Summary

Influence of airtightness on soundproofing, exemplified by roof constructions

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As part of a larger research project on soundproofing, investigations were conducted on whether and to what extent airtightness, or the airtight construction of a roof, have an effect on the soundproofing quality. For this study, a solid wood box was built and insulated with 24 fibre insulation (wood fibre and cellulose flock). The exterior surface is a double plasterboard cladding, acoustically decoupled from the floor. The roof could be quickly changed with a hoist, to facilitate measurement of as many different roof configurations and materials as possible.

Summary

At the start of the measurements, the airtightness of the box was determined, achieving an n50 value of 0.79. Then the airtightness was progressively worsened by drilling (small holes, diameter of 12 / 25 mm and larger openings, diameter 100 mm) and the soundproofing quality of the roof measured. Airtightness was steadily reduced from n50=0.79 to 5.8. Summarised, the following scenario emerged:

- Initially the roof with good soundproofing had approx. 46 dB soundproofing ($D_{l,2m,nT,w}$).
- Many small holes (12 / 25 mm) hardly worsened soundproofing at all although airtightness declined from 0.79 to 2.30. The sound was ‘swallowed’ by the fibre insulation (soft wood fibre matting).
- The roof tiles made hardly any contribution to soundproofing (c. 1 dB).
- A single large opening with a smooth surface (PP, diameter 100 mm) worsened soundproofing dramatically (declining from 47 dB to 35 dB). This opening equalled the area of the former numerous small holes.
- When a hole of the same diameter (thus creating the same degree of airtightness) without a pipe lining was made, good soundproofing of 46 dB was once again measured.
- A second large opening lined with a smooth plastic pipe (diameter 100 mm) worsened the situation just fractionally, even though the airtightness n50 encreased from 3.6 to 5.8.

Conclusion

There is no direct correlation between airtightness and soundproofing; the main factors are the type of insulation material and the hole: if the hole has a smooth, non-absorbent surface then soundproofing is markedly worsened. If the hole has an absorbent surface then poor airtightness has hardly any effect on soundproofing.