

Precast concrete units with vacuum insulation




Precast concrete units play an important role in the building trade. This project included the development of all-purpose concrete facade elements with integrated vacuum insulation. Prefabricated room-high elements are used to construct slim facades with excellent heat insulation characteristics that are suitable for use in passive houses. The vacuum panels are fastened to the concrete units by means of low thermal bridging brackets to allow the subsequent replacement of defective panels. Meanwhile a demonstration building has also been constructed using these new types of precast concrete units; this building is currently being scientifically evaluated.



The application of vacuum insulation panels under construction.

© Hangleiter

Technology summary

Term of project	10/2002 - 05/2004
Technology status	 Pilot Project
Key aspects	Heat insulation, Facade systems

Project description

Previously, insulation thicknesses of 30 – 40 cm and wall thicknesses of up to 60 cm were required in order to attain the U-values necessary for low-energy and passive houses. On the one hand, this resulted in architecturally unattractive "loophole effects" on windows whilst also reducing the amount of available living area for fixed outer dimensions.

The above problems may be solved by utilising vacuum insulation panels (short VIP) whose thermal conductivity is 5 to 10 times lower as compared to conventional insulation materials such as foam or fibre. However, it should be noted that these fragile vacuum insulation panels are not well suited to being machined on-site. Prefabrication by the facade element manufacturer can significantly reduce the risk of errors. The goal of the project was to develop ultra-slim vacuum-insulated precast concrete units suitable for passive houses with an average U-value (incl. all thermal bridges) of only 0.15 W/m²K. These VIPs can also be replaced at a later date. A demonstration building was constructed in Ravensburg (Germany) to field-test the VIP-insulated precast concrete units.

Focus

The primary advantage of this facade element solution lies in its complete prefabrication; defective panels can also be replaced at a later date. Any type of facade panel including plaster base panels may be used. Individual designs are also possible providing they are based on the standard grid of 12.5 cm used in wall construction. The company Hangleiter has a product which it is currently testing, in which the vacuum panels are fastened to concrete wall and roof elements. A special manufacturing process with pre-mounted anchoring holds the panels onto the concrete using tension, and also accommodates the substructure for a ventilated facade. In this manner, room-high precast concrete units with vacuum insulation, furnished with a ventilated facade, are the result. The elements achieve a U-value of 0.15 W/m²K, which complies with the passive house standard, with a total thickness of only 27 cm.

Success

Numerous functional models of vacuum-insulated precast concrete units were made during the project, and subjected to extensive testing. A completely vacuum-insulated demonstration building was constructed in Ravensburg in order to field-test the precast concrete units. Due to consistent horizontal and vertical use of a grid in the early planning phase, only three VIP standard sizes were required (cost factor). Even a round structure was also insulated in segments using VIPs. In the manufacture of the solid floors, prefabricated heating and cooling heat exchangers were set in concrete. These heat exchangers lie only a few millimetres (!) from the concrete surface, and thus radiate the required heat (winter) or cold (summer) with fast reaction times. The necessary heating and cooling energy is produced by means of three borehole heat exchangers and a heat pump.

Milestones

The demonstration building is built, and has been occupied since April 2005. The first measurement data is

encouraging, and the indoor climate is described as being consistently very pleasant.

To document the durability of the construction, the functionality of the VIPs on the facade is to be assessed in sample tests. In parallel, efforts are being made towards attaining building regulations approval for the system. The prerequisite for this is the building regulations approval of vacuum insulation itself.

Application

Vacuum-insulated solid roof for flat roofs and recessed balconies. Supplier: A. Hangleiter GmbH & Co. KG



Detailed project description in project portal



Project description of the company ALbert Hangleiter

This project is funded within the framework »Energy Optimized Building« (EnOB) by the German Federal Ministry of Economics and Technology, on the basis of a decision by the German Bundestag. Get further information at www.enob.info.