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Effects of geometry on the sound field in atria

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Abstract

The atria in commercial buildings are widespread. However, the sound environment has not been given sufficient consideration. Geometry affects the acoustics in the atria. The concept of geometry in this paper includes five parameters, namely, length (*l*), height (*h*), aspect ratio of length to width (*l/w*), skylight form and slope, to provide suggestions for the acoustic environment design in atria. A series of computer models are simulated to analyse the effects of the form parameters on the acoustic environment, such as sound pressure level (SPL) and reverberation time (T_{30} in this paper). The results indicate that with an increase in the length or height, the values of the average SPL decrease, and the trends of the curves are logarithmic. For an increasing length, the T_{30} increases first sharply and then slowly. With the scattering increasing, the increment of the T_{30} is smaller. For an increasing height, the changes of T_{30} are determined by the absorption and scattering. In terms of the aspect ratio of *l/w* increasing for a given volume and area, the average SPL values approximately decrease linearly; furthermore, the T_{30} decreases unless the atrium is extremely high. The T_{30} is the longest for a flat skylight compared to that of other forms, and it is shorter when the skylight has a slope, including either a single or a double-pitch skylight. It can decrease nearly by 40% when the angle of the lean-to skylight is 7°. The T_{30} is lower and the amount of decrease is considerably smaller for an increasing slope. When the absorption is evenly distributed in the atria, the skylight has minimal effect on the average SPL or T_{30} values. Additionally, the classical formula can approximately calculate the SPL distribution unless the atrium is in a form of long space. **The Arau-Purchades formula is generally appropriate to predict T_{30} with uneven absorption distributions** unless the absorption or scattering coefficient is low.

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