, the outer sash (in this case the historic sash) will be cold in the winter, and hence moisture may condense there. This condensation often collects on the flat surface of the sash or window sill causing paint to blister and the wood to begin to deteriorate. Rigid plastic sheets are used as interior storm windows by attaching them directly to the historic sash. They are not quite as effective as the storm windows described previously because of the possibility of air infiltration around the historic sash. If the rigid plastic sheets are used, assure that they are installed with minimum damage to the historic sash, removed periodically to allow the historic sash to dry, and that the historic frame and sash are completely caulked and weatherstripped.

Vinyl siding has jeopardized the character of this historic office building and is, thus, not a recommended approach. Photo: Mike Jackson.

In most cases, interior storm windows of either metal frames or of plastic sheets are not recommended for preservation retrofitting because of the potential for damage to the historic window. If interior storm windows are in place, the potential for moisture deterioration can be lessened by opening (or removing, depending on the type) the storm windows during the mild months allowing the historic window to dry thoroughly.

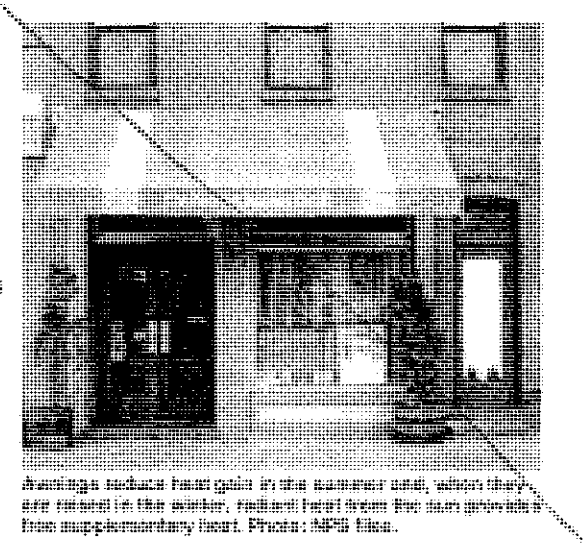
Basement and Crawl Space Insulation: Substantial heat is lost through cold basements and crawl spaces. Adding insulation in these locations is an effective preservation retrofitting measure and should be a high priority action. It is complicated, however, because of the excessive moisture that is often present. One must be aware of this and assure that insulation is properly installed for the specific location. For instance, in crawl spaces and certain unheated basements, the insulation is generally placed between the first floor joists (the ceiling of the basement) with the **vapor barrier facing up**. Do not staple the insulation in place, because the staples often rust away. Use special anchors developed for insulation in moist areas such as these.

In heated basements, or where the basement contains the heating plant (furnace), or where there are exposed water and sewer pipes, insulation should be installed against foundation walls. Begin the insulation within the first floor joists, and proceed down the wall to a point at least 3 feet below the exterior ground level if possible, with the **vapor barrier facing in.** Use either batt or rigid insulation.

Installing insulation in the basement or crawl space should be a high priority of a preservation retrofitting plan, as long as adequate provision is made to ventilate the unheated space, perhaps even by installing an exhaust fan.

Duct and Pipe Insulation: Wrapping insulation around heating and cooling ducts and hot water pipes, is a recommended preservation retrofitting measure. Use insulation which is intended for this use and install it according to manufacturer's recommendations. Note that air conditioning ducts will be cold in the summer, and hence moisture will condense there. Use insulation with the **vapor barrier facing out**, away from the duct. These measures are inexpensive and have little potential for damage to the historic building.

Awnings and Shading Devices: In the past, awnings and trees were used extensively to provide shade to keep buildings cooler in the summer. If awnings or trees are in place, keep them in good condition, and take advantage of their energy-saving contribution. Building owners may consider adding awnings or trees if the summer cooling load is substantial. If awnings are added, assure that they are installed without damaging the building or visually impairing its architectural character. If trees are added, select deciduous trees that provide shade in the summer but, after dropping their leaves, would allow the sun to warm the building in the winter. When planting trees, assure that they are no closer than 10 feet to the building to avoid damage to the foundations. Adding either awnings or shade trees may be expensive, but in hot climates, the benefits can justify the costs.



Awnings reduce heat gain in the summer and, when they are removed in the winter, radiant heat from the sun provides free supplementary heat. Photo: NPS files.

Doors and Storm Doors: Most historic wooden doors, if they are solid wood or paneled, have fairly good thermal properties and should not be replaced, especially if they are important architectural features. Assure that the frames and doors have proper maintenance, regular painting, and that caulking and weatherstripping is applied as necessary.

A storm door would improve the thermal performance of the historic door; however, recent studies indicate that installing a storm door is not normally cost effective in residential settings. The costs are high compared to the anticipated savings. Therefore, storm doors should only be added to buildings in cold climates, and added in such a way to minimize the visual impact on the building's appearance. The storm door design should be compatible with the architectural character of the building and may be painted to match the colors of the historic door.

Vestibules: Vestibules create a secondary air space at a doorway to reduce air infiltration occurring while the primary door is open. If a vestibule is in place, retain it. If not, adding a vestibule, either on the exterior or interior, should be carefully considered to determine the possible visual impact on the character of the building. The energy savings would be comparatively small compared to construction costs. Adding a vestibule should be considered in very cold climates, or where door use is very high, but in either case, the additional question of visual intrusion must be resolved before it is added. For most cases with historic buildings, adding a vestibule is not recommended.

Replacement Windows: Unfortunately, a common weatherization measure, especially in larger buildings, has been the replacement of historic windows with modern double paned windows. The intention was to improve the thermal performance of the existing windows and to reduce

longterm maintenance costs. The evidence is clear that adding exterior storm windows is a viable alternative to replacing the historic windows and it is the recommended approach in preservation retrofitting. However, if the historic windows are severely deteriorated and their repair would be impractical, or economically infeasible, then replacement windows may be warranted. The new windows, of either wood or metal, should closely match the historic windows in size, number of panes, muntin shape, frame, color and reflective qualities of the glass.

Wall Insulation--Wood Frame: The addition of wall insulatihn in a wood frame building is generally not recommended as a preservation retrofitting measure because the costs are high, and the potential for damage to historic building materials is even higher. Also, wall insulation is not particularly effective for small frame buildings (one story) because the heat loss from the uninsulated walls is a relatively small percentage of the total, and part of that can be attributed to infiltration. If, however, the historic building is two or more stories, and is located in a cold climate, wall insulation may be considered if extreme care (as explained later) is exercised with its installation.

The installation of wall insulation in historic frame buildings can result in serious technical and preservation problems. As discussed before, insulation must be kept dry to function properly, and requires a vapor barrier and some provision for air movement. Introducing insulation in wall cavities, without a vapor baruier and some ventilation can be disastrous. The insulation would become saturated, losing its thermal properties, and in fact, actually increasing the heat loss through the wall. Additionally, the moisture (in vapor form) may condense into water droplets and begin serious deterioration of adjacent building materials such as sills, window frames, framing and bracing. The situation is greatly complicated, because correcting such problems could necessitate the complete (and costly) dismantling of the e□terior or interior wall surfaces. It should be clear that adding wall insulation has the potential for causing serious damage to historic building materials.

If adding wall insulation to frame buildings is determined to be absolutely necessary, the first approach should be to consider the careful removal of the exterior siding so that it may later be reinstalled. Then introduce batt insulation with the **vapor barrier facing in** into the now accessible wall cavity. The first step in thns approach is an investigation to determine if the siding can be removed without causing serious damage.

If it is feasible, introducing insulation in this fashion provides the best possible solution to insulating a wall, and provides an excellent opportunity to view most of the structural system for possible hidden structural problems or insect infestations. A building owner should not consider this approach if it would result in substantial damage to or loss of historic wooden siding. Moss siding, however, would probably withstand this method if reasonable care is exercised.

The second possible approach for wall insulation involves injecting or blowing insulation into the wall cavity. The common insulations are the loose fill types that can be blown into the cavity, the poured types, or the injected types such as foam. Obviously a vapor barrier cannot be simultaneously blown into the space. However, an equivalent vapor barrier can be created by assuring that the interior wakl surfaces are covered with an impermeable paint layer. Two layers of oil base paint or one layer of impermeable latex paint constitute an acceptable vapor barrier. Naturally, for this to work, the paint layer must cover all interior surfaces adjacent to the newly installed wall insulation. Special attention should be given to rooms that are major sources of interior moisture--the laundry room, the bathrooms and the kitchen.

In addition to providing a vapor barrier, make provisions for somb air to circulate in the wall cavity to help ventilate the insulation and the wall materials. This can be accomplished in several ways. One method is to install small screened vents (about 2 inches in diameter) at the base of each stud cavity. If this option is taken, the vents should be as inconspicuous as possible. A second venting method can be used where the exterior siding is horizontally lapped. Assure that each piece of siding is separated from the other, allowing some air to pass between thej. Successive exterior paint layers often seal the joint between each piece of siding. Break the paint seal (carefully insert a chisel and twist) between the sections of exterior siding to provide the necessary ventilation for the insulation and wall materials.

With provisions for a vapor barrier (interior paint layer) and wall ventilation (exterior vents) satisfied, the appropriate type of wall insulation may then be selected. There are three recommended types to consider: blown cellulose (with boric acid as the fire retardant), vermiculite, or perlite. Cellulose is the preferred wall insulation because of its higher R factor and its capability to flow well into the various spaces within a wall cavity.

There are two insulation types that are not recommended for wall insulation: ***ureaformaldehyde foams, and cellulose*** which uses aluminum or ammonium sulfate instead of boric acid as a fire retardant. The cellulose treated with the sulfates reacts with moisture in the air and forms sulfuric acid which corrodes many metals and causes building stones to slowly disintegrate. This insulation is not appropriate for use in historic buildings.

Although ureaformaldehyde foams appear to have potential as retrofit materials (they flow into any wall cavity space and have a high R factor) their use is not recommended for preservation retrofitting until some serious problems are corrected. The major problem is that the injected material carries large quantities of moisture into the wall system. As the foam cures, this moisture must be absorbed into the adjacent materials. This process has caused interior and exterior paint to blister, and caused water to actually puddle at the base of a wall, creating the likelihood of serious deterioration to the historic building materials. There are other problems that affect both historic buildings and other existing buildings. Foams are a twopart chemical installed by franchised contractors. To obtain the exact proportion of the two parts, the foam must be mixed and installed under controlled conditions of temperature and humidity. There are cases where the controls were not followed and the foam either cured improperly, not attaining the desired R factor, or the foam continued to emit a formaldehyde smell. In addition, the advertised maximum shrinkage after curing (3%) has been tested and found to be twice as high. Until this material is further developed and the risks eliminated, it is clearly not an appropriate material for preservation retrofitting.

Wall Insulation--Masonry Cavity Walls: Some owners of historic buildings with masonry cavity wall construction have attempted to introduce insulation into the cavity. This is not good practice because it ignores the fact that masonry cavity walls normally have acceptable thermal performance, needing no improvement. Additionally, introducing insulation into the cavity will most likely result in condensation problems and alter the intended function of the cavity. The air cavity acts as a vapor barrier in that moist air passing through the inner wythe of masonry meets the cold face of the outer wythe and condenses. Water droplets form and fall to the bottom of the wall cavity where they are channeled to the outside through weep holes. The air cavity also improves the thermal performance of the wall because it slows the transfer of heat or cold between the two wythes, causing the two wall masses to function independently with a thermal cushion between them.

Adding insulation to this cavity alters the vapor barrier and thermal cushion functions of the air space and will likely clog the weep holes, causing the moisture to puddle at the base of the wall. Also, the addition of insulation creates a situation where the moisture dew point (where moisture condenses) moves from the inner face of the outer wythe, into the outer wythe itself. Thus, during a freeze, this condensation will freeze, causing spalling and severe deterioration. The evidence is clear that introducing insulation, of any type, into a masonry cavity wall is not recommended in a preservation retrofitting plan.

Wall Insulation--Installed on the Inside: Insulation could be added to a wall whether it be wooden or masonry, by attaching the insulation to furring strips mounted on the interior wall faces. Both rigid insulation, usually 1 or 2 inches thick, and batt insulation, generally 3-1/2 inches thick, can be added in this fashion, with the vapor barrier facing in. Extra caution must be exercised if rigid plastic foam insulation is used because it can give off dense smoke and rapidly spreading flame when burned. Therefore, it must be installed with a fireproof covering, usually 1/2-inch gypsum wallboard. Insulation should not be installed on the inside if it necessitates relocation or destruction of important architectural decoration, such as cornices, chair rails, or window trims, or causes the destruction of historic plaster or other wall finishes. Insulation installed in this fashion would be expensive and could only be a recommended preservation retrofitting measure if it is a large building, located in a cold climate, and if the interior spaces and features have little or no architectural significance.

Wall Insulation--Installed on the Outside: There is a growing use of aluminum or vinyl siding installed directly over historic wooden sidings, supposedly to reduce longterm maintenance and to improve the thermal performance of the wall. From a preservation viewpoint, this is a poor practice for several reasons. New siding covers from view existing or potential deterioration problems or insect infestations. Additionally, installation often results in damage or alteration to existing decorative features such as beaded weatherboarding, window and door trim, corner boards, cornices, or roof trim. The cost of installing the artificial sidings compared with the modest increase, if any, in the thermal performance of the wall does not add up to an effective energy-saving measure. The use of artificial siding is not recommended in a preservation retrofitting plan.

Good preservation practice would assure regular maintenance of the existing siding through periodic painting and caulking. Where deterioration is present, individual pieces of siding should be removed and replaced with matching new ones. Refer to the earlier sections of this brief for recommended retrofitting measures to improve the thermal performance of wood frame walls.

Waterproof Coatings for Masonry: Some owners of historic buildings use waterproof coatings on masonry believing it would improve the thermal performance of the wall by keeping it dry (dry masonry would have a better R factor than when wet). Application of waterproof coatings is not recommended because the coatings actually trap moisture within the masonry, and can cause spalling and severe deterioration during a freezing cycle.

In cases where exterior brick is painted, consider continued periodic painting and maintenance, since paints are an excellent preservation treatment for brick. When repainting, a building owner might consider choosing a light paint color in warm climates, or a dark color in cold climates, to gain some advantage over the summer heat gain or winter heat loss, whichever the case may be. These colors should match those used historically on the building or should match colors available historically.

Mechanical Equipment

A detailed treatise of recommended or not recommended heating or air conditioning equipment, or of alternative energy sources such as solar energy or wind power, is beyond the scope of this brief. The best advice concerning mechanical equipment in historic buildings is to assure that the existing equipment works as efficiently as possible. If the best professional advice recommends replacement of existing equipment, a building owner should keep the following considerations in mind. First, as technology advances in the coming years, the equipment installed now will be outdated rapidly relative to the life of the historic building. Therefore, it may be best to wait and watch, until new technologies (such as solar energy) become more feasible, efficient, and inexpensive. Secondly, do not install new equipment and ductwork in such a way that its installation, or possible later removal, will cause irreversible damage to significant historic building materials. The concept of complete invisibility, which necessitates hiding piping and ductwork within wall and floor systems, may not always be appropriate for historic buildings because of the damage that often results. Every effort should be made to select a mechanical system that will require the least intrusion into the historic fabric of the building and that can be updated or altered without major intervention into the wall and floor systems. These points should be considered when weighing the decision to replace a less than efficient exiting system with a costly new system, which may cause substantial damage to the historic building materials and in turn may prove inefficient in the future.

Summary

The primary focus of this brief has been to describe ways to achieve the maximum energy savings in historic buildings without jeopardizing the architectural, cultural and historical qualities for which the properties have been recognized. This can be accomplished through undertaking the

passive measures and the "recommended" preservation retrofitting. Secondly, this brief has emphasized the benefits of undertaking the retrofitting measures in phases so that the actual energy savings anticipated from each retrofitting measure can be realized. Thus, the "not recommended" retrofitting measures, with potential for damage or alteration of historic building materials, would not have to be undertaken, because the maximum feasible savings would have already been accomplished.

Lastly, and perhaps most important, we must recognize that the technologies of retrofitting and weatherization are relatively new. Unfortunately, most current research and product development is directed toward new construction. It is hoped that reports such as this, and the realization that fully 30% of all construction in the United States now involves work on existing buildings, will stimulate the development of new products that can be used with little hesitation in historic buildings. Until that time, owners of historic buildings can undertake the preservation retrofitting measures recommended here and greatly reduce the energy used for heating and cooling, without destroying those historic and architectural qualities that make the building worthy of preservation.

NOTE

(1) R factor is the measure of the ability of insulation to decrease heat flow. The higher the factor, the better the thermal performance of the material.

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This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

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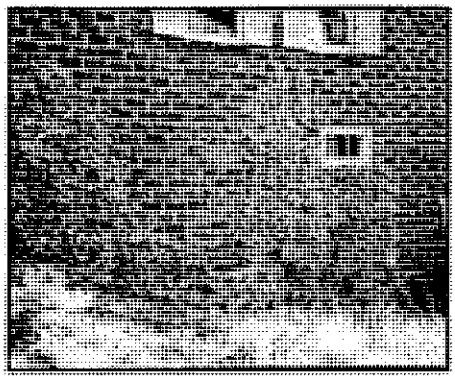
Holding the Line
Controlling Unwanted Moisture in Historic Buildings



Sharon C. Park, AIA

»Remedial Actions
»How and Where to Look for Damaging Moisture
»Looking for Signs
»Uncovering and Analyzing Moisture Problems
»Transport or Movement of Moisture
»Surveying and Diagnosing Moisture Damage
»Selecting an Appropriate Level of Treatment
»Ongoing Care
»Conclusion
»Reading List
»Glossary

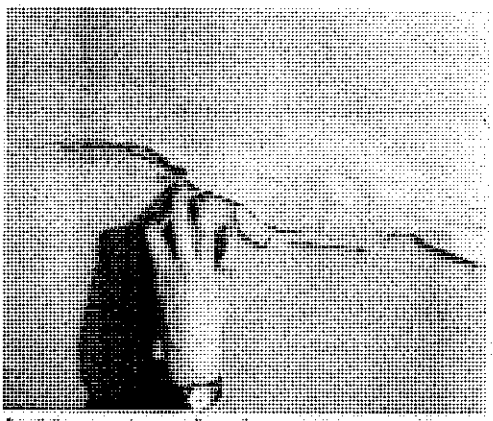
Uncontrolled moisture is the most prevalent cause of deterioration in older and historic buildings. It leads to erosion, corrosion, rot, and ultimately the destruction of materials, finishes, and eventually structural components. Ever-present in our environment, moisture can be *controlled* to provide the differing *levels* of moisture necessary for human comfort as well as the longevity of historic building materials, furnishings, and museum collections. The challenge to building owners and preservation professionals alike is to understand the patterns of moisture movement in order to better manage it-not to try to eliminate it. There is never a single answer to a moisture problem. Diagnosis and treatment will always differ depending on where the building is located, climatic and soil conditions, ground water effects, and local traditions in building construction.

Remedial Actions within an Historic Preservation Context

In this Brief, advice about controlling the sources of unwanted moisture is provided within a preservation context based on philosophical principles contained in the *Secretary of the Interior's Standards for the Treatment of Historic Properties.* Following the Standards means significant materials and features that contribute to the historic character of the building should be preserved, not damaged during remedial treatment.

It also means that physical treatments should be reversible, whenever possible. The majority of treatments for moisture management in this Brief stress preservation maintenance for materials, effective drainage of troublesome ground moisture, and improved interior ventilation.

The Brief encourages a systematic approach for evaluating moisture problems which, in some cases, can be undertaken by a building owner. Because the



Applying a waterproof coating to an aboveground masonry wall can trap moisture underneath, causing further damage to the historic material. Photo: NPS files.

source of moisture can be elusive, it may be necessary to consult with historic preservation professionals prior to starting work that would affect historic materials. Architects, engineers, conservators, preservation contractors, and staff of State Historic Preservation Offices (SHPOs) can provide such advice. Regardless of who does the work, however, these are the principles that should guide treatment decisions:

Avoid remedial treatments without prior careful diagnosis.
Undertake treatments that protect the historical significance of the resource.
Address issues of ground-related moisture and rain run-off thoroughly.
Manage existing moisture conditions before introducing humidified/dehumidified mechanical systems.
Implement a program of ongoing monitoring and maintenance once moisture is controlled or managed.

- Be aware of significant landscape and archeological resources in areas to be excavated.

Finally, mitigating the effects of catastrophic moisture, such as floods, requires a different approach and will not be addressed in this Brief.

How and Where to Look for Damaging Moisture

Finding, treating, and managing the sources of damaging moisture requires a systematic approach that takes time, patience, and a thorough examination of all aspects of the problem-including a series of variable conditions.Moisture problems may be a direct result of one of these factors or may be attributable to a combination of interdependent variables.

Factors Contributing to Moisture Problems

A variety of simultaneously existing conditions contribute to moisture problems in old buildings. For recurring moisture problems, it may be necessary for the owner or preservation professional to address many, if not all, of the following variables:

- Types of building materials and construction systems
- Type and condition of roof and site drainage systems and their rates of discharge
- Type of soil, moisture content, and surface /subsurface water flow adjacent to building
- Building usage and moisture generated by occupancy
- Condition and absorption rates of materials
- Type, operation, and condition of heating, ventilating, cooling, humidification/ dehumidification, and plumbing systems
- Daily and seasonal changes in sun, prevailing winds, rain, temperature, and relative humidity (inside and outside), as well as seasonal or tidal variations in groundwater levels
- Unusual site conditions or irregularities of construction
- Conditions in affected wall cavities, temperature and relative humidity, and dewpoints
- Amount of air infiltration present in a building
- Adjacent landscape and planting materials

Diagnosing and treating the cause of moisture problems requires looking at both the localized decay, as well as understanding the performance of the entire building and site. Moisture is notorious for

traveling far from the source, and moisture movement within concealed areas of the building construction make accurate diagnosis of the source and path difficult. Obvious deficiencies, such as broken pipes, clogged gutters, or cracked walls that contribute to moisture damage, should always be corrected promptly. For more complicated problems, it may take several months or up to four seasons of monitoring and evaluation to complete a full diagnosis. Rushing to a solution without adequate documentation can often result in the unnecessary removal of historic materials-and worse-the creation of long-term problems associated with an increase, rather than a decrease, in the unwanted moisture.

Debris will impede the normal flow of water from the roof's gutter and downspout system to the ground and result in moisture problems. Photo: NPS files.

Looking for Signs

Identifying the type of moisture damage and discovering its source or sources usually involves the human senses of sight, smell, hearing, touch, and taste combined with intuition. Some of the more common signs of visible as well as hidden moisture damage, include:

- Presence of standing water, mold, fungus, or mildew
- Wet stains, eroding surfaces, or efflorescence (salt deposits) on interior and exterior surfaces
- Flaking paint and plaster, peeling wallpaper, or moisture blisters on finished surfaces
- Dank, musty smells in areas of high humidity or poorly ventilated spaces
- Rust and corrosion stains on metal elements, such as anchorage systems and protruding roof nails in the attic
- Cupped, warped, cracked, or rotted wood
- Spalled, cracked masonry or eroded mortar joints
- Faulty roofs and gutters including missing roofing slates, tiles, or shingles and poor condition of flashing or gutters
- Condensation on window and wall surfaces
- Ice dams in gutters, on roofs, or moisture in attics

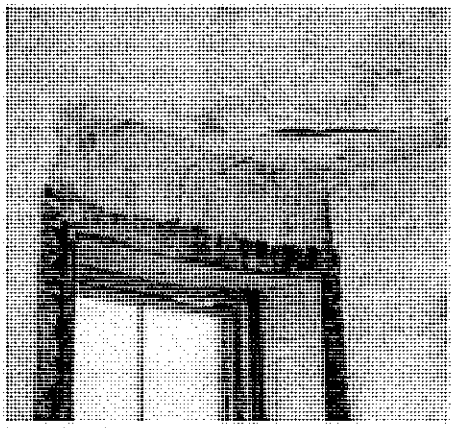
Uncovering and Analyzing Moisture Problems

Moisture comes from a variety of external sources. Most problems begin as a result of the weather in the form of rain or snow, from high ambient relative humidity, or from high water tables. But some of the most troublesome moisture damage in older buildings may be from internal sources, such as leaking plumbing pipes, components of heating, cooling, and climate control systems, as well as sources related to use or occupancy of the building. In some cases, moisture damage may be the result of poorly designed original details, such as projecting outriggers in rustic structures that are vulnerable to rotting, and may require special treatment. The five most common sources of unwanted moisture include:

- Above grade exterior moisture entering the building
- Below grade ground moisture entering the building
- Leaking plumbing pipes and mechanical equipment
- Interior moisture from household use and climate control systems
- Water used in maintenance and construction materials.

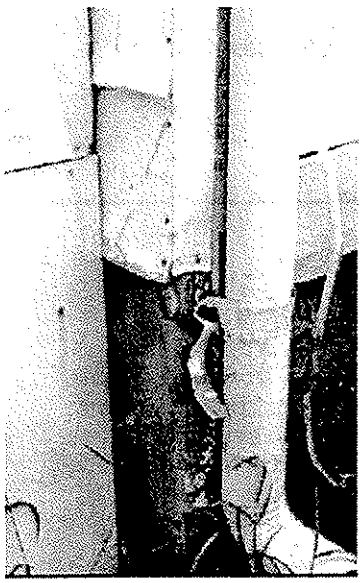
Above grade exterior moisture generally results from weather related moisture entering through deteriorating materials as a result of deferred maintenance, structural settlement cracks, or damage from high winds or storms. Such sources as faulty roofs, cracks in walls, and open joints around window and door openings can be corrected

through either repair or limited replacement. Due to their age, historic buildings are notoriously "drafty," allowing rain, wind, and damp air to enter through missing mortar joints; around cracks in windows, doors, and wood siding; and into uninsulated attics. In some cases, excessively absorbent materials, such as soft sandstone, become saturated from rain or gutter overflows, and can allow moisture to dampen interior surfaces. Vines or other vegetative materials allowed to grow directly on building materials without trellis or other framework can cause damage from roots eroding mortar joints and foundations as well as dampness being held against surfaces. In most cases, keeping vegetation off buildings, repairing damaged materials, replacing flashings, rehanging gutters, repairing downspouts, repointing mortar, caulking perimeter joints around windows and doors, and repainting surfaces can alleviate most sources of unwanted exterior moisture from entering a building above grade.



Damp interior plaster around windows generally indicates moisture has entered from the outside. Photo: NPS files.

Below grade ground moisture is a major source of unwanted moisture for historic and older buildings. *Proper handling of surface rain run-off is one of the most important measures of controlling unwanted ground moisture.* Rain water is often referred to as "bulk moisture" in areas that receive significant annual rainfalls or infrequent, but heavy, precipitation. For example, a heavy rain of 2" per hour can produce 200 gallons of water from downspout discharge alone for a house during a one hour period. When soil is saturated at the base of the building, the moisture will wet footings and crawl spaces or find its way through cracks in foundation walls and enter into basements. Moisture in saturated basement or foundation walls-also exacerbated by high water tables-will generally rise up within a wall and eventually cause deterioration of the masonry and adjacent wooden structural elements.



A clogged or broken downspout causes the water to pour directly into the ground. NPS files. Photo: NPS files.

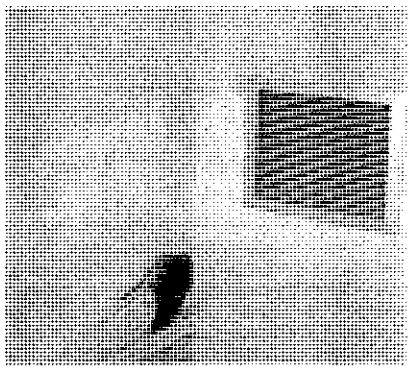
Builders traditionally left a working area, known as a builder's trench, around the exterior of a foundation wall. These trenches have been known to increase moisture problems if the infill soil is less than fully compacted or includes rubble backfill, which, in some cases, may act as a reservoir holding damp materials against masonry walls. Broken subsurface pipes or downspout drainage can leak into the builder's trench and dampen walls some distance from the source. Any subsurface penetration of the foundation wall for sewer, water, or other piping also can act as a direct conduit of ground moisture unless these holes are well sealed. A frequently unsuspected, but serious, modern source of ground moisture is a landscape irrigation system set too close to the building. Incorrect placement of sprinkler heads can add a tremendous amount of moisture at the foundation level and on wall surfaces.

The ground, and subsequently the building, will stay much drier by 1) re-directing rain water away from the foundation through sloping grades, 2) capturing and disposing downspout water well away from the building, 3) developing a controlled ground gutter or effective drainage for buildings historically without gutters and downspouts, and 4) reducing splash-back of moisture onto foundation walls. The excavation of foundations and the use of dampproof coatings and footing drains should only be used after the measures of reducing ground moisture listed above have been implemented.

Leaking plumbing pipes and mechanical equipment can cause immediate or long-term damage to historic building interiors. Routine maintenance, repair, or, if necessary, replacement of older plumbing and mechanical equipment are common solutions. Older water and sewer pipes are subject to corrosion over time. Slow leaks at plumbing joints hidden within walls and ceilings can ultimately rot floor boards, stain ceiling plaster, and lead to decay of structural members.

Frozen pipes that crack can damage interior finishes. In addition to leaking plumbing pipes, old radiators in some historic buildings have been replaced with water-supplied fan coil units which tend to leak. These heating and cooling units, as well as central air equipment, have overflow and condensation pans that require cyclical maintenance to avoid mold and mildew growth and corrosion blockage of drainage channels. Uninsulated forced-air sheet metal ductwork and cold water pipes in walls and ceilings often allow condensation to form on the cold metal, which then drips and causes bubbling plaster and peeling paint. Careful design and vigilant maintenance, as well as repair and insulating pipes or ductwork, will generally rid the building of these common sources of moisture.

Interior moisture from building use and modern humidified heating and cooling systems can create serious problems. In northern U.S. climates, heated buildings will have winter-time relative humidity levels ranging from 10%-35% Relative Humidity (RH). A house with four occupants generates between 10 and 16 pounds of water a day (approximately 1 ½- 2 gallons) from human residents. Moisture from food preparation, showering, or laundry use will produce condensation on windows in winter climates. When one area or floor of a building is air-conditioned and another area is not, there is the chance for condensation to occur between the two areas. Most periodic condensation does not create a long-term problem.



If adequate ventilation is installed, damage to interior walls such as this can be prevented. NPS files.Photo: NPS files.

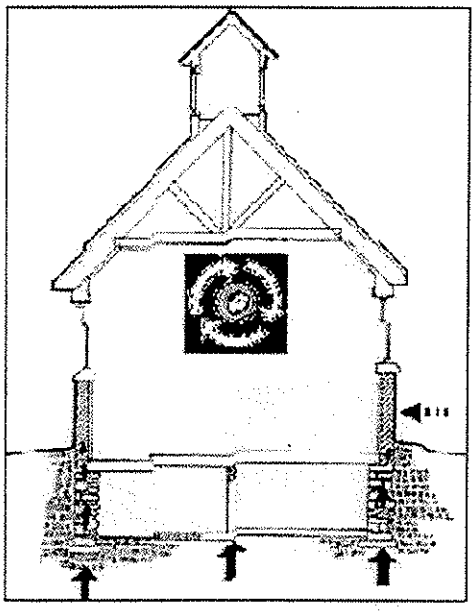
Humidified climate control systems are generally a major problem in museums housed within historic buildings. They produce between 35%-55% RH on average which, as a vapor, will seek to dissipate and equalize with adjacent spaces. Moisture can form on single-glazed windows in winter with exterior temperatures below 30°F and interior temperatures at 70°F with as little as 35% RH. Frequent condensation on interior window surfaces is an indication that moisture is migrating into exterior walls, which can cause long-term damage to historic materials. Materials and wall systems around climate controlled areas may need to be made of moisture resistant finishes in order to handle the additional moisture in the air. Moist interior conditions in hot and humid climates will generate mold and fungal growth. Unvented mechanical equipment, such as gas stoves, driers, and kerosene heaters, generate large quantities of moisture. It is important to provide adequate ventilation and find a balance between interior temperature, relative humidity, and airflow to avoid interior moisture that can damage historic buildings.

Moisture from maintenance and construction materials can cause damage to adjacent historic materials. Careless use of liquids to wash floors can lead to water seepage through cracks and dislodge adhesives or cup and curl materials. High-pressure power washing of exterior walls and roofing materials can force water into construction joints where it can dislodge mortar, lift roofing tiles, and saturate frame walls and masonry. Replastered or newly plastered interior walls or the construction of new additions attached to historic buildings may hold moisture for months; new plaster, mortar, or concrete should be fully cured before they are painted or finished. The use of materials in projects that have been damaged by moisture *prior* to installation or have too high a moisture content may cause concealed damage.

Transport or Movement of Moisture

Knowing the five most common sources of moisture that cause damage to building materials is the first step in diagnosing moisture problems. But it is also important to understand the basic mechanisms that affect moisture movement in buildings. Moisture transport, or movement, occurs in two states: liquid and vapor. It is directly related to pressure differentials. For example, water in a gaseous or vapor state, as warm moist air, will move from its high pressure area to a lower pressure area where the air is cooler and drier. Liquid water will move as a result of differences in hydrostatic pressure or wind pressure. *It is the pressure differentials that drive the rate of moisture migration in either state.* Because the building materials themselves resist this moisture

movement, the rate of movement will depend on two factors: the permeability of the materials when affected by vapor and the absorption rates of materials in contact with liquid.



The dynamic forces that move air and moisture through a building are important to understand, particularly when selecting a treatment to correct a moisture problem. This drawing shows how moisture can invade "inward" from the exterior; "upward" from the ground; and be generated from "within" the interior. All have damaging effects. Drawing: NPS files.

The mechanics, or physics, of moisture movement is complex, but if the driving force is difference in pressure, then an approach to reducing moisture movement and its damage is to reduce the difference in pressure, not to increase it. That is why the treatments discussed in this Brief will look at *managing moisture by draining bulk moisture and ventilating vapor moisture* before setting up new barriers with impermeable coatings or over-pressurized new climate control systems that threaten aging building materials and archaic construction systems.

Three forms of moisture transport are particularly important to understand in regards to historic buildings-*infiltration, capillary action, and vapor diffusion*--remembering, at the same time, that the subject is infinitely complex and, thus, one of continuing scientific study. Buildings were traditionally designed to deal with the movement of air. For example, cupolas and roof lanterns allowed hot air to rise and provided a natural draft to pull air through buildings. Cavity walls in both frame and masonry buildings were constructed to allow moisture to dissipate in the air space between external and internal walls. Radiators were placed in front of windows to keep cold surfaces warm, thereby reducing condensation on these surfaces. Many of these features, however, have been altered over time in an effort to modernize appearances, improve energy efficiency, or accommodate changes in use. The change in use will also affect moisture movement, particularly in commercial and industrial buildings with modern mechanical systems. Therefore, the way a building handles air and moisture today may be different from that intended by the original builder or architect, and poorly conceived changes may be partially responsible for chronic moisture conditions.

Moisture moves into and through materials as both a visible liquid (capillary action) and as a gaseous vapor (infiltration and vapor diffusion). Moisture from leaks, saturation, rising damp, and condensation can lead to the deterioration of materials and cause an unhealthy environment. Moisture in its solid form, ice, can also cause damage from frozen, cracked water pipes, or split gutter seams or spalled masonry from freeze-thaw action. Moisture from melting ice dams, leaks, and condensation often can travel great distances down walls and along construction surfaces, pipes, or conduits. The amount of moisture and how it deteriorates materials is dependent upon complex forces and variables that must be considered for each situation.

Determining the way moisture is handled by the building is further complicated because each building and site is unique. Water damage from blocked gutters and downspouts can saturate materials on the outside, and high levels of interior moisture can saturate interior materials. Difficult cases may call for technical evaluation by consultants specializing in moisture monitoring and diagnostic evaluation. In other words, it may take a team to effectively evaluate a situation and determine a proper approach to controlling moisture damage in old buildings.

Infiltration is created by wind, temperature gradients (hot air rising), ventilation fan action, and the stack or chimney effect that draws air up into tall vertical spaces. Infiltration as a dynamic force does not actually move liquid water, but is the vehicle by which dampness, as a component of air, finds its way into building materials. Older buildings have a natural air exchange, generally from 1 to 4 changes per hour, which, in turn, may help control moisture by diluting moisture within a building. The tighter the building construction, however, the lower will be the infiltration rate and the natural circulation of air. In the process of infiltration, however, moisture that has entered the building and saturated materials can be drawn in and out of materials, thereby

adding to the dampness in the air. Inadequate air circulation where there is excessive moisture (i.e., in a damp basement), accelerates the deterioration of historic materials. To reduce the unwanted moisture that accompanies infiltration, it is best to incorporate maintenance and repair treatments to close joints and weatherstrip windows, while providing controlled air exchanges elsewhere. The worst approach is to seal the building so completely, while limiting fresh air intake, that the building cannot breathe.

Capillary action occurs when moisture in saturated porous building materials, such as masonry, wicks up or travels vertically as it evaporates to the surface. In capillary attraction, liquid in the material is attracted to the solid surface of the pore structure causing it to rise vertically; thus, it is often called "rising damp," particularly when found in conjunction with ground moisture. It should not, however, be confused with moisture that laterally penetrates a foundation wall through cracks and settles in the basement. Not easily controlled, most rising damp comes from high water tables or a constant source under the footing. In cases of damp masonry walls with capillary action, there is usually a whitish stain or horizontal tide mark of efflorescence that seasonally fluctuates about 1- 3 feet above grade where the excess moisture evaporates from the wall. This tide mark is full of salt crystals, that have been drawn from the ground and building materials along with the water, making the masonry even more sensitive to additional moisture absorption from the surrounding air. Capillary migration of moisture may occur in any material with a pore structure where there is a constant or recurring source of moisture. The best approach for dealing with capillary rise in building materials is to reduce the amount of water in contact with historic materials. If that is not possible due to chronically high water tables, it may be necessary to introduce a horizontal damp-proof barrier, such as slate course or a lead or plastic sheet, to stop the vertical rise of moisture. Moisture should not be sealed into the wall with a waterproof coating, such as cement parging or vinyl wall coverings, applied to the inside of damp walls. This will only increase the pressure differential as a vertical barrier and force the capillary action, and its destruction of materials, higher up the wall.

Vapor diffusion is the natural movement of pressurized moisture vapor through porous materials. It is most readily apparent as humidified interior air moves out through walls to a cooler exterior. In a hot and humid climate, the reverse will happen as moist hot air moves into cooler, dryer, air-conditioned, interiors. The movement of the moisture vapor is not a serious problem until the dewpoint temperature is reached and the vapor changes into liquid moisture known as *condensation*. This can occur within a wall or on interior surfaces. Vapor diffusion will be more of a problem for a frame structure with several layers of infill materials within the frame cavity than a dense masonry structure. Condensation as a result of vapor migration usually takes place on a surface or film, such as paint, where there is a change in permeability.

The installation of climate control systems in historic buildings (mostly museums) that have *not* been properly designed or regulated and that force pressurized damp air to diffuse into perimeter walls is an ongoing concern. These newer systems take constant monitoring and back-up warning systems to avoid moisture damage.

Long-term and undetected condensation or high moisture content can cause serious structural damage as well as an unhealthy environment, heavy with mold and mildew spores. Reducing the interior/exterior pressure differential and the difference between interior and exterior temperature and relative humidity helps control unwanted vapor diffusion. This can sometimes be achieved by reducing interior relative humidity. In some instances, using vapor barriers, such as heavy plastic sheeting laid over damp crawl spaces, can have remarkable success in stopping vapor diffusion from damp ground into buildings. Yet, knowledgeable experts in the field differ regarding the appropriateness of vapor barriers and when and where to use them, as well as the best way to handle natural diffusion in insulated walls.

Adding insulation to historic buildings, particularly in walls of wooden frame structures, has been a standard modern weatherization treatment, but it can have a disastrous effect on historic buildings. The process of installing the insulation destroys historic siding or plaster, and it is very difficult to establish a tight vapor barrier. While insulation has the benefit of increasing the efficiency of heating and cooling by containing temperature controlled air, it does not eliminate surfaces on which damaging moisture can condense. For insulated residential frame structures, the most obvious sign of a moisture diffusion problem is peeling paint on wooden siding, even

after careful surface preparation and repainting. Vapor impermeable barriers such as plastic sheeting, or more accurately, *vapor retarders*, in cold and moderate climates generally help slow vapor diffusion where it is not wanted.

In regions where *humidified* climate control systems are installed into insulated frame buildings, it is important to stop *interstitial,* or in-wall, dewpoint condensation. This is very difficult because humidified air can penetrate breaches in the vapor barrier, particularly around electrical outlets. Improperly or incompletely installed retrofit vapor barriers will cause extensive damage to the building, just in the installation process, and will allow trapped condensation to wet the insulation and sheathing boards, corrode metal elements such as wiring cables and metal anchors, and blister paint finishes. Providing a tight wall vapor barrier, as well as a ventilated cavity behind wooden clapboards or siding appears to help insulated frame walls, if the interior relative humidity can be adjusted or monitored to avoid condensation. Correct placement of vapor retarders within building construction will vary by region, building construction, and type of climate control system.

Surveying and Diagnosing Moisture Damage: Key Questions to Ask

It is important for the building to be surveyed first and the evidence and location of suspected moisture damage systematically recorded before undertaking any major work to correct the problem. This will give a baseline from which relative changes in condition can be noted.

When materials become wet, there are specific physical changes that can be detected and noted in a record book or on survey sheets. Every time there is a heavy rain, snow storm, water in the basement, or mechanical systems failure, the owner or consultant should note and record the way moisture is moving, its appearance, and what variables might contribute to the cause. *Standing outside to observe a building in the rain may answer many questions and help trace the movement of water into the building.* Evidence of deteriorating materials that cover more serious moisture damage should also be noted, even if it is not immediately clear what is causing the damage. (For example, water stains on the ceiling may be from leaking pipes, blocked fan coil drainage pans above, or from moisture which has penetrated around a poorly sloped window sill above.) Don't jump to conclusions, but use a systematic approach to help establish an educated theory-or hypothesis-of what is causing the moisture problem or what areas need further investigation.

Surveying moisture damage must be systematic so that relative changes can be noted. Tools for investigating can be as simple as a notebook, sketch plans, binoculars, camera, aluminum foil, smoke pencil, and flashlight. The systematic approach involves looking at buildings from the top down and from the outside to the inside. Photographs, floor plans, site plan, and exterior elevations-even roughly sketched-should be used to indicate all evidence of damp or damaged materials, with notations for musty or poorly ventilated areas. Information might be needed on the absorption and permeability characteristics of the building materials and soils. Exterior drainage patterns should be noted and these base plans referred to on a regular basis in different seasons and in differing types of weather. It is best to start with one method of periodic documentation and to use this same method each time. Because moisture is affected by gravity, many surveys start with the roof and guttering systems and work down through the exterior walls. Any obvious areas of water penetration, damaged surfaces, or staining should be noted. Any recurring damp or stain patterns, both exterior and interior, should also be noted with a commentary on the temperature, weather, and any other facts that may be relevant (driving rains, saturated soil, high interior humidity, recent washing of the building, presence of a lawn watering system, etc.).

The interior should be recorded as well, beginning with the attic and working down to the basement and crawl space. It may be necessary to remove damaged materials selectively in order to trace the path of moisture or to pinpoint a source, such as a leaking pipe in the ceiling. The use of a basic resistance moisture meter, available in many hardware stores, can identify moisture contents of materials and show, over time, if wall surfaces are drying or becoming damper. A

smoke pencil can chart air infiltration around windows or draft patterns in interior spaces. For a quick test to determine if a damp basement is caused by saturated walls or is a result of condensation, tape a piece of foil onto a masonry surface and check it after a day or two; if moisture has developed behind the foil, then it is coming from the masonry. If condensation is on the surface of the foil, then moisture is from the air.

Comparing current conditions with previous conditions, historic drawings, photographs, or known alterations may also assist in the final diagnosis. A chronological record, showing improvement or deterioration, should be backed up with photographs or notations as to the changing size, condition, or features of the deterioration and how these changes have been affected by variables of temperature and rainfall. If a condition can be related in time to a particular event, such as efflorescence developing on a chimney after the building is no longer heated, it may be possible to isolate a cause, develop a hypothesis, and then test the hypothesis (by adding some temporary heat), before applying a remedial treatment. If the owner or consultant has access to moisture survey and monitoring equipment such as resistance moisture meters, dewpoint indicators, salt detectors, infrared thermography systems, psychrometer, fiber-optic boroscopes, and miniaturized video cameras, additional quantified data can be incorporated into the survey. If it is necessary to track the wetting and drying of walls over a period of time, deep probes set into walls and in the soil with connector cables to computerized data loggers or the use of long-term recording of hygrothermographs may require a trained specialist. Miniaturized fiber-optic video cameras can record the condition of subsurface drain lines without excavation. It should be noted, however, that *instrumentation, while extremely useful, cannot take the place of careful personal observation and analysis.* Relying on instrumentation alone rarely will give the owner the information needed to fully diagnose a moisture problem. To avoid jumping to a quick-potentially erroneous-conclusion, a series of questions should be asked first. This will help establish a theory or hypothesis that can be tested to increase the chances that a remedial treatment will control or manage existing moisture.

How is water draining around building and site? What is the effectiveness of gutters and downspouts? Are the slopes or grading around foundations adequate? What are the locations of subsurface features such as wells, cisterns, or drainage fields? Are there subsurface drainage pipes (or drainage boots) attached to the downspouts and are they in good working condition? Does the soil retain moisture or allow it to drain freely? Where is the water table? Are there window wells holding rain water? What is the flow rate of area drains around the site (can be tested with a hose for several minutes)? Is the storm piping out to the street sufficient for heavy rains, or does water chronically back up on the site? Has adjacent new construction affected site drainage or water table levels?

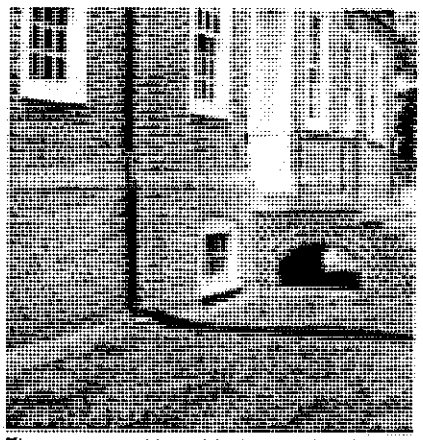
How does water/moisture appear to be entering the building? Have all five primary sources of moisture been evaluated? What is the condition of construction materials and are there any obvious areas of deterioration? Did this building have a builder's trench around the foundation that could be holding water against the exterior walls? Are the interior bearing walls as well as the exterior walls showing evidence of rising damp? Is there evidence of hydrostatic pressure under the basement floor such as water percolating up through cracks? Has there been moisture damage from an ice dam in the last several months? Is damage localized, on one side of the building only, or over a large area?

What are the principal moisture dynamics? Is the moisture condition from liquid or vapor sources? Is the attic moisture a result of vapor diffusion as damp air comes up through the cavity walls from the crawl space or is it from a leaking roof? Is the exterior wall moisture from rising damp with a tide mark or are there uneven spots of dampness from foundation splash back, or other ground moisture conditions? Is there adequate air exchange in the building, particularly in damp areas, such as the basement? Has the height of the water table been established by inserting a long pipe into the ground in order to record the water levels?

How is the interior climate handling moisture? Are there areas in the building that do not appear to be ventilating well and where mold is growing? Are there historic features that once helped the building control air and moisture that can be reactivated, such as operable skylights or windows? Could dewpoint condensation be occurring behind surfaces, since there is often condensation on the windows? Does the building feel unusually damp or smell in an unusual way

that suggest the need for further study? Is there evidence of termites, carpenter ants, or other pests attracted to moist conditions? Is a dehumidifier keeping the air dry or is it, in fact, creating a cycle where it is actually drawing moisture through the foundation wall?

Does the moisture problem appear to be intermittent, chronic, or tied to specific events? Are damp conditions occurring within two hours of a heavy rain or is there a delayed reaction? Does rust on most nail heads in the attic indicate a condensation problem? What are the wet patterns that appear on a building wall during and after a rain storm? Is it localized or in large areas? Can these rain patterns be tied to gutter over-flows, faulty flashing, or saturation of absorbent materials? Is a repaired area holding up well over time or is there evidence that moisture is returning? Do moisture meter readings of wall cavities indicate they are wet, suggesting leaks or condensation in the wall?



The owner used long black extender pipes to test a theory that it was faulty roof drainage causing the problem. Photo: NPS files.

Once a hypothesis of the source or sources of the moisture has been developed from observation and recording of data, it is often useful to prove or disprove this hypothesis with interim treatments, and, if necessary, the additional use of instrumentation to verify conditions. For damp basements, test solutions can help determine the cause. For example, surface moisture in low spots should be redirected away from the foundation wall with regrading to determine if basement dampness improves. If there is still a problem, determine if subsurface downspout collection pipes or cast iron boots are not functioning properly. The above grade downspouts can be disconnected and attached to long, flexible extender pipes and redirected away from the foundation. If, after a heavy rain or a simulation using a hose, there is no improvement, look for additional ground moisture sources such as high water tables, hidden cisterns, or leaking water service lines as a cause of moisture in the basement. New data will lead to a new hypothesis that should be tested and verified. *The process of elimination can be frustrating, but is required if a systematic method of diagnosis is to be successful.*

Selecting an Appropriate Level of Treatment

The treatments that follow this section in chart format are divided into levels based on the degree of moisture problems. Level I covers preservation maintenance; Level II focuses on repair using historically compatible materials and essentially mitigating damaging moisture conditions; and Level III discusses replacement and alteration of materials that permit continued use in a chronically moist environment. It is important to begin with Level I and work through to a manageable treatment as part of the control of moisture problems. Buildings in serious decay will require treatments in Level II, and difficult or unusual site conditions may require more aggressive treatments in Level III. Caution should always be exercised when selecting a treatment. The treatments listed are a guide and not intended to be recommendations for specific projects as the key is always proper diagnosis.

Start with the repair of any obvious deficiencies using sound preservation maintenance. If moisture cannot be managed by maintenance alone, it is important to reduce it by mitigating problems *before* deteriorated historic materials are replaced. Treatments should not remove materials that can be preserved; should not involve extensive excavation unless there is a documented need; and should not include coating buildings with waterproof sealers that can exacerbate an existing problem. Some alteration to historic materials, structural systems, mechanical systems, windows, or finishes may be needed when excessive site moisture cannot be controlled by drainage systems, or in areas prone to floods. These changes, however, should, be sensitive to preserving those materials, features, and finishes that convey the historic character of the building and site.

Level I Preservation Maintenance

Exterior: Apply cyclical maintenance procedures to eliminate rain and moisture infiltration.

Installing ventilating fans can improve damp conditions or reduce cooling loads. Photo: NPS files.

Roofing/ guttering: Make weather-tight and operational; inspect and clean gutters as necessary depending on number of nearby trees, but at least twice a year; inspect roofing at least once a year, preferably spring; replace missing or damaged roofing shingles, slates, or tiles; repair flashing; repair or replace cracked downspouts.

Walls: Repair damaged surface materials; repoint masonry with appropriately formulated mortar; prime and repaint wooden, metal, or masonry elements or surfaces; remove efflorescence from masonry with non-metallic bristle brushes.

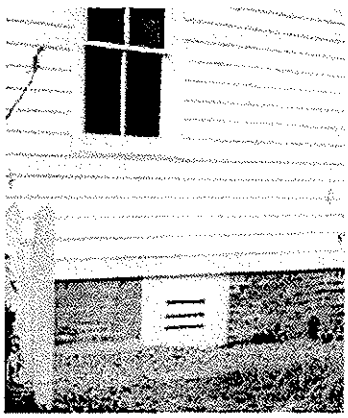
Window and door openings: Eliminate cracks or open joints; caulk or repoint around openings or steps; repair or reset weatherstripping; check flashing; repaint, as necessary.

Ground: Apply regular maintenance procedures to eliminate standing water and vegetative threats to building/site.

Grade: Eliminate low spots around building foundations; clean out existing downspout boots twice a year or add extension to leaders to carry moisture away from foundation; do a hose test to verify that surface drains are functioning; reduce moisture used to clean steps and walks; eliminate the use of chlorides to melt ice which can increase freeze/thaw spalling of masonry; check operation of irrigation systems, hose bib leaks, and clearance of air conditioning condensate drain outlets.

Crawl space: Check crawl space for animal infestation, termites, ponding moisture, or high moisture content; check foundation grilles for adequate ventilation; seasonally close grilles when appropriate-in winter, if not needed, or in summer if hot humid air is diffusing into air conditioned space.

Foliage: Keep foliage and vines off buildings; trim overhanging trees to keep debris from gutters and limbs from rubbing against building; remove moisture retaining elements, such as firewood, from foundations.



A vent may be added if there is none. Close grilles in the summer, if hot

Basements and foundations: Increase ventilation and maintain surfaces to avoid moisture.

Equipment: Check dehumidifiers, sump pump, vent fans, and water detection or alarm systems for proper maintenance as required; check battery back-up twice a year.

Piping/ductwork: Check for condensation on pipes and insulate/seal joints, if necessary.

Interior: Maintain equipment to reduce leaks and interior moisture.

Plumbing pipes: Add insulation to plumbing or radiator pipes located in areas subject to freezing, such as along outside walls, in

humid air is getting into air conditioned spaces. Photo: NPS files.

attics, or in unheated basements.

Mechanical equipment: Check condensation pans and drain lines to keep clear; insulate and seal joints in exposed metal ductwork to avoid drawing in moist air.

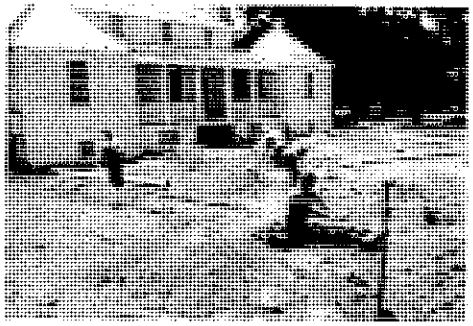
Cleaning: Routinely dust and clean surfaces to reduce the amount of water or moist chemicals used to clean building; caulk around tile floor and wall connections; and maintain floor grouts in good condition.

Ventilation: Reduce household-produced moisture, if a problem, by increasing ventilation; vent clothes driers to the outside; install and always use exhaust fans in restrooms, bathrooms, showers, and kitchens, when in use.

Level II Repair and Corrective Action

Exterior: Repair features that have been damaged. Replace an extensively deteriorated feature with a new feature that matches in design, color, texture, and where possible, materials.

Roofing: Repair roofing, parapets and overhangs that have allowed moisture to enter; add ice and water shield membrane to lower 3-4 feet or roofing in cold climates to limit damage from ice dams; increase attic ventilation, if heat and humidity build-up is a problem. Make gutters slope @ 1/8" to the foot. Use professional handbooks to size gutters and reposition, if necessary and appropriate to historic architecture. Add ventilated chimney caps to unused chimneys that collect rain water.



New drainage systems for roof run-off may be installed in order to remove moisture from the base of the building. Photo: NPS files.

Walls: Repair spalled masonry, terra cotta, etc. by selectively installing new masonry units to match; replace rotted clapboards too close to grade and adjust grade or clapboards to achieve adequate clearance; protect or cover open window wells.

Ground: Correct serious ground water problems; capture and dispose of downspout water away from foundation; and control vapor diffusion of crawlspace moisture.

Grade: Re-establish positive sloping of grade; try to obtain 6" of fall in the first 10' surrounding building foundation; for buildings without gutter systems, regrade and install a positive subsurface collection system with gravel, or waterproof sheeting and perimeter drains; adjust pitch or slope of eave line grade drains or French drains to reduce splash back onto foundation walls; add subsurface drainage boots or extension pipes to take existing downspout water away from building foundation to the greatest extent feasible.

Crawl space: Add polyethylene vapor barrier (heavy construction grade or Mylar) to exposed dirt in crawlspace if monitoring indicates it is needed and there is no rising damp; add ventilation grilles for additional cross ventilation, if determined advisable.

Foundations and Basements: Correct existing high moisture levels, if other means of controlling ground moisture are inadequate.

Mechanical devices: Add interior perimeter drains and sump pump; add dehumidifiers for seasonal control of humidity in confined, unventilated space (but don't create a problem with pulling dampness out of walls); add ventilator fans to improve air flow, but don't use both the dehumidifier and ventilator fan at the same time.

Walls: Remove commentates coatings, if holding rising damp in walls; coat walls with vapor permeable lime based rendering plaster, if damp walls need a sacrificial coating to protect mortar from erosion; add termite shields, if evidence of termites and dampness cannot be controlled.

Framing: *Reinforce existing floor framing weakened by moisture by adding lolly column support and reinforcing joist ends with sistered or parallel supports. Add a vapor impermeable shield, preferably non-ferrous metal, under wood joists coming into contact with moist masonry.*

Interior: Eliminate areas where moisture is leaking or causing a problem

Plumbing*: Replace older pipes and fixtures subject to leaking or overflowing; insulate water pipes subject to condensation.*

Ventilation*: Add exhaust fans and whole house fans to increase air flow through buildings, if areas are damp or need more ventilation to control mold and mildew.*

Climate*: Adjust temperature and relative humidity to manage interior humidity; Correct areas of improperly balanced pressure for HVAC systems that may be causing a moisture problem.*

Level III Replacement / Alterations For Chronically Damp Conditions

Exterior: Undertake exterior rehabilitation work that follows professional repair practices-i.e., replace a deteriorated feature with a new feature to match the existing in design, color, texture, and when possible, materials. In some limited situations, non-historic materials may be necessary in unusually wet areas

Roofs: Add ventilator fans to exhaust roofs but avoid large projecting features whose designs might negatively affect the appearance of the historic roof. When replacing roofs, correct conditions that have caused moisture problems, but keep the overall appearance of the roof; for example, ventilate under wooden shingles, or detail standing seams to avoid buckling and cracking. Be attentive to provide extra protection for internal or built-in gutters by using the best quality materials, flashing, and vapor impermeable connection details.

Walls: If insulation and vapor barriers are added to frame walls, consider maintaining a ventilation channel behind the exterior cladding to avoid peeling and blistering paint occurrences.

Windows: Consider removable exterior storm windows, but allow operation of windows for periodic ventilation of cavity between exterior storm and historic sash. For stained glass windows using protective glazing, use only ventilated storms to avoid condensation as well as heat build-up.

Ground: Control excessive ground moisture. This may require extensive excavations, new drainage systems, and the use of substitute materials. These may include concrete or new sustainable recycled materials for wood in damp areas when they do not impact the historic appearance of the building.

Grade: Excavate and install water collection systems to assist with positive run-off of low lying or difficult areas of moisture drainage; use drainage mats and under finished grade to improve run-off control; consider the use of column plinth blocks or bases that are ventilated or constructed of non-absorbent substitute materials in chronically damp areas. Replace improperly sloped walks; repair non-functioning catch basins and site drains; repair settled areas around steps and other features at grade.

Foundations: Improve performance of foundation walls with damp-proof treatments to

stop infiltration or damp course layers to stop rising damp. Some substitute materials may need to be selectively integrated into new features.

Walls: excavate, repoint masonry walls, add footing drains, and waterproof exterior subsurface walls; replace wood sill plates and deteriorated structural foundations with new materials, such as pressure treated wood, to withstand chronic moisture conditions; materials may change, but overall appearance should remain similar. Add dampcourse layer to stop rising damp; avoid chemical injections as these are rarely totally effective, are not reversible, and are often visually intrusive.

Interior: Control the amount of moisture and condensation on the interiors of historic buildings. Most designs for new HVAC systems will be undertaken by mechanical engineers, but systems should be selected that are appropriate to the resource and intended use.

Windows, skylights: Add double and triple glazing, where necessary to control condensation. Avoid new metal sashes or use thermal breaks where prone to heavy condensation.

Mechanical systems: Design new systems to reduce stress on building exterior. This might require insulating and tightening up the building exterior, but provisions must be made for adequate air flow. A new zoned system, with appropriate transition insulation, may be effective in areas with differing climatic needs.

Control devices/Interior spaces: If new climate control systems are added, design back-up controls and monitoring systems to protect from interior moisture damage.

Walls: If partition walls sit on floors that periodically flood, consider spacers or isolation membranes behind baseboards to stop moisture from wicking up through absorbent materials.

Ongoing Care

Once the building has been repaired and the larger moisture issues addressed, it is important to keep a record of additional evidence of moisture problems and *to protect the historic or old building through proper cyclical maintenance.* In some cases, particularly in museum environments, it is critical to monitor areas vulnerable to moisture damage. In a number of historic buildings, in-wall moisture monitors are used to ensure that the moisture purposely generated to keep relative humidity at ranges appropriate to a museum collection does not migrate into walls and cause deterioration. The potential problem with all systems is the failure of controls, valves, and panels over time. Back-up systems, warning devices, properly trained staff and an emergency plan will help control damage if there is a system failure.

Ongoing maintenance and vigilance to situations that could potentially cause moisture damage must become a routine part of the everyday life of a building. The owner or staff responsible for the upkeep of the building should inspect the property weekly and note any leaks, mustiness, or blocked drains. Again, observing the building during a rain will test whether ground and gutter drainage are working well.

For some buildings a back-up power system may be necessary to keep sump pumps working during storms when electrical power may be lost. For mechanical equipment rooms, condensation pans, basement floors, and laundry areas where early detection of water is important, there are alarms that sound when their sensors come into contact with moisture.

Conclusion

Moisture in old and historic buildings, though difficult to evaluate, can be systematically studied and the appropriate protective measures taken. Much of the documentation and evaluation is based on common sense combined with an understanding of historic building materials, construction technology, and the basics of moisture and air movement. Variables can be evaluated step by step and situations creating direct or secondary moisture damage can generally be corrected. The majority of moisture problems can be mitigated with maintenance, repair, control of ground and roof moisture, and improved ventilation. For more complex situations, however, a thorough diagnosis and an understanding of how the building handles moisture *at present*, can lead to a treatment that solves the problem without damaging the historic resource.

It is usually advantageous to eliminate one potential source of moisture at a time. Simultaneous treatments may set up a new dynamic in the building with its own set of moisture problems. Implementing changes sequentially will allow the owner or preservation professional to track the success of each treatment.

Moisture problems can be intimidating to a building owner who has diligently tried to control them. Keeping a record of evidence of moisture damage, results of diagnostic tests, and remedial treatments, is beneficial to a building's long-term care. The more complete a survey and evaluation, the greater the success in controlling unwanted moisture now and in the future.

Holding the line on unwanted moisture in buildings will be successful if 1) there is constant concern for signs of problems and 2) there is ongoing physical care provided by those who understand the building, site, mechanical systems, and the previous efforts to deal with moisture. For properties with major or difficult-to-diagnose problems, a team approach is often most effective. The owner working with properly trained contractors and consultants can monitor, select, and implement treatments within a preservation context in order to manage moisture and to protect the historic resource.

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Glossary

Air flow/ infiltration: The movement that carries moist air into and through materials. Air flow depends on the difference between indoor and outdoor pressures, wind speed and direction as well as the permeability of materials.

Bulk water: The large quantity of moisture from roof and ground run-off that can enter into a building either above grade or below grade.

Capillary action: The force that moves moisture through the pore structure of materials. Generally referred to as rising damp, moisture at or below the foundation level will rise vertically in a wall to a height at which the rate of evaporation balances the rate at which it can be drawn up by capillary forces.

Condensation: The physical process by which water vapor is transformed into a liquid when the relative humidity of the air reaches 100% and the excess water vapor forms, generally as droplets, on the colder adjacent surface.

Convection: Heat transfer through the atmosphere by a difference in force or air pressure is one type of air transport. Sometimes referred to as the "stack effect," hotter less dense air will rise, colder dense air will fall creating movement of air within a building.

Dewpoint: The temperature at which water vapor condenses when the air is cooled at a constant pressure and constant moisture content.

Diffusion: The movement of water vapor through a material. Diffusion depends on vapor pressure, temperature, relative humidity, and the permeability of a material.

Evaporation: The transformation of liquid into a vapor, generally as a result of rise of temperature, is the opposite of condensation. Moisture in damp soil, such as in a crawl space, can evaporate into the air, raise the relative humidity in that space, and enter the building as a vapor.

Ground moisture: The saturated moisture in the ground as a result of surface run-off and naturally occuring water tables. Ground moisture can penetrate through cracks and holes in foundation

walls or can migrate up from moisture under the foundation base.

Monitoring instrumentation: These devices are generally used for long term diagnostic analysis of a problem, or to measure the performance of a treatment, or to measure changes of conditions or environment. In-wall probes or sensors are often attached to data-loggers which can be down-loaded into computers.

Permeability: A characteristic of porosity of a material generally listed as the rate of diffusion of a pressurized gas through a material. The pore structure of some materials allows them to absorb or adsorb more moisture than other materials. Limestones are generally more permeable than granites.

Relative humidity (RH): Dampness in the air is measured as the percent of water vapor in the air at a specific temperature relative to the amount of water vapor that can be held in a vapor form at that specific temperature.

Survey instrumentation: technical instrumentation that is used on-site to provide quick readings of specific physical conditions. Generally these are hand-held survey instruments, such as moisture, temperature and relative humidity readers, dewpoint sensors, and fiber optic boroscopes.

Acknowledgments

Sharon C. Park, AIA is the Senior Historical Architect, Technical Preservation Services, Heritage Preservation Services Program, National Park Service, Washington, D.C. The author wishes to thank the following individuals and organizations for providing technical review and other assistance in developing this publication: The attendees, speakers, and sponsors of the Diagnosing Moisture in Historic Buildings Symposium held in Washington, DC in 1996 and funded by a grant from the National Center for Preservation Technology and Training, National Park Service ; Hugh C. Miller, FAIA; Michael Henry, AIA, PE, PP; Baird M. Smith, AIA; Ernest A. Conrad, P.E.; William B. Rose; Rebecca Stevens. AIA; Wendy Claire Jessup; Elizabeth Sasser, AIA; Bryan Blundell; George Siekkinen, AIA; Larry D. Dermody; Kimberly A. Konrad; Barbara J. Mangum and the Isabella Stewart Gardner Museum, Boston; Gunston Hall Plantation; Friends of Meridian Hill; Friends of Great Falls Tavern; The National Trust for Historic Preservation; Thomas McGrath, Douglas C. Hicks and The Williamsport Preservation Training Center, NPS; the staff at Heritage Preservation Services, NPS, Charles E. Fisher, Brooks Prueher, Anne E. Grimmer, Antoinette Lee, and especially Kay D. Weeks.This publication has been prepared pursuant to the National Historic Preservation Act, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Comments about this publication should be directed to de Teel Patterson Tiller, Acting Manager, Heritage Preservation Services Program, National Park Service, P.O. Box 37127, Washington, DC 20013-7127. This publication is not copyrighted and can be reproduced without penalty. Copyright photographs included in this publication may not be used to illustrate publications other than as a reference to this Preservation Brief, without permission of the owners. Normal procedures for credit to the authors and the National Park Service are appreciated.

Washington, DC October, 1996

Home page logo: Invasive vegetation on a brick wall. Photo: Richard Wagner, AIA.

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