How moisture control standards should be updated to improve moisture tolerance and practical applicability

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Abstract

Moisture related damage is still a formidable cost factor in the building sector. Besides installation deficiencies, moisture control design failures are the most frequent reasons for moisture problems. Therefore, adequate moisture control analysis has become the key for sustainable buildings. However, by focusing on vapour diffusion only other important moisture loads such as driving rain, construction moisture and air infiltration are mostly neglected. Therefore, international moisture control standards often refer to simulation models for more realistic analysis, leaving many practitioners wondering how to handle these tools. To overcome this dilemma, the updated German moisture control standard has introduced a three-pathway approach for design evaluation: 1st deemed to satisfy list, 2nd restricted Glaser calculation and 3rd fully fledged hygrothermal simulation. The third pathway includes the option to account for small leaks or imperfections in the building component.

Peer-review under the responsibility of the organizing committee of the ICMB21.

Keywords: Moisture control design standard; hygrothermal simulation; vapour diffusion calculation; deemed to satisfy; component leaks;

1. Introduction/Background

In the past, moisture control meant for most practitioners steady state vapour diffusion calculations, often called dew-point or “Glaser” calculations. However, due to numerous simplifications the results of these calculations may be misleading especially when capillary flow or moisture storage have an impact. This penalizes materials with moisture storage capacity, such as renewable insulation materials, because it assumes the formation of condensation where in real life only the sorption moisture content is slightly increased. There are actually many more draw-backs of employing dew-point calculations for moisture control design which has turned the focus on hygrothermal simulation. To arrive at comparable results pertinent application standards for hygrothermal simulation models have been developed. The first guideline on moisture control analysis by hygrothermal simulation was issued in 2002 by the WTA, an association dealing with preservation and renovation of heritage constructions and rehabilitation of the building stock (predecessor of [1]). The European Standard EN 15026 [2] is largely based on this WTA guideline. However, both documents disregard the impact of small defects in the building envelope. The updated version of WTA 6-2 [1] remedied this problem by considering imperfections in the building envelope by simplified models.

This means, in theory we have the necessary models and simulation tools, however, they are difficult to apply for inexperienced architects and the effort involved in a detailed hygrothermal analysis is often not rewarded by the client. Therefore, there must be a more flexible approach to moisture control design for the building practice. It should include a list of deemed to satisfy constructions subject to some restrictions, e.g. indoor climate conditions representative for residential as well as office buildings and normal exposure condition (e.g. excluding locations high up in the mountains). This list should contain assemblies that already have a long track record and possibly also those that have been studied extensively by field tests or hygrothermal simulations. Since the Glaser method is well established and may give useful results for some construction types, it could also be part of the analysis if the limits of this method are clearly observed. The German moisture control standard for building envelope components DIN 4108-3 updated in October 2018 [3] may serve as an example for such a flexible approach, this is why its general outline is presented here.

2. DIN 4108-3 moisture control standard offering a three-pathway approach

Due to a history of severe building failures caused by moisture problems, German builders, material manufacturers and forensic experts have been searching for better moisture control design guidelines which is not an easy task, considering the nature of the very conservative construction sector. As compromise between “accurate but complicated” and “easy but oversimplified” the following three-pathway approach has been developed. The first option is to select a wall or roof assembly from a list of deemed to satisfy (DTS) constructions included in the standard. The second option represents the assessment by a steady-state dew-point calculation with fixed boundary conditions. However, there are a number of restrictions that have to be observed. Most importantly, pathway one and two may only be applied for envelope components of residential buildings or those that have a similar indoor climate (e.g. offices, shops, etc.) and no air-conditioning. In all other cases pathway three applies, i.e. the designer

has to perform a hygrothermal simulation according to appendix D of the standard. This appendix references EN 15026 [2] and WTA 6-2 [1] as well as some other standards and guidelines dealing with the evaluation of hygrothermal simulation results, e.g. mould risk evaluation. A flow chart showing the preconditions for selecting one of the options is depicted in figure 1.

DIN 4108-3 (2018)

Moisture Control Analysis

Figure 1 Flow chart explaining the preconditions for the moisture control assessment options in DIN 4108-3 [3].

3. Conclusions

Hygrothermal simulation models have become essential to advance our skills in sustainable and resilient building design. However, their application only makes sense for experienced moisture control experts. Therefore, a more flexible approach including simplified evaluation methods may help to bridge the gap between science and practice.

Practical experience has proven repeatedly that imperfections and small leakages in the building envelope are unavoidable and have to be accounted for. This is a new paradigm and must be included in all types of analysis. This is probably easier to achieve in simulation models but it could be transferred to simpler methods too. The development of new approaches that are able to represent real life impacts caused by imperfections is a challenge, because it depends on the question “what is unavoidable?” Ultimately, the definition of unavoidable moisture sources will result in a clear discrimination between design and installation failures. This will also result in more moisture tolerant building component design. Since a lot of money is involved in this important classification, the discussions between architects and trades will probably intensify in the future, but any progress in this field will benefit us all.

References

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- [2] EN 15026. (2007). *Hygrothermal performance of building components and building elements - Assessment of moisture transfer by numerical simulation*.
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