Villa Castelli

Author: Antonello Durante (EURAC)

Classical central ventilation with suspended ceiling - Villa Castelli

HVAC

What is the solution?

Mechanical ventilation system with heat recovery centralized at each floor, with suspended ceiling. It guarantees a pollen-free, healthy indoor environment and improve the comfort indoor for the users. It controls the air humidity in the rooms, given that the building is lying in a zone closed to the lake. A set of CO2 sensors regulates automatically the air exchanges and the heat exchanger allows a further reduction of the building energy demands. The mechanical ventilation system is centralized at each floor, in order to guarantee the independency of each flat. Thus, three centralized comfort ventilation units with 480m^3/h per unit and a heat recovery of 87% (according to the passive house certificate) were installed.

Why does the solution work?

Compatibility with conservation: Integrating the distribution ducts in the ceiling allows to hide them, nevertheless adequate floor-to-ceiling heights are required. Moisture safety: With ventilation systems high indoor humidity which might induce condensation within the construction at any weak point is avoided. Energy improvement: A central system for controlled ventilation with heat recovery ensures not only that the necessary exchange of air takes place automatically but also that the incoming air from outdoors is warmed by cooling the exhaust air (the “Air-to-Air Heat Exchanger” recovers up to 85 percent of the heat from outgoing air).

Description of the context:

Villa Castelli is a listed building from the 19th century located at the riverside of Lake Como (Italy). The owners set the ambitious goal of renovating the Villa, which had belonged to the family for about 140 years, to the lowest possible

energy demand while maintaining the original use of the rooms and the external appearance. The renovation achieved a 90% energy demand reduction and a significant increase in comfort, demonstrating that also a listed building can become nZEB.

Pros and cons of the solution:

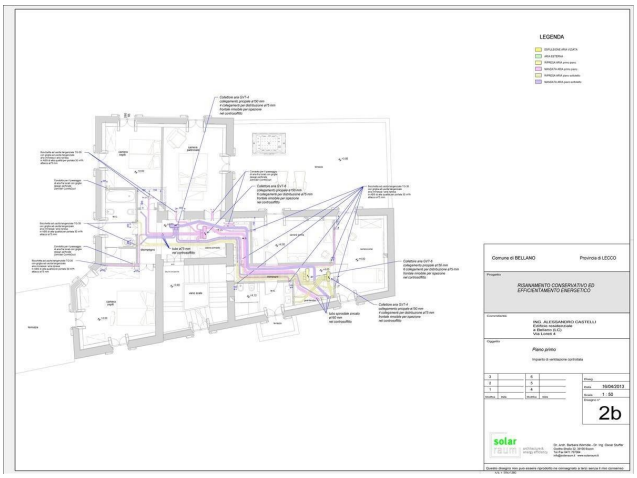
The pros of the solution are that the mechanical ventilation systems with heat recovery provide better air quality, lower humidity and no condensation. Keeping slight underpressure avoids that warm, humid interior air enter via cracks into the construction (causing moisture issues there). Another advantage is that the constant supply of warm air through the heat recovery system can reduce energy costs because the environment temperature is kept constant, this provides greater comfort in cold climates. The disadvantages of the system are that mechanical ventilation systems with heat recovery do require that filters and fans must be kept clean to ensure effective operation (additional maintenance costs). That the heat recovery work efficiently a good level of airtightness must be achieved in the rooms where it is installed, this can lead to additional costs. Since heat dispersed from ceiling ducts reaches the upper air first, the HVAC system has to work harder to push the heat lower into a room. It is always necessary to check the space availability for the mechanical systems and to control the dimension of the air ducts.

Additional information about the solution:

P. Penna, O. Stuffer, A. Troi, V. Carì (2019) “Villa Castelli - Transformation of Historical Building into Nearly Zero Energy Building”, Applied Mechanics and Materials, vol. 887, pp 148-155. Troi, O. Stuffer, V. Carì (2018) "Villa Castelli: Sanierung mit Innendämmung auf nZEBStandard. Nutzerüberlegungen zur Nachhaltigkeit", Denkmal und Energie, pp 161-175. V. Carì, O. Stuffer, E. Lucchi (2014) “Risanamento conservativo sulle sponde del lago”, Casa&Clima n°51, pp 44-52.

Are there any related publications or pictures of the solution?

Horizontal ventilation distribution / piping, © Valentina Cari



Ventilation plan, © Solarraum GmbH

Ventilation outlets on the wall just below the ceiling, © Valentina Cari