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Prediction of Sound Transmission Through Framed Façade Systems

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Abstract : With growing population density and further urbanization, the average noise level in cities is increasing. Excessive noise is not only annoying but also leads to a negative impact on human health. To deal with the increasing city noise, environmental regulations bring up higher standards on acoustic comfort in buildings by mitigating the noise transmission from building envelope exterior to interior. Framed window, door and façade systems are the leading choice for modern fenestration construction, which provides demonstrated quality of weathering reliability, environmental efficiency, and installation ease. The overall sound insulation of such systems depends both on glasses and frames, where glass usually covers the majority of the exposed surfaces, thus it is the main source of sound energy transmission. While frames in modern façade systems become slimmer for aesthetic appearance, which contribute to a minimal percentage of exposed surfaces. Nevertheless, frames might provide substantial transmission paths for sound travels through because of much less mass crossing the path, thus becoming more critical in limiting the acoustic performance of the whole system. There are various methodologies and numerical programs that can accurately predict the acoustic performance of either glasses or frames. However, due to the vast variance of size and dimension between frame and glass in the same system, there is no satisfactory theoretical approach or affordable simulation tool in current practice to access the over acoustic performance of a whole façade system. For this reason, laboratory test turns out to be the only reliable source. However, laboratory test is very time consuming and high costly, moreover different lab might provide slightly different test results because of varieties of test chambers, sample mounting, and test operations, which significantly constrains the early phase design of framed façade systems. To address this dilemma, this study provides an effective analytical methodology to predict the acoustic performance of framed façade systems, based on vast amount of acoustic test results on glass, frame and the whole façade system consist of both. Further test results validate the current model is able to accurately predict the overall sound transmission loss of a framed system as long as the acoustic behavior of the frame is available. Though the presented methodology is mainly developed from façade systems with aluminum frames, it can be easily extended to systems with frames of other materials such as steel, PVC or wood.

Keywords : city noise, building facades, sound mitigation, sound transmission loss, framed façade system
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