KATHOLIEKE UNIVERSITEIT LEUVEN

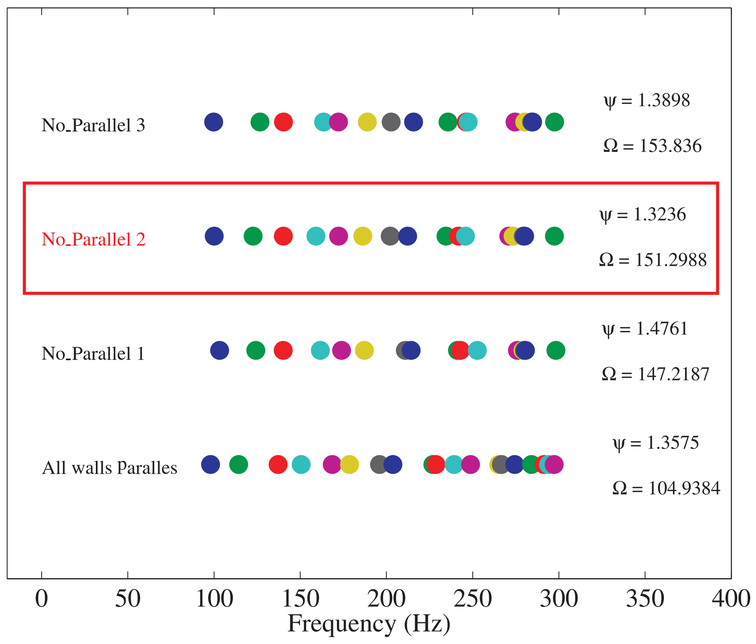
Department of Mechanical Engineering
Celestijnenlaan 300 B box 2420, BE 3001 Heverlee (LEUVEN), BELGIUM

Transmission suite design for vibro-acoustic characterization of lightweight panels

C. González Díaz, M. Vivolo, B. Pluymers, D. Vandepitte, W. Desmet
Katholieke Universiteit Leuven. Department of Mechanical Engineering. Division Production engineering, Machine design and Automation
c.gonzalezdiaz@mech.kuleuven.be www.mech.kuleuven.be

ABSTRACT
This poster concerns with the design of an acoustic cavity (transmission suite) for the vibro-acoustic characterization of lightweight panels. This setup has the big advantage of being small (1150x984x820 mm) which allows the identification of the studied behaviour for both structure- and air- borne excitation, on panels of different size (from A4 to A2) and thickness (up to 5cm). Particular effort is made for selecting an optimum geometric configuration. Taking into account the acoustic eigenfrequencies' occurrences up to the Schroeder frequency and considering the surface averaged sound absorption coefficient (α) this design leads to the smoothest and most uniform distribution of the natural frequencies of the acoustic cavity. The final design results in a non-parallel walled concrete box of moderate dimensions. Specific care is taken for the implementation and building of the test setup. The resulting facility allows the identification of both structure-borne and air-borne acoustic isolation parameters in lightweight panels of different size.

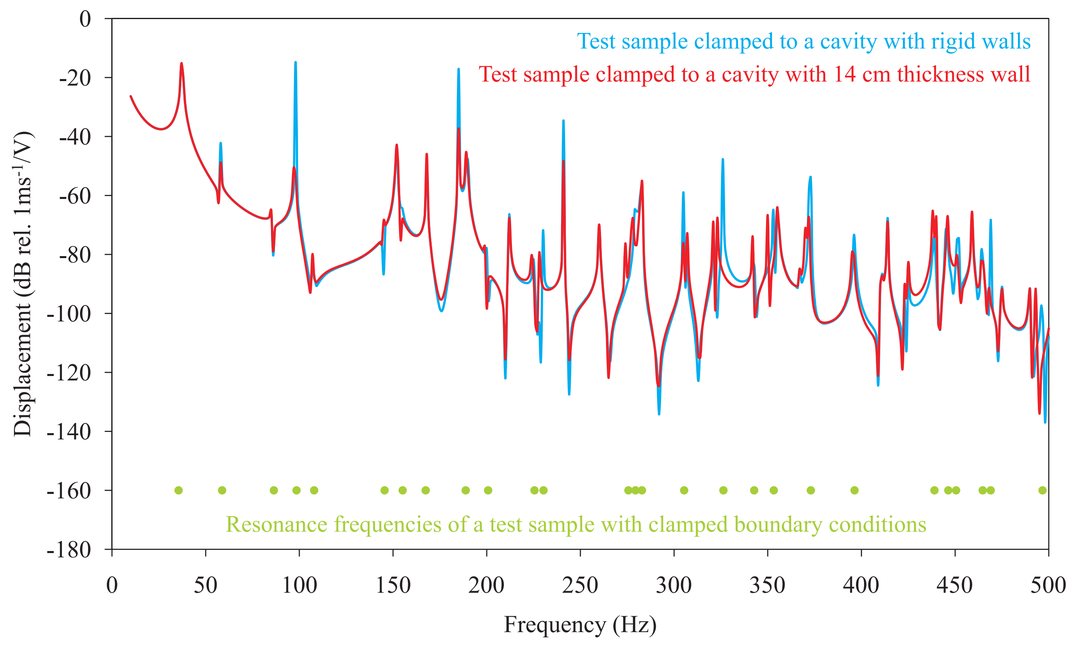
Natural frequency distributions for α=0.5; {1.25,1.5,1.75}



ψ = mean square of the deviations of the actual distance between subsequent modes from the mean value in the frequency range of interest; this is a way to quantify the homogeneity of the eigenfrencies distribution; **the higher the value of ψ, the bigger the variations of the frequency spacing.**

Ω = shows how big is the "gap" between the eigenfrequencies over the specified frequency range; **the higher the value of Ω, the bigger the "gap".**

Wall thickness effect



MEASUREMENTS

- Sound Power Level (SPL)
- Sound Power Intensity.
- Transmission Loss (TL).
- Insertion Loss (IL).
- Noise Reduction Coefficient (NRC).
- Vibration Reduction

FINAL DESIGN OF THE ACOUSTIC CAVITY

- Reverberation chamber made out of reinforced concrete.
- It has a set of 4 aluminium front walls with different sample test window size (A2, A3, A4 and fully closed)
- Its volume is 0.8 $m^{3.}$
- It has no two parallels walls.
- The thickness of the reinforced concrete walls are 15 cm.
- The thickness of the aluminium front walls are 35 mm.
- The aluminium front walls are linked to the acoustic cavity by a steel frame (double row of 84 bolts).
- The steel frame is attached to the acoustic cavity by 84 studs

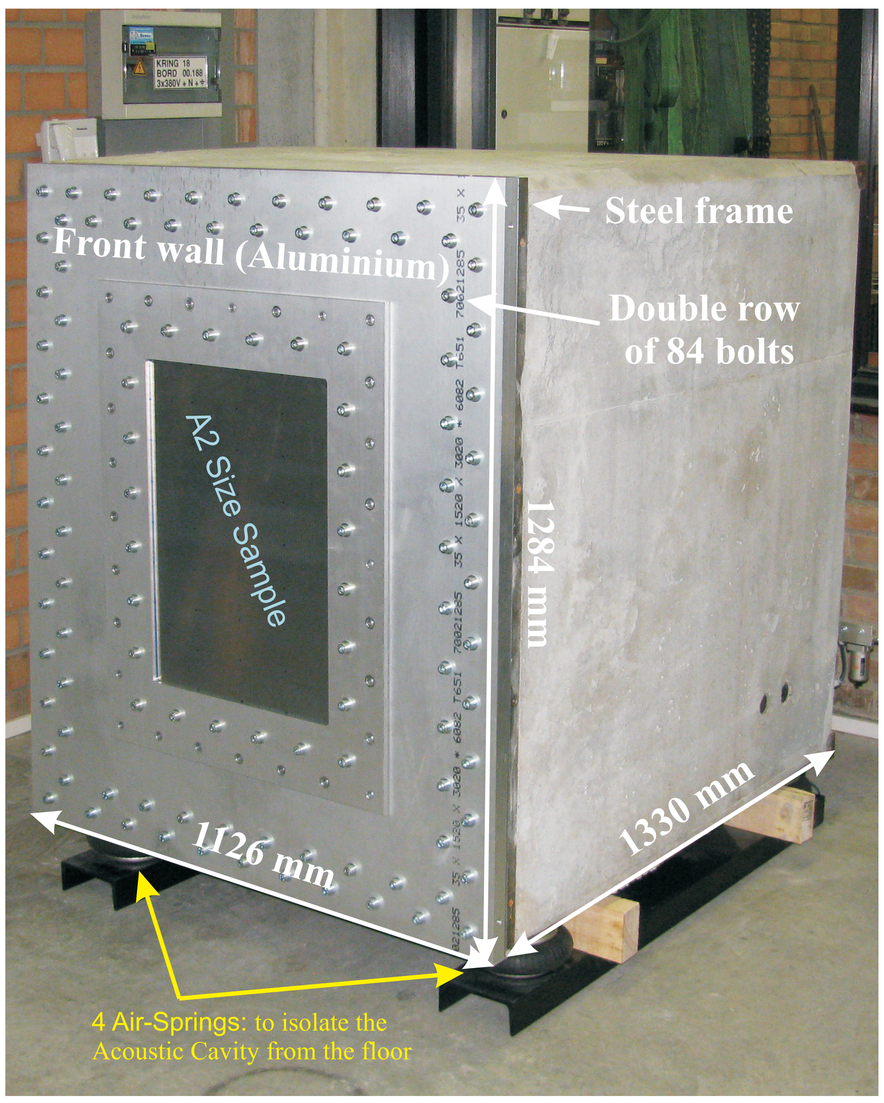


Figure 1: Outer dimensions

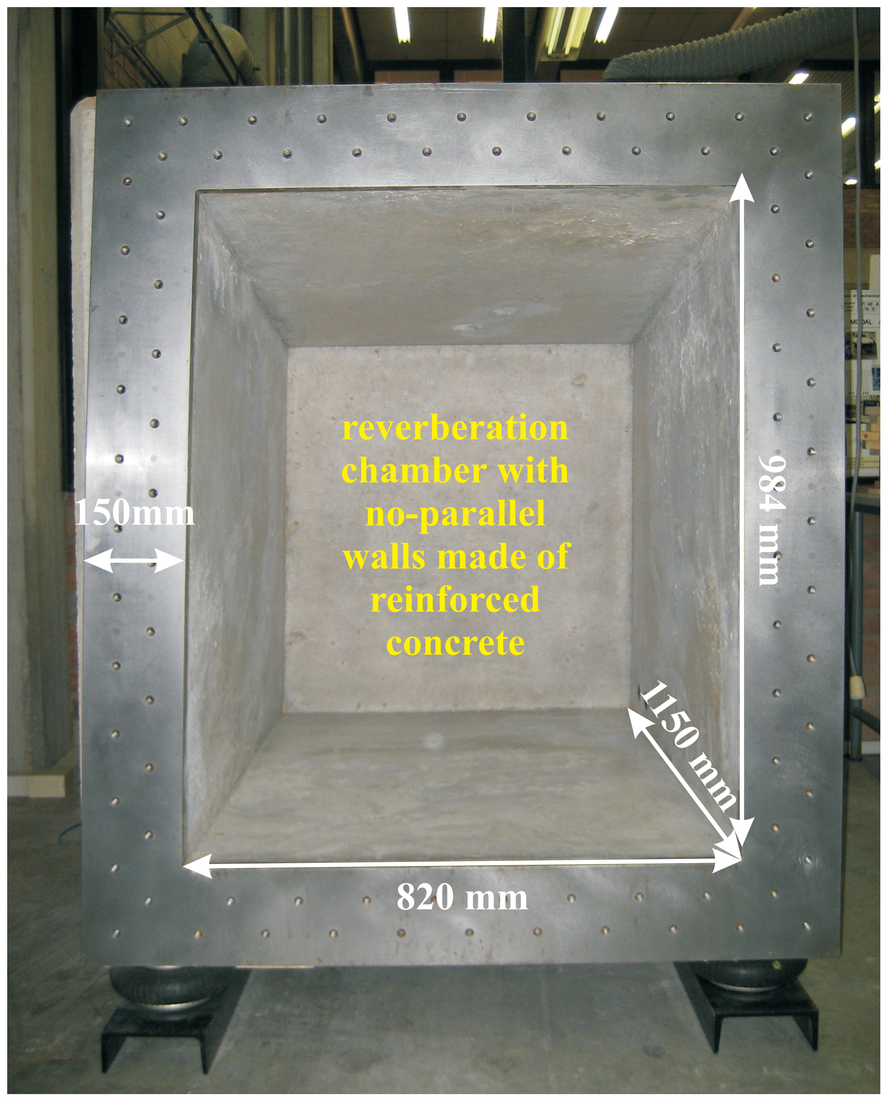


Figure 2: Inner dimensions

Acknowledgments
The research was supported by the Research Training Network funded under the 6th Framework Programme of the European Commission under the project "Smart Structures-A Computer Aided Engineering Approach to Smart Structures" (http://www.smart-structures.eu, contract nr. MRTN-CT-2006-035559), from which the first author holds an Experience Research Training Grant. Furthermore, the authors also kindly acknowledge the European Commission for their support of the Marie Curie EST project SIMVIA2 (http://www.simvia2.eu, contract nr. MEST-CT-2005-020263), from which the second author holds a Research Training grant. Also the fund for Scientific Research - Flanders (F.W.O.), Belgium, is gratefully acknowledged for its support.

Reference
- C. Gonzalez Diaz, M. Vivolo, B. Pluymers, D. Vandepitte, W. Desmet, "Transmission suite design for vibro-acoustic characterization of lightweight panels" *ISMA2010 International Conference on Noise and Vibration Engineering*, 20-22 September, 2010.
- M. A. Blaszak, "Acoustic design of small rectangular rooms: Normal frequency statistics," *Applied Acoustics*, vol. 69, no. 12, pp. 1356-1360, Dec.2008.