Riverdale

2007

NOW

2030

2050

Existing Buildings

Existing Buildings Being Retrofitted

Recent Code-built Buildings

NZ Building so far

All New Buildings NZ from 2030 on
Ritchie Deep Energy Retrofit

http://renubuildingscience.com/wartime-in-ritchie/
Connors Hill Deep Energy Retrofit
EnergieSprong
Unit #22

Similar to Unit #15, Unit #22 has a history of occupant complaints due to cold rooms and wall surfaces. We undertook a similar thermal imaging review of this unit, with findings summarized in Figure 8 and 9. Similarly, we found minor areas with raised surface temperature, mostly around the front patio wall to ceiling connection. This area could certainly lead to a localized cold spot on the interior of the unit, however, we’d suggest that a proper volume of heating air supply should maintain internal comfort. The main wall areas show a relatively uniform surface temperature, which suggests current insulation levels are quite consistent. We’d suggest that if thermal comfort continues to be an issue in this unit, then a service contractor could be brought into assess the airflow balance of the furnace.

Figure 8: Infrared Thermal Images of Sundance Unit #15, taken just after sunrise on November 15, 2017. IR images shown on the left, with corresponding regular image shown to the right. The color legend represents the range in temperature present in the image; note that glass temperature is not accurately reflected in these images.
Our energy modelling has produced estimated peak heating and cooling load data for the Sundance site, shown in Table 2, as well as annual heating and cooling energy demand, shown in Table 3.

Table 2: Summary of estimated Sundance retrofit peak heating and cooling loads, using ASHRAE Heat Balance Method. Heating setpoint of 22°C, Cooling setpoint of 24°C.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Peak Load (BTU/h)</th>
<th>% Decrease in Peak Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heating</td>
<td>Cooling</td>
</tr>
<tr>
<td>Scenario #1</td>
<td>37769</td>
<td>8141</td>
</tr>
<tr>
<td>Scenario #2</td>
<td>33618</td>
<td>7311</td>
</tr>
<tr>
<td>Scenario #3B</td>
<td>24399</td>
<td>5818</td>
</tr>
<tr>
<td>Scenario #3A</td>
<td>16009</td>
<td>5067</td>
</tr>
</tbody>
</table>

Table 3: Summary of estimated Sundance retrofit annual heating and cooling energy demand, from IES energy modelling. Heating setpoint of 22°C, Cooling setpoint of 24°C.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Ann. Demand (KWh)</th>
<th>% Decrease in Ann Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heating</td>
<td>Cooling</td>
</tr>
<tr>
<td>Scenario #1</td>
<td>1719108</td>
<td>12359</td>
</tr>
<tr>
<td>Scenario #2</td>
<td>1497241</td>
<td>10192</td>
</tr>
<tr>
<td>Scenario #3B</td>
<td>690119</td>
<td>8744</td>
</tr>
<tr>
<td>Scenario #3A</td>
<td>304354</td>
<td>9648</td>
</tr>
</tbody>
</table>

Our team has worked with Butterwick Construction and NuEnergy Systems to produce detailed capital cost estimates for the three proposed building envelope retrofit scenarios. This data is summarized in Table 4.
Site Conditions

- Lower roof junctions
- Tight jogs
- Openings tight to inside corners
- Utility Connections
- Vents and Hose bibs
- Member built additions
- Porches
- Cantilevers
Retrofit Decision Map

Building Condition Assessment

Energy Modelling of Existing Building

Use energy modelling to design the lowest cost zero carbon retrofit

Costing

OK

Work plan

Digital Capture

Detailed Design

Do it

Too Expensive

Work plan for rational incremental execution

Identify tasks that are affordable and can be completed without making the full retrofit more difficult

Complete by 2050
Foundation Options

Full Height 2x8 PFW Exterior Wall

Partial 2x8 PFW Exterior Wall w/ Poured Spray foam Below

Inside R 35 Frostwall with R 10 Basement Floor Insulation
## Cost of Church Underslab Insulation Increments

<table>
<thead>
<tr>
<th>SLAB INSULATION</th>
<th>R16</th>
<th>R16 - R24</th>
<th>R24 - R40</th>
<th>R40 - R56</th>
<th>R56 - R64</th>
<th>R16 - R64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat loss -kWh/m²/A *</td>
<td>28</td>
<td>24.8</td>
<td>22.1</td>
<td>20.6</td>
<td>20.1</td>
<td>20.1</td>
</tr>
<tr>
<td>Energy Saving of Increment kWh/A</td>
<td>0*</td>
<td>1672.32</td>
<td>1411.02</td>
<td>783.9</td>
<td>261.3</td>
<td>4128</td>
</tr>
<tr>
<td>Cost of Increment</td>
<td>$3,210.00</td>
<td>$6,420.00</td>
<td>$6,420.00</td>
<td>$3,210.00</td>
<td>$19260</td>
<td></td>
</tr>
<tr>
<td>Cost/kWh/A of Increment</td>
<td>$1.92</td>
<td>$4.55</td>
<td>$8.19</td>
<td>$12.28</td>
<td>$4.67</td>
<td></td>
</tr>
</tbody>
</table>

* From PHPP9 using the ‘Variants’ function

** Based on Edmonton Climate ~ 9000°F HDD
# Cost Benefit Using Modelling Results*

## Entire Retrofit

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Annual Heating Demand (kWh/a)</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>As built</td>
<td></td>
<td>1719108</td>
<td></td>
</tr>
<tr>
<td>Scenario 3B from BCA #2</td>
<td></td>
<td>690119</td>
<td>$4,878,508.00</td>
</tr>
<tr>
<td>Reduction from 3B measures</td>
<td></td>
<td>1028989</td>
<td></td>
</tr>
</tbody>
</table>

Cost per annual kWh saved $4.74

## Foundation Options

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Annual Heating Demand (kWh/a)</th>
<th>Reduction from Scenario #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>As built</td>
<td>9557</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Energiesprong roof, wall upgrade including windows, 1.25ACH 50, No foundation insulation (kWh/a)</td>
<td>4146</td>
<td>5411</td>
</tr>
<tr>
<td>3</td>
<td>2 plus inside inside - wall only, 1.0 ACH50 (kWh/a)</td>
<td>2446</td>
<td>1700</td>
</tr>
<tr>
<td>4</td>
<td>2 plus outside insulation- wall only, 1.0 ACH50 (kWh/a)</td>
<td>2190</td>
<td>1956</td>
</tr>
<tr>
<td>6</td>
<td>Inside Wall Insulation R35 , Slab at R10 , No Thermal bridge (kWh/a)</td>
<td>1812</td>
<td>2334</td>
</tr>
</tbody>
</table>

Annual Heating demand reduction to insulate the floor (kWh/a) (Scenario 4- Scenario 6) 378

Cost difference to Insulate the floor (from BCA#2) $5,250.00

Cost per Annual kWh saved $13.89

*From HOT2000 and IES>VE
Sundance Project Plan

- Choose and master Digital Capture tool
- Retrofit the first two-unit building using site-built panels
- Monitor the first building, evaluate details and work flow
- Market like crazy and evaluate the business case for a small panel factory

Plan A
- Outfit a small panel factory
- Finish the other 57 Sundance Units
- Jump into the DER business with both feet.

Plan B
- Finish the Sundance Retrofit with site built panels
- Keep doing DER’s the hard way until we can build the market needed to start a panel factory
- Jump into the DER business with both feet.
Digital Capture

Extruded window boxes for panel holes

Control line for panel dimensions

Sketchup Model from Digital Capture
Panel Details

- Cladding
- 3/8” Rain screen
- Air tight, vapour open WRB
- 7/16” OSB
- 2x4 spruce, R 14 Roxul
- 2x2 spruce, R10 Roxul
- 3/8” OSB
- Gap for tolerance
- Original wall
Air and Water Sealing
Caulking vs Sealed Flaps
Air and Water Sealing
Roof

- One full sheet left off prefibbed roof sections for insulation installation
- 2x2 Strips to prevent insulation sliding
- Additional R50 cellulose
- New poly air / vapour barrier
- Top up insulation from inside via attic hatch access

Existing insulation R20
Starting a Panel Factory

• What can we learn from Europe?

• Can we find enough of a market to support a factory?

• At what volume do the savings from plant production offset the added cost of overhead, transport and lifting?

• What annual volumes are required to support varying levels of capital investments in the plant?
Mechanical Systems
Cladding Options
Cladding Options

- Renewing the building exterior can greatly enhance the retrofit value proposition
- Stocking multiple materials in a small factory can be expensive.
Information?
Thanks

Comments and Questions?