inter.noise 2000
The 29th International Congress and Exhibition on Noise Control Engineering
27-30 August 2000, Nice, FRANCE

I-INCE Classification: 5.1

COMBINING HEAVY AND LIGHT WEIGHT BUILDING CONSTRUCTIONS TO ACHIEVE HIGH SOUND INSULATION

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Keywords:
SOUND INSULATION, SOUND REDUCTION, FLOATING FLOOR, C CORRECTION FACTOR

ABSTRACT
To achieve field measured apparent sound reduction indexes in the region of R'$_w$ = 64-75 dB, the control of flanking transmission is very important. The combination of lightweight "box in box" solution in heavy concrete structures has shown to provide sufficient reduction of flanking transmission. When comparing measured sound reduction in the common 100-3150 Hz range, with sound reduction in the extended 50-3150 Hz range, the sound reduction in the extended range is 3- 10 dB lower. For light-weight wall constructions the importance of the low frequency noise reduction must not be underestimated. Based on the figure above it is recommended that in projects where it is required to take into account sound reduction from 50 Hz C corrections of 6-8 should be assumed.

1 - INTRODUCTION

The company of consulting engineers, Multiconsult has been involved in many projects with building constructions with high sound insulation requirements. We will like to introduce to you the experience achieved during design and verification of the Norwegian State Academy of Music. The most important construction methods to achieve satisfactory results are highlighted.

2 - CONSTRUCTION

The sound reduction requirements between the most important rooms at the Norwegian State Academy of Music is varying between R'w = 60 to R'$_w$ = 75 dB. The most frequently occurring requirement is the R'$_w$ = 64 dB requirement. Since we have most measurement results for this wall, we will concentrate on the R'$_w$ = 64 dB wall with the following construction:

- 2 layers of 13 mm of gypsum board on both sides
- 100 mm steel profiles with 100 mm mineral wool
- 50 mm air gap
- 100 mm steel profiles with 100 mm mineral wool
- 2 layers of 13 mm of gypsum board on both sides

The load bearing deck below is concrete with a concrete floating floor with the following construction:

- 200 mm concrete
- 30 mm of mineral wool
- 65 mm of fibre-reinforced concrete

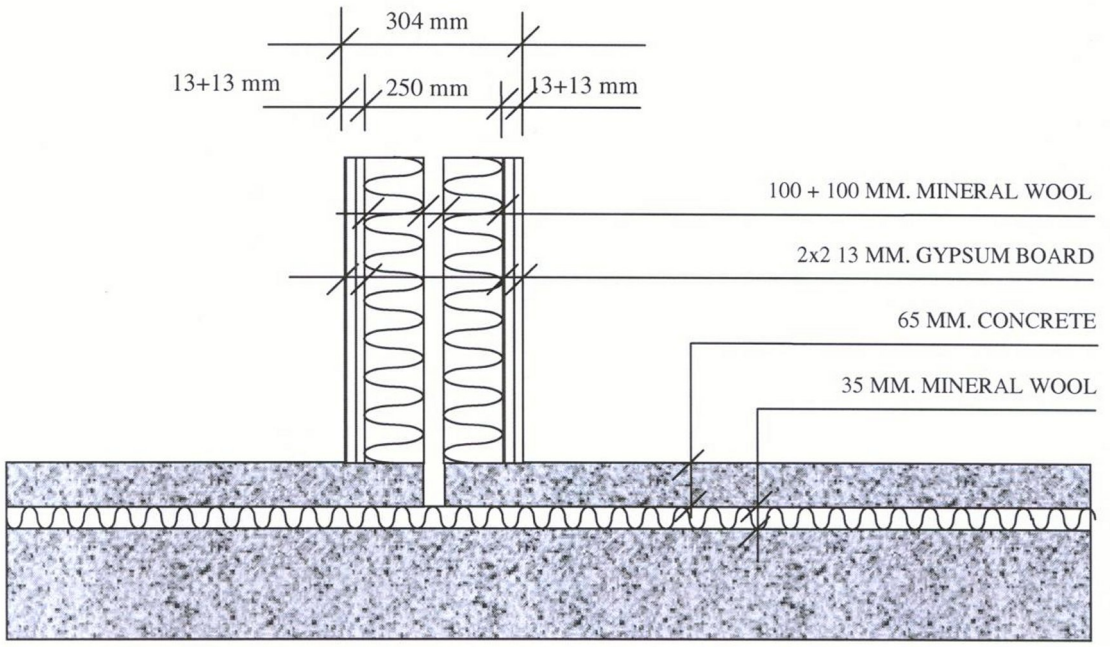

Figure 1: Vertical section of floor and the wall connection.

The floating floor was slitted between each room as indicated on the figure 1. Before wall installation it must be verified that the floating floor have no structural connection between the two rooms. Normally the slit is sealed with elastic sealing compound.
The wall steel profiles were directly mounted to the load bearing concrete deck above. A separate gypsum board ceiling was mounted in each room to reduce the flanking transmission via the concrete deck above. The total thickness of the wall was 304 mm as shown in the chapter figure 1.

3 - MEASUREMENT RESULTS

When high sound reduction indexes are required it is often necessary to control sound transmission outside the common 100-3150 Hz range. The sound reduction index R'_w and $R'_w+C_{50-3150}$ have been calculated according to standard EN-ISO 717-1 (ref 1): shown figure 1. The calculated values and corresponding partition wall area and receiving room volume are shown in the table below.

Room No:	**Partition wall m^2**	**Receiving room volume m^3**	**$R'_w+C_{50-3150}$ dB**	**R'_w dB**	**$C_{50-3150}$ dB**
021-020	14	58	66	74	8
443-442	14	38	66	71	5
530-531	8	30	62	66	4
422-423	17	95	62	65	3
217-214	22	99	60	65	5
213-214	25	99	59	67	8
515-514	14	50	56	66	10
555-554	9	28	56	66	10
201-202	21	81	56	63	7
007-008	14	154	55	61	6

Table 1.

The table shows that the $C_{50-3150}$ correction factor is varying from 3 to 10 dB. For light-weight wall constructions the importance of the low frequency noise reduction must not be underestimated.
Based on the figure above it is recommended that in projects where it is required to take into account sound reduction from 50 Hz, C corrections of 6-8 should be assumed. If not evaluating the low frequency sound reduction the required R'_w should be increased by 6-8 dB.

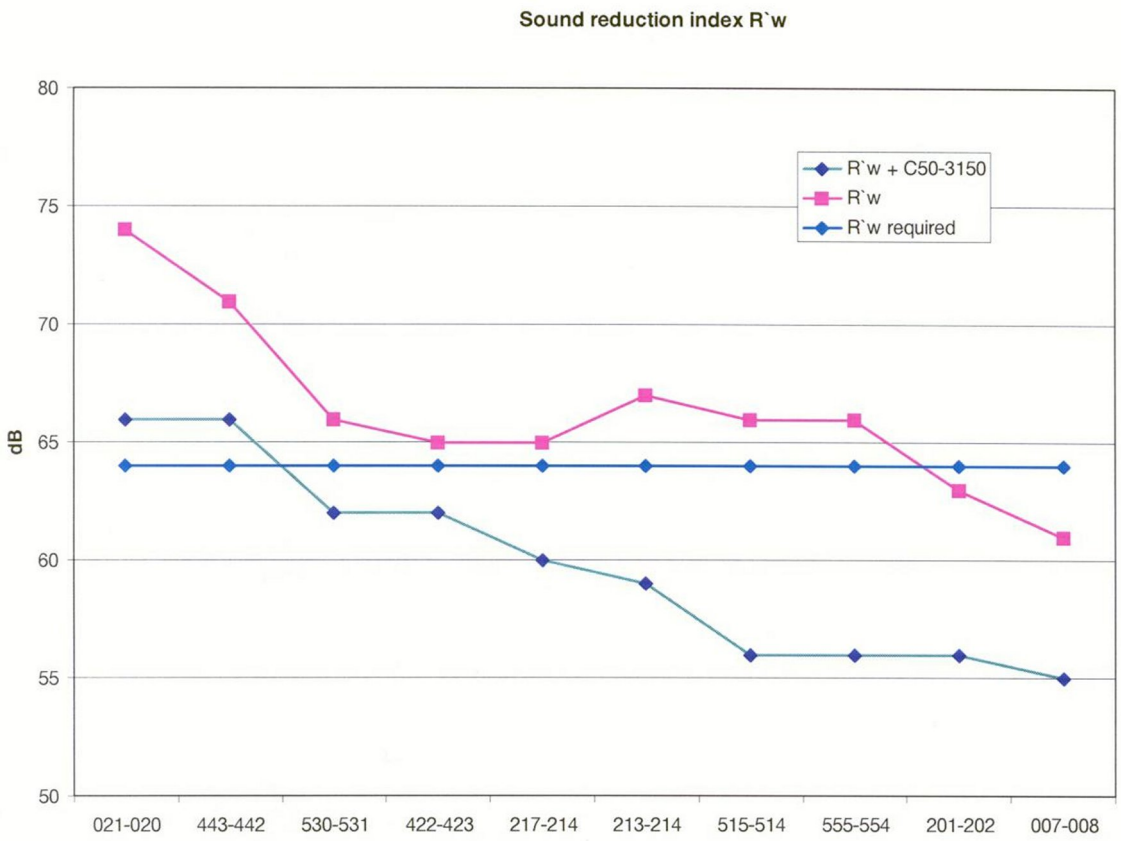

Figure 2: Results from field measured R'$_w$ and R' $_w$+C$_{50-3150}$.

4 - OTHER IMPORTANT ASPECTS

The evaluation of the measurement results from the Norwegian State Academy of Music shows that the required sound reduction index R'$_w$ is fulfilled for the majority of the walls.
To fulfil the requirements, noise transmission trough the ventilation system, noise leakage's around electrical cable penetrations and flanking transmission must be controlled

4.1 - Ventilation

Silencers on the inlet and outlet ducts must be dimensioned according to the required sound reduction. These silencers should be combined with the necessary noise reduction for the air supply / extract system.

4.2 - Cable penetrations

Cable channels must not penetrate the wall without proper designed silencers. It must also be avoided that any cable channels introduce structural connections between the steel profiles on each side of the wall.
Electrical cables penetrations or electric outlets should not be located on the same place on both sides of the partition wall without special precautions.

4.3 - Flanking transmission

Flanking transmission in the deck below the partition wall should be avoided as described above.
Flanking transmission through the deck above the partition wall could preferably be controlled by separate gypsum ceiling in each room. Necessary air gap and number of gypsum board layers should be dimensioned based on the weigh of the concrete deck above and the required sound reduction for the partition wall.

4.4 - Ageing

After construction some movements will occur in the building. The sealing details between the wall and adjacent building element must be designed to take account for these movements. Especially the joint between the partition wall an the above deck must be considered.

REFERENCES

1. **EN ISO 717-1**, *Acoustics - Rating of sound insulation of buildings and of building elements - Part 1 - Airborne sound insulation*, ISO 717-1: 1996, 1996