RENOVATING A PRE 1980’S WEATHERBOARD HOME; WHAT ABOUT CONDENSATION?

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Introduction

• What have my teams at UTas been doing since 2010:
  - Identifying condensation problems in new housing (Tas, Vic, NSW, ACT, Qld, NT, WA)

• Current research activities
  - Buildings less than 7 years old
  - Software tools and inputs
  - Additions and modifications to older homes
  - Developing new build guidelines.
Introduction

• In 1999, the majority of Australian homes were more than 20 years old.

• Many of these homes built between 1900 and 2004, have limited ceiling insulation and rarely include wall insulation and other measures to improve the thermal performance.

• Many research tasks have explored methods to improve these homes with support for low income families, guidelines and recommendations provided by local, state and federal governments, and low interest Bank loans.

• But many of these renovated homes are showing a presence of condensation and mould.
Introduction

• Aside from the accepted structural concerns associated with wet buildings, internationally, and within Australia, there is a growing body of medical evidence regarding cold buildings, wet buildings and their impact on human health.

• This project sought to explore the condensation risk that may arise from providing thermal performance based retrofits to existing minimally insulated weatherboard housing.
Method

This research required the:

• Selection of a typical home more than 20 years old
• Establishing likely levels of envelope improvement
• Establishing likely internal and external temperatures for each envelope scenario
• Completing a condensation risk assessment for each external wall system
Method – House Selection

- Including additions the house has a floor area of 192m², which is still a little smaller than the average size of new Australian homes (231m²).
- The glazing area is 31.1m², providing a glass to floor area of 16%.
Method – House improvements

- Using the online Smarter Renovations Planner, the house plan was assessed with sixteen different orientations. http://www.sustainability.vic.gov.au/smarter-renovations-planner

- Aspects explored included adding ceiling insulation, wall insulation, floor insulation, draught proofing, improved glazing, improving the efficiency of lighting and the addition of Photo-voltaic power.

- The research showed singular interventions and orientation affected return on investment for ceiling insulation of 7 to 18 years and double glazing of 41 to 389 years.
The impact of building and room orientation cannot be ignored.
Method – NatHERS simulation

- More than 500 AccuRate NatHERS simulations were completed to support the recommendations from the Smarter Renovations Planner

- The analysis of the AccuRate simulation data allowed for the establishment of the three house improvement typologies, namely:
  
  - Base Design – No floor or wall insulation, R1.0 ceiling insulation, minimal draught proofing, timber framed single glazed windows
  
  - Medium upgrade (similar to NCC) – Floor R2.5, Walls R2.5, Ceiling R4.0, Windows unchanged, medium draught sealing practises

  - Best upgrade – Floor R2.5, Walls R4.0, Ceiling R7.0, Windows unchanged, high quality draught sealing actions.
Method – Condensation risk simulation

- The ISO and BS5250 approved JPA software was used to complete the condensation risk analysis (JPA TL Ltd, 2016).

- Key reasons for selecting the JPA software included:
  - the many commonalities between UK and Australian construction systems
  - the capacity to easily create and use project based climate and interior environmental data.
Method – Condensation risk simulation

- Specifically, this research examined wall systems and vapour pressure management. This resulted in five wall systems for simulation, namely:
  - Base design wall – plasterboard/no insulation/no wall membrane/weatherboard
  - Medium wall 1 – p-board/R2.5 insulation/vapour impermeable membrane/cavity/w-board
  - Medium wall 2 – p-board/R2.5 insulation/vapour permeable membrane/cavity/w-board
  - Best wall 1 – p-board/R4.0 insulation/vapour impermeable membrane/cavity/w-board
  - Best wall 2 – p-board/R4.0 insulation/vapour permeable membrane/cavity/w-board
Results – Base design – No membrane

Fig. 7: Condensation risk from a conditioned bedroom

Fig. 8: Condensation risk from a conditioned living room
Results – Medium upgrade – Impermeable membrane

Fig. 9: Condensation risk from a conditioned bedroom with vapour impermeable membrane

Fig. 10: Condensation risk from a conditioned living room with vapour impermeable membrane
Results – Medium upgrade – Permeable membrane

Fig. 11: Condensation risk from a conditioned bedroom with vapour permeable membrane

Fig. 12: Condensation risk from a conditioned living room with vapour permeable membrane
Results – Best upgrade
– Impermeable membrane

Fig. 13: Condensation risk from a conditioned bedroom with vapour impermeable membrane in the best upgrade wall

Fig. 14: Condensation risk from a conditioned living room with vapour impermeable membrane in the best upgrade wall
Results – Best upgrade – Permeable membrane

Fig. 15: Condensation risk from a conditioned bedroom with vapour permeable membrane in the best upgrade wall

Fig. 16: Condensation risk from a conditioned living room with vapour permeable membrane in the best upgrade wall
Interlude
Interlude
Conclusion

• On a daily basis, many existing homes in Australia’s temperate climates are being improved or upgraded.
• However, very few consider vapour pressure management.
• In temperate and cool temperate climates, the vapour pressure is often outward, for significant portions of the year.
• In this research, the condensation risk analyses for the as-is (base design), medium upgrade and best upgrade houses all demonstrated dewpoint occurring somewhere within the external envelope. ** We cannot stop condensation but we must manage it!
Conclusion

- In the wall systems which included a vapour impermeable membrane, (or building wrap), the vapour and moisture was shown to form on the inside surface of the membrane, leading to an accumulation of moisture within the wall frame.

- The simulations identified long-term accumulation of moisture, from less than 1 kg/m² to more than 20 kg/m², which is significant and is likely to promote structural degradation, a reduction in the insulation properties and mould growth.
Conclusion

• The medium upgrade and best upgrade walls which included a vapour permeable membrane did show a much lower, or nil, moisture accumulation within the wall. The vapour permeability properties of the wall membrane allowed the water vapour to leave the built fabric.

• This research highlights a significant long-term, and built fabric affecting, condensation risk that is occurring in many renovated Australian homes in temperate climates, when a vapour impermeable membrane system has been installed.
Conclusion

• Additionally, most housing, (not including brick veneer), does not include a vapour or drainage cavity. The thermal bridging between cladding system and wall membrane would significantly compromise the capability of vapour to leave the internally conditioned wall.

• However, this research did identify that the most robust wall system, included a vapour permeable wall membrane and a vapour cavity between the membrane and the cladding.
THANK YOU

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