INSTRUMENTATION CORNER

Laboratory measurement of sound transmission: Improving accuracy at low frequencies

High uncertainties have long been accepted when testing sound transmission of building elements at low frequencies. This is far from ideal in a landscape with abundant low frequency sources like air source heat pumps and ventilation units, noise from aircraft and road traffic, and wind turbines.

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In the laboratories at the University of Salford, Dr Joshua Meggitt, supported by Danny Wong McSweeney and Toby Clarity, have been putting a new in-direct method through its paces that avoids diffuse field assumptions and aims to bring those low frequency uncertainties right down.

Measuring sound transmission of building elements – partitions, doors, windows etc – follows the well-known methods described in ISO 10140. Carried out in laboratory conditions using source and receiving reverberation chambers, the approach relies on the assumption that the measurements in both chambers are carried out in a diffuse field.

By definition, that means we expect that all microphone positions in the incident source room and all microphone positions in the receiving room are measuring the same thing. If they are, we can expect a reliable estimate of incident and radiated sound power, and so an accurate estimate of sound transmission. This is a fair assumption at mid and high frequencies. But at low frequencies the assumption breaks down as modal effects of the rooms start to increase in dominance. Well separated modes lead to large variations in the sound pressure level across the space. This inevitably leads to a high measurement uncertainty at low frequencies – not ideal for modern requirements where low frequency transmission from sources like air source heat pumps can be all important. For this reason, there is great interest in alternative methods, particularly suited to low frequencies, that avoid the uncertainties associated with the diffuse field assumption. Over the past year, our laboratories have been working towards developing a new in-direct method, that avoids the diffuse field assumption and its associated uncertainties. P32

Below: Validation performed in the transmission suite at the University of Salford using a simple dual leaf plasterboard partition with mineral wool infill

Above: Microphones positioned randomly in the receiving room at the University of Salford. Plasterboard partition located in aperture

Inspired by an earlier method involving laser doppler vibrometry[1] the proposed in-direct method leads to a practical measurement routine that can be performed with standard acoustic test equipment. Results demonstrate that the method successfully avoids the effects of room modes, whil providing transmision loss estimates that agree with ISO 10140 in the mid frequency range.

Another important feature of the in-direct method is that the volume velocities obtained are independent of any modal characteristics of the receiving room. In the process of relating the receiver room pressure to the volume velocities, the characteristics of the room (i.e. its modes) are effectively 'removed'. This means the effects of low frequency modes are avoided and the result is a free field transmission loss.

The full theory of the method was presented at the IOA conference in Manchester in September[2] alongside an experimental validation, performed in the transmission suite at the University of Salford by MSc student, Toby Charity and supported by Dr Danny Wong-McSweeney, the lead of the university's Centre for Acoustics of the Built Environment.

The in-direct method has proved itself a practical method that can be readily incorporated into laboratory measurement routines and the University of Salford laboratories are starting to offer this as a measurement solution to clients requiring more from their low frequency sound transmission results, both in terms of accuracy and resolution. This has large implications for the future measurement of low frequency sound transmission in a world of low frequency noise.

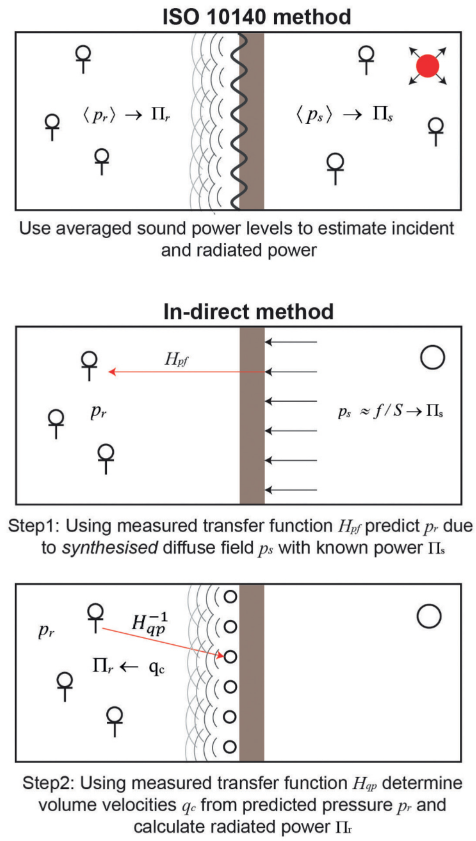

Figure 1 - Summary of in-direct method vs ISO 10140

References

1 N B Roozen, Q Leclere, D Urbán, T M Echenagucia, P Block, M Rychtáriková, and C Glorieux. Assessment of the airborne sound insulation from mobility vibration measurements; a hybrid experimental numerical approach. Journal of Sound and Vibration, 432:680–698, 2018 2

2 J W R Meggitt, T Charity, Acoustics Research Centre, University of Salford, UK. Towards an indirect method for low frequency sound transmission. Proceedings of the Institute of Acoustics, Conference 2024 (Manchester)