An EnerPHit Certified Retrofit

Joel Seagren

Images courtesy of Dale Roberts & Phil Hines
Project Location
Bellbrae Project
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Bellbrae Project

South Elevation

East Elevation

North Elevation

West Elevation

line weatherboards

corrugated cladding
Decision Process

• New Build v’s Retrofit
  – Maintain family connection to building

• Extent of works
  – Complete strip down to frame and weatherboard cladding (except 2 bedrooms where wall remained intact)

• Budget - $3.5K/sqm across 130 sqm
  – although executed on cheaper family rates :)
  – $50K of structure retained
PHPP Design

• EnerPhit certification intent from outset

• Fully stripped areas
  – high confidence in insulation and airtightness

• 2 unstripped bedrooms (budget driven)
  – creates uncertainty
Insulation - walls

- Insulation: R2.7 High Density Earthwool bulk insulation
- Existing Baltic pine weatherboards: 30mm
- 60mm High Performance Gutex Sarking Board: R1.3
- 90 x 45 MGP10 TP vertical battens: @ 600 cts
- Plasterboard
- Air tight system
- Solitex Extasana (Breathable Sarking)
Insulation - ceiling

Air Tightness = taped XPS board
Thermal Bridges

• Full wall wrap in insulated board
Thermal Bridges
Glazing

- Triple Glazed
- $U_W \ 0.90-0.95 \ \text{W/m}^2\text{K (total window)}$
Glazing

Additional stumps added to support window weight
Air Tightness

- Main leakage via 2 unstripped bedrooms
- Some ceiling contribution

### Combined Test Data

<table>
<thead>
<tr>
<th>Description</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air flow at 50 Pa, $Q_{50}$ [m$^3$/h]</td>
<td>426.5</td>
</tr>
<tr>
<td>Air changes, $n_{50}$</td>
<td>0.96</td>
</tr>
<tr>
<td>Equivalent leakage area at 50 Pa [cm$^2$]</td>
<td>212.5</td>
</tr>
<tr>
<td>Permeability at 50 Pa [m$^3$/h/m$^2$]</td>
<td>0.997</td>
</tr>
</tbody>
</table>
Ventilation System

• Passive House Methodology
  – EN13779 – IDA3
  22-36 m³/h of fresh air / person => 600-1000 ppm CO₂ increase compared outside air. Maintains acceptable IAQ
  20-30 m³/h adopted per person across the whole building
  – Tested & proven in residential buildings
  – Minimum of 0.3 ach (air changes/hour) for building
Ventilation Layout

MVHR Energy Consumption

35 Watts @ 150 m3/h
Maintaining air balance

Rangehood Extraction
- In bench style
- Recirculation (with carbon filters.)

Combustion Heating
- High efficiency wood heater
  - Tested 71% therm. eff
  - 7kW radiant output (fuel dependant!!)
  - Self contained supply air via base/rear
Retrofitting MVHR duct

Insulated ductwork outside thermal envelope

- 25mm thick R1 insulation
- 90mm pipe
- 45°C roof space
- 8m avg duct length x 16 runs (supply & extract)

Up to 1 kW heat again!
Building Performance

• Occupant Feedback
  – Very pleased with project
  – Proposing to build 2 more small PH buildings
  – 2 unstripped bedrooms are not as comfortable
Temperature Data Logging

Bedroom Temp Sensor

Living Room Temp Sensor

Supply Air

Extract Air

Outside Air

Exhaust
Temperature Data

Bellbrae House Temperature Data
(Oct 31st - Nov 7th 2016)

Living room temp range
18-23 Deg.C

Bedroom temp range
17-21 Deg.C

OA
SA
RA
EA
Bedroom Temperature
Living Room Temperature
EnerPHit Certification

<table>
<thead>
<tr>
<th>Building quality</th>
<th>This building</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>14</td>
<td>≤ 15</td>
</tr>
<tr>
<td>Cooling</td>
<td>3</td>
<td>≤ 15</td>
</tr>
<tr>
<td>Airtightness</td>
<td>1.0</td>
<td>≤ 1.0</td>
</tr>
<tr>
<td>Non-renewable primary energy (PE)</td>
<td>69</td>
<td>≤ 120</td>
</tr>
</tbody>
</table>
Lessons Learnt

• Underfloor insulation
  – Insulation board difficult to work with overhead

• Ventilation system time consuming to fit
  – Roof space insulation time consuming
  – Ceiling height reduction would have allowed duct runs inside thermal envelope

• 2 unstripped bedrooms
  – weak points in the envelope (insulation and airtightness)
  – Should have stripped as per rest of building