Parameter study on a composite sound-absorbing structure lined on elevator shafts

Ting Qu[1], Hequn Min[2*]

(1.School of Architecture, Southeast University, Nanjing 210096, China;)

(2.Key Laboratory of Urban and Architectural Heritage Conservation of Ministry of Education, Southeast University, Nanjing 210096, China)

Abstract: In order to reduce the noise in elevator shafts, a composite sound-absorbing structure which can be applied to inner walls of elevator shafts is proposed. Based on the theory of acoustic impedance of porous material proposed by K. Attenborough and the theory of acoustic impedance of perforated plates proposed by Bies, parameter optimization of the sound-absorption structure is discussed in the paper. The composite structure, as shown in Figure 1, is composed of damping gypsum mortar board, composite rock wool board and cement mortar perforated board . Based on theoretical analysis, numerical simulation and experimental measurement, parameter optimization of the structure is discussed on the structure normal incidence sound absorption performance, based on the influence of parameters, such as thickness, flow resistance and porosity of the rock wool board, and perforation rate, thickness and density of the perforated board. Results show that porosity, flow resistance and bulk density of the rock wool board, and the perforation rate and thickness of the perforated board play a key role in the structure sound-absorbing performance. Increasing the thickness of the perforated board, reducing the perforation rate and increasing the porosity of the porous material can enhance absorption performance at low- frequencies, as shown in Fig. 2-3. Normal incidence sound absorption coefficient of the optimized composite structure may reach 0.6 and 0.8 600Hz and 1600Hz, respectively. It is indicated that, there is great application potential for the proposed composite sound-absorbing structure has in elevator shaft noise control.

Keywords: Elevator shaft; Sound absorbing structure; Porous material; Flow resistance; Acoustic impedance

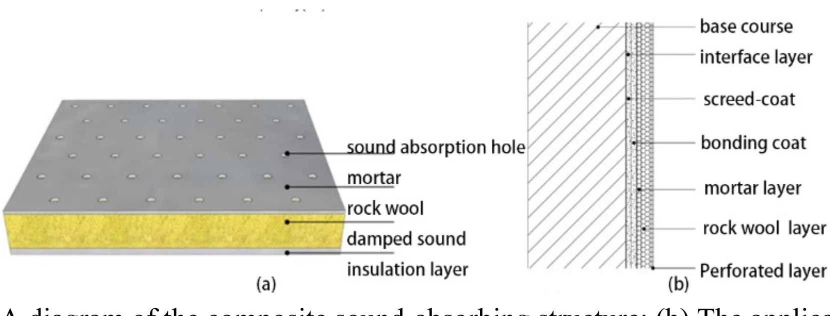

Fig.1 (a) A diagram of the composite sound-absorbing structure; (b) The application of the composite sound-absorbing structure lined on elevator shafts

* Corresponding author.
E-mail address: hqmin@seu.edu.cn

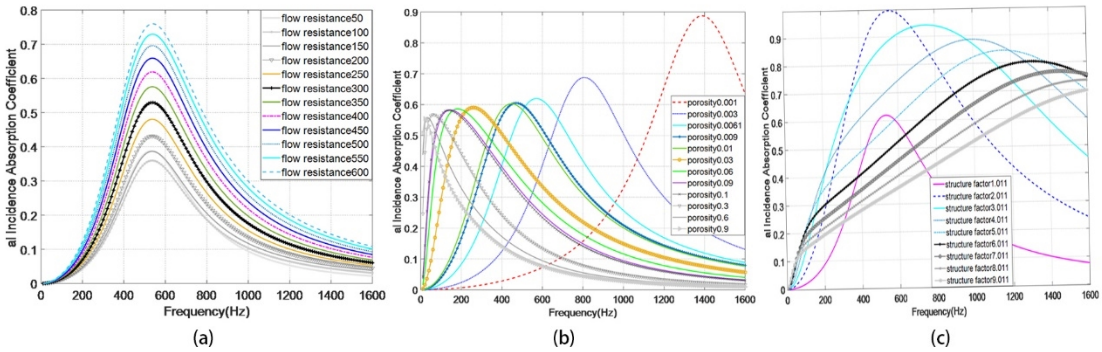

Fig.2 The effect of (a) flow resistance, (b) porous rates, (c) structure factor of porous material on sound absorption coefficient of composite structure

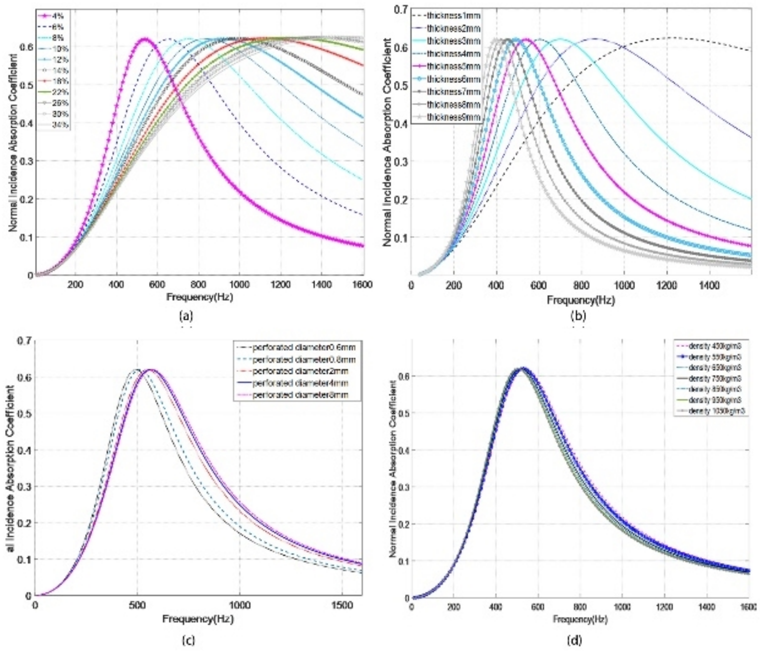

Fig.3 The effect of (a) perforated rates, (b) thickness, (c) perforated diameter, (d) density of perforated panel on sound absorption coefficient of composite structure

参考文献

[1] K. Attenborough. Ground parameter information for propagation modeling. Journal of Acoustical Society of America, 1992, 92: 418–427.

[2] David A. Bies, Colin H. Hansen Engineering noise control theory and practice. London and New York: spon press taylor francls group 2013, 636-637.

[3] Cui Y Q. Study on the preparation and modeling process of foam-sandwich structure acoustic composites. Harbin Engineering University, 2019

[4] Ma D Y. Engineering manual for noise and Vibration control. Beijing: Machinery Industry Press, 2002

[5] ISO 10534-2:1998. Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 2: Transfer-function method