

BCBEC AGM  
November 06, 2019

# Modular Construction for Energy Efficient, Affordable Housing

Elyse Henderson | MSc, CMVP, LEED Green Associate  
Energy & Sustainability Analyst  
[ehenderson@rdh.com](mailto:ehenderson@rdh.com)



# Prefabrication, Modular Construction

The slide features a light gray background with several thin, dark gray geometric shapes scattered across it. These include horizontal and vertical line segments, as well as plus and minus signs. A solid blue vertical bar runs along the right edge of the slide.

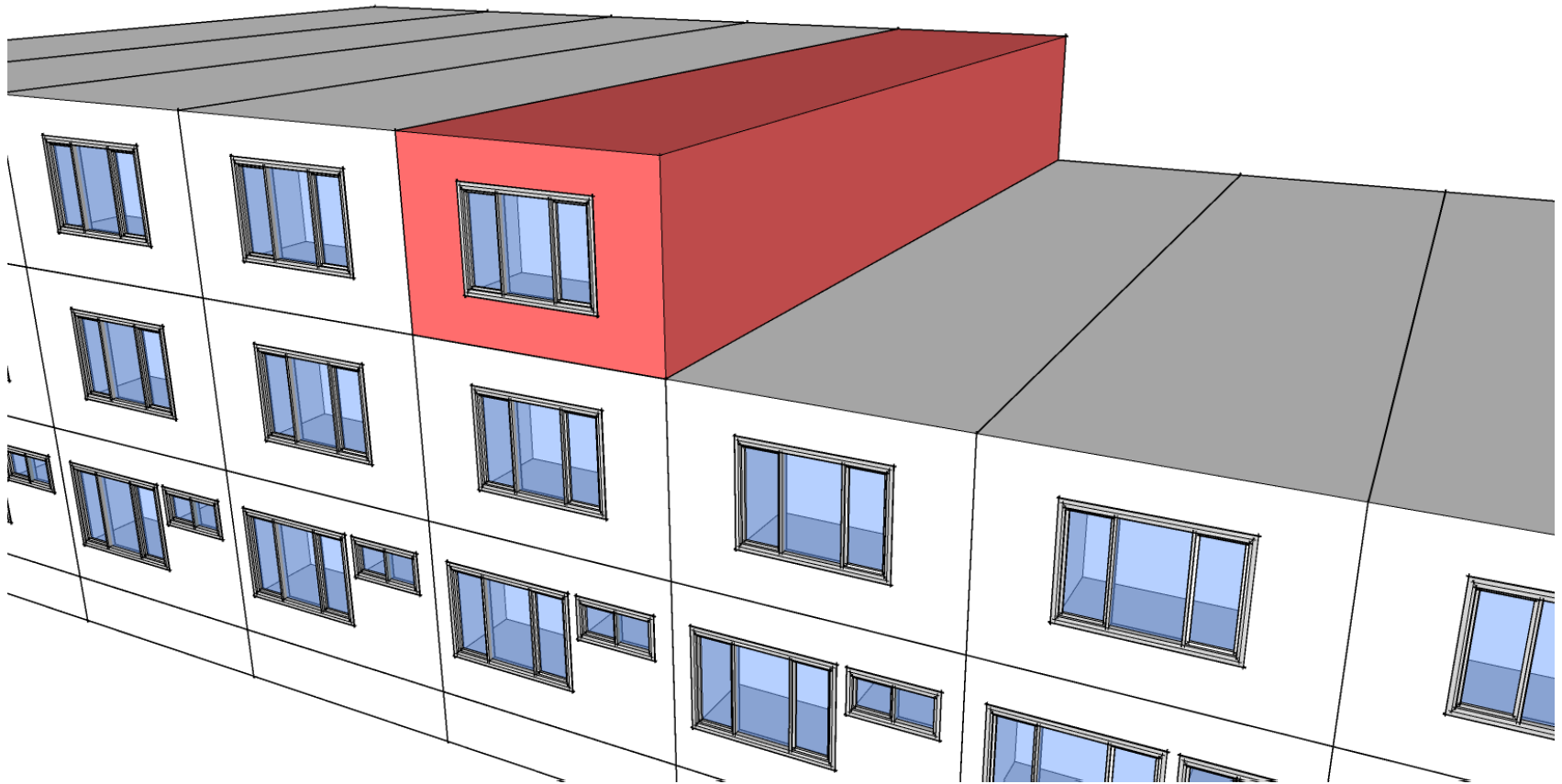
**Mandate:  
fast, affordable,  
sustainable housing**

# How can we meet our mandate?



- **FAST:** Rapid Response to Homelessness (BC Housing)
- **AFFORDABLE:** Housing for those in greatest need & community housing sustainability (CMHC-NHS)
- **SUSTAINABLE:** Sustainable housing and communities (CMHC-NHS); BC Energy Step Code (BC Housing)
- Also, housing for underserved communities (CMHC-NHS):
  - Northern housing
  - Indigenous housing

# Solution – Modular Construction?





# Case Studies

## → Bella Bella, BC

- Remote location
- Wet climate
- Passive House

## → Abbotsford, BC

- Timeline
- Step Code targets
- Considerations for overheating



# Case Study #1: Bella Bella Staff Housing





# Project Overview

- **Owner/Operator:** Vancouver Coastal Health Authority
- **Building type:** 6-unit staff accommodations
- **Location:** Bella Bella, BC
- **Construction year:** 2015
- **Manufacturer/Builder:** Britco/Spani Developments
- **Energy Target:** Passive House





# Heiltsuk First Nation



# Apartment fire in 2014





# Challenges

- 6 month timeline
- Wet coastal British Columbia weather
- First Passive House project for the design team & construction team
- Remote site with limited access, labour, and materials







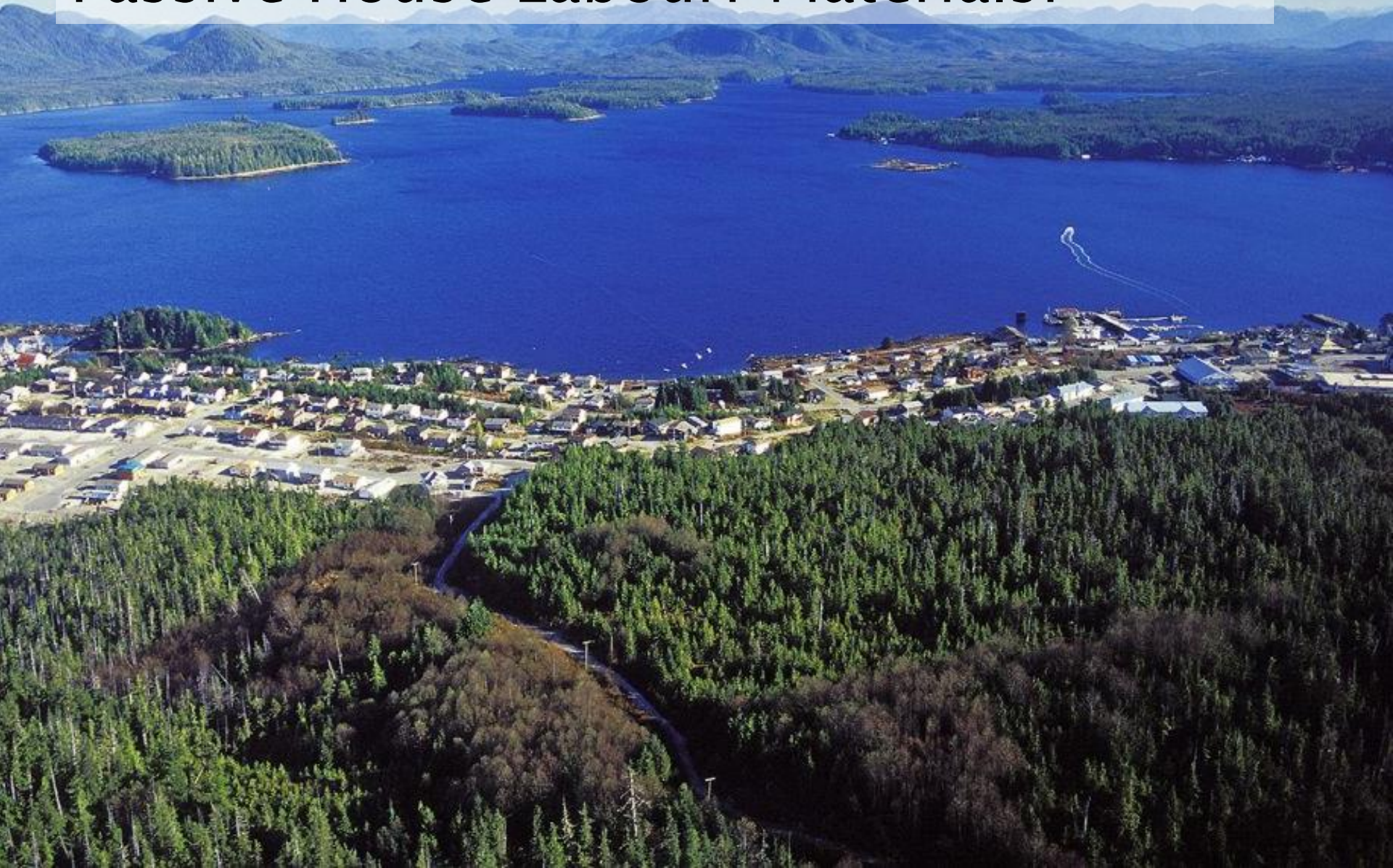
# Vision: first fully modular Passive House







**Remote location... Where do you find  
Passive House Labour? Materials?**





Solution: off-site  
construction



Clean, dry,  
accessible



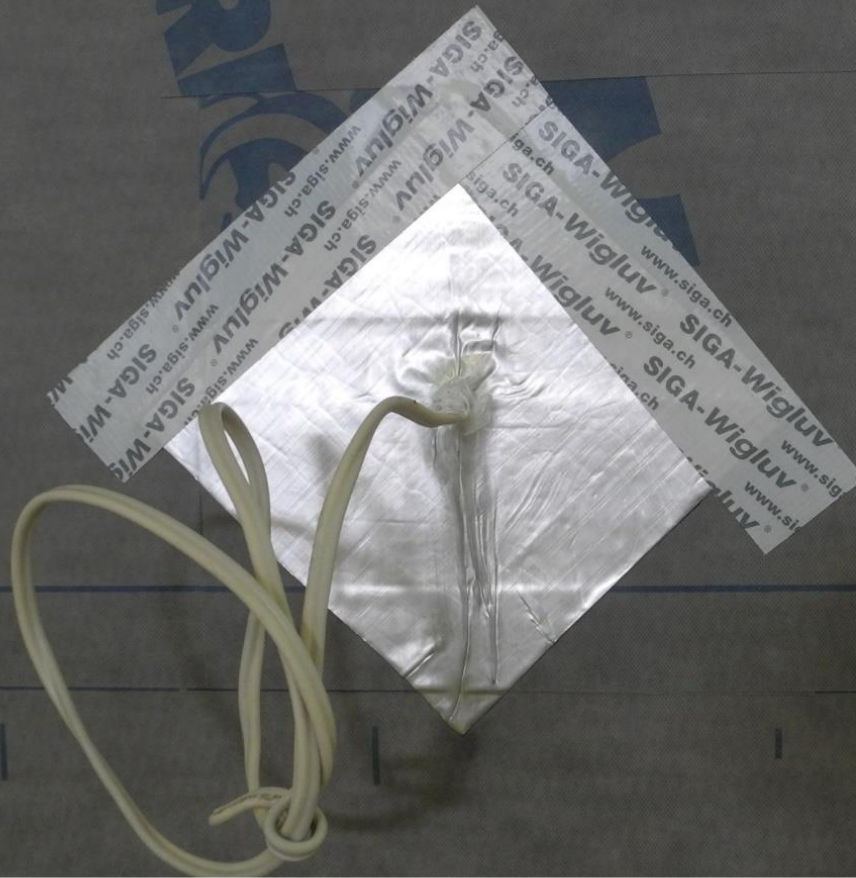
# Train the trades for Passive House in off-site factory











Air barrier details: especially important for Passive House certification

# Mid-construction airtightness test?

- Construction time is only 1-2 days on site
  - So when do you test?
- Exterior insulation and cladding is complete prior to arriving on site
  - So how would you fix any issues?





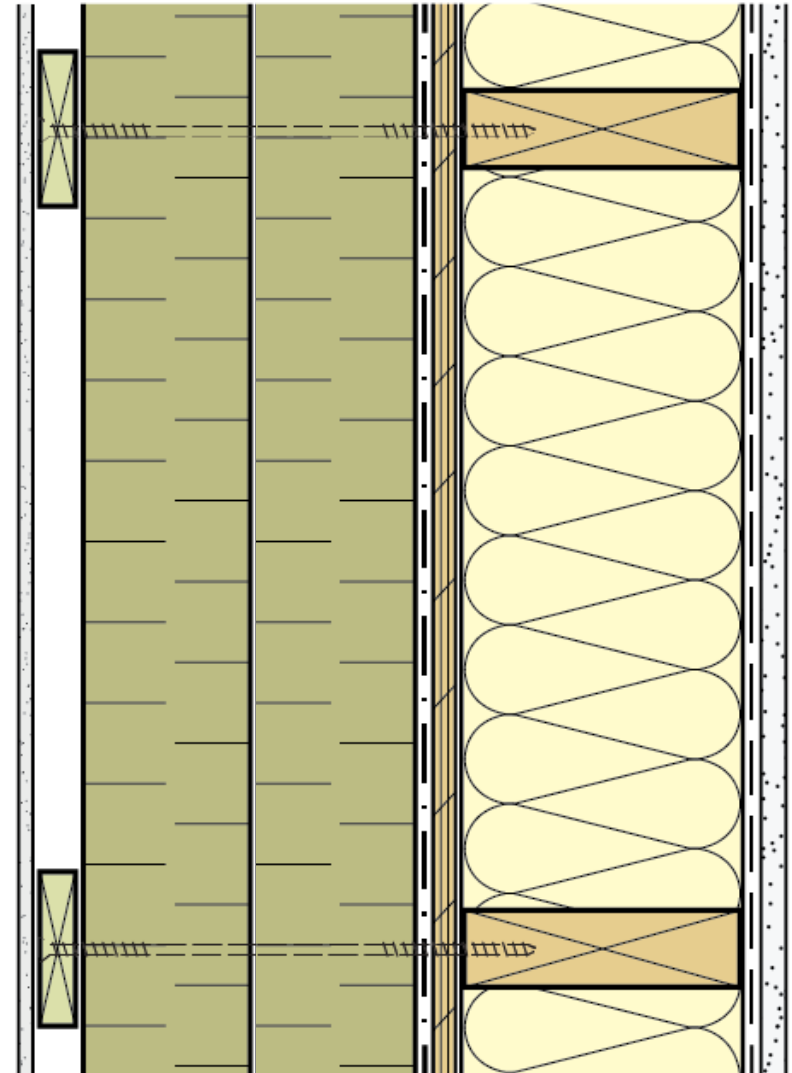
**Solution: make each module airtight!**

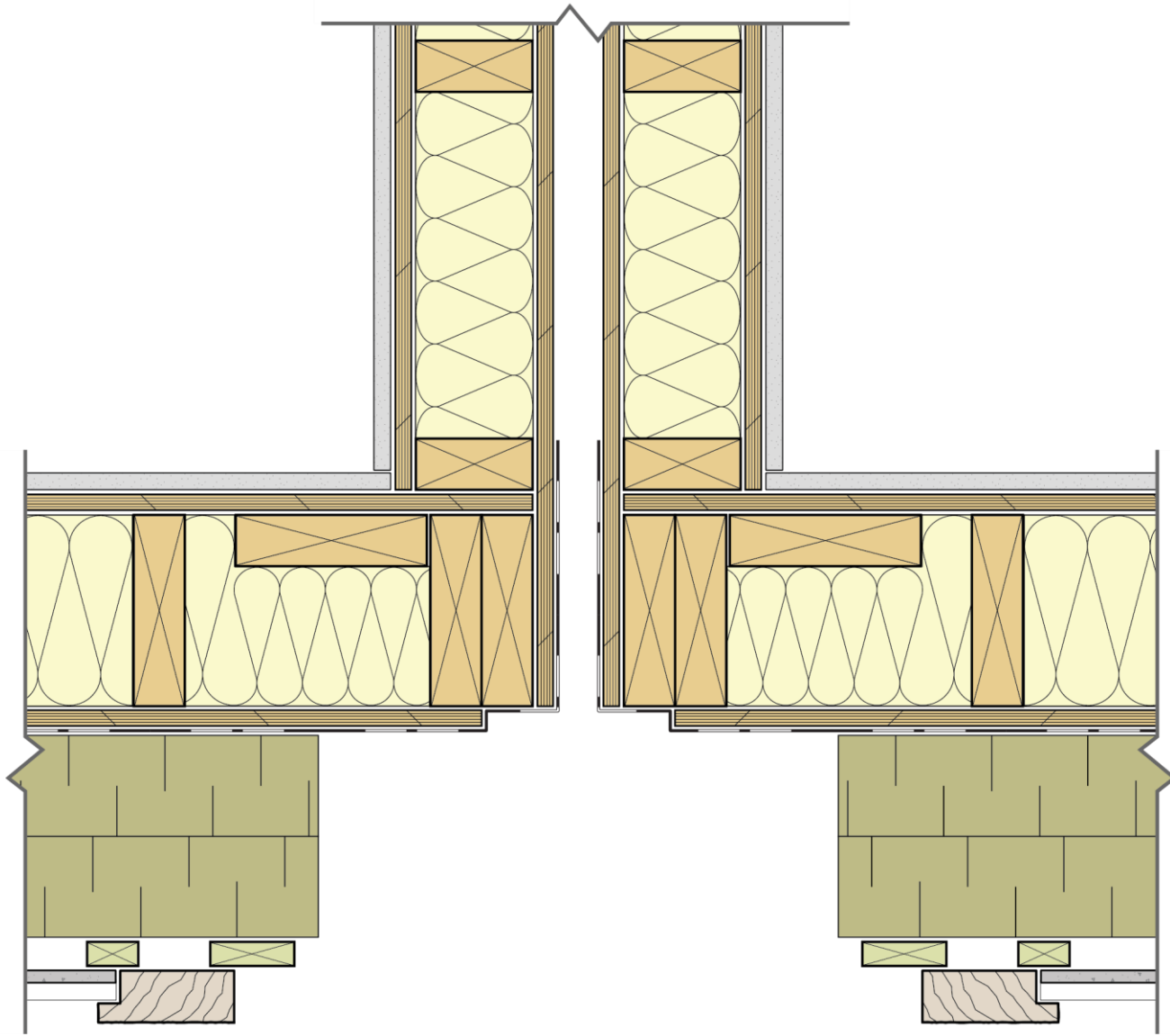


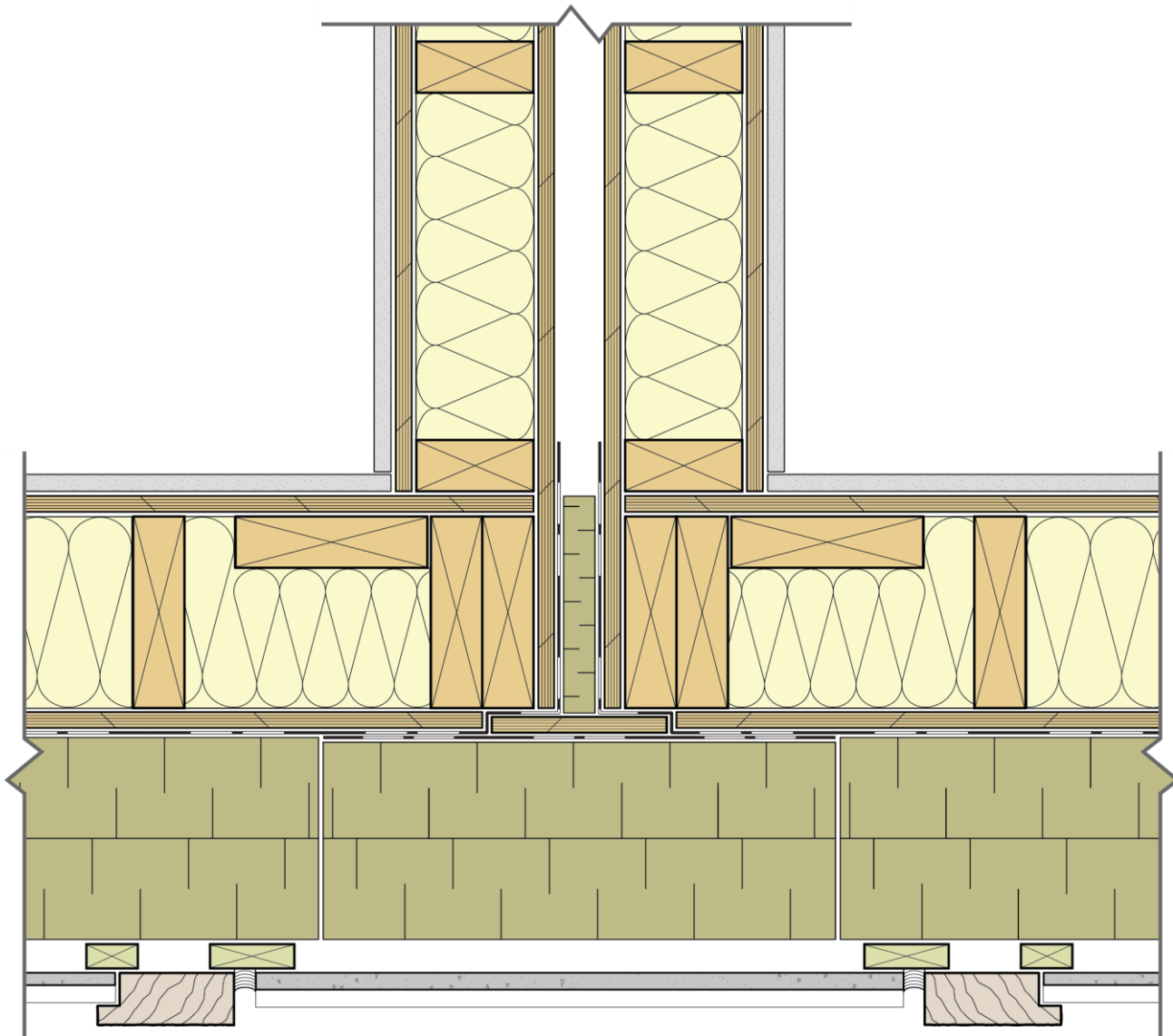
# Another Challenge...

## Modular Passive House enclosure details

- R-40 walls with 6" exterior insulation
- Critical barriers are at the sheathing
  - need to access that connection
- Also, all details need to be finalized before manufacturing begins

























Foundation and site prep work is done during manufacturing & shipping







Modules protected on all 6 sides







# Done! 6-Plex Staff Housing





# Lessons Learned

- Stacked boxes inspire concise form factor – helps TEDI
- Factory production requires detailed drawings sooner
- Site labour & shipping savings exceed Passive House costs
- Community was happy with the short disruption
- The project has been replicated!





# Case Study #2: Abbotsford Shelter



Case Study #2: Abbotsford Temporary Homeless Shelter

Image provided by Metric Modular

# Project Overview

- **Owner:** City of Abbotsford
- **Operator:** Lookout Housing and Health Society
- **Building type:** Temporary Transitional Housing
- **Location:** Abbotsford, BC
- **Construction year:** 2019
- **Manufacturer/Builder:** Metric Modular
- **Energy Target:** Step 3





# Challenges

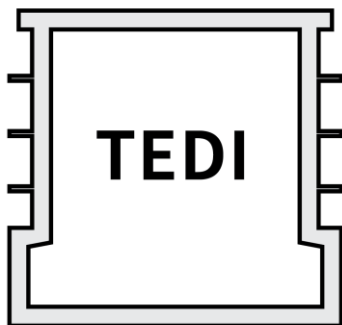
- Fast project timeline to provide temporary transitional housing
- Stringent overheating requirements
- Step Code energy targets



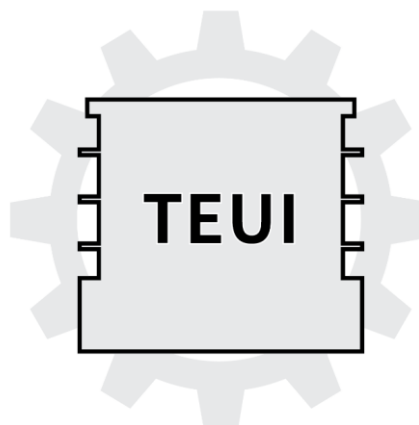
Case Study #2: Abbotsford Temporary Homeless Shelter



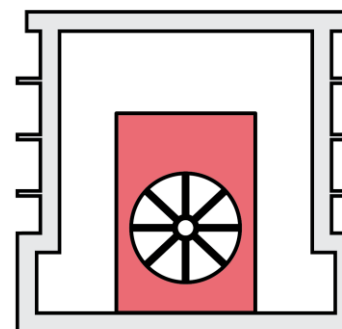
# BC Energy Step Code Performance Based Metrics



Building Envelope  
& Ventilation



Whole Building  
Energy Consumption



Airtightness

STEP 3 →

30 kWh/m<sup>2</sup>/yr

120 kWh/m<sup>2</sup>/yr

Whole Building: 2.0 l/s-m<sup>2</sup> @ 75 Pa

Suites: 1.2 L/s-m<sup>2</sup> @ 50 Pa



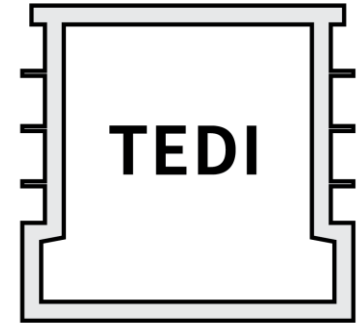
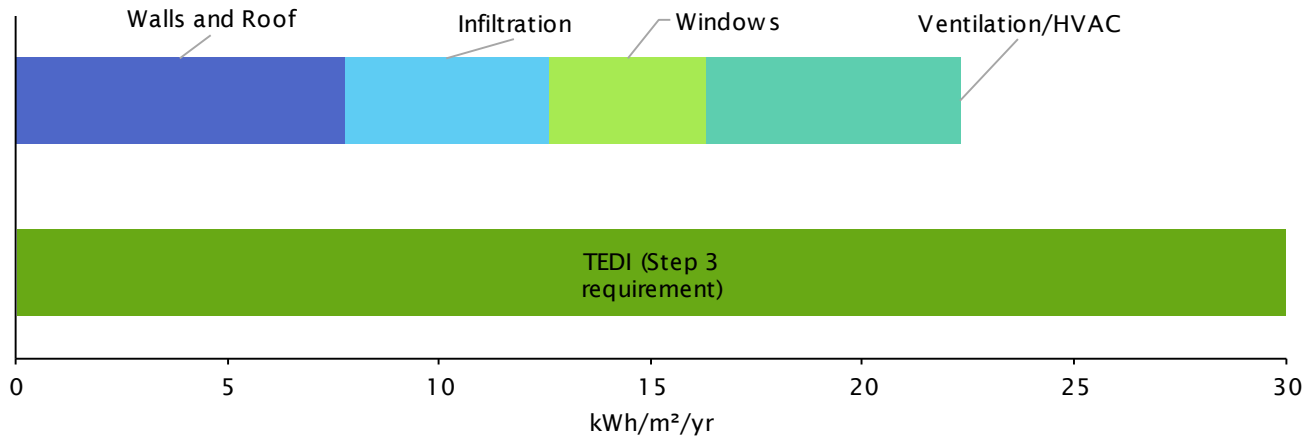


# Design Strategy

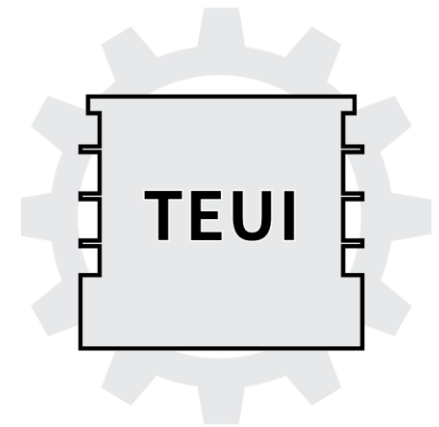
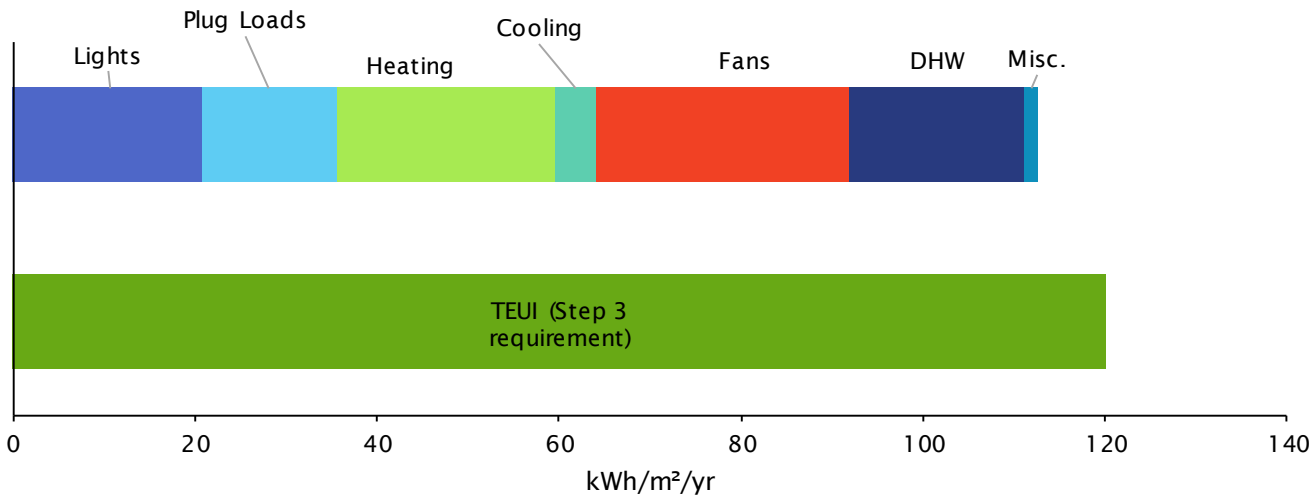
- Heat recovery ventilation: in all suites and common spaces
  - 70% SRE
- Wall assemblies: split insulated wood frame
  - 1.5" exterior mineral wool or 1" XPS
- Window performance: double glazed with vinyl frames
  - U-value of 0.26 Btu/(hr-F-ft<sup>2</sup>), SHGC 0.3
- Airtightness: target per modelling guidelines & BC Housing



# Energy Modelling



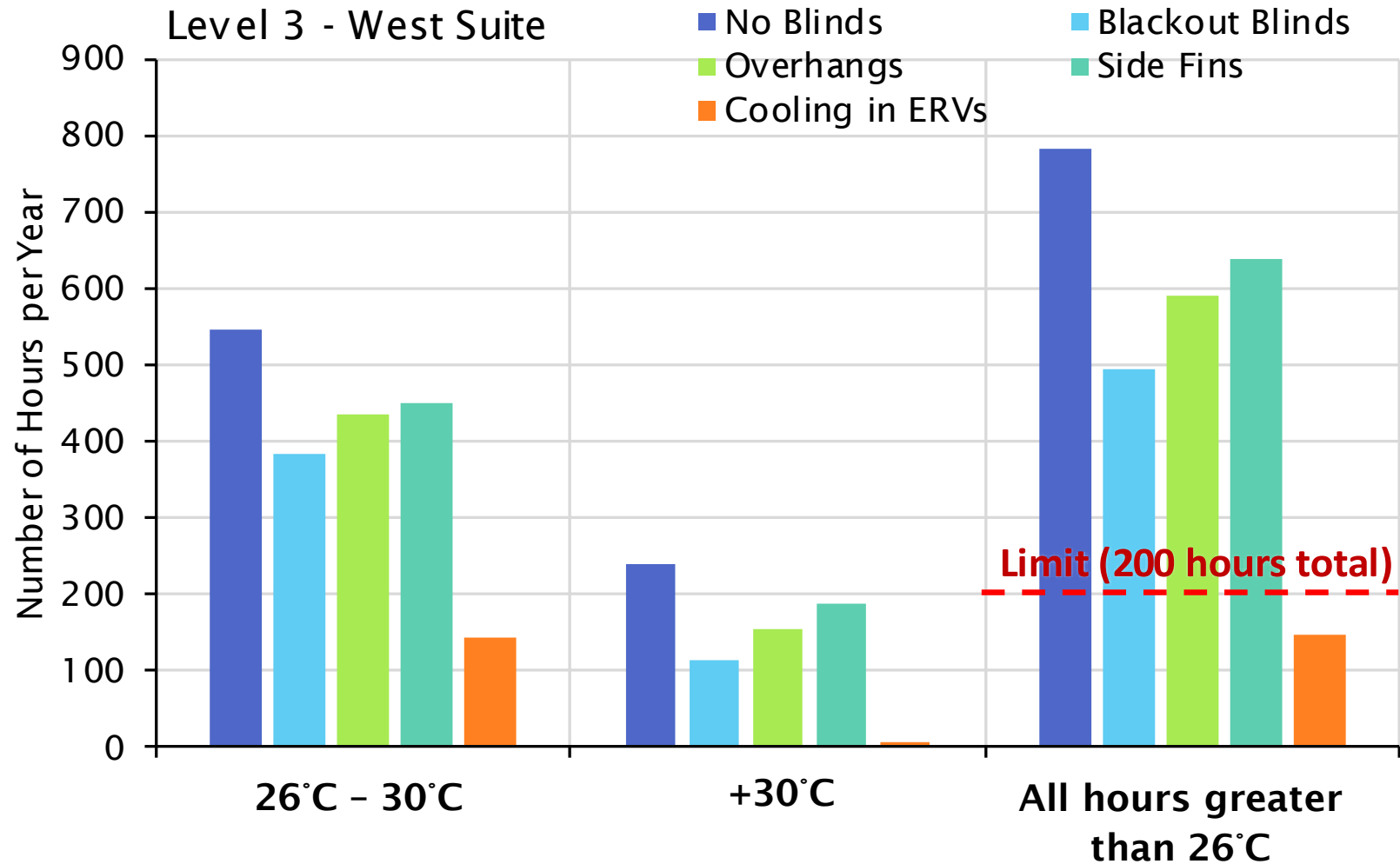
Building Envelope  
& Ventilation



Whole Building  
Energy Consumption



# Considerations for Overheating



# Typical Project Timelines



DESIGN & ENGINEERING



PERMITS &  
APPROVALS



SITE PREP & FOUNDATION WORK



ON-SITE CONSTRUCTION

SITE-BUILT CONSTRUCTION TIMELINE



DESIGN & ENGINEERING



PERMITS &  
APPROVALS



SITE PREP &  
FOUNDATION  
WORK



FACTORY



ON-SITE  
CONSTRUCTION



OCCUPANCY

MODULAR CONSTRUCTION TIMELINE



# Lessons Learned

- Engage early with local jurisdictions to facilitate permitting
- Energy analysis helps guide the design approach
- Consider overheating in design – mechanical cooling may be necessary
- Temporary housing can still be energy efficient and airtight!

Case Study #2: Abbotsford Temporary Homeless Shelter



# How can we meet our mandate?



- **FAST:** 6 month project timelines
- **AFFORDABLE:** provides basic housing needs
- **SUSTAINABLE:** Passive House & Step Code
  
- Also, housing for underserved communities:
  - Solution for remote locations



# Iqaluit – steel framed modular



Where  
next?

MODULAR CONSTRUCTION FOR ENERGY EFFICIENT,  
AFFORDABLE HOUSING

# Discussion + Questions

ehenderson@rdh.com

Learn more at  
[rdh.com](http://rdh.com)



RDH Building Science



@RDHBuildings