CALCULATING FACADE SOUND INSULATION FOR DIFFERENT INCIDENT SPECTRA: A NEW METHOD TO DETERMINE THE OPTIMUM SINGLE NUMBER RATING

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1 ABSTRACT

The requirement for façade sound insulation to control external noise ingress is often based on measured noise levels. For an unspecified external spectrum, there is no unique solution to the problem of specifying the minimum performance requirements, either as an octave band spectrum or a single figure value such as $R_w + C_{tr}$ or $R_w + C$, to achieve an internal A-weighted ambient noise level limit. Any method used to derive a single-figure performance requirement involves uncertainty. There is a risk of under-specifying the requirement, leaving the consultant exposed, or over-specifying, causing unnecessary cost.

This paper describes a new method to determine the lowest single figure performance value for façade elements to achieve the internal noise level limits for the incident spectrum. The single figure values are determined in terms of either $R_w + C_{tr}$, $R_w + C$, $D_{n,e,w} + C_{tr}$ or $D_{n,e,w} + C$ as most appropriate for each element and incident spectrum. This method reduces over-specification of façade element performance and also reduces the risk of under-specification compared with commonly used methods. Glazing is typically the most expensive part of the building per square metre; there can be considerable cost savings by reducing unnecessary performance requirements.

2 UNCERTAINTY IN A SINGLE NUMBER RATING

If the most significant noise source is general road traffic travelling between 30 - 50 kmh and there are no intervening features that may cause a change of frequency content, such as barriers, then the source spectrum is likely to be well represented by the idealised spectrum in BS EN 1793-3[1]. In this case, façade sound insulation calculations can accurately be based on the A-weighted source noise level, and facade sound insulation based on the parameter $R_w + C_{tr}$ described in ISO 717-1[2]. However, if the source noise is not well represented by this reference spectrum, a single figure calculation adds additional and variable uncertainty to the performance requirement.

To include a variety of different incident noise spectra, ISO 717-1 classifies the noise sources to two groups, where the spectrum correction C and C_{tr} can be applied and the sound insulation performance can be described by a single figure values such as $R_w + C_{tr}$ and $R_w + C$. $R_w + C_{tr}$ and $R_w + C$ are used for describing façade sound insulation performance against sources with low and high frequency components respectively.

There are methods in common use that suggest performance requirements in terms of the weighted sound reduction, R_w; these methods add a further level of uncertainty and are not discussed in this paper. Another approach commonly adopted by consultants is to analyse the external noise ingress based on the performance of a sample product, and then to declare the performance of that product to be the element performance requirement. This process of analysis (rather than design) adds further levels of uncertainty and should be avoided.

Studies also show a considerable range in the measured source spectra even for the traffic noise[1,7]. In many cases, the reference spectrum described in BS EN 1793-3 does not well represent these spectra. Using single figure calculations adds additional uncertainty to the analysis. The level of additional uncertainty can be difficult to quantify. A new method to determine the lowest single figure performance value for façade elements achieves the internal noise level limits is described.