Wooden Structures in Acoustic Design and Soundproofing Applications

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Extensive summary in English

This paper deals with the behaviour and capabilities of wooden structures in that branch of building science covering acoustic and soundproofing applications. These applications are evaluated in the crucial areas of standardisation and reliability, in other words production time and appearance, factors that determine the cost, efficiency and functionality of the final manufactured product.

In the field of soundproofing, applications utilising wooden structures are being used less and less due to a decline in industrial standardisation and problems at the final processing stage (finishing, fireproofing). These developments are indicative of the disadvantages of wood products compared to similar applications using metals or composites (plasterboard, mineral fibres).

In theory, wooden structures meet the standard specifications:

- mass (sufficient weight per unit surface area per unit of cross-sectional thickness),

- elasticity (ease of application of spring supports) and

- discontinuity (complete collaboration with cavity insulation).

For doors and windows, comparative evaluation of the various applications should focus on the method of support, on protection around the frame or on the cross-section of the window panes, rather than on the choice of material.

For internal walls, the question of the tried and tested effectiveness of wooden structures is shifted to the related problems of production and standardisation.

For horizontal dividers in particular, problems met in both new buildings and in restoration and repair work, detailed solutions involving wooden floating floors and warm roofs are presented. The soundproofing capabilities of the various applications are examined as functions of cross-sectional weight and thickness, in accordance with sound insulating limits and criteria.

In the field of acoustics, and especially in large and medium-sized acoustically demanding spaces, the use of wood cladding has boomed this century, and has been particularly noticeable in Greece in the last decade.

Concerning echo damping in public or work places, where limited acoustic correction is required, wood cladding applications face the previously mentioned problems and disadvantages compared to alternative materials. In the acoustic design of major projects (theatres, opera houses, conference and concert halls, churches) wood cladding comes into its own again as a result of the experimental and calculated confirmation of the various and variable acoustic properties of wood.

The long-recognised “perfect” acoustic behaviour of wood, by turns reflective, diffusive and absorptive (the experience through the centuries, from the wooden scenery in the ancient theatres to the wooden rood screens in churches) derives from its ability to invert the frequency function of the absorption coefficient, and especially the possibility of peaks appearing in a restricted band of the frequency range. This flexibility gives wooden structures an incomparable acoustic advantage.

Theoretically, the frequency behaviour of the sound absorbing (or sound reflecting) capabilities of wood cladding depend on:

- mass (processing stages-porous, weight-thickness of cross-section, perforation).
- elasticity (means of support, dimensions)
- discontinuity (cavity, cavity insulation)

Regarding the prediction of the acoustic behaviour of a hall, each wood application can be simulated as a composite combination of the thickness of the cladding, the percentage of perforation and the dimensions of the internal wall, as well of as the mechanical properties of the construction. Using these parameters, detailed solutions are presented for sound absorbent internal walls, resonator membranes and cavities.