

Wood Specification: Durability

Terminology

Building Durability Plan (BDP): provides a framework within which durability targets are set and establishes criteria for durability performance of a building.

Design service life: the period of time during which a product is expected by its designers to work within its specified parameters.

Commissioning: accomplishes higher energy efficiency, environmental health, and occupant safety; improves indoor air quality by making sure the building components are working correctly and the plans are implemented with the greatest efficiency using standard protocols and peer review processes.

Resources

Guideline on Durability in Buildings CSA S478-95 (R2007) (available for purchase from www.shopcsa.ca): referenced by LEED, this guideline provides a set of recommendations to assist designers in creating durable buildings.

Sample of a Building Durability Plan: following CSA S478-95, available free from www.morrisonhershfield.com/newsroom/technicalpapers/Pages/SampleBuildingDurabilityPlan.aspx.

ISO 15686-5:2008 – Buildings and constructed assets – Service life planning – Part 5: Life-cycle costing (www.iso.org/iso/catalogue_detail?csnumber=39843): life-cycle costing enables comparative cost assessments to be made over a specific time, by taking into account initial capital costs and future operational costs.

www.durable-wood.com: a joint Canadian Wood Council/FPIInnovations, Forintek Division website that provides current information on the durability of wood products in order to ensure long service life of wood structures.

WoodWorks (www.woodworks.org/Publications/informationSheets.aspx): a primer on durability and wood.

Durability is defined as the ability of a building or any of its components to perform the required functions in a service environment over a period of time without unforeseen cost for maintenance or repair.

Using durable materials, as well as appropriate building applications and design, minimizes materials use. It also minimizes construction waste that would result from inappropriate material selection or premature failure of the building and its constituent components and assemblies. Using durable materials, while sometimes involving greater up-front costs, can result in significant savings in terms of reduced-cost maintenance and repairs later in a building's life.

Why a Durable High-performance Wood Building Envelope Adds Value

- Durable envelope design delivers the benefits of lower operation costs and a healthier building. Good design will ensure that wood materials last and weather well in various climates and physical contexts. Strategies may include minimizing contact of moisture with untreated wood, allowing for ventilation to both sides of untreated wood and designing structures to shed water.
- Planning for maintenance, deconstruction, and adaptability can extend the life of building components and of the building as a whole. Designing with wood allows for the use of easily demountable components and connections, and for the use of fasteners that ease deconstruction, facilitate maintenance, and increase the potential future reuse of building materials and components. In addition, the incorporation of easily accessible systems (such as removable panels, etc.) reduces the need for extensive renovations or even replacement in the future.
- In general, as durability performance increases, so do the environmental merits of the project as a whole. A durable assembly can dramatically reduce energy consumption because the elements providing thermal performance are protected and maintain their functionality over the life of the building. Utilizing energy modeling software that incorporates building envelope performance criteria such as insulative value and air tightness will help designers to better understand the impacts of material choices—particularly the use of wood, in accomplishing an energy-efficient, durable envelope.
- Indoor air quality can also be improved by using durable materials that have zero or low emissions and that prevent moisture accumulation and mould or mildew growth.
- Durable materials and components that follow carefully considered design details can potentially remain useful in the materials cycle for longer periods of time, thus reducing the need for new materials and the environmental costs of resource extraction, production processes, and waste disposal.
- Assessing life cycle costs based on design service life of the structure and the building envelope can be helpful in evaluating alternative design approaches for the building.
- Some green building rating systems encourage high-performance and durable envelope design, either explicitly through the development of a Building Durability Plan, or indirectly by setting goals for energy efficiency, thermal comfort, and indoor air quality (all of which are facilitated through the design of the building envelope).
- With proper design and construction, wood-frame buildings resist damage from moisture, insects and other organisms, and provide decades of service equivalent to other building types.
- Wood structures are adaptable and allow for design flexibility to meet changing needs. When they have been designed properly with local climate impacts in mind, wood buildings can last centuries. Further, when part of a well-planned regular maintenance program, wood products will last well beyond their planned service life. When it is time to refurbish, wood products can be re-used and recycled.

How to Include Durability Considerations in Design

- Develop a Building Durability Plan at the concept stage, and review the plan during design for implementation during construction. Components of particular relevance are major structural elements (including foundations), building cladding assemblies, roofing assemblies, and those elements likely to have significant impacts on the building's operation or performance (excluding mechanical and electrical equipment).
- Early on, optimize the design of all components of the building envelope by using energy simulation and life cycle assessment tools to analyze overall envelope performance.
- Make informed decisions about the components of the building envelope (i.e., based on life cycle performance).
- To minimize premature deterioration of walls, roofs, and floors, select design strategies that are appropriate to the geographic region.
- Reduce construction problems by specifying realistic and achievable levels of workmanship that are based on practical construction methods and readily available technologies.
- Follow a building envelope commissioning process to ensure performance and durability standards are correctly established at the outset and followed through during construction and operation.

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What to Ask Suppliers

- It is important to get information about what the expected service life of the building envelope products will be in the context of the building's assembled condition.
- Ensure that the scope and limitations of product warranties are fully understood.
- Enquire about care and maintenance solutions for proposed materials and convey this information to the building operator.

The Building Durability Plan

A Building Durability Plan (BDP) requires the design professional (usually a building envelope consultant) to agree to the following points:

- The building is designed and constructed with the intent that the predicted service life will equal or exceed the design service life.
- Where the service life of a component or assembly design is shorter than that of the building, those components or assemblies are designed and constructed to be readily replaced.
- The service life is predicted by documenting demonstrated effectiveness, by modeling of the deterioration process, or by testing.
- A quality management program is developed and documented.
- Quality assurance activities need to be carried out to verify that the predicted service life is achieved.
- The building envelope construction is in general conformance with the design details, and is co-signed by the building science professional and the general contractor.
- The BDP is endorsed, implemented, and signed by the building owner.

Procedure

Step-by-step approach to incorporating durability considerations into the design

Pre-design: determine durability goals by establishing performance targets for the design service life of the structure and building envelope (50 years is standard).

Design: create a BDP; review the details with the design team, owner, and builder; update the Plan at milestones throughout the project.

Contract documentation: confirm that the BDP is developed and signed by a building science professional, and that it is endorsed, implemented, and signed by the building owner.

Contract documentation: use a commissioning procedure to confirm that the building envelope construction is in general conformance with the design details, and that it is co-signed by the building science professional and the general contractor.

Contract documentation: circulate copies of the reports on the building envelope design review and the building envelope field review, and of the BDP.

World's Tallest Modern Residential Building Constructed of Timber

In the Borough of Hackney in London stands Stadthaus, the world's tallest modern timber structure (<http://www.waughthistleton.com>). Stadthaus is a nine-storey high-performance residential building of which the top eight are constructed from cross-laminated timber and designed according to passive design principles. Pre-fabricated timber panels comprise the load-bearing walls and floor slabs as well as the stair and lift cores. Each panel is made up of five layers of timber positioned at 90 degree angles and glued over their entire surface, making a panel that could be compared to precast concrete. To address global concerns about carbon emissions, the design team made use of pre-fabricated panels that provide several advantages: improved thermal performance, a continuous air barrier, ease and speed of construction, and waste minimization.

Because wood products continue store carbon absorbed during the tree's growing cycle, this modern timber building will actually keep 205 tons (186 tonnes) of carbon out of the atmosphere for its entire service life—or longer if the materials are reclaimed and manufactured into other products. within its structure over its lifetime.

CLT construction reduces wetting potential because prefabrication reduces construction time. CLT also provides considerable insulation with an inherent R-value of about R-1.2/per inch resulting in R-4.2 for 3 1/2" thick panel. The solid panel also reduces convection in the assembly.



Photo: Ben Rahn, A-Frame

Fifth Town Artisan Cheese Company

This green project is located on the shores of Lake Ontario in Prince Edward County, Ontario. The decision to use Durisol, a stay-in-place wall form made of waste wood and concrete, was made because it is extremely resistant to mould and mildew and is strong and durable.

Engineered lumber and reclaimed barn beams were used for areas where the environmental concerns were less demanding. Wood was used to reinforce the vernacular architecture, as well as to add warmth to the building. The use of all three states of wood was advantageous in achieving green certification – the recycled content of the Durisol blocks, the third-party certified wood framing and the local barn beams, all added to the project's environmental sustainability.

Building Envelope Commissioning

The building commissioning process should include commissioning of the envelope to ensure that all performance goals are met.

Building envelope commissioning can identify areas of concern related to air infiltration and leakage, moisture diffusion, surface condensation, and rain water entry—all are issues that can negatively impact the building's energy performance, indoor environmental quality and service life.

It is important to begin envelope commissioning during the design phase, when modifications can be easily incorporated. Waiting until construction to do remediation can cost significantly more.