2nd International Conference on Moisture in Buildings (ICMB23), online, 3-4 July 2023

IWI Thermal Properties and the Risk of Condensation and Mould Growth Imposed upon Neighbors at a Party Wall Junction

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Abstract

Internal wall insulation (IWI) is one of the few retrofit approaches to reduce heat loss through solid brick walls. Discontinuities in the insulation layer can result in thermal bridges, leading to reduced surface temperatures and the potential for condensation to form. Party wall junctions retrofitted with IWI act as discontinuities when neighbouring homes do not have IWI, leading to reduced surface temperatures on the neighbouring side. The condensation risk imposed on the uninsulated neighbour by a range of notional IWI systems are simulated, the resulting temperature factors indicate whether each system imposes a risk upon the uninsulated neighbour. Thicker, higher performing IWI systems were found to result in greater risk in the neighbouring property.

Peer-review under the responsibility of the organizing committee of the ICMB23.

Keywords: Internal wall insulation; Solid wall; Retrofit; Temperature factor; Thermal simulation; Mould; Surface condensation;

1. Introduction/Background

Solid walled dwellings make up an estimated 31% of the housing stock in England, theses dwellings also tend to have poor thermal performance with 80% of solid walled homes having an EPC score below the average for English homes [1]. The high thermal transmittance of solid walls is partially responsible for their poor performance, with U-values up to 2.3 W/m²K measured [2]. The thermal performance of solid walls can be improved by the introduction of solid wall insulation (SWI) which can reduce energy consumption in a typical home be 12% [3] Internal wall insulation (IWI) is one form of SWI that can be used to improve the energy efficiency of solid walled homes, however the introduction of IWI can have unintended consequences, discontinuities can lead to increased heat loss sue to thermal bridging [4] which can in turn lead to condensation and mould risk due to reduced surface temperatures [5]. This paper is based on work carried out as part of the author's PhD research, and expands on that research [6].

2. Aims

One form of discontinuity that can occur when carrying out an IWI retrofit is the discontinuity at the external wall to party wall junction with a conjoined neighbouring dwelling, where insulation is fitted only to one side of the junction [7]. The reduced heat flow from the insulated side of the party wall junction can lead to reduced surface temperatures and an increased risk of condensation formation on the uninsulated neighbouring side, more so when an insulation return is also fitted along the party wall surface on the insulated side of the junction [8]. Current best practice guidance is for the insulation return to be omitted from party wall junctions where the neighbouring dwelling is not also fitted with IWI [9]. This paper seeks to explore the role that the characteristics of the IWI system fitted plays in the risk imposed upon an uninsulated neighbouring dwelling.

3. Methods

Numerical thermal simulation techniques were used to model the party wall junction in solid brick walled case study dwelling using Physibel's TRISCO 12.0 software. The thermal resistance of the external solid brick wall was refined to match measured surface temperatures [6] A range of IWI insulation systems of the plasterboard-thermal laminate type were added to the model on a single side, with and without insulation returns of the same IWI material along the party wall. The thickness and thermal conductivity of the insulation component of thermal laminate was varied within the range of IWI systems tested within the case study dwelling [10] The minimum surface temperature simulated on the neighbouring side of the junction was used to calculate a temperature factor (f_{RSi}) values below 0.75 are taken to indicate a risk of surface condensation and mould growth at that side of the junction.

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 DOI: 10.14293/ICMB230031

4. Results

The results of the numerical thermal simulations are included in Table 1 below. When modelled in an uninsulated state the party wall junction was found to have an f_{RSi} of 0.790 on both the case study side and the neighbouring side, prior to retrofit this junction would not be considered at risk of condensation and mould.

Table 1. Temperature factor (f_{RSi}) results of thermal simulations on the neighbouring side of party wall junction.

Without insulation return		**Insulation thickness (mm)**					
		10	20	30	40	50	60
Insulation λ	0.015	0.776	0.772	0.770	0.768	0.766	0.764
	0.02	0.777	0.773	0.771	0.768	0.766	0.764
	0.025	0.778	0.774	0.771	0.769	0.767	0.765
	0.03	0.778	0.775	0.772	0.769	0.767	0.766
	0.035	0.779	0.775	0.772	0.770	0.768	0.766
	0.04	0.779	0.776	0.773	0.770	0.768	0.766
With insulation return		**Insulation thickness (mm)**					
		10	20	30	40	50	60
Insulation λ	0.015	0.762	0.757	0.754	0.752	0.750	0.749
	0.02	0.764	0.759	0.755	0.753	0.751	0.750
	0.025	0.766	0.760	0.756	0.754	0.752	0.751
	0.03	0.767	0.761	0.758	0.755	0.753	0.752
	0.035	0.768	0.762	0.759	0.756	0.754	0.752
	0.04	0.768	0.763	0.759	0.757	0.755	0.753

In all cases the neighbouring side of the party wall junction is subject to a reduction in f_{RSi}, indicating an increase in risk. Comparing IWI systems; thicker insulation and insulation with lower thermal conductivity result in lower values of f_{RSi}. The introduction of an IWI return results in a lower f_{RSi} in comparison to the same IWI without an insulation return. Of the simulations undertaken only IWI with an insulation return resulted in a f_{RSi} below 0.75.

5. Discussion

The reduction in f_{RSi} on the neighbouring side of a party wall junction is in agreement with the behaviour suggested by previous literature [7, 8] the inclusion of an insulation return reduced f_{RSi} further. The thinner IWI systems simulated in this study did not result in so great a reduction in f_{RSi} as simulated for thicker IWI systems up to 100 to 150mm in previous studies. f_{RSi} as an indicator of risk and TRISCO are limited by SteadyState assumptions and do not consider moisture and humidity.

6. Conclusion

The simulations carried out in this study confirmed that thinner IWI systems impose less condensation and mould risk to neighbouring dwellings than thicker higher performance systems. Contrary to best practice guidance [9] insulation returns can be fitted when using thin IWI systems.

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