FORSCHUNGSINITIATIVE Zukunft BAU

Zukunft Bau

SHORT REPORT

Title: 0EneMau

Innovative Insulation Technology for Reducing the Heat Losses in Masonry Construction, with the Aim of Ensuring 0-Energy Standards

Az.: SWD-10.08.18.7-12.33

Motive / Initial Position

The statutory requirements for energy saving buildings in new construction exacerbate continuously, so that ever greater demands are placed on thermal insulation. The aim of the research project is to solve the problematic of the heat losses in multi leave masonry walls by suggesting an innovative insulation system. The new insulation system should achieve different essential requirements in term of geometry, safety, flexibility, lifetime and demount ability of building items in addition of considering the special thermal requirements to meet the 0-energy standards.

Scientific scope

The suggested insulation system within the research project is designed to bridge the gaps that exist in recent systems, mainly in term of thermal sufficiency in relation to geometry and working applicability.

This research project focuses on the use of vacuum panels as medial insulation core in multi leave masonry walls. At the beginning of the project the different application problems; technical, geometrical and thermal, are analysed introducing a concept of proper solution.

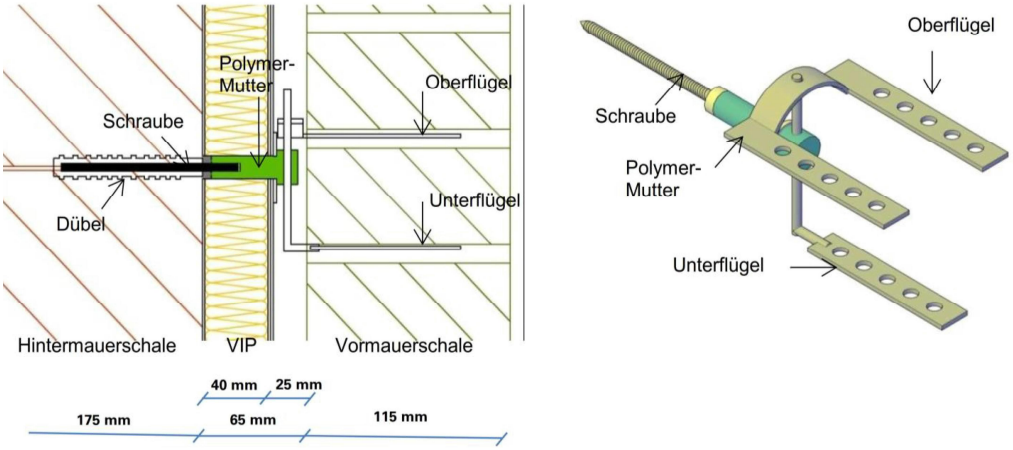

Figure 1 Anchor-Design installed in VIP insulation system, section and 3D

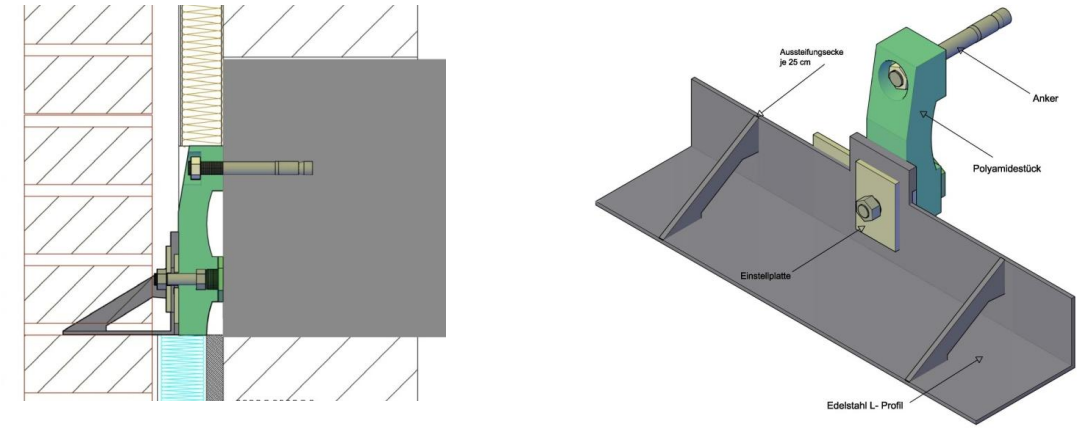

Figure 2 Consol-Design installed VIP insulation system, section and 3D

Then the solution, consisting of insulation and anchoring system (Figure 1 and Figure 2), is presented in detail and all needed experimental, numerical (Figure 3 and Figure 4) and building physical tests were carried out in order to analyse the physical requirements and structure behaviour. The solution introduces the application of new form of modular insulation vacuum panels with special assembly details that fits the different

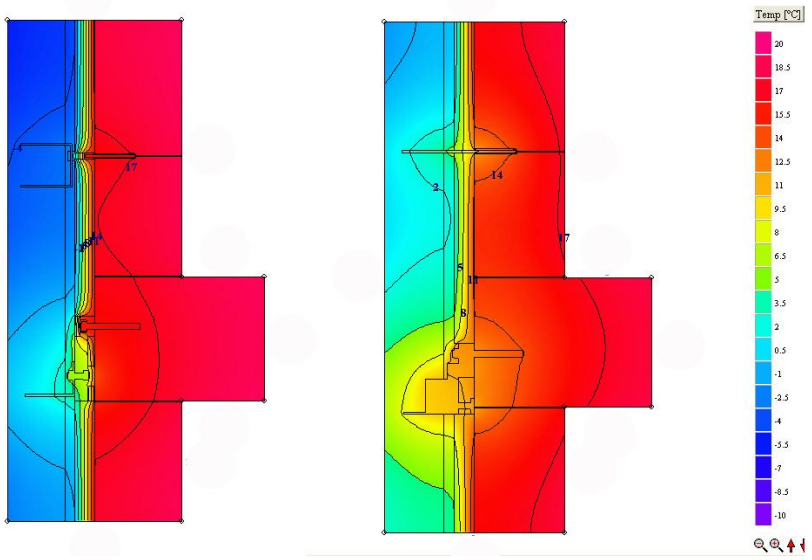

Figure 3 Comparison of thermal distribution when using anchoring system with polyamide separation parts to classic anchoring system from 3D model steel.

Vacuum panels provide premium thermal insulation at low assembly thickness in comparison to classic insulation panels, the use of such insulation panels achieves better energy saving buildings on one hand, and on the other hand it considerably increases the usable area of the building.

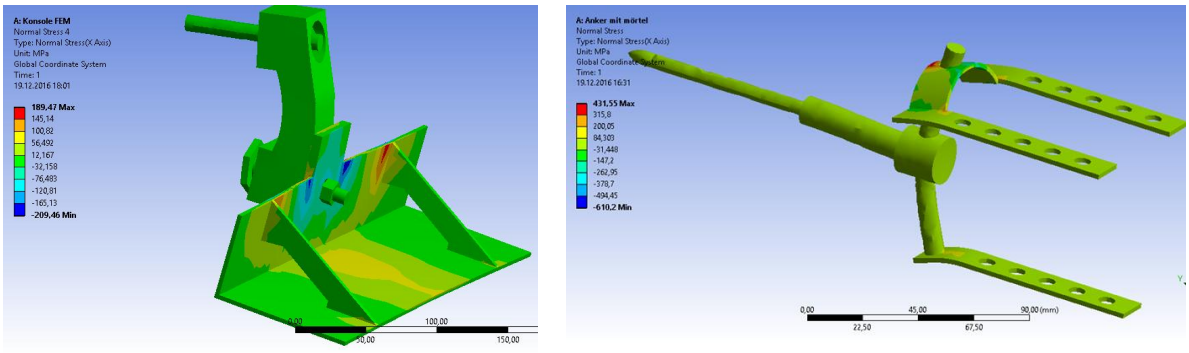

Figure 4 The numerical, structural analysis of the anchoring system

Applying the suggested system reduces the distance needed to install insulation to only 65 mm including air space of 25 mm for easier construction and bricks chandelling. In comparison to other currently applied insulation systems the Vacuum insulation panels reduce the needed thickness between 3-4.5 times. Due to its slimmer walls, the buildings that were built with the suggested Vacuum insulation system will have more sunshine gain on one hand, and on the other hand, the save in wall thickness will increase in turn the usable area of the building.

To issue more realistic comparison to other insulation systems muster house was designed following the system requirements (Figure 5). The usable area of this Muster house was calculated considering applying different insulation systems to the walls, insulation with Rockwool, XPS panels, ESP panels and PUR panels aiming to reach the same U-Value (0.157 W/m^{2}K) which is achieved by the designed system with only 65 mm insulation leaf including the air space of 25 mm.

Figure 5 Design of the Muster house: Two levels, entrance, living room, kitchen, WC, stairs, bedroom, Bathroom, dressing room, balcony and terrace, Constructed area=52,51 m^2 = 8.9 m x 5.9 m, height 6.8 m

The application of the suggested vacuum insulation system increase the usable area of the reference house 13,9 % in comparison to the use of Rockwool, to 11,6 % in comparison to the use of Swisspor XPS 300 GE, and to 5,9 % in comparison to the best PUR/PIR insulation panels which are provided with Alu-protection on both sides.

In addition to the previous advantages the designed system is demountable where damaged parts can be easily exchanged, furthermore, the suggested system can be applied to other façade finishing systems after minor modification to the anchor metal heads. For example, the systems can be easily applied with ceramic façade plates (i.e. Wienerberger), concrete façade plates and to the dry staked brick façades (i.e. ClickBrick System). In all previous cases the suggested system can be totally dismantled and reused in case of change in building function or shape.

All needed experimental tests on the anchoring system, especially testing the system as linear anchoring solution in order to analyse the structural behaviour (Figure 6) were carried out. In a preliminary study it was found out that the vertical positioning of the anchors linearly leads to a better exploitation of the outer leaf made by masonry. The result of the tests was that a further reduction of costs for such a solution will be possible due to the minimizing of the number of anchors and the enlargement of the vacuum panels.

Figure 6 Testing the line anchoring system (left position of the vertical anchor lines; right the finished test arrangement)

The suggested insulation system should be not burnable; therefore, the fire test was carried out in order to insure prevention of direct exposing to fire in case of fire action (Figure 7). The most important point in case of fire is that the spread of the fire in the air gap will be hindered according to the regulation of the German building authority.

The results from the experiments have shown that the suggested insulation system covers all the physical und structural requirements in multi leave masonry walls.

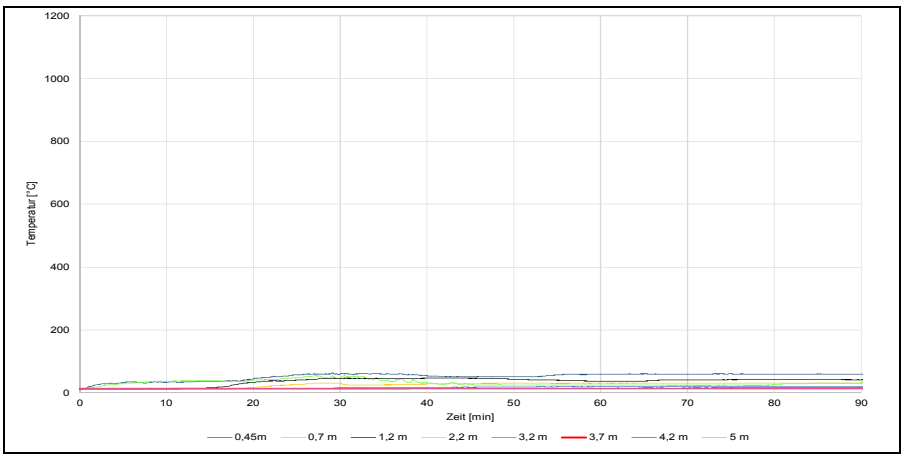

Figure 7 Fire temperature in the air gap in the middle over the fire place in different heights

Due to the current fabrication difficulties of the irregular VIP panels forms and the fact that manufacturing VIP is still half automated, the vacuum insulation panels are still expensive in comparison to other insulation panels. Applying the modular forms which are suggested in this research will reduce the manufacturing forms and enable producers to full automate the production process and set it to production lines to produce only certain forms that can be applied to all buildings. This will reduce in turn the production costs.

Conclusion

Based on the material, geometry and thermal sufficiency, herein can generally find, that the suggested insulation system can be used in the course of practice. It is especially recommended in case of high property prices because it allows a better utilisation of the land area.

Key data

Short Title: Innovative Insulation Technique for Reducing Heat Loss in Multi Leaf Masonry Walls

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