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Validation of the Formula for Air Attenuation Coefficient for Acoustic Scale Models

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Abstract : Methodology of measurement of sound absorption coefficient in scaled models is based on the ISO 354 standard. The measurement is realised indirectly - the coefficient is calculated from the reverberation time of an empty chamber as well as a chamber with an inserted sample. It is crucial to maintain the atmospheric conditions stable during both measurements. Possible differences may be amended basing on the formulas for atmospheric attenuation coefficient α given in ISO 9613-1. Model studies require scaling particular factors in compliance with specified characteristic numbers. For absorption coefficient measurement, these are for example: frequency range or the value of attenuation coefficient m. Thanks to the possibilities of modern electroacoustic transducers, it is no longer a problem to scale the frequencies which have to be proportionally higher. However, it may be problematic to reduce values of the attenuation coefficient. It is practically obtained by drying the air down to a defined relative humidity. Despite the change of frequency range and relative humidity of the air, ISO 9613-1 standard still allows the calculation of the amendment for little differences of the atmospheric conditions in the chamber during measurements. The paper discusses a number of theoretical analyses and experimental measurements performed in order to obtain consistency between the values of attenuation coefficient calculated from the formulas given in the standard and by measurement. The authors performed measurements of reverberation time in a chamber made in a 1/8 scale in a corresponding frequency range, i.e. 800 Hz - 40 kHz and in different values of the relative air humidity (40% 5%). Based on the measurements, empirical values of attenuation coefficient were calculated and compared with theoretical ones. In general, the values correspond with each other, but for high frequencies and low values of relative air humidity the differences are significant. Those discrepancies may directly influence the values of measured sound absorption coefficient and cause errors. Therefore, the authors made an effort to determine an amendment minimizing described inaccuracy.

Keywords : air absorption correction, attenuation coefficient, dimensional analysis, model study, scaled modelling
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