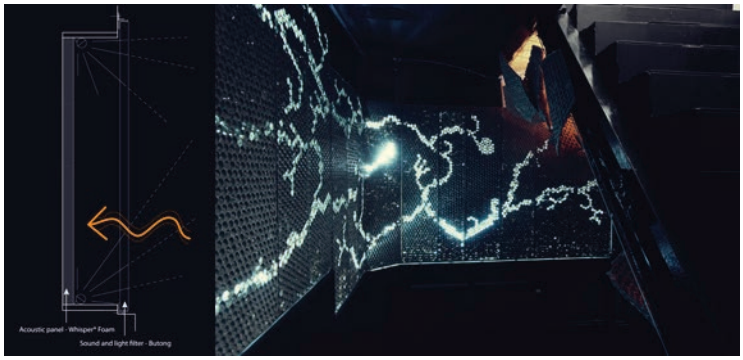
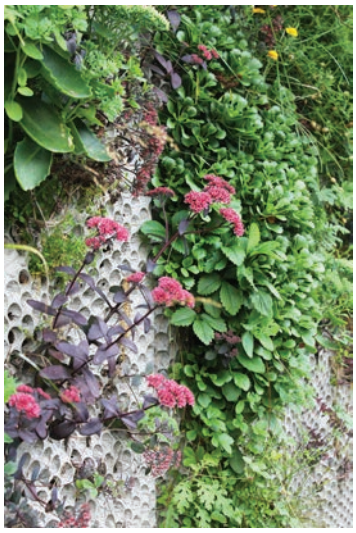
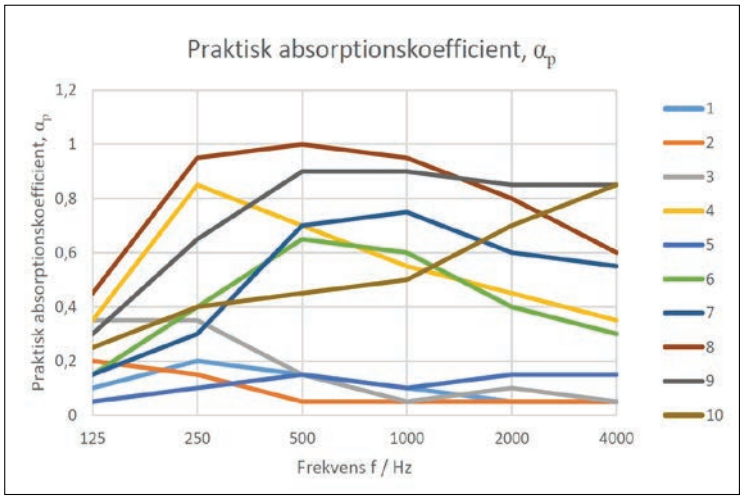
butong | Akustikkonsulten







Acoustic description for professionals

Last updated 2016-07-13

We are a creative concrete producer dedicated to improving the built environment.

Our patented method for casting concrete allows us to introduce organic life in your room or city environment.

living · concrete
casting · brilliance

Aim of document:

This document aims at describing the acoustic properties of butong

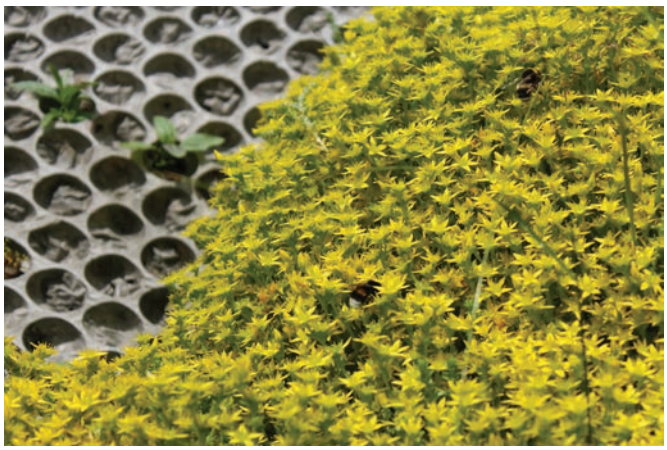
Butong offer unique opportunities for optimizing the acoustic properties in a space. At Butong we have two visions for the future - One is to create the living breathing cities of the future - The other is to help realize the interior space of an opera house: Perfectly shaped for acoustics and glistening like a starry night.

One step in achieving these goals has been to test our different products to verify the acoustic properties. The report following in this document was carried out by professional acoustic consultants - Akustikkonsulten - who akso performed the testing, performed in the reverbaration room in the Royal Institute of Science, Stockholm.

The test result show that Butong panels vary from unclassified to C-class and all the way up to the highest class, A.

Dictionary:

Culture medium (Substrate) - **is used in vertical gardens behind the Butong panel to hold moisture and nutrients for roots. Primarily pumice stone.**



The following situations were tested

Measurment 1
Butong panels laid directly against the test surface.

Measurment 2
Butong panels laid on top of a 45x120 mm timber stud frame, with no material in the 120 mm high air cavity.

Measurment 3
Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity.

Measurment 4
Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity."

Measurment 5
Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with no insulation in the 120 mm high cavity.

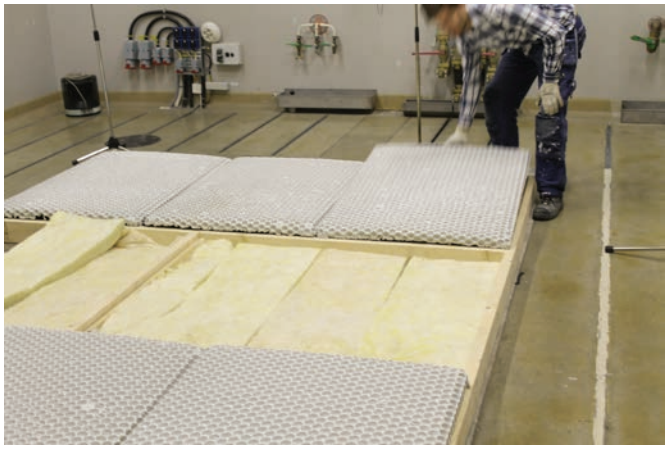
Measurment 6
Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity.

Measurment 7
Fully open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity.

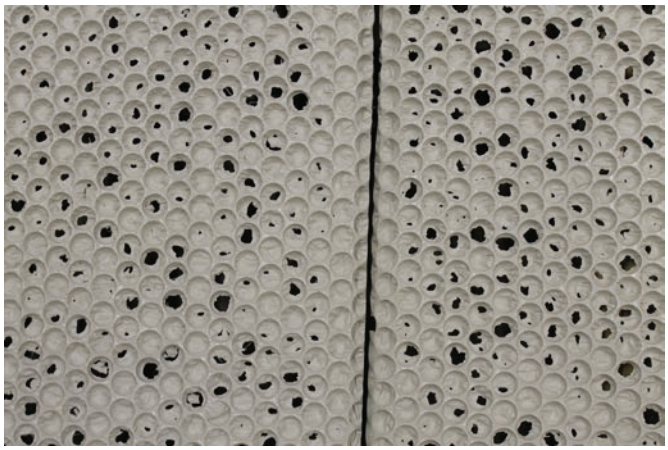
Measurment 8
Fully open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity.

Measurment 9
Fully open Butong panels covered by moss and laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity.

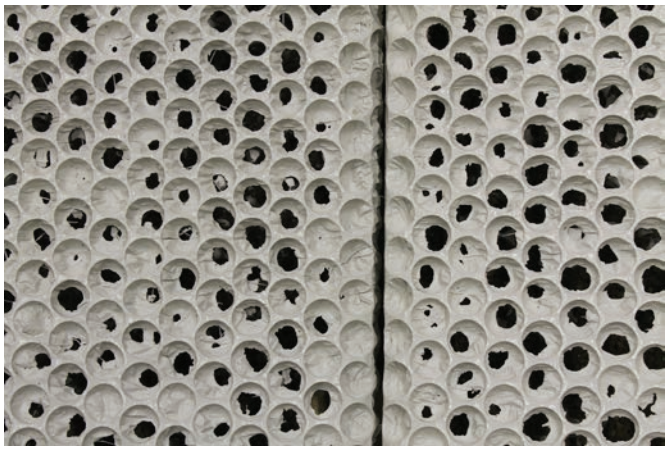
Measurment 10
Fully open Butong panels covered by moss and laid on top of a 45x120 mm timber stud frame, with no insulation in the 120 mm high cavity.



Example of solid panels - 1,2,3



Example of semi-open panels - 4,5,6



Example of fully-open panels - 7,8

Example of moss-panels - 9,10

Project No:
10-16015
Report A

Date
2016-07-12

Project Manager:
David Geiger
Phone:
0730-780 952
E-mail:
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Client:
Butong AB
Client's representative:
Staffan Snis

Butong AB

Sound Absorption Testing of Butong Panels

Akustikkonsulten i Sverige AB

Magnus Tiderman

Checked

David Geiger

Akustikkonsulten i Sverige AB
Org.nr. 559037-9201
Adolfsbergsvägen 31, 168 66 Bromma

Table of Contents

1 Project Description

Akustikkonsulten i Sverige AB has been engaged by Butong AB to carry out sound absorption testing on various configurations of Butong's panels. The acoustic testing was conducted in a laboratory.

2 Test Objects

The following panels and configurations were tested:

Table 1. Test objects

Test No.	Description
1	Butong panels laid directly against the test surface.
2	Butong panels laid on top of a 45x120 mm timber stud frame, with no material in the 120 mm high air cavity.
3	Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity.
4	Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity.
5	Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with no insulation in the 120 mm high cavity.
6	Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity.
7	Fully open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity.
8	Fully open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity.
9	Fully open Butong panels covered by moss and laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity.
10	Fully open Butong panels covered by moss and laid on top of a 45x120 mm timber stud frame, with no insulation in the 120 mm high cavity.

2.1 Laboratory Testing

The measurements were carried out by David Geiger and Magnus Tiderman at The Marcus Wallenberg Laboratory for Sound and Vibration Research (MWL) at the Royal Institute of Technology (KTH) in Stockholm. The measurements were conducted in accordance with SS-EN ISO 354 and the results evaluated in accordance with ISO 11654. The measurement results are corrected for variations in the climatic conditions in accordance with ISO 9613-1. The following measurement equipment were used:

Table 2. Measurement equipment

Description	Manufacturer and type	Serial No.
Acoustic analyser	Norsonic 140	1406499
Calibrator	Norsonic type 1251	34627
Loudspeaker and amplifier	*MWL's equipment*	-
Thermal hygrometer	Testo	-
Barometer	Davis vantage pro 2	AS160224090

2.2 Panel Configuration

The tested panels had the dimensions 900x1200 mm (test 1-8) and 600x1200 mm (test 9-10) respectively. A total of 9 panels were used for test 1-8 and a total of 6 panels for test 9-10. The overall Dimensions of the specimen as measured were 2700x3600 mm and 1200x3600 mm respectively. The configurations are shown in Figure 1 and Figure 2 below.

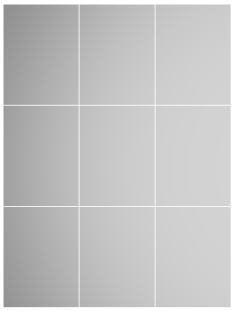


Figure 1. Configuration with 9 panels

Figure 2. Configuration with 6 panels

Three different types of panels were tested; solid panels, semi-open panels and fully open panels. The semi-open and fully open panels are shown in Figure 3 and Figure 4.

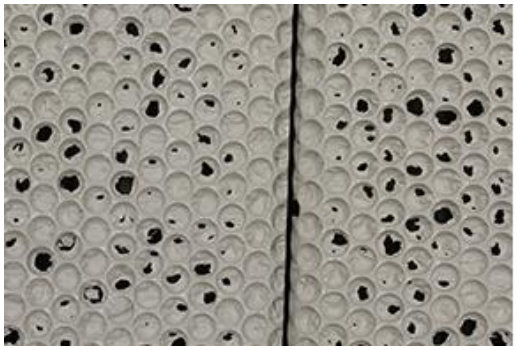


Figure 3. Semi-open panels

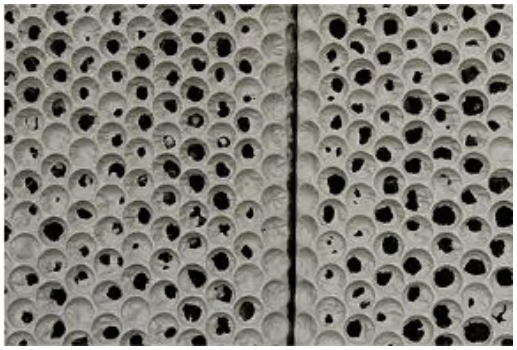


Figure 4. Fully open panels

2.3 Non-conformities

The measurements have been conducted with deviations from the standard, with regard to the overall size of the tested specimen.

3 Measurement Results

In Table 3 and Figure 5 below, the results are presented detailing the measured Practical Sound Absorption Coefficient, the Weighted Sound Absorption Coefficient and the Sound Absorption Class for each test respectively. The results are also presented in Appendix A.

Table 3. Measurement results

Test No.	Practical sound absorption coefficient α_p at octave band (Hz)						Weighted sound absorption coefficient α_w	Sound absorption class
	125	250	500	1000	2000	4000		
1 (*see Appendix A*)	0.10	0.20	0.15	0.10	0.05	0.05	0.10 (L)	Not classified
2 (*see Appendix A*)	0.20	0.15	0.05	0.05	0.05	0.05	0.05 (L)	Not classified
3 (*see Appendix A*)	0.35	0.35	0.15	0.05	0.10	0.05	0.10 (L)	Not classified
4 (*see Appendix A*)	0.35	0.85	0.70	0.55	0.45	0.35	0.45 (LM)	D
5 (*see Appendix A*)	0.05	0.10	0.15	0.10	0.15	0.15	0.15	E
6 (*see Appendix A*)	0.15	0.40	0.65	0.60	0.40	0.30	0.4	D
7 (*see Appendix A*)	0.15	0.30	0.70	0.75	0.60	0.55	0.6	C
8 (*see Appendix A*)	0.45	0.95	1.00	0.95	0.80	0.60	0.75 (LM)	C
9 (*see Appendix A*)	0.30	0.65	0.90	0.90	0.85	0.85	0.9	A
10 (*see Appendix A*)	0.25	0.40	0.45	0.50	0.70	0.85	0.5 (H)	D

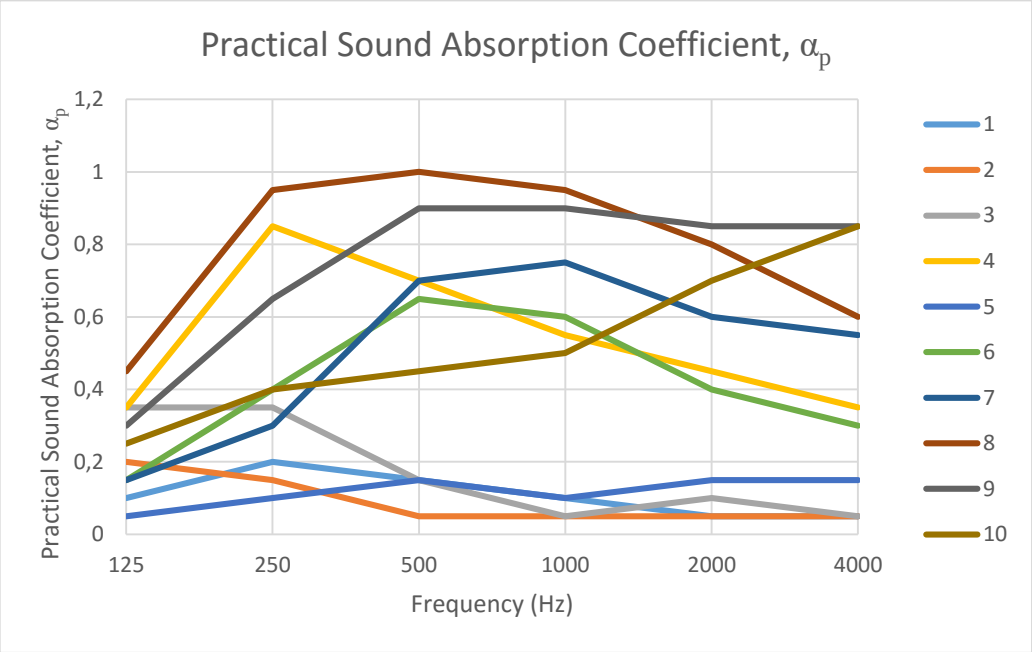


Figure 5. Measured Practical Sound Absorption Coefficient (α_p) for test 1-10.

Appendix A

Sound absorption coefficient acc. to ISO 354

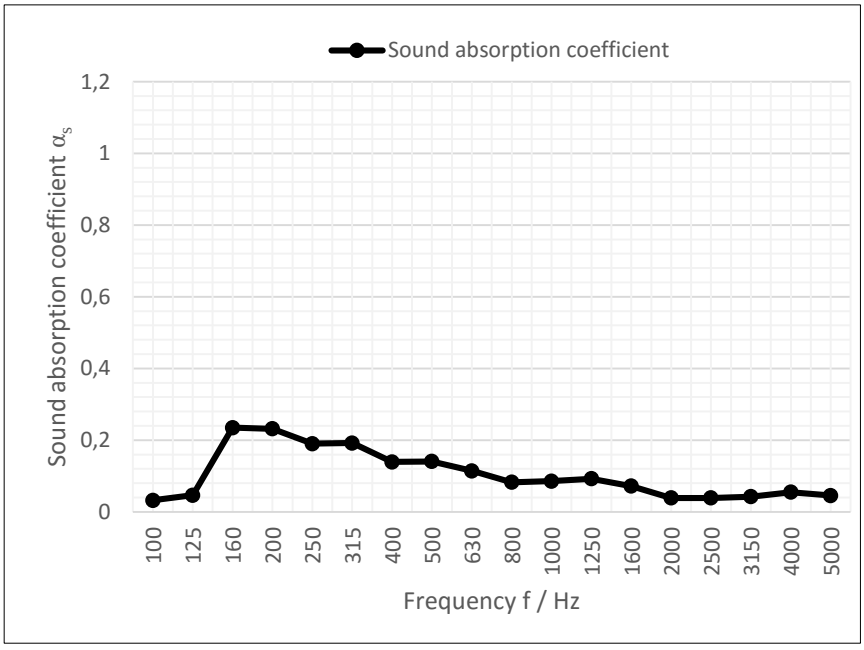
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Butong panels laid directly against the test surface. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	*r.h.*[%]	P_0 [Pa]
with specimen	20	36	101200
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.03[1]	0.10
125	0.05[1]	
160	0.23	
200	0.23	0.20
250	0.19	
315	0.19	
400	0.14	0.15
500	0.14	
630	0.11	
800	0.08[1]	0.10
1000	0.09[1]	
1250	0.09[1]	
1600	0.07[1]	0.05
2000	0.04[1]	
2500	0.04[1]	
3150	0.04[1]	0.05
4000	0.05[1]	
5000	0.05[1]	



[1] Equivalent sound absorption area less than 1.0 m^2
α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.10 (L)

Sound absorption class **Not classified**

Appendix A

Sound absorption coefficient acc. to ISO 354

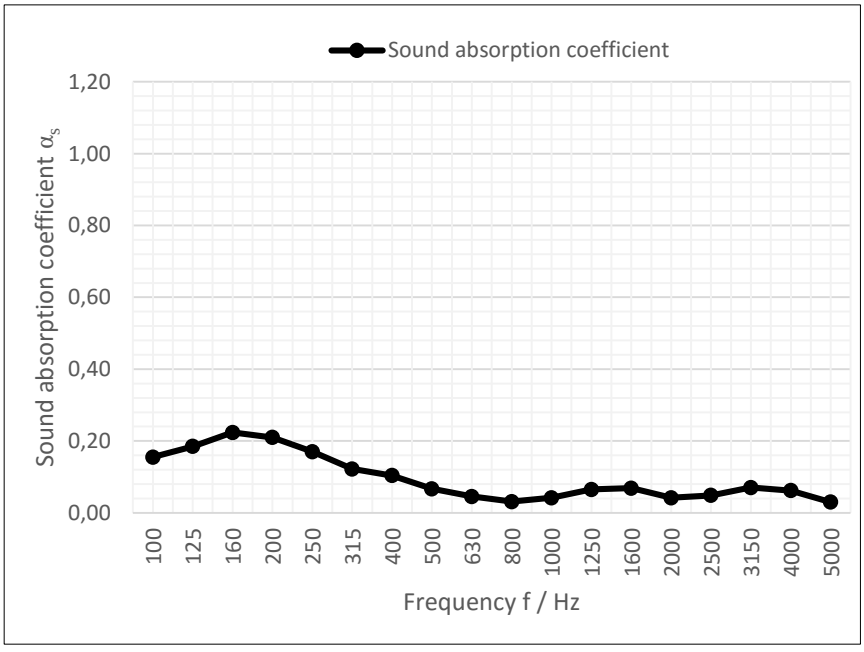
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Butong panels laid on top of a 45x120 mm timber stud frame, with no material in the 120 mm high air cavity. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	*r.h.*[%]	P_0 [Pa]
with specimen	20	36	101200
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.16	0.20
125	0.19	
160	0.22	
200	0.21	0.15
250	0.17	
315	0.12	
400	0.10	0.05
500	0.07[1]	
630	0.05[1]	
800	0.03[1]	0.05
1000	0.04[1]	
1250	0.06[1]	
1600	0.07[1]	0.05
2000	0.04[1]	
2500	0.05[1]	
3150	0.07[1]	0.05
4000	0.06[1]	
5000	0.03[1]	



[1] Equivalent sound absorption area less than 1.0 m^2
α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.05 (L)

Sound absorption class **Not classified**

Appendix A

Sound absorption coefficient acc. to ISO 354

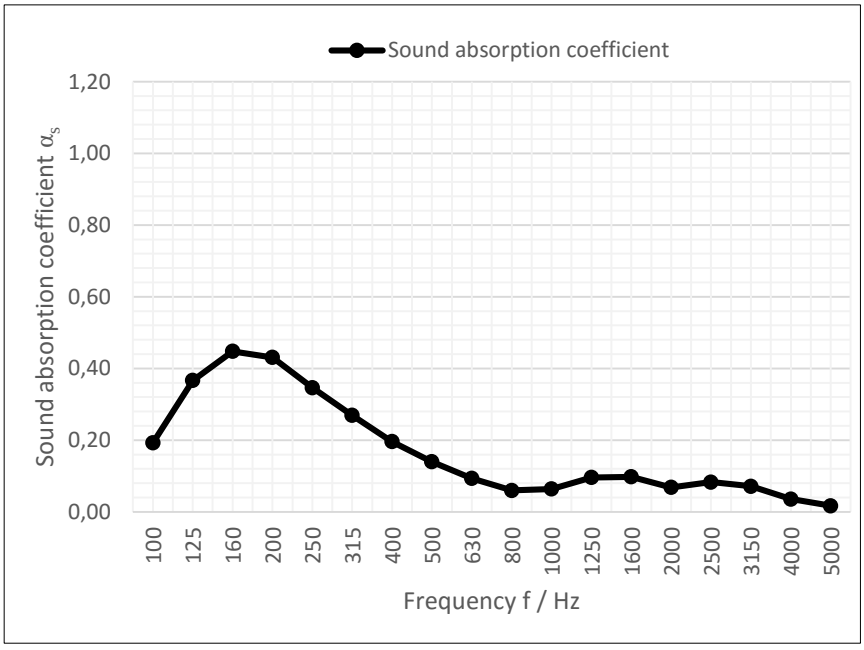
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity. The glasswool's density was approximately 15 kg/m^3. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	$r.h.$[%]	P_0 [Pa]
with specimen	20	36	101200
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.19	0.35
125	0.37	
160	0.45	
200	0.43	0.35
250	0.35	
315	0.27	
400	0.20	0.15
500	0.14	
630	0.09[1]	
800	0.06[1]	0.05
1000	0.06[1]	
1250	0.10[1]	
1600	0.10	0.10
2000	0.07[1]	
2500	0.08[1]	
3150	0.07[1]	0.05
4000	0.04[1]	
5000	0.02[1]	



[1] Equivalent sound absorption area less than 1.0 m^2
α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.10 (L)

Sound absorption class **Not classified**

Sound absorption coefficient acc. to ISO 354

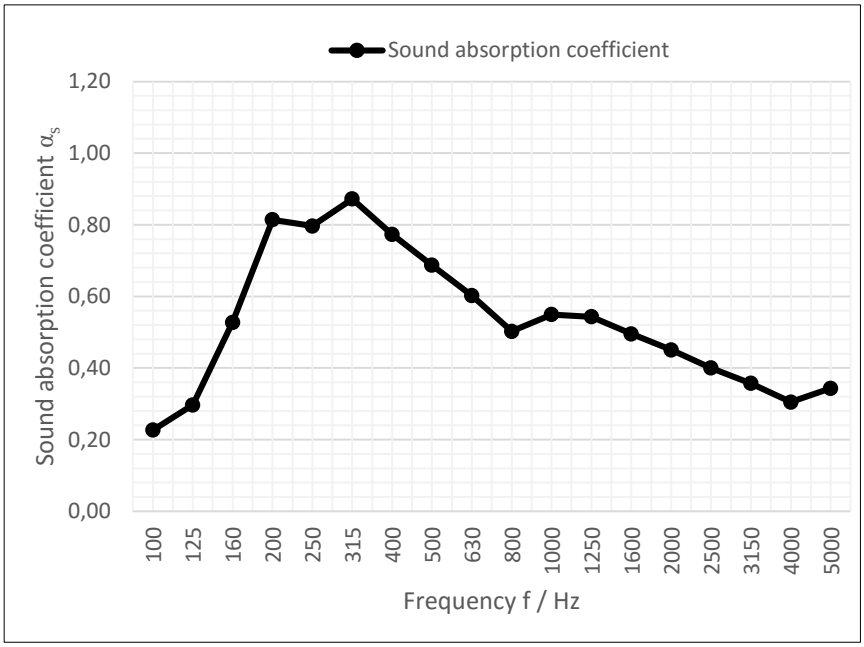
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity. The glasswool's density was approximately 15 kg/m^3. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	$r.h.$[%]	P_0 [Pa]
with specimen	20.7	42	101200
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.23	0.35
125	0.30	
160	0.53	
200	0.81	0.85
250	0.80	
315	0.87	
400	0.77	0.70
500	0.69	
630	0.60	
800	0.50	0.55
1000	0.55	
1250	0.54	
1600	0.50	0.45
2000	0.45	
2500	0.40	
3150	0.36	0.35
4000	0.30	
5000	0.34	



α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.45 (LM)

Sound absorption class **D**

Sound absorption coefficient acc. to ISO 354

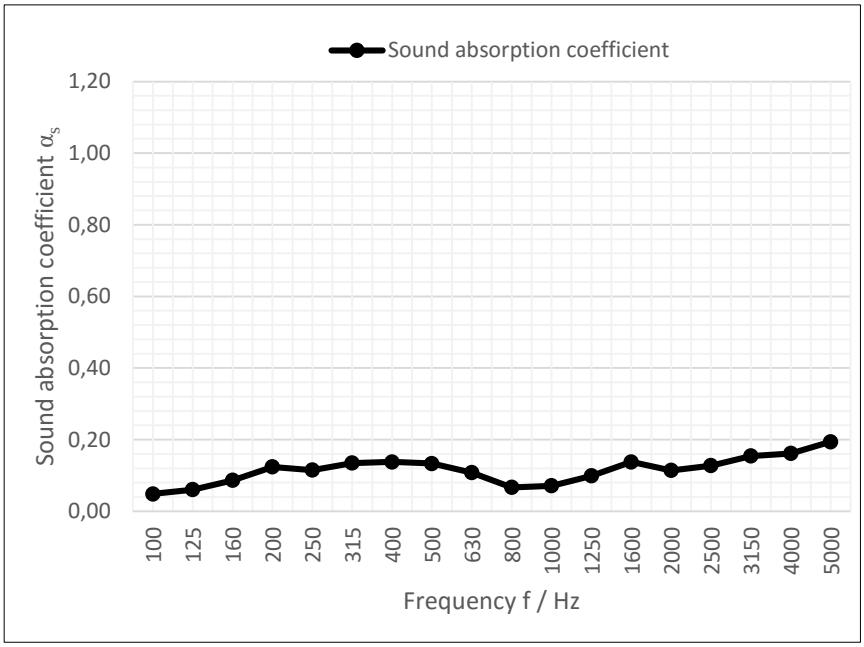
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with no insulation in the 120 mm high cavity. The glasswool's density was approximately 15 kg/m^3. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	$r.h.$[%]	P_0 [Pa]
with specimen	20.7	42	101200
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.05[1]	0.05
125	0.06[1]	
160	0.09[1]	
200	0.12	0.10
250	0.11	
315	0.13	
400	0.14	0.15
500	0.13	
630	0.11	
800	0.07[1]	0.10
1000	0.07[1]	
1250	0.10	
1600	0.14	0.15
2000	0.11	
2500	0.13	
3150	0.15	0.15
4000	0.16	
5000	0.19	



[1] Equivalent sound absorption area less than 1.0 m^2
α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.15

Sound absorption class **E**

Sound absorption coefficient acc. to ISO 354

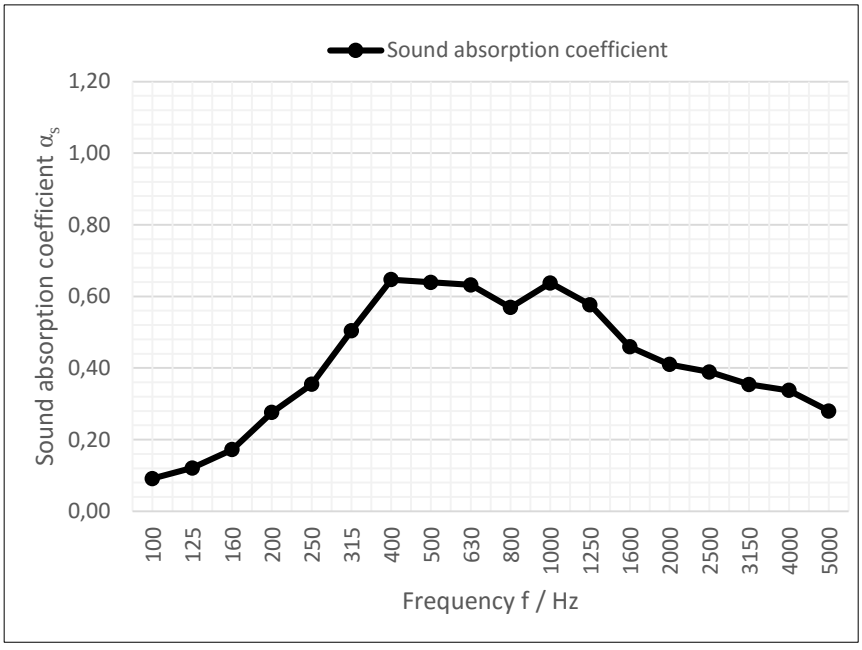
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Semi-open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	*r.h.*[%]	P_0 [Pa]
with specimen	20	44.5	101200
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.09[1]	0.15
125	0.12	
160	0.17	
200	0.28	0.40
250	0.35	
315	0.50	
400	0.65	0.65
500	0.64	
630	0.63	
800	0.57	0.60
1000	0.64	
1250	0.58	
1600	0.46	0.40
2000	0.41	
2500	0.39	
3150	0.35	0.30
4000	0.34	
5000	0.28	



[1] Equivalent sound absorption area less than 1.0 m^2
α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.40 (M)

Sound absorption class **D**

Appendix A

Sound absorption coefficient acc. to ISO 354

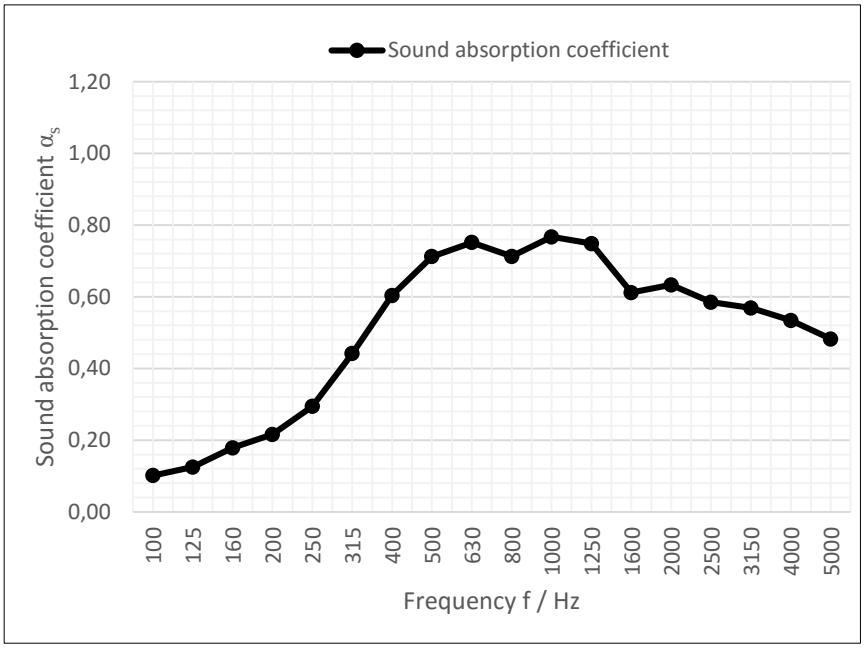
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Fully open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	*r.h.*[%]	P_0 [Pa]
with specimen	20	49.6	100900
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.10	0.15
125	0.12	
160	0.18	
200	0.22	0.30
250	0.29	
315	0.44	
400	0.60	0.70
500	0.71	
630	0.75	
800	0.71	0.75
1000	0.77	
1250	0.75	
1600	0.61	0.60
2000	0.63	
2500	0.58	
3150	0.57	0.55
4000	0.53	
5000	0.48	



α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.60

Sound absorption class **C**

Sound absorption coefficient acc. to ISO 354

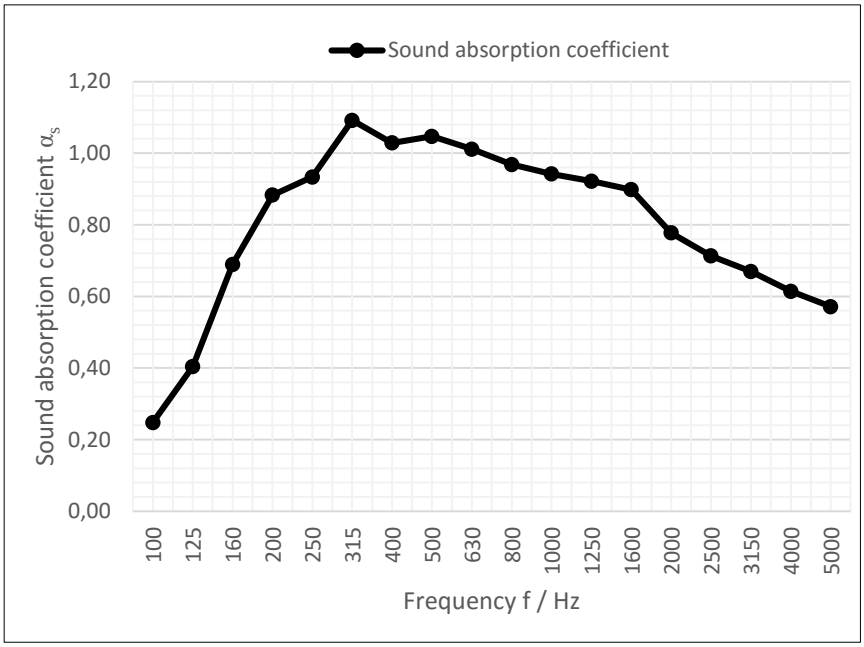
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Fully open Butong panels laid on top of a 45x120 mm timber stud frame, with 70 mm glasswool insulation in the 120 mm high cavity. The glasswool's density was approximately 15 kg/m^3. The specimen consisted of 9 panels. Each panel was 900x1200 mm for an overall size of 2700x3600 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	9.72 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	*r.h.*[%]	P_0 [Pa]
with specimen	19.6	47.5	100900
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.25	0.45
125	0.40	
160	0.69	
200	0.88	0.95
250	0.93	
315	1.09	
400	1.03	1.00
500	1.05	
630	1.01	
800	0.97	0.95
1000	0.94	
1250	0.92	
1600	0.90	0.80
2000	0.78	
2500	0.71	
3150	0.67	0.60
4000	0.61	
5000	0.57	



α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.75 (LM)

Sound absorption class **C**

Appendix A

Sound absorption coefficient acc. to ISO 354

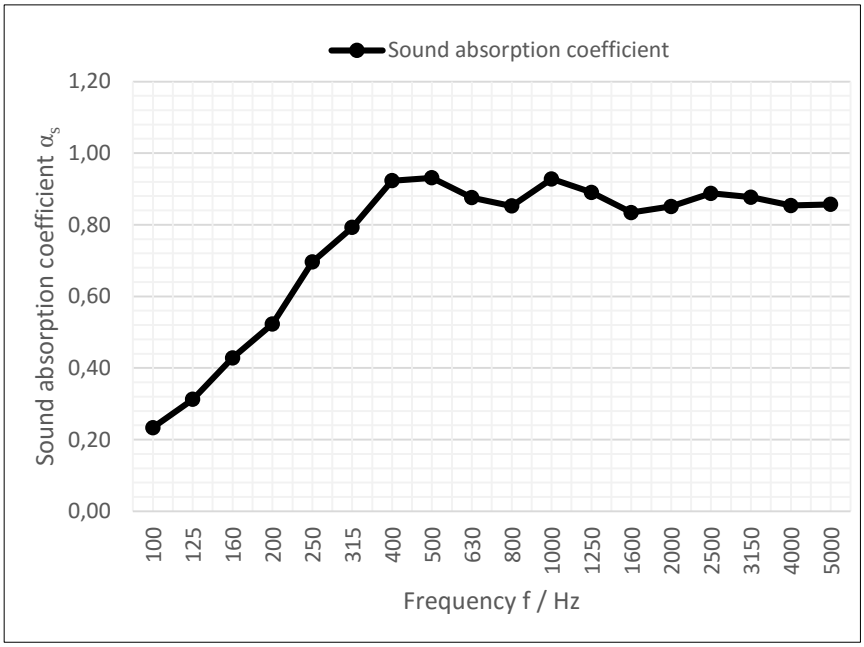
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Fully open Butong panels covered by moss and laid on top of a 45x120 mm timber stud frame, with 70 mm of Butong's culture medium in the 120 mm high cavity. The specimen consisted of 6 panels. Each panel was 600x1200 mm for an overall size of 3600x1200 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m^3
Test area	4.32 m^2
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	$r.h.$[%]	P_0 [Pa]
with specimen	19.8	50	100900
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.23	0.30
125	0.31	
160	0.43	
200	0.52	0.65
250	0.70	
315	0.79	
400	0.92	0.90
500	0.93	
630	0.88	
800	0.85	0.90
1000	0.93	
1250	0.89	
1600	0.83	0.85
2000	0.85	
2500	0.89	
3150	0.88	0.85
4000	0.85	
5000	0.86	



α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.90

Sound absorption class **A**

Appendix A

Sound absorption coefficient acc. to ISO 354

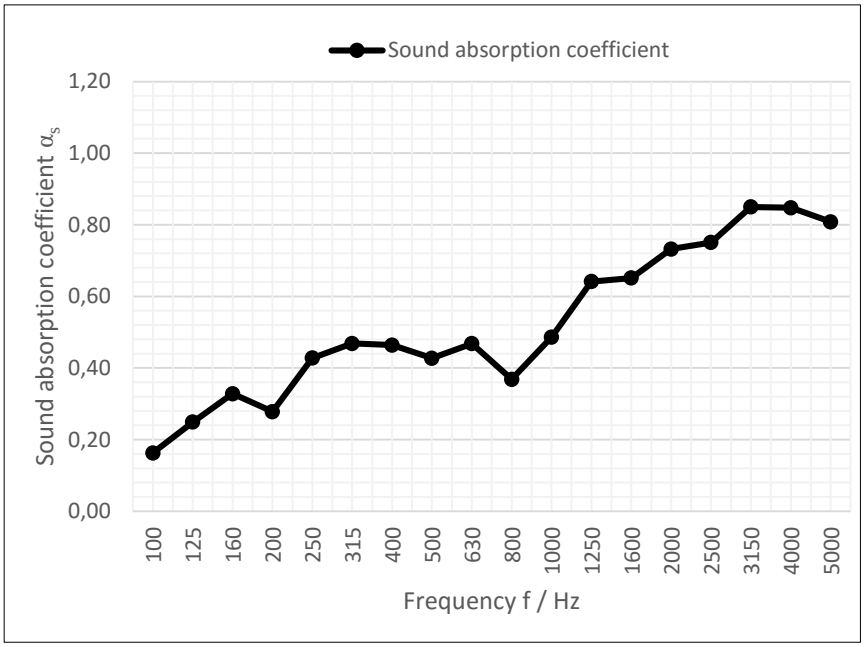
Measurement of sound absorption in a reverberation room

Client:	Butong AB
Test specimen:	Fully open Butong panels covered by moss and laid on top of a 45x120 mm timber stud frame, with no insulation in the 120 mm high cavity. The specimen consisted of 6 panels. Each panel was 600x1200 mm for an overall size of 3600x1200 mm.

Test lab	MWL, KTH
Type	Reverberation room
Volym	246 m³
Test area	4.32 m²
Test date	2016-04-28
Measuring staff	David Geiger and Magnus Tiderman

	t [°C]	*r.h.*[%]	P_0 [Pa]
with specimen	19.8	50	100900
without specimen	20	36	101200

Frequency [Hz]	α_s 1/3 octave	α_p 1/1 octave
100	0.16[1]	0.25
125	0.25	
160	0.33	
200	0.28	0.40
250	0.43	
315	0.47	
400	0.46	0.45
500	0.43	
630	0.47	
800	0.37	0.50
1000	0.49	
1250	0.64	
1600	0.65	0.70
2000	0.73	
2500	0.75	
3150	0.85	0.85
4000	0.85	
5000	0.81	



[1] Equivalent sound absorption area less than 1.0 m²
α_s Sound absorption coefficient according to ISO 354
α_p Practical sound absorption coefficient according to ISO 11654

Rating according to ISO 11654

Weighted sound absorption coefficient α_w = 0.50 (H)

Sound absorption class **D**