Acoustical Properties of the Composite Structures

Made of Micro-Perforated Plates and Honeycomb Core

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Abstract

The noise around the airport, the comfort degree of passengers, the stealth of the aircraft and so on are the important aspects in the design of aircraft. All these requirements need to reduce the noise level of the engine dramatically. Although the micro-perforated plate (MPP) gradually becomes one of the most promising and commonly used noise reduction measures, the fact that the stiffness of the MPP isn't strong enough for several situations can't be ignored. The composite structure made of MPP and honeycomb core was put forward to make up for this shortage [1]. In addition, based on the Helmholtz resonator principle[2], the honeycomb core attached behind the MPP also improves the overall acoustical properties of the composite structure.

Nowadays, the studies of the liner's acoustical properties are usually based on theoretical derivation [3-5]. However, these theoretical formulas introduce several simplifying assumptions inevitably, so more exact methods need to be studied for better prediction of the liner's characteristics. And we choose to use the numerical simulation method to study the composite structure's acoustical properties.

In this paper, since it is costly in time and economy to take the geometry of the whole structure into account during the simulation, considering the air on the back of the MPP is divided into periodical spaces by the honeycomb, a unit-cell model is extracted from the structure to study the acoustical properties of the composite structure, as Figure 1 shows.

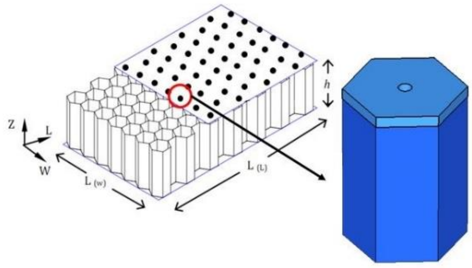

Figure 1 The unit-cell model

First, the reliability of the unit-cell model was verified by comparing the Helmholtz resonator frequency in the internal air cavity with the theoretical values. Then, based on the same unit-cell model, the sound insulation performance of the composite structure was simulated. After that, in order to determine the sound absorption coefficient of the composite structure, a rigid standing wave tube was placed in the upper side of the unit-cell to obtain the standing wave in

it. The new unit-cell model was used to approximately simulate the standing wave ratio test. Final, the influences of structural parameters (aperture, porosity, thickness of the MPP etc.) on the sound insulation performance and the sound absorption coefficient were discussed to describe the acoustical properties of the composite structure.

Keywords: Unit-cell model, Micro-perforated plate, Honeycomb structure, Sound transmission loss, Sound absorption coefficient

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