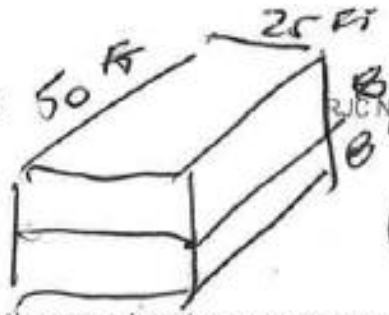
The Dangers of a Black Box

Read Jones Christoffersen Ltd.
Creative Thinking **Practical Results**

Responsible Registrant

Firms are required to have at least one Responsible Registrant who acknowledges responsibility for the firm and will complete the application.

The Responsible Registrant must be an engineering or geoscience professional who will be responsible for ensuring that the firm's practice meets ethical, quality management, and continuing education requirements.



~ 2500 sq Ft House.

(50 x 2 + 25 x 2) x B x 2
= 2400 Ft²
Wall area
≈ 220 m²

4.0 OUTPUTS

The energy breakdown for the proposed building along with the associated energy savings are outlined in Table A7 (the tabular data in Table A7 is shown in graphical form in Figure A1):

Table A7: Annual Energy Consumption for the Proposed Building

End Use	Energy Consumption
Lighting	58.87
Equipment	83.64
Elevators	11.61
Space Heating	121.40
Service Water Heating	132.72
Fans	26.81
Pumps	2.10
Total [MWh]	437.15
TEUI [kWh/m²/year]	100.48

100 W Lightbulb
Hrs in a year
365 x 24 = 8760

$$\frac{100 \times 8760\ hr}{220} = 3981 \frac{kWhr}{m^2/yr}$$

$$= 4 \frac{kWhr}{m^2/yr}$$

Work is Transfer of Energy

Work: 1 Joule = N x m

Power is the Rate of Work

Power: 1 Watt = 1 Joule / Second

Energy is ability to do Work and Heat is Energy

1kWhr = 3,600,000 Joules

= 1C temp rise in 900 L water

A Lamborghini is Powerful and Expensive

600 kW (802 HP) = 0-100 kmh in 2.8 sec

= 0.47 kWhr = 1.692 mJ

= $2.64M

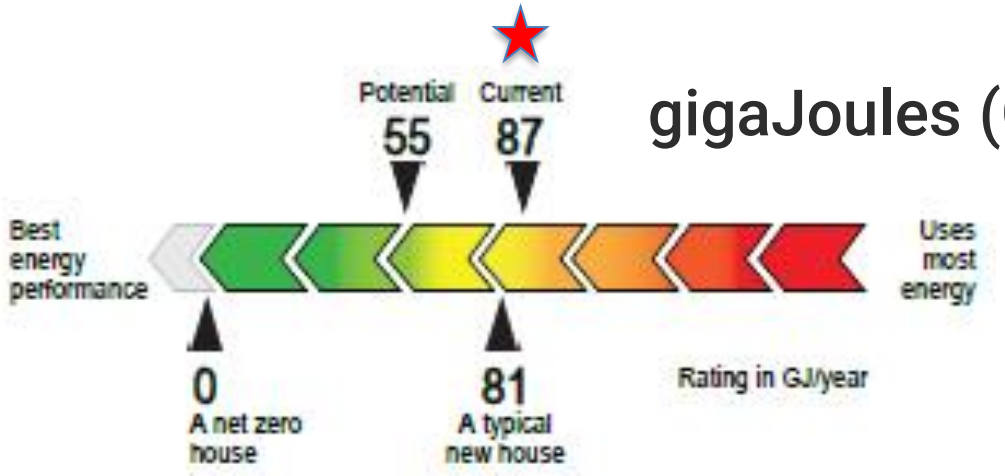
900 Litres

2022 Lamborghini Countach

RENOVATION UPGRADE REPORT

ENERGUIDE

MY HOUSE



Enclosure

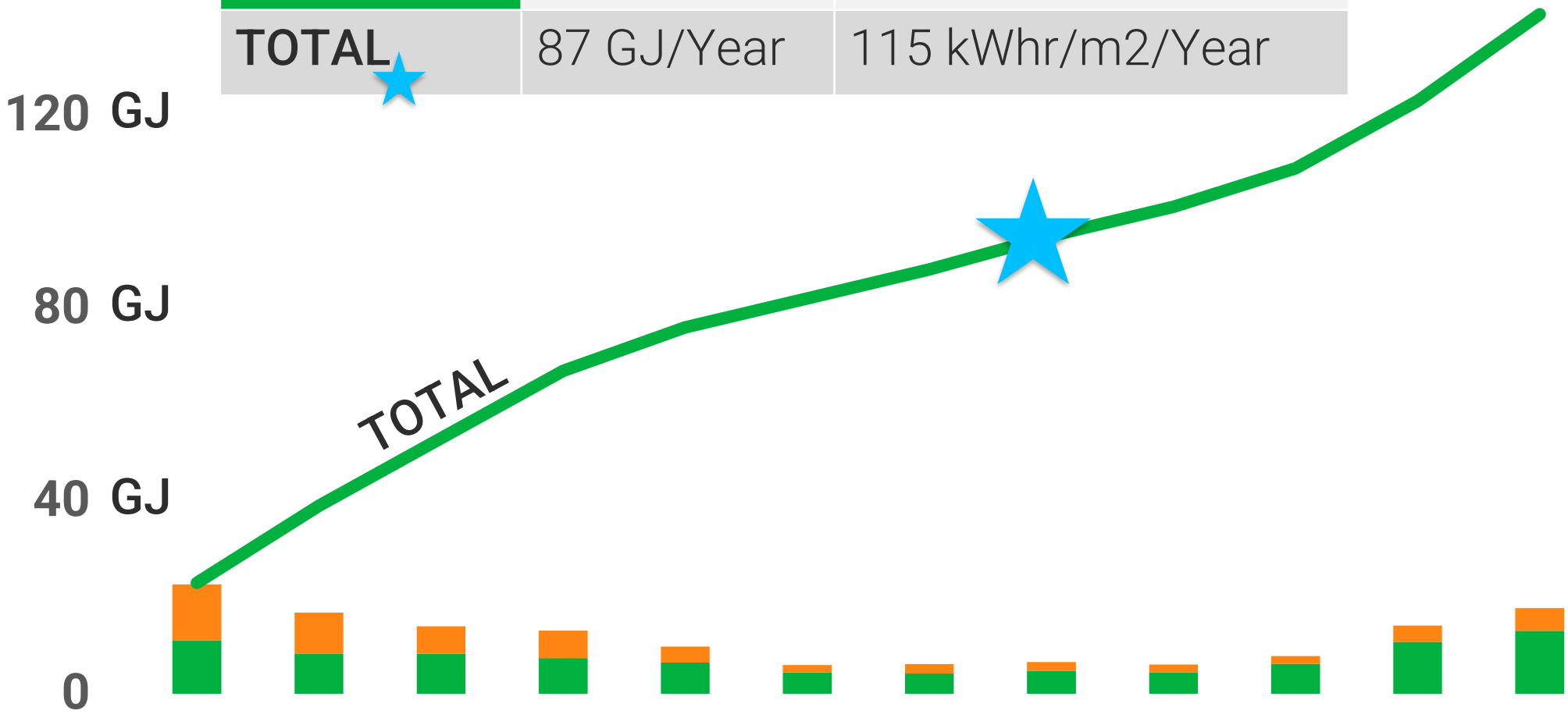
Walls:	RSI 2.46 (R14)
Roof:	RSI 7.0 & 4.9 (R40 & R28)
Windows:	1.9 W/m2C
Air Leakage:	3.97 ACH at 50 Pa

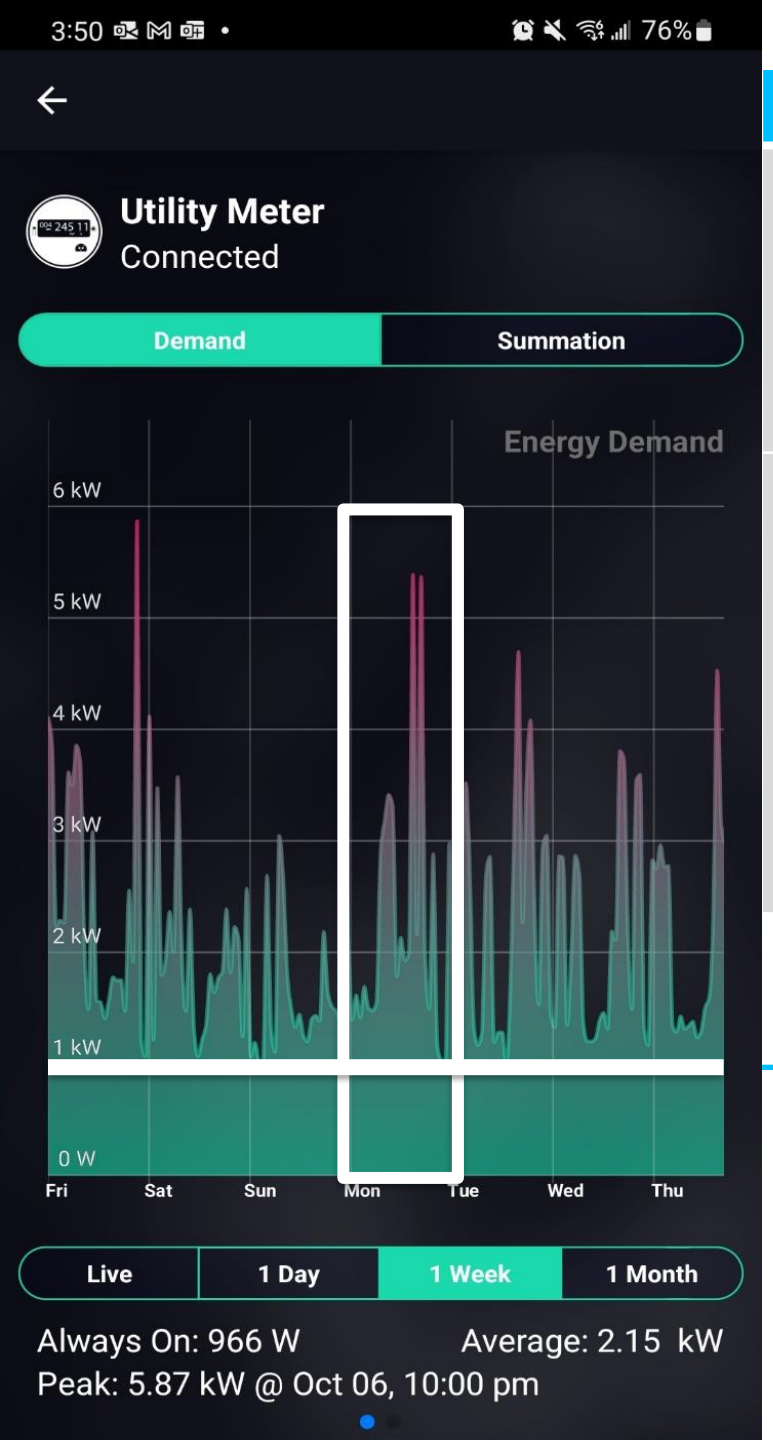
Mechanical System

Condensing Natural Gas Furnace:	14.4 kW
Natural Gas Fire Place:	2kW
Natural Gas Water Tank:	151 L
Electric Water Tank:	189L

MODEL RESULTS		
Natural Gas	56 GJ/Year	74 kWhr/m2/Year
Electricity	31 GJ/Year	41 kWhr/m2/Year
TOTAL	87 GJ/Year	115 kWhr/m2/Year

ACTUAL
140 GJ/Year
185 kWhr/m2/Year

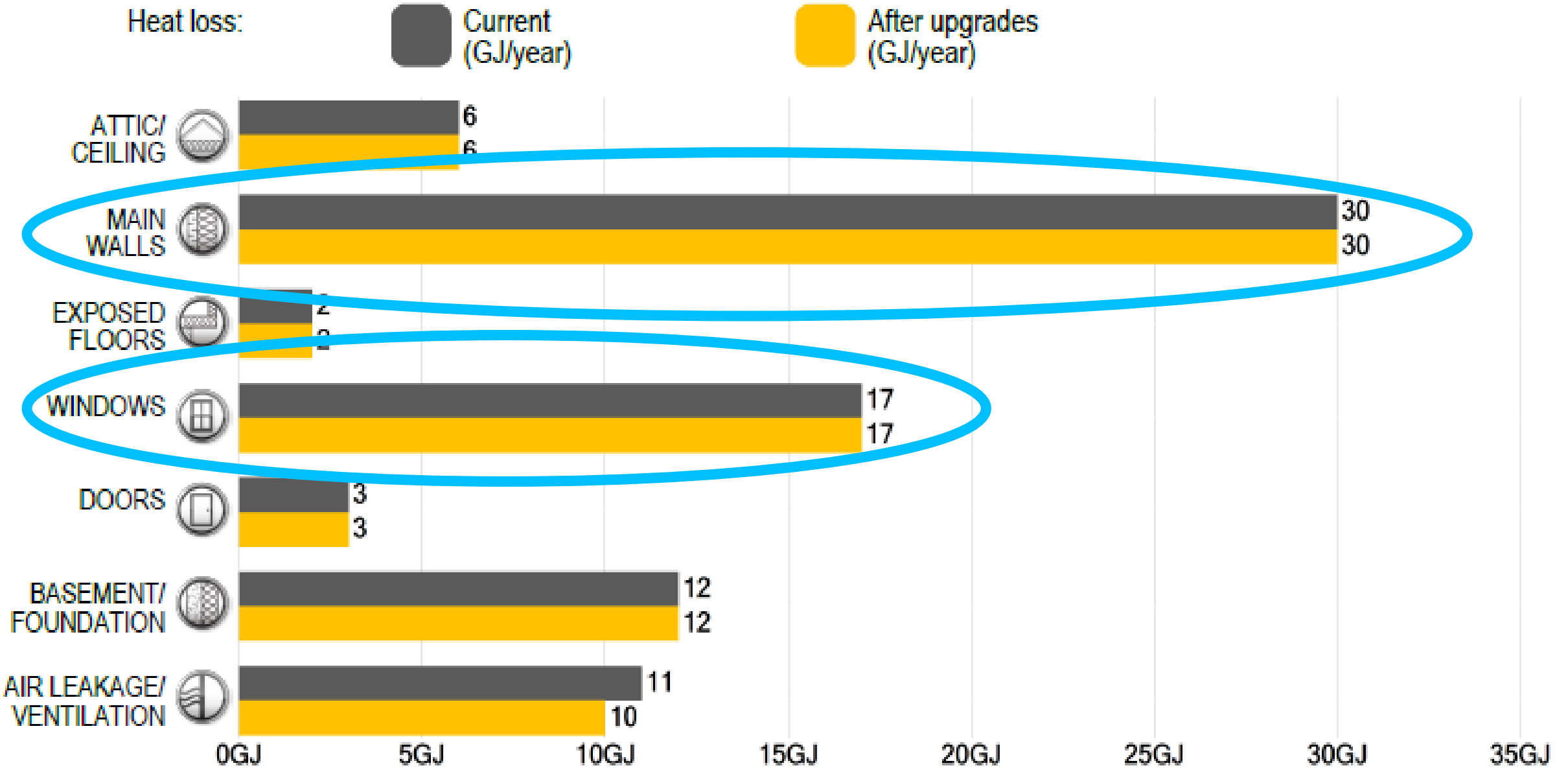




SOME RELEVANT ASSUMPTIONS

Occupancy Density & Schedules	2 adults and 1 child at home 50% of the time	
Electrical Base Loads	Interior lighting	2.6 kWh/day
	Electrical appliances	6.3 kWh/day
	Other electrical loads	9.7 kWh/day
	Average exterior lighting, etc	0.9 kWh/day/unit
	Annual total for a house	**25.6 GJ/year**

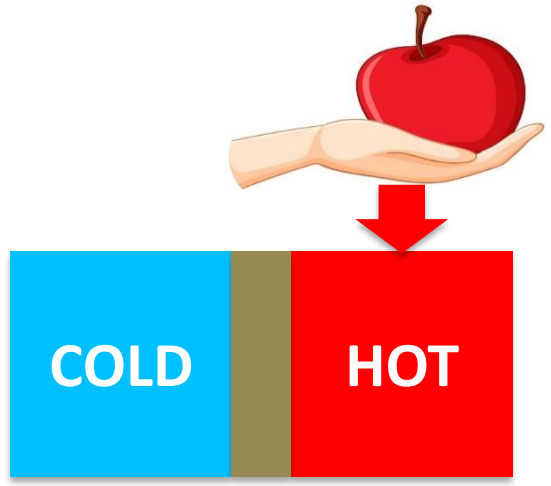
1 kW every hour all year
=
32 GJ/year
+ 25%

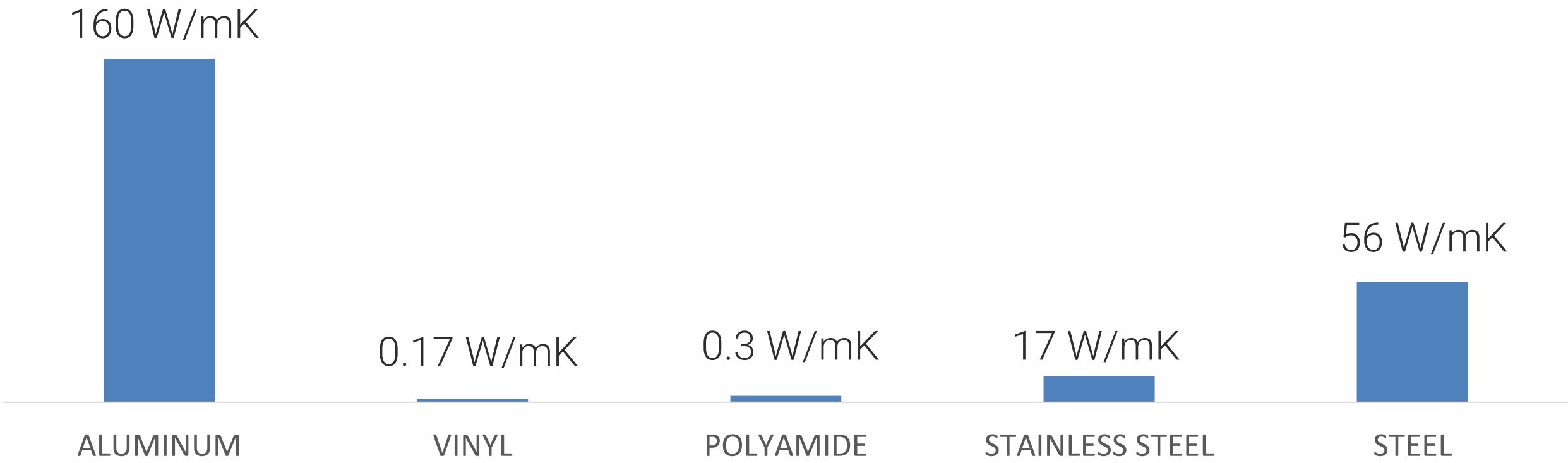

Heat loss:
Current (GJ/year)
After upgrades (GJ/year)
ATTIC/ CEILING
6
6
MAIN WALLS
30
30
EXPOSED FLOORS
WINDOWS
17
17
DOORS
3
3
BASEMENT/ FOUNDATION
12
12
AIR LEAKAGE/ VENTILATION
11
10
0GJ
5GJ
10GJ
15GJ
20GJ
25GJ
30GJ
35GJ

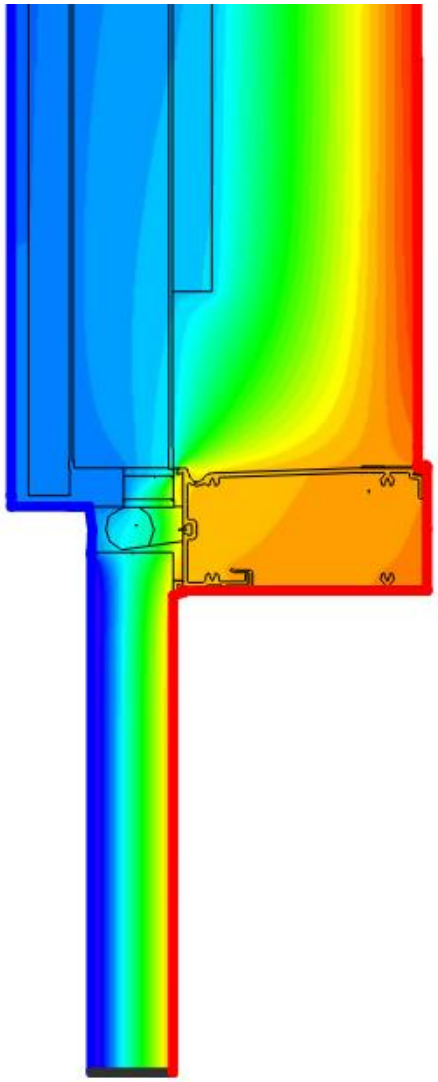
Thermal Conductivity: λ = W/m2/m/K = W/mK

Coefficient: **U Value =** λ/ Thickness = W/m2K

Heat in Watts: **H = A x U x (T1 – T2)**

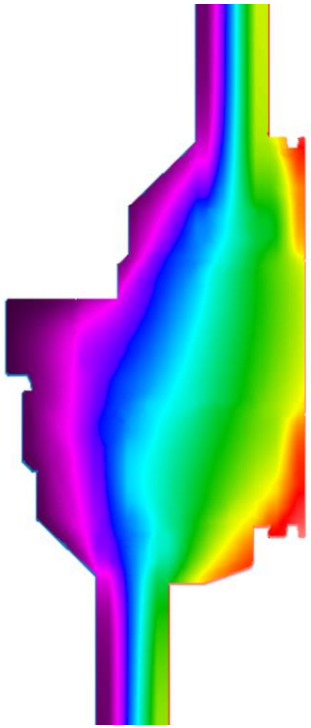


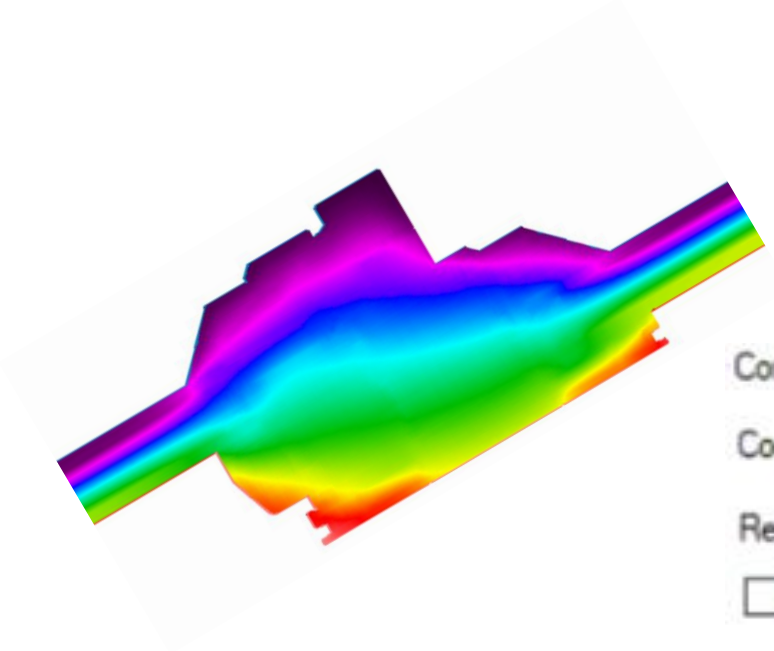




In general _____ is a 2D steady state thermal bridge analysis software using FEM (triangle elements) with an optimized conjugate gradient solver and adaptive remeshing.

Boundary Conditions



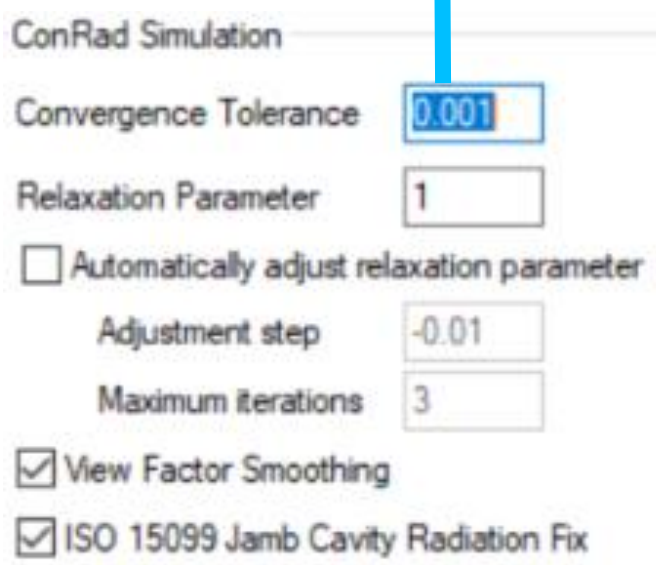


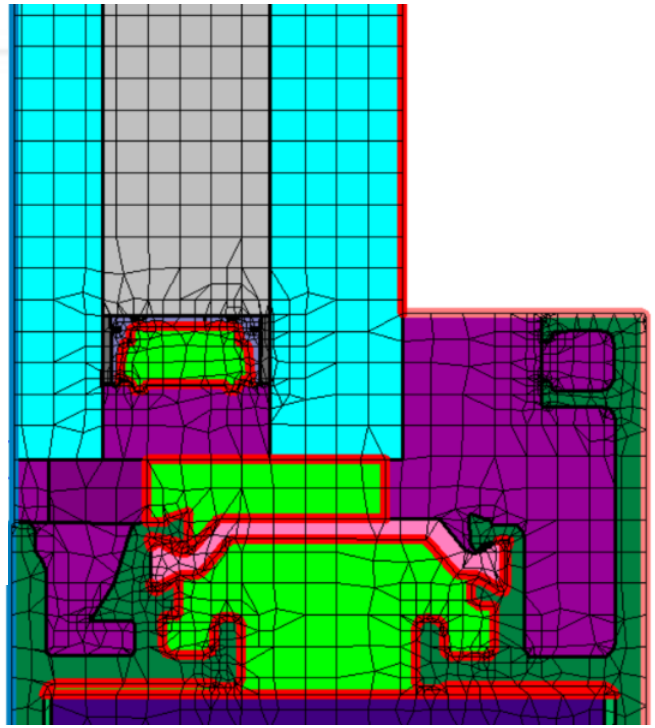
U = 2.25 W/m2K
(VERTICAL)

U = 2.45 W/m2K
(@ 20 degrees)
9% difference

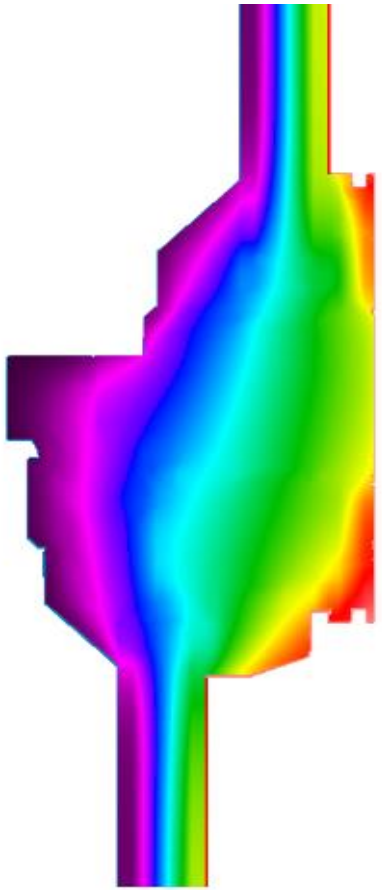
Solver Parameters

0.001 → U = 5.4 W/m2K
10.0 → U = 6.0 W/m2K
10% difference



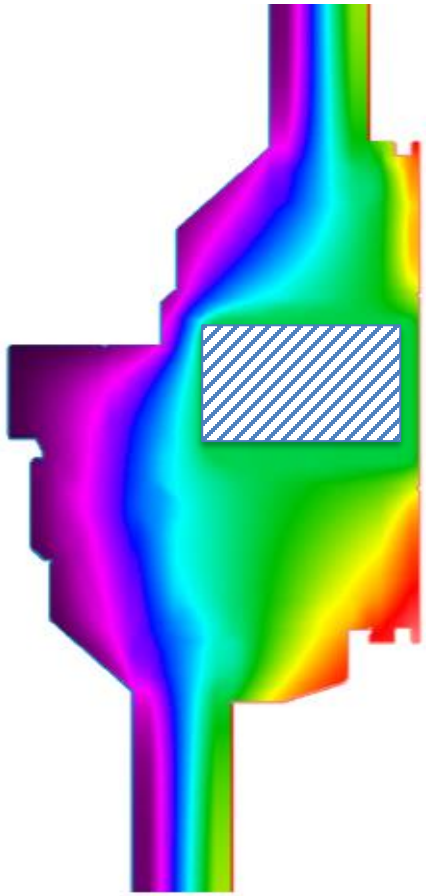


Parametric Checking



U = 2.25 W/m2K

Unreinforced Vinyl



U = 2.65 W/m2K

Add Reinforcing

18% difference

Comparing to known Standard

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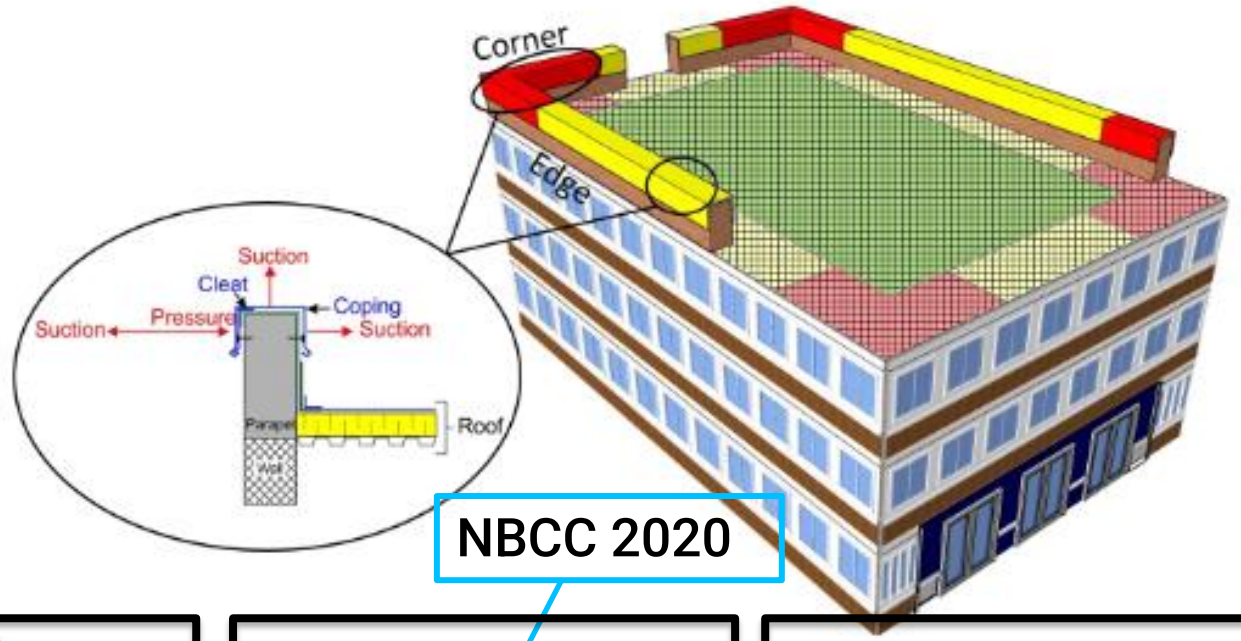
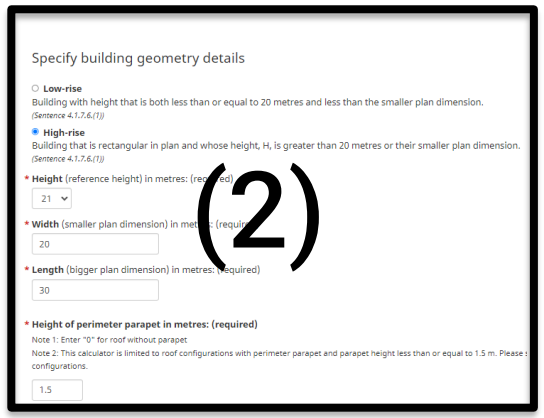
Factored wind loads for parapet cladding and metal edge components

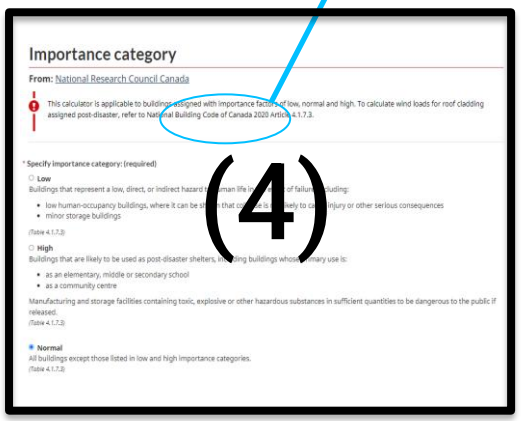
Parapet location on roof area	Wind load
Corner (suction)	-5.1 kPa *
Edge (suction)	-3.6 kPa *
Corner & edge (pressure)	2.5 kPa *

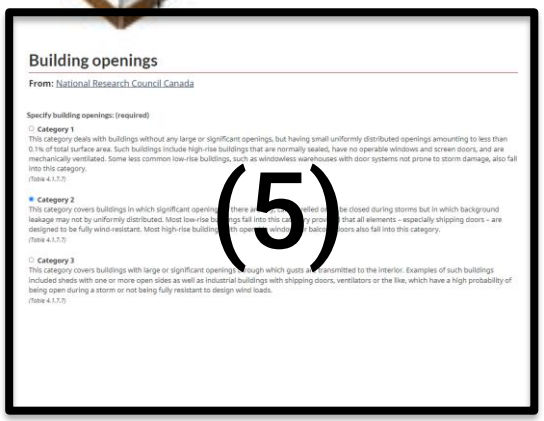
*Worst of windward and leeward



NBCC 2020







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