Investigation of the requirements for the components of ETICS in wooden construction through the determination of the functional relationships of the properties of the system components

Short Report 7/18

Keywords

External thermal insulation composite systems, wooden construction, system components, physical properties

Initial situation

External thermal insulation composite systems (ETICS) for the insulation of exterior building walls were developed at the end of the 1950s. They essentially consist of the components skim plaster, rendering plaster, reinforcing fabric, insulating material, and fastenings. In masonry construction, they primarily serve the thermal protection of the building, whilst in timber construction, ETICS also provide the wooden building with weather protection against high moisture levels. Polystyrene foam is usually used as the insulating material. Wood-fiber insulation boards were introduced into ETICS in the mid-1990s but still only occupy a small share of the market.

Up to now, ETICS have had to be tested and evaluated in order to obtain a so-called proof of usability under building law. As most of these tests were developed for ETICS in masonry construction, they do not adequately cover the special requirements of ETICS in timber construction (permanent protection of the wooden supporting structure, deformation of the substructure). Replacement of the components of the tested system is not permissible without further - usually laborious - substantiation, as this would invalidate the proof of usability. This is because the evaluation and building authority approval of ETICS has so far been carried out as a whole system.

The interaction of the system components in ETICS has not yet been sufficiently researched. It is at present therefore not possible to place requirements on the individual components of ETICS, only on the whole system. In this research project, the largely unknown interaction of all the system components will therefore be investigated and analyzed. Simplifications can already be performed for extremely complex overall systems, thereby greatly reducing the number of variants.

In the first step, the actually relevant physical properties of the system components should be identified. The hygrothermal properties of the materials, such as the moisture dependency of the modulus of elasticity in the panel plane as well as the thermal and hygric expansion coefficients, are hereby of great relevance. Until now, these have not been taken into account in the system evaluation. With the aid of numerical investigations, the interaction of all the system components is then investigated on the basis of existing physical laws. The results of practical system tests and object assessments form the basis for the subsequent validation of the numerical investigations.

The project objectives include the prediction of the overall behavior of an ETIC system in wooden construction by means of the properties of the system components and the preparation of a guideline. This is intended to facilitate the assessment of defects occurring relatively frequently in practice (Figure 1) as regards the determination of whether or not damage can arise through the defects.

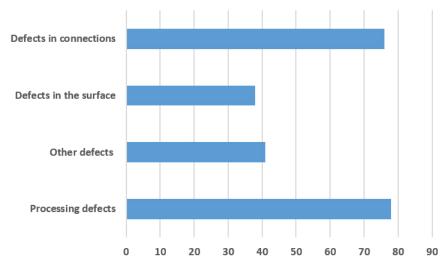

Figure 1: Result of an evaluation of object assessments regarding defects in the processing of ETICS.

Research partners

TU Braunschweig, Institut für Baukonstruktion und Holzbau iBHolz[1]
Schleinitzstraße 21a
38106 Braunschweig

Fraunhofer-Institut für Holzforschung
Wilhelm-Klauditz-Institut WKI [2]
Bienroder Weg 54 E
38108 Braunschweig

Implementation
M. Sc. Xinyi Li[1]
Dipl.-Ing. (FH) Norbert Rüther[2]

Support
BMWi via AiF/iVTH
IGF 19906 N

Publisher

Int. Association for Technical Issues related to Wood (iVTH)
Bienroder Weg 54 E
38108 Braunschweig
Germany
Fon: +49 531 2155-209
Fax: +49 531 2155-334
contact@ivth.org | www.ivth.org

Initial results

Within the project, all relevant physical properties have been and will continue to be determined, either by means of existing literature or through our own laboratory tests. Figure 2 shows an example of the dependence of the modulus of elasticity of wood-fiber insulation boards (dry process) on the bulk density and the relative humidity.

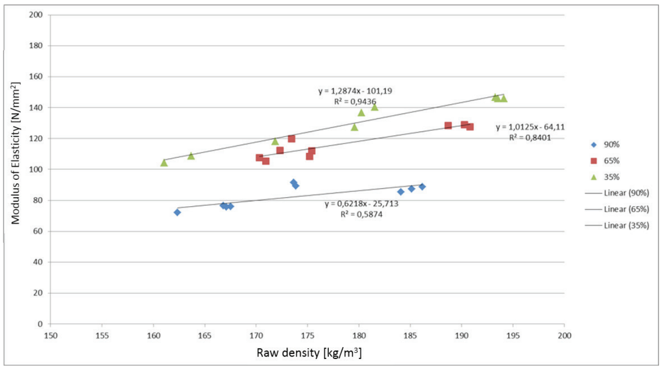

Figure 2: Modulus of elasticity of wood-fiber insulation boards in dependence on bulk density and material moisture (here: as relative humidity).

These and many other results serve as input parameters for computational models with which the behavior of the ETICS can be described. Figure 3 shows an example of the result of the numerical simulation of a tensile-shear test specimen (deformation), i.e. under the interaction of fastening material (steel screw with plastic head), wood-fiber insulation board and solid wood under mechanical impact.

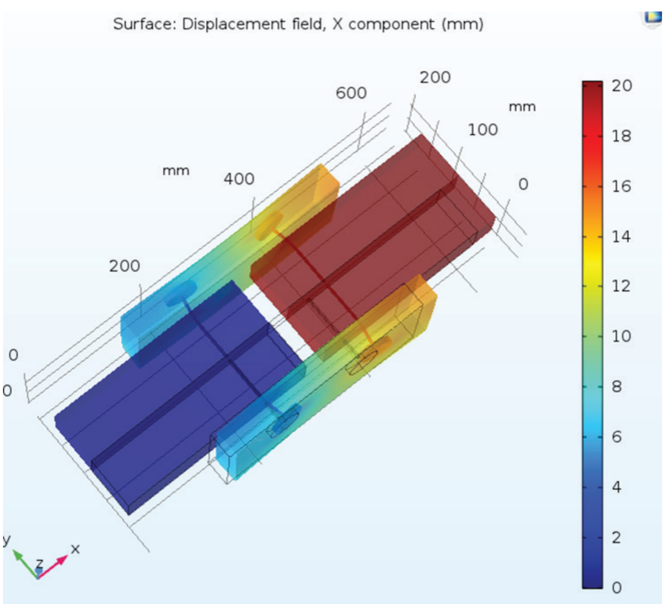

Figure 3: Visualized result (deformation) of the simulation of a tensile-shear test specimen.

Figure 4, in turn, shows exemplarily the result of a numerical simulation of a section of an ETICS element. Here, the thermal and hygric expansions in combination with the effects of dead load were taken into account.

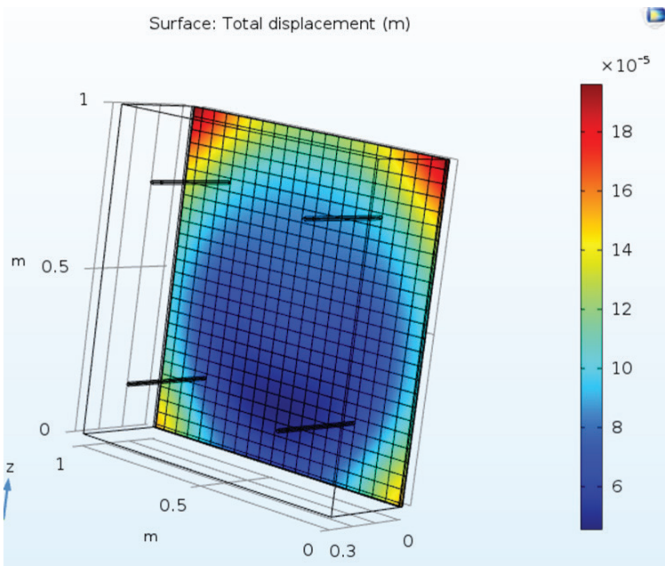

Figure 4: Visualized result (deformation) of the simulation of an ETICS section as a result of hygrothermal and mechanical (dead load) stresses.

The project is planned to run until the end of 2020. The results therefore provide solely an informative intermediate status and will be developed further.

This information is intended solely for members of the iVTH. Disclosure to third parties, in whole or in part, requires approval.

The respective research center is responsible for the content of the short report.