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JISFA4#3 - Acoustic Absorption in business jets cabin

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The acoustic design of a philharmonic auditorium involves controlling the propagation path between the instruments and the listeners. Today, this control has become a standard practice and is applied more broadly, even extending to the definition of the sound environment in business aircraft. Absorption needs to be strategically distributed based on its cost, mass, size, and effectiveness on specific sources (aerodynamics, systems, passengers, etc.).

Before modeling the distribution of absorption, an assessment is necessary. The perception and measurements of in-situ reverberation times indicate that a cockpit does not have the same properties as a cabin. Thus, a primary analysis objective is to quantify and differentiate this observation. By increasing precision, it is possible to distinguish between different cabin configurations based on the materials used.

To bridge the gap between overall observations and the role of each component, a link must be established between elementary measurements taken with a "Kundt tube" or in an "alpha" chamber, and the effect of bursting balloons in different areas of the aircraft. A testing pyramid must be implemented, taking into account the specificities and constraints of each level. The measurement tools and analysis methods must consider the mechanical properties of material samples with a diameter of 30 mm, as well as the geometry of full-scale prototypes of interior elements or local in-situ measurements.

Once the measurement data is gathered, it is necessary to verify that the calculation tools allow for restitution and extrapolation. Typically, and in coherence with the testing pyramid, there are several levels and types of modeling: synthesis, energy-based propagation methods, "BEm," volumetric finite elements depending on the degree of homogenization, etc.

Once the observations and requirements have been identified, and the foundations of measurement and simulation techniques have been established, the discussion can focus on control, i.e., the design of an optimized interior. This involves considering the localization/application (sound traps, silencers, wall treatments, etc.) and the elements used (meta-)materials and specific features (perforations, gaps, assemblies, elemental mesh architectures, etc.).

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