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A NEW MUSIC SCHOOL IN AN EXISTING BUILDING - INCREASED SOUND INSULATION SOLUTIONS

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1. INTRODUCTION

In a countryside city of Hungary, the local authority has decided to develop the music education possibilities. For that purpose, the most important thing was to find a comfortable building for the music school. To build a new one would have been very expensive therefore they decided to rebuild an existing building, which had been used as the house of youth (pioneers).

The building with a ground floor and 2 floors is near a main road and railway and it had been executed with prefabricated concrete elements of Russian method and it had a rather poor sound insulation.

During the design of the reconstruction, the first step was to decide the possibilities how to increase the necessary airborn- and impact sound insulation.

2. SOUND INSULATION REQUIREMENTS

In the Hungarian standard MSZ 04.601-3 there are requirements for a traditional school building only and not for that of music purposes. To decide the airborn sound insulation values, which are needed between music teaching and rehearsal rooms, we have used two starting data.

A/ The expected sound pressure levels (A-weighted) in the rooms are the following: string instruments and piano 85 - 90 dBA,
brass instruments 90 - 95 dBA,
percussions 95 -100 dBA.

B/ The background noise requirement in the school rooms is L_{Aeq} = 40 dB but the 35 dB value is preferred.

According to these, at the walls and ceilings between two music rooms the preferred average airborn sound insulation value is R'_w = 60 dB and at the ceilings the average impact sound insulation value is $L'_{n,w}$ = max. 55 dB.

Between the music rooms and corridors, the recommended values are for the walls of R'_w = 45 - 50 dB and for the doors of R'_w = 30 dB.

It is important not to set a piano or violine practice room beside the noisy rooms (brass instruments, percussions).

According to the Hungarian standard of MSZ 04.601-5, the average airborn sound insulation value of the facade construction of the buildings should be minimum +5 dB higher than the difference between the outside noise effect (L_{Aeq}) exciting the facade surfaces and the background noise requirement.

Room acoustic conditions

During the design of the reconstruction there were a lot of consultations with the director and the teachers of the music school. We accepted their remarks to keep the music rooms reverberant, therefore no absorbing surfaces were designed in the rooms except for the rooms of the brass instruments and those of the percussions.

3. ENVIRONMENTAL NOISE EFFECTS

Due to the busy main road and railway traffic, the existing outdoor noise at the front of the building facade is L_{Aeq} = 64 dB with a peak value of 78 dB.

Before reconstrucion, the background noise in the rooms with closed windows was L_{Aeq} = 46 dB with a peak value of 54 dB, which are very high and disturbing.

4. THE ACTUAL SOUND INSULATION SOLUTIONS

Airborn Sound Insulation

Between the new music rooms there are four different wall-constructions (signed a - d). We had to keep in mind the existing brick-walls (6 cm thick, 120 kg/m^2) and the concrete pillars (with 6 m distances and 35 cm behind the facade). The details and the results are shown on Figure 1 - 4.

Due to the continuous metal-window constructions on the facades, the thickness of the joining wall construction was limited in 7 cm in the 35 cm tracks. The original facade and window construction had to be kept. To increase the noise protection of the facade and that of the dividing walls a second window construction was designed with 35 cm distance from the facade. At the walls under the windows, there is only the 7 cm construction which reduces the average insulation of the walls. Fortunately, later cupboards were installed and this solution reasonable increased the insulation.

Under the reinforced-concrete ceiling (19 cm thick, hollowed), a light-wall construction wascarried out with C50 metal frame, 5 cm glasswool sheets and two sheets of gypsum board. In the music rooms carpet floors were built in. The sound insulation results are shown in Figure 5.

Between the rooms and corridors a supplied light-wall construction was executed (with C75 metal-frames, 5 cm glasswool on it and two sheets of gypsum board). The new special doors with double closing surfaces assure a sufficient airborn sound insulation.

The sound absorbent ceiling surfaces in the corridors support a better acoustic comfort in the building.

The summarized average airborn sound insulation (R'_w) results at the different constructions are the following: Type **a** walls, R'_w= 55,5 dB, Type **b** walls, R'_w= 57 dB, Type **c** walls, R'_w= 59,5 dB, Type **d** walls, R'_w= 54 dB, doors, R'_w= 35 dB.

Impact sound insulation

The realized weighted impact sound insulation with $L'_{n,w}$ = 24,5 - 34,5 dB values are very good.

Background noise

- The maximum traffic noise effect in the music rooms (during truck, bus and train traffic) is L_{Aeq} = 29 dB, with peak values of 35-36 dBA.
- Between the music rooms the measured sound effects of different instrumental music: during piano playing (forte-L_{Aeq} = 91dB), in the next room, L_{Aeq} = 40 dB, above the piano room, L_{Aeq} = 34 dB, in the corridor, L_{Aeq} = 59 dB, violine playing (forte-L_{Aeq} = 79 dB), in the next room, L_{Aeq} = 30 dB, in the corridor, L_{Aeq} = 50 dB.

Reverberation time

The average reverberation time values on mid-frequencies, 500-1000 Hz (T_k) in rooms with different volumes are the following: 35 m^3 - T_k = 0,90 s, 57 m^3 - T_k = 0,95 s, 76 m^3 - T_k = 0,90 s (before reconstruction - 2,00 s), 115 m^3 - T_k = 1,05 s, in brass instrument room of 76 m^3 (with absorbent surfaces) - T_k = 0,45 s.

CONCLUSIONS

The careful execution of the rebuilding assured the sufficient sound insulation values, which are needed for the undisturbed music teaching.

It is a good solution, that the rooms which are divided by walls Type-d with an lower insulation value than expected are used for teaching the less "noisy" instruments such us the violine.

The most important thing is that after a short period of practical use of the music school the subjective judgements of the teachers and director were positive. They did not mention any acoustical faults which might disturb their activities.

References

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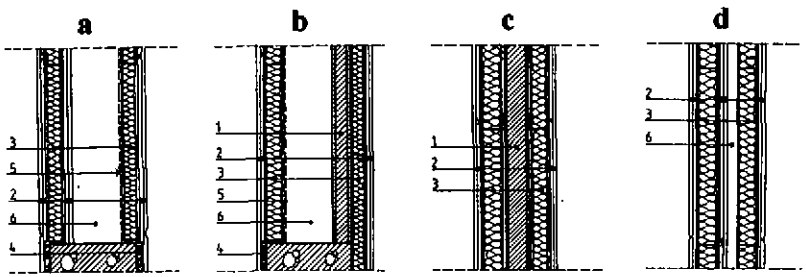


Remarks in the figures:

1 existing wall (9 cm,120 kg/m^2)
2 gypsum board (2x1,25 cm)
3 glasswool (5 cm, 32 kg/m^3)
4 glasswool (2 cm, 32 kg/m^3)
5 metal net
6 airspace

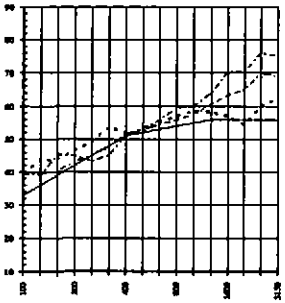


Fig. 1 **Type a**

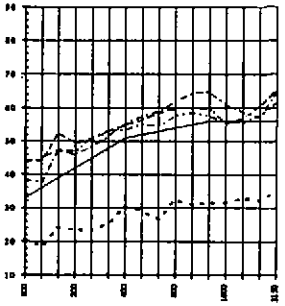


Fig. 2 **Type b**

The wall constructions and the achieved airborn sound insulations

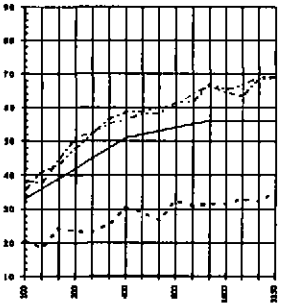


Fig. 3 **Type c**

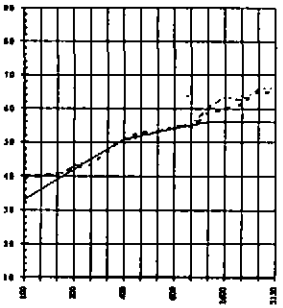
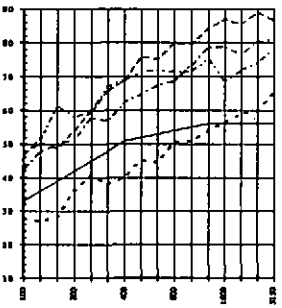
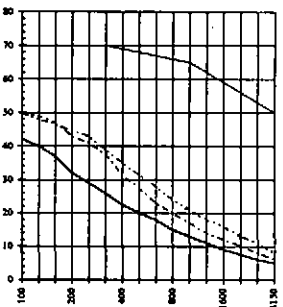


Fig. 4 **Type d**

The wall constructions and the achieved airborn sound insulations



A/ airborn sound insulation
(dotted line: before rebuilding)



B/ impact sound insulation

Fig. 5 The improved ceiling construction and the achieved sound insulations