Noise control through open windows
A solution model

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Abstract

The ever increasing road traffic noise is making natural ventilation through windows, in urban dwellings, a difficult challenge.

Due to the general increase in noise levels and the requirements of having natural ventilation, the Danish environmental protection agency has since 2007 urged municipalities to in incorporate solutions for reducing noise trough open windows.

ÅF Buildings Denmark Acoustics has in collaboration with national well renowned entrepreneur KPC and window manufacture Velfac developed and tested a solution that meets the requirements by the Danish environmental protection agency while being an attractive solution for architects as an alternative to the well-known "russervindue" normally used when facing high noise levels.

The window solution, when open, attenuates incoming noise, plus spectral corrections, by an order of half when compared to the subjective noise level through an ordinary window.

This has been designed through computer simulations and verified successfully through in-situ measurements.

Initial concept of design for noise attenuation through natural ventilation

- Vertical box, built-in to one side of the window frame.
- In open configuration, external noise is dampened by a vertical, curved transmission path, incorporating various thicknesses of absorption.

Figure 1: Attenuated transmission path

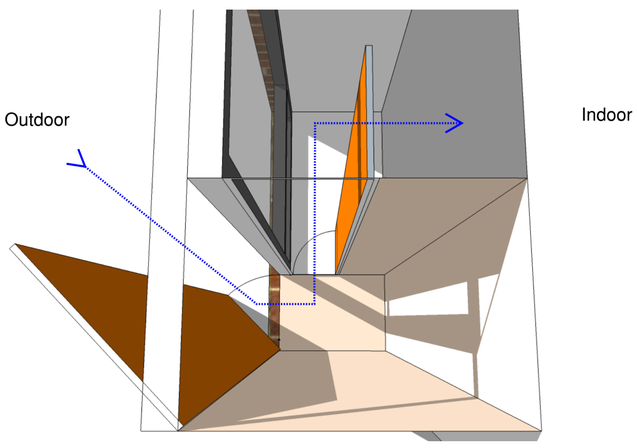


Figure 2: Closed configuration

Figure 3: Open configuration

Method of modeling

- Two field testing methods from ISO 16283-3 "Field measurement of sound insulation in buildings and of building elements - Façade sound insulation", was modelled in computer simulation software. Methods applied were:

  1) "Element loudspeaker" $R'_{45\ degree}$
  2) "Element road trafiic" $R'_{tr,s}$

- Simulation software:

  a) The acoustic properties of the window, was tested in room-acoustic simulation software ODEON 15.
  b) Noise modelling software, SoundPLAN 8.0, was used to predict the road traffic noise spectrum.
  c) Sound insulation prediction software INSUL 9.0, was used to assign transmission data to materials, in ODEON.

Method of in-situ testing

- ISO 16283-3 "Element loudspeaker" and "Element road traffic" was measured in a finished building façade from the 1st floor.
- $R'_{45\ degree}$ was measured using 3 loudspeaker positions. The positions were angled at a negative 45 degree down and azimuth -45, 0 and +45 degrees respectively, relative to the middle of the window element.
- $R'_{tr,s}$ was measured using road traffic noise from a busy road, parallel to the building façade.

Results

- Results shown, are the acoustic attenuation through the open configuration.
- Results are given in reference to a 0,35 m^2 opening areal.

Noise reduction through the open ventilation box	Modelled results	Measured results
ISO 16283-3 "Element loudspeaker" $R'_{45\ degree} + C_{tr}$	**15 dB**	**13 dB**
ISO 16283-3 "Element road traffic" $R'_{tr,s} + C_{tr}$	**14 dB**	**11 dB**

Discussion

- Limitations

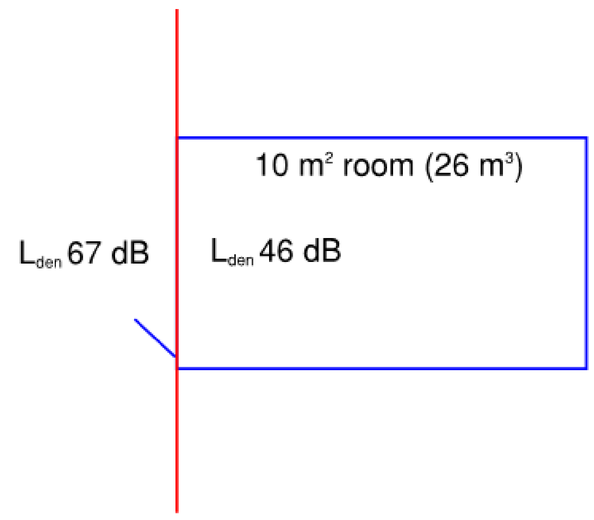
  A) Internal transom reduces opening areal to 0,27 m^2.

  b) Fluctuating amount of traffic, due to traffic lights, could have influenced the result during "Element road traffic" measurements.

  c) Neither ODEON nor ISO 16283-3 were designed to test sound insulation through open windows.

Conclusion

- With an opening reference area to 0,35 m^2, measured results, shows an acoustic attenuation of:
  $R'_{tr,s} + C_{tr}$ = 11 dB
- In a 10 m^2 (Volume 26 m^3) room, this equals the possibility of an internal noise level of L_{den} 46 dB, with external noise levels up to L_{den} 67 dB, via natural ventilation.



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