Virtual Design & Carbon:

Using Open-Sourced and Non-Profit BIM Tools to Support Early-Phase Building Design and Data

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Early phase design is the most important and appropriate leverage point for industry associations and public sector agencies to focus thir tool-building efforts. In international markets and the USA especially, we must defer to downstream workflows, managed by the responsible professionals. Supporting the architect at the start of the process is a critical and complex problem space which is constantly evolving in practice.

Other industries who transform materials into structural components of buildings, (i.e. concrete & steel) have already benefited for years by feeding reliable and detailed BIM content into every design technology toolkit. Every builldng assembly that can be produced with timber, whether in solid form, engineered components, or mass timber, comes from a young, regional, and non-standard industry. Unprecedented levels of cooperation and knowledge sharing by North American producers will be needed to engage within the tools used by digital technology managers working in a global and virtual marketplace.

Collective and open-source software may be the fastest, fairest, and most transparent means to the end, of transforming construction into a carbon-fixing industry. The tasks can be shared by young communities of practice with a lot to teach about how to manage big data and share authorship of complex calculations.

This course focuses on solutions for the impactful early design phase, by starting with the structure of nonprofit BIM tools overall, showcasing successful systems and whole projects, then providing a broad survey of design technology tools with demonstrations from the builders themselves.

A suite of tools designed to deliver in early phases

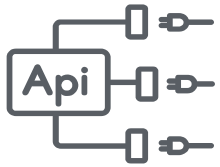
Functionality

Create a comparative scenario with basic building info

Configure and visualize the building and its GHG impact

Create a report to pitch to the client or design team

Start the model with the BIM content that you researched



Program

CarbonFixers web application

Data call to an open database of embodied carbon (EC3)

OpenBIM by Speckle, Regional Dashboard on CarbonFixers

Offsite Wood Revit Content (thru plugin or website)

People

Product Manager: Eli Gould dba STIX (Sustainable Timber Investment eXchange), Vt.

Web app and OpenBIM server developers: Brainpool,(Canadian offices in BC, Toronto)

BIM Content Creation Supervisor: RevitPure's Nicolas Catellier (Quebec City)

Content support: DETEO's Laurent Belanger & SiEnergia's Angela Barreto, LEED AP, ASHRAE

Structural Data Verification & Engineering: Mass Timber Consultants, Montreal. Nikita Lina, Alex Chygryn, Mathias Oberholzer

Sustainability Data and Life Cycle Review: Groupe Ageco's Alban Pilard & Elsa Moawad

Web Design & Mgt for www.offsitewood.org: Frederic Robert, Quebec, Alex Fortin, QWEB

Learning Objectives

How to classify and understand key elements of Building Information Modelling (BIM) practice, using case studies of open-sourced suites of tools provided by nonprofit associations and advocates for bio-sourced materials in construction

Graphic examples will identify, provide definitions, and differentiate between

What is BIM, what is a basic level of practice, and what is <u>not</u> BIM.
- Data: what **Information** is the « I » in BIM?

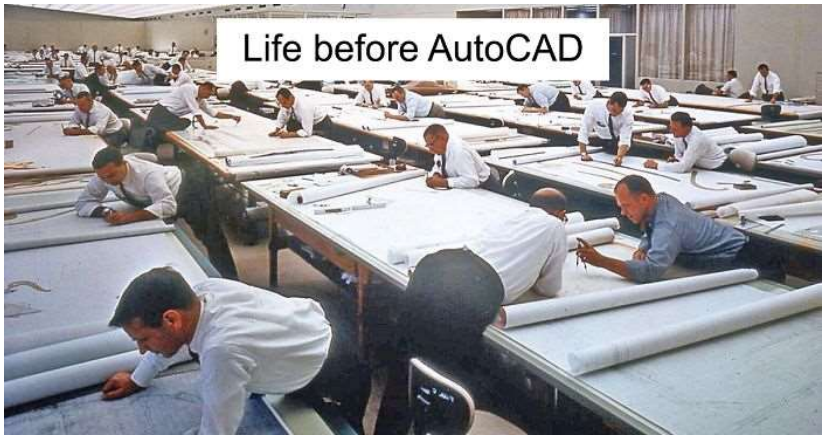
How and architects may treat the model if it will be shared.
- How the BIM marketplace serves the architects virtual design

Object based catalogs (Offsite Wood plugin, BIM object, etc)
- Dynamic objects within BIM « Revit family » example

How are the new parametric tool different than a catalog?

How is web access changing the BIM environment?
- Plug-ins: catalogs that can refresh and update
- Configurators.: simple Assembly creator example (BIMSmith)
- Collaboration platforms: online multi-player example (Speckle)

What is BIM (Building Information Modeling), and what isn't.

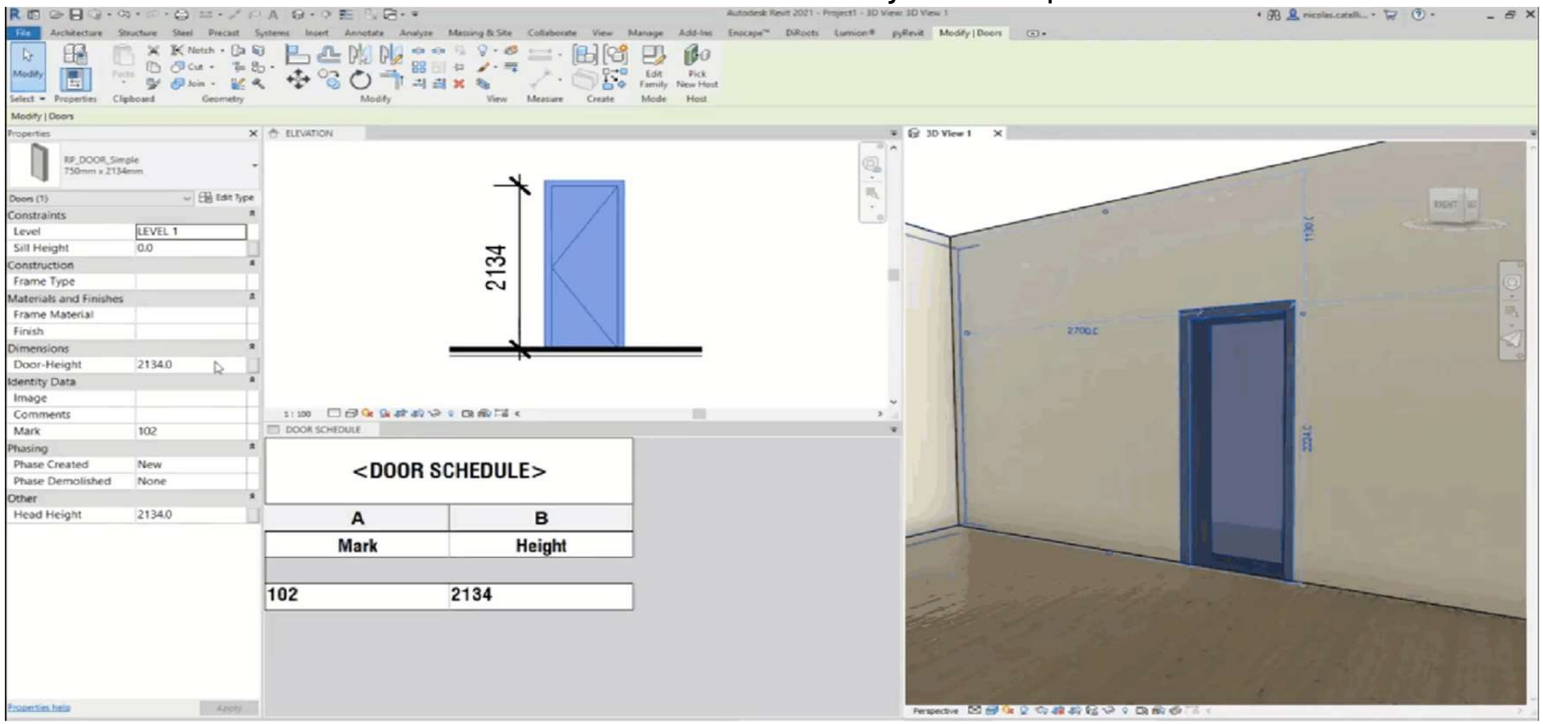


The hand drafting was replaced by CAD drafting. The advent of rapid modelling tools like Sketch-Up may have delyed integrated BIM models/plans in the early phase of design.

Detailing in later phases also is surprisingly problematic to this day, so most architects have to settle on the most cost-effective use of BIM…or even cut their losses! Modelling tools are still needed to explore massing and intersection, and Rhino offers more buildable bridges to BIM.

Linked data for coordinated drawing delivery is still the meeting ground.

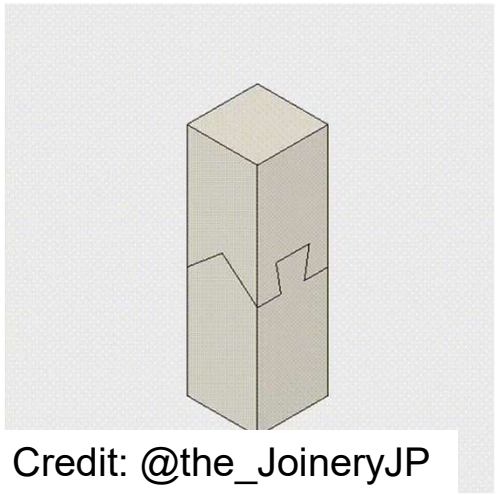
Producing coordinated documents to be printed (Level 2 BIM use). Key concepts:



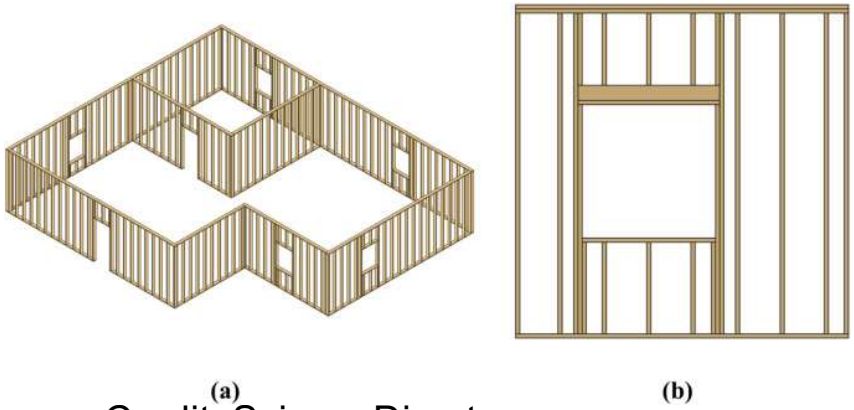
Loadable components
Cross-section libraries.
System families
Schedule/lists.
Material data.

How has CAD/CAM been linked to BIM, and how does that relate to new terms: DfMA & DfMAD?

Credit: Building Smart



Credit: @the_JoineryJP

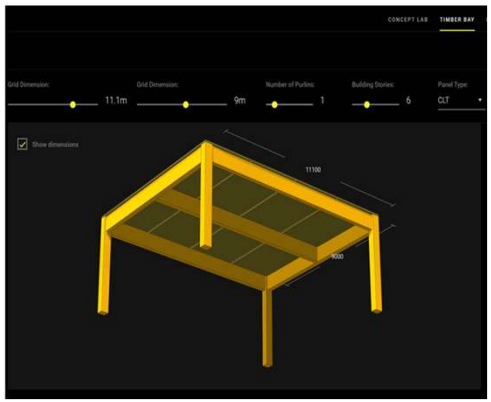


Credit: ScienceDirect.com

The nonprofit organizations advocating for interoperability have been around for a long time, and the file transfer protocols and file formats reflect that “design by committee”. The European practice community of automated wood system manufacturers (and steel) have a reliable workflow to feed detailed models back into BIM, through the .ifc transfer. Timber industry CAM software can broadly be categorized as joinery and framing applications, and machine interfaces also have common languages developed in Europe

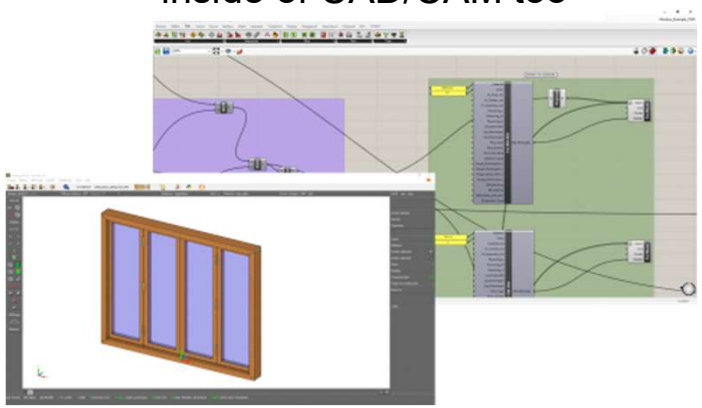
What is parametric design?How does it impact traditional BIM & « new » DfMA processes?

Graphical scripting with Grasshopper & Rhino



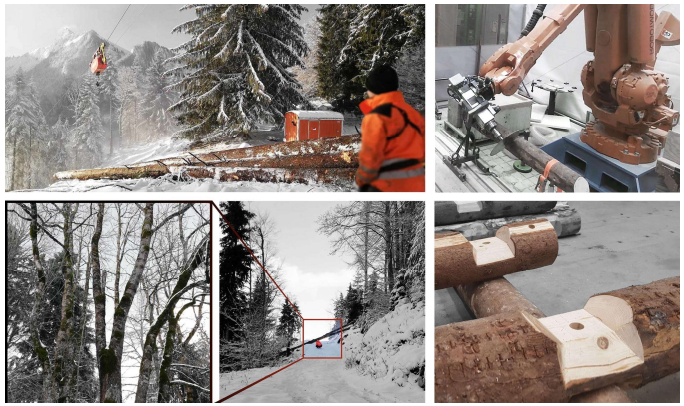
Credit: Fast & Epp Timber Bay Design Tool

Rhino can now run inside of CAD/CAM too



Credit: Food4Rhino

Tomorrow's swiss tools already at work

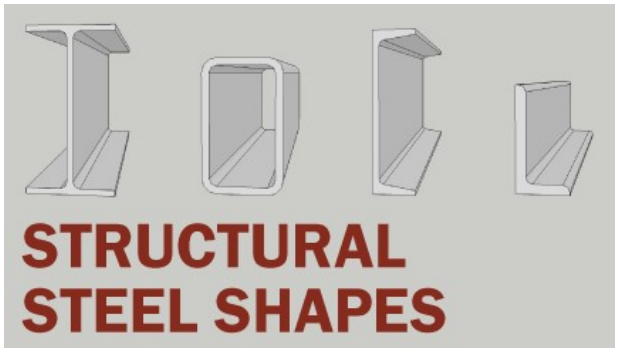


Credit: EPFL research by Petra Pestartas

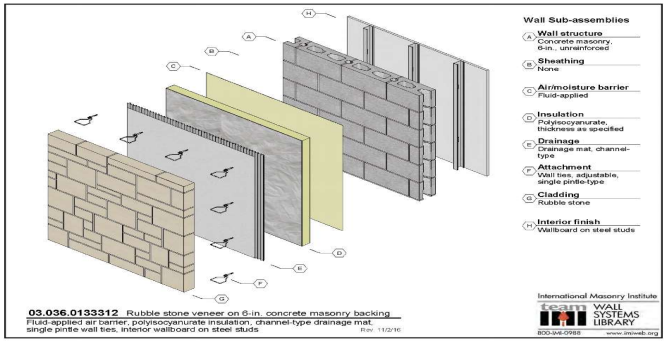
A parametric object is a 3d relationship model. It is created using geometric definitions, associated data and rules that define their behaviour, how they interact with other objects or respond to changes in their parameters. Driven by industry expertise, this is a powerful new path to support Design for Manufacturing and Assembly processes.

Are catalogs obsolete? Not yet!

Life before the “I” in BIM



Credit: ArchToolBox



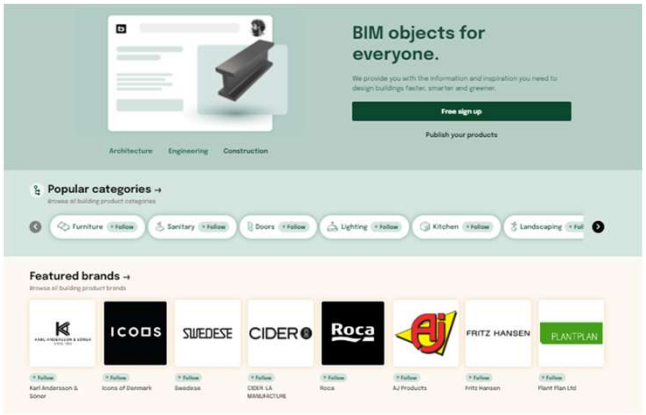
Credit: International Masonry Institute

Credit: Graitec

The BIM environment for steel, concrete, and even rebar has already advanced through the work of nonprofit associations in those industries, private application developers, and also through the standard materiality and dimensionality of those industries. Much progress can be made even while acknowledging (and celebrating) the regional variations of wood and bio-sourced construction materials.

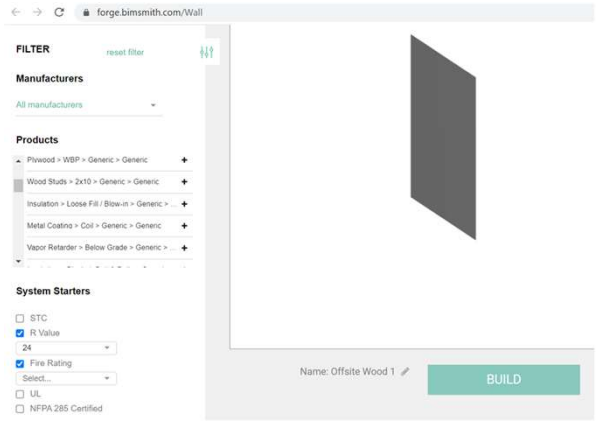
How is web access changing BIM?

Object marketplace model



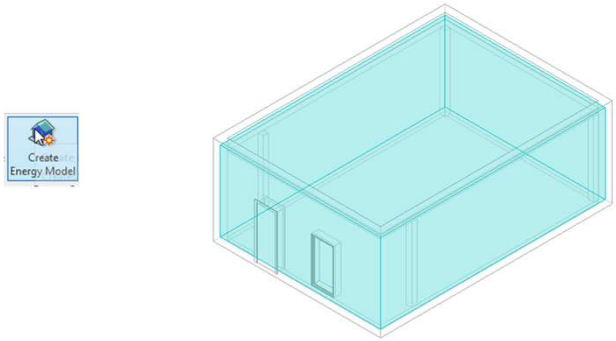
Credit: BIM Object

Online configurator model



Credit: BIM Smith

Calculation as cloud service model



Credit: Insight

The fact that BIM software can have an API link to the web now creates both inflow and outflow with just as much potential (and misinformation) as the internet can offer.

Can web-enabled catalog delivery help an industry that is constantly “refreshing”?

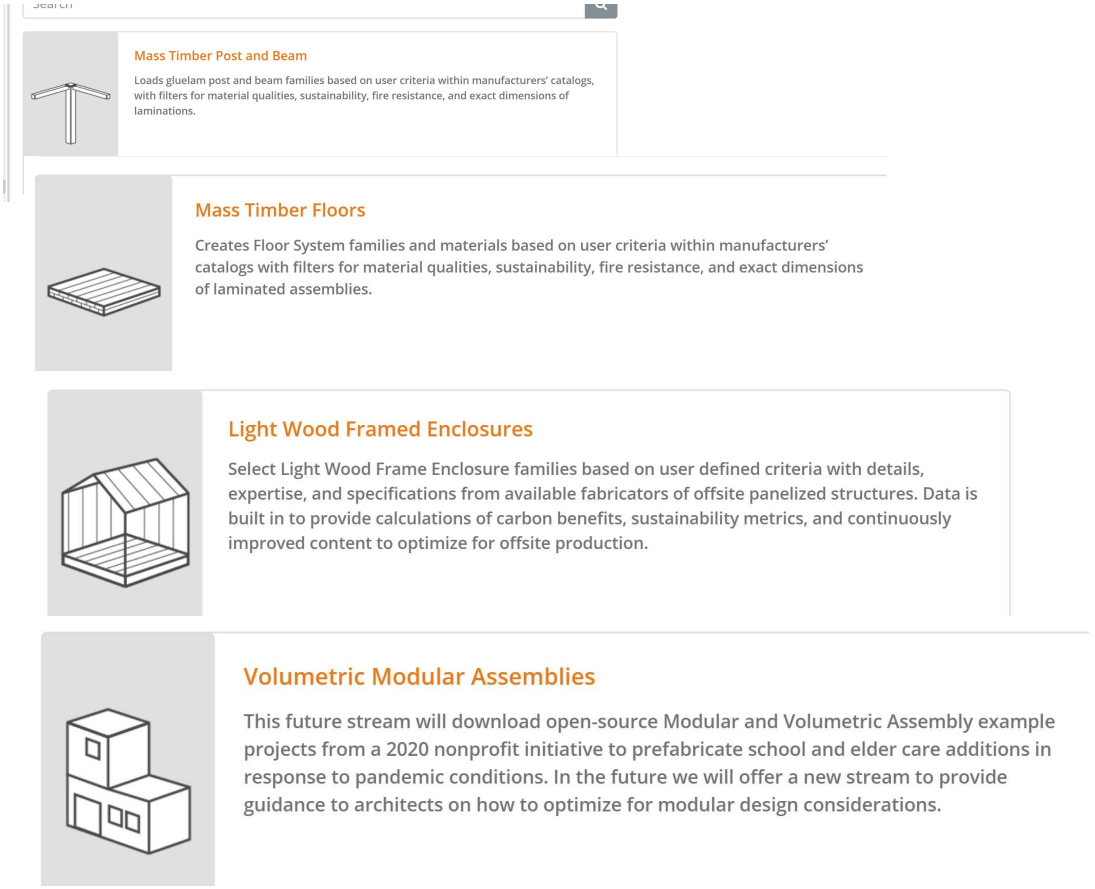
Four “streams” of components and system families were built to be continuously updated:

Mass Timber Columns/Beams (Loadable Components)

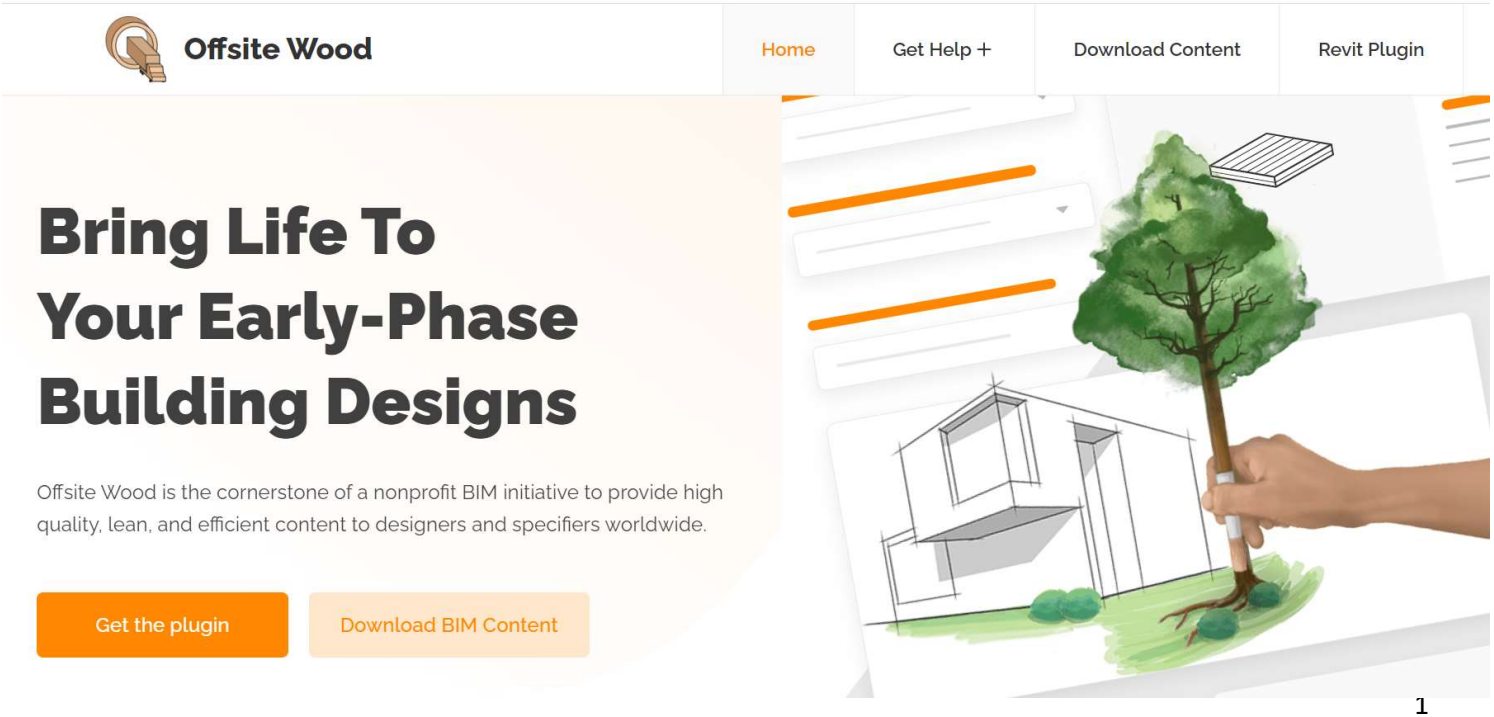
Mass Timber Horizontal Slabs (Floor System Families

Bio-Sourced Enclosure Systems (Wall System Families, Roof Systems under construction)

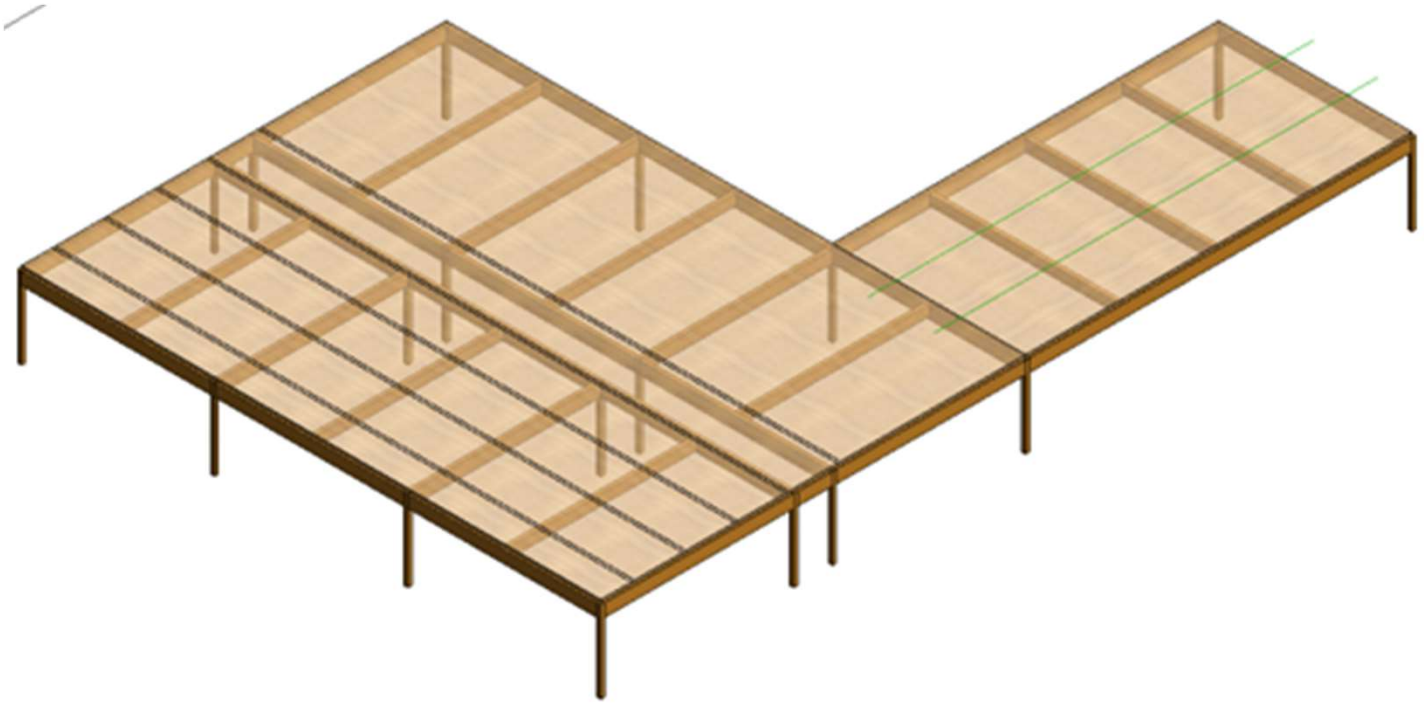
Volumetric/Modular (coming spring 2023). 950+ architectural studios have downloaded the tool. It is updated to 2022, w/ western canadian integration well under way.

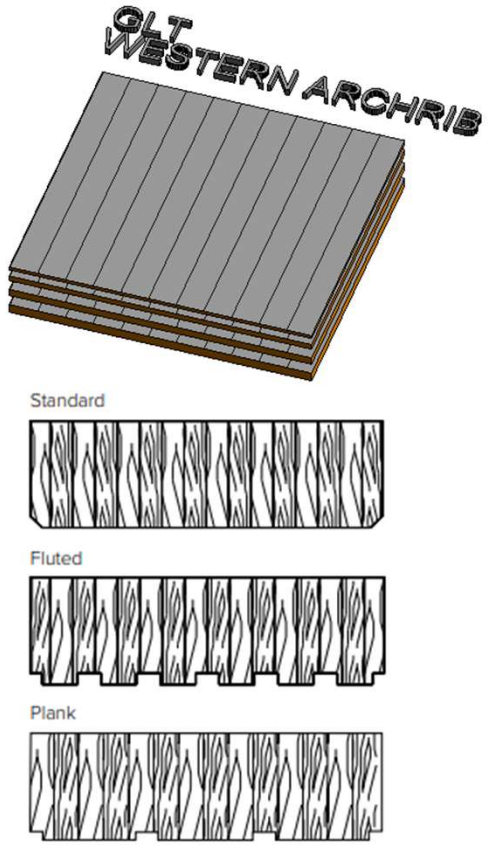


www.offsitewood.org can provide parallel BIM educational resources in container files, textures, detailing, videos, specs, and 3d viewers.



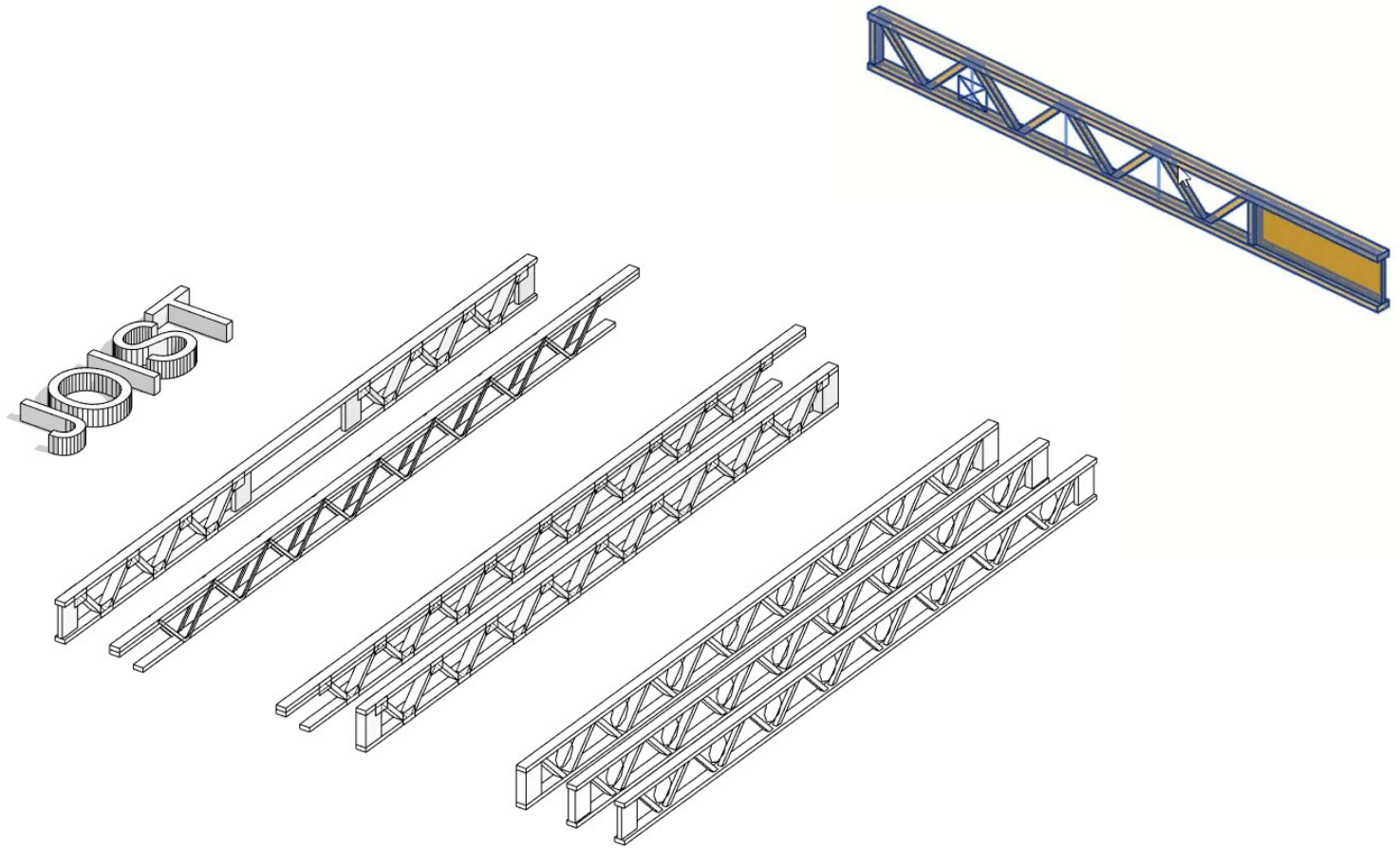
Industry comfort level vs BIM data, example 1: bidirectional slabs.





Example Billet Profiles

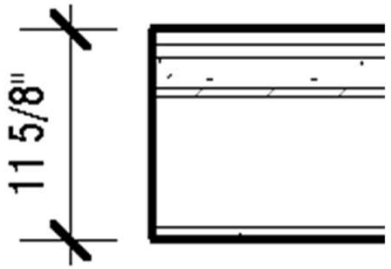
Industry comfort level vs BIM data, example 2: engineered floor systems.

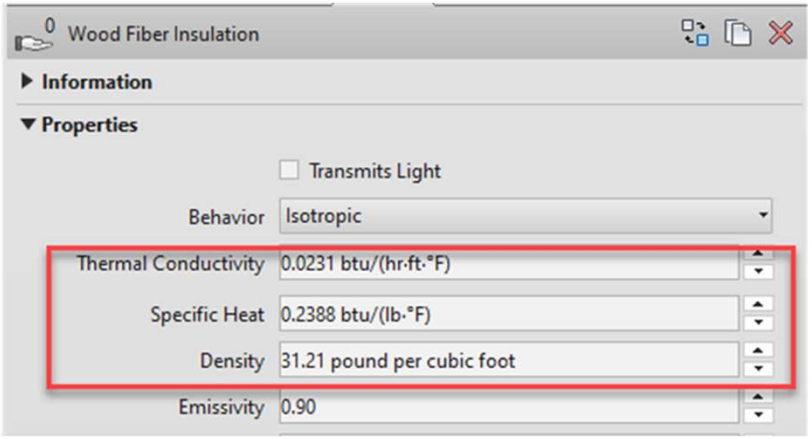


Industry comfort level vs BIM data, example 3: Building Physics data.

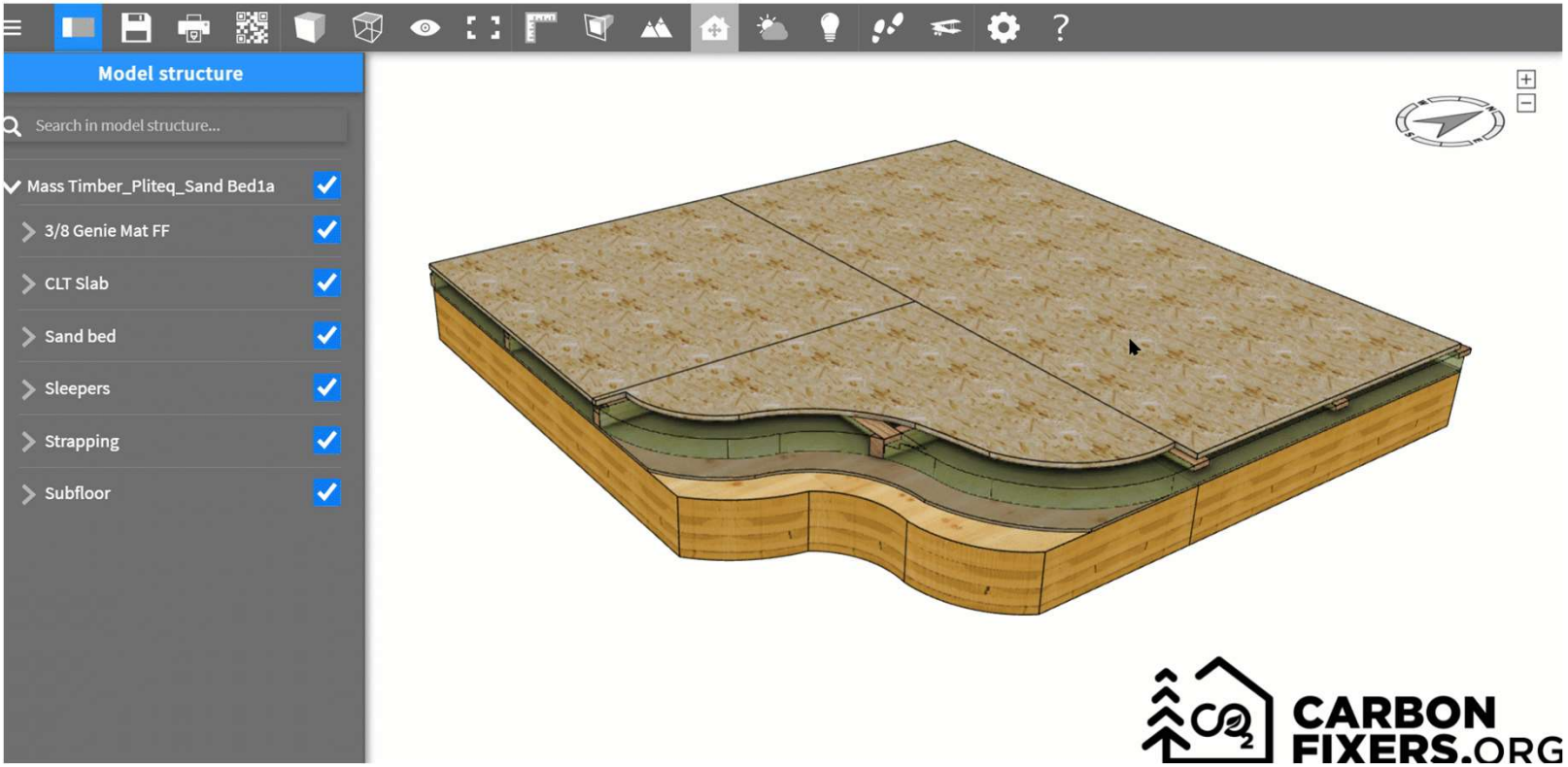
Analytical Properties	
Heat Transfer Coefficient (U)	0.1790 W/(m²·K)
Thermal Resistance (R)	31.7293 (h·ft²·°F)/BTU
Thermal Mass	8.79 kJ/K

BC PASSIVE HOUSE
WALL COMP 2



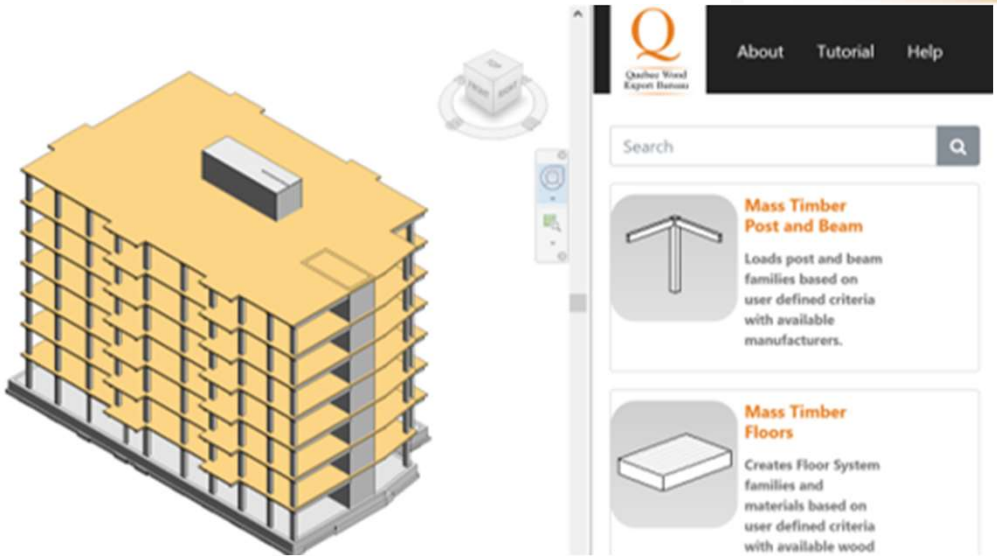


While we wait to build consensus, we can still educate and ask the market to help us convince



CARBON FIXERS.ORG

While we build more content, we build beta testing relationships & buildings!



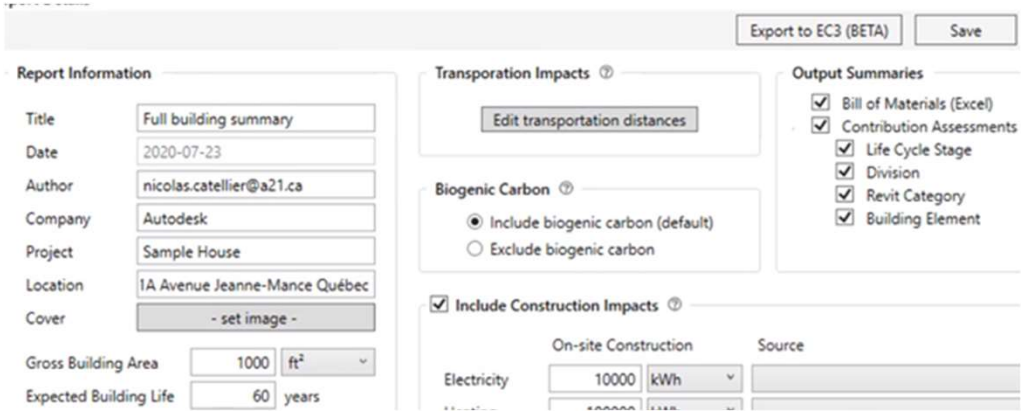
Boston 7 story, under high rise (70') with no podium and FRTW walls (non-load bearing). A competitive, Passivehaus, urban infill precedent with direct relevance in Toronto.

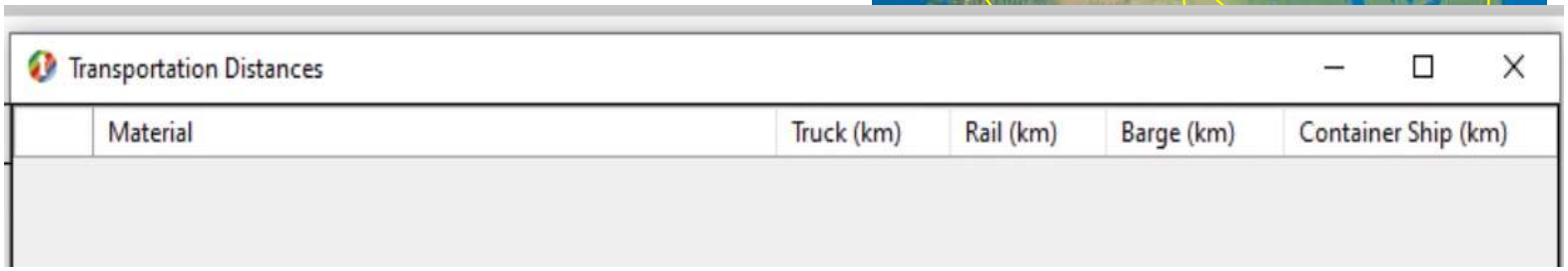
Credit: Nordic, Haycon, MFDS, H&O, & QWEB

Born as a beta tester, opening night on the 7th story in Boston last month

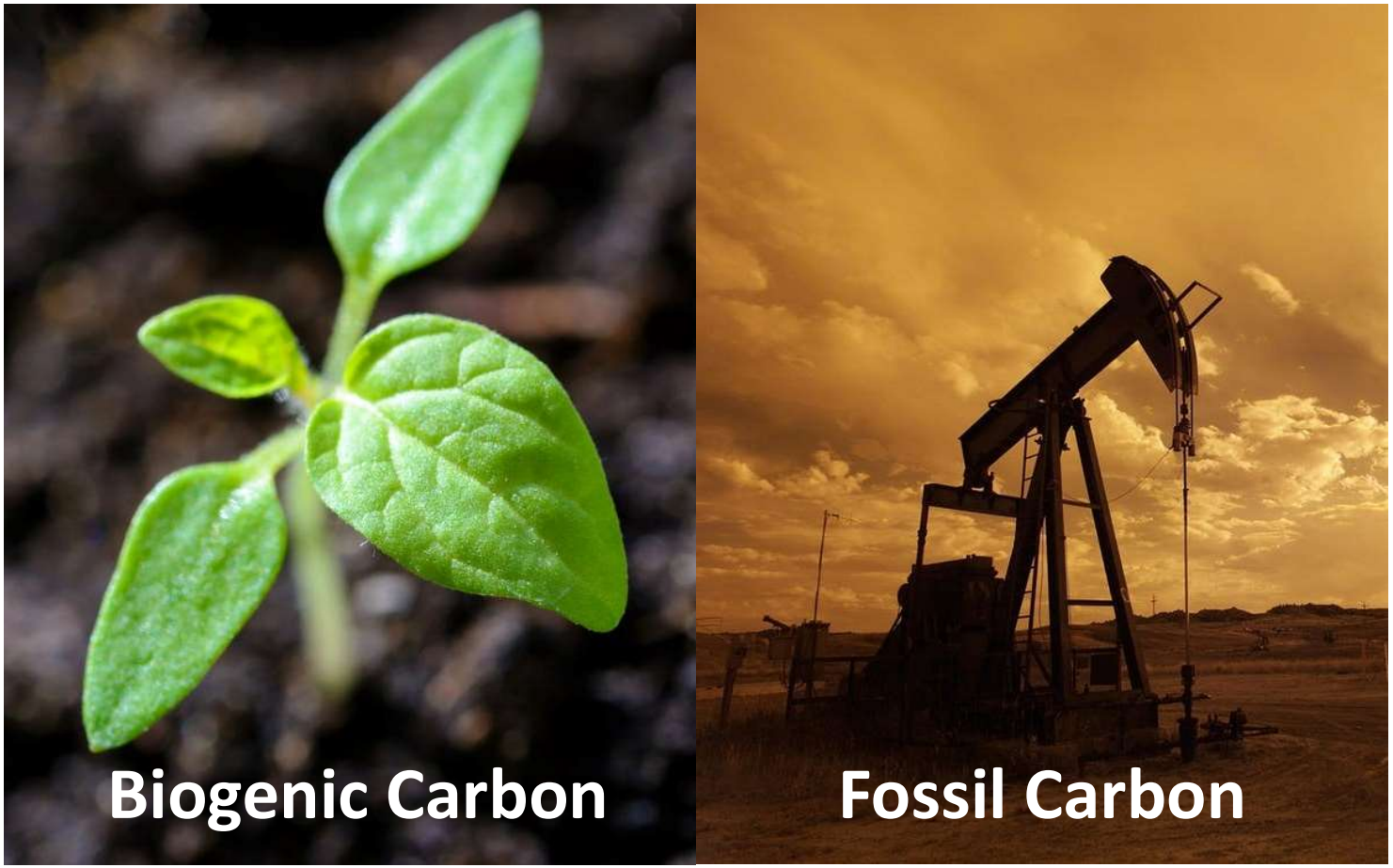
Boston exposed mass timber at the building opening last month.

Including transport sensitivity as a way to erase political borders

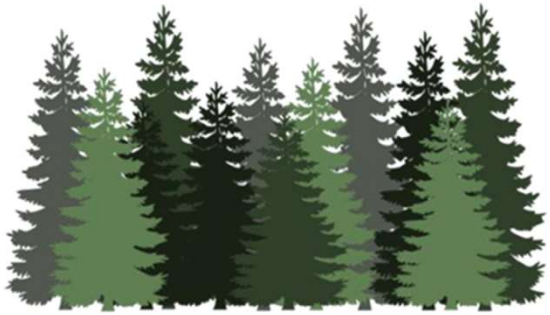


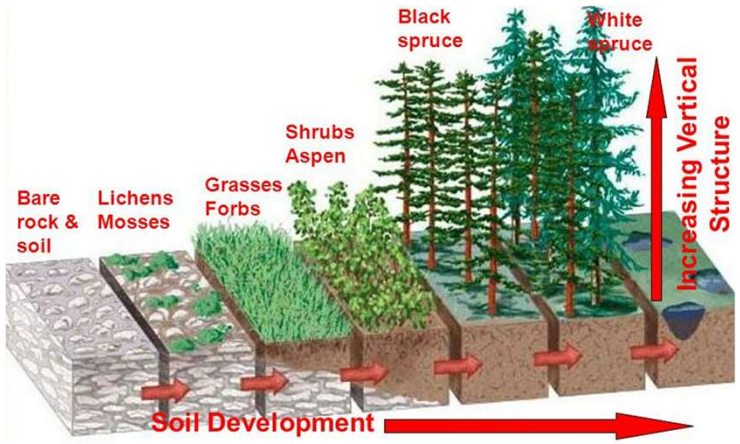


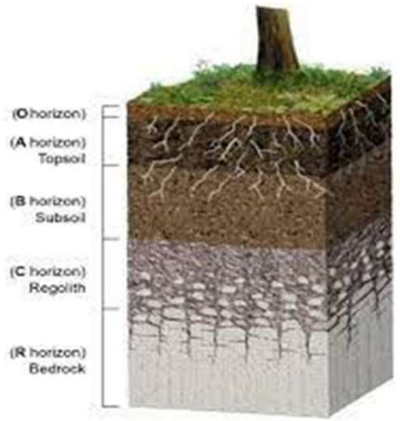
Data mission for the next phase: Part 1



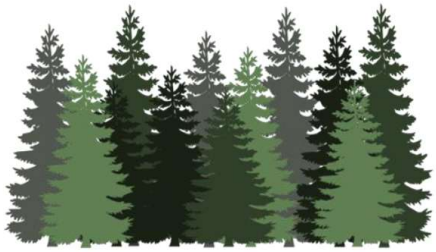
Data mission for the next phase: Part 2



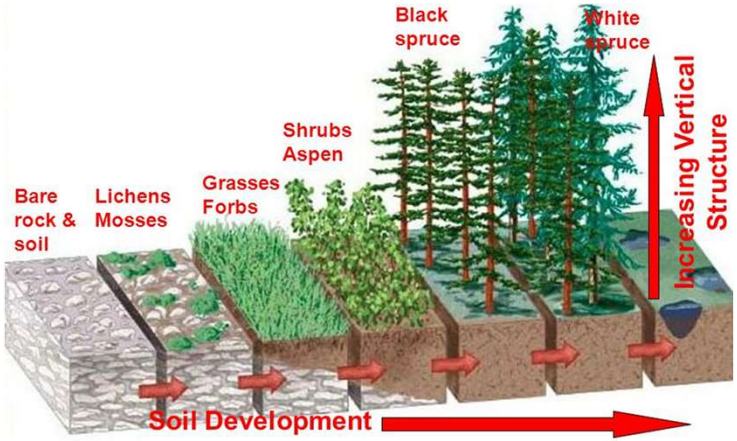


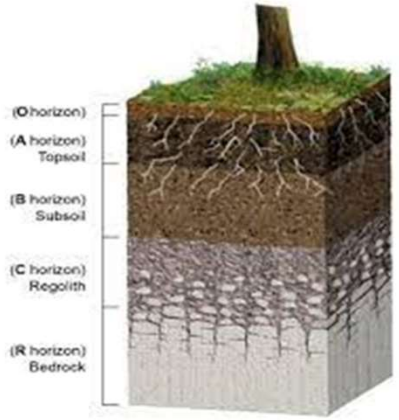


Data that we want to include, Part 1

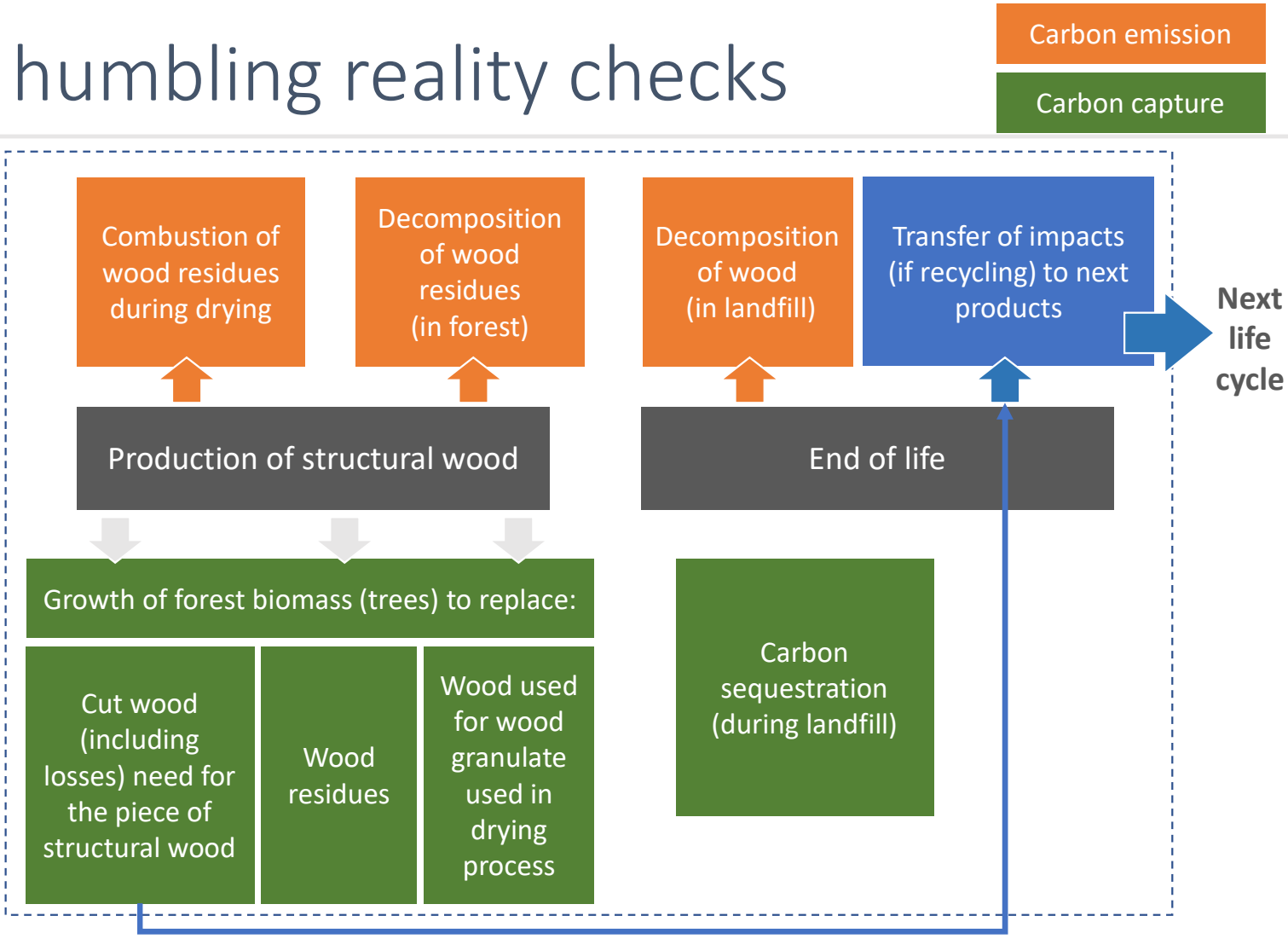


Also: a reminder from *outside* the system boundary: soils!

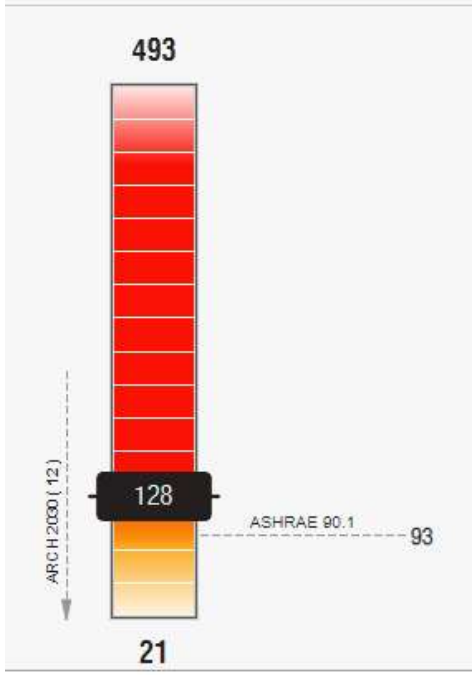




Some humbling reality checks



When we succeed, today's EUI will become tomorrow's CUI



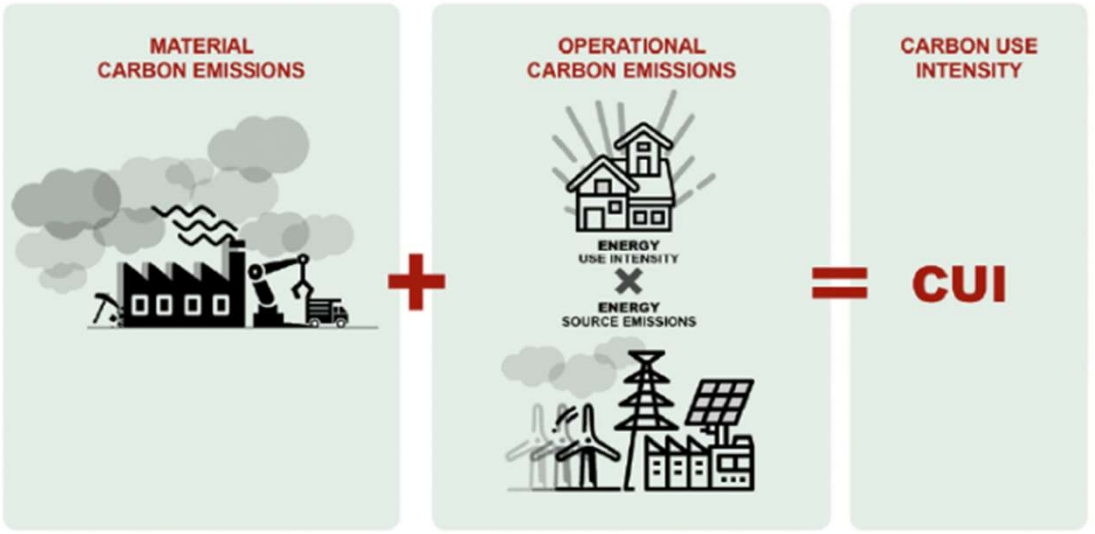


Figure 15 Carbon Use Intensity (CUI) a combined metric of upfront MCE plus OCE

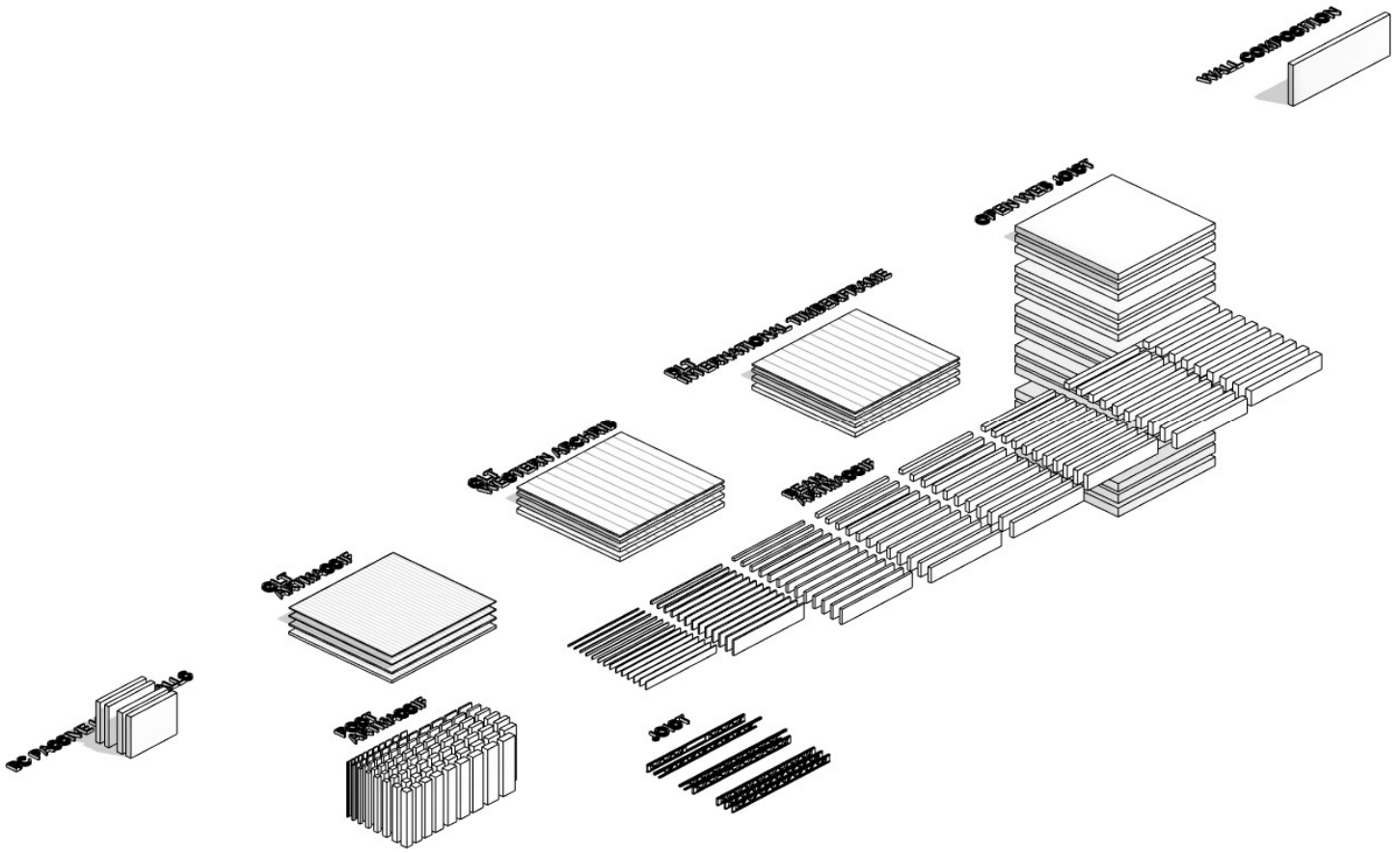
Questions?

Quebec Wood
Export Bureau

Thanks to our host

Thanks to their sponsor

Growing libraries of Revit Families



Learning Objectives

1. How to introduce wood structure and biogenic material alternatives at the proper level of detail in schematic design.
    1. Definition of LOD using Development not Detail
    2. The Reality Check of Cost
    3. Material Vs Process
    4. Delivery model examples

Learning Objectives

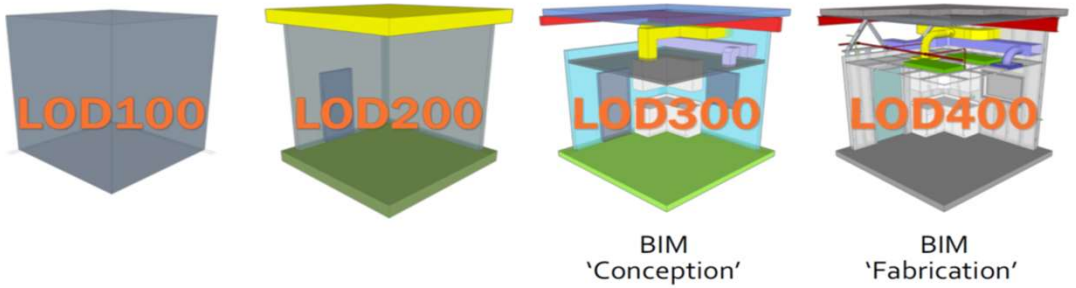
How to use LOD specifications to achieve design integration of mass timber's unique advantages at an early enough phase to impact the cost, feasibility, procurement, and successful delivery of a project.

Definitions of LOD specifications from a Toronto-centered CanBIM Think Tank.

Starter definitions from LOD 100-350 to help differentiate Level of Detail *and* Level of Development in a BIM model

Level of Detail is how much detail is enclosed within the model element. **Level of Development** is the degree to which the components' specification, geometry, and data has been thought through - the degree to which project team members can depend on that data in the model.

Level of Detail can be thought of as input to the element, while the **Level of Development** is a *reliable output.*



Source: AIA E202 BIM Pro

At LOD 100, which is the pre-design stage, the model consists of 2D symbols and the masses to signify an element's existence

At LOD 200, the elements are partially defined by outlining its approximate quantity, size, shape, and location

By LOD 300, the elements are defined with exact dimensions and their relative positions bolstering precision

LOD 350 describes the information about an element precisely and outlines an element's relation and connection with other components

Early LOD reality check

1. The wood option is only competitive when it comes in at early enough level of detail to be optimized.

2. Most LOD 250 BIM models have already been optimized for other systems, sometimes without design intent to do so.

3. Grids are variable and fiber is non-standard, so early LOD design is a targeting process. So is procurement strategy.

4. Cost planning was already hard before supply chain spikes as the industry tired of pricing studies. Unit costs are not a trustworthy baseline, installed cost/sf may be.

Delivery models matter:

Mass Timber

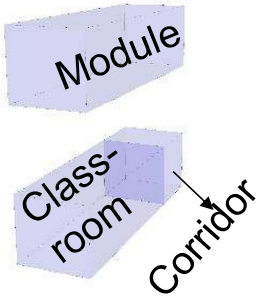
Photo: naturally:wood
Sources: reThink Wood, Nordic

Delivery models already are in your backyard.

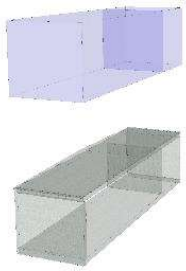
Light wood frame

Source: AmeriCan Structures and RG Solutions

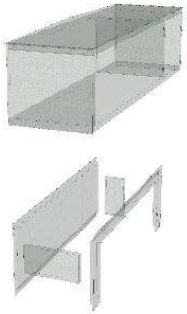
Delivery models matter: example being worked on for modular industry by CanBIM



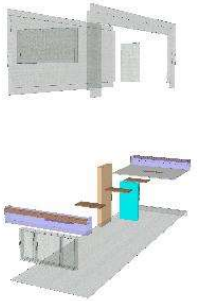
At LOD 100, which is the pre-design stage, the model consists of 2D symbols and the masses to signify an element's existence. **Example: occupancy & code**.



At LOD 200, the elements are partially defined by outlining its approximate quantity, size, shape, and location. **Ex: space types/ separations.**



By LOD 300, the elements are defined with exact dimensions and their relative positions. **Ex: headers, bearing, structural, and thermal reqs.**



LOD 350 describes the information about an element precisely and outlines an element's relation and connections. **Ex: prelim MEP and Contract readiness**