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Passivhaus: indoor comfort and energy dynamic analysis.

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The research aims to verify the energy performance as well as the indoor comfort of an energy class A+ building, built so that the sum of the heat passive contributions of solar radiation, transmitted through the windows, and the heat generated inside the building, are adeguate to compensate for the envelope loss during the cold season.
The building, located in Emilia Romagna (Italy), was built using a wooden structure, an envelope realized using a pinewood sandwich panels (transmittance U = 0.250 W/m2K) and, inside, a wool flax insulation layer and thermal window frame with low-emissivity glass (U = 0524 W/m2K). The building design and construction process has followed the guidelines set by “CasaClima”. The building has been modeled in the code of dynamic calculation "Energy Plus" by the Design Builder application and divided it into homogenous thermal zones, characterized by winter indoor temperature set at 20 ° (+ / - 1 °) and summer indoor temperature set at 26 ° (+ / - 1 °). It has modeled: the envelope, as described above, the "free” heat contributions, the air conditioning system, the Mechanical Ventilation system as well as home automation solutions. The air conditioning system is an heat pump, able to guarantee an optimization of energy consumption (in fact, it uses the "free" heat offered by the external environment for conditioning indoor environment).
As regards the air recirculation system, it has been used a mechanical ventilation system with internal heat cross-flow exchanger, with an efficiency equal to 50%. The domotic solutions, instead, regard a system for the control of windows external screening using reeds, adjustable as a function of incident solar radiation and a lighting management system adjusted automatically using a dimmer.
A so realized building meets the requirement imposed from Italian standard UNI/TS 11300 1, UNI/TS 11300 2 and UNI/TS 11300 3.
The analysis was performed according to two different configurations: in “spontaneous-state analysis” (that provides the only energy performance of the structure) and considering the “building-equipments” as a system (which provides the overall performance of the "building system"). The first analysis shows as the absence of thermal mass and the envelope super-heating prevent to incoming heat to exit, overheating the indoor environment. The analysis of the overall performance of the "building system" highlights, instead, as the thermal load is much greater during the summer than in winter; this means that, using a low inertia envelopes, the energy saved in the winter can be used to satisfy the thermal performance in the summer.
This is further demonstrated by comparing the performance of indoor temperatures and the relative energy consumption of a similar building with greater thermal inertia.
Further analysis involved a critical comparison between the “semisteady-state analysis” (“CasaClima” methodology) and the analysis in dynamic conditions (using "Energy Plus" software).