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**Sound Reduction Prediction of Double-Leaf Walls in Detached Houses**

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The sound insulation of double-leaf walls is predicted according to the German standard DIN 4109 from the surface mass of the walls. So far in the standard the flanking transmission was treated there global and the actual building situation was not taken into account. This investigation reveals a calculation model for the direct and flanking sound transmission across double wall constructions based on single number values. Hereby the resulting sound insulation is calculated from direct and flanking sound reduction based on the EN 12354-1 model.

The weighted sound reduction index of the double wall construction is evaluated from the surface mass of the walls and the design of the joint. The weighted direct sound reduction index is determined from the surface mass of an equally weighted single masonry wall. The weighted direct sound reduction index of the double wall construction with a joint of 40 mm thickness is obtained by adding 12 dB. The influence on the sound reduction due to a differing thickness d is counted for the term 10 log (d/40mm).

The two decoupled double walls are often connected by the ground plate in the ground floor due to economic and structurally engineered necessities. These connections appear often when detached houses were built without basement and the common foundation or a continuous base floor plate will reduce the sound insulation of the double wall construction. In this case the resulting sound insulation is calculated from the direct sound reduction index of the separating double wall and the flanking sound reduction on the correspondent flanking paths. The flanking sound reduction index of one path is then determined from the direct sound insulation of a single wall and/or the base plate and the vibration reduction index at the junction. The vibration reduction index of a double wall on a continuous base plate (double T-junction) is in this case calculated as a cross junction according to Annex E of EN12354-1.

The flanking sound transmission from any adjacent solid construction element in the sending room to the separating wall and from the separating wall in the receiving room to any adjacent solid element is considered by two additional terms. These terms are calculated from the difference between direct sound reduction of the single separating wall and the calculated resulting sound reduction.

The flanking sound reduction index $R_{ij}$ of lightweight building elements (e.g. lightweight ceiling) is calculated from the flanking normalized level difference $D_{n,f}$ obtained by laboratory measurements. The total sound reduction between the rooms is then calculated by summing up the direct and the flanking transmission.

With these specifications of the prediction procedure for sound reduction of detached houses with solid double walls the direct sound transmission and the flanking sound transmission of the majority of construction settings the sound reduction index can be predicted with an acceptable accuracy. The direct sound reduction can either be measured in the laboratory or predicted.