Short report
(Aktenzeichen: SWD-10.08.18.7-15.23)

Title (long): Noise protection in buildings with interior thermal insulation

Initial Situation

Restoration of buildings is progressively done using interior thermal insulation systems. Contrary to exterior thermal insulation, systems fixed on the inside of a building also have an influence on the flanking sound transmission of the wall. Currently there are no measurement data or tools for their prognosis. Aim of this research project was to deliver such a tool validated by measurement of typical systems.

Object of the research project

Aim of the accomplished investigations was to get a representative overview of the acoustic behaviour of common interior thermal insulation systems. For this purpose of 13 interior thermal insulation systems were measured the sound reduction index and the normalized flanking level difference and compared to the reference values of the same wall configuration without thermal insulation applied. The selection contained all typical systems on the market. Measurement and evaluation was done in third octave band frequencies. Evaluated were the single number values of the weighted sound reduction index and the weighted normalized flanking level difference. Additionally the spectrum adaption term $C_{tr,50\text{-}5000}$ was evaluated to consider lower frequencies.

The acoustic influence of the interior thermal insulation systems on the sound reduction index of the wall configuration was measured from ΔR_w = -6 dB to +5 dB. The influence on the flanking transmission did reach values from $\Delta D_{n,f,w}$ = -11 dB to +7 dB. Using the spectrum adaption terms $C_{50\text{-}5000}$ the influence was reduced to -6 dB to 0 dB for $\Delta(R_w + C_{tr,50\text{-}5000})$ and -10 dB to +2 dB for $\Delta(D_{n,f,w} + C_{tr,50\text{-}5000})$.

Interior insulation systems applied on the outer wall have an influence on the sound insulation between two adjacent rooms of a building. In Germany this is usually calculated according to DIN 4109, by summating the sound propagation of individual propagation paths. If a path includes the sound propagation through the interior thermal insulation, the improvement $\Delta D_{n,f,w}$ is the same as for ΔR_w. For the path Ff the sound propagation is two times passing the interior thermal insulation. In this case the improvement $\Delta D_{n,f,w}$ =1.5 x ΔR_w. Usually this is the propagation path with the largest impact on the total sound reduction between two rooms.

The calculation method for additional wall layers from DIN 4109 and DIN EN ISO 12354-1 is not accurate for bonded interior thermal insulation systems. Because of that, a new calculation method had to be developed. With the new method it is possible to calculate the influence on ΔR_w and $\Delta D_{n,f,w}$ including $C_{tr,50\text{-}5000.}$ It is also possible to calculate the total effect on the sound reduction index between two rooms in a building acc. to. DIN 4109-2 and 4109-32.

The parameters needed for the calculation are the dynamic stiffness which can be determined acc. to. DIN 29051, the area related mass of the covering (e.g.plaster or gypsum board) and the sound reduction index of the base wall. The standard deviation of the calculation method is σ = 1,6 dB for the weighted sound reduction index and σ = 1,8 dB for the weighted normalized flanking level difference. These values are comparable or even slightly better, than the measurement deviation for laboratory measurements.

Conclusion:

The main aims of the research project were to get a representative overview and to generate a calculation method for the prognosis of the acoustic behaviour of common interior thermal insulation systems. The influence of typical insulation systems on the sound reduction and the flanking transmission were determined. Furthermore a calculation method which needs rather simple parameters as input was generated. The accuracy of the calculation method is comparable with the standard deviation of laboratory measurements.

Basic information:

Short title: Noise protection with interior thermal insulation

Researchers / project management: Lutz Weber, Mark Koehler

Total costs: € 159.900,00

Amount of federal subsidy : € 99.900,00

Project duration: 15.07.2015 – 15.10.2016 (verlängert bis 31.05.2017)

Figures:

Figure 1: „02 Kurzbericht Innendämmung Bild 1.bmp“

Sketch of the test setup in the test facility for flanking transmission and the propagation path Ff

Figure 2: „02 Kurzbericht Innendämmung Bild 2.bmp“

Picture of the test setup

Figure 3:„02 Kurzbericht Innendämmung Bild 3.bmp“

Measurement results of the influence of the sound reduction index of the 13 interior insulation systems

Figure 4: „02 Kurzbericht Innendämmung Bild 4.bmp“

Measurement results of the influence of the flanking transmission of the 13 interior insulation systems

Figure 5:„02 Kurzbericht Innendämmung Bild 5.bmp“

Calculation method for the influence of a interior thermal insulation on the sound reduction index of a wall

Figure 6:„02 Kurzbericht Innendämmung Bild 6.bmp“

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