LEEP LOCAL ENERGY EFFICIENCY PARTNERSHIPS

LEEP *Larsen Truss Case Study*
High Performance Exterior Wall Renovation
Event / ENBIX / Nose Creek Valley Museum

April 8th, 2025

Airdrie, Alberta

LEEP Contact: Clarice Kramer, clarice.kramer@nrcan-rncan.gc.ca

Natural Resources Canada | Ressources naturelles Canada

Canada

Today's Speaker

Stephen Magneron, MEA
smagneron@homesol.ca

Ontario Manager

HOMESOL BUILDING SOLUTIONS INC. Energy Conservation Consultants

- CHBA NZ Technical Committee
- NZ Qualified EA and Trainer
- Member, CACEA
- Passive House Consultant and Phius Verifier

Acknowledgements

Fellipe Falluh – Retrofit Construction

Steve Norris – SNAP Building

Jer Greene – Jer Greene Architect

Chelsah Thomas – Sol Invictus Energy Services

Kim Walton – Bow Crow Design

Stephen Magneron - Homesol

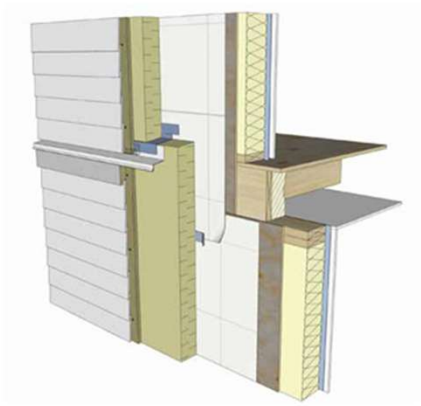
It takes collaboration and an Integrated Design Process (IDP) to deliver an affordable, efficient, sustainable, resilient and healthy high-performance building.

Agenda

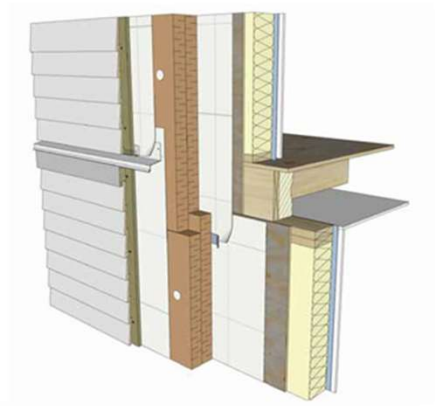
- Larsen Truss
- Case Study 1: Retrofit Construction, Quebec
- Case Study 2: SNAP Building, Alberta
- Lessons Learned

LEEP LOCAL ENERGY EFFICIENCY PARTNERSHIPS NET ZERO ENERGY **Wall Assemblies**

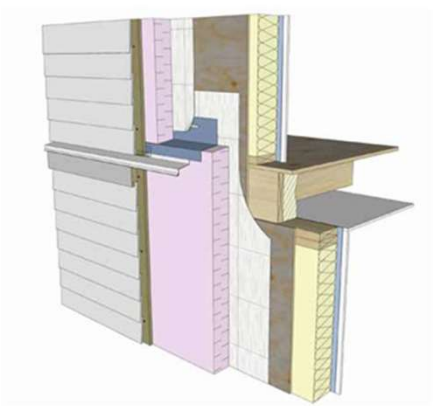
Introduction: LEEP NZE Wall Guide Series & The Wall Selection Guide



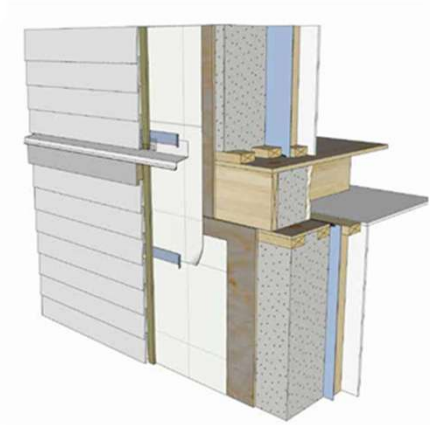
Wall #1 Split-Wall: Vapour Permeable Exterior Insulation



Wall #2 Split-Wall: Wood fibre Exterior Insulation



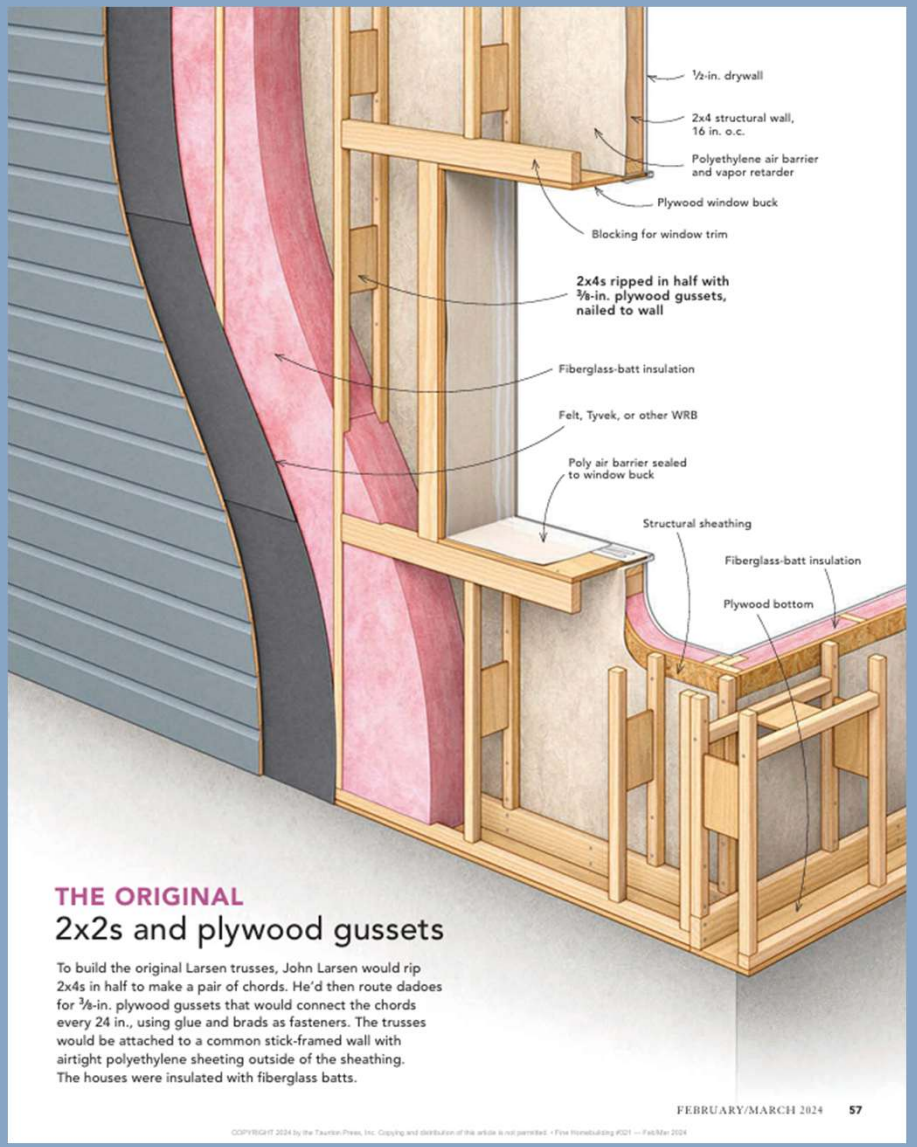
Wall #3 Split-Wall: Low-Permeance Exterior Insulation



Wall #4 Double stud Wall with Interior Service Wall

Larsen Truss
“The Original”

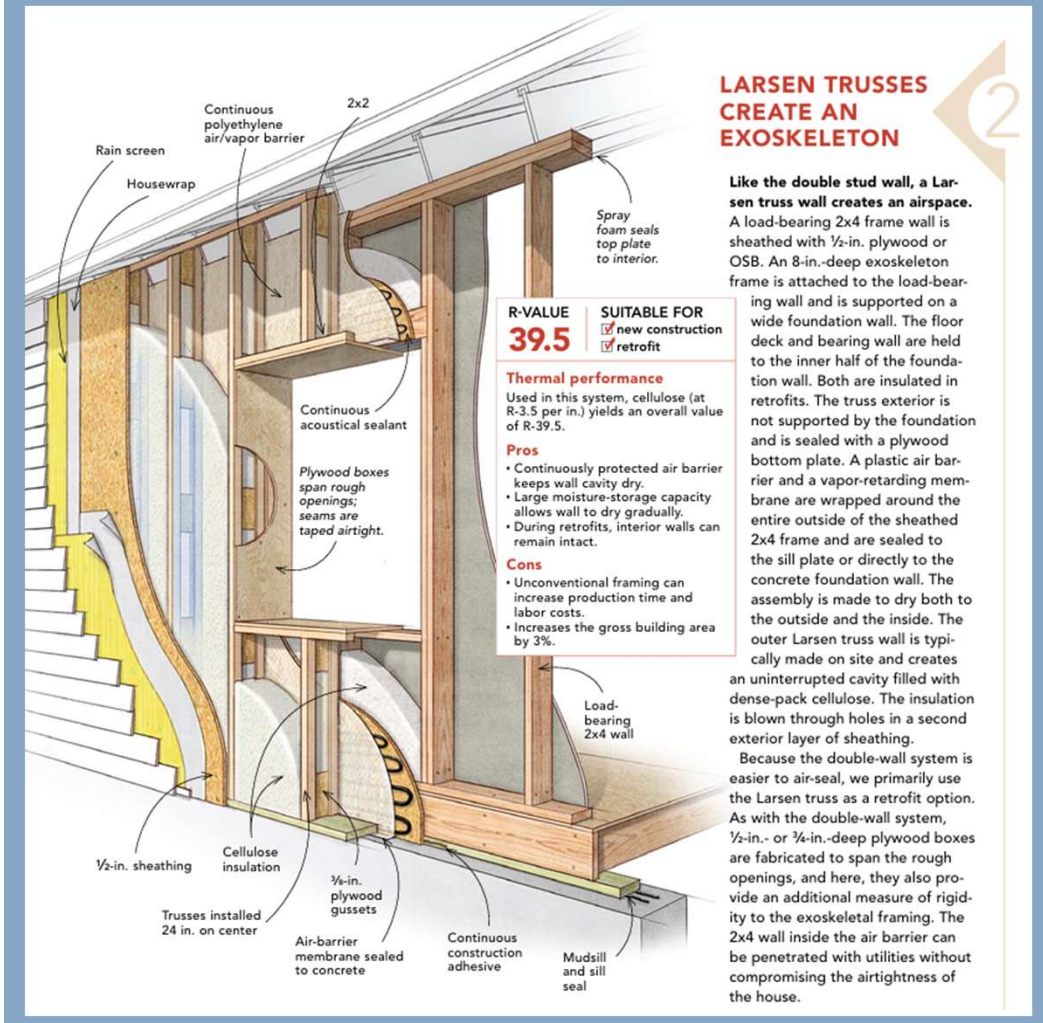
- John Larsen, Edmonton, Alberta
- 1980s
- Alternative to double stud walls
- Sub-trade to framers
  - Air and vapour barriers
  - Exterior insulation
  - Siding



Fine Home Building #321 –Feb/Mar 2024 – Understanding Larsen Trusses

Fine Home Building - 2009

- Effective ~R-40
- New construction and retrofit
- Protected air barrier
- Interior walls can remain untouched in retrofits
- Higher labour costs
- Increases in gross building area/lot lines

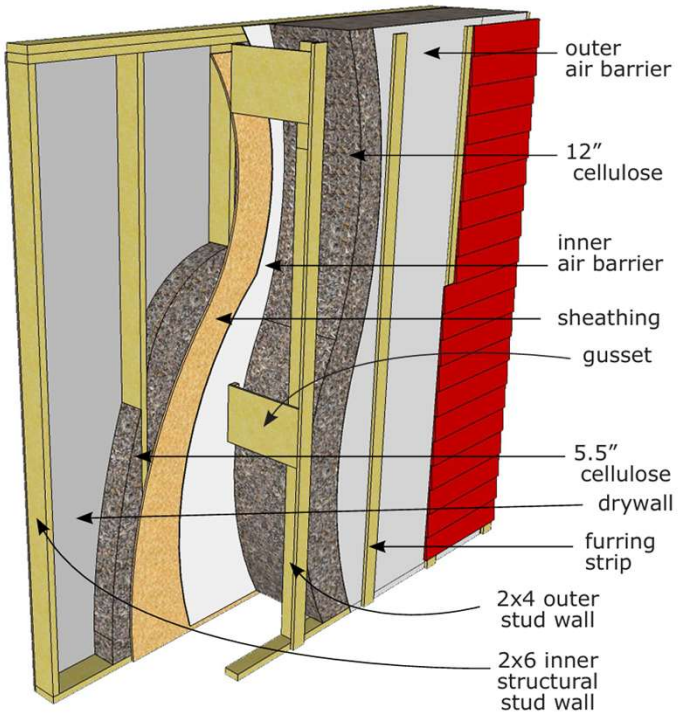


Fine Home Building 2009 – Six Proven Ways to Build Energy-Smart Walls

COLD CLIMATE HOUSING RESEARCH CENTER
CCHRC
August 2013

Arctic Wall Performance

A super-insulated vapor-permeable wall design in Interior Alaska



Vapor Diffusion and Airtightness

The highly airtight Arctic Wall minimizes air movement and heat loss through the walls. The home was measured as much tighter (0.45 air changes per hour at 50 Pascals of pressure) than the maximum air-tightness of 3 ACH 50 set by the 2012 International Energy Code.

Taped plywood sheathing and house wrap serves as the primary air barrier system. While this system is very airtight, it allows water to move through vapor diffusion. Vapor barriers, or Class I vapor retarders, are deliberately excluded from this wall design. The vapor permeability provides greater drying potential for the wall throughout the year.

The cellulose insulation in this wall system is capable of storing moisture, or moisture buffering, over the winter without succumbing to moisture damage or mold.

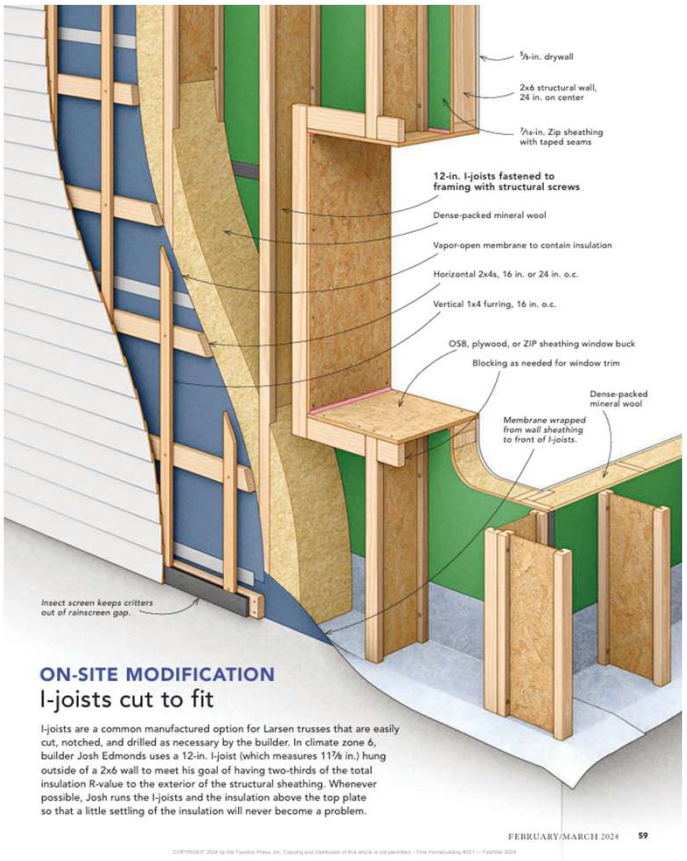
Keeping The Heat In - Section 7: Insulating Walls: insulating, renovating and building additions

Batt/blanket insulation

- Build a wooden framework on top of the entire outside wall to hold the insulation and support the new siding (see Figure 7-10). Ensure the air and vapour barriers are properly installed.
- Alternatively, a lightweight frame wall (such as a Larsen truss) can be hung from the rafters or supported on a bottom plate out from the old wall. This would allow two layers of snugly installed batt type insulation, one horizontally behind the frame, the other vertically between the studs. Using this method, RSI 3.5 (R-20) or higher can be installed.

Figure 7-10 Trusses can be hung from the rafters and nailed to the existing wall

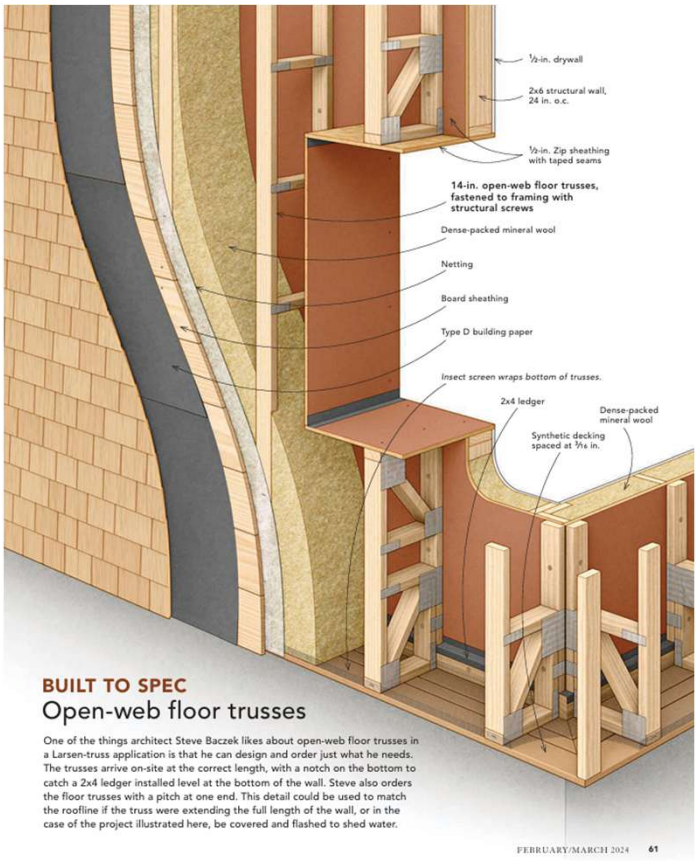
Fine Home Building - Understanding Larsen Trusses - 2024



ON-SITE MODIFICATION

I-joists cut to fit

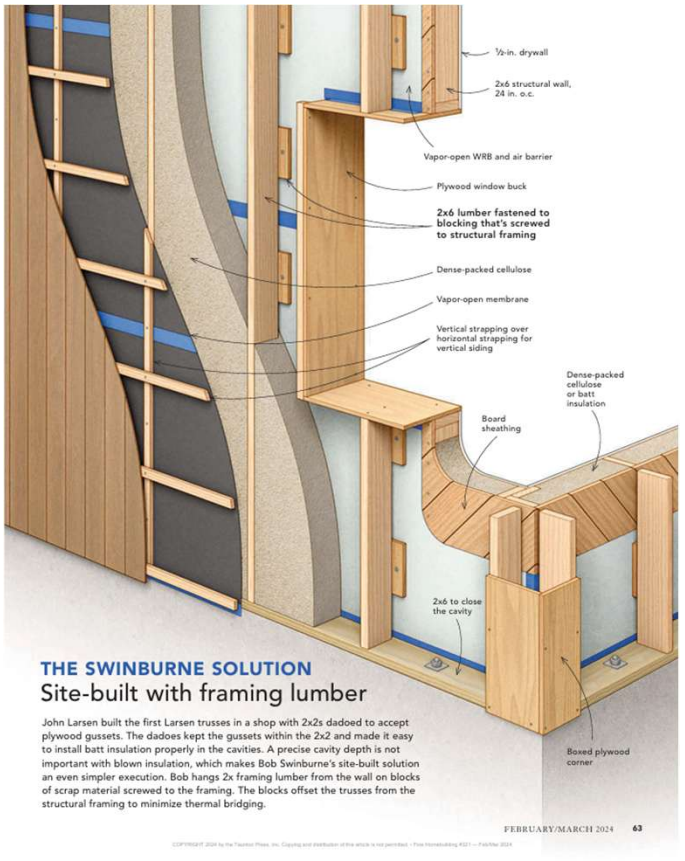
I-joists are a common manufactured option for Larsen trusses that are easily cut, notched, and drilled as necessary by the builder. In climate zone 6, builder Josh Edmonds uses a 12-in. I-joist (which measures 11⅞ in.) hung outside of a 2x6 wall to meet his goal of having two-thirds of the total insulation R-value to the exterior of the structural sheathing. Whenever possible, Josh runs the I-joists and the insulation above the top plate so that a little settling of the insulation will never become a problem.



BUILT TO SPEC

Open-web floor trusses

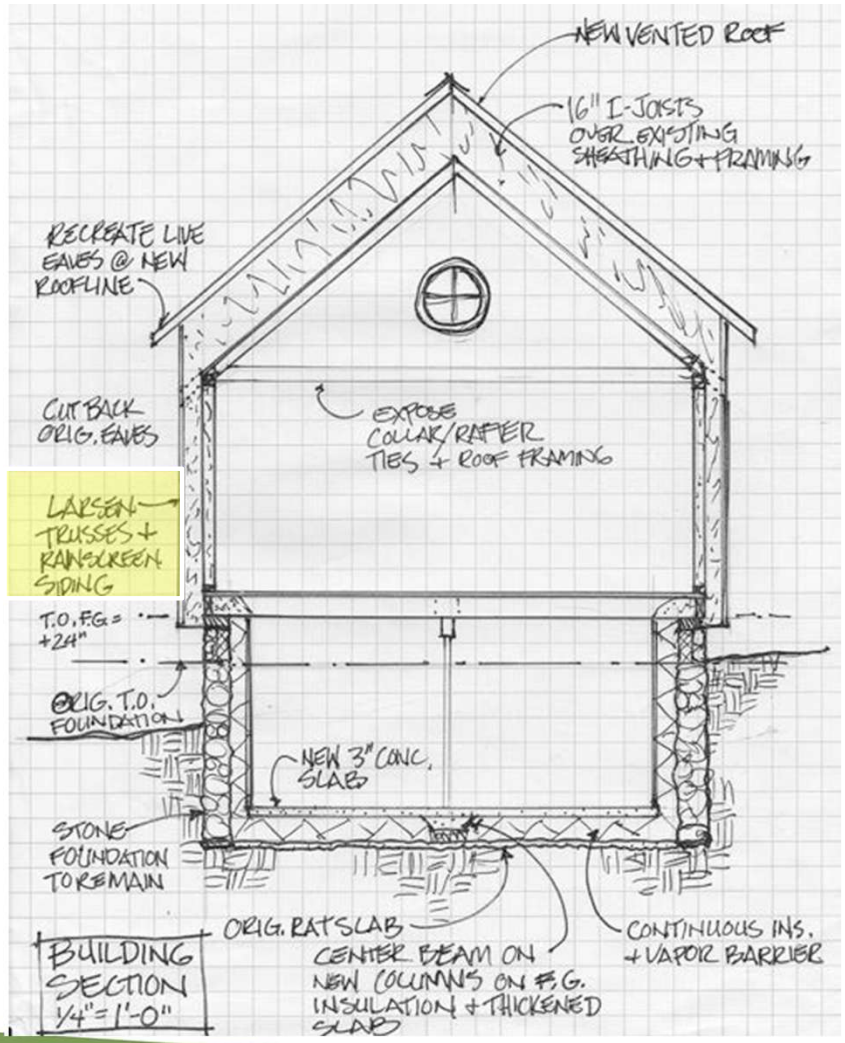
One of the things architect Steve Baczek likes about open-web floor trusses in a Larsen-truss application is that he can design and order just what he needs. The trusses arrive on-site at the correct length, with a notch on the bottom to catch a 2x4 ledger installed level at the bottom of the wall. Steve also orders the floor trusses with a pitch at one end. This detail could be used to match the roofline if the truss were extending the full length of the wall, or in the case of the project illustrated here, be covered and flashed to shed water.



THE SWINBURNE SOLUTION

Site-built with framing lumber

John Larsen built the first Larsen trusses in a shop with 2x2s dadoed to accept plywood gussets. The dadoes kept the gussets within the 2x2 and made it easy to install batt insulation properly in the cavities. A precise cavity depth is not important with blown insulation, which makes Bob Swinburne's site-built solution an even simpler execution. Bob hangs 2x framing lumber from the wall on blocks of scrap material screwed to the framing. The blocks offset the trusses from the structural framing to minimize thermal bridging.



River ARCHITECTS

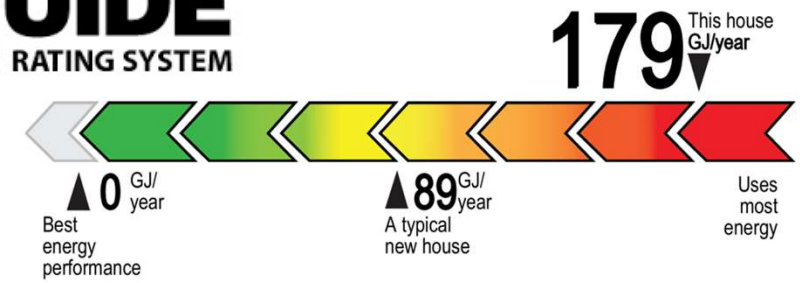
(Modified) Larsen Truss Case Study #1

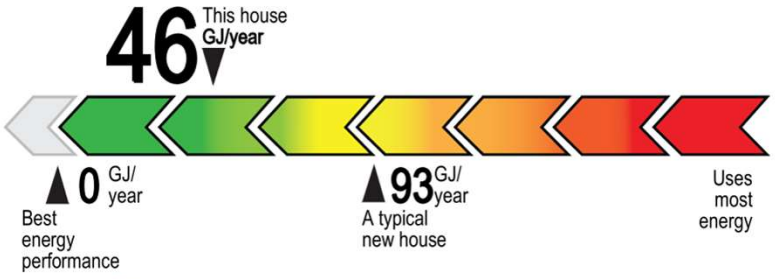
retrofit

Year Built: 1968

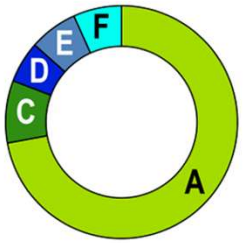
Year Renovated: 2024

ENERGUIDE RATING SYSTEM

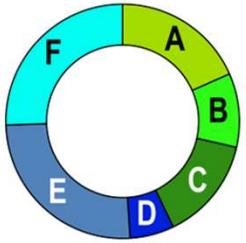




HOW YOUR RATED ENERGY IS USED:

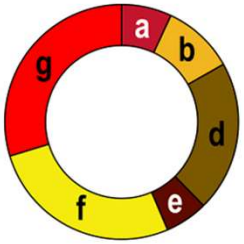


A.	Space heating	75%
B.	Space cooling	0%
C.	Water heating	9%
D.	Ventilation	1%
E.	Lights & appliances	7%
F.	Other electrical	8%

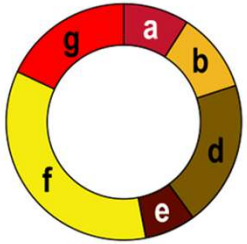


A.	Space heating	18%
B.	Space cooling	10%
C.	Water heating	14%
D.	Ventilation	3%
E.	Lights & appliances	25%
F.	Other electrical	30%

WHERE YOUR HOME LOSES HEAT:

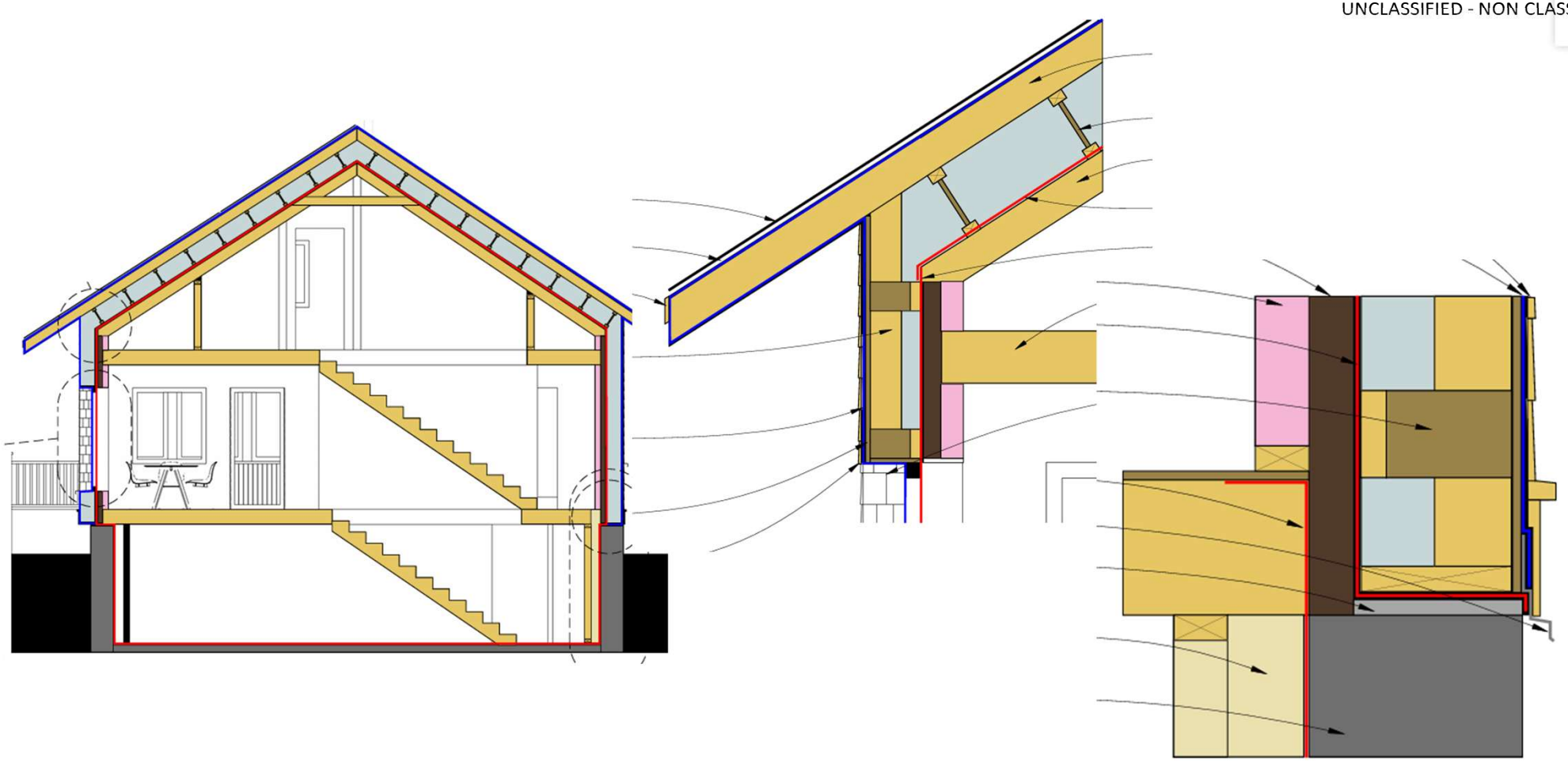


a.	Attic/Ceiling	7%
b.	Main Walls	10%
c.	Exposed floors	0%
d.	Windows	21%
e.	Exterior doors	5%
f.	Basement/Foundation	27%
g.	Air leakage/ventilation	30%



a.	Attic/Ceiling	9%
b.	Main Walls	11%
c.	Exposed floors	0%
d.	Windows	20%
e.	Exterior doors	7%
f.	Basement/Foundation	35%
g.	Air leakage/ventilation	18%

	Pre-retrofit	Post-retrofit	Difference
Effective R-value (RSI)	20.33 (3.58)	47.30 (8.33)	133%
ERS (GJ/yr)	179	46	-74%
Wall Heat Loss (GJ)	17.5	4.7	-73%
ACH_{50}	8.93	0.74	-92%
ELA (in^2 (cm^2))	285 (1,837)	20 (126)	-93%
NLR (cfm/ft^2 ($L/s/m^2$))	0.64 (3.23)	0.06 (0.28)	-91%
Whole house F280 Heat Loss (btu/hr)	71,925 (21,079)	14,855 (4,354)	-79%
Headers and walls only F280 Heat Loss (btu/hr)	4,338 (1,271)	517 (152)	-88%




TESCON
Vana


MENTOR
TESCON
Vana


DG1000-9549
Pressure (Pa)
-49.7
ACH50
0.73

Test Results at 50 Pascals:	Depressurization	Pressurization	Average
cfm (Airflow)	162 (+/- 0.5 %)	125 (+/- 2.1 %)	144
ACH50	0.53	0.41	0.47
cfm/ft² (Surface Area)	0.0394	0.0304	0.0349
Leakage Areas:			
Canadian EqLA @ 10 Pa (in²)	12.9 (+/- 1.5 %)	16.2 (+/- 6.9 %)	14.5
in²/ft² Surface Area	0.0031	0.0039	0.0035
LBL ELA @ 4 Pa (in²)	5.9 (+/- 2.5 %)	9.8 (+/- 11.5 %)	7.9
in²/ft² Surface Area	0.0014	0.0024	0.0019

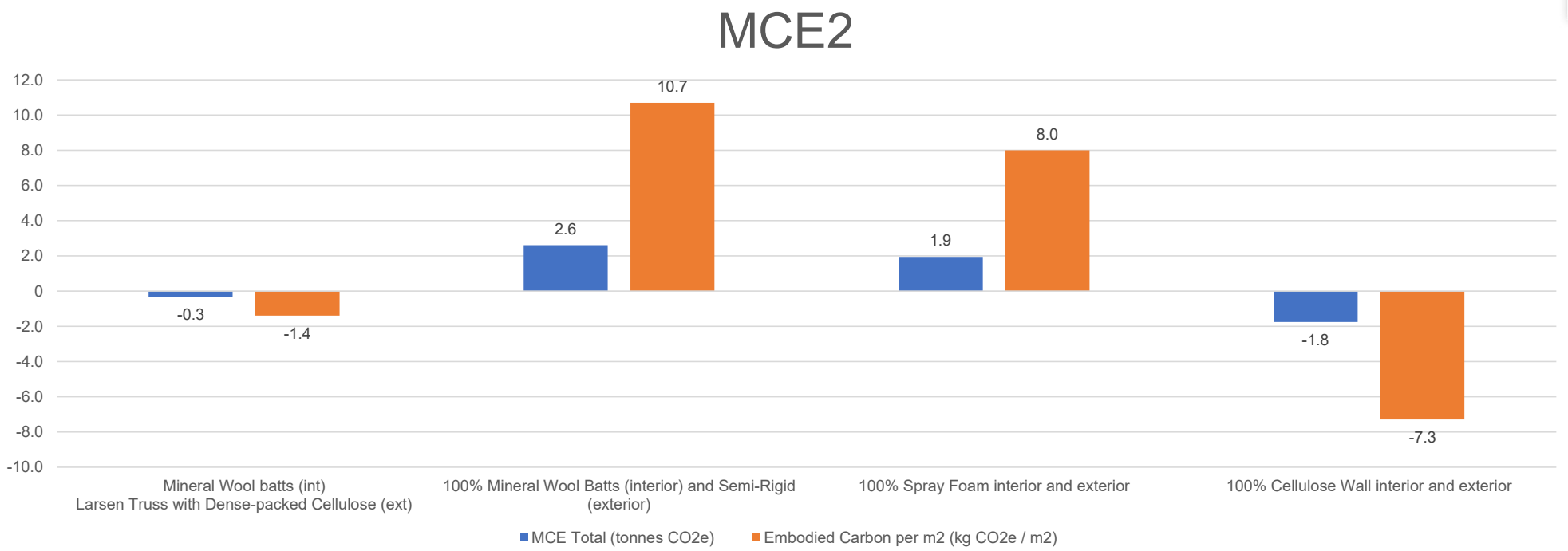

TESCON Vana
CRETE


pro clima SOLITEX
MENTO 1000


INTELLO PLUS

	8” Mineral wool	I-joist	Larsen Truss	Modified Larsen
Total cost	$ 31,500	$ 30,500	$ 24,500	$ 22,000
Window Bucks	$ 1,500	$ 1,500	$ 1,500	$ 1,500
Brick ledge repointing	$ 4,000	$ 4,000	$ 4,000	$ 4,000
Insulation and framing	$ 17,000	$ 16,000	$ 8,500	$ 7,500
Labour	$ 9,000	$ 9,000	$ 10,500	$ 9,000
Total cost per sqft of wall and header area 1,041 ft2	$ 30	$ 29	$ 24	$ 21

Schedule	Weeks
Wall Demolition	1
Window resizing and window bucks, and restructuring of wall where damaged	2
Repair and cap existing stone foundation wall	1
Window installation	1
Roof work for chainsaw retrofit - demolition, restructuring, and I-joist installation	3
Interior wall and roof insulation and primary air barrier	1
Larsen truss	1
Re-creating roof overhangs	1
Final airtightness and dense-packed cellulose in Larsen Truss	1
Rain screen, kickout flashing and siding install	3
Total	15



Energy Sources	Rated Consumption (GJ/year)	Equivalent Units (per year)	Greenhouse Gas Emissions (tonnes/year)
Electricity	179	49797 kWh	0.1
Total	179		0.1

Operational Energy and Carbon

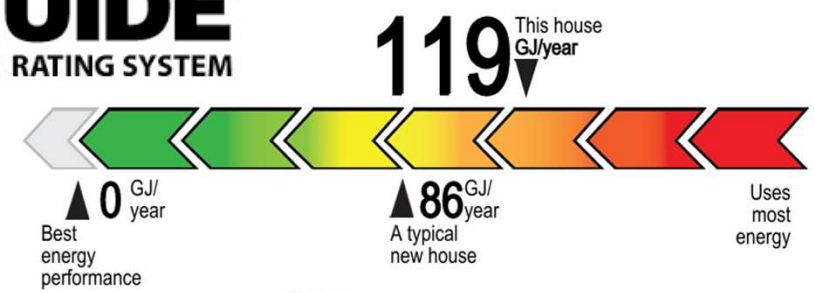
Energy Sources	Rated Consumption (GJ/year)	Equivalent Units (per year)	Greenhouse Gas Emissions (tonnes/year)
Electricity	46	12795 kWh	0.0
Total	46		0.0

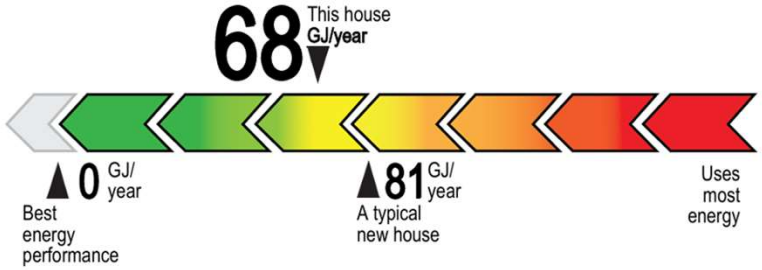
(Modified) Larsen Truss Case Study #2 - Alberta

Year Built: 1968

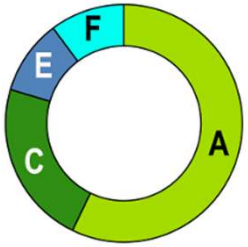
Year Renovated: 2024

ENERGUIDE RATING SYSTEM

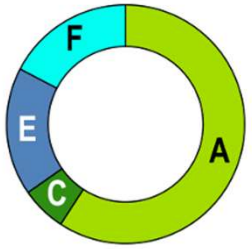




HOW YOUR RATED ENERGY IS USED:

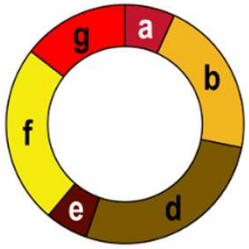


A.	Space heating	56%
B.	Space cooling	0%
C.	Water heating	22%
D.	Ventilation	0%
E.	Lights & appliances	10%
F.	Other electrical	12%

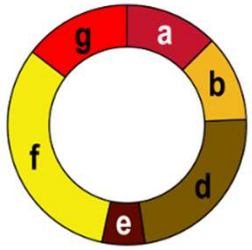


A.	Space heating	58%
B.	Space cooling	0%
C.	Water heating	5%
D.	Ventilation	0%
E.	Lights & appliances	17%
F.	Other electrical	20%

WHERE YOUR HOME LOSES HEAT:

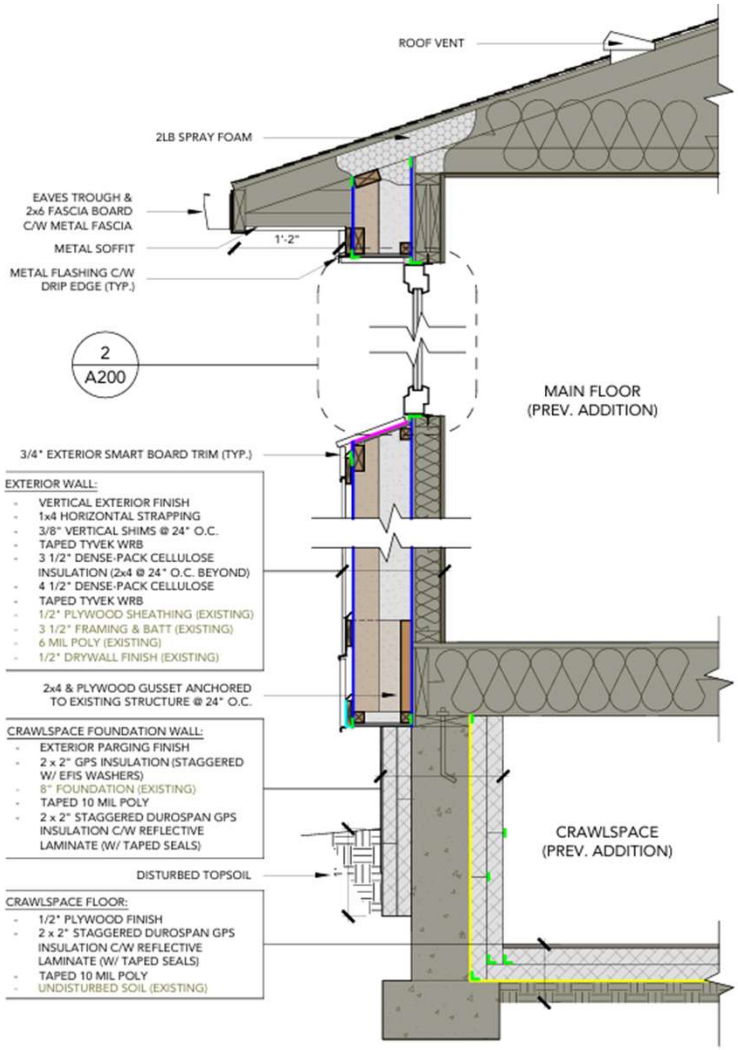


a.	Attic/Ceiling	7%
b.	Main Walls	22%
c.	Exposed floors	0%
d.	Windows	28%
e.	Exterior doors	3%
f.	Basement/Foundation	25%
g.	Air leakage/ventilation	15%



a.	Attic/Ceiling	13%
b.	Main Walls	12%
c.	Exposed floors	0%
d.	Windows	24%
e.	Exterior doors	3%
f.	Basement/Foundation	33%
g.	Air leakage/ventilation	15%

	Pre-retrofit	Post-retrofit	Difference
Effective R-value (RSI)	8.15 (1.44)	38.13 (6.72)	468%
ERS (GJ/yr)	119	68	43%
Operational GHG Emissions (tonnes/yr)	10.8	8.1	25%
Wall Heat Loss (GJ)	26.2	7.9	70%
ACH_{50}	5.26	2.62	50%
ELA (in^2 (cm^2))	142 (916)	70 (453)	51%
NLR (cfm/ft^2 ($L/s/m^2$))	0.33 (1.70)	0.17 (0.84)	48%
Whole house F280 Heat Loss (btu/hr (W))	45,524 (13,341)	25,171 (7,377)	44%
Headers and walls only F280 Heat Loss (btu/hr(W))	10,292 (3,016)	2,952 (865)	71%


ROOF VENT
2LB SPRAY FOAM
EAVES TROUGH &
2x6 FASCIA BOARD
C/W METAL FASCIA
METAL SOFFIT
METAL FLASHING C/W
DRIP EDGE (TYP.)
1'-2"
2
A200
MAIN FLOOR
(PREV. ADDITION)
3/4" EXTERIOR SMART BOARD TRIM (TYP.)
EXTERIOR WALL:
- VERTICAL EXTERIOR FINISH
- 1x4 HORIZONTAL STRAPPING
- 3/8" VERTICAL SHIMS @ 24" O.C.
- TAPED TYVEK WRB
- 3 1/2" DENSE-PACK CELLULOSE INSULATION (2x4 @ 24" O.C. BEYOND)
- 4 1/2" DENSE-PACK CELLULOSE
- TAPED TYVEK WRB
- 1/2" PLYWOOD SHEATHING (EXISTING)
- 3 1/2" FRAMING & BATT (EXISTING)
- 6 MIL POLY (EXISTING)
- 1/2" DRYWALL FINISH (EXISTING)
2x4 & PLYWOOD GUSSET ANCHORED
TO EXISTING STRUCTURE @ 24" O.C.
CRAWLSPACE FOUNDATION WALL:
- EXTERIOR PARGING FINISH
- 2 x 2" GPS INSULATION (STAGGERED W/ EFIS WASHERS)
- 8" FOUNDATION (EXISTING)
- TAPED 10 MIL POLY
- 2 x 2" STAGGERED DUROSPAN GPS INSULATION C/W REFLECTIVE LAMINATE (W/ TAPED SEALS)
DISTURBED TOPSOIL
CRAWLSPACE FLOOR:
- 1/2" PLYWOOD FINISH
- 2 x 2" STAGGERED DUROSPAN GPS INSULATION C/W REFLECTIVE LAMINATE (W/ TAPED SEALS)
- TAPED 10 MIL POLY
- UNDISTURBED SOIL (EXISTING)
CRAWLSPACE
(PREV. ADDITION)


DUPONT
Tyvek


DUPONT
Tyv
Home


Tyvek
HomeWrap


DUPONT
Tyvek
HomeWrap
DICK'S
LUMBER & BUILDING SUPPLIES

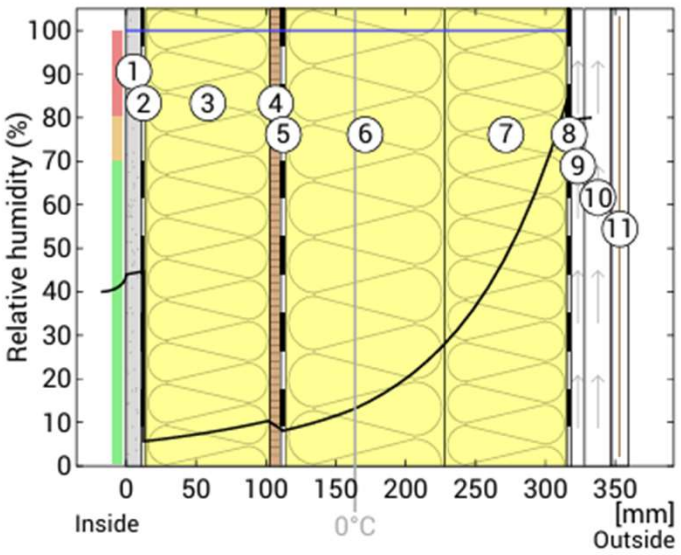

DUPONT
Tyvek
HomeWrap
DICK'S
LUMBER & BUILDING SUPPLIES

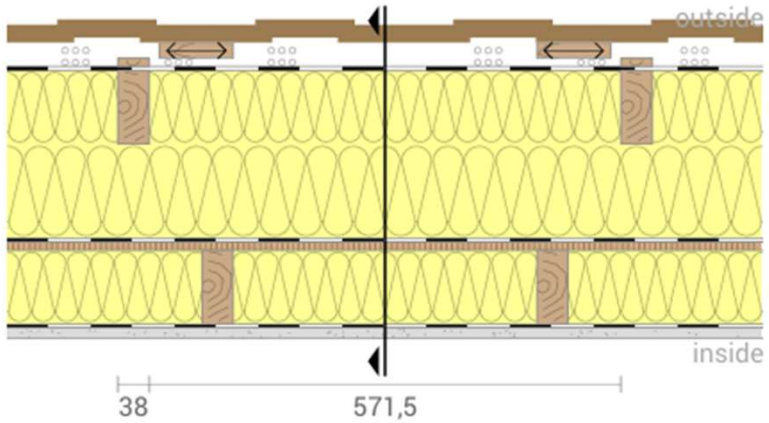
Plywood blocks

Moisture proofing

Drying reserve: 645 g/m²a
No condensate

excellent — insufficient



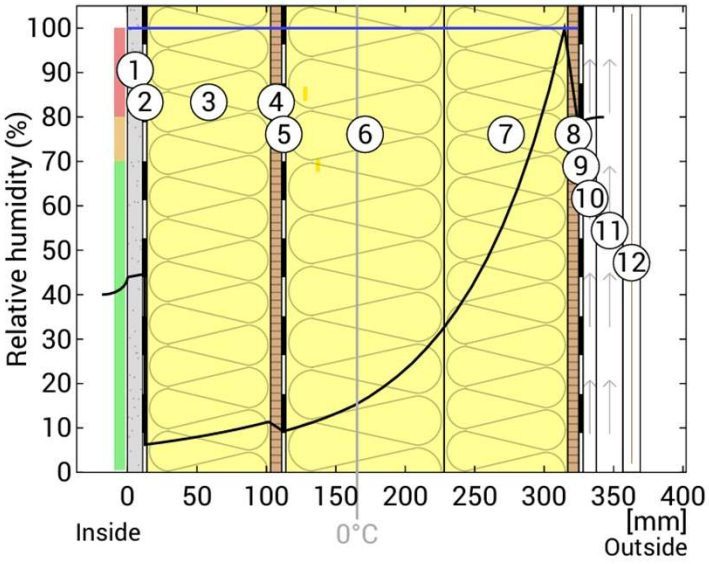


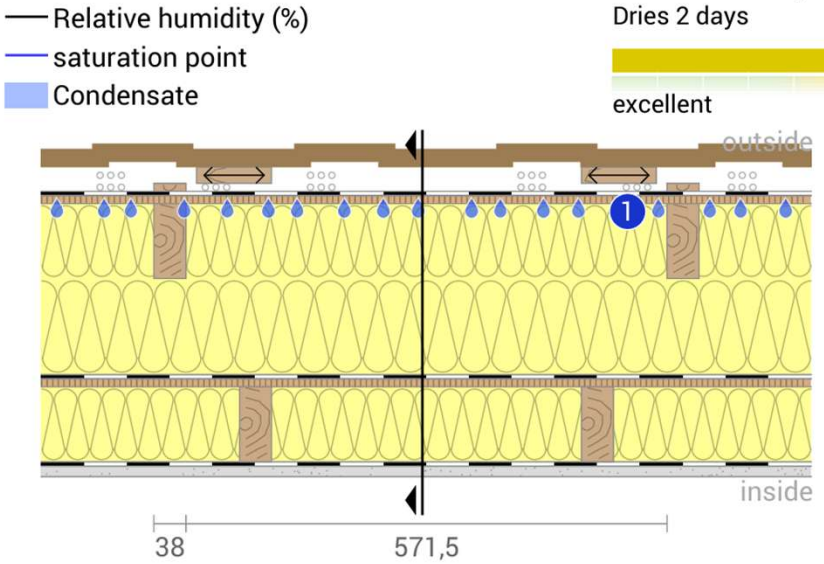
① Gypsum board (12,5 mm)
② Foil, PE
③ Insulation, blanket and batt, rock ...
④ Plywood - Douglas fir (9,5 mm)
⑤ Tyvek® HomeWrap®
⑥ Isocell (114 mm)
⑦ Isocell (89 mm)
⑧ Tyvek® HomeWrap®
⑨ Rear ventilated level (9,53 mm)
⑩ Rear ventilated level (19 mm)
⑪ Vertical cladding (12,5 mm)

Moisture proofing

Wood moisture: +3,2%
Condensate: 77 g/m²
Dries 2 days

excellent — insufficient



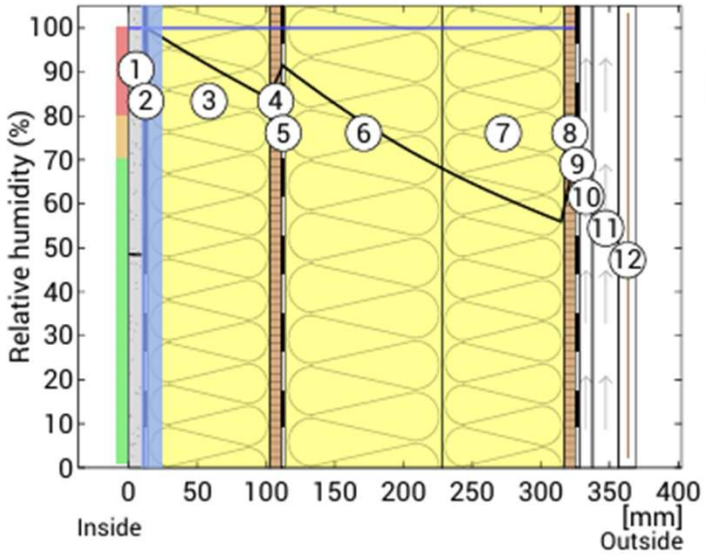


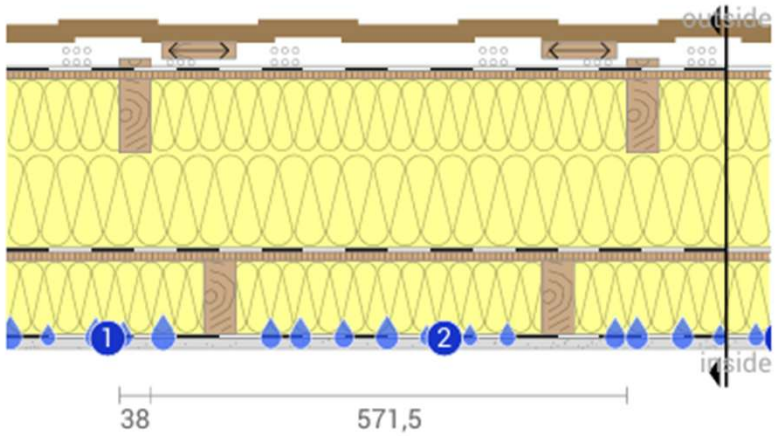
① Gypsum board (12,5 mm)
② Foil, PE
③ Insulation, blanket and batt, rock ...
④ Plywood - Douglas fir (9,5 mm)
⑤ Tyvek® HomeWrap®
⑥ Isocell (114 mm)
⑦ Isocell (89 mm)
⑧ Plywood - generic softwood (9,5 mm)
⑨ Tyvek® HomeWrap®
⑩ Rear ventilated level (9,53 mm)
⑪ Rear ventilated level (19 mm)
⑫ Vertical cladding (12,5 mm)

Moisture proofing

Dries 170 days
Drying reserve: 0 g/m²a
Condensate: 0,63 kg/m²

excellent — insufficient





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③ Insulation, blanket and batt, rock ...
④ Plywood - Douglas fir (9,5 mm)
⑤ Tyvek® HomeWrap®
⑥ Insulation, loose-fill insulation, ce...
⑦ Insulation, loose-fill insulation, ce...
⑧ Plywood - generic softwood (9,5 mm)
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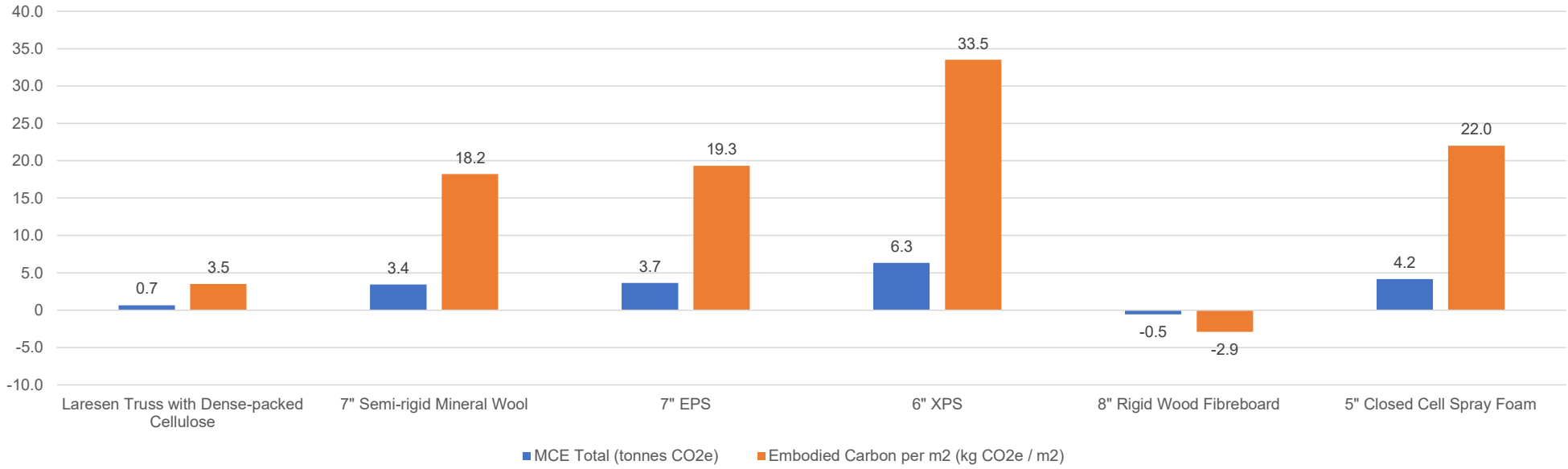
⑩ Rear ventilated level (9,53 mm)
⑪ Rear ventilated level (19 mm)
⑫ Vertical cladding (12,5 mm)

	Larsen Truss
Total cost	$ 18,500
Materials and Labour	$ 14,500
Insulation	$ 4,000
Total cost per sqft of wall and header area 1,096 ft2	$ 17

Schedule	Weeks
Abatement of asbestos containing stucco, and 2 chimneys	1
Deconstruction of original lap siding	1
Primary air barrier, Lasen truss, and window bucks (window delays)	2
Installation of cellulose, WRB, windows, and strapping	2
Siding - 2 weeks	2
Total	8

MCE2



Energy Sources	Rated Consumption (GJ/year)	Equivalent Units (per year)	Greenhouse Gas Emissions (tonnes/year)
Natural gas	92	2473 m3	4.8
Electricity	27	7449 kWh	6.0
Total	119		10.8

Operational Energy and Carbon

Energy Sources	Rated Consumption (GJ/year)	Equivalent Units (per year)	Greenhouse Gas Emissions (tonnes/year)
Natural gas	38	1019 m3	2.0
Electricity	30	8408 kWh	6.1
Total	68		8.1

Lessons Learned

- **IDP**

- **Larsen Truss**
  - An adaptable method
  - Synergy with airtightness and updating windows
  - Interior wall insulation (?)

- **Schedule**
  - Time can be sped up with experience
  - Ordering and supplying windows early helps

- **Air barrier**
  - Redundancy is good, but can be expensive
  - A complete approach to achieve great airtightness
  - Test often

Q&A