Villa Castelli

Author: Daniel Herrera (EURAC)

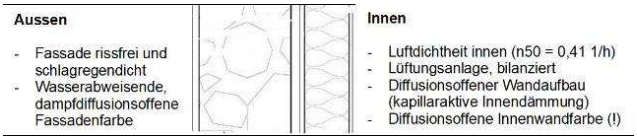
Perlite and aerogel

Walls

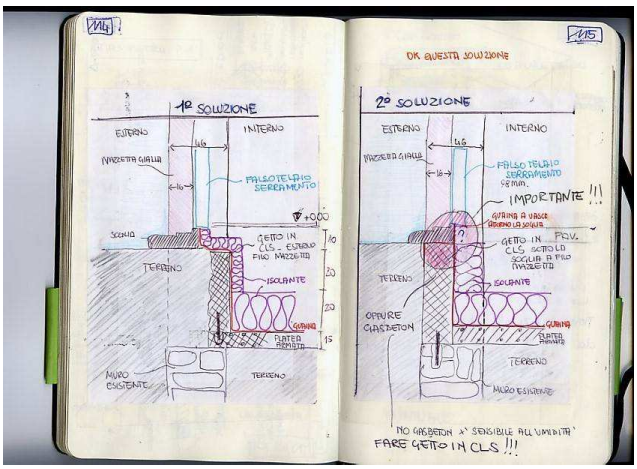
What is the solution?

This solution includes a complementary use of perlite and aerogel. The outer wall was insulated internally with 20 cm perlite or 8 cm Aerogel, depending on the geometric requirements. The moisture transport was simulated for both internal insulations. In addition to that, all emerging nodes were designed for “buildability” with particular attention to airtightness, vapor diffusion and convection.

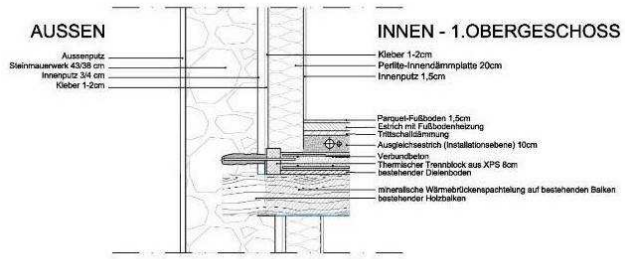
Cross section of the wall build-up, available pictures of the solution:



Concept of the internal insulation, copyright: Valentina Cari



Thermal bridge detail, copyright: Valentina Cari



Cross section, copyright: Valentina Cari

Installation of internal insulation, copyright: Valentina Cari

Facade of the building, copyright: Valentina Cari

Why does the solution work in terms of compatibility with conservation, moisture safety and energy improvement?

The decorative frescos and the volume proportions of the historical facade of this building are worth to preserve, thus the choice of internal insulation. An air-tight building envelope was important in two respects: first, to ensure the long-term performance of the interior insulation, and second, to limit the ventilation losses in a wind-exposed location. A mechanical ventilation system ensures optimum air hygiene (primarily CO2 concentration, but also indoor air

humidity). Hygrothermal simulations indicate a cold bridge in the beam end, but moisture does not rise to critical level. Overall, the simulation for Lake Como does not show any condensation. However, simulations with Essen's climate are more critical and require attention.

Description of the context:

The Villa Castelli is a listed building (as part of the lake "vincolo paesaggistico", as well as the building itself "vincolo architettonico") from the 19th century located at the Lake Como. Modifying the external façade of the building was not possible, it was necessary to work together with energy-related and structural issues in order to find solutions that meet all requirements. The client required a high level of energy efficiency for the refurbishment and this could only be reached with internal insulation. In order to maximize the thickness of insulation and avoid hygrothermal risks, detailed dynamical simulations were carried on.

Pros and cons of the solution:

There are two main "pros" in this solution: the easy construction process that allows a full bond between masonry and insulation, and the heat loss reduction across the wall. The heating requirement was reduced from 248 kWh/m^{2}a to 18 kWh/m^{2}a, which represents a saving of over 90%. The cooling requirement, on the other hand, increased because of the decoupling of the thermal mass of the outer walls (from 8.4 kWh/m^{2}a to 11.5 kWh/m^2). The main disadvantages are the loss of floor space due to the thickness of the insulation layer in the case of perlite, or the high investment costs in the case of aerogel. Additionally, a high number of critical points (mainly connections and thermal bridges) had to be carefully designed during the planning phase (about 30 pcs.).

Type of data available (level of information, simulation):

The building is well documented, as detailed information of the decision-making process and the construction details are available. Hygrothermal simulations were done.

Is there any related publication? If yes, please provide any available link or document for further reading

https://www.hiberatlas.com/smartedit/projects/23/Presentation1.pptx

Link to best practice example (Hiberatlas):

https://www.hiberatlas.com/de/villa-castelli--2-23.html