

Short report to the research project

Building elements and systems for the acoustic design of sports halls

Forschungsinitiative Zukunft Bau des Bundesinstitutes für Bau-, Stadt- und Raumforschung
Aktenzeichen: II 3-F20-12-1-184 / SWD -10.08.18.7 – 13.44 / IBP-412325

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Report B-BA 2/2018
May 15, 2018

Title

Long title: Building elements and systems for the acoustic design of sports halls

Occasion / starting situation

kurze Beschreibung des Problems und des Lösungsansatzes
max. 450 Zeichen (mit Leerzeichen)

In more than 30.000 sports halls teachers and pupils are on a daily basis depending on good teaching and learning environments. For the lessons and education by sports clubs a decent acoustical quality is indispensable. A study of the Fraunhofer Institute IBP has revealed the poor acoustical environment in many sports halls. The discontent of questioned teachers is high and measurements have refined the deficits. Potential for improvement are given with measures at the building and technical equipment.

Matter of the research project

Beschreibung der Arbeitsschritte und des Lösungswegs
max. 4.300 Zeichen (mit Leerzeichen)

The main focus of this research project was to transform the requirements of DIN 18041 on the reverberation time in sports halls to concrete solutions for installed building elements in typical sports halls. Following this, actions for the acoustical properties of the building elements were deduced. With room acoustic simulations, the necessary acoustic properties of building elements for a better acoustic environment in sports halls were derived.

To use different typical building systems for the implementation of better acoustics, sound absorption properties of model constructions were measured in an impedance tube and in a reverberation chamber. The analysis of the measurements on the building elements show the potential of today's used building elements. Additionally the investigation shows, which constructions could be optimised in regards of their acoustic behaviour and how constructional errors can be avoided.

The most important results of the project can be summarised as follows:

- For sports halls with separation capability into three parts, there are different possibilities of design to reach the requirements on reverberation time. The combination of absorbing ceiling and highly absorbing impact protection wall up to a height of 2 m is being favoured. An even distribution of sound absorbing constructions in all room directions is preferred, to reduce the possibility of flutter echo and longer reverberation times.
- For sports halls being separated into three parts by partition curtains, the modelling shows that in any case a sound absorbing partition curtain should be used. It should be combined with a highly absorbing impact protection wall up to a height of 2 m and an absorbing ceiling.

- Regarding smaller sports halls with only one playing field, the simulation shows that a highly sound absorbing impact protection wall up to 4 m height at all walls can provide enough sound absorption to reach the required reverberation time theoretically. This can lead to flutter echo between floor and ceiling. Therefore, the proposed solution can be a highly absorbing impact protection wall up to 2 m height, in combination with a sound absorbing ceiling.
- The best solution for small and all other investigated sports halls is the additional implementation of highly absorbing sports hall gates to adjacent storage areas. These gates can provide low frequency absorption in the gymnasium, which reduces low frequency noise and booming sounds. The combination of different sound absorbing constructions results in a higher variety of possible constructions in the (acoustical) design of the gymnasium, as each construction by itself needs to deliver lower sound absorption coefficients.
- The analysis of the different building systems showed, that today's systems with the right dimensions and systems depth are capable to deliver the necessary sound absorption in sports halls. Additionally it showed that the potential for improvement in the acoustical performance is partly high, therefore the systems could be improved substantially.
- The novelty of measuring the sound absorption of an acoustically relevant equipment door in a practically relevant setup revealed especially at low frequencies high absorption potential, which can work against long reverberation times at low frequencies and booming sounds.
- Investigations on partition curtains of sports halls showed solutions to improve the sound insulation of such installations in situ. Additionally the partition curtains should have absorbing properties. Within the project a proposal was made how modern partition curtains could be constructed to provide both functionalities.

With this research project the planning of sports halls can be improved substantially. Important is to spread this knowledge. Consequently, a guideline will be worked out to distribute the main findings in compact form. By informing the stake holders, the topic of acoustics in sports halls will be given an increased attention. This should lead to the implementation of acoustically effective and efficient constructions to improve the room acoustic situation for teachers and pupils in sports halls.

Conclusion

Beschreibung der geplanten Ziele und der erreichten Ergebnisse
max. 700 Zeichen (mit Leerzeichen)

The goals of the project, to translate the requirements of DIN 18041 for the reverberation time in sports halls into requirements for the surface constructions of widely used sports hall types were fully reached. Additionally, investigations of such constructions and on improvements measures were conducted. Following, suggestions were proposed to stimulate not least the partner companies to optimise their products in terms of their acoustic impact in sports halls. With the final report and a guideline the stake holders should be informed about the acoustical design of sports halls.

Project data

Short title: acoustic design of sports halls
 Researcher / Project leader: Prof. Dr.-Ing. Philip Leistner
 Total costs: 185.001,92 €
 Federal subsidy: 110.001,92 €
 Project duration: 18 Monate

Figures

5 - 7 Druckbare Bilddaten als **eigene Datei** (*.tif, *.bmp, ...) mit der Auflösung von mind. 300 dpi in der Abbildungsgröße (z.B. Breite 10 - 20cm). Bilder frei von Rechten Dritter. Bildnachweis jeweils:

Figure 1: Dateiname: BBSR_SWD -10.08.18.7-16.08_Bild1_E.tif

Bildunterschrift: Modelled sports hall with sound absorbing impact protection wall on the inside of the hall (Source: Fraunhofer IBP).

Figure 2: Dateiname: BBSR_SWD -10.08.18.7-16.08_Bild2_E.tif

Bildunterschrift: Modelled sports hall separated by two partition curtains. (Source: Fraunhofer IBP)

Figure 3: Dateiname: BBSR_SWD -10.08.18.7-16.08_Bild3_E.tif

Bildunterschrift: Modelled small sports hall with gates to adjacent storage areas. (Source: Fraunhofer IBP)

Figure 4: Dateiname: BBSR_SWD -10.08.18.7-16.08_Bild4_E.tif

Bildunterschrift: Sketch of a sports hall gate between a semi-anechoic chamber and a reverberation chamber for measurement of the sound absorption (Source: Fraunhofer IBP)

Figure 5: Dateiname: BBSR_SWD -10.08.18.7-16.08_Bild5.tif

Bildunterschrift: Sketch of a partition curtain in a sports hall with arrows showing possible flanking transmission paths. (Source: Fraunhofer IBP)