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IMPACT NOISE HORIZONTALLY WITH 80 MM CONCRETE SLAB AND UPPER 80 MM POLYSTYRENE SPLITTED WITH CONTINUOUS POLYSTYRENE BENEATH

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ABSTRACT

Measurement of impact noise horizontally for slab on ground has been done between different rooms in a residence building. The construction is with vinyl coating fastened with adhesive Casco Proff Extra on concrete. The thickness of the splitted concrete slab is 80 mm on 3 mm continuous thick tar coating. In administration part of the building the upper layer of 80 mm polystyrene is splitted, and the two lower layers of polystyrene beneath (total thickness 160 mm) are continuous. Corrected for the damping of the flooring (2 dB for vinyl coating with adhesive) and to receiving room volume of 100 m^3, the measurement shows 62 dB horizontally for impact noise without any flooring on the concrete. Between living room and common room the situation is with splitted concrete slab, continuous 3 mm thick tar coating and all three layers of polystyrene splitted and $L'_{n,w}$ sideways of 53-55 dB. The comparison shows that continuous tar coating does not transmit significantly impact noise horizontally or limits impact noise through the polystyrene, but that the transmission to neighbor room is through continuous layers of polystyrene.

Keywords: *impact noise, concrete slab, splitted polystyrene, continuous tar coating*

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1. INTRODUCTION

Few studies have been made in field on impact noise horizontally with concrete slab on ground and layers of polystyrene beneath [1]. This paper shows impact noise levels with splitted concrete slab and upper layer of polystyrene splitted as well as the case with splitted concrete slabs and all layers of polystyrene splitted. For all situations there is a continuous 3 mm tar coating between the concrete slab and the upper layer of polystyrene.

2. METHOD AND MEASUREMENTS

The impact noise levels were measured with tapping machine Norsonic 211 in finished building. The measurement with concrete slab and upper layer of polystyrene splitted was done in administration part of a healthcare building, while the measurement with both concrete and all layers of polystyrene splitted was done between living room and neighbor room. The results are given for bare concrete slab, corrected for damping effect of floor coating and to receiving room volume of 100 m^3. Above the concrete slab, there was vinyl coating fastened with adhesive. The damping effect of vinyl coating with adhesive is assumed to be 2 dB, as for tiles fastened to concrete with adhesive. The frequency spectrum is also given in figures for both measurements. The results are compared with paper from year 2021 [2].

3. CONCRETE SLAB AND UPPER LAYER OF POLYSTYRENE SPLITTED

The construction was as follows in the administration, where the concrete and upper layer of polystyrene were both splitted:

- Vinyl coating fastened with CascoProff Extra adhesive

- 80 mm concrete (splitted)
- 3 mm continuous tar coating
- 80 mm EPS (polystyrene splitted)
- 2 x 80 mm continuous EPS (polystyrene)

The measured $L'_{n,w}$ for this configuration was 56 dB. Corrected for floor coating and to receiving room volume of 100 m^3, the $L'_{n,w}$ is 62 dB. When only concrete slab is split with plastic film below the concrete, results from 2021 [2], showed $L'_{n,w}$ of 66 dB, which shows a reduction of 4 dB by splitting the upper layer of polystyrene and still with continuous film/coating between concrete and polystyrene. The measured result shows very good correspondance with given values in paper from 2021 [2] with similar configuration, where values of $L'_{n,w}$ for similar configuration was 58-61 dB. Difference in results could be explained by the 3 mm tar coating below the concrete for results presented here, and thin plastic film between layers of polystyrene in the measurements presented year 2021. The measurements from 2021 [2] show lower values in the highest frequencies due to a coating with much better damping effect above the concrete slab.

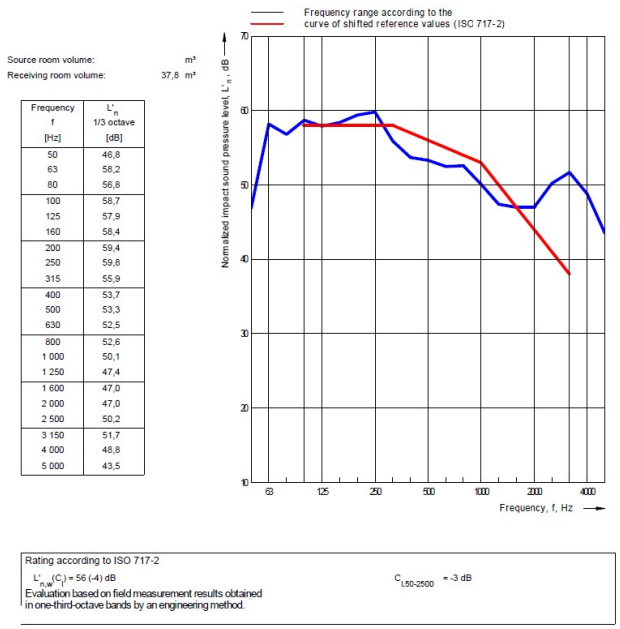

Figure 1. Impact noise level for slab on ground, with concrete and upper layer of polystyrene splitted

The reason for limited reduction in the higher frequencies is due to continuous layers of polystyrene and due to limited damping effect of vinyl coating fastened with adhesive to the concrete slab. The 3 mm continuous tar coating transfers impact noise in the frequency range from 315 to 630 Hz, in a similar way like connection points across concrete for a situation not properly splitted.

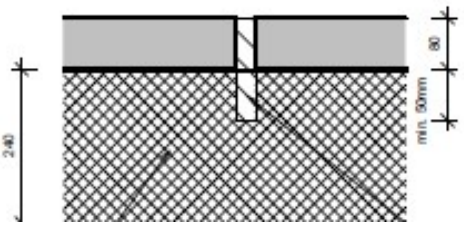

Figure 2. Splitting of concrete and polystyrene in administration part of healthcare building

The figure shows the splitted 80 mm concrete with 3 mm continuous tar coating below and splitted upper layer of polystyrene.

4. CONCRETE SLAB AND ALL LAYERS OF POLYSTYRENE SPLITTED

Between living room and neighbor room both the concrete slab and all three layers of polystyrene were splitted. The construction was as follows:

- Vinyl coating fastened with CascoProff Extra adhesive
- 80 mm splitted concrete slab
- 3 mm continuous tar coating
- 3 x 80 mm EPS (polystyrene) splitted

The measured $L'_{n,w}$ for this configuration was 48 dB. Corrected for floor coating and to receiving room volume of 100 m^3, the $L_{n,w}$ is 55 dB. The results shows very good correspondance with given values in paper from 2021 with similar configuration. There is a significant reduction of impact levels in the high frequency range due to the splitting of all layers of polystyrene. The detailed result is shown below in figure 3.

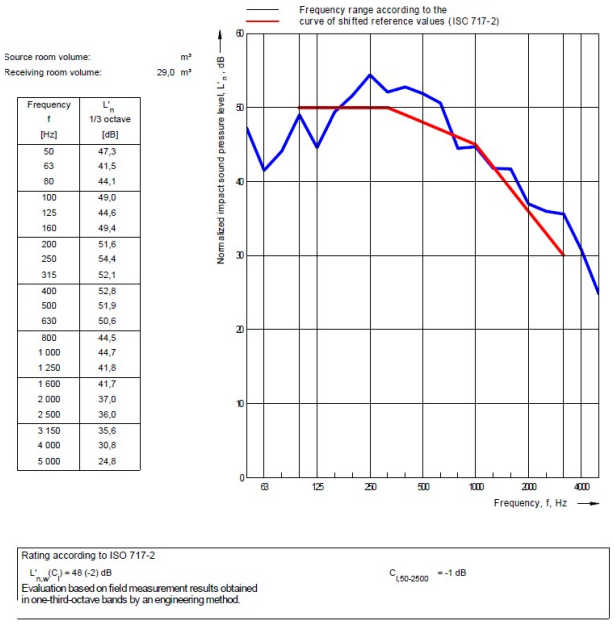

Figure 3. Impact noise level for slab on ground, with concrete and all layers of polystyrene splitted.

The result shows significant reduction in the whole frequency range, compared with the situation where only concrete slab and upper layer of polystyrene are splitted. At frequency 500 Hz the level is almost similar. From comparison of the two measurements, the continuous tar coating is seen to transmit significant impact noise in the frequency range from 315 to 630 Hz. Outside that range, the impact noise levels are at least 10-15 dB lower when the construction is splitted down to the ground. The splitting for results in figure 3 is shown below in figure 4. Comparison with similar splitting and plastic film between layers of polystyrene in [2] proves that the high levels in frequency range 315-630 Hz are transmitted through the continuous 3 mm tar coating below the concrete.

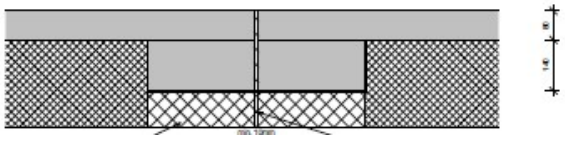

Figure 4. Splitting between living rooms.

There was also a measurement with splitting of concrete and all layers of polystyrene, but with continuous pipes of plastic for water and heating in the first and second layer of polystyrene. The result of this measurement is given in figure 5.

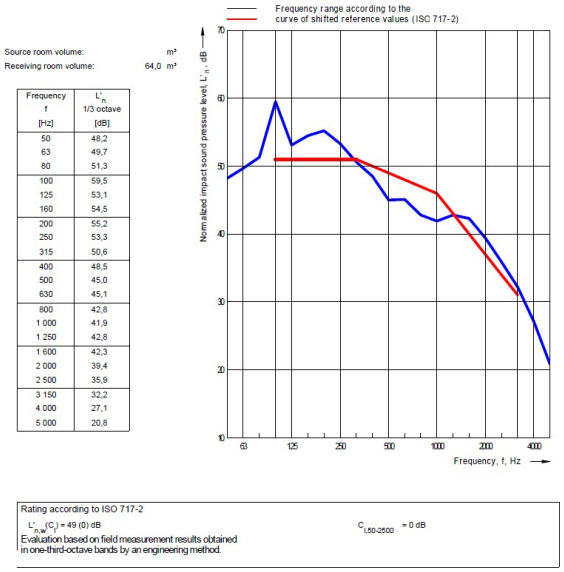

Figure 5. Impact noise level for slab on ground, with concrete and all layers of polystyrene splitted. Water pipes of plastic are continuous 5 cm down in upper layer of polystyrene, while heating pipes of plastic are continuous in the second layer of polystyrene.

The result in figure 5 corrected to 100 m3 is $L'_{n,w}$ of 53 dB, and shows that continuous pipes in the polystyrene will not increase horizontally impact noise.

5. CONCLUSION

The measurements done for concrete slab with 3 mm tar coating below the concrete and splitted upper layer of polystyrene shows very good correspondance with similar measurements in 2021 [2]. With splitting of concrete and upper layer of polystyrene, $L'_{n,w}$ is 62 dB compared with 58-61 dB from the measurements in 2021. The difference of 1-4 dB is supposed to be due to transmission through continuous tar coating and because earlier measurements had plastic film between splitted and continuous layers of polystyrene. When concrete and all layers of polystyrene are splitted (but with continuous tar coating and continuous

pipes of plastic in the polystyrene), $L'_{n,w}$ horizontally is 53-55 dB, which is similar with measurements summarized in [2] with continuous foundation below the layers of polystyrene. The correspondance with earlier measurements confirms that it seems to be correct with 2 dB damping effect of vinyl coating fastened to concrete slab with adhesive. The situation with continuous tar coating below the concrete and continuous foundation below all layers of polystyrene both give the same value of sideways $L'_{n,w}$.

5.1 Effect of continuous tar coating below the concrete

The measurements show that with polystyrene splitted to the ground, a continuous 3 mm tar coating (and continuous pipes for water and heating) seems not to limit achieved $L'_{n,w}$ of 53-55 dB compared with earlier results for similar configuration [2] when there is continuous foundation below splitted layers of polystyrene. It seems that the dominating impact noise horizontally is through the continuous layers of polystyrene. In Norway the need for continuous tar coating is critical in areas with radon gas. The measurements show that such a solution may be used to achieve good results for impact noise. The continuous tar coating below the concrete is not thought to limit single-value of horizontally impact noise, because reduction from 62 to 53-55 dB is achieved only by splitting more layers of polystyrene. Because the impact noise level is similar (1-4 dB difference) with only concrete slab and upper layer of polystyrene splitted with earlier experience [2], there is no reason to assume that continuous 3 mm tar coating transfers significant impact noise sideways. It seems that the tar coating transfers impact noise in the frequency range from 315 to 630 Hz, by comparing figure 1 and 3. This is confirmed by comparing the levels in figure 1 with earlier measurements where concrete and first layer of polystyrene are both splitted and a with a plastic film below the upper layer of polystyrene which shows lower levels in the range 315-630 Hz. From earlier measurements with all layers splitted to the ground [2] and $L'_{n,w}$ 46 dB, a continuous tar coating below the concrete seems to give 7-9 dB higher value sideways than with all layers splitted.

5.2 Meaning for future projects

The experience shows that it is possible to achieve limits in Norwegian rules with a continuous tar coating below concrete slab, which may be necessary due to radon gas from the ground. With splitting of layers of polystyrene and proper floor coating, this kind of solution may both give low impact noise levels, and good sound insulation between apartments. The achieved R'_w for the situation with concrete slab and all three layers of polystyrene splitted was 64 dB. The sideways $L'_{n,w}$ with concrete splitted, continuous 3 mm tar coating and upper layer of polystyrene splitted corresponds very well with earlier measurements and experience.

6. SUMMARIZING POEM

Impact noise to the side is transmitted
Even though flooring on top is splitted
Below the concrete a continuous tar coating
On upper splitted polystyrene is floating
The result for splitted polystyrene was like expected
Effect of continuous tar coating – to be neglected

Continuous polystyrene gives impact high
Measurements show we cannot deny
The reduction is big for the impact sound
When polystyrene is splitted to ground

7. ACKNOWLEDGMENTS

May I give my biggest acknowledgements to Kristiansand kommune, who allowed me to present results from measurements in their building with valuable information on impact levels from slab on ground.

8. REFERENCES

[1] John LoVerde and Wayland Dong, Measurement of Lateral impact noise isolation, *24th International Congress on Sound and Vibration (2017)*.

[2] Bernt Mikal Larsen, “Impact sound pressure values – Field measurements for different configurations of concrete slabs on ground”, *Internoise21, Washington DC*