SCHOOL OF ARCHITECTURE + LANDSCAPE ARCHITECTURE

Canadian Wood Council
Conseil canadien du bois

Forestry Innovation Investment

Design for Deconstruction in Light Wood Frame

January 2025

Future of Wood

Wood is now established as a desirable material to reduce GHG in construction of new buildings due to its favourable properties including the ability to store carbon. However, the end-of-life for buildings is rarely considered in the design leading to massive quantities of wood from demolished buildings being landfilled in Canada every year, allowing that wood to release a portion of its stored carbon through decomposition. This guidebook seeks to address the linearity of our current light wood frame construction methods to allow wood to be cycled back into the built environment.

Preface

The Guidebook of Design for deconstruction in Light Wood Frame presents a methodology for altering typical light wood frame assemblies so that they can be easily disassembled and the materials of the building can be reused. The province of BC and, more broadly, Canada, has relatively little infrastructure for recycling wood waste. In Vancouver alone, the construction, renovation, and demolition (CRD) sector produces about 1.7 million tonnes of waste per year.[1] Of this, an estimated 30-60% is wood waste which is largely discarded in landfills. What little wood that is recycled is generally incinerated for waste-to-energy conversion or shredded for biomass. Deconstructing wood buildings and reusing the salvaged wood for new construction would extend the lifespan of the wood, add value and longevity to a valuable material, reduce GHG emissions and reduce the amount of new resources required for new construction projects.

Despite the benefit of re-using wood, there are some barriers to deconstructing typical light wood frame buildings, including the use of irreversible fasteners, adhesives, spray foams, and liquid applied sealants. The presence of toxic materials such as asbestos and lead are also of concern when deconstructing a building. While use of toxic materials is now prohibited in new constructions the use of nails (particularly when applied with nail guns) and adhesives makes deconstruction very difficult if not impossible in some cases.[2] This guidebook proposes a design for deconstruction system that addresses these remaining issues with simple modifications of typical light wood frame construction practices, allowing for both simple construction, solid performance, and easy deconstruction.

Purpose

This guide is intended for architects, builders, designers, developers, and all others who have an interest in sustainable construction and circular economy for the built environment. This guide is set up as general reference resource for those interested in design for deconstruction and presents both general principles and practical examples of how to implement design for deconstruction in the design and construction phases of a building project.

The guide is structured in four sections.

First the theory of a circular construction economy for wood and the principles of a design for deconstruction in light wood frame construction are described; the principles have been developed based on CSA Guidelines for Design for Disassembly and adapted to the specific requirements for light wood frame construction.

The second section contains examples of standard construction details for a light wood frame building that has been designed for deconstruction.

The third section shows an example case study of a mock-up construction with a roof, wall, floor, and window that is based on the details showcased in section two. The mock-up construction shows the modifications to standard light wood frame construction practices as well the deconstruction process.

Finally, the guidebook offers some comparative references on material selection, cost comparison compared to traditional construction, and a method for documenting design for deconstruction elements in building permit applications to serve as a reference for future deconstruction.

This guidebook is not a complete reference of every possible way of implementing design for deconstruction but is intended to give sufficient detail on the general practices of DfD such that the principles and practical solutions might be applied to a wide range of light wood frame building projects.

[1] Metro Vancouver, comp., 2021 Biennial Report Integrated Solid Waste and Resource Management Plan, 10-11, January 11, 2022, accessed September 19, 2022, https://metrovancouver.org/services/solid-waste/Documents/iswrmp-biennial-report-2021.pdf

[2] Jacob Forrest, The Feasibility of Recycling and Reusing Building Materials Found in Single-family Homes Built after 1970 in Metro Vancouver, 10-14, August 2021, accessed September 29, 2022.

Contents

Acknowledgements

This guide was produced with the generous support from the Forestry Innovation Investment (FII) and the Canadian Wood Council and was prepared by Kaia Nielsen-Roine and Professor Annalisa Meyboom at the University of British Columbia.

This research was conducted primarily at UBC Point Grey (Vancouver) campus, which sits on the traditional, ancestral, unceded territory of the xʷməθkʷəy̓əm (Musqueam) First Nation.

Authors

Kaia Nielsen-Roine | UBC SALA

Annalisa Meyboom | UBC SALA

Graphics & Research Assistant

Hemi Patel | UBC SALA

External Reviewers & Contributors

Envelope Review

Graham Finch | RDH

Greg Johnson | UBC SALA

Michelle Mazzotta | KIWI Construction

Lindsey Tourand | Tourand Engineering

Facilities & Construction Support

Graham Entwistle | UBC SALA

Derek Fiddler | BCIT

International Timberframes

UBC SCHOOL OF ARCHITECTURE + LANDSCAPE ARCHITECTURE

Canadian Wood Council
Conseil canadien du bois

Forestry Innovation Investment

Introduction

Design for Deconstruction in Light Wood

Wood is an essential resource for Canadian construction. It is the primary construction material for the majority of low and mid-rise buildings in Canada and is increasingly in demand for high-rise mass-timber applications. Despite Canada's reputation of abundant forests, the national fibre supply is decreasing—reducing the availability of wood materials and increasing lumber prices.

Yet there is an untapped collection of building resources within our built environment. Most buildings in Canada, particularly light wood frame buildings, are only in use for an average of 70 years before they are demolished.[3] The materials available in these buildings represent a significant mass of wood and other construction materials which have the potential to be reused or recycled back into construction. Demolishing buildings leads to wastage of otherwise durable materials. As land uses change, and cities densify, the volume of construction materials sent to landfills may become overwhelming to municipal waste management systems. The use of deconstruction–where a building is disassembled into its component parts–over demolition to remove unwanted buildings allows for greater material diversion from landfills, and the reuse of those materials for further construction. While Canadian municipalities are already implementing requirements for the deconstruction of buildings to encourage material recycling and salvage, these efforts are usually restricted to light wood frame buildings built prior to 1950. Modern construction methods, which make liberal use of adhesives, spray foams, and irreversible fasteners do not lend themselves to deconstruction. Therefore, standard construction methods should be adjusted to allow for deconstruction. By designing light wood frame buildings for deconstruction, the built environment can be designed to anticipate changes to land-use by facilitating deconstruction, reducing material loads on municipal waste management systems and facilitating the direct reuse of materials in the built environment.

[3] Caroline O'Donnell and Dillon Pranger, The Architecture of Waste: Design for a Circular Economy (New York, NY: Routledge, 2021), xxiv, pdf.

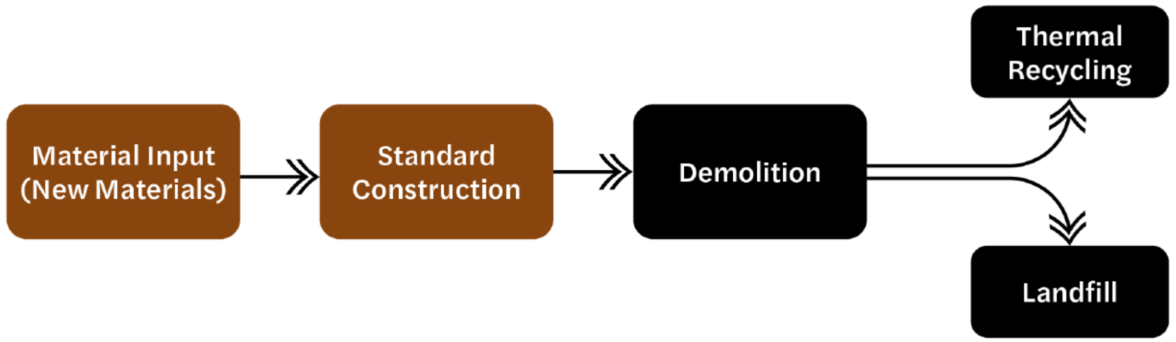
Beyond Deconstruction

Design for deconstruction is just one facet of improving material efficiency and reuse in the built environment. The collection of changes to our building practices and waste habits which allows for the continuous reuse of materials is the foundation of a circular economy. At present our economy is linear; we make, use, and dispose of the vast majority of materials we use. Within a circular economy the disposal end of the process is altered by creating infrastructure for adaptive reuse of buildings and assemblies and reuse and recycling of materials. It is important to note that current building code requirements do not easily allow for direct structural reuse of many materials including wood, however our building codes could be adapted similarly to the building codes of the states of Washington and Oregon which recently amended their building codes to allow for the structural reuse of dimensional lumber at an assumed no 2. grade or stud grade depending on the state and lumber dimensions.[4,5] Furthermore, there are a number of Canadian businesses that are expanding the sector of reuse and remanufacturing of construction materials which further promotes the economic opportunities of a circular economy. Adopting design for deconstruction methods in our current building practices will help build up a stock of reusable materials that can feed into this burgeoning economic system.

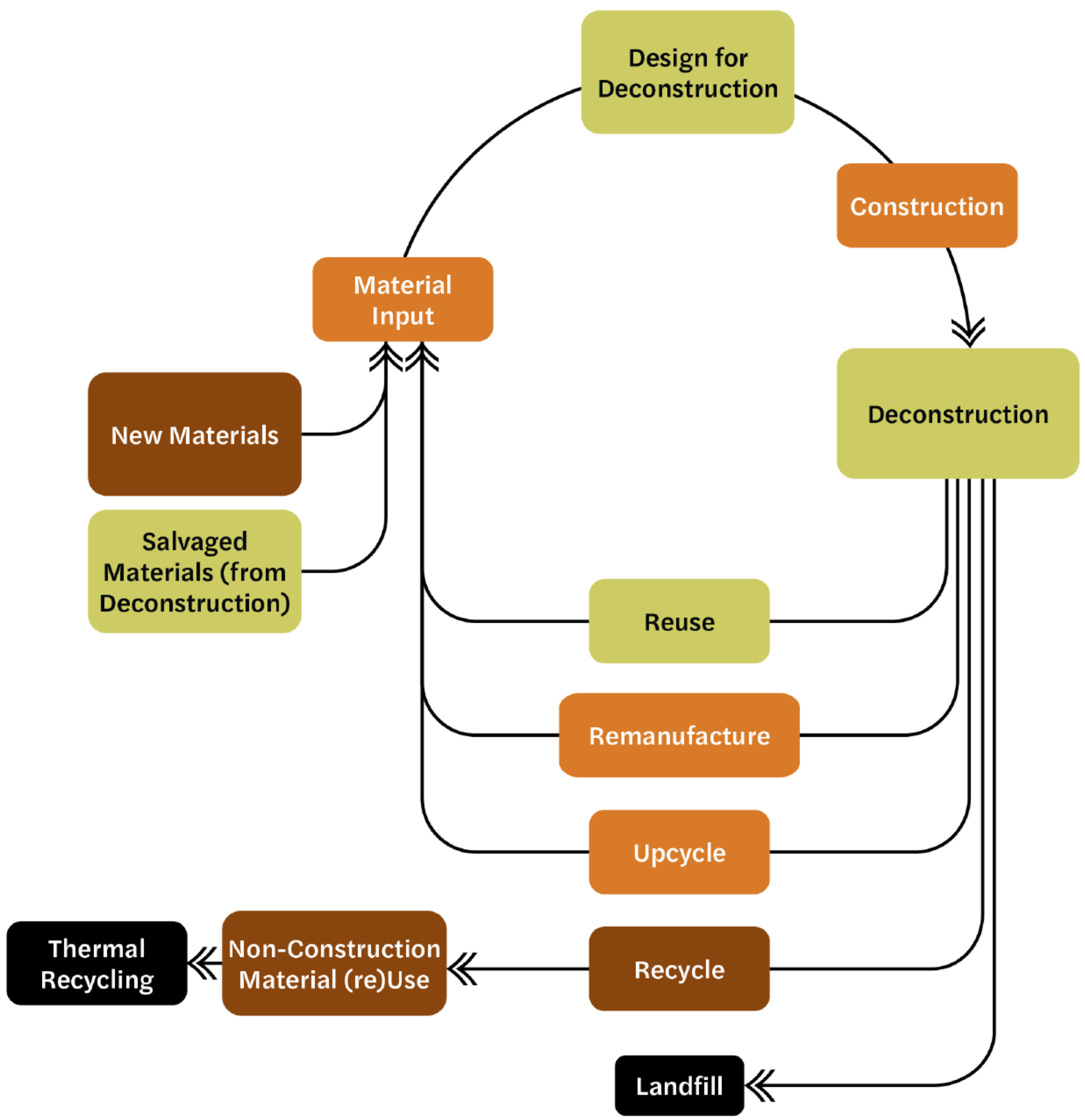
[4]Oregon Residential Specialty Code, Or. Rev. Stat. § 104.9.1 (July 2021). Accessed February 22, 2025. https://codes.iccsafe.org/content/ORRSC2021P1/chapter-1-scope-and-administration#ORRSC2021P1_ChPanel_SecR104.9.1.

[5]Washington State Building Code, Wash. Rev. Code § 2303.1.1.3 (July 2024). Accessed February 22, 2025. https://codes.iccsafe.org/content/WABC2021P2/chapter-23-wood#WABC2021P2_Ch23_Sec2303.1.1.3.

LINEAR CONSTRUCTION ECONOMY



CIRCULAR CONSTRUCTION ECONOMY



Theory of DfD

Linear vs Circular Construction Economy

Linear Construction Economy

A Linear Economy follows a Make, Use, Waste pattern of material consumption, and does not readily allow for materials to be salvaged. Some energy may be derived from disposed materials through thermal recycling (i.e. incineration) or other destructive recycling options, however the value of the materials is reduced. For wood materials a portion of the carbon it stores is released into the atmosphere.

Material Input

A linear economy uses primarily new materials for every construction. Wood materials are derived exclusively from fresh lumber and post-industrial wood waste.

Standard construction

Typical construction assembles new buildings in such a way that deconstruction allowing for separation and reuse of materials is limited or requires significant labour making deconstruction economically challenging. Materials in standard construction are often damaged due to the permanence of their construction if deconstruction is attempted.

Demolition

Due to the difficulty of deconstruction, and the cost of material separation, buildings at the end of their life are demolished and few if any materials are separated for salvage. As they are difficult to separate, the mixed materials from the demolished building must be landfilled or incinerated (though this can generally only happen if some separation of burnable materials from non-burnable materials has occurred)

Landfill/Thermal Recycling

Circular Construction Economy

A circular construction economy foresees the end-of-life of a building and accounts for the extended lifespan of the materials it contains. A circular construction economy requires multiple interventions to the linear economy in order to be established, including infrastructure for material reuse, remanufacturing, and recycling, as well as industry commitment to changing standard construction practices. However, once the economy begins to establish it can be largely self-sustaining due to the flow of materials in and out of the built environment and can expand to incorporate new ways of salvaging materials.

Material Input

In a circular construction economy the material input should be derived firstly from deconstructed building stock and new materials are used as a supplement rather than primary resource.

Design for deconstruction

The design and planning of construction to allow for subsequent deconstruction and material salvage is essential to extending the usable lifespan of a building's materials.

Construction

Construction is done as with typical light wood frame construction, however the modifications detailed in the design phase are incorporated to allow for future deconstruction. Close collaborations between architect and contractors/subcontractors is essential at this stage.

Deconstruction

At this stage the deconstruction of the building is carried out as facilitated by the building's design. The materials of the building can then be funnelled into several salvage categories

Reuse

This option is for materials which can be directly reused in construction such as cladding, demountable finishes (e.g. flooring), fixtures, windows and doors, lumber, screws and hardware, etc.

Re-manufacture

This category of material salvage is for materials which cannot be directly reused in new construction without some repair, refurbishment, or other modification, but will be recycled for the same purpose. This includes items such as appliances, mechanical systems which may be returned to a manufacturer for refurbishment through systems such as Extended Producer Responsibility Programs. For materials like dimensional lumber, re-manufacturing may entail using the salvaged lumber as stock for finger-jointed lumber, or mass timber applications.

Upcycle

Materials which cannot be reused for their original purpose can still be used to make new materials for building which preserves or improves the value of the materials. Examples include making ornamental interior finishes from salvaged structural panels, or insulation from salvaged lumber.

Recycle

When a material is unsuitable for further use in construction even through upcycling, it could be recycled in one of two ways. First it could be used as feedstock for **non-construction manufacturing/material (re)use** operations or if it has no further utility and is not compostable it could be incinerated for energy production (**thermal recycling**). This is a final end-of-life option for materials which have no further use in higher value salvage categories

Landfill

A small amount from any deconstruction project can be expected to be landfilled. While the aim of a circular economy is to reuse, repurpose, or otherwise salvage as much material as possible, it is impossible to completely avoid waste in construction. A common saying in the sustainable building industry is that the most sustainable building is one that is not built. Nevertheless, the goal of a circular construction economy and design for deconstruction should be to reduce the amount of wasted materials as much as possible.

The Future? Seven Generations of Wood Use

In a robust circular economy, construction materials can be reused, re-purposed, or recycled many times before they are discarded. Each use of a wood construction material in a building extends that material's lifespan for yet another generation buildings, which as mentioned in the introduction is around 70 years. The following diagram shows how a single piece of dimensional lumber could be reused as many as seven times for a total usable lifetime of nearly 500 years. Each previous generation of use can feed into the next direct generation or may be down-cycled to subsequent generations depending on the quality of the material.

Seven Generations for Wood Materials

① Whole wood
Whole wood is salvaged during primary deconstruction, and can be reused (generally in non-structural applications) or may be used in engineered products such as finger-jointed lumber, OSB, or wood fibre insulation

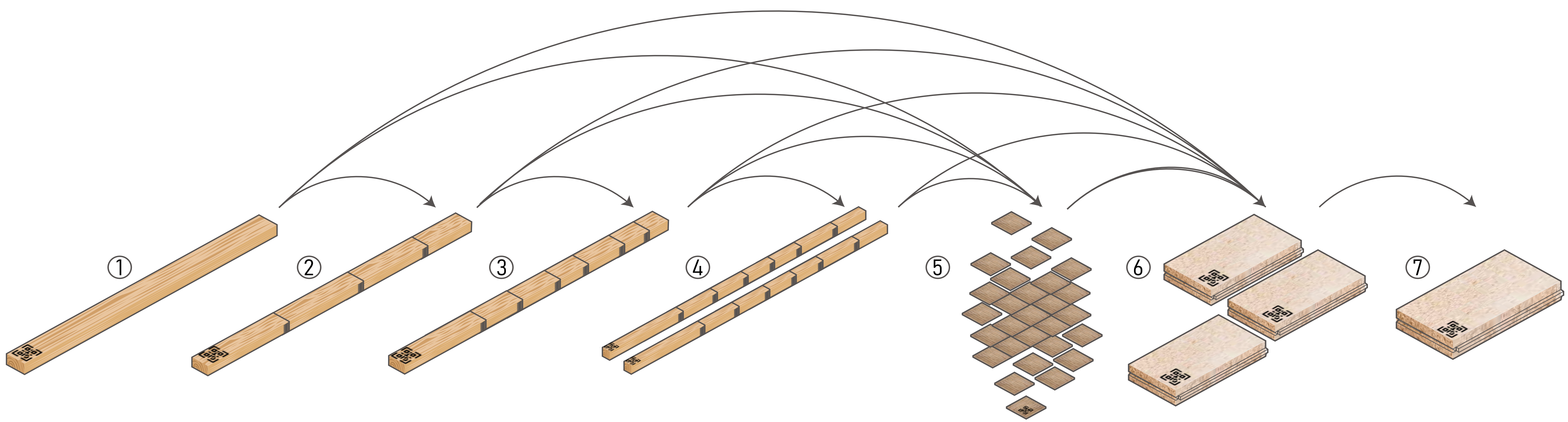
②③ Finger-Jointed Lumber
May be used for light wood structural purposes (pending grading and code acceptance), or used in mass timber products such as CLT, DLT, and glulam. May be recycled into more finger-jointed lumber providing the number of joints doesn't compromise the strength of the board.

④ Non-structural whole wood
Whole wood and finger-jointed lumber can be milled to smaller sizes for non-structural reuse.

⑤ Finishes and Fixtures
Finishes such as cladding, flooring, and interior wall panels can be made from wood that no longer has use in solid-wood applications. Use in furniture and other non-construction recycled products are also a possibility.

⑥ Wood fibre insulation
With no further use, wood products may be shredded/ refined into a range of insulation products including exterior insulation boards, flexible batt insulation, and blown-in fibre. other fibre or particle based products may also be made such as particleboard and MDF.

⑦ End of life
Wood fibre insulation and other similar products can theoretically be recycled until the fibres or particles are too small to be formed into new products. At that point the panels could be used for waste-to-energy, or depending on the compositon of adhesives and additives, composted or disposed.



Principles

The following principles are the foundation for design for deconstruction in light wood frame. These principles are adapted from The Canadian government's Guide for Design for Disassembly (CSA Z782-06) which sets out general guidelines for designing for deconstruction and disassembly.

The Guidebook applies those principles to typical light wood frame construction to show the justification for the alterations made to standard construction which allows for deconstruction.

6 Principles

Design for Deconstruction

1. DISASSEMBLABILITY

The ability to take apart materials, components, or structures easily without damaging them.

In light wood frame construction, disassembly refers to designing the structure so that individual components, such as studs, joists, and sheathing, can be removed without damaging the materials. This could involve using mechanical fasteners like screws instead of adhesives or nails, which makes it easier to deconstruct the building without breaking or splintering the wood. Note that attention to seismic requirements and use of appropriate design values is necessary when using screwed connections. Careful planning of joints and connections ensures that parts can be taken apart systematically, allowing for future repairs or reuse.

2. SIMPLICITY

Keeping the design straightforward, with minimal complexity, making it easier to build, disassemble, and reuse.

Simplicity means designing the light wood frame structure in a straightforward manner, with minimal complexity in its layout and assembly. By reducing the number of unique parts or complex joints, the construction process becomes easier, faster, and less prone to errors. Simple, repeatable design elements like standard framing techniques (platform or balloon framing) make the building easier to disassemble or modify in the future. Simplicity also improves material efficiency and minimizes construction waste.

3. REUSABILITY

The capability to use components again in the same or different applications, without significant modification.

Reusability in light wood frame construction focuses on ensuring that wood components such as beams, studs, and panels can be re-purposed. By designing with standardized sizes and untreated wood, components may enable reuse in future buildings or other projects. Avoiding treatments or coatings that might make the wood difficult to handle later helps maintain the material's quality for reuse. The goal is to prolong the service and lifecycle of these materials, making them valuable beyond the building's lifespan.

4. RECYCLEABILITY

The potential for materials to be processed and transformed into new products, reducing waste.

In this context, recycleability means using wood and other materials that can be easily processed into new products after the building is deconstructed. For instance, wood from light frame structures could be chipped and used in products like particleboard or insulation. Recycleability is enhanced by choosing materials with minimal chemical treatments or finishes, and designing for easy separation of wood from other materials like insulation, drywall, or metal connectors, which makes recycling processes more efficient.

5. INTERCHANGEABILITY

The ability to swap parts or components with others of the same type, allowing for easy replacements or upgrades.

Interchangeability in light wood frame construction means designing components so that they can be replaced with new or identical ones without requiring major modifications. This involves using standard lumber dimensions (such as 2x4s, 2x6s) and connectors that fit universally in various parts of the structure. Interchangeable parts allow builders to easily replace damaged sections, reducing waste and increasing the building's lifespan by enabling upgrades or changes without needing to demolish large sections.

6. FLEXIBILITY

The design's capacity to adapt to different needs, uses, or configurations over time.

Flexibility in light wood frame construction refers to designing a structure with the ability to adapt to future changes. For example, walls could be designed to allow easy modification, such as adding new windows or doors, or even expanding rooms. This might involve using modular components or leaving space within walls for easy rerouting of electrical or plumbing systems. Flexibility allows buildings to evolve according to changing needs without requiring significant demolition or reconstruction.

Details

How to detail design for deconstruction?

This section contains examples of typical light wood frame assemblies which have been designed for deconstruction. Examples are given of roof, window, inter-storey, and foundation assemblies which are designed for deconstruction.

The details pictured in this section are design to above an R22 effective insulation value which is the recommended performance for climate zone 4 (i.e. South Western British Columbia). The exact specifications of insulation, cladding, and structural requirements will be different for every project and these assemblies are meant to serve only as examples of possible solutions. Common variations in material selection is presented both in the assembly drawings and in the Material Guide on page 40, which are intended to serve as a baseline resource for putting together specifications for construction details.

Notes on
Detail Variations

The basic wall shown across the different details is made with a rain screen ventilated façade over 60mm wood fibre insulation board, 19mm plywood sheathing is used to help support the weight of the cladding and insulation and to give a reliable screwed attachment in the event that the insulation/furring screws do not go through a joist. The structure is a 89mm wall filled with hemp batt insulation and is covered on the inside with 13mm drywall. Wood fibre insulation board is used as exterior insulation in these cases as it allows for the omission of a weather resistant barrier (WRB) membrane layer, such as building paper, because the wood fibre insulation itself acts as the WRB. Wood fibre insulation is also preferable to many non-biobased insulations for its low embodied carbon.

The specifications of this base wall were chosen to show the minimum amounts of material that may be used to conform with base thermal and structural requirements, they are intended as an example and should be modified as needed for different structural requirements.

Each type of assembly shows a variation that uses mineral wool in place of the wood fibre and hemp insulation. In these cases note the difference in how the WRB is detailed.

Using mineral wool may be desirable in cases where a non-combustible or non-biobased (but still vapour permeable) assembly is preferred or required. For example, this may be preferable in constructions where a very high interior moisture load is expected—such as in high-occupancy residences—and the designer wishes to reduce mould growth potential (**Appendix B** shows detailed mould growth simulations for bio-based and non-bio-based insulations and the thresholds for requiring a vapour retarder).

Vapour barriers/retarders

As one of the goals of design for deconstruction is to simplify extraneous construction elements wherever possible, the details presented in this guidebook are designed without the use of a polyethylene vapour barrier. Instead the interior surface of the walls, which are painted with an acrylic latex paint, act as a vapour retarder. As the assemblies are vapour open and the sheathing is protected from cold by exterior insulation the condensation--and thus mould growth risk--is mitigated. For a complete analysis on the use of vapour-retardant paint and considerations for mitigating moisture and mould problems, please refer to **Appendix B.**

Weather Resistant Barriers

The base version of the walls employs wood fibre insulation board (WFIB) as both thermal insulation and weather resistant barrier (WRB) layer. In order for the WFIB to be effective as a WRB it should be covered with the cladding within the manufacturer's maximum recommended exposure timeframe. The non tongue-and-groove intersections of the WFIBs—such as at corners and apertures—should be sealed with a vapour-permeable, flexible WRB tape. For cases where exposure time of the exterior insulation must be longer than the manufacturer guidelines for any reason, a non-adhesive, vapour-permeable WRB membrane should be applied and direct taping of the WFIB's can be omitted.

For the assemblies that employ Rockwool as the exterior insulation, a non-adhesive, vapour-permeable WRB/air barrier membrane must be installed against the sheathing.

Insulation Requirements

While the wall mock-up and base assemblies are designed for Climate Zone 4 the systems proposed here do not require significant modification to acheive the thermal performance required for different climate zones and provinces. Below is a chart of the effective insulation requirements for different regions in Canada. Note that the greatest fluctuation in thermal performance is in the roof assembly. Increased thermal performance can be accomodated by specifying thicker joists and rafters, however the proportion of exterior to interior insulation must be according to local building regulations.

Requirements for Thermal Resistance of Assemblies by Province

Locations	Wall		Cathedral Ceiling		Attic Ceiling		Code Reference
	RSI	R	RSI	R	RSI	R	
BC							BC Building Code 9.36.2.6
Zone 4	3.85*	R22*	5.28*	R30*	8.5*	R48*	Table 10.2.2.6
Zone 5	3.69	R21	4.67	R26	8.67	R49	Table 9.36.2.6-C
Zone 6	3.69	R21	4.67	R26	8.67	R49	Table 9.36.2.6-C
Zone 7A	3.69	R21	5.02	R28	10.43	R59	Table 9.36.2.6-C
Zone 7B	3.96	R22	5.02	R28	10.43	R59	Table 9.36.2.6-C
Zone 8	3.96	R22	5.02	R28	10.43	R59	Table 9.36.2.6-C
Ontario							Ontario Building Code 12.2.1.2.
Zone 5	4.1	R23	6.2**	R35**	10.6	R60	Table SB 5.5-5 -2017
Zone 6	4.1	R23	6.2**	R35**	10.6	R60	Table SB 5.5-6 -2017
Zone 7	4.1	R23	7.2**	R40**	12.5	R71	Table SB 5.5-7 -2017
Quebec							Quebec Construction Code 11.2.2.1
≤7A	4.31	R24.5	7.22***	R41***	7.22***	R41***	Table 11.2.2.1.-A
≥7B	5.11	R29	9.00***	R51***	9.00***	R51***	Table 11.2.2.1.-B

*Vancouver Building By-Law 2019 Rev. July 25, 2023.

**For roofs with only exterior insulation.

***Quebec building code does not distinguish between cathedral and attic type roofs.

Data is accurate as of January 2025.

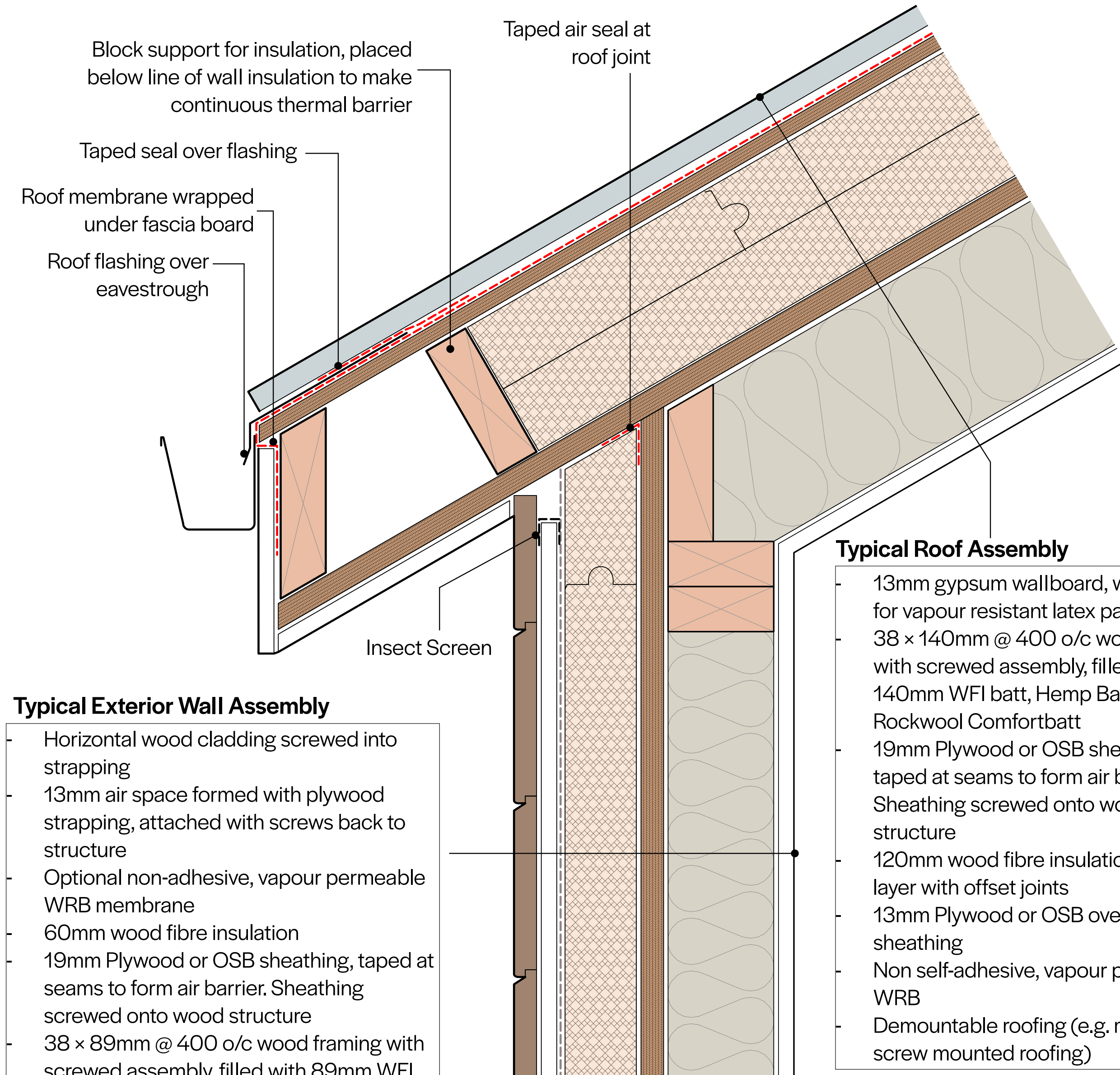
Screwed connections and shear walls

The details in this guidebook use screwed connections wherever possible to facilitate deconstruction. While it is currently uncommon for screws to be used in the construction of shear walls, research by FPInnovations does provide engineering design guidelines for the seismic force modification factor and inter-storey drift required for sound shear-wall construction using screws.[3] The BC Building Code (section 9.23.3) also provides sizing and spacing recommendations for the structural use of wood screws.

While nailed structures can be successfully deconstructed, the labour required to do so is significant and can add excessive cost and time to a deconstruction project. If nailed connections absolutely must be used for structural requirements, the application of the nails should be limited to the minimum amount required so that future removal is not entirely impossible.

[3] Chun Ni, Performance of Shear Walls with Wood Screws Under Lateral Loads, research report no. W-3071, 17, March 2014, accessed May 3, 2023,https://library.fpinnovations.ca/en/

Roof



Typical Roof Assembly

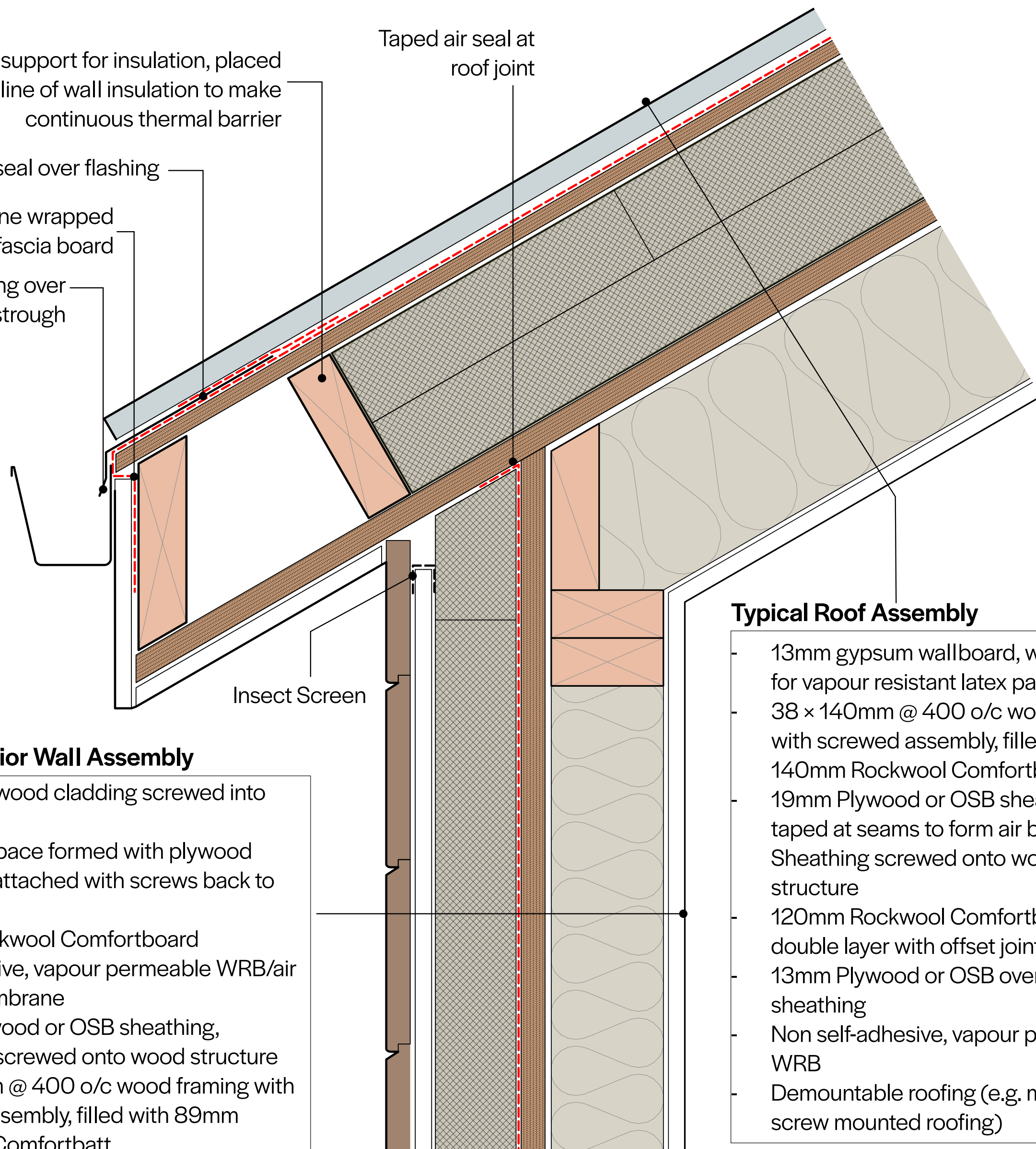
- 13mm gypsum wallboard, with option for vapour resistant latex paint
- 38 × 140mm @ 400 o/c wood framing with screwed assembly, filled with 140mm WFI batt, Hemp Batt or Rockwool Comfortbatt
- 19mm Plywood or OSB sheathing, taped at seams to form air barrier. Sheathing screwed onto wood structure
- 120mm wood fibre insulation, double layer with offset joints
- 13mm Plywood or OSB over-roof sheathing
- Non self-adhesive, vapour permeable WRB
- Demountable roofing (e.g. metal, tiles, screw mounted roofing)

Typical Exterior Wall Assembly

- Horizontal wood cladding screwed into strapping
- 13mm air space formed with plywood strapping, attached with screws back to structure
- Optional non-adhesive, vapour permeable WRB membrane
- 60mm wood fibre insulation
- 19mm Plywood or OSB sheathing, taped at seams to form air barrier. Sheathing screwed onto wood structure
- 38 × 89mm @ 400 o/c wood framing with screwed assembly, filled with 89mm WFI Batt, Hemp Batt, or Rockwool Comfortbatt*
- 38mm service cavity formed with 38 × 89mm boards
- 13mm gypsum wallboard, with option for vapour resistant latex paint

Design for deconstruction details	Roof with WFI
Notes: Effective R-value Roof = R38 Effective R-Value Wall = R24.4	

Roof Variations



Typical Roof Assembly

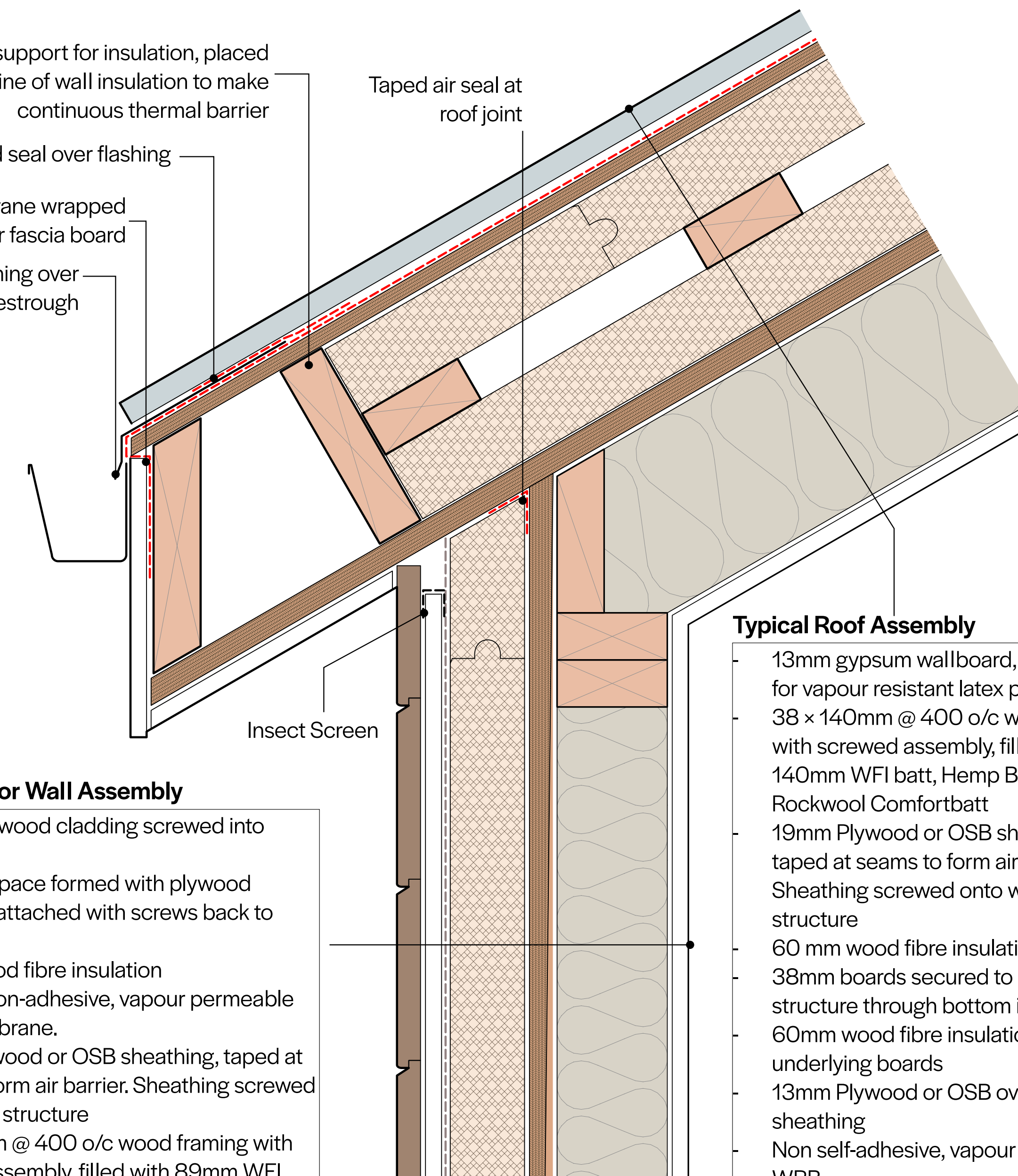
- 13mm gypsum wallboard, with option for vapour resistant latex paint
- 38 × 140mm @ 400 o/c wood framing with screwed assembly, filled with 140mm Rockwool Comfortbatt
- 19mm Plywood or OSB sheathing, taped at seams to form air barrier. Sheathing screwed onto wood structure
- 120mm Rockwool Comfortboard, double layer with offset joints
- 13mm Plywood or OSB over-roof sheathing
- Non self-adhesive, vapour permeable WRB
- Demountable roofing (e.g. metal, tiles, screw mounted roofing)

Typical Exterior Wall Assembly

- Horizontal wood cladding screwed into strapping
- 13mm air space formed with plywood strapping, attached with screws back to structure
- 64mm Rockwool Comfortboard
- Non-adhesive, vapour permeable WRB/air barrier membrane
- 19mm Plywood or OSB sheathing, Sheathing screwed onto wood structure
- 38 × 89mm @ 400 o/c wood framing with screwed assembly, filled with 89mm Rockwool Comfortbatt
- 38mm service cavity formed with 38 × 89mm boards
- 13mm gypsum wallboard, with option for vapour resistant latex paint

Design for deconstruction details	Roof with Rockwool

Notes:
Effective R-value Roof = R42.5
Effective R-Value Wall = R26.9



Typical Roof Assembly

- 13mm gypsum wallboard, with option for vapour resistant latex paint
- 38 × 140mm @ 400 o/c wood framing with screwed assembly, filled with 140mm WFI batt, Hemp Batt or Rockwool Comfortbatt
- 19mm Plywood or OSB sheathing, taped at seams to form air barrier. Sheathing screwed onto wood structure
- 60 mm wood fibre insulation
- 38mm boards secured to roof structure through bottom insulation
- 60mm wood fibre insulation secured to underlying boards
- 13mm Plywood or OSB over-roof sheathing
- Non self-adhesive, vapour permeable WRB
- Demountable roofing (e.g. metal, tiles, screw mounted roofing)

Typical Exterior Wall Assembly

- Horizontal wood cladding screwed into strapping
- 13mm air space formed with plywood strapping, attached with screws back to structure
- 60mm wood fibre insulation
- Optional non-adhesive, vapour permeable WRB membrane.
- 19mm Plywood or OSB sheathing, taped at seams to form air barrier. Sheathing screwed onto wood structure
- 38 × 89mm @ 400 o/c wood framing with screwed assembly, filled with 89mm WFI Batt, Hemp Batt, or Rockwool Comfortbatt
- 38mm service cavity formed with 38 × 89mm boards
- 13mm gypsum wallboard, with option for vapour resistant latex paint

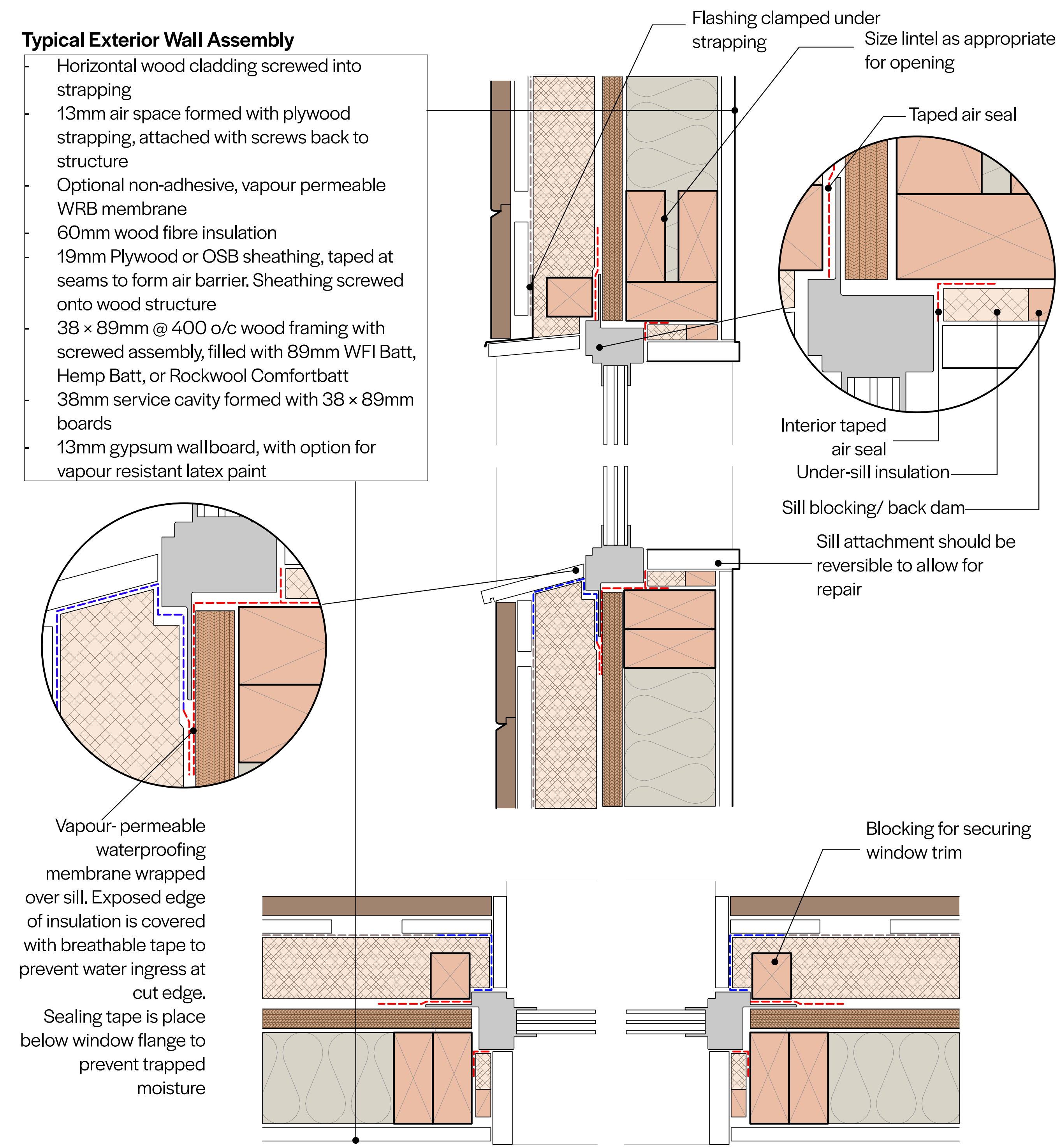
Design for deconstruction details	Roof with WFI - layered construction

Notes:
The roof assembly variation allows for thick exterior insulation without the need for costly, extra-long insulation screws. The outermost layer of insulation is secured to the boards rather than the roof structure.
Effective R-value Roof = R38
Effective R-Value Wall = R24.4

Roof Variations

A possible variation on the roof assembly is a layered system (shown on page 29) which allows for construction without specialized, extra-long construction screws for attaching thick layers of insulation. The first layer of insulation is overlayed with solid wood boards that create an attachment layer for the second layer of insulation. In this way the first layer of insulation and the boards are screwed directly to the roof structure and the second layer of insulation is attached to the boards, allowing for standard length construction screws to be used to secure each layer. This has an advantage of reducing the cost of hardware for the insulation layer and the use of standard sized screws allows for easier deconstruction by simplifying the number of screw types used.

Window

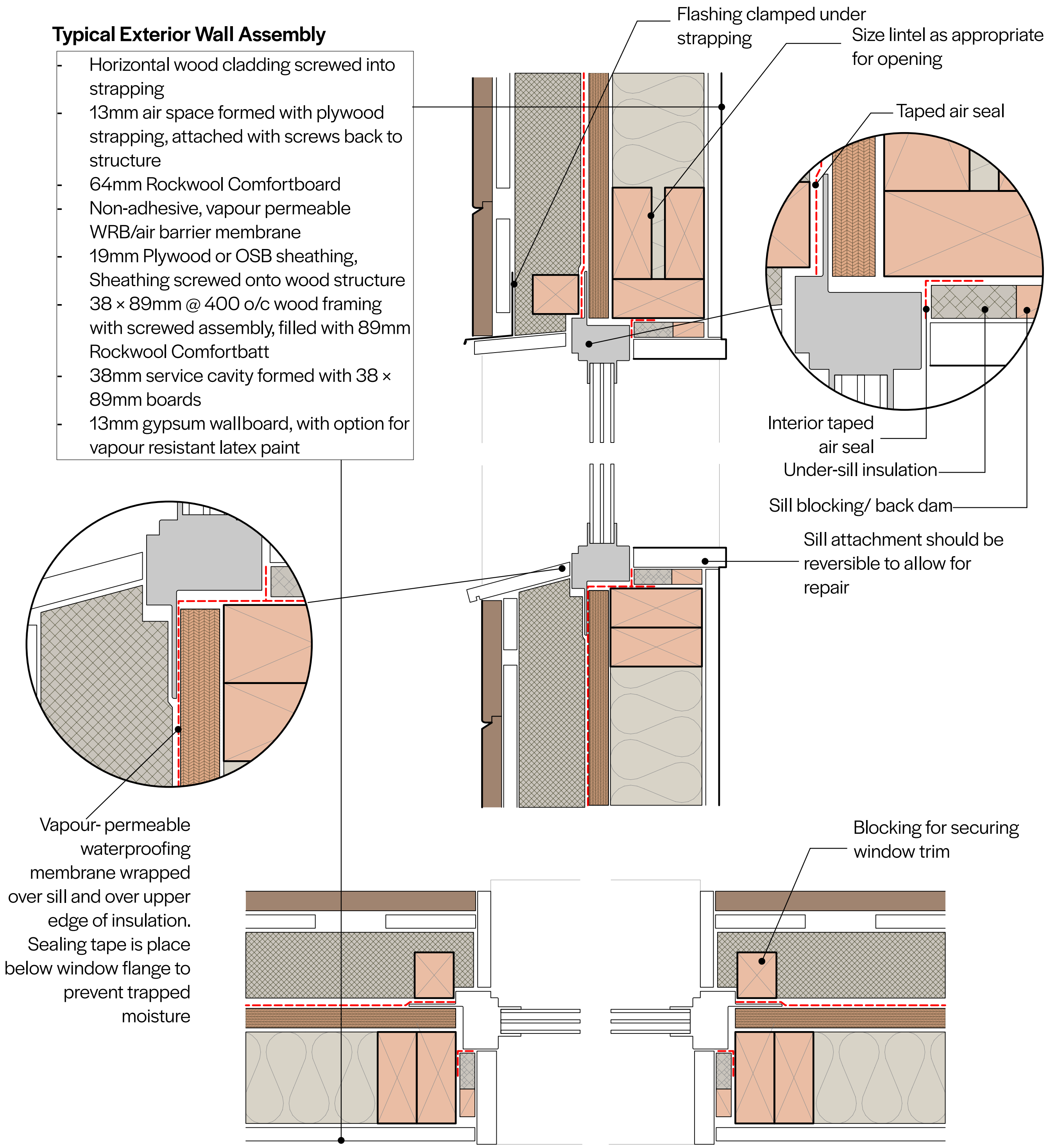


Design for deconstruction details	**Window - flanged**
Notes: Effective R-Value Wall = R24.4 Window detailing will depend on selected window type and material.	

Window Variations

Typical Exterior Wall Assembly

- Horizontal wood cladding screwed into strapping
- 13mm air space formed with plywood strapping, attached with screws back to structure
- 64mm Rockwool Comfortboard
- Non-adhesive, vapour permeable WRB/air barrier membrane
- 19mm Plywood or OSB sheathing, Sheathing screwed onto wood structure
- 38 x 89mm @ 400 o/c wood framing with screwed assembly, filled with 89mm Rockwool Comfortbatt
- 38mm service cavity formed with 38 x 89mm boards
- 13mm gypsum wallboard, with option for vapour resistant latex paint

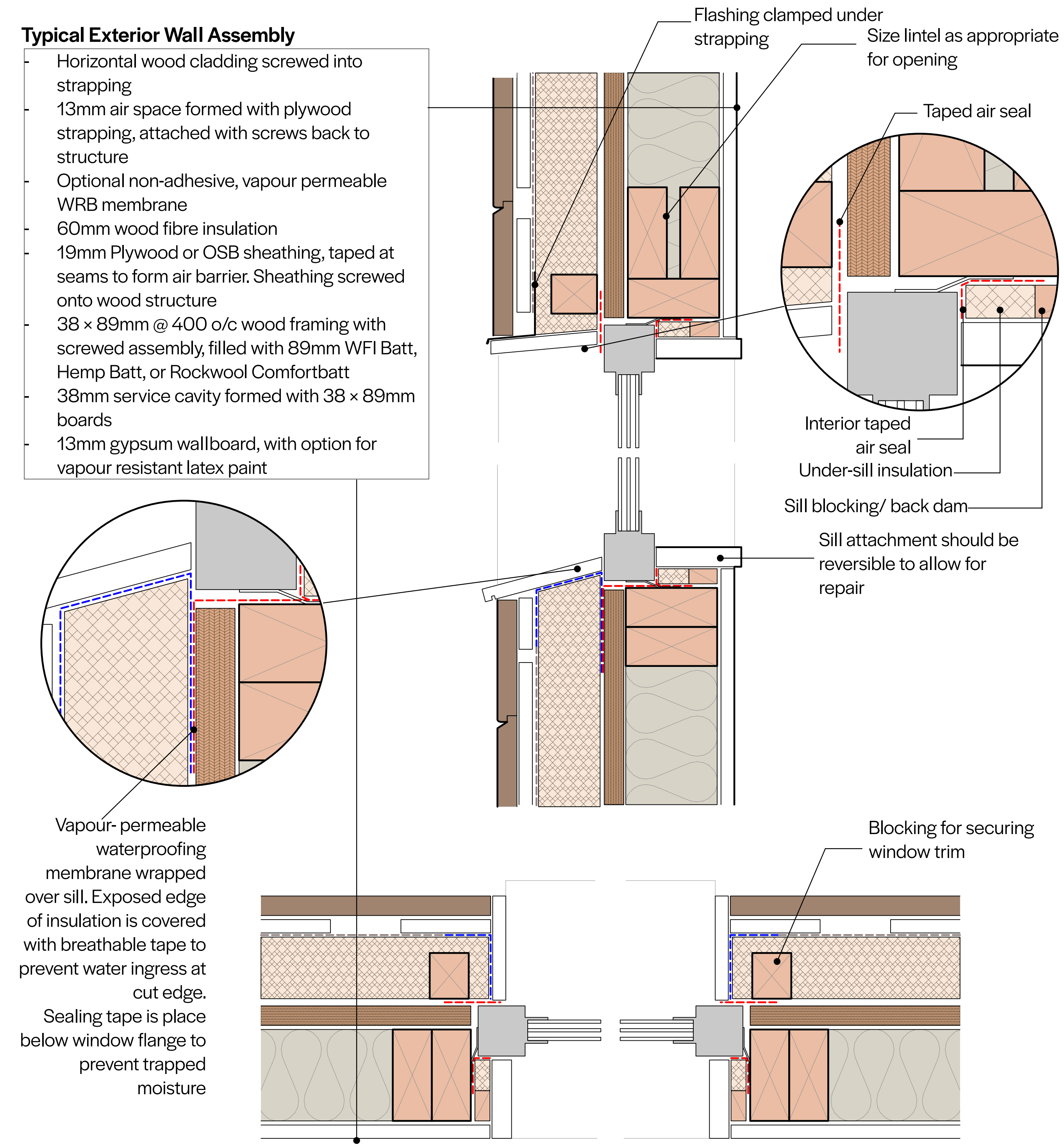


Design for deconstruction details	Window with Rockwool- flanged

Notes:
Effective R-Value Wall = R26.9
Window detailing will depend on selected window type and material.

Typical Exterior Wall Assembly

- Horizontal wood cladding screwed into strapping
- 13mm air space formed with plywood strapping, attached with screws back to structure
- Optional non-adhesive, vapour permeable WRB membrane
- 60mm wood fibre insulation
- 19mm Plywood or OSB sheathing, taped at seams to form air barrier. Sheathing screwed onto wood structure
- 38 x 89mm @ 400 o/c wood framing with screwed assembly, filled with 89mm WFI Batt, Hemp Batt, or Rockwool Comfortbatt
- 38mm service cavity formed with 38 x 89mm boards
- 13mm gypsum wallboard, with option for vapour resistant latex paint



Design for deconstruction details	Window - non-flanged

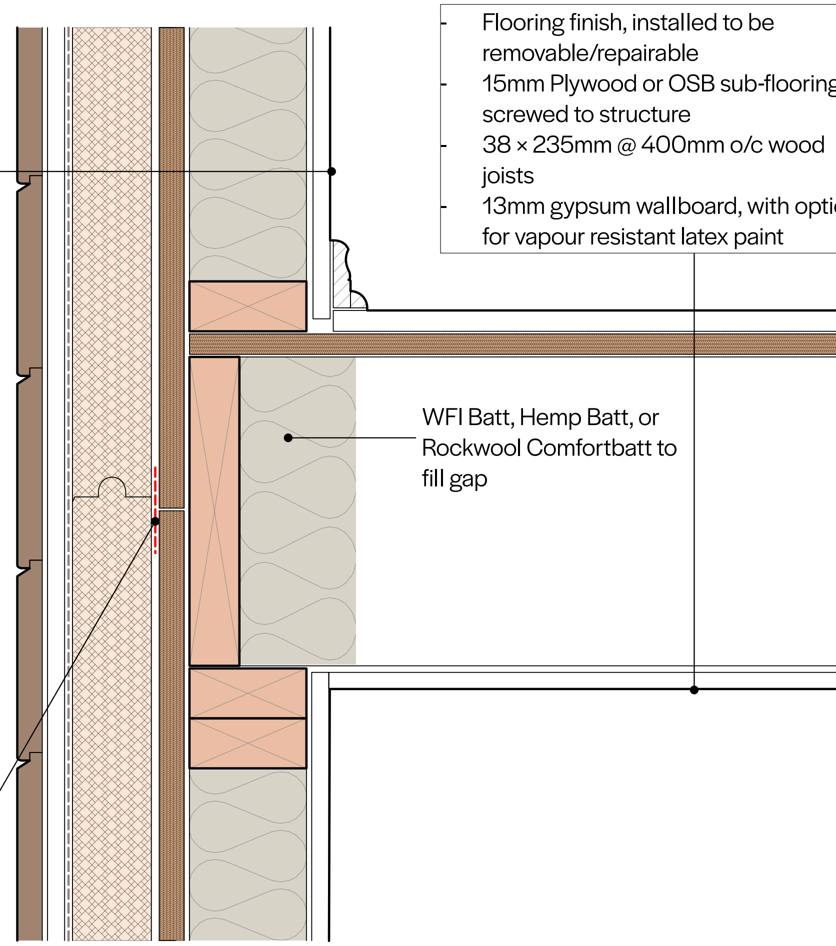
Notes:
Effective R-Value Wall = R24.4
Window detailing will depend on selected window type and material.

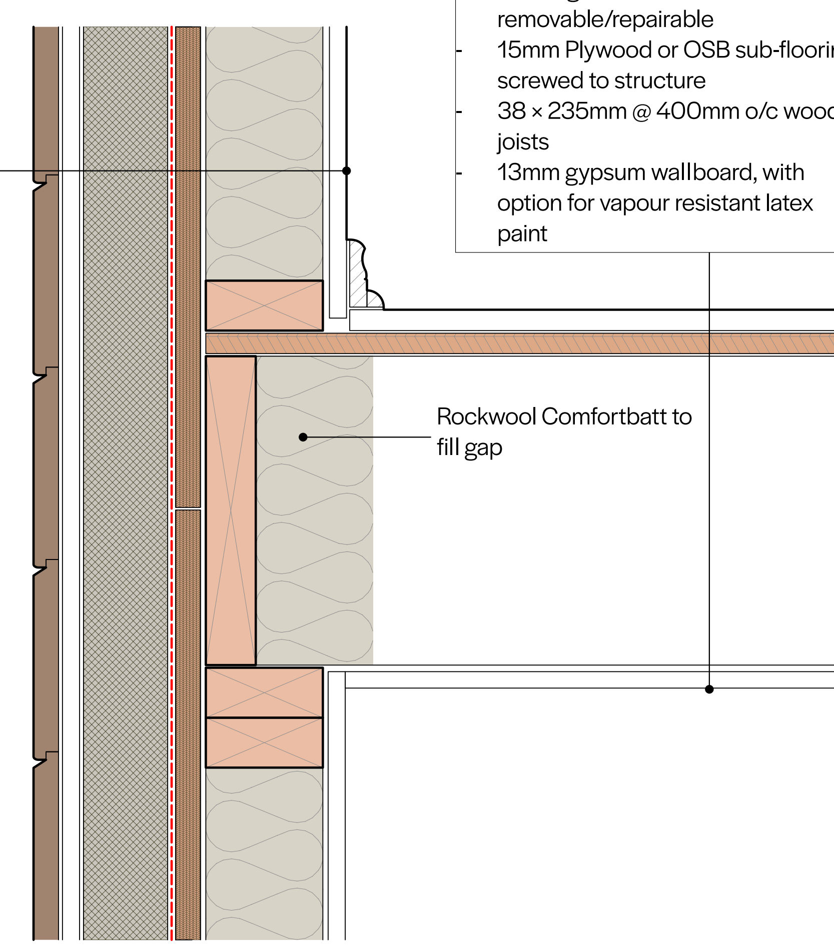
Window Variations

While many light wood frame buildings in Canada, particularly smaller-scale residences, use flanged windows in their construction, non-flanged windows are becoming increasingly common. From a design-for-deconstruction standpoint non-flanged windows are actually preferable as they can be upgraded, repaired, or replaced without disrupting the exterior cladding or insulation. For a flanged window to be replaced the flanged must be exposed in order to remove the window which requires removing and replacing portions of the exterior cladding and insulation.

When using tape to air-seal the interior side of a non-flanged window special care must taken to avoid gaps at the attachment clips. See the detail on page 35 for complete assembly information.

Interstorey Wall

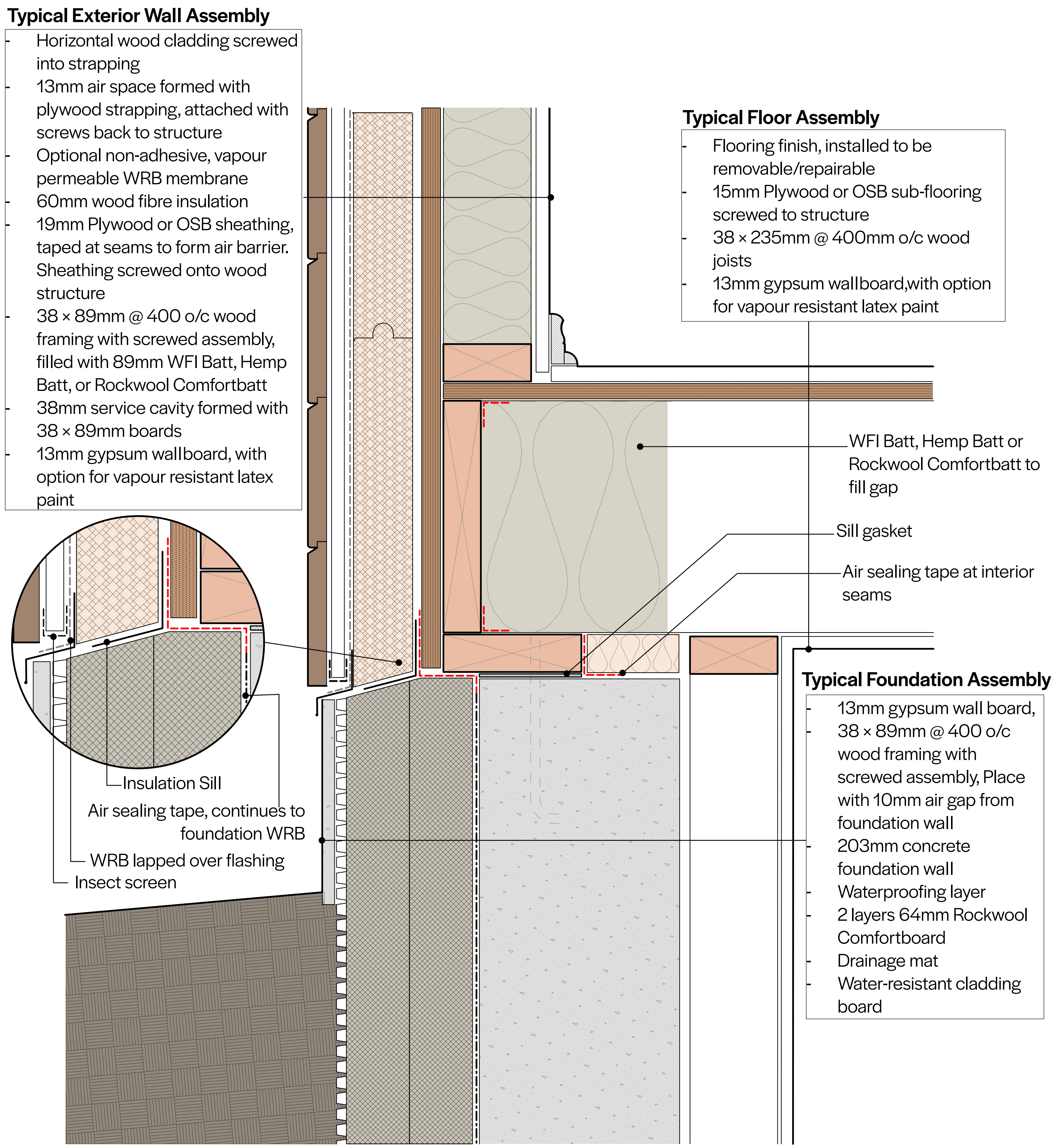




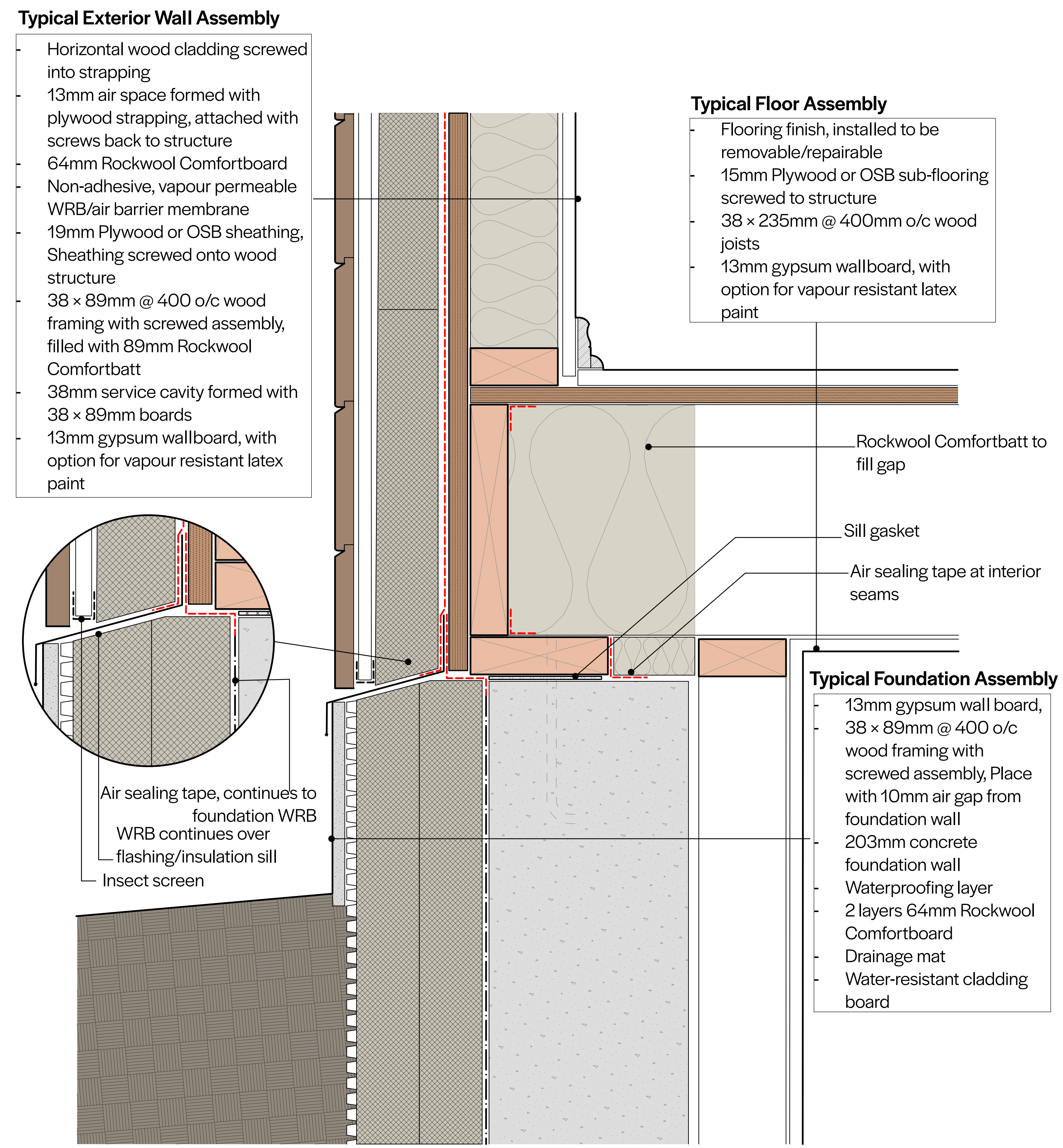
Design for deconstruction details	Interstorey Wall with WFI
Notes: Effective R-Value Wall = R24.4	

Design for deconstruction details	Interstorey Wall with Rockwool
Notes: Effective R-Value Wall = R26.9	

Foundation



Design for deconstruction details	Foundation - conditioned basement
Notes: Effective R-Value Wall = R24.4 Effective R-Value Foundation = R22.7	



Design for deconstruction details	Foundation with Rockwool- conditioned basement
Notes: Effective R-Value Wall = R26.9 Effective R-Value Foundation = R22.7	

Materials

As shown in the previous details, there are many possible variations in form and material for light wood frame construction. The specification of materials is dependent on many factors including desired performance, environmental footprint, cost and availability, and aesthetics. This material guide shows some of the possible options for deconstructable and sustainable materials for all layers of a construction, and compares their performance and cost per square metre.

There are many materials possible for every kind of light wood frame building, and the layers depicted here are meant only as reference for possible material selection. This selection of materials is not meant to endorse any specific brand or type of material but rather compares the value and performance of different materials.

Vapour Permeable Membranes

MAJVEST by Siga
54 US PERM
Exterior water-resistive barrier and air barrier for walls and roof

TYVEK HomeWrap by DuPont
56 US PERM
Exterior water-resistive barrier and air barrier for walls and roof

Interior Tapes

TUCK TAPE by cantech
0.068 US PERM
Design to seal, seam PE, vapour barrier

Rissan by Siga
0.088 US PERM
Air barrier accessory and vapour barrier tape

TESCON VANA by Pro clima
8 US PERM
Airtight tape for membranes and airtight wood-based panels

Exterior Tapes

WIGLUV by Siga
1.7 US PERM
Vapour Permeable, single-sided tape used to bond overlaps and joints. Good for connecting between different materials

Tyvek Tape by DuPont
< 1 US PERM
Exterior seam tape, effective air and water barrier

TESCON VANA by Pro clima
8 US PERM
Wind proofing and rainproofing of underlay and wall lining membranes and underlay panels. Airtight taping in vapour open application

WHAT WE USED	Most Common	Other Options!		

Exterior Finish

Wood (Cedar, Pine, Larch) Siding	Metal Siding / Roofing	Wood Fibre Cement Board	Hemp Fibreboard Cladding	Cork Cladding
R-0.9 / inch	R-0.5 - R-0.7 / inch	R-0.5 / inch	R-3.7 / inch	R-3.6 / inch
$4.00 - $7.00 / sq.ft	$7.00 - $35.00 / sq.ft	$5.50 - $9.00 / sq.ft	$6.00 - $10.00 / sq.ft	$8.00 - $12.00 / sq.ft

Exterior Insulation

Wood Fibre Rigid Insulation	Mineral Wood Rigid Insulation	Hempcrete Rigid Panels	Hemp Fibreboard Insulation	Corkboard Insulation
R-3.7 - R-4.0 / inch	R-4.0 / inch	R-2.4 - R-3.5 / inch	R-3.7 / inch	R-3.6 - R-4.0 / inch
$2.42 - $4.15 / sq.ft	$2.08 - $3.46 / sq.ft	$2.08 -$4.15 / sq.ft	$2.49 - $4.15 / sq.ft	$4.00 - $7.00 / sq.ft

Cavity Insulation

Hemp Batt Insulation	Fiberglass Batt Insulation	Mineral Wool Batt Insulation	Cotton (Denim) Batt Insulation	Wood Fibre Batt Insulation
R-3.5 / inch	R-3.2 - R-4.3 / inch	R-4.0 / inch	R-3.5 - R-3.7 / inch	R-3.6 / inch
$1.87 - $3.46 / sq.ft	$0.69 - $1.52 / sq.ft	$1.38 - $2.42 / sq.ft	$1.52 - $2.77 / sq.ft	$2.42 - $3.46 / sq.ft

Interior Finish

Gypsum Wallboard	New or Engineered Wood	Reclaimed Wood Panelling	Cork Panelling	Hemp Fibreboard Panelling
R-0.56 / inch	R-1.25 / inch	R-1.25 / per inch	R-3.6 / inch	R-3.7 / inch
$0.80 - $2.00 / sq.ft	$4.00 - $10.00 / sq.ft	$1.00 - $7.00 / sq.ft	$4.00 - $10.00 / sq.ft	$6.00 - $10.00 / sq.ft

Mock-Up Design

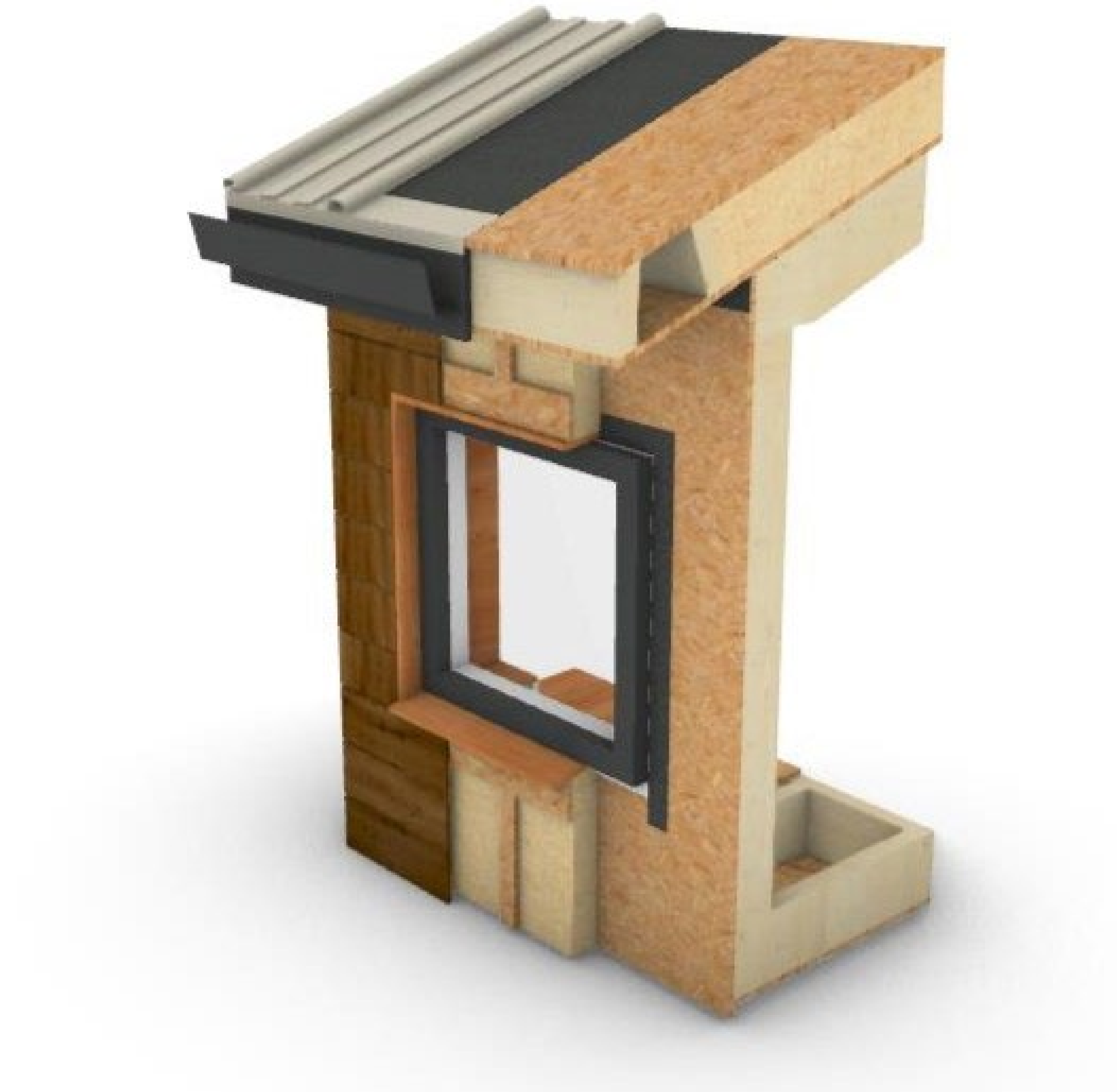
Part of the research process for this guidebook included the construction and deconstruction of a mock-up to simulate and troubleshoot the lifecycle of a design-for-deconstruction project. The mock-up combines the details shown in the previous section to construct a wall-window-roof system that was built and deconstructed.

Standard construction order and logics where used for the construction of the mock-up except where specified. For example, nails were replaced with screws, construction adhesives were avoided, and demountable cladding and roofing systems were used. The purpose of this mock-up was to show the variations to standard light wood frame construction that are necessary to allow for deconstruction, as well as to demonstrate the deconstruction process which could be scaled up for whole-building deconstruction.

This section will show a brief summary of the construction process to explain the differences to standard construction, then the final mock-up and complete deconstruction process will be shown.

Fun fact: Construction of this project took approximately 2.5 weeks, whereas deconstruction, including clean-up, took 5 hours.

Key materials for this build were generously provided by International Timberframes and Derek Fiddler, BCIT.



Construction

Construction Notes

Standard- tilt up wall panel construction was used, however all connections are made with screws.

Sheathing for shear-wall and roof where installed with screws at 150mm o/c for panel edges and 300mm o/c for intermediate supports per BCBC 9.23.3.5. Fastener spacing must be determined by anticipated seismic loading in a project's region, for the mock-up, Vancouver, BC was used as the "site" location to determine seismic requirements and climate.

Thermally protected blocking is added around the top and sides of window to create an attachment point for window trim. Window flashing is clamped under strapping (see Window details for further clarification)

A layer of insulation is added under the windowsill and trim to create a thermal break around the window.

Exterior side of sheathing is taped at seams (e.g. between panels and at wall/roof intersection) to create the air barrier layer. Interior seams of windows are also taped to create continuous air barrier.

Structure is screwed together

Attaching sheathing

Installing the window

Interior window insulation

Insulation around window

Interior-taped air sealing

Completed Mock-Up

Deconstruction

Deconstruction Notes

Deconstruction reverse the order of construction as detailed below.

1. Salvageable interior materials and components are removed. (e.g. flooring, cabinetry, fixtures, doors, etc.)

2. Recycleable interior materials (e.g. drywall, cavity insulation) and electrical/mechanical/plumbing systems are removed.

3. Walls of the house are stripped back to sheathing; Exterior cladding, strapping, insulation are removed.

4. Windows and air-sealing tapes and membranes are removed. Tape may be cut at seams or pealed depending on the end-use of the windows and sheathing.

5. Roof materials are removed. Any skylights are deconstructed in the same way as other windows.

6. Sheathing is deconstructed.

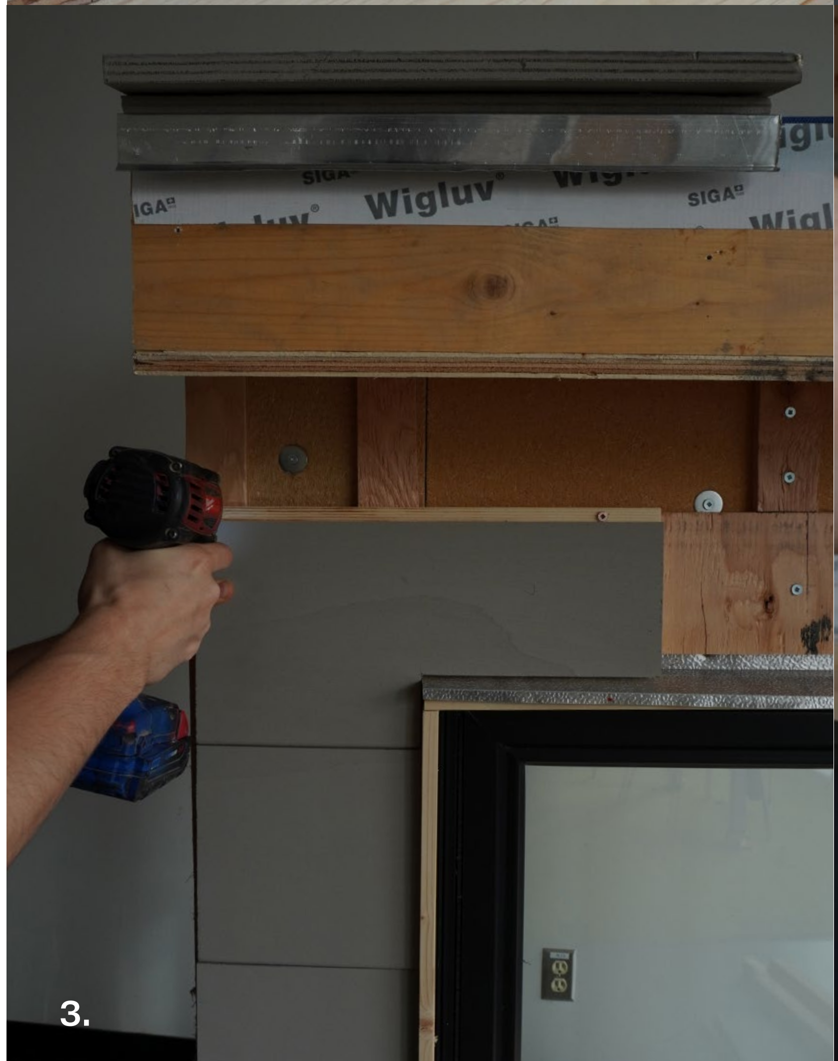
7. Structure is dismantled from top to bottom.

8. Foundations may be deconstructed or used as a base for rebuilding.

As shown in the final deconstructed image all the materials are in good condition, are well sorted, and are ready to be sent to future reuse and recycling streams. Even the screw connectors can be reused or sent to metal recycling (depending on their condition).

1.

2.



3.

3.

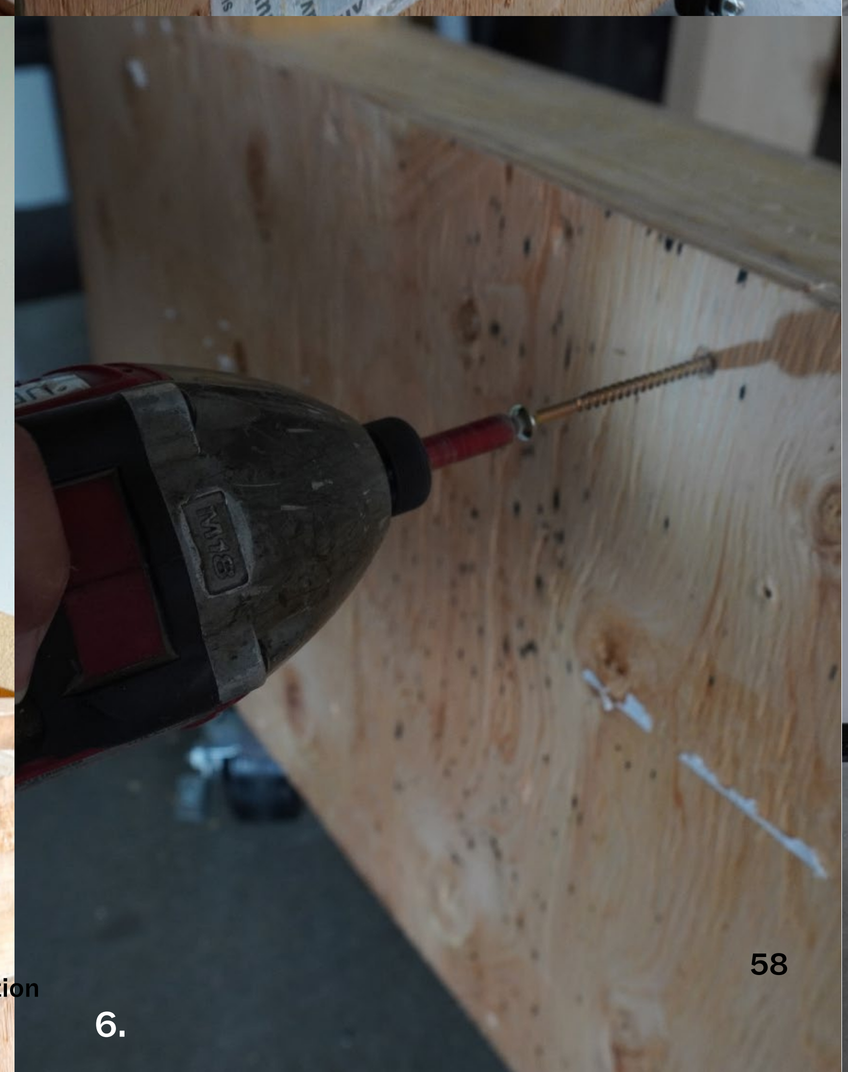
4.

4.

5.


5.

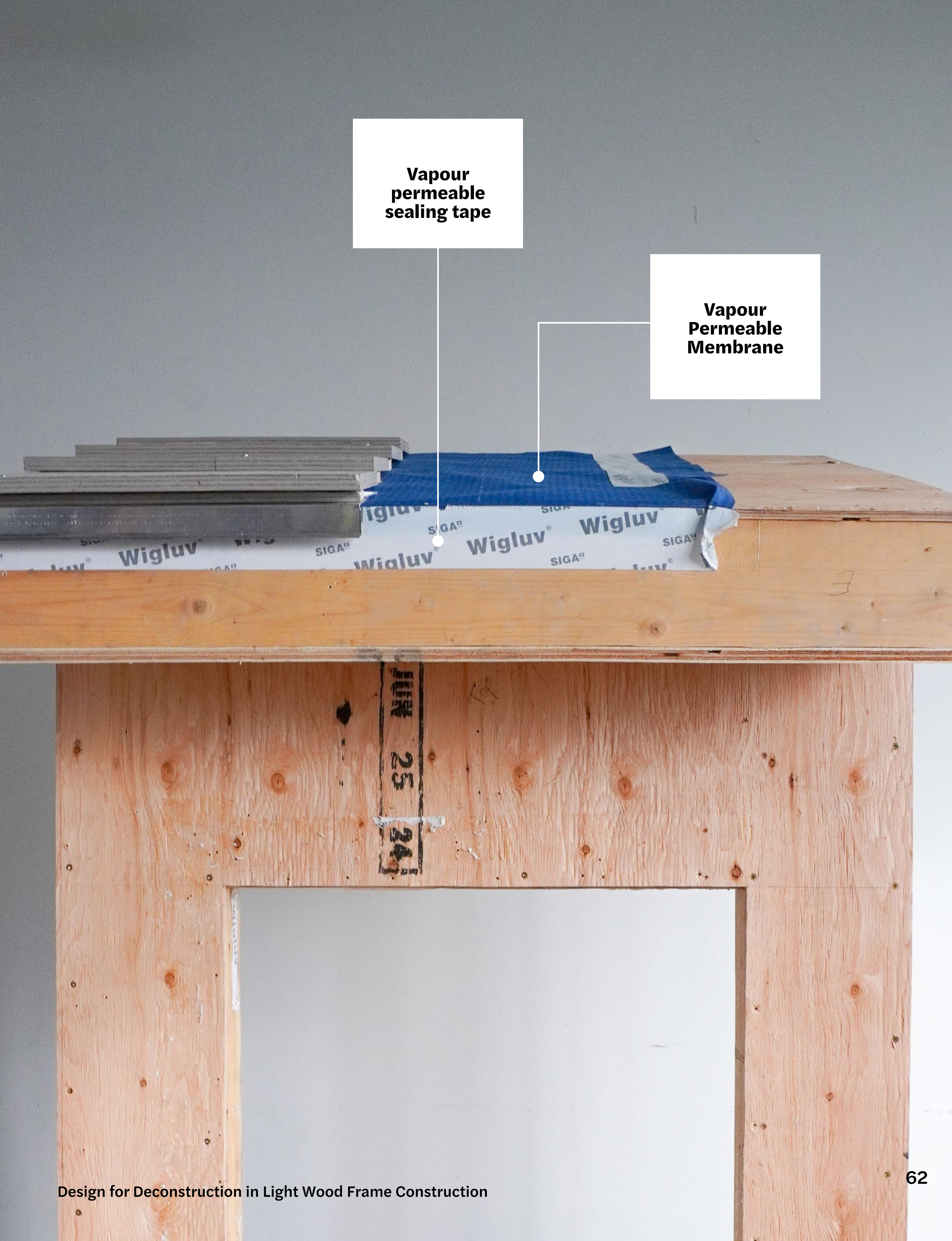

5.


6.


7.

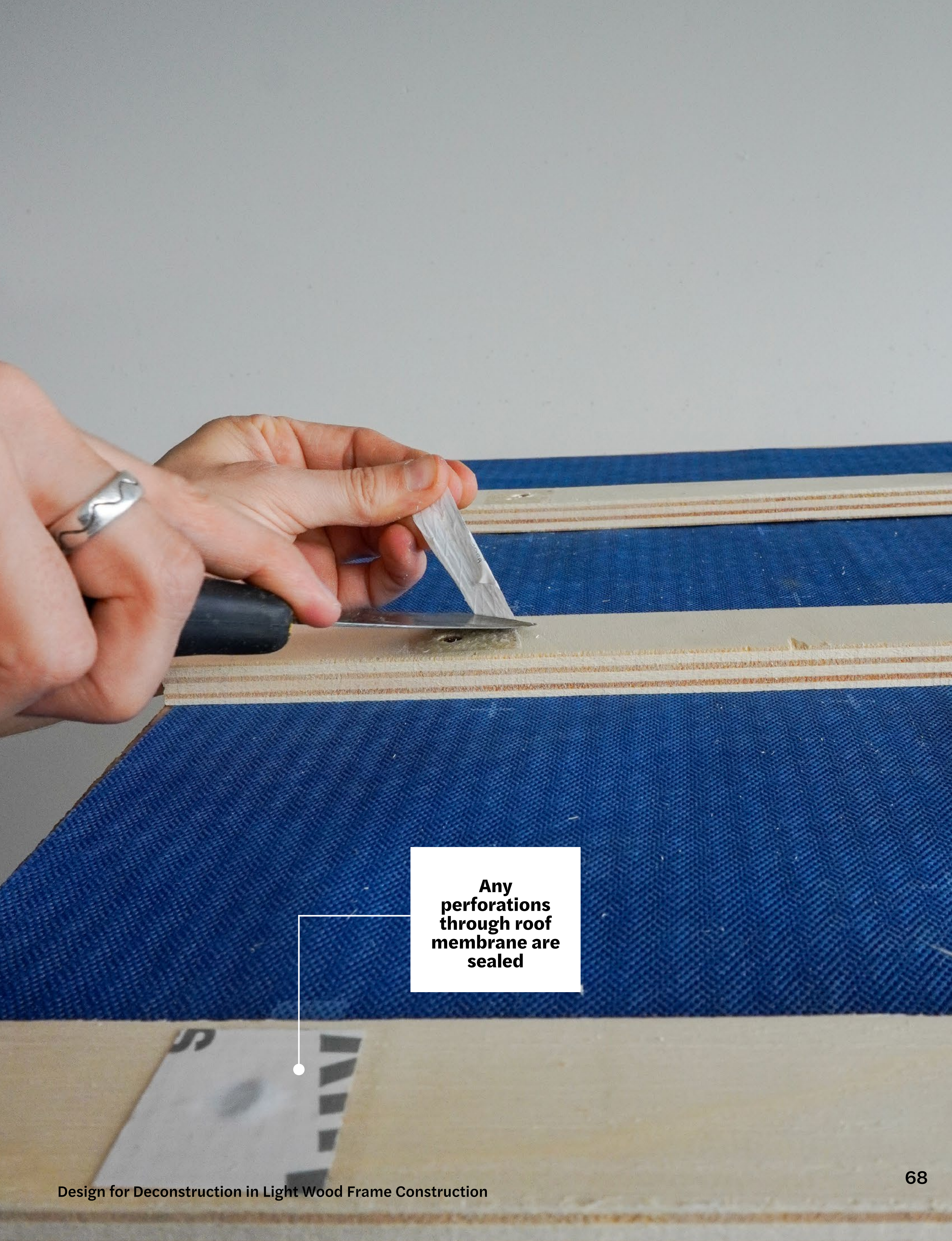

7.


Wall Framing


Vapour permeable sealing tape
Vapour Permeable Membrane


Vapour Permeable WRB wrapped around window sill

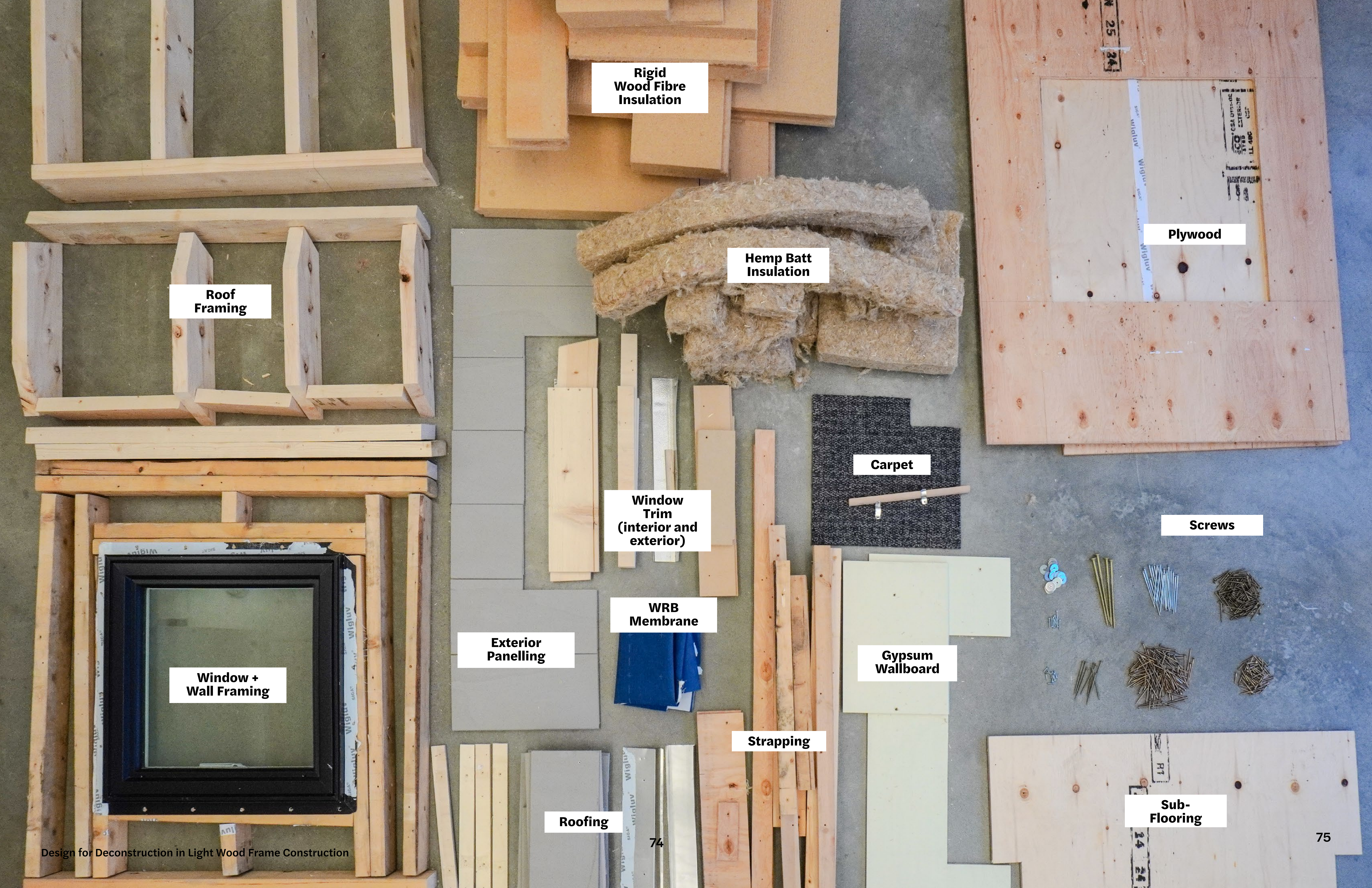

Blocking to attach window trim, encapsulated by exterior insulation


Any perforations through roof membrane are sealed


SIGA


SIGA
Wiglu


SIGA
1966


Rigid Wood Fibre Insulation
Plywood
Hemp Batt Insulation
Roof Framing
Carpet
Window Trim (interior and exterior)
Screws
WRB Membrane
Exterior Panelling
Gypsum Wallboard
Window + Wall Framing
Strapping
Roofing
Sub-Flooring

Additional Resources

Guidelines for design for disassembly and adaptability in buildings (CSA Z782-06), CSA Group, 2006: https://www.csagroup.org/store/

Manual of Recycling: Buildings as Sources of Materials. Annette Hillebrandt, Petra Riegler-Floors, Anja Rosen, and Johanna-Katharina, 2019: https://doi.org/10.11129/9783955534936

Opportunities for Circularity of Wood in Construction, Renovation and Demolition in Canada, Environment and Climate Change Canada, 2024: https://www.canada.ca/en/services/environment/conservation/sustainability/circular-economy/workshop-report-opportunities-circularity-wood-construction-renovation-demolition.html

The Feasibility of Recycling and Reusing Building Materials Found in Single-family Homes Built after 1970 in Metro Vancouver, Jacob Forrest, 2021: https://sustain.ubc.ca/about/resources/feasibility-recycling-and-reusing-building-materials-found-single-family-homes-built

Photo Credits

Cover: ungvar - stock.adobe.com

Page 2: The folded sawn wood lies in the woodpile, alexandrabeganskaya on Evato Elements.

Page 5: ungvar - stock.adobe.com

Page 8: Wooden frame house under construction near forest, anatoliy_gleb on Evato Elements.

All other images and diagrams: Kaia Nielsen-Roine & Hemi Patel.

Appendix A: Deconstruction Elements Checklist

This checklist can be included with a project's drawing set to guide future deconstruction efforts by indicating which building elements are likely to be deconstructable and salvageable. The boxes to indicate if a particular design-for-deconstruction strategy was employed in a project.

Including evidence of design-for-deconstruction strategies in building design can be used to gain an assumed carbon emission reduction for compliance with City of Vancouver Building Bylaw's new embodied carbon requirements. See the City of Vancouver Embodied Carbon Guidelines (2023) for complete details.

A version of this checklist which is formatted to be included in a drawing set can be found at:

https://blogs.ubc.ca/design4deconstruction/guidebook/.

Deconstruction Elements Checklist

Structure

- ○ Reversible connections
- ○ Minimal connector variance
- ○ Recycled/reused materials

Air Sealing

- ○ Removable without damage to substrate

Membranes

- ○ Removable/mechanically attached
- ○ Vapor permeable
- ○ Recyclable

Roofing

- ○ Repairable
- ○ Replaceable without damage to underlying systems
- ○ Reversible attachments
- ○ Materials can be salvaged for reuse upon building's deconstruction

Interior Finishes

- ○ Repairable/replaceable with out damage to surrounding systems
- ○ Reversible fasteners
- ○ Materials can be salvaged for reuse upon building's deconstruction

Insulation

- ○ Non-adhesive
- ○ Simple to remove or repair
- ○ Recycled/reused materials
- ○ Bio-based

Windows

- ○ Accessible for repairs/replacement (i.e. non-flanged windows are generally easier to replace than flanged windows)
- ○ Reversible attachments
- ○ Air and weather sealing is removable without damage to substrate

Cladding

- ○ Repairable
- ○ Replaceable without damage to underlying systems
- ○ Reversible attachments
- ○ Materials can be salvaged for reuse upon building's deconstruction

Other

Use this area to describe other design-for-deconstruction elements included in the building or to add detail about check-marked solutions that will facilitate deconstruction and material salvage.

Appendix B: Mould Risk Analysis

Proper building envelope design is crucial to prevent mould growth in light wood frame buildings. The assemblies presented in the guidebook were analyzed for mould growth potential; the requirements for insulation ratios, vapour retarders and WRB permeability were determined based on this analysis. A summary the complete analysis for mould risk of wall assemblies with various insulation types and vapour retarder layers can be found at:

https://blogs.ubc.ca/design4deconstruction/guidebook/.

Analysis Summary:

The basic wall assemblies presented in the Guidebook—with either bio-based or mineral insulation and without a specifically detailed vapour retarder—are suitable for the vast majority of light wood frame applications where indoor relative humidity is maintained at standard levels (30-55%). However, when constructing for high humidity applications or for extra surety of moisture performance a simple vapour retarder in the form of acrylic latex paint layer on interior wall surfaces is fully sufficient for managing moisture transport throughout the assembly. Further to this, the inclusion or exclusion of a vapour-permeable WRB membrane outboard of exterior WFI insulation has no significant impact on mould growth either at the interior face of the sheathing or on the exposed face of the insulation.

The analysis presented here should be taken for general information only and is based on simulated rather than physical experimental findings. All designs should be developed in consultation with qualified envelope engineers to prevent envelope failure and mould growth.

REDUCE, REUSE, RECYCLE

Design for Deconstruction in Light Wood Frame

SCHOOL OF ARCHITECTURE + LANDSCAPE ARCHITECTURE

Canadian Wood Council
Conseil canadien du bois

Forestry Innovation Investment

February 2025, Vancouver, British Columbia | CANADA