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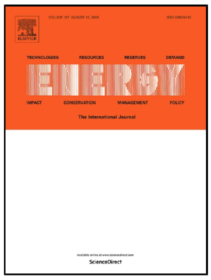

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INFLUENCE OF DRIVING RAIN AND VAPOUR DIFFUSION ON THE HYGROTHERMAL PERFORMANCE OF A HYGROSCOPIC AND PERMEABLE BUILDING ENVELOPE

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Abstract
Most natural building materials are hygroscopic and permeable to water vapour. These two characteristics have the potential to improve the longevity and indoor air quality of buildings. However, the potential of winter condensation due to vapour diffusion and the risk of mold growth should be assessed for safeguarding the longevity of building assemblies.

This study investigates the relative importance of driving rain, plaster capillarity and the presence of a vapour barrier on the moisture content of building materials and the risk of mold growth for a hygroscopic and permeable building envelope (HPBE). Hygrothermal simulation of a single-family house in Denmark mainly made of wood and clay are performed with WUFI. Results indicate that the presence of an overhang is essential to ensure the durability of a HPBE rendered with a capillary active lime-based plaster while the presence of an overhang has a negligible impact for a mineral cement-based plaster. Including a vapour barrier in this wall assembly did not introduce significant changes on the moisture content of this wall assembly. Simulation results indicate that the type of plaster and the wind driven rain exposure are the most critical variables affecting the hygrothermal performance of this wall assembly.

Keywords: Water vapour, hygroscopicity, water management techniques, diffusion, permeability

1 INTRODUCTION.

Water is estimated to be responsible for 75% of building failures [1]. Water management in buildings is therefore one of the most important factor related to building longevity. The moisture content of building materials may also influence significantly their thermal performance. Building materials with an elevated moisture content can cause 2-9% increased heat losses because of the increase in thermal conductivity and latent heat effects [2]. For bricks, the difference between the steady-state and transient U-value due to changes in thermal conductivity was shown to be up to 37% [3]. A light weight structure made of mineral wool insulation and plasterboard showed an increase of up to 228% of its specific heat loss coefficient when exposed to wetted conditions (40 hours at 90% RH) [4].

Water management in buildings is also closely related to the indoor air quality and health of building occupants. Keeping the indoor relative humidity level between 40% and 60% can reduce asthmatic reactions, mites, fungi and the survival rate of infectious bacteria and viruses [5]. As such, water management strategies should be an important part of building design and should rely on more than one strategy to insure satisfactorily performance over time.

Different moisture management strategies can be effective, depending on the building usage and climate. The use of impervious or inorganic materials is often touted as a safe practice, but these could actually pose additional risks. For instance, manufacturers of petroleum-based insulation products claim that they are safer than natural products because of the absence of organic material available for mold growth. However, natural materials tend to be more hygroscopic (able to absorb and release moisture), which reduces the risk for mold growth by having a more uniform moisture distribution [6]. Therefore, most water leaks do not cause problems in building envelopes with a high hygric buffer capacity while even small leaks can be problematic when the hygric buffer capacity is low [7]. As for