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The research of new perforated ABS panels applied sound absorption

Chuan-wen CHOU[1]; Rong ping LAI[2]; Michael CHANG[3]

[1] National Cheng Kung University, Taiwan

[2] NCKU Research and Development Foundation, Taiwan

[3] GIXIA GROUP Co., Taiwan

ABSTRACT

As the demands for the multiple types of present space, the interior space especially commercial space would be claimed to decorating materials with suitable costs and flexible for appearance. The study applied small-perforated manufacture to ABS panel. The module design and injection molding would produce special pattern on surface of small-perforated ABS panel. The hole is formed by V type cannelure, which is on different side of panel and with direction in perpendicular. In this form, the holes would be in the cannelure instead on the surface of panel, and also have extremely minuteness depth (about 1 mm) and diameter with 0.25 mm. This particular form of holes would occur sound damping effect and increase the absorption of panels. The sound absorption coefficient above 1250 Hz of single small-perforated ABS panel would reach to 0.4, and in further the value above 250 Hz of the panel back with 20 cm air layer would reach to 0.3. This outcome indicates the small-perforated form would make the ABS panels provide functional sound absorbing effects. In additional, the surface of ABS panel would match suitable appearance for different interior demands by spray printing. As the results, the small-perforated manufacture and flexible appearance of ABS panels would bring new development for the absorbing materials application.

Keywords: Sound, Absorption, ABS panel, small perforated

1. INTRODUCTION

The interior acoustical environment is usually ignored from spatial design as unsuitable interior material. This condition causes the reverberation time not to conform the quality of interior space demands due to insufficient sound absorption. The results would cause that the comforts of space would be level down. According to the absorbing materials in present, the simplex applied pattern and fragile quality of materials induced the huge limitation of application in interior space because of the concerns of durable and appearance. This also made the insufficient control for interior acoustics.

As the results of the strait of the absorbing materials spatial application, the absorbing materials were demands as the convenience of interior decoration flexibility and also acceptable costs. Therefore the study applied the acrylonitrile butadiene styrene plastic injection molding technique as the sound absorbing panel. The ABS panel with small perforated would be set in more multiple module to fit the variable interior decoration demands. The module could be design as complex molding based on the ABS injection molding technique. Furthermore, the small perforated could be also molding in one time through specific module instead of boring on the panel. These ways of the panel manufacture would be faster and in lower costs.

The study was focused on the sound absorption characteristic of small perforated ABS panel. Through the factors of the panel, the basic sound absorption of small perforated ABS panel wound be shown. In additional, the different construction types due to different ways of application in interior space were also confirmed as sound absorption. These data of the small perforated ABS panel would be used to evaluate field acoustics environment as improvements of uncomfortable interior space.

The factors of small perforated ABS panel would affirm its sound absorption characteristic, and the

[1] gege39th@gmail.com
[2] nckuteastudio@gmail.com
[3] michaelchang@gixia-group.com

field space would be according to the data to improve the acoustics environment as one case of application of ABS panel. Therefore, the application of ABS panel as absorbing materials for interior space would be clarified.

2. OBJECT

2.1 Small Perforated ABS Panel

The injection molding was applied to the small perforated on ABS panel. The bores would be produced by two cannelure with direction in perpendicular on two surface of panel. In the intersection, the suitable depth of cauulure on two surface would create bores with smaller diameter less than 1 mm. According to the concepts, the small perforated ABS panel would be in specification as Figure 1 and Table 1. In presupposition of mold with high precision, this way of small perforated would be well uniform for bores on the panel in one process of manufacture.

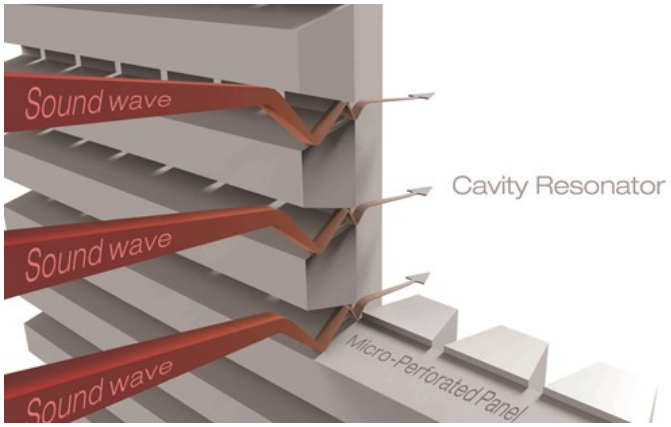

Figure 1 – Injection molding of small perforated ABS panel

Table 1 – Physical parameters of liquids

Size	Thickness	Diameter of Bore	Perforation Rate
300*300 mm	2 mm	0.17 ~ 0.25 mm	1.40 ~ 2.89 %

2.2 Sound Absorption of ABS Panel

The small bores less than 1 mm diameter would be possessed well sound absorption based on the micro-perforated theory as Figure 2. The core factors of sound absorption were based on the perforation rate and depth of air layer for resonator. These factors would be the points for the follow-up confirmation of sound absorption.

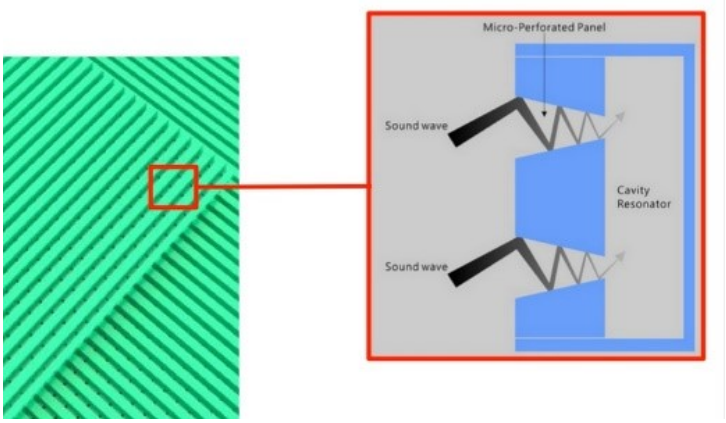

Figure 2 – Sound absorption of small perforated ABS panel

In order to confirm the actual sound absorbing characteristic of small perforated ABS panel applied to interior space, the performance measurement was demanded to base on the core factors and combine extra factors of behaviors with different applying types. The laboratory measurement and field acoustics application would be the main method to conclude the basis.

3. ANALYSIS

3.1 Method and Specimen

The laboratory measurement was executed in NCKU Architectural Acoustics Laboratory with standards ISO 354. The sample setting would be based on the conferring factors, which were as two fronts as basic acoustics and applying types. The small perforated ABS panel construction as Figure.3 would be confirmed the sound absorption coefficient in different types from factors.

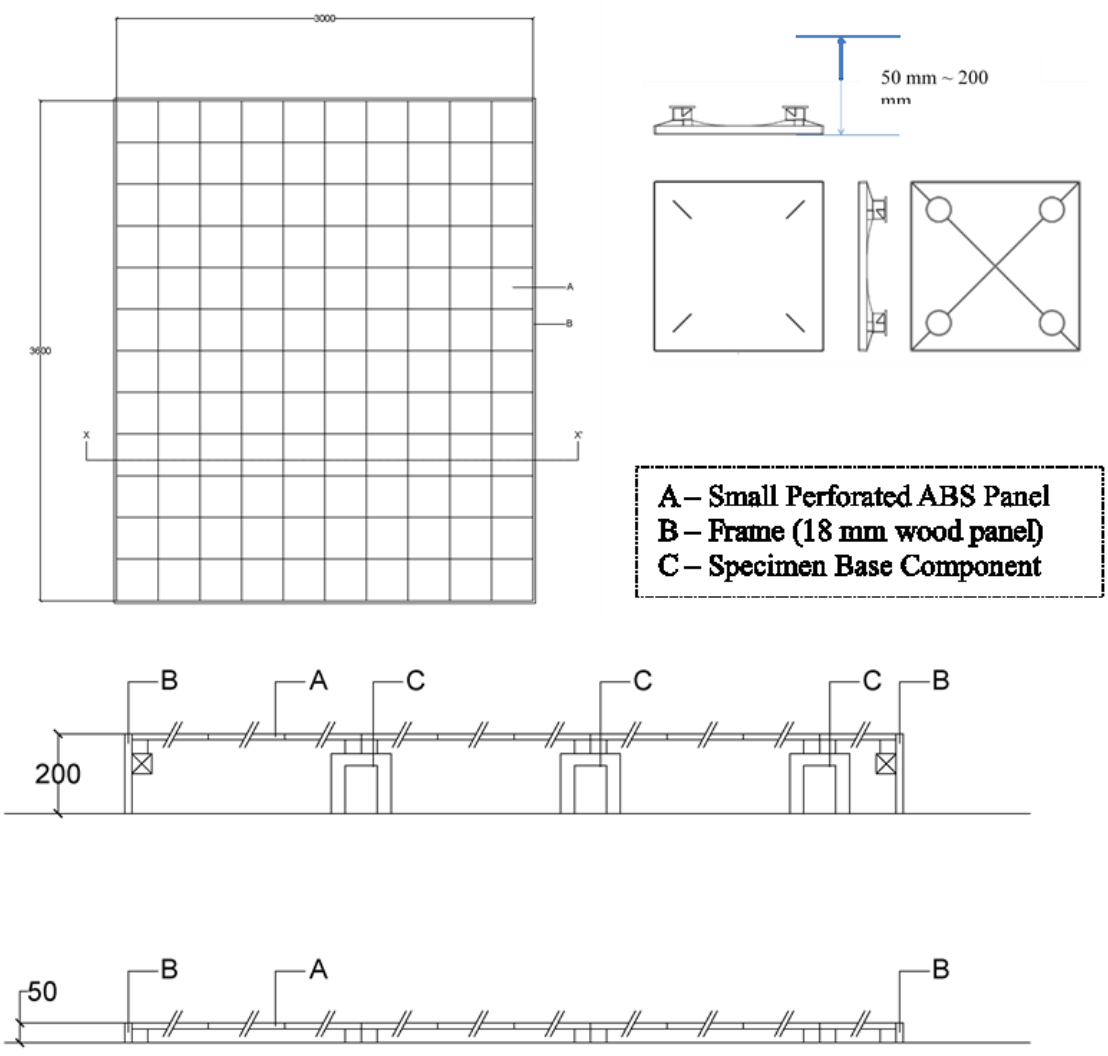

Figure 3 – Specimen setting

3.2 Factors of Specimen

The factors based on the basic acoustics were include diameter of bores, depth of air layer back panels. The applying types were separated into framed, un-framed, and independent. These factors as Table.2 would be the topic to analysis in follow-up measurement.

Table 2 – Factors of specimen

Sample	Basic Acoustics			Applying Types
	Diameter of Bore	Perforation Rate	Depth of Air Layer	
YM001	0.17 mm	1.40%	200 mm	--
YM002	0.25 mm	2.89%	200 mm	--
YM003	0.25 mm	2.89%	50 mm	--
YM004	0.25 mm	2.89%	200 mm	un-framed
YM005	0.25 mm	2.89%	200 mm	framed
YM006	0.25 mm	2.89%	200 mm	independent

3.3 Mandatory Registration of Authors

The results were in two parts. First part was analysis of the small perforated ABS panel in different basic acoustics factors setting. The factors were include perforation rate from adjusting diameter of bore, and depth of air layer back the panel with specimen as Figure.4. As results as Figure.4, the lower perforation rate of ABS panel provided better absorption on whole frequencies than 0.10 at least, and in middle and low frequencies almost 0.20. In the other factor about depth of air layer back panels, the measurement results obviously revealed the absorption in middle and low frequencies was depended on the enough depth of air layer. However, the setting with less depth of air layer still revealed sound absorption above 0.30.

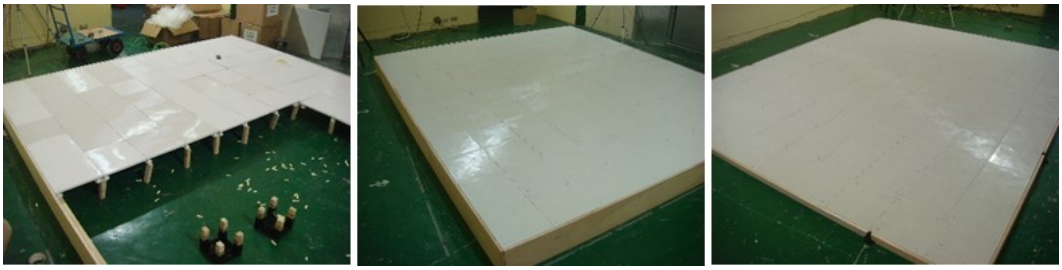

Figure 4 –Specimen of YM001, YM002, and YM003

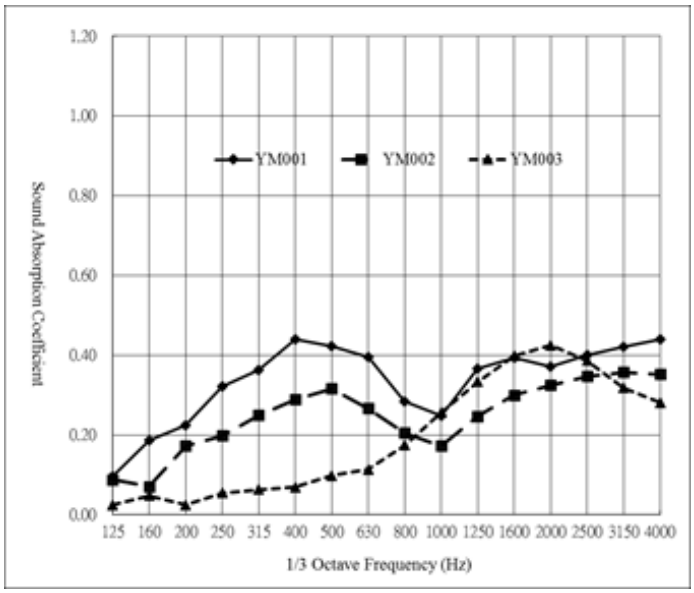

Figure 5 – Sound absorption of YM001, YM002, and YM003

The second part was about the applying types of ABS panels as absorbers. The setting of framed, un-framed and independent, as Figure, was reflected the actual application of absorbing panels as spatial decoration objects. As the difference of sound absorption, the type of framed obviously provided better absorption than one of un-framed almost one time, especially in middle and low frequencies. In the other side, the type of independent provided more uniform absorption with whole frequencies.

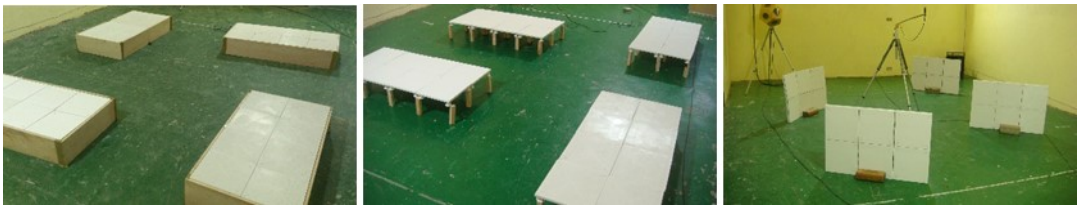

Figure 6 –Specimen of YM004, YM005, and YM006

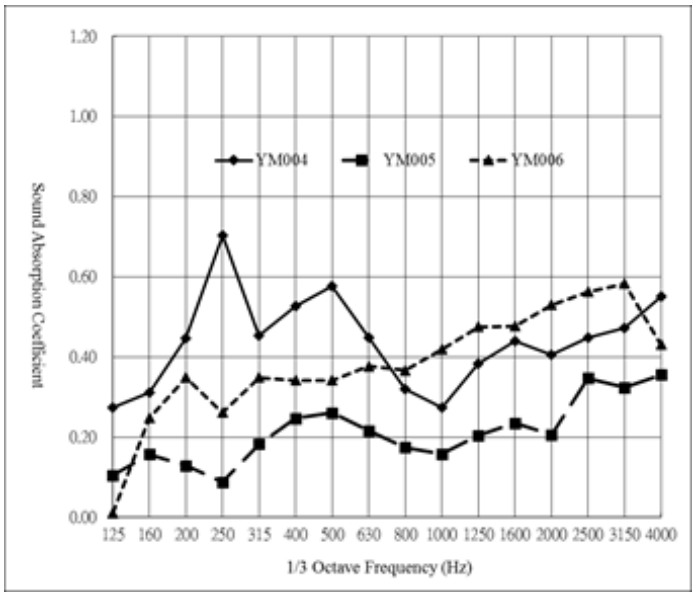

Figure 7 – Sound absorption of YM004, YM005, and YM006

4. APPLICATION

4.1 Actual Space for Acoustics Design

According to the data from laboratory measurement, the small perforated ABS panel would be set in interior space to affirm the sound absorbing effect in actual environment. The space was used for audio-visual room, and would be re-decoration in concern of room acoustics through the small perforated ABS panel. Based on the original space as Figure.8, the room acoustics was in over rich reverberation time. Through the spatial average absorption calculation according to sound absorption of ABS panel, the expectable reverberation time suitable for spatial purpose would be shown relied on distribution of ABS panel as Figure.8.

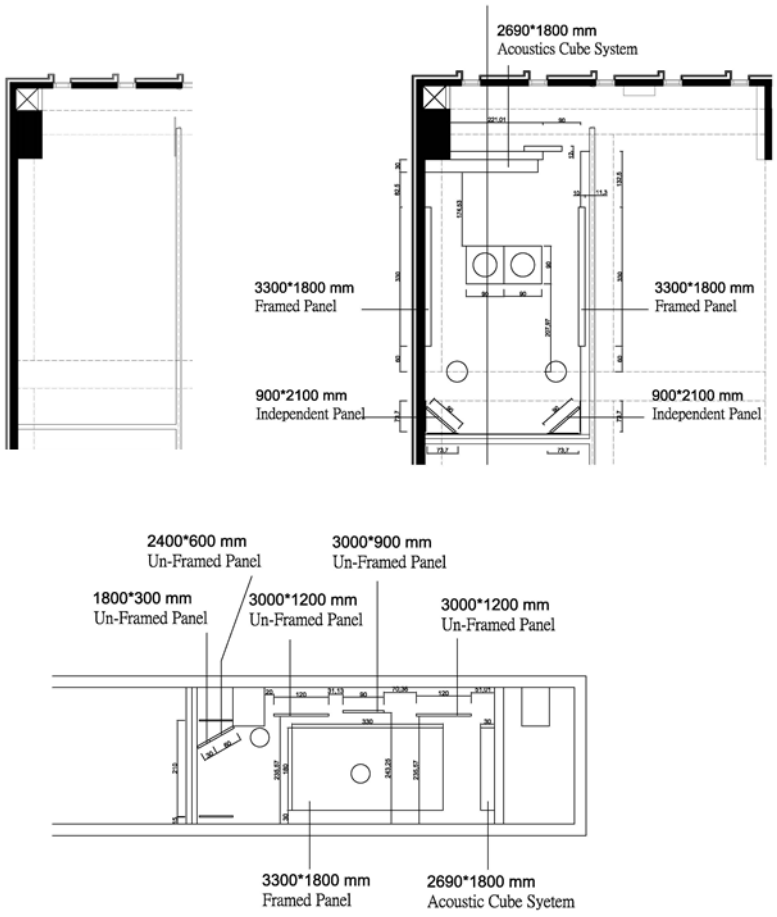

Figure 8 – Original space and distribution of ABS panel

4.2 Effects of actual spatial acoustics design

The actual space after decoration as Figure.10 would be confirmed with reverberation time by field measurement. The measurement results revealed that the reverberation time of space after acoustical design achieve suitable level for audio-visual space. Furthermore, the similar results of measurement and calculation have been shown a believable application for small perforated ABS panel in acoustical design.

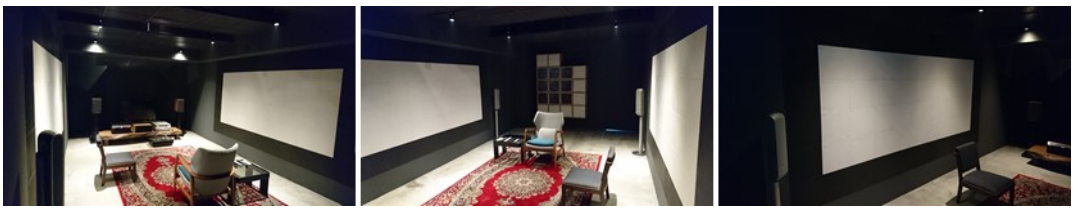

Figure 9 – Space after decoration for acoustics design

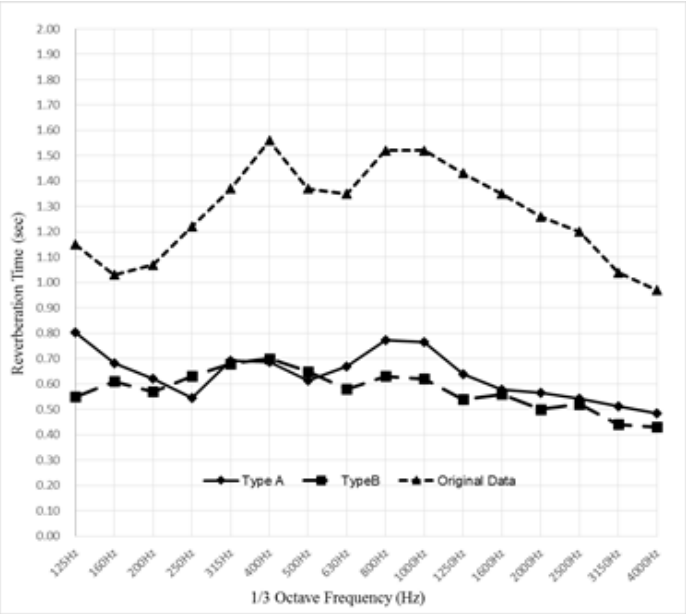

Figure 10 –Reverberation time of original space, calculation, and field measurement

5. CONCLUSIONS

Through the laboratory measurement to spatial acoustics design, the acoustical characteristic and actual spatial application of small perforated ABS panel would be clarified as three parts. In first part, the small perforated ABS panels possess sound absorption as 0.40, and be effective for room acoustics design. Then, the perforation rate of panel directly influenced the absorption of ABS panels in whole frequencies, and the depth of air layer made huge difference of absorption in middle and low frequencies. Besides, the absorption in high frequencies would be effective whether the air layer setting or not. Finally, the process from calculation to actual decoration would be a practical method to confirm effects of the new material for acoustical design.

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