Double walls with complete and incomplete separation

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Introduction

Double walls with incomplete separation in the ground floor have been investigated according to the sound reduction index R und the junction level difference $D_{v,ij}$.

ΔR_w-additional, dependent on the quality of the separation/linkage

The sound reduction index R between two row houses with incomplete separation is shown in Figure 1.

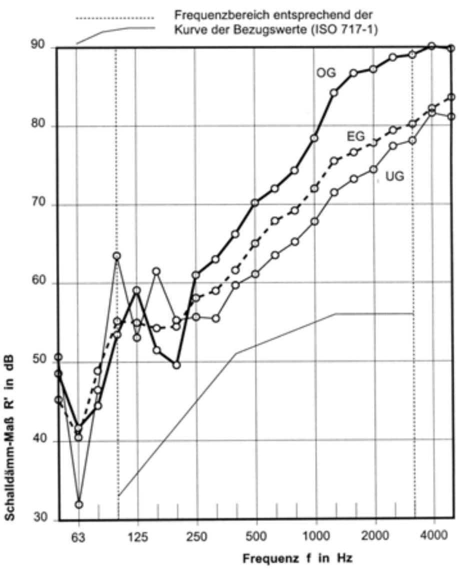

Figure 1: Sound reduction index R between two row houses with incomplete separation

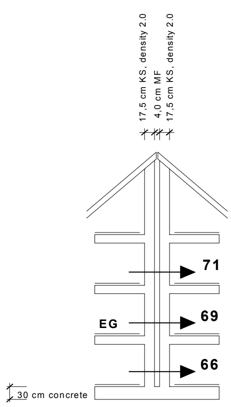

Figure 2: Weighted sound reduction index R'_w between the row houses according to Figure 1

The base-plate was made of 30 cm concrete. Up from below, 2/3 of the cellar walls had contact to the ground (resp. to XPS). The upper 1/3 of the cellar walls were off the ground and were separated by the fugue between the row houses.

In the ground floor (UG) a weighted sound reduction index R'_w = 66 dB was measured. In the upper floors, the sound reduction increases to R'_w = 69 dB (EG) resp. R'_w = 71 dB (OG), (Figure 2). Chr. Halbe has reported similar results [1]. The decrease of the sound reduction curves due to the incomplete separation occurs in the frequency range $f \geq 250$ Hz. Here the transmission of the junction dominates. The junction level difference $D_{v,Dd}$ shows in a corresponding way an additional transmission of the junction in the frequency range $f \geq 250$ Hz (not shown).

One can distinguish between different qualities of separation/linkage:

complete separation	upper floor (OG)
slight linkage	floor provided with a cellar (unterkellertes EG)
medium linkage	ground floor with unseparated flanking base-plate and/or wall in contact to ground (UG)
strong linkage	low-mass linkage/Schallbrücke

An ΔR_w-additional dependent on the quality of the separation/linkage of the double wall is proposed in Figure3.

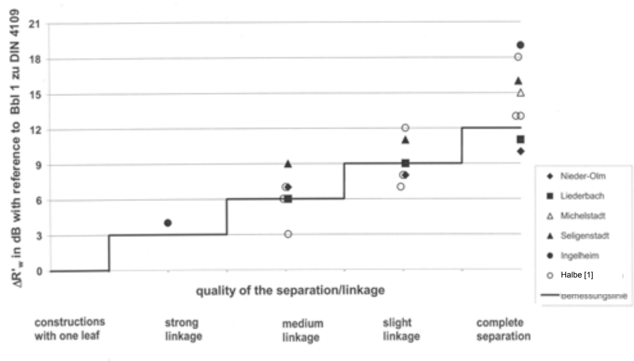

Figure 3: ΔR_w-additional, dependent on the quality of the separation/linkage (mass of the double walls under investigation ≥ 2 x 230 kg/m²). $\Delta R'_w = R'_{w,mess} - R'_{w,R\_DIN4109}$ without the additional of +12 dB for double walls. The suggested 3-dB-steps have to be confirmed with additional experimental data.

The mass-dependence on the weighted sound reduction index R'_w is placed together in Figure 4 with respect to different qualities of separation. No measurement results of double walls with masses lower than 2 x 230 kg/m² are in our hands. Most of the measured double walls had masses of

> 2 x 300 kg/m². Therefore, no statements can be made for the sound reduction behaviour of lighter double walls with incomplete separation.

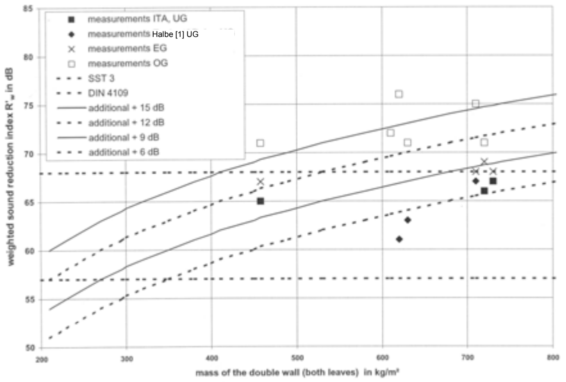

Figure 4: Mass-dependence on the weighted sound reduction index R'_w for different qualities of separation

Calculation following DIN EN 12354-1

As a first approximation we suggest to treat the junction "double wall with unseparated base-plate" as a generalized cross junction with ground contact (Figure 5).

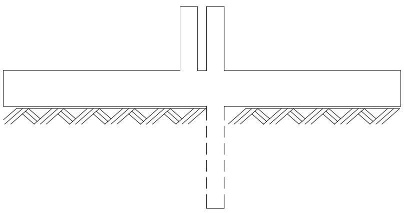

Figure 5: Generalized cross junction with ground contact

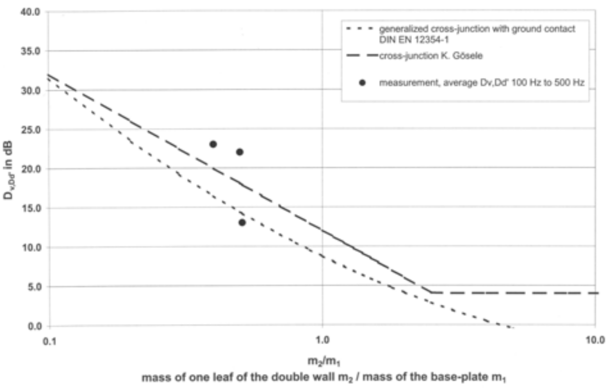

Figure 6: Generalized cross-junction with ground contact of base-plate with respect to the in situ structure-borne reverberation time:

$$D_{v,Dd'} = 8.7 + 17.1 \cdot \lg \frac{m_1}{m_2} + 5.7 \cdot \left(\lg \frac{m_1}{m_2} \right)^2 \text{ dB} \qquad (2)$$

With respect to the structure-borne reverberation times T_s of the double wall, one can find for the junction Dd' (' marks the ground contact of the base-plate) approximately

$$D_{v,Dd'} = K_{Dd'} \qquad (1)$$

Following DIN EN 12354-1 the mass-dependence of the junction level difference $D_{v,Dd'}$ for the generalized cross-junction is calculated in Figure 6. The sound reduction index of each path ij can be calculated by

$$R_{ij} = \frac{R_{i,situ}}{2} + \frac{R_{j,situ}}{2} + \overline{D}_{v,ij,situ} + 10 \lg \frac{S_{Dd}}{\sqrt{S_j S_j}} \qquad (3)$$

Treating all junctions paths as generalized cross-junctions, one can calculate the resulting sound reduction index [2], Figure 7. It must be emphasised again, that for lighter double walls no experimental data is in our hands. Such constructions have to be investigated to prove the calculation model.

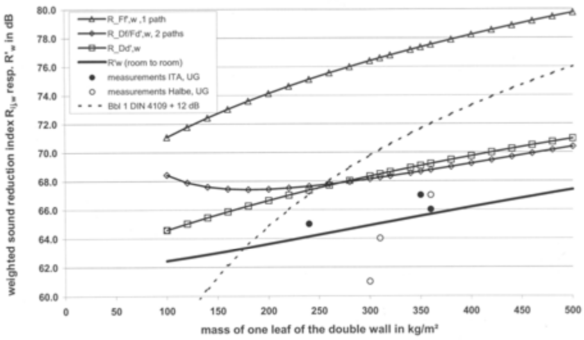

Figure 7: Calculation model: Resulting weighted sound reduction index R'_w for a double wall with variable mass m' using generalized cross-junctions to treat the incomplete separation. Flanking element: 25 cm concrete. This calculation model has to be approved by experimental data, especially for double walls with m'< 300 kg/m².

Outlook

Other groups are working in this field of research. The measurement data showed be gathered. The work can result in a suggestion fo an ΔR_w-additional for the new DIN 4109. Therefore, the "steps" in Figure 3 give a first hint.

To improve the sound reduction, additiv components as an elastic layer or a mass-step layer (using elements of thermal isolation) are at the moment under investigation [2].

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References

[1] Chr. Halbe: "Reihenhaustrennwände, welche Schalldämmung ist möglich?", DAGA 2003, 140-141

[2] J. Maack, E. Sälzer: "Schallschutz zwischen Reihenhäusern mit unvollständiger Trennung", Abschlussbericht, gefördert durch das Bundesamt für Bauwesen und Raumordnung BBR Z 6 – 5.4-02.19, completion date Summer 2004