Contributing to a flagship project of the strategy

Baltic Sea Region Programme 2007–2013

Part-financed by the European Union (European Regional Development Fund and European Neighbourhood and Partnership Instrument)

$Co_2olBricks$

WP5 Education and Economic Promotion

Post-insulation of cellar ceiling and cellar walls

Educational product: New lecture material for training modules dealing with knowledge and skills how to apply suitable methods of energy efficient refurbishment of historic constructions and how innovation can be combined with cultural heritage

Post-insulation of cellar ceiling and cellar walls

Target group: architecture, construction, energy audit students

Educational objectives: To show the possibilities and methods for further improving building envelope.
This measure can help to save up to 3% total energy used in building

Lecture course: 2 academic hours, additional on-site visit recommended

References:

Megri, Ahmed C., et al. "Thermal Comfort and Energy Analysis for the Slab-on-Grade Floor and Basement of a Building." (2011).

Rasmussen, Torben Valdbjørn. "Post-insulation of existing buildings constructed between 1850 and 1920." *Department of Construction and Health, Danish Building Research Institute, Aalborg University, Hørsholm* (2010).

Roberts, S., and R. Stephenson. "Measure Guideline: Wall Air Sealing and Insulation Methods in Existing Homes." (2012).

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Introduction

The project “CO_2ol Bricks” considers measures to improve the thermal envelope of buildings constructed with exterior walls of Brick. Measures with a focus on good technical solutions for improving the thermal insulation of the building envelope are outlined. Both buildings with a recognised unique architecture, where measures must be carried out at the inside, and buildings without a recognised unique architecture, where measures can be carried out at the indside as well as the outside, are shown.

However, special attention should be paid to prevent degradation of the existing construction when the energy demand for heating and thermal comfort of a building decreases as a result of measures to improve the thermal envelope. Besides lower heating costs and reduced CO_2 emissions, improvement of the insulation standard could contribute to the elimination of other aspects of discomfort e.g. from draught originating from cold surfaces inside. Building physics requirements of importance is addressed as well.

Houses built before 1980 often have little or no wall insulation. Given that walls can represent most of the building envelope area, ensuring that walls have proper levels of insulation is an essential part of any historic building energy retrofit. Post-insulation of outer walls is the most challenging and most energy effective measure for historic building. The retrofit of interior insulation is commonly implemented to improve energy performance of these buildings, while maintaining their often historic exterior appearance.

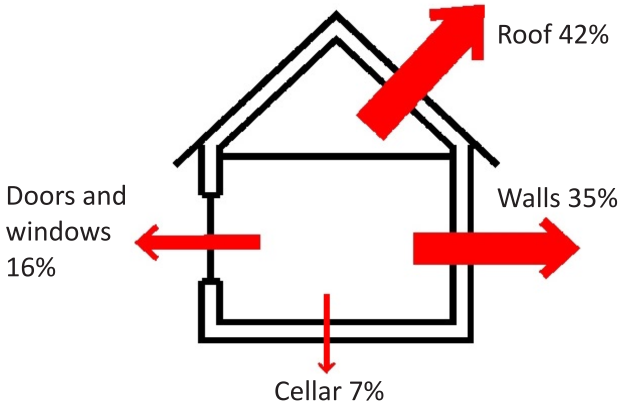

Fig. 1 Energy losses in typical historic building in BSR

Insulation is a key tool in the fight to save energy used in buildings. However, in the rush to insulate consideration must be given to the types of materials used and how suited they are to the original construction. Inappropriate use of cheap, impermeable materials can cause an imbalance in the movement of air and moisture in a building and could lead to problems of decay and damage which in the long run will cost more to remediate.

Improved thermal insulation measures of the horizontal partition towards the basement is relevant if the basement is cold. Improvements of the vertical section is carried out by blowing loose-fill mineral fibre insulation into the cavity between the timber beams, see Figure 21 and Figure 22. The cavity allowed 100 mm mineral fibre insulation.

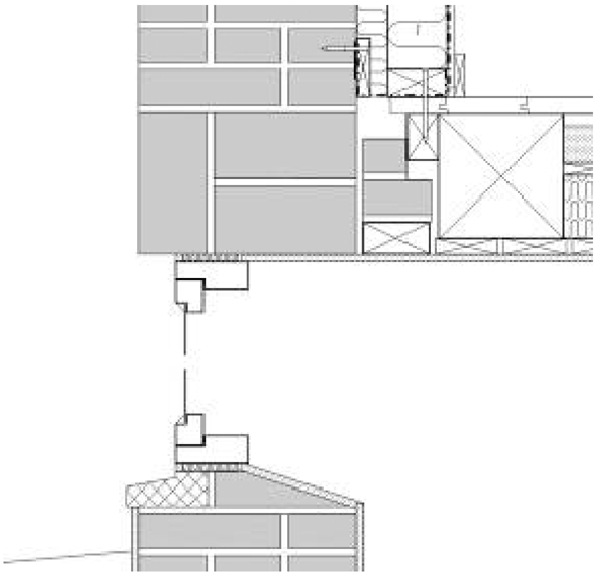

Figure 2. Horizontal partition by timber beams towards the basement at the window wall. An improved thermal insulation measure is carried out by blowing loose-fill mineral fibre insulation material into the cavity between the timber beams underneath the clay infill.

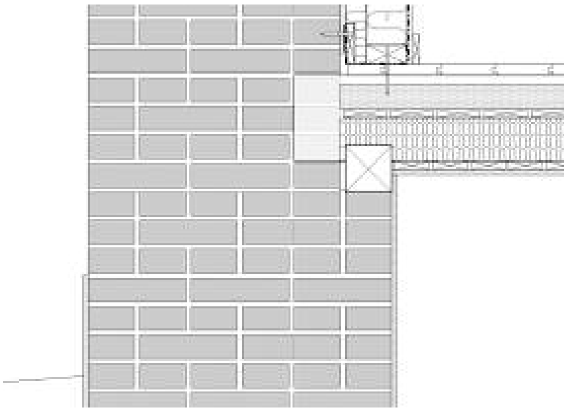

Figure 3. Horizontal partition by timber beams towards the basement at the load bearing wall. An improved thermal insulation measure is carried out by blowing loose-fill mineral fibre insulation material into the cavity between the timber beams underneath the clay infill.

An improved thermal insulation measure of the horizontal partition towards the basement is not relevant if the basement is warm, heated by uninsulated and poorly insulated installations for heating. However, if the basement is warm it might be a good idea to increase the thermal insulation of the basement, see Figure 23 and Figure 24.

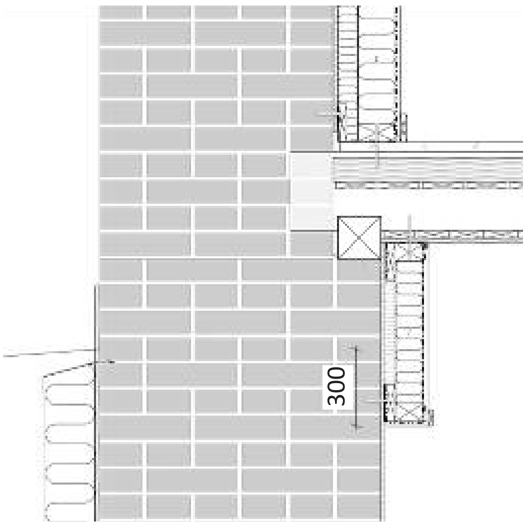

Figure 4. Vertical section of the loadbearing wall in the basement after improved thermal insulation measures.

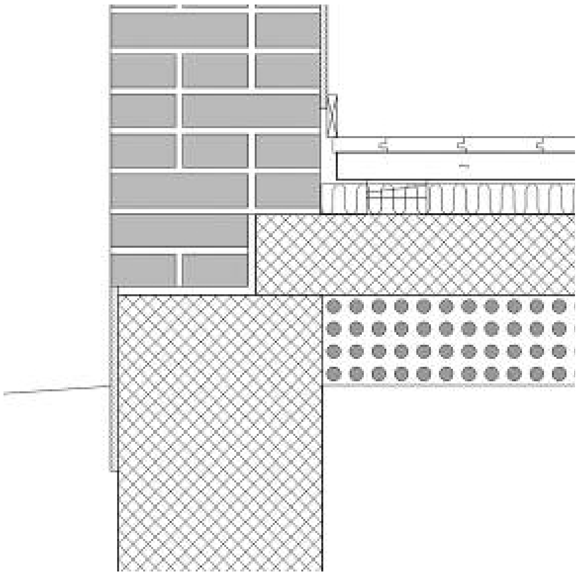

Figure 5. Vertical section at the base of the loadbearing exterior wall placed on a foundation of concrete.

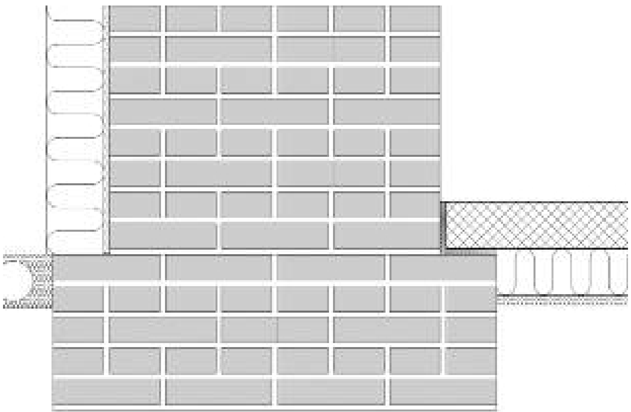

Figure 6. Vertical section at the base of the loadbearing wall in the basement after improved thermal insulation measures.

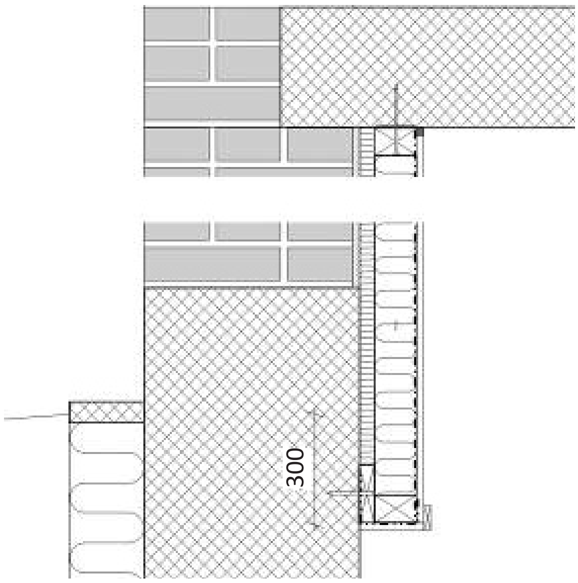

Figure 7. Vertical section of the load bearing wall in the basement after improved thermal insulation measures.

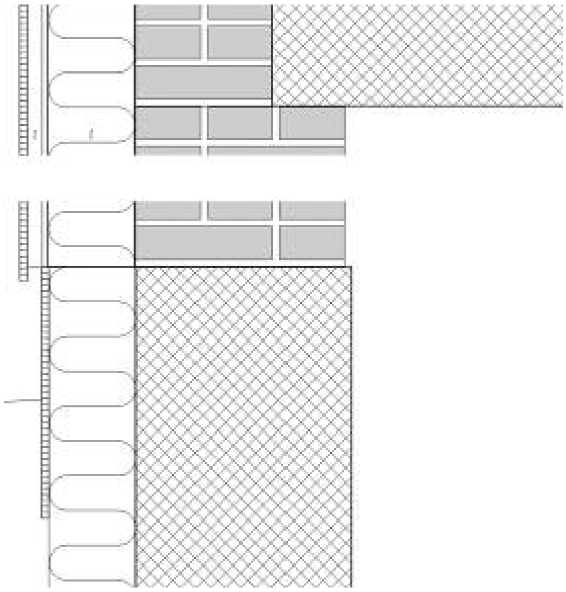

Figure 8. Vertical section of the load bearing wall in the basement after improved thermal insulation measures.

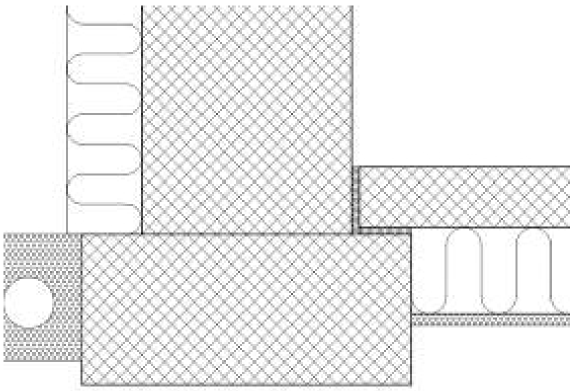

Figure 9. Vertical section at the base of the load bearing wall in the basement after improved thermal insulation measures.

Floor insulation

The temperature difference between indoor and the first or basement floor is considerably lower than the temperature differences in external walls of buildings. Studies have shown that floor insulation provides a very small part of the total heat gains in comparison with roof and exterior wall insulation. Floors in historical buildings can also have a great cultural and historical value that makes it harder to install thermal insulation. However, if floor modification or reconstruction is planned the opportunity to improve the efficiency of it should be used [15].

Historical buildings usually have two types of flooring - solid or wood construction floor.

Wood floors

Insulation process of wood floors is easier in comparison with that of the solid floors. Hygroscopic insulating material is inserted between the joists (see Fig. 10).

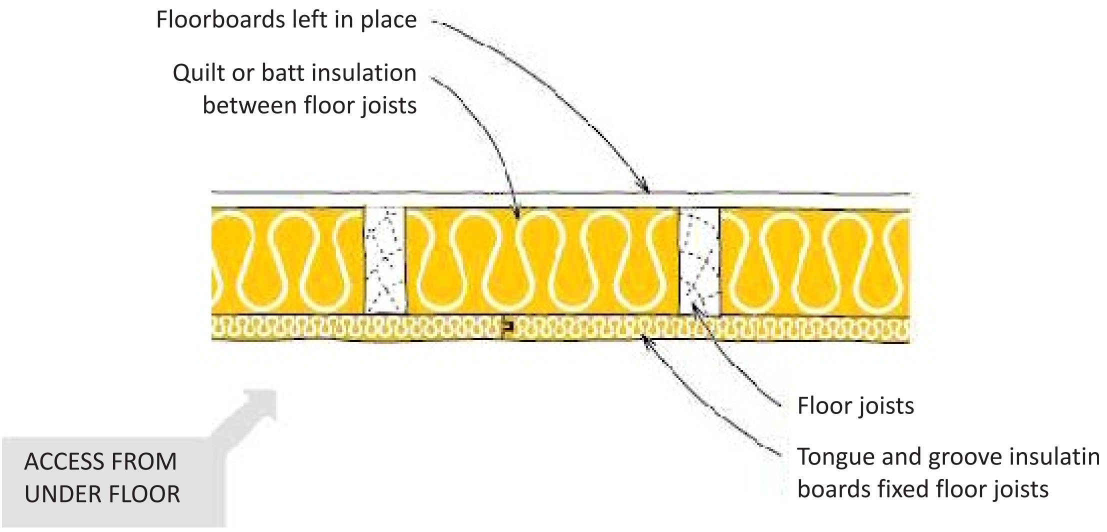

Figure 10. Insulation from below

In Figure 10. insulation is applied from the bottom and the floor boards does not have to be removed. Soft heat insulation material, which is located between the joists are secured with hermetic wood fibre plates. Sheep wool or hemp insulation, which reduces the risk of condensation, would be more appropriate.

If the floor is not accessible from downstairs, insulation must be installed from the top. Insulating material may be affixed with permeable membrane or fastenings depending on the insulation material. Hygroscopic insulation materials are the most appropriate [17].

Solid floors

Traditionally, for the insulation of solid floors traditional thermal insulation materials are used, that is - foam glass, extruded polystyrene and others, below which waterproofing is incorporated to protect them from moisture.

Major risks that should taken into account after the installation of insulation is water vapor condensation and moisture absorption from the soil, because solid floors is in a direct contact with the ground. After the insulation the moisture that was absorbed by the original floor is drawn to fundaments, and then capillary forces move it up the masonry walls. To avoid such risks, a specific method is designed for the floor insulation of historical buildings (see Fig. 11).

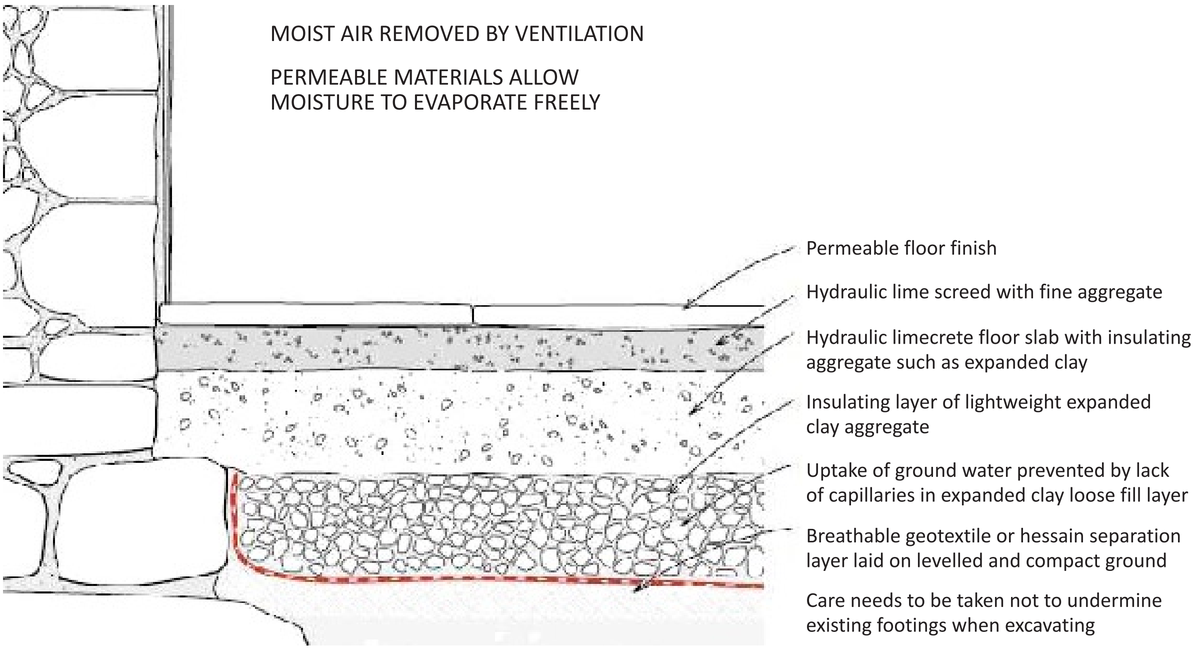

Fig.11 Lime concrete insulation

Method is based on natural, hydraulic lime mixture and isolation mass. These materials have the ability to absorb moisture, and then give it to the environment, creating "breathing" floor system, which reduces the disadvantages of traditional methods.