Zukunft Bau

Short report

Title

Complete title: "Acoustical effectiveness of facade surfaces or facade structures in relation to acoustical evaluations of receiver positions in urban spaces – Determine the effects of transformation“

Status quo

The current trend of moving from rural areas in metropolitan areas is forcing the densification of existing urban structures. The need for new living and working spaces is increasing the number of facade surfaces in metropolitan areas. The increasing mobility demand and the reflection of its noise on the increasing number of mainly hard reflective facades leads to more and more noise in urban spaces. An overlay of direct traffic noise and reflected traffic noise originating from the facades is responsible for rising noise levels. Despite the fact that in acoustic practice this is a well know effect current measurement procedures, technical rules and sound prediction algorithms are based only on the material aspect. The effect of individual urban settings is not sufficiently implemented in current sound propagation tools. In consequence the facade effect is not integrated in current building design processes because of insufficient data.

Subject of research

The main objective of this research was to determine the acoustical effect of facades in the context of surrounding urban space. For the basic requirement of implementing test facade surfaces in specific urban spaces a mobile facade test rig was developed. With the mobile test rig it was feasible to measure the acoustical effect of test facades in urban spaces. Therefore a measurement and evaluation procedure was developed in order to use the existing sound scape and its characteristic properties as signal input for acoustical measurements. The selection of measurement locations was defined by the noise sources, which are present on site and the necessary requirements regarding the logistics of the mobile test rig. The selection of measurement sites represents the essential urban noise sources as street traffic, railway noise and airborne noise. During the two-month measurement campaign in 2017 five types of test facades were acoustically measured at eight measurement sites. The results are documenting a level reduction by structured facade surfaces of up to 4 dB in 4 m distance to the front face of the test modules. Manifold structured facades are showing only small deviations for the value of level change when the direction of the impact of the noise source changes. A similar level change was reported for street traffic noise as well as for airborne noise. Less structured facades are showing strong deviations for the value of level change when the direction of the impact of the noise source changes. The results and their dependency to the surrounding space were leading to specific results for the test facades at certain measurement sites. Transferring the findings of the measurement results into a building design process leads to the requirement of an individual acoustical documentation of any considered building project. The acoustical situation around an intended building project has to be investigated similar to the mandatory investigation of soil properties for the verification of stability before starting construction. The individuality of each building project leads to a development of specific individual acoustical investigations. With these individual investigation methods it is feasible to determine the characteristic parameters of the surrounding soundscapes and their major components.

Conclusion

The results of the field measurements in the framework of this research proof that an aimed modification of acoustical situations in front of a facades is feasible by structured facade surfaces. Furthermore the results are revealing the potential for designing quieter cities that is currently not applied by architects and engineers. With an aimed implementation of acoustically effective facades in building projects quieter cities are feasible. Therefore a basic understanding of the relation between noise impact and facades has to be trained in continuing education measures conducted by education institutions in all stages. The development of design parameters for acoustically effective facades will be part of future research projects.

Key data

Short title: Determining the acoustical effectiveness of facade surfaces in urban spaces

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Total cost: 125.747,70 € €

Share of federal subsidy: 88.000,00 €

Project term: 24 Months

Pictures:

5 - 7 printable pictures in a single file (*.tif, *.bmp, ...) resolution min. 300 dpi in printsize (width 10 - 20cm). Pictures free from third party rights
Captions for each picture:
Picture 1: Akustische_Fassaden_Krimm_1.tif
Set up of the facade test rig at Lyoner Straße in Frankfurt / Main ©Jochen Krimm

Picture 2: Akustische_Fassaden_Krimm_2.tif
Artificial stone test modules made by Lithodecor® attached to the facade test rig ©Jochen Krimm

Picture 3: Akustische_Fassaden_Krimm_3.tif
The facade test rig, equipped with artifical stone test modules in the area of Lyoner Straße (former known as office city Niederrad) in Frankfurt / Main ©Jochen Krimm

Picture 4: Akustische_Fassaden_Krimm_4.jpg
The artificial stone test modules made by Lithodecor® under measurement in the test rig ©Jochen Krimm

Picture 5: Akustische_Fassaden_Krimm_5.png
Reported level changes for airborne noise and street traffic noise in 4 m distance to the front face of the artificial stone modules ©Jochen Krimm

Picture 6: Akustische_Fassaden_Krimm_6.png
The facade test rig, equipped with metal cassette modules in the area of Lyoner Straße (former known as office city Niederrad) in Frankfurt / Main ©Jochen Krimm

Picture 7: Akustische_Fassaden_Krimm_7.tif
The facade test rig, equipped with thermal composite test modules made by Alsecco® in the area of Stephanstraße in the inner city of Frankfurt / Main ©Jochen Krimm