

THE QUEST FOR THE MISSING SEVEN DECIBELS

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ABSTRACT

Lighthweight cellular concrete is a very sensitive structural material in terms of sound and vibration. This is due to a high noise radiation coefficient and a low structural damping. The material is anyway often used in constructing of partitioning walls built as double walls. The wall usually consists of two 100 mm thick concrete bricks (approx. 600 kg/m³) with a cavity between. The thickness of the cavity usually varies between 75 – 125 mm and should be filled with mineral wool. In the perfect situation there is no rigid connection between the two wall parts. During the building process some connection will occur, but well designed and erected with care on a split foundation a sound insulation of $R'_w \geq 60$ dB can often be achieved. Small imperfections or design errors can though bring the R'_w below 50 dB. The errors can then be hard to find.

1. INTRODUCTION

In connection with the handing-over procedure Acoustica did some random tests of the sound insulation at a housing estate consisting of 25 terraced houses. All constructed with party walls built as a double wall of two 100 mm cellular concrete with a 90 mm cavity filled with (soft) mineral wool. The sound insulation R'_w and the impact level $L'_{n,w}$ were measured for two party wall samples. The impact level did for both measurement meet the demands in the building regulations ($L'_{n,w} \leq 53$ dB). The sound insulation measurements showed one good result and one poor (see figure 1). The poor sound insulation was only $R'_w = 48$ dB (demand $R'_w \geq 55$ dB). The poor result shows a clear indication of a rigid connection between the two wall parts.

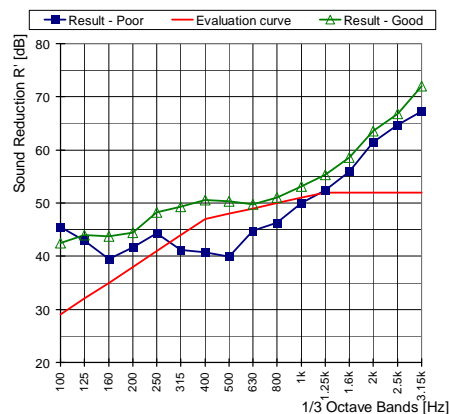


Figure 1 – *Initial sound*

insulation results for the two

samples

2. INITIAL INVESTIGATIONS

Construction drawings were provided by the civil engineer (see figure 2). The foundation of the two wall elements is separated – not entirely as described by the supplier of wall material, but the deviation was not expected to give a loss of 7 deciBels. There seem to be the following possibilities of rigid connections:

- a) The roof detail indicates that the laths connect the wall parts.
- b) The wall could be erected using binders between the wall parts.
- c) Mortar “bridges” under the walls could connect the wall parts.

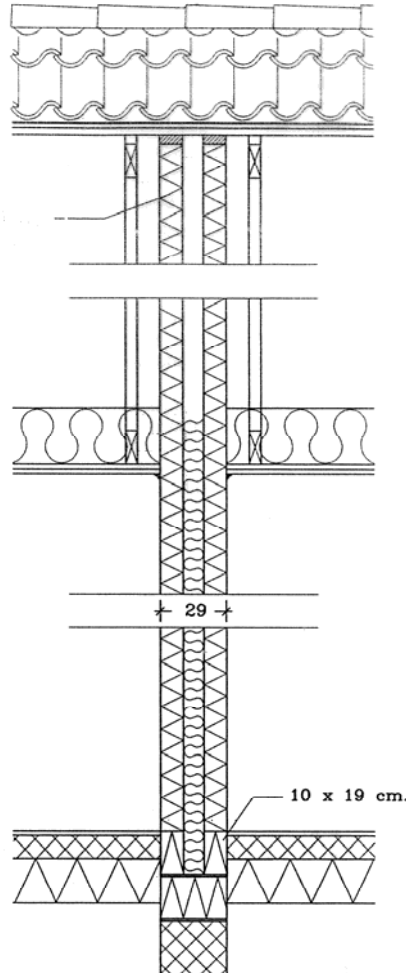


Figure 2 – Construction drawing of the party wall

Ad a:

The laths did bridge the two wall parts. All the laths were then cut and a new measurement of R'_w was done. Result $R'_w = 49$ dB – well within the measurement uncertainty. The conclusion was that this was not the sole fault – but possible one of more.

Ad b:

A long thin plate was drawn through the entire cavity showing that there were no binders.

Ad c:

In order to check for mortar bridges a piece of the party wall was cut out. The sight was surprising – see figure 3. There were no mortar bridges, but some untold steel profiles revealed themselves. Because the entire foundation was covered by a radon sheeting the civil engineer was afraid that the house should slide off the foundation. Therefore all four corners were fixed by an L-steel bar embedded deep down in the foundation. In the party wall two of these steel bars were placed just opposite each other. According to the design project these profiles should only be embedded from 200 mm below the cellular concrete and down. Actually they had been embedded up to the top of the foundation. This certainly looked like the cause of the troubles. The conclusion of the three initial investigations was that the problems lied in the foundation of the double wall. As the cost for correcting the problem in what have shown out to be 17 out of 20 party walls could be imposed either on the civil engineer or on the contractor, it was mandatory that the cause of the problem was identified as precisely as possible.

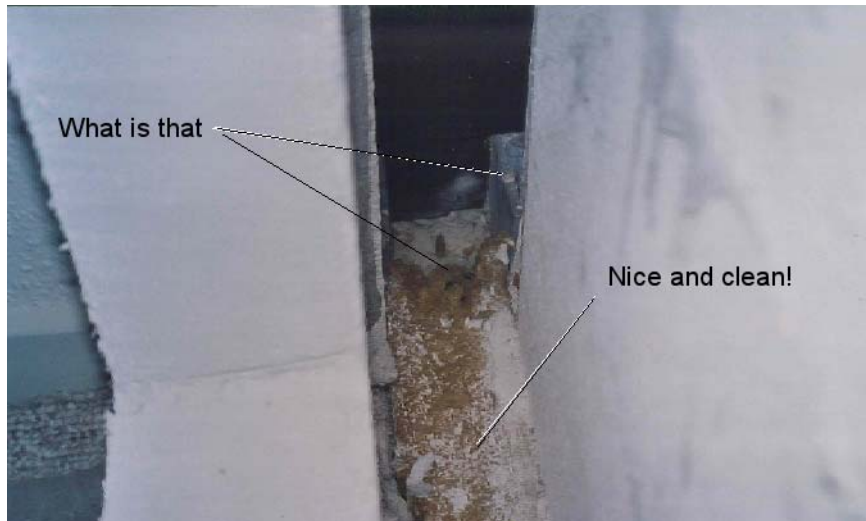


Figure 3 – Picture of the cavity - towards the façade

3. SOLVING THE FOUNDATION PUZZLE

At first the erected building was brought in accordance with the design project by cutting away the concrete “plug” between the steel bars (to the designed depth of 200 mm). This was done from outside the façade using a special chain saw. This step resulted in a reduction of sound insulation back to the initial level of $R'_w = 48$ dB!

Did the steel bars form a “tuning fork” strong enough to result in a rigid connection of the wall parts? In order to investigate this a deep horizontal cut was made through the façade foundation – deep enough to cut both steel bars (see figure 4). This resulted in an increase of R'_w to 49 dB.

It turned out that there was a difference between small rooms (width less than 40% of the entire party wall) and large rooms (entire party wall). For the small room it was enough to add gypsum boards (2 layers) on one side of the party wall. For the large room the results shown in table 1 were obtained. In all cases the gypsum boards were mounted directly onto the existing wall surface without removing the wall paper. The gypsum boards were mounted with standard screws as close as normally recommended for mounting gypsum board to frameworks etc.

Test no.	Gypsum board on		Measured R'_w
	First side	Second side	
A	None	None	48 dB
B	15 mm heavy	None	49 dB
C	15 mm heavy 13 mm standard	None	52 dB
D	15 mm heavy 13 mm standard	15 mm heavy	53 dB
E	15 mm heavy 13 mm standard	15 mm heavy 13 mm standard	55 dB

Table 1 – Measured R'_w with different gypsum board solutions

5. CONCLUSIONS

The design of the foundation for double wall construction made from cellular concrete is crucial for obtaining a high sound insulation between dwellings. When low sound insulation is measured the problem could be corrected by mounting a few layers of gypsum boards directly to the surface of the cellular concrete.