Short Report

(Aktenzeichen: SWD-10.08.18.7-16.38)

Title (long) Noise protection of windows with an exposed installation position

Initial situation

In addition to the structure of the glazing and the frame, heat and sound insulating properties depend to a great extent on the installation conditions (position of the window, fixing and sealing). Prognosis of the sound insulation is possible for the classical method of installation. It is also known that a critical influence on the sound insulation may be expected in the case of exposed installation (fig. 1), but reliable data is not available.

Object of the research project

As part of the research project, the influence of the superior installation position of windows on external walls with thermal insulation composite system (ETICS) on sound insulation was investigated. The objectives of the study were to determine measurement results for different assembly systems and different installation positions in the laboratory (fig. 2) and to compare them with the reference installation, as used in building acoustics tests in the laboratory. For this reason, all measurements were carried out in the window test facility in accordance with DIN EN ISO 10140-1 to 5. In the measuring program, a total of three different mounting systems with four different installation positions and windows with sound insulation classes 2 to 5 were combined. The selection of the windows and systems was carried out together with the industrial partners and an engineering office, which had special experience in the execution of superior window systems.

The selection was intended to cover the widest possible range of customary variants for superior window installation. Expanded polystyrene was used as the insulation material for the ETICS, since this insulation, material is used particularly frequently in residential construction and usually has the lowest sound insulation compared to mineral wool or wood fibreboards. Measurement and evaluation of the results were frequency dependent in thirds from 50 to 5000 Hz. As a measure of the acoustic effect in terms of practical application (mathematical sound insulation according to DIN 4109) Single number values, namely the improvement of the weighted sound reduction index ΔR_w were used. In addition, the spectrum adaption term $C_{tr,50\text{-}5000}$ was also considered for low-frequency noise.

The frequency curves (fig. 3) did all show negative influences of the exposed assembly position at 63 to 100 Hz. In the case of sound insulation classes 4 and 5, there are also drops in the 500 Hz range, especially in the frame systems. These drops were unincisive for the bracket systems. The following key results were determined:

- For Windows with sound insulation classes 2 and 3 the monting position has no great influence (- 1 dB)
- For Windows with sound insulation classes 4 and 5 the mounting position can lead to a significant deterioration of the sound insulation with values up to -3 dB, especially if a uncertified metal frame is used. With mounting frames made of hard foam and especially in console systems, the risk of deterioration is less.
- Considering the spectrum adaption term $C_{tr,50\text{-}5000}$ for low-frequency noise, e.g. Traffic noise, the negative influences are bigger up to -4 dB. Overall, the previously measured differences between the constructions reunite, since the system with the best values in the middle frequency range at class 5 has the largest low-frequency dips.
- Basically, no appreciable influence of the size of the edge joint between window frame and wall opening was found with careful sealing. On the other hand, however, a considerable influence of up to -5 dB has been caused by assembly defects such as e.g. cavities determined as a result of insufficiently reacted assembly foam (fig. 4). It can be assumed that these influences increase with larger joints. Of course, cavities are

to be avoided for hygrothermal reasons. For these reasons, it should always be ensured that all work is carried out according to the system-specific requirements of the manufacturer.

- The possible deteriorations can be taken into account in the case of a computational proof of sound insulation by introducing additional safety factors based on DIN 4109 (fig. 5).

Conclusion:

The main goals were the determination of measurement data of common systems and the construction of a component catalog. It could be stated that the influence of **exposed** installation **positions** is lower in all systems than was feared by the results of preliminary investigations. Especially with the special systems it can be assumed with careful execution that only minimal influences with the sound protection classes 4 and 5 are to be feared. For reasons of simplicity, these can be taken into account with flat deductions of approx. 1-2 dB in the building acoustics frequency range of 100 to 3150 Hz. When using uncertified metal frames and extended frequency range higher discounts must be applied.

Basic information:

short title: exposed windows

Researchers / project management: Lutz Weber, Mark Koehler

Total costs: € 214.894,44

Amount of federal subsidy: € 134.894,44

Project duration: 01.10.2016 – 01.10.2018 (verlängert bis 31.12.2018)

Figures:

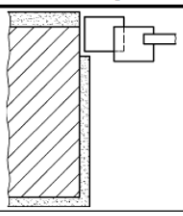
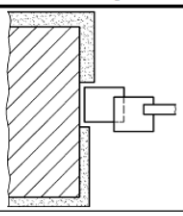
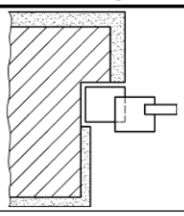
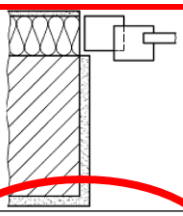
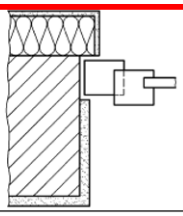
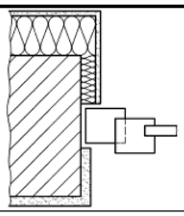
Außenwand	Einbaubeispiel 1	Einbaubeispiel 2	Einbaubeispiel 3
Monolithisches Mauerwerk			
Einbaulage	Einbau außen bündig	Einbau mittig in der Wand	Einbau gegen Anschlag
Einbausituation	schalltechnisch unkritisch	schalltechnisch unkritisch	schalltechnisch unkritisch
Mauerwerk mit WDVS			
Einbaulage	Einbau in Dämmebene	Einbau außen bündig im Mauerwerk	Einbau mittig im Mauerwerk
Einbausituation	schalltechnisch kritisch	schalltechnisch unkritisch	schalltechnisch unkritisch

Figure 1: „02 Kurbericht vorgesetzte Fenster Bild 2.bmp“

Abstract from DIN 4109-2:2016 [2] – Tabelle 5

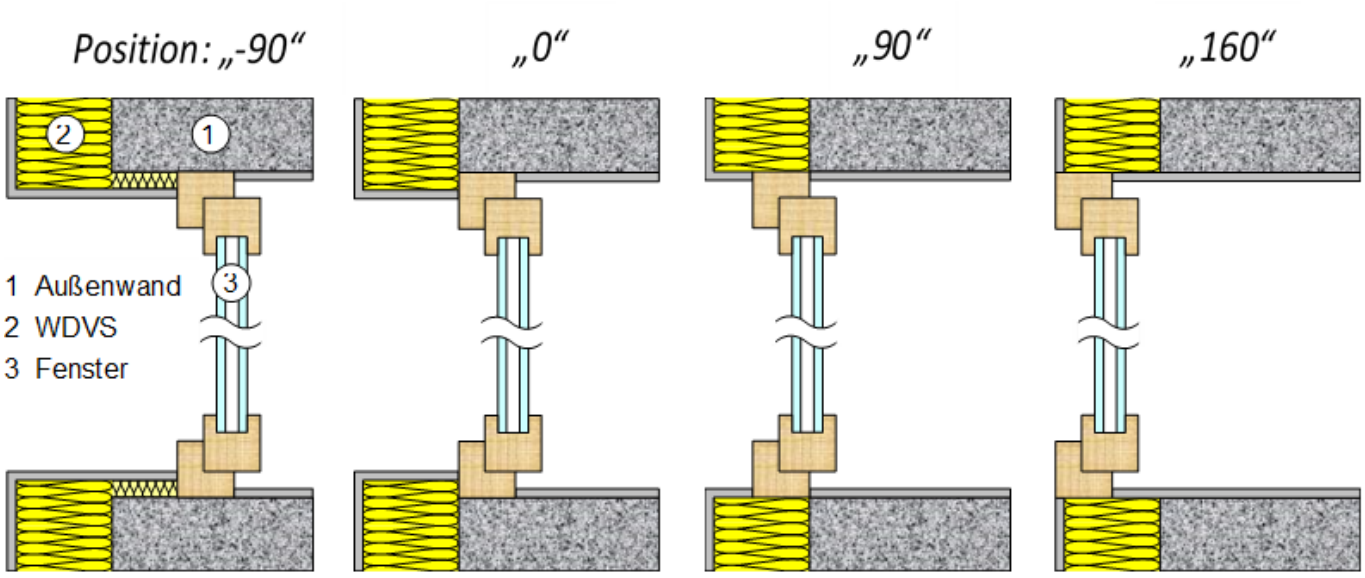


Figure 2: „02 Kurbericht vorgesetzte Fenster Bild 2.bmp“

Window Positions in the wall opening

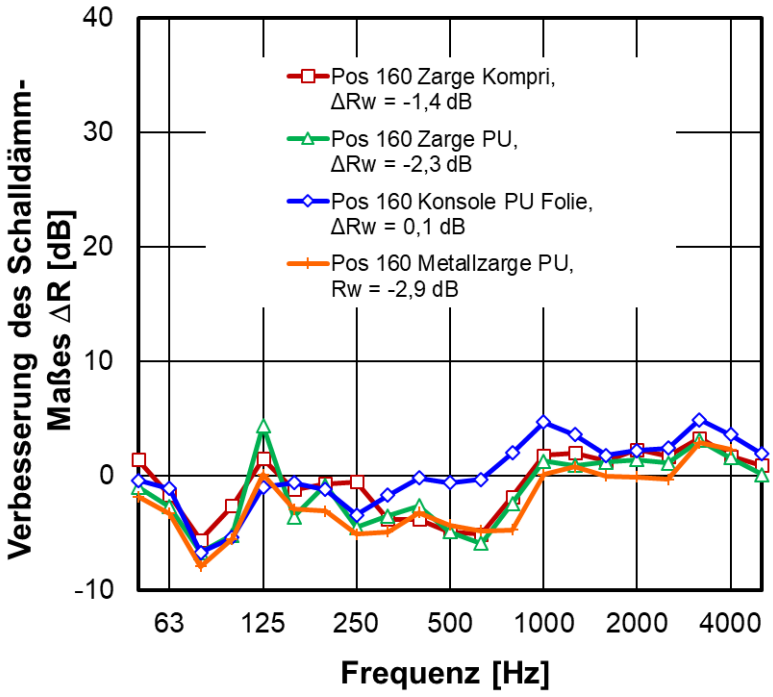


Figure 3: „02 Kurbericht vorgesetzte Fenster Bild 3.bmp“

Comparison of the different systems for sound insulation class 5 in installation position 160 Improvement of sound insulation

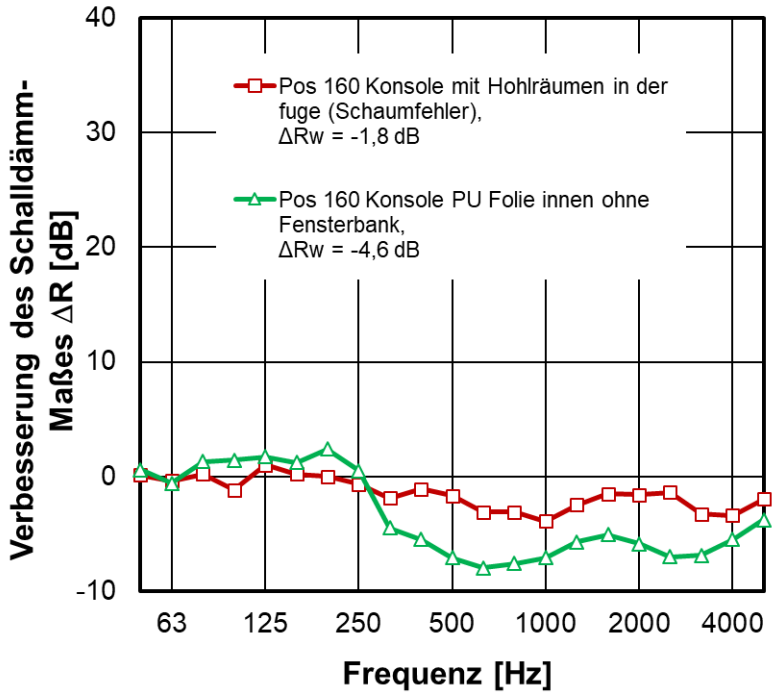


Figure 4: „02 Kurbericht vorgesetzte Fenster Bild 4.bmp“

Improvement of the sound reduction index of the window with SSK 5 for installation position 160 with mounting deficiencies compared to careful, professional installation.

SSK	zusätzlicher Sicherheits-beiwert R_w [dB]	zusätzlicher Sicherheits-beiwert $R_w+C_{tr,50-5000}$ [dB]
2	-1	-1
3	-1	-1
4	-2	-3
5	-2	-4

Figure 5: „02 Kurbericht vorgesetzte Fenster Bild 5.bmp“

Determined safety factors for advanced installation depending on the sound insulation class of the window