SIMULATION OF POROUS ACOUSTIC MATERIALS APPLIED TO LIGHTWEIGHT PARTITION WALLS

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Abstract: The increased need to save material and energetic resources, allied with a growing concern on the environmental issues and incertitude on the evolution of the economy, and has impelled minimalist-approaches to Architecture and Engineering, reducing to the minimum necessary expression the building elements.

The development of new lightweight materials, most of them composites with fibrous reinforcement systems, has interest for building materials and textile industries. However, these materials still do not have a significant implementation in the building industry or, at least, this implementation is not being made exploring all their potentialities.

Non load bearing interior partition walls are thin elements built to divide the indoor space into rooms or other compartments. Porous materials applied in interior partition walls have a significant importance in these building elements because sound insulation is an important requirement. Walls must provide an airborne sound barrier between rooms in a same dwelling and especially between different dwellings, this last issue as a compulsory requirement to fulfil in Portuguese regulations.

In the present study it will be considered a lightweight interior partition wall composed by insulation material and layered within two membranes. The process of selecting materials for that interior partition wall is a challenging task. This paper intends to compare results of functional (acoustic and thermal) performance of materials such as expandable polystyrene (EPS), polyurethane foam (PU), Ethylene-vinyl acetate (EVA), 3D warp knitted polyester fabrics (3DWK), Cork (CK), Expanded Cork (CKE), Rockwool (RW), coconut fibber (CCF), silicone (SI), waste fiber (WF), to discuss about their potentialities as insulation or membrane materials applied in interior dividing walls technologies. It also presents a morphological characterization of materials, through microscopic analysis, in order to define the relationship between the morphology and acoustic performance.

The results of tests are compared with reference values of rock wool as insulation material - conventionally used in lightweight dividing walls made of plasterboard leaves and light gauge steel framing structure.

One of the results of this paper is that a lightweight and thin interior partition wall filled with insulation material present acoustic advantages when compared with a heavyweight interior partition wall with more thickness.

The concept of membrane goes back to the Latin word “membrana”, meaning parchment or skin. In previous studies it could be verified that low density makes membrane structures poor thermal and acoustic insulators. However, it is available in the market heavily coated or microperforated membranes that have dampening effect

A low density generally also implies a high porosity or a high volume of voids, which leads to a decrease in the thermal conductivity. In previous studies from the same authors, it was concluded that the presence of air gap between insulation materials in a lightweight interior partition can increase the acoustic insulation between 2 to 5 dB, the inclusion of porous materials in

the air gap can contribute between 1 to 4 dB in thicknesses till 10cm. The compromise between thermal and acoustic performance should also be attended. However thermal performance is only a requirement for interior partition walls between useful and non useful areas in housing buildings. In this study it will be presented results for different densities of insulation material.

To establish the above-mentioned goals and scopes, the acoustic and thermal insulation and the mechanical performance of different types of insulation materials were simulated. The simulation tests were conducted according to the European guideline for Technical Approval (EOTA) WG 05.05/01 [8] for Internal Partition Systems for use as non-load bearing walls. In accordance with EOTA WG 05.05/01, the acoustic, thermal and mechanic behavior of test walls was simulated using *6.5* FEM packages [9] were used to predict the mechanical behavior of the impact resistance tests, by finite element analysis. Non-linear analyses were used in the mechanical behavior simulations.

The Impact resistance tests were conducted according Standard ISO 7892: 1998. Partition sample dimensions of 4200 x 2700 x 0.15 mm were used. The test conditions given in part 4.5 of standard ISO 7892 are for Impact from a large soft body. The bag is suspended by its ring to a cable C, passing through a pulley 50 Kg, which is attached to the frame and arranged in Position so that the a angle a between the cable and the vertical, when the bag is at its starting position, is 45º.

In the process of airborne sound transmission between two spaces, should be distinguished: a) direct transmission, that occurs directly through the separation element; or b) marginal transmission - that occurs through other building elements interlocked to the element of separation in study.

The heat transfer coefficient calculation tests were conducted according UNE EN 6946.

The sound insulation estimation between locals was conducted according to EN 12354-1. Procedures for measuring the reverberation of a room, the absorption of the covering layers, as well as the sound absorption coefficients of a specimen of sound absorptive material were made according to ASTM C – 423.

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