

Test Report No. 7191014292-MEC11-EMK  
dated 19 Aug 2011



PSB Singapore

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**SUBJECT:**

Laboratory measurement of sound absorption of slotted panel system submitted by BA Furnishing Pte Ltd on 17 August 2011.

Choose certainty.  
Add value.

**TESTED FOR:**

BA Furnishing Pte Ltd  
10 Admiralty Street,  
NorthLink Building #06-30  
Singapore 787695

Attn: Mr John Goh

**DATE OF TEST:**

18 Aug 2011

**DESCRIPTION OF SAMPLES:**

12 pieces of slotted "Murano/SIU akustik" HDF panel were received for testing.

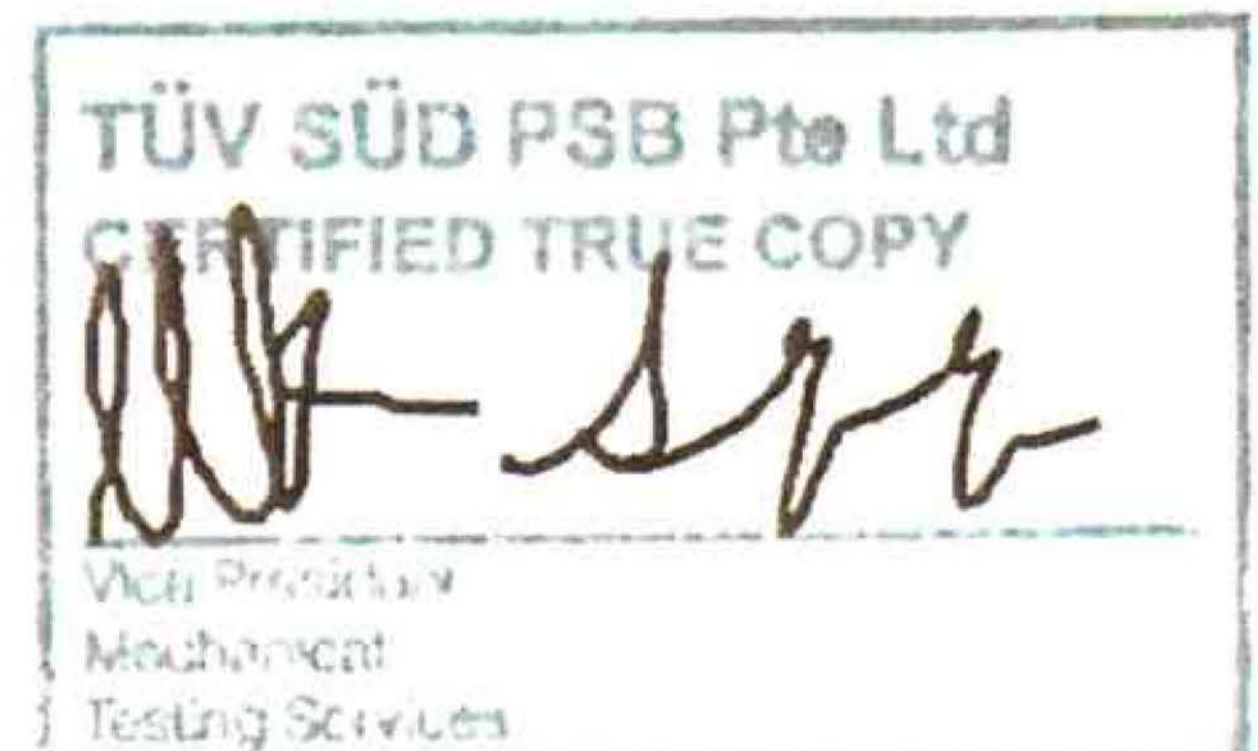
<u>Dimension</u>	<u>Weight</u>	<u>Quantity</u>
800mm (width) x 1200mm (length) x 17.85mm (thick)	14.6kg	7 pieces
800mm (width) x 900mm (length) x 17.85mm (thick)	11.2kg	4 pieces
710mm (width) x 1200mm (length) x 17.85mm (thick)	12.4kg	1 piece

The panel system was framed up using 75mm galvanised steel channel.

The panel system consisted of slotted "Murano/SIU akustik" HDF panels with a layer of black felt glued on its back and a layer of 25mm thick airspace and 50mm thick, 60kg/m<sup>3</sup> density rockwool.

The panel system was placed on the chamber floor as Type A mounting configuration in the reverberation room (refer to Figure 3). The gaps between the edges of the steel channel and the floor were sealed with reflective aluminium tapes.

The technical drawing of the panels system was shown in Appendix.



Laboratory:  
TÜV SÜD PSB Pte. Ltd.  
No.1 Science Park Drive  
Singapore 118221



LA-2007-0380-A  
LA-2007-0381-F  
LA-2007-0382-B  
LA-2007-0383-G  
LA-2007-0384-G  
LA-2007-0385-E  
LA-2007-0386-C  
LA-2010-0464-D

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

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**METHOD OF TEST:**

The test was conducted in accordance with the following test standards :

- a) ISO 354 : 2003 "Measurement of sound absorption in a reverberation room"
- b) ISO 11654 : 1997 "Sound absorbers for use in buildings - Rating of sound absorption"

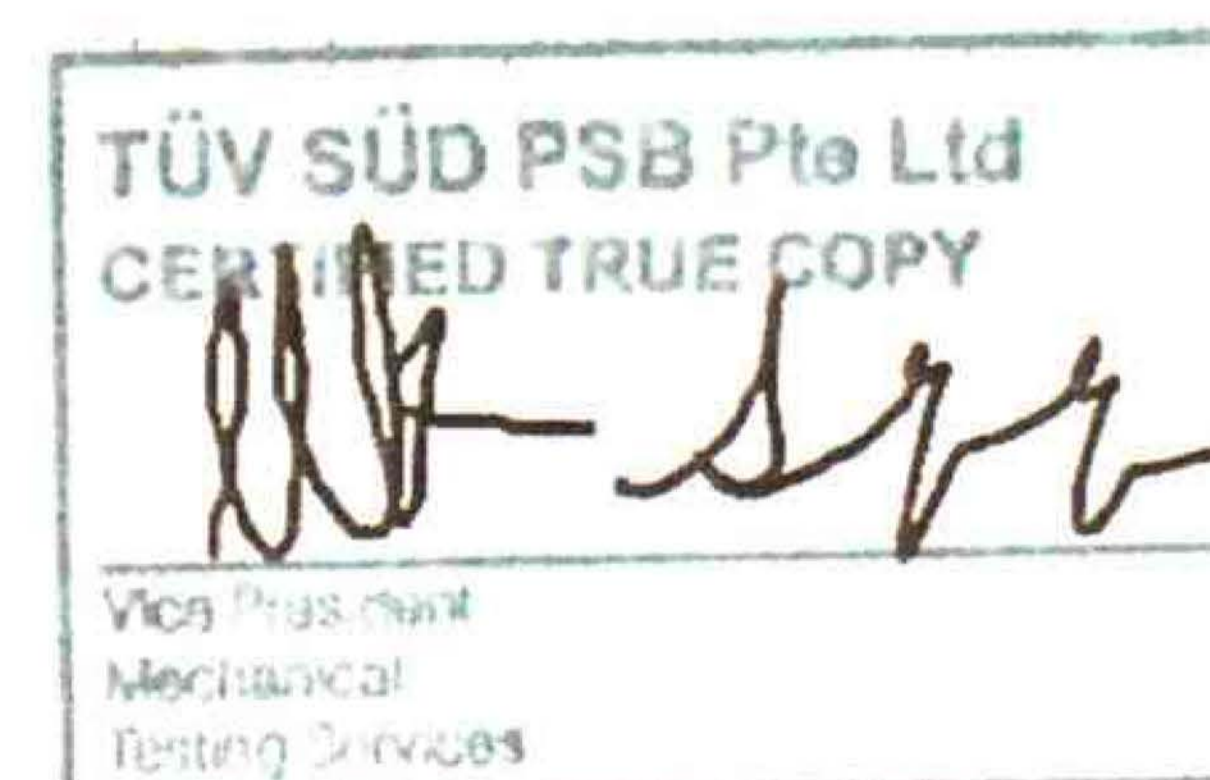
Test specimen exposed area : 10.49m<sup>2</sup>  
Temperature in reverberation room : 26°C  
Relative humidity in reverberation room: 45%  
Reverberation room volume : 206m<sup>3</sup>  
Location of the test : Acoustics Lab of TÜV SÜD PSB Pte Ltd

Figure 2 shows the test set-up in the reverberation room.

**TEST EQUIPMENT:**

The following instruments were used for the test.

- 1) Multi-channel Data Acquisition Unit (B & K Type 2816) with Pulse System
- 2) 2 unit of loudspeakers (JBL MPro MP415)
- 3) 1 set of ½" diffuse-field microphone (B & K Type 4943) and pre-amplifier (B & K Type 2669)
- 4) A power amplifier for speaker (Crown Model CE 1000)
- 5) A Sound Pressure Level Calibrator (Norsonic Type 1251)





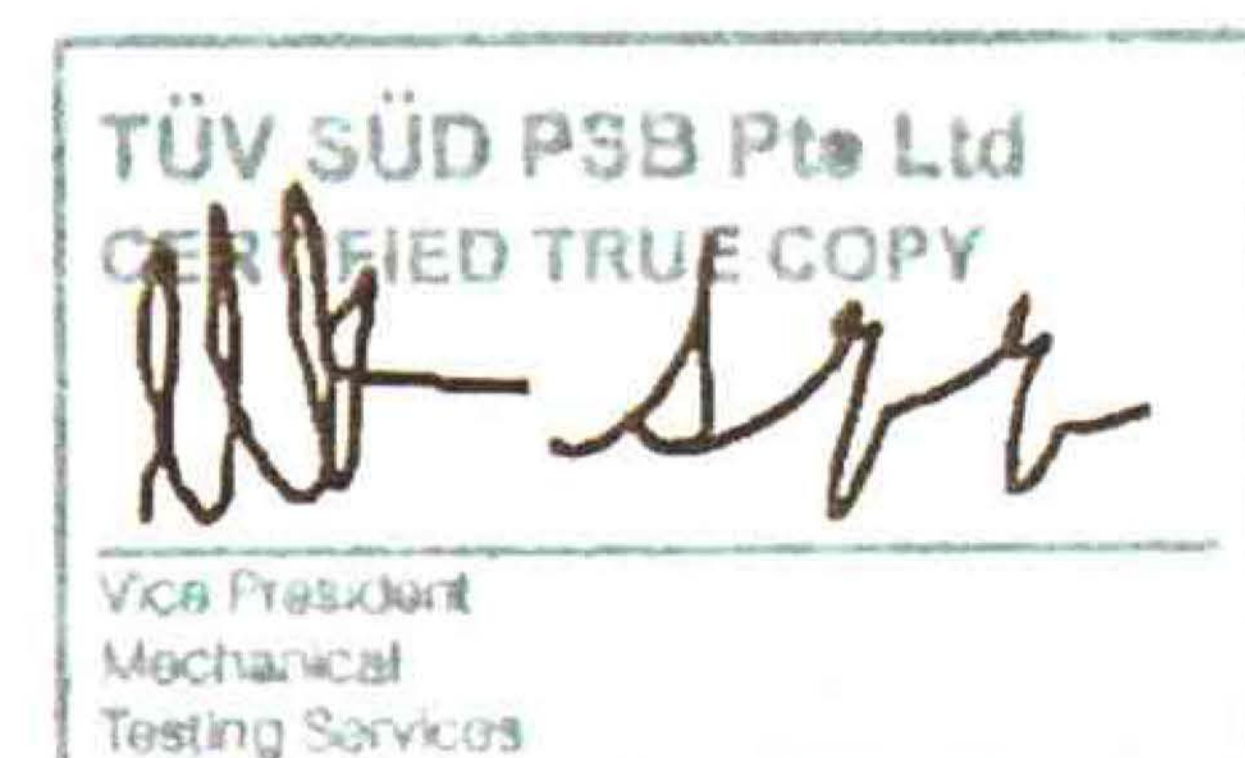
**TEST PROCEDURES:**

- 1) Instrumentation was set up according to ISO 354.
- 2) Measurement system was calibrated using a sound level calibrator.
- 3) 2 loudspeakers were placed at 2 different corners of the reverberation room.
- 4) Microphone was placed at 1m away from the test specimen, reverberation room and diffusers and 2m away from loudspeaker.
- 5) Measurement was conducted in 18 decays for each centre frequency of 1/3 octave band from 100Hz to 5000Hz.
- 6) Measurement was repeated for another 15 different microphone positions.
- 7) Mean reverberation time was calculated based on 16 measured reverberation time for each individual frequency of 1/3 octave band from 100Hz to 5000Hz.
- 8) Steps 3 to 7 were repeated after the test sample was installed in the reverberation room to obtain mean reverberation time for each frequency band.
- 9) Sound absorption area of the test specimen was calculated using formula

$$A = (55.3V/c) \times (1/T_2 - 1/T_1)$$

where V is the volume of the empty reverberation room, (m<sup>3</sup>)  
c is the velocity of sound in air,  
T<sub>1</sub> is the mean reverberation time of empty reverberation room, (s)  
T<sub>2</sub> is the mean reverberation time of reverberation room with test specimen installed, (s)

- 10) Sound absorption coefficient  $\alpha_i$  was calculated using formula,  $\alpha_i = A/S$  where S is the exposed surface area of the test specimen, (m<sup>2</sup>).
- 11) Practical sound absorption coefficient  $\alpha_{pi}$  for each octave band from the arithmetic mean value of the three one-third-octave sound absorption coefficient within the octave bands.
- 12) Weighted sound absorption coefficient  $\alpha_w$  was determined at the frequency of 500Hz of the shifted reference curve.



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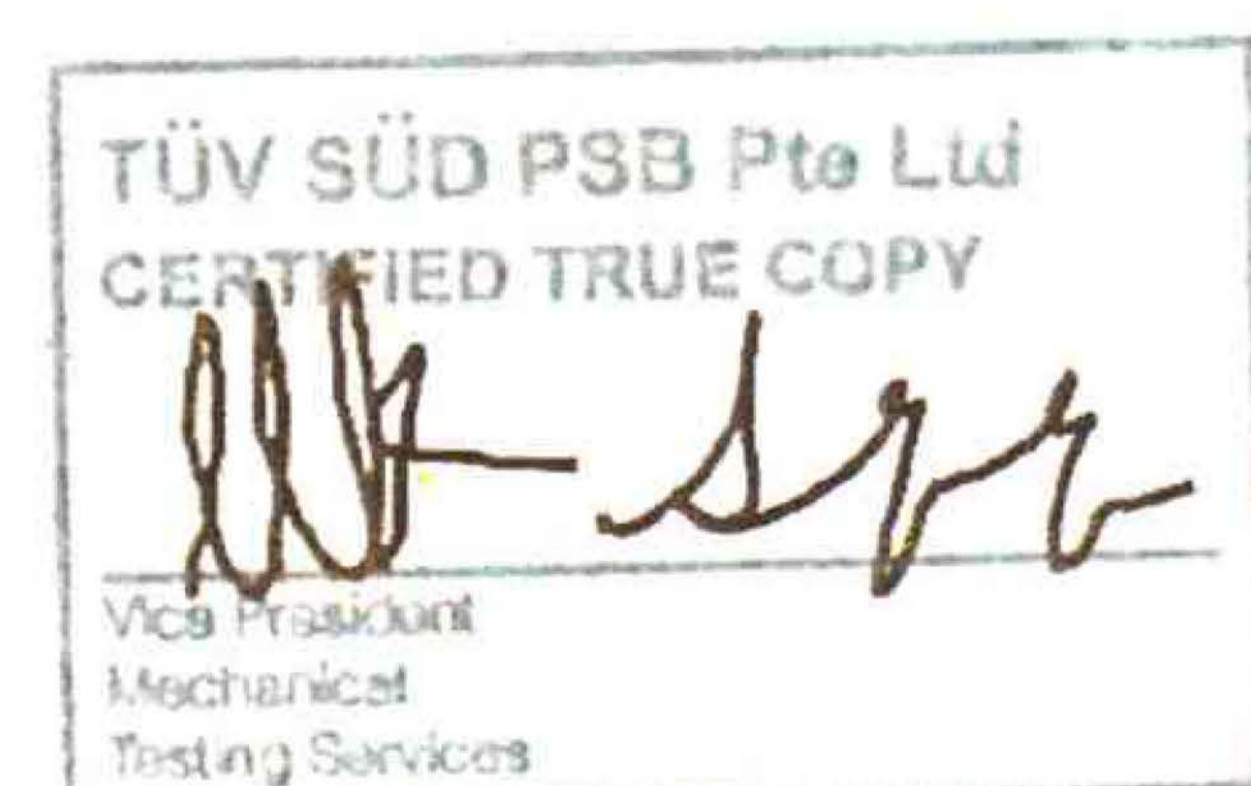
**RESULTS:**

- 1) Values of sound absorption coefficient  $\alpha_i$  and practical sound absorption coefficient  $\alpha_{pi}$  of the tested sample were tabulated in Table 1.
- 2) Weighted sound absorption coefficient  $\alpha_w$  rating was tabulated in Table 2.

**Table 1 : Sound Absorption Coefficient and Practical Sound Absorption Coefficient of slotted "Murano/SIU akustik" HDF panel system**

1/3 Octave Frequency (Hz)	"Murano/SIU akustik" HDF panel system (Type A mounting)		
	Sound Absorption Coefficient, $\alpha_i$	Practical sound absorption coefficient, $\alpha_{pi}$	Uncertainty
100	0.59		± 0.13
<b>125</b>	0.70	(0.62)	± 0.11
160	0.56		± 0.08
200	0.75		± 0.08
<b>250</b>	0.58	(0.60)	± 0.05
315	0.49		± 0.02
400	0.36		± 0.02
<b>500</b>	0.29	(0.29)	± 0.01
630	0.22		± 0.01
800	0.14		± 0.01
<b>1000</b>	0.13	(0.12)	± 0.00
1250	0.10		± 0.00
1600	0.09		± 0.00
<b>2000</b>	0.08	(0.09)	± 0.00
2500	0.09		± 0.00
3150	0.07		± 0.00
<b>4000</b>	0.09	(0.09)	± 0.00
5000	0.12		± 0.00

**Remark :** Values in bracket ( ) denotes the values of Practical Sound Absorption Coefficient,  $\alpha_{pi}$  at 1/1 Octave Frequency Bands.

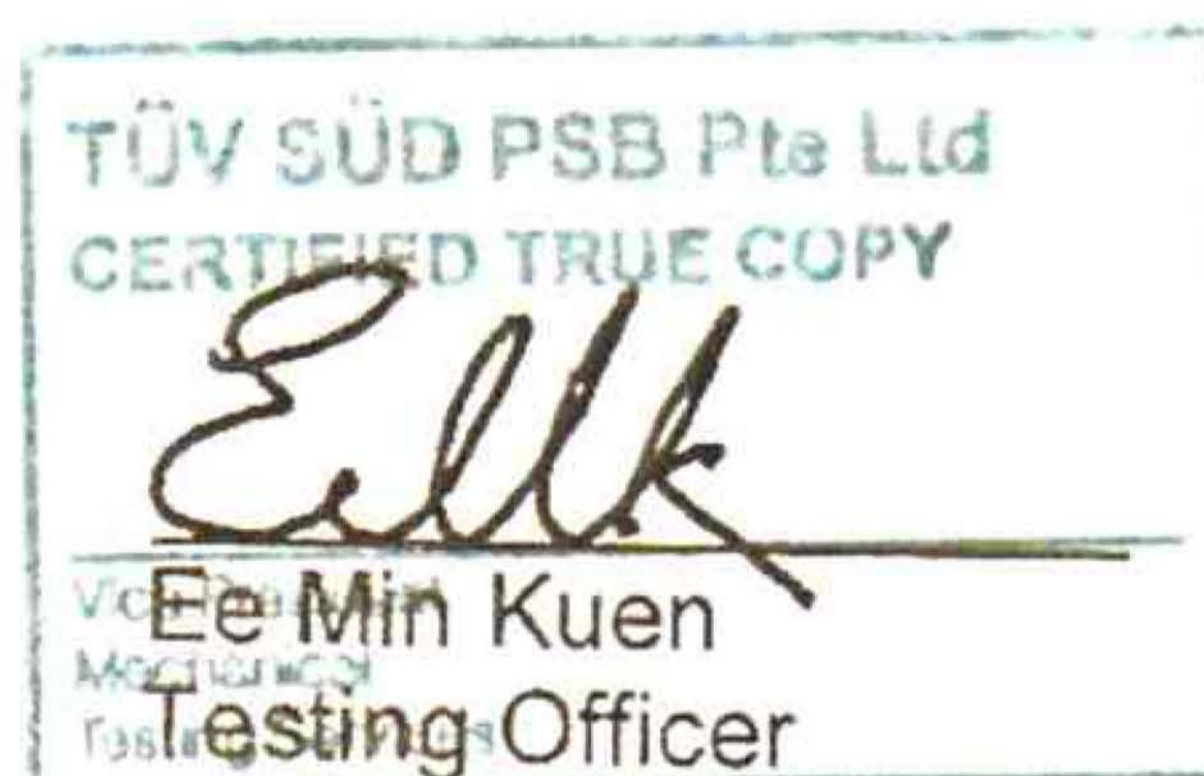


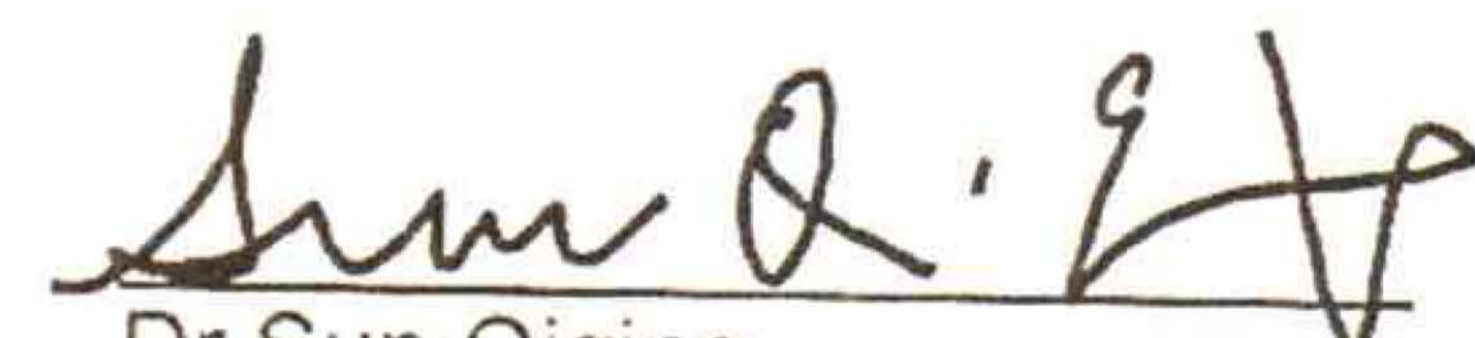
RESULTS: (cont'd)

Table 2 : Weighted sound absorption coefficient  $\alpha_w$  rating of slotted  
"Murano/SIU akustik" HDF panel system

Frequency (Hz)	Shifted reference Curve	Practical Absorption Coefficient, $\alpha_{pi}$	Deficiency	
125	-	0.60	-	-
250	-0.05	0.60	-0.65	0.00
500	<b>0.15</b>	0.30	-0.15	0.00
1000	0.15	0.10	0.05	0.05
2000	0.15	0.10	0.05	0.05
4000	0.05	0.10	-0.05	0.00
Total Deficiency (250Hz - 4000Hz)				0.10
Weighted Sound Absorption Coefficient, $\alpha_w$				<b>0.15 (L)</b>

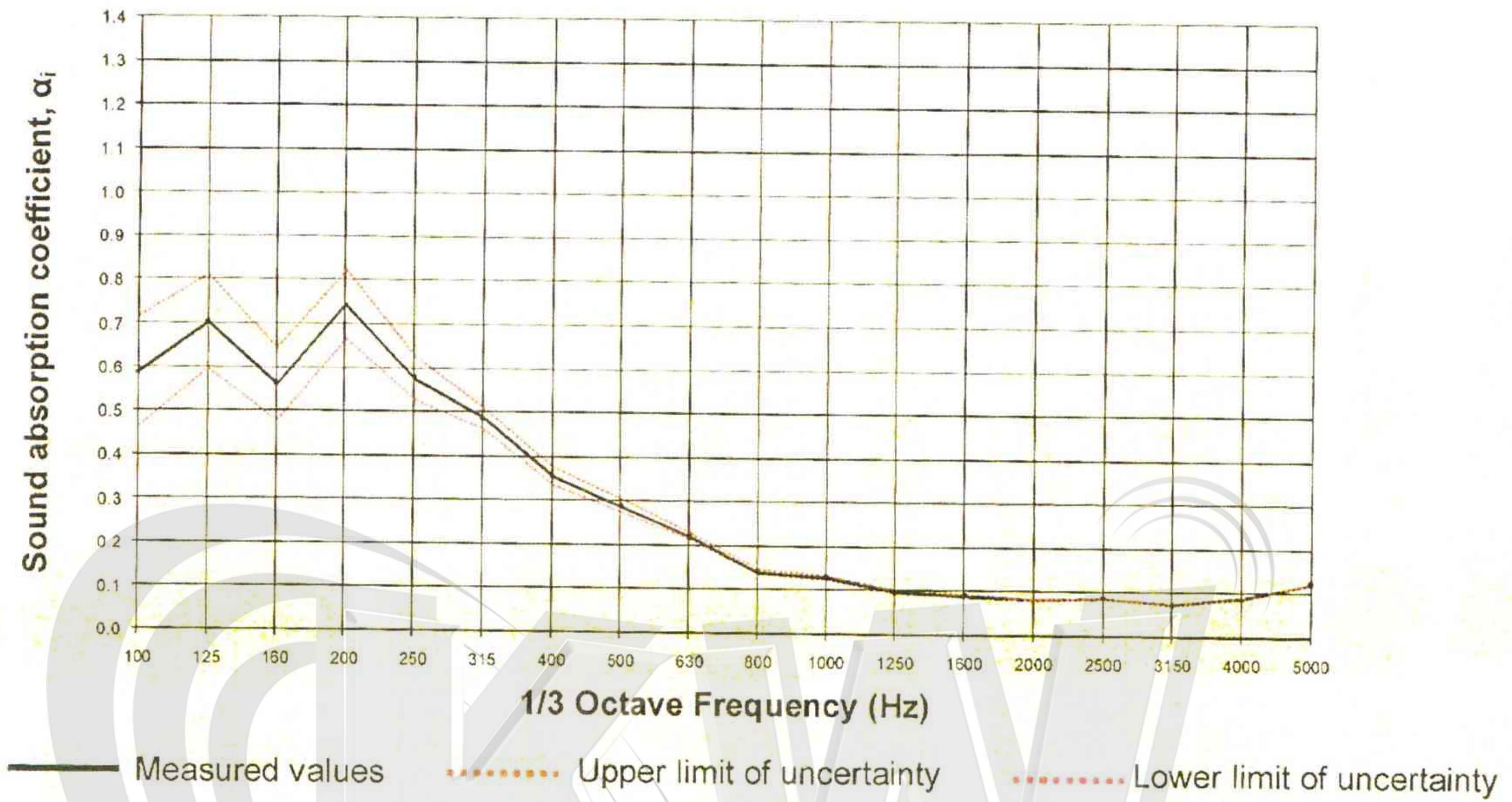
**Remark :** Values in bracket (L) denotes the values of Practical Sound Absorption Coefficient,  $\alpha_{pi}$  at 250Hz exceed the value of the shifted reference curve by 0.25 or more.



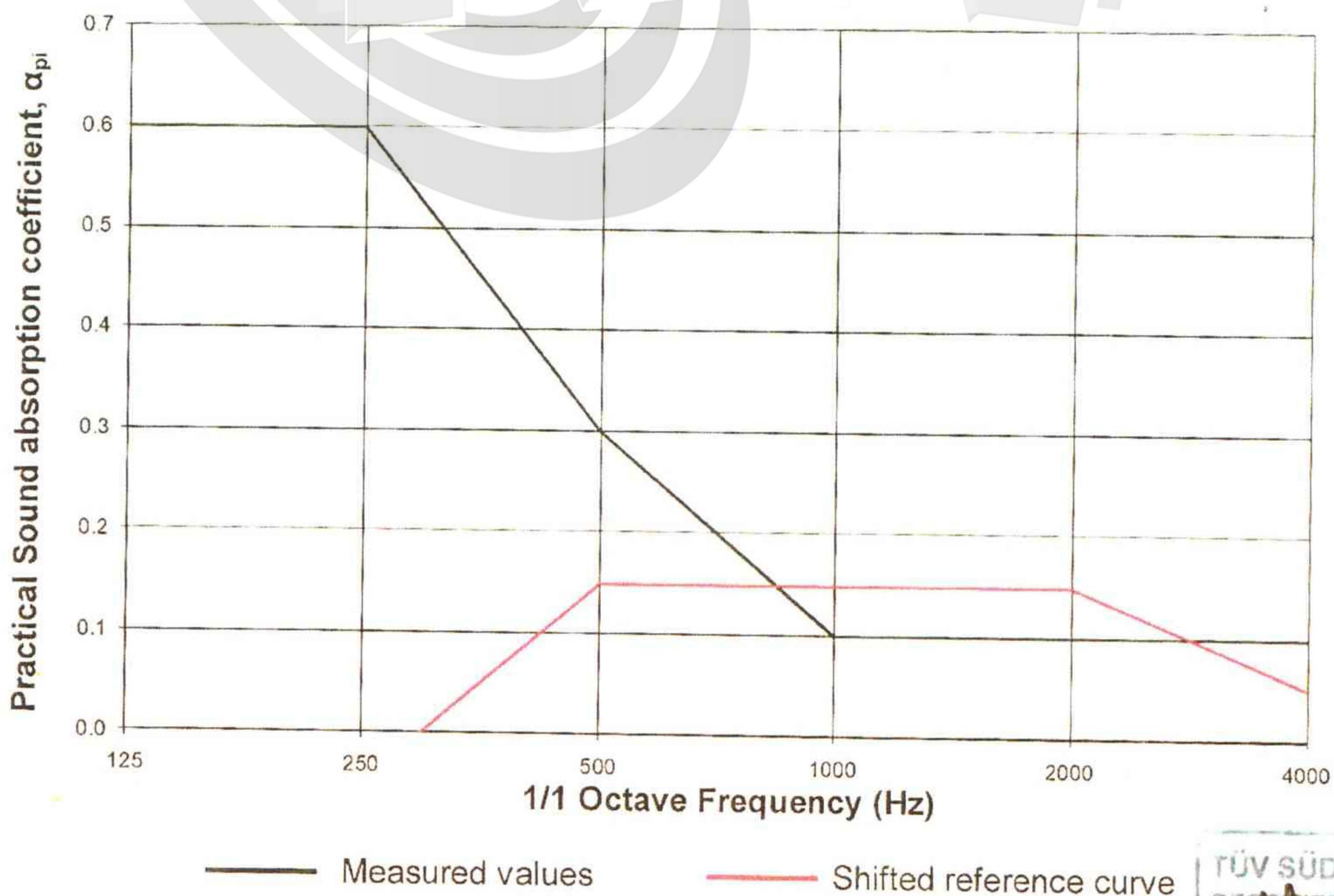
  
Dr Sun Qiqing  
Assistant Vice President  
Building and Acoustics  
Mechanical Centre

**RESULTS: (cont'd)**

**Figure 1 : Sound absorption performance of slotted "Murano/SIU akustik" HDF panel system**



**Figure 2 : Weighted Sound absorption coefficient performance of slotted "Murano/SIU akustik" HDF panel system (Type A mounting)**



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Vice President  
Mechanical  
Testing Services  
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Figure 3 : Sound absorption test setup of "Murano/SIU akustik" HDF panel system in reverberation room (Type A mounting)



Figure 4 : 50mm (thick), 60kg/m<sup>3</sup> density rockwool were installed inside 75mm thick steel channel frame



Figure 5 : Slotted "Murano/SIU akustik" HDF panel laying on steel channel leaving 25mm airspace between the rockwool and the panel



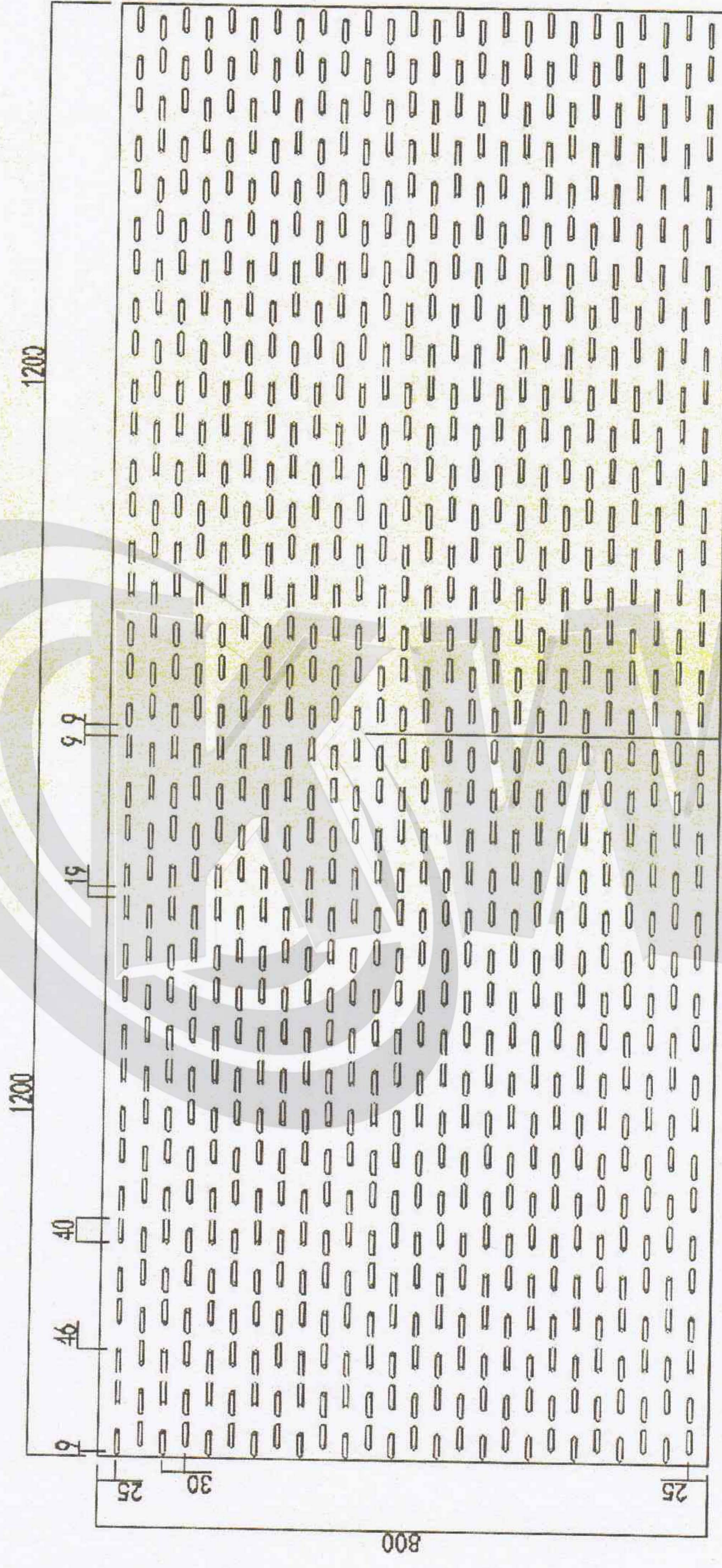
Figure 6 : Slotted "Murano/SIU akustik" HDF panel





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Appendix - Technical Drawing



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Please note that this Report is issued under the following terms :

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July 2011