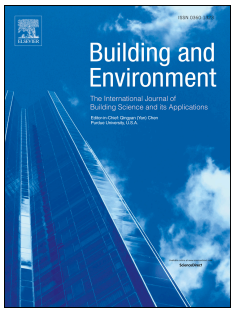
# Accepted Manuscript




Development of predictive models for the probabilistic moisture risk assessment of internal wall insulation

Valentina Marincioni, Giampiero Marra, Hector Altamirano-Medina

PII: S0360-1323(18)30198-7

DOI: 10.1016/j.buildenv.2018.04.001

Reference: BAE 5397

To appear in: *Building and Environment*

Received Date: 7 February 2018

Revised Date: 25 March 2018

Accepted Date: 1 April 2018

Please cite this article as: Marincioni V, Marra G, Altamirano-Medina H, Development of predictive models for the probabilistic moisture risk assessment of internal wall insulation, *Building and Environment* (2018), doi: 10.1016/j.buildenv.2018.04.001.

# Development of predictive models for the probabilistic moisture risk assessment of internal wall insulation

Valentina Marincioni[a,1,*], Giampiero Marra[b], Hector Altamirano-Medina[a]

[a] *Institute for Environmental Design and Engineering, University College London, 14 Upper Woburn Place, London WC1H 0NN, UK*

[b] *Department of Statistical Science, University College London, Gower Street, London WC1E 6BT, UK*

**Abstract**

Solid wall buildings account for a quarter of the UK building stock and need to be thermally upgraded to meet national greenhouse gas emission targets. Internal wall insulation (IWI) is often the only option for the retrofit of solid walls, especially when they are of architectural or historical interest. However, IWI can lead to moisture accumulation within the existing wall, affecting the structural integrity of the building and the health of occupants. To avoid these issues, a thorough risk assessment is necessary.

This paper presents a method for developing predictive meta-models that can be used for a fast probabilistic moisture risk assessment of IWI, considering both the uncertainty and variability of input variables. First, in a Monte Carlo analysis, the uncertainty and variability of inputs were propagated through hygrothermal simulations. Then, generalized additive models for location, scale and shape (GAMLSS) were used to describe the relationship between inputs and response variables of the Monte Carlo analysis. The key input variables were identified by a global sensitivity analysis - using the elementary effects method - and in model building. Two types of response variable were considered for the models: variables based on percentage values (e.g. maximum relative humidity) and dose-response relationships (e.g. mould index). The paper shows that both risk assessment models had a good predictive power, highlighting the suitability of the developed method for the moisture risk assessment of the internal insulation of solid walls.

*Keywords:* moisture risk assessment, probabilistic risk assessment, internal wall insulation, predictive modelling, hygrothermal simulations, traditional buildings

*Corresponding author

*Email address:* v.marincioni@ucl.ac.uk (Valentina Marincioni)