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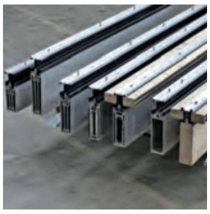
ift RESEARCH REPORT
Short Report
March 2017

Developing a component catalogue for determining airborne sound insulation as well as flanking sound insulation of curtain walling



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Short Report

Topic	**Developing a component catalogue for determining airborne sound insulation as well as flanking sound insulation of curtain walling**
Short title	Component catalogue, sound insulation, curtain walling
Sponsored by	Research initiative Zukunft Bau of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (File number: SWD-10.08.18.7-14.26)
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The authors are responsible for the contents of this report.

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1 Motivation and Project Goal

Specifications for airborne and flanking sound insulation are required for planning the building acoustics of buildings. For the building component group "curtain walling", such specifications can be verified at present only on the basis of laboratory measurements or from quality inspections made on the construction (from a so-called standard control). At present, there is no option for planning and verification with the help of a tabular procedure, in contrast to windows.

The aim of this project was to compile a component catalogue for the airborne and flanking sound insulation of curtain walling. In the first step, existing measurements of airborne and flanking sound insulation of curtain walling were analysed for this purpose. In the second step, specific measurements of sample facades were made for complementing the analyses.

By developing a component catalogue for curtain walling, it becomes possible to verify specifications for airborne and flanking sound insulation for standard facade details without measurements. As a result, the cost and effort of verification reduces considerably, since this affects both the costs and the time required for execution. In addition, the certainty of planning gets enhanced by a well-founded basis of data.

While developing a component catalogue for planning the airborne and flanking sound insulation of curtain walling, the following influences, among others, need to be taken into consideration.

- Sound transmission path (transmission and flanking sound insulation horizontally from room to room and vertically from floor to floor)
- Construction of the facades (e.g. mullion-transom facade, element facade)
- Frame material (metal, wood and combinations thereof)
- Division as well as sizes of the fillings
- Type of the fillings (insulated glass, opaque infill panels etc.)
- Construction details, e.g. grid, dimensions of the profile
- Connection details

Especially for flanking sound insulation

- Connection details at the separating building component (wall / ceiling)
- Design of facade details in the connection area
- Common edge length

The collection of building components has been compiled with the aim of integrating tabular data in the component catalogue of DIN 4109 and in the product standard for curtain walling.

2 Procedure

In order to achieve the goal of the project, both existing measurements have been analysed as well as other measurements have been made, since it is not expected that a sufficiently comprehensive collection of building components can be compiled only by statistical analysis of the existing data alone.

MS Excel-based data collections have been prepared for the analysis of the airborne and also the flanking sound insulation. In the first step, an analysis was conducted in the measured data archive of ift Rosenheim, and the table created from this was supplemented with external measurement data. Based on the collection of data, an initial proposal for a component catalogue could be developed. Based on the "gaps" determined, the superstructures were specified, which were still measured in the course of the project.

It was established in the course of the analysis that for the area of airborne sound insulation, adequate existing measurements were available. For the area of flanking sound insulation (both horizontal and vertical sound transmission), however, additional experimental analyses were necessary. The measurements were made on appropriate test specimens of mullion-transom facades made from the frame materials wood-metal, aluminium as well as steel and also on element facades made from aluminium.

By coordinating the test specimen planning of the mullion-transom facades with the project partners, it was possible to use the same transparent infill panels (insulated glazing) in all facades. By doing this, any potential impact caused by different glazing could be avoided.

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3 Results

The proposal for a component catalogue was compiled on the basis of the analyses and examinations. The basis for the fundamental design of the proposed component catalogue is the master document according to DIN 4109-31. A proposal was developed for the following areas:

1. Airborne sound insulation of curtain walling
2. Horizontal flanking sound insulation of window sections
3. Horizontal flanking sound insulation of curtain walling
4. Vertical flanking sound insulation of curtain walling

In the course of this brief report, the proposal developed for vertical flanking sound insulation of curtain walling is illustrated by way of an example. You may refer to the complete final report for the proposals on the other subject areas mentioned above.

While analysing the data on flanking sound insulation, it was established that the sound insulation of the profiles used is a significant criterion for the assessment of the flanking sound insulation, especially with horizontal sound transmission. This is why a measurement method was specified for determining the profile sound insulation in the course of the project. This is used as an option for comparison and assessment in order to be able to assess the impact of variants of the profile geometry, material changes or even measures for improvement on complete building components.

3.1 Vertical flanking sound insulation of curtain walling

The following sections contain a text proposal for a component catalogue. The analyses according to Chapter 6 of this final report form the basis for this purpose.

3.1.1 The parameters affecting sound insulation

The vertical flanking sound insulation of curtain walling is affected primarily by several parameters, which are listed below:

- Vertical and horizontal profiles
- Formation of the ceiling connection
- Separation and storage of the profile for mullion-transom facades
- Location of the element joint in element facades
- Type, material and cross-section of the profiles
- Profiles and cavities running beyond the T-joint
- Location of the (glass) filling on the room side

In particular, profiles and/or cavities running through can impair the flanking sound insulation of curtain walling significantly, provided that they are not sealed off near the connection of the separating floor.

3.1.2 Notes for design and execution

The parameters specified in the following tables are related to a common edge length of l0 = 4.5 m at the connection of the separating floor junction. For different common edge lengths, this must be taken into consideration by calculation according to equation 1:

Equation 1
$$D_{n,f,w} = D_{n,f,l_0,w} - 10 \cdot \lg \frac{l}{l_0} \text{ dB}$$

Cavities running through the profiles and even in the connection must be sealed off near the wall connection in order to prevent sound transmission along these cavities. The outer facade of double skin facades can be ignored for the design of flanking sound insulation and sound transmission takes place through the inner facade construction. Connections to the floor covers and/or to suspended ceilings have not been taken into consideration in the tables.

3.1.3 Data for computational verification

Table 1 below describes the vertical flanking sound insulation of curtain walling in mullion-transom constructions. Table 2 describes the vertical flanking sound insulation of curtain walling in element constructions. The constructions differ in the area of the separating floor junction such that they can be described independently.

Table 1 Flanking sound insulation of mullion-transom facades, vertical sound transmission, related to l_0 = 4.5 m

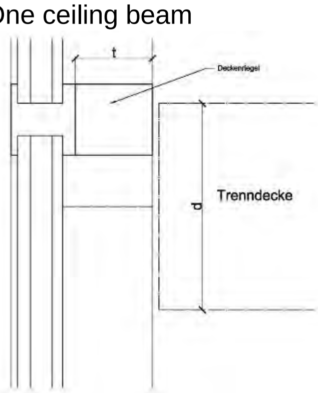
Separating floor junction	Mullion profile	Profile depth t in mm	Ceiling height in mm	Frame material	$D_{n,f,l0,w}$ $(C;C_{tr})$ in dB
One ceiling beam 	Continuous	≤ 125	No specification	Aluminium hollow profile, profile width ≥ 50 mm	32 (-2;-3)
		≤ 80		Steel hollow profile	40 (-2;-3)
	Separated with spigot	≤ 160	No specification	Aluminium hollow profile, profile width ≥ 50 mm	33 (-3;-4)
		≤ 80		Steel hollow profile	42 (-2;-4)
	Separated with spigot, profile Chamber closed with partition	≤ 160	No Specification	Aluminium hollow profile, Profile width ≥ 50 mm	39 (-2;-5)

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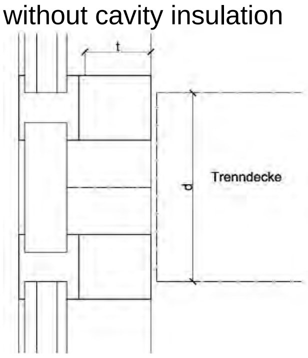
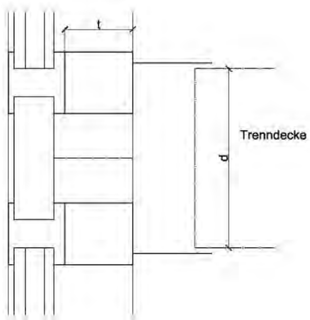
Table 1 Flanking sound insulation of mullion-transom facades, vertical sound transmission, related to l_0 = 4.5 m

Separating floor junction	Mullion profile	Profile depth t in mm	Ceiling height in mm	Frame material	$D_{n,f,l0,w}$ ($C;C_{tr}$) in dB
Two ceiling beams, without cavity insulation 	Continuous	≤ 140	≥ 180	Wood profile, profile width ≥ 80 mm	48 (-2;-4)
	Separated with spigot	≤ 160	≥ 200	Aluminium hollow profile, profile width ≥ 50 mm	36 (-1;-3)
	Separated, dowelled	≤ 140	≥ 180	Wood profile, profile width ≥ 80 mm	50 (-2;-4)
	Separated with spigot, profile chamber closed with partition	≤ 160	≥ 280	Aluminium hollow profile, profile width ≥ 50 mm	47 (-5;-7)
Two ceiling beams, cavity insulated with mineral wool, connecting plate 2 mm steel sheet above and below 	Continuous	≤ 125	≥ 200	Aluminium hollow profile, profile width ≥ 50 mm	39 (-2;-3)
			≥ 400		45 (-3;-5)
		≤ 140	≥ 180	Wood profile, profile width ≥ 80 mm	48 (-1;-5)
	Separated with spigot	≤ 160	≥ 280	Aluminium hollow profile, profile width ≥ 50 mm	41 (-1;-3)
	Separated, dowelled	≤ 140	≥ 180	Wood profile, profile width ≥ 80 mm	54 (-1;-4)
	Separated with spigot, profile chamber closed with partition	≤ 100	≥ 140	Aluminium hollow profile, profile width ≥ 50 mm	49 (-1;-4)
		≤ 125	≥ 400		48 (-2;-4)
		≤ 160	≥ 280		48 (-4;-6)

The following boundary conditions are applicable for applying Table 1:

1.) Minimum sound insulation of the room-side wall of $R_w \geq 31$ dB.
2.) Minimum material thickness for metallic hollow profiles 2 mm
3.) The values are valid for permanently glazed elements and elements with openable sashes with seal on all four sides on the room side.
4.) Window sashes require at least two sealing levels on all four sides.
5.) Installation of the filling with sealing profiles or bonded (structural glazing SG)
6.) Through-running profiles and cavities must be sealed off near the floor connection with a partition.
7.) Connections of floors or suspended ceilings are not considered in the table.

Table 2 Flanking sound insulation of element facades, vertical sound transmission, related to l0 = 4.5 m

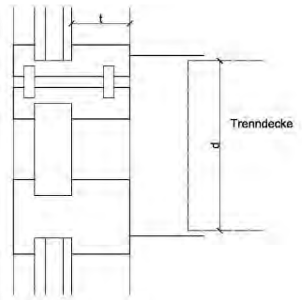
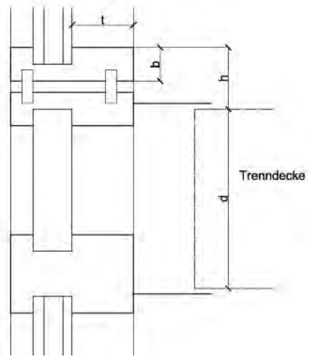
Separating floor junction	Distance h in mm	Profile depth t in mm	Ceiling height in mm	Frame material	$D_{n,f,w}$ ($C;C_{tr}$) in dB
Element joint in the ceiling area, two ceiling beams, cavity insulation, connecting area 2 mm steel sheet above and below	0 (in the ceiling area)	0 (Glazing bead or set of panels flush-mounted inside)	≥ 300	Aluminium hollow profile, profile width b ≥ 50 mm	61 (-2;-7)
		≤ 100	≥ 150	Aluminium hollow profile, profile width b ≥ 100 mm	55 (-1;-6)
Element joint above the ceiling area, two ceiling beams, cavity insulation, connecting area 2 mm steel sheet above and below	≤ 150	≤ 50	≥ 250	Aluminium hollow profile, profile width b ≥ 50 mm	57 (-1;-5)
			≥ 100	Aluminium hollow profile, profile width b ≥ 130 mm	51 (-2;-5)
			≥ 260		56 (-2;-6)
			≥ 190	Aluminium hollow profile, profile width b ≥ 200 mm	49 (-1;-5)
		≤ 100	≥ 150	Aluminium hollow profile, profile width b ≥ 50 mm	54 (-1;-4)
		≤ 150	≥ 150		51 (-1;-3)
		≤ 200			45 (-1;-3)

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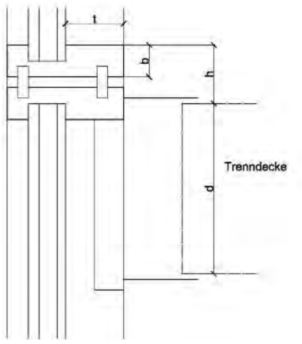
Table 2 Flanking sound insulation of element facades, vertical sound transmission, related to l0 = 4.5 m

Separating floor junction	Distance h in mm	Profile depth t in mm	Ceiling height in mm	Frame material	$D_{n,f,w}$ (C;C_{tr}) in dB
Element joint above the ceiling, one ceiling beam (undercut), cavity insulation, connecting area 2 mm steel sheet above and below 	≤ 150	≤ 90	≥ 200	Aluminium hollow profile, profile width b ≥ 50 mm	50 (-2;-4)
		≤ 180			44 (-2;-4)

The following boundary conditions are valid for applying the table 2:

1.) Minimum sound insulation of the room-side wall of Rw ≥ 31 dB.
2.) Minimum material thickness for metallic hollow profiles 2 mm
3.) The values are valid for permanently glazed elements and elements with openable sashes with seal on all four sides on the room side.
4.) Window sashes require at least two sealing levels on all four sides.
5.) Installation of the filling with sealing profiles or bonded (structural glazing SG)
6.) Through-running profiles and cavities must be sealed off near the floor connection with a partition.
7.) Connections of floors or suspended ceilings are not considered in the table.

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