Exploring retrofit options on a 1930s home

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@cswd
Exploring retrofit options on 1930s home

- Extending & retrofitting 1930s detached home
  - Currently cold & some damp issues

- Want to answer questions such as:
  - Where should I concentrate my effort - best return on expenditure?
  - What should I insulate (loft, walls, floors?)
  - What should I spend on windows vs other options?
Passive House Planning Package (PHPP)

- Great big spreadsheet developed & improved over 20+ years covering:
  - U-values of ‘components’ e.g. walls, loft, floors etc.
  - Heating
  - Ventilation
  - Windows
  - Shading...
- Models the house, predicts performance
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  - Windows
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PHPP component EnerPHit values

1. EnerPHit requires certain criteria are met:
   1. Space heat demand <25 kWh/m2.a
   2. Airtightness normally 0.6ach
   3. Proof moisture management issues have been adequately addressed

2. If 25kWh/m2.a is exceeded then they recommend U-values:
   - Walls EWI U values below 0.15 W/m2K (>75% of wall area)
   - Roofs / top floor ceiling - U <= 0.12
   - Windows - installed whole windows U <= 0.85 etc

   Use numbers in (2) as **default U-values** and explore effect of changes from there
Vary each component individually around EnerPHit ‘default’ value

- Pick 1st component, vary U-value
- **Rendered Masonry Wall**: Test at U-value of:
  - 0.239, 0.15, **0.12**, 0.11, 0.1
  - Bold & underlined number = default EnerPHit value
- Take readings of kWh/m^2 pa & Overheating at different U-values
- Plot on graph & get equation
Vary each component individually around EnerPHit

- Repeat for other components:
- 03ud Wall below DPC: Test at U-value of:
  - 1.553, 0.5, 0.3, 0.15, 0.14, 0.13, 0.1
- Take readings of kWh/m^2 pa & Overheating
- Plot on graph & get equation
- Tells us:
  - Each Unit change in U-Value for Wall saves 53 kWh/m^2pa
  - Each Unit change in U-value for Wall below DPC saves only 5 kWh/m^2pa
  - The variation is linear
Can also analyse Airtightness

- Each unit change in Air tightness = 3.7 kWh/m^2pa
- Obviously not directly comparable with unit change in U-value!
Vary each component individually around EnerPHit

- Repeat for all components
- Savings:

<table>
<thead>
<tr>
<th>Component</th>
<th>Saving per Unit Change in U-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>01ud Rendered Masonry Wall</td>
<td>52.8</td>
</tr>
<tr>
<td>04ud Clay Tile Pitched Roof</td>
<td>45.8</td>
</tr>
<tr>
<td>05ud Suspended Floor</td>
<td>16.9</td>
</tr>
<tr>
<td>10ud New Roof</td>
<td>11.1</td>
</tr>
<tr>
<td>03ud Wall below DPC</td>
<td>4.94</td>
</tr>
<tr>
<td>Air Tightness</td>
<td>3.70*</td>
</tr>
</tbody>
</table>

* = Saving per Unit Change in ACH (not U-value)
Can also use this for prediction

<table>
<thead>
<tr>
<th>Component</th>
<th>U-value</th>
<th>Effect</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>01ud Rendered Masonry Wall</td>
<td>0.15</td>
<td>52.81</td>
<td>7.92</td>
</tr>
<tr>
<td>03ud Wall below DPC</td>
<td>0.15</td>
<td>4.94</td>
<td>0.74</td>
</tr>
<tr>
<td>04ud Clay Tile Pitched Roof</td>
<td>0.12</td>
<td>45.77</td>
<td>5.49</td>
</tr>
<tr>
<td>05ud Suspended Floor</td>
<td>0.15</td>
<td>16.90</td>
<td>2.53</td>
</tr>
<tr>
<td>10ud New Roof</td>
<td>0.12</td>
<td>11.10</td>
<td>1.33</td>
</tr>
<tr>
<td>Air Tightness</td>
<td>1</td>
<td>3.70</td>
<td>3.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>21.72</strong> Sub-total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.6 Adjust</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>24.3</strong> Predicted kWh/m2pa</td>
</tr>
</tbody>
</table>
What effect would these changes have on energy usage?

<table>
<thead>
<tr>
<th>Component</th>
<th>U-value (Existing/ as designed)</th>
<th>U-value (EnerPHit)</th>
<th>Savings (kwh/M2pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01ud Rend Masonry Wall</td>
<td>1.18</td>
<td>0.15</td>
<td>54.4</td>
</tr>
<tr>
<td>03ud Wall below DPC</td>
<td>1.553</td>
<td>0.15</td>
<td>6.9</td>
</tr>
<tr>
<td>04ud Clay Tile Pitched Roof</td>
<td>0.239</td>
<td>0.12</td>
<td>5.4</td>
</tr>
<tr>
<td>05ud Suspended Floor</td>
<td>0.244</td>
<td>0.15</td>
<td>1.6</td>
</tr>
<tr>
<td>10ud New Roof</td>
<td>0.219</td>
<td>0.12</td>
<td>1.1</td>
</tr>
<tr>
<td>Air Tightness</td>
<td>5.3</td>
<td>1</td>
<td>15.9*</td>
</tr>
</tbody>
</table>

* = Saving per Unit Change in Air Changes per Hour (not U-value)
Results & next steps

Results:
- I have worked out the relative importance of each set of options
- Focus on walls & loft
- Don’t insulate under the Damp Proof Course - lots of effort, little return

What’s next?
- Check practicality of insulation depths (is roof overhang enough?)
- Try to align with costs? Work out change per £?
- E.g. have window quotes - is it worth spending more on windows or insulation?
- Work out which materials to use (performance vs cost vs sustainability etc)
The End