

Structural Woodwork

Introduction

Wood is a natural and renewable material that has been widely used for the construction and ornamentation of our built heritage, and continues to be used today. Regardless of the varying appearances and strengths of different trees and resulting wood types, all possess great tensile strength yet are susceptible to deterioration. Wood has unique compression and expansion characteristics that include slight changes in dimensions. These shifts in size will often vary with moisture changes, as well as the wood type and its milling. It is important that exposed wood and woodwork be well protected and maintained to deter moisture related problems and deterioration. Any woodwork project on a heritage building should strive to identify, retain, and conserve wood features that are important in defining the overall historic character of the building such as siding, stairs, cornices, brackets, window architraves, and doorway pediments.

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Wooden Construction

Variances in regional construction traditions, building types and available materials had an impact on the construction method used. Common framing schemes, such as post and beam, balloon and platform construction, as well as log and barn building, are identified on the following pages.

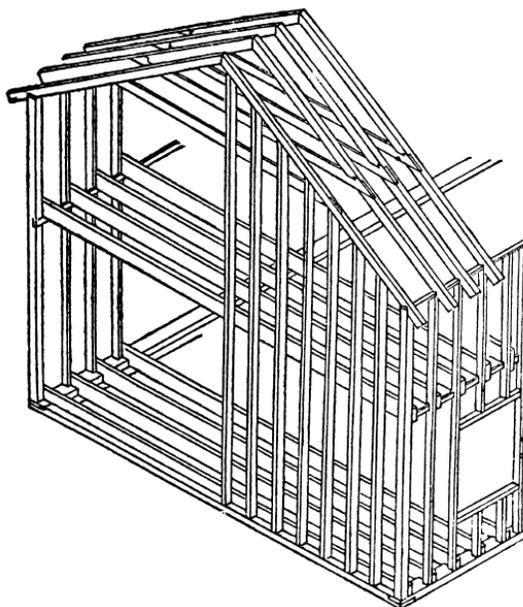


Image: Isometric perspective view of the Balloon Frame (George E. Woodward, 1981, p. p.312)

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Old Growth Wood

The wood used in most heritage buildings is a superior building material as it was harvested from old growth timber. It incorporates both hardwoods and softwoods, often harvested from unfertilized old-growth stock, with a denser and more naturally occurring grain structure than the second-growth stock or fertilized tree-farm wood used today. These materials are stronger, more stable and durable than modern wood products.

Wood types once commonly found in the Region and used when constructing many of the area's historic buildings include: red pine, oak, chestnut, butternut, maple and cherry.

Each species of tree will result in wood with different characteristics and will require different approaches to restoration based on traits such as density and colour. **Heartwood** should be used when possible as it is the most disease-resistant. **Sapwood** of most species should never be used.

Log Construction

A log building is characterized by horizontal or vertical structural walls built of logs. A distinction should be made between the log cabin, an impermanent one to one-and-a-half storey round-log construction, and the log house, typically a hewn-log permanent construction of a more intricate design. The log construction method was also utilized for commercial buildings, schools, barns, gristmills and churches.

Notchings, the way in which the logs are joined at each corner, are characteristic of log construction. If the construction includes vertical posts at its corners, logs may be fastened with tenons. The latter is known as false notching.

Log constructions would typically be covered with wooden siding or stucco for aesthetic and practical reasons. Over time, historic cladding may become damaged or logs may deteriorate. Cladding should not be removed unless necessary, and should first be properly documented and identified. Log constructions should be regularly inspected for signs of moisture damage, insect infestation and/or rot. Where the logs or planks can't be repaired, replace with like materials and installation techniques.

Post and Beam

Post and beam construction, also referred to as timber framing, is a method of wood construction that uses heavy timbers rather than more precisely cut lumber, such as 2"x4"s. This method, common in wood buildings from the 1800s and earlier, was used to build structures using heavy squared-off and carefully fitted and joined timbers with joints secured by large wooden pegs, somewhat similar to mortise and tenon joints in furniture, but at a larger scale. This method originated with the use of logs before modern saws were available to precisely cut lumber. Artisans or farmers would gradually assemble buildings using these timbers as vertical support posts that were formed using axes, draw knives, hand powered auger drill bits and labour intensive woodworking. Due to the centuries old tradition of post and

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beam construction across the world, there are many styles of historic framing categorized by foundation type, walls, beam intersection, the use of curved timbers and roof framing details. In English-speaking countries there are three basic types of timber frames: **box**, **cruck** and **aisled**.

Barns

Barns, typically of post and beam construction, are the gems of our rural landscapes. These historic structures face multiple threats regardless of their aesthetic appeal. If they are not dismantled for their timber, barns are often left to deteriorate due to changes in the farming industry, as well as a shift in farm size and economy. Maintenance and repair of these structures can be challenging due to their vulnerability and size. However, the retrofitting of barns to accommodate contemporary farming practices and building codes can be economically beneficial and is strongly encouraged to conserve these rural landmarks. The surrounding farming landscape, along with the barn's relationship to silos, should be conserved as alteration could negatively impact the cultural heritage resource's character.

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Balloon Framing

In the late-1800s to early-1900s, balloon framing was the preferred method of construction (see image on page 1). This framing system enabled buildings to be erected quickly and soundly by employing light standard-cut lumber boards held together by nails. This method of construction did not offer good fire resistance, however, as the exterior and certain interior studs ran the entirety of the building's vertical height from the foundation to the roof framing. Although rarely used today, this framing system influenced the practice of contemporary platform construction.

Platform Construction

Inspired by balloon framing, platform construction has been a dominating practice since the 1940s and is the conventional housing construction method in Canada today. Advantageously, the walls can be prefabricated off-site as the studs run the height of a storey rather than the entire height of the building. This system enables a platform for easier assembly as well as floor and ceiling fire stops provided by the bottom and top plates.

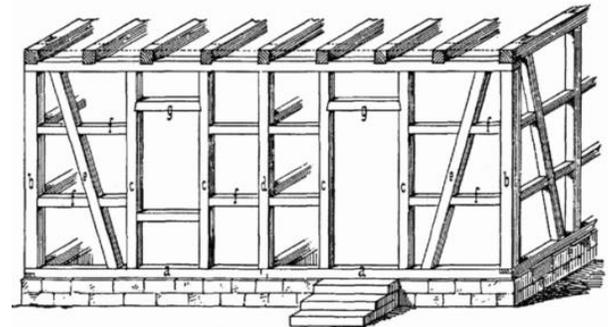


Fig. 1.

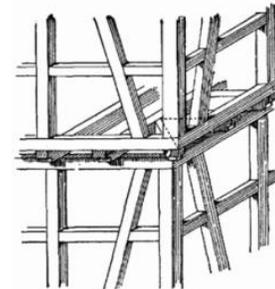


Fig. 2.

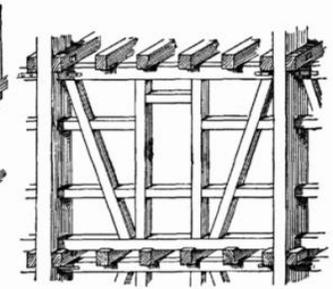


Fig. 3.

Image: Illustration of post and beam construction (Otto Lueger, Lexikon der gesamten Technik, 1904)

Wooden Architectural Elements and Details

Uniquely authentic to heritage buildings, architectural details and elements such as wood siding, wide plank flooring, wooden porches and shingle roofs are character defining elements that should be conserved.

Flooring

Wide-plank, or antique, flooring is characteristic of heritage homes, although the look can be achieved by installing salvaged timber flooring. Original flooring should not be removed unless absolutely necessary. Damaged or deteriorated planks can often be consolidated, without losing the desired appearance of wear. If the lifting of boards is required for plumbing or electrical purposes, hire a qualified carpenter capable of doing the job without damaging the floor planks.

Wood Siding

Siding is installed for both aesthetic and functional purposes. Wooden siding can be found in a variety of patterns, materials and sizes to add texture and intricacy, complementing the building's intended style. It can be installed horizontally or vertically, or as shingles in various patterns. Siding is important to the building's appearance and compatibility within the streetscape. Siding protects the structure within from weather and deterioration. The weather proofing system typically consists of siding, also referred to as the weather-shedding surface, along with the elements it is attached to (planks or girts) by means of fasteners. For optimal weather protection, siding is coated with oil, stain, paint or limewash. Wind protection is often installed between the siding and underlying surface, while the fasteners are covered and protected by putty. The siding system should regularly be maintained to ensure good performance against rot.

If replacement is necessary, wooden siding should be replaced with like materials and painted to adhere to your building's exterior colour palette. Wood siding should not be replaced with vinyl or aluminum counterparts as the building's character, along with its decorative detail, will be lost with its installation.

Porches

For information on the preservation, repair and maintenance of wooden porches, please refer to the [Region of Waterloo's Practical Guide: Porches](#).

Roofing

Wooden cedar shakes and shingles can on average last between 30 to 60 years. The durability and resistance of wooden shingles and shakes to rot and insects heavily depends on the quality of the material. Wooden shingles and shakes should not be painted. Please refer to the [Practical Guide: Roofs](#) for more information on repair and maintenance of wooden roofing shakes and shingles.

Maintenance and Repair of Exterior Woodwork

To conserve your home or barn's character and authenticity, it is best to maintain and repair the heritage woodwork. Failing to identify, evaluate, and treat the causes of wood deterioration, such as faulty flashing, leaking gutters, cracks and holes in siding, deteriorated caulking in joints and seams, plant material growing too close to wood surfaces, or insect (powder post beetles, termites, carpenter ants, etc.) or fungus infestation could lead to larger problems and should be proactively avoided.

Ensuring that your exterior woodwork is protected from the elements by maintaining paint and repairing any moisture related issues immediately will prolong your woodwork's life. If woodwork has too badly deteriorated, replace only the affected areas with like materials. In this case, wood splicing, as described below, is a common and affordable course of action.

If you choose to undertake maintenance and repair work yourself, ensure that you have properly researched the most effective method before you begin to avoid causing further damage. If you choose to hire a contractor it is important to select one that is knowledgeable about and has experience in traditional construction methods and materials.

Paint

Exterior wooden elements should be painted, in accordance to your building's colour palette. It is important that exterior paint be kept in good condition, as it protects the underlying wooden surface from moisture and subsequent deterioration. Heritage conservationists recommend that paint should be retained and repaired instead of being stripped whenever possible to preserve your structure's authenticity. Refer to the Region of Waterloo's [Practical Guide: Paint & Colour](#) for design, maintenance and repair guidelines to conserve your building's painted wooden surfaces as well as tips on how to effectively remove paint and prepare wood for repainting. In addition, applying chemical preservatives to wood features, such as beam ends or outriggers that are exposed to decay hazards and are traditionally unpainted, is also recommended.

Wood Splicing

Wood splicing, also known as "piecing-in," enables the replacement of a badly deteriorated piece of wood without having to replace the entire unit. This localized repair is begun by carefully removing the rotted wood by carving out the affected area, and replacing the void with like material. The replacement wood should have a grain pattern similar to the previous material but should still be identifiable upon close inspection to guide future research and interventions. Whenever possible, stabilizing, repairing or replacing only the portion of wood that is deteriorated should be undertaken rather than replacing entire historic wood features. It is useful to document all new work to assist future interventions.

Epoxy Consolidation

Use epoxy resin techniques to repair smaller badly deteriorated areas. Remove loose rotted material and drill ¼-inch holes at an angle into the damaged area. Use a plastic squeeze bottle to insert the resin into the holes. Fill and shape with a paste of resin and sawdust. Profiles of missing sections can be replicated by pouring epoxy into hand held molds.

Managing Moisture

Moisture flows within any building must be managed to prevent water accumulation that can lead to premature deterioration of building materials. Water will lead to deterioration by corrosion in steel products, by spalling and cracking in concrete products, and by fungi or insect infestation in wood products.

Moisture sources in and around buildings are numerous. Exterior moisture sources include precipitation, irrigation systems and groundwater. Water vapour is also present in the exterior environment and may affect the building envelope in some climates. Rainwater, especially wind driven, is the moisture source that impacts the performance of the envelope most.

For more information on how to control unwanted moisture in your heritage home, refer to the US National Park Service Preservation Brief 39, “Holding the Line: Controlling Unwanted Moisture in Historic Buildings.”

Moisture and Woodwork

APT’s Practice Points bulletin entitled, “Basics of Wood Inspection: Considerations for Historic Preservation,” provides a helpful overview of the impacts of moisture on the wood in your heritage building. The guidance that follows was largely adopted from this bulletin.

Wood can perform well in a structure for over a century when kept dry and protected from moisture and deterioration as a result of insects and fungi. The open construction typical of historic buildings allows them to breathe as air can travel through the structure, quickly drying out wood if it gets wet. Problems may arise when moisture is trapped in a structure, or the strength requirements of wooden members change, due to alterations, etc.

When planning work on a heritage building, yourself as the property owner and/or architects and engineers need to know when deterioration has occurred and if the structural members are strong enough to proceed with the planned work. Carrying out a wood inspection is the best way to determine this.

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There are three reasons to conduct a wood inspection:

- concerns about moisture and its effects
- deterioration (both physical and biological)
- need to determine material properties

The behaviour of wood is variable due to the following reasons:

- different wood species
- rate of tree growth (measured in growth rings per inch)
- age of the tree
- how the lumber was cut from the log
- presence of defects (i.e. knots)
- end-use conditions (interior or exterior use)

When working on a heritage structure it is important to understand the variable nature of its wood components.

Long-term exposure to moisture can result in maintenance issues in the wood components of a building, leading to moisture stains, peeling paint, and warping of lumber and timber. It is important to determine whether a stain is the result of a single leak or an ongoing moisture problem. Decay and insect attacks are significant problems associated with both periodic leaks and sources of moisture.

Deterioration of wood can be the result of physical processes:

- weathering
- failure due to overload
- mechanical damage
- shrinkage

Or biological processes:

- decay
- insect attack

Wood Decay

The most common type of wood decay is a result of fungi. Depending on the wood species, large timbers will hold on to moisture internally, which can lead to interior rot invisible from the surface. Moisture absorption through end grain, checks (separation of wood fibers in a piece of wood, typically along the length of the piece, from drying of the wood after processing or installation in a structure), or holes provides an ideal environment for decay fungi to attack the

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heartwood at the center of a large timber. The heartwood (the inner growth rings of the tree) usually has more decay resistance than the sapwood (the outer growth rings of the tree). However, even the heartwood of durable species, such as chestnut, will decay when exposed to enough moisture.

Deterioration is a concern where the wood is in contact with the ground or with other materials, such as porous masonry, that may allow for moisture to be absorbed into the wood.

Fungi associated with wood include mildew, and stain and decay fungi:

- Fungi grows from spores in the air
- Mildew grows on the surface of wood and paint and does not affect the strength of the wood
- Stain fungi (not to be confused with moisture stains) penetrate the surface of the wood but do not reduce its strength
- Decay fungi breaks down wood components over time and all types of decay fungi (brown rot, white rot, and dry rot) affect woods performance

Determining the specific fungus during wood inspection is not essential, but identifying the location and extent of deterioration is important.

Generally, fungi can't grow if the moisture content of the wood is less than 20%. Areas with moisture content between 20-30% can support the growth of fungi, but the moisture may not be enough for long-term active decay. Moisture content between 30-40% is ideal for active fungal growth and can indicate advanced decay with symptoms such as internal voids and surface deterioration. Insects prefer moisture levels above 10% to actively deteriorate wood.

Termites and wood-boring insects affect wood by either digesting or tunneling through it. Subterranean and drywood termites digest wood as they move below the surface of it. You can identify termites through the presence of mud tubes on the exterior of either the structure or the individual wood members. Wood-boring beetles create holes that are packed with frass (byproduct of the tunneling process). Carpenter ants and bees leave large clean tunnels in wood.

Wood Inspection

The goal of a wood inspection will determine what parts of a structure to inspect and what tools to use. Begin inspections by looking for problems where they are most likely to occur. Missing or deteriorated wood members, moisture stains, the presence of fungus, decayed wood, insect bore holes, mud tubes, or frass will require more investigation. Focus an inspection on these potential problem areas:

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- wood in contact with the ground
- wood with moisture stains
- wood with visible decay
- roof penetrations (i.e. around chimneys, vents)
- attic sheathing, framing lumber, timbers
- sill beams and wall plates, especially if in contact with masonry
- floor joists and girders, particularly where they rest on exterior walls
- openings (i.e. doors, windows)
- places where two materials intersect (i.e. wood and masonry)
- exterior woodwork (i.e. cladding, shingles, soffits)
- porches
- crawl spaces and basements
- altered areas of the structure

It is important to remember that the purpose of an inspection is to provide information that can be used to answer questions raised by the architect, engineer, and/or property owner about the condition of the wood.

Simply by controlling the environment of the area in which moisture is causing damage to woodwork can eradicate the problem. Straightforward interventions, such as ventilation and the use of a dehumidifier, can significantly reduce moisture levels.

Summary

Identifying, retaining, and preserving wood features that are important in defining the overall historic character of a building is a vital component of the conservation process. To successfully undertake woodwork projects it is helpful to first understand the various wood components of a heritage structure and the deficiencies each is most susceptible to. Wood is a common decorative feature on heritage properties and composes many unique and valuable architectural elements. Preventing, monitoring, stabilizing and/or repairing weaknesses in each wood feature will prolong the life and aesthetic appeal of heritage structures.

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If you would like to learn more about conserving your structural woodwork, please refer to the following primary sources:

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