Delivering high performance residential pitched roofs in the real world

Qualicheck Conference
December 2016
Ross Holleron & Jelle Langmans
Overview

Background to the issues

Key influences on real performance

Best practice guidance

Research led by KU Leuven

– Jelle Langmans
– Staf Roels
Government & industry drive for thermal performance
Delivery in the real world proving to be challenging
Example
Issues from UK industry study

CONCEPT DESIGN & PLANNING
- Limited understanding of impact of early design decisions on energy performance

DETAILED DESIGN
- D1: Inadequate understanding and knowledge within detailed design team
- D2: Lack of integrated design between fabric, services & renewables
- EMB: Issues around use of U-value and thermal bridging calculation procedures
- EM7: Concern over competency of SAP assessors

PROCUREMENT
- PR2: Inadequate consideration of skills and competency at labour procurement

CONSTRUCTION & COMMISSIONING
- C5: Product substitution on site without consideration of energy performance
- C15: Poor installation of fabric
- C9: Poor installation or commissioning of services
- CT3: Lack of site team energy performance knowledge & skills
- C6: Lack of adequate energy performance related QA on site

VERIFICATION & TESTING
- T3: Concern over consistency of some test methodologies & interpretation of data
- EM4: As-Built SAP not reflective of actual build
- V2: Lack of robust energy performance related verification, reliance on third party information
- V5: Lack of clarity over documentary evidence for Part L & Part F compliance
Focus on Warm Roof Construction

Up to 90% increase in measured U-value
Wind speeds up to 7.5 ms\(^{-1}\)

**BUT** – construction type counter to what researchers already know......
Working with Academia to define and trial best practice
How to construct a domestic pitched roof with high thermal quality?

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QUALICHeCK, Brussels, December 2016
Overview of international research on air flows within pitched roof elements

Practical guidelines for good practice
Typical air flow patterns

FORCED EXFILTRATION
(driven by air pressure differentials)
1) Exfiltration: air barrier

<table>
<thead>
<tr>
<th>Air barrier material</th>
<th>Di Lenardo et al. (1995)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.0096 m³/m²/h/Pa</td>
<td></td>
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<td>&lt; 0.0018 m³/m²/h/Pa</td>
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2) Air rotations: insulation density & installation quality
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2) Air rotations: insulation density & installation quality

advertisement: perfect

practise: difficult corners, joints
2) Air rotations: insulation density & installation quality

Quality control impossible?

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<tr>
<th>Density</th>
<th>Application</th>
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<td>&gt;13 kg/m³</td>
<td>Filled insulation compartment</td>
<td>Brown et al. (1993)</td>
</tr>
<tr>
<td>&gt;21 kg/m³</td>
<td>Avoid small air channels</td>
<td>Powell et al. (1989)</td>
</tr>
<tr>
<td>20-30 kg/m³</td>
<td></td>
<td>Langmans et al. (2013)</td>
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2) Wind washing: wind barrier

![Image of wind washing with marked edge joint]

- Edge joint not sealed
- Sealed edge joint
2) Wind washing: wind barrier

[Image of a wind barrier setup with labeled equipment: Testkast, Meetmonster, Debietmeter, Drukmeter]
Practical guidelines
2) Wind washing: wind barrier

- Foil overlap/ tongue-groove joints mostly ok
- Sealing

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<td>$&lt;0.05 \text{ m}^3/\text{m}^2/\text{h}/\text{Pa}$</td>
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Quality control planned in building phase

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Conclusions: pitched roof is possible if...

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**Air barrier system**

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<th>Insulation layer</th>
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**Wind barrier**

**Air permeability**

<0.05 m³/m²/h/Pa
An example from the real world
Social Housing Retrofit – Eeklo Belgium

- Working closely with stock owners
- Increasing installer knowledge
- Jointly developing sequences
- Identifying key QA stages
- Monitoring performance

1 – Plan ahead
2 – Explain the point
3 – Make ‘good’ visual
In summary

Real world requires a **system** approach
Supported by appropriate **quality checks**

**Key performance criteria**

**Air barrier as a system**
- <0.0047 m³/m²/h/Pa

**Insulation material and installation**
- When possible completely fill compartment
- Specific air permeability limit (7-8 x 10⁻⁹ m²)
- Avoid gaps between structure

**Wind barrier**
- <0.05 m³/m²/h/Pa
Thank you

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