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Flanking transmission of metal stud walls with different junction details

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ABSTRACT

Measurements of the normalised flanking sound level difference of different gypsum board flanking walls are reported. Results of a "standard" wall construction confirmed some results of the current draft standard of DIN 4109. Different constructions with various junction details and different wall constructions are described and measurement results are presented. By additional measurements on the walls, a prediction model for the weighted flanking level difference is suggested, based on the methodology of EN 12354. For the flanking transmission prediction of path Ff, three transmission paths are proposed. The model gives good agreement between calculated and measured weighted flanking level difference except for the case where the transmission along the inner lining of the flanking wall is dominant. In this case the prediction underestimates measurements by up to 7 dB.

1. Introduction

The flanking transmission of metal stud walls has been a topic of the Cost Action 0702 [1]. Two methods to gain the normalised flanking level difference $D_{n,f}$ were discussed: the direct measurement of $D_{n,f}$ or $L_{n,f}$ according to ISO 10848 [2], or alternatively the "hybrid approach", estimating $D_{n,f}$ from a combination of measured and calculated data. The calculation method is based on EN 12354-1 [3], including a renewed definition of $K_{i,j}$. The direct measurement of $D_{n,f}$ in an appropriate laboratory leads to useful data for prediction purposes. Nevertheless, it is not possible to measure all different constructions on the market. In the recent past, dry wall companies have developed a number of different plate materials. Additionally, walls can be equipped with multiple layers of plates, and different construction details of the junction between flanking and separating walls are used. Therefore, the number of combinations is high so that it seems not feasible to measure all possible combinations. Instead, the hybrid approach is suggested, where with the knowledge of some measured data the flanking transmission is calculated.

In the draft of the new German DIN 4109 [4], similarly to the current edition of DIN 4109 [5], the flanking transmission is handled by a building catalogue, in which measured data of the normalised flanking level difference $D_{n,f}$ are given. The assumption is made, that the transmission Ff across the flanking element dominates the flanking transmission. Therefore, the paths Fd and Df are neglected. In a recent research project, supported by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development BBSR and the Knauf Gips KG, measurements on different metal stud wall constructions have been conducted. The main goal was to verify earlier measurements and the data given in the current draft of DIN 4109. Additionally, data for other constructions, besides the currently available data, was to be provided. Further, a calculation model for the weighted normalised flanking sound reduction $D_{n,f,w}$ was developed within the project.

2. Laboratory measurements

The measurements were conducted in the diagonal transmission suite of the Fraunhofer IBP in Stuttgart. A horizontal sketch of the laboratory is shown in Fig. 1.

The flanking wall, together with the separating walls between Room 1 and 4 (denoted "wall 1/4") and between room 2 and 3 ("wall 2/3") separate the transmission suite into four rooms. The flanking sound level difference is measured between Room 1 and 4. The wall 1/4 has a high direct sound insulation, as it is additionally equipped with acoustical linings on both sides of the wall. The construction of the wall 1/4 is shown in Fig. 2.

The measured sound transmission between room 1 and 4 is entirely due to the flanking transmission across the flanking wall. This was confirmed by vibration measurements on the flanking and separating wall 1/4.

Near the junction of the flanking wall and separating wall 1/4, the linings were reduced in distance to the separating wall, so that a common junction detail of flanking and separating wall was

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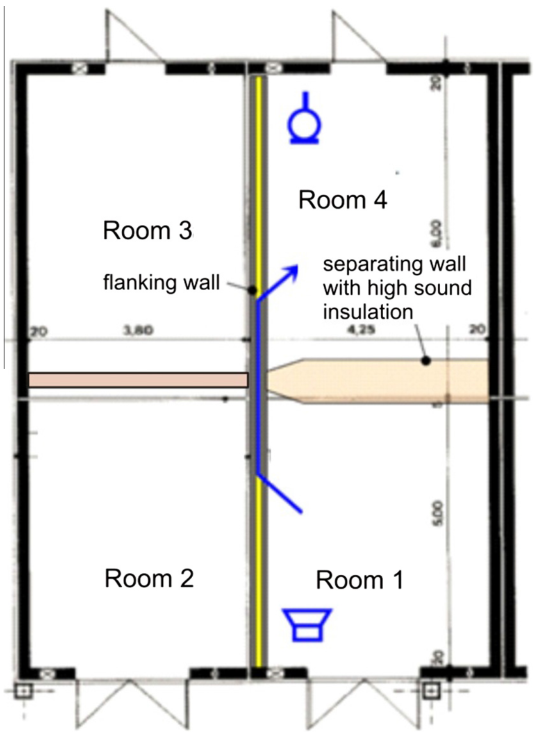

Fig. 1. Horizontal sketch of the diagonal transmission suite of the IBP.

constructed. At this reduction piece, the lining material was altered to a higher sound insulating material and the sheet number was increased to three sheets (two sheets of "Knauf Silentboard" + one gipsumboard with a laminated lead layer). The separating wall 1/4 itself was rigidly connected to the flanking wall. For this connection, the end metal stud was screwed to the flanking wall, and the cladding was screwed to the metal stud. Finally the edges were filled by gypsum wall filler. This connection was built according to the instructions for metal stud gypsum walls published by the Knauf Gips KG.

All surrounding elements of the transmission suite are of heavy weight reinforced concrete. Between the four rooms, the transmission suite building elements are elastically separated by an elastically filled joint gap. Therefore, flanking transmission across the concrete building elements can also be neglected. All four rooms possess a Volume between 60 and 70 m^3.

The separating wall 2/3 was installed to properly measure additionally the diagonal transmission from room 1 to room 3 (or from room 2 to room 4). Nevertheless, the way how the separating wall 2/3 was attached to the flanking wall was altered. The first variant was a loose connection without mechanical contact to the flanking wall and a small gap of approximately 3 mm between both walls. It was built by placing the metal stud so that the open end of the stud was facing towards the flanking wall. The inner part of the stud was filled with absorbing mineral wool. The stud was placed with a distance of 3 mm to the flanking wall and the cladding of wall 2/3 was screwed to the metal stud, leaving again the gap of 3 mm to the flanking wall. This gap was closed by thin tape, to gain airtightness of the junction. This variant of the junction was denoted "T-junction" and is shown in Fig. 2.

The second variant is a "rigid" connection of the separating wall 2/3 to the flanking wall. The end metal stud was fixed to the flanking wall, and the cladding was screwed to the metal stud. Then the edges were filled by gypsum filler, similar to the separating wall 1/4 and according to the instructions of Knauf Gips KG. This variant of the junction was denoted "X-junction" (shown in Fig. 3).

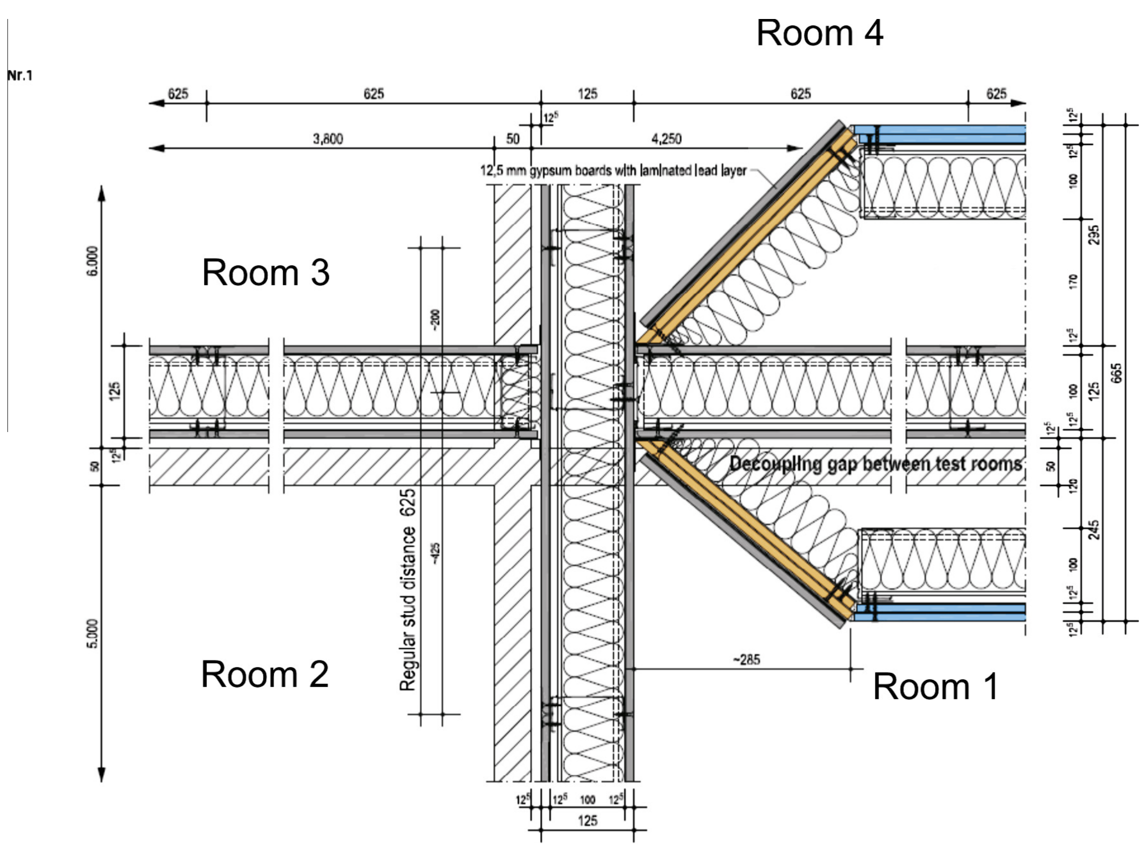

Fig. 2. Horizontal sketch of the junction detail and the separating wall 1/4 with linings (between Room 1 and 4). The separating wall 2/3 on the left side of the flanking wall is attached with a gap of 5 mm and sealed with tape ("T-junction").