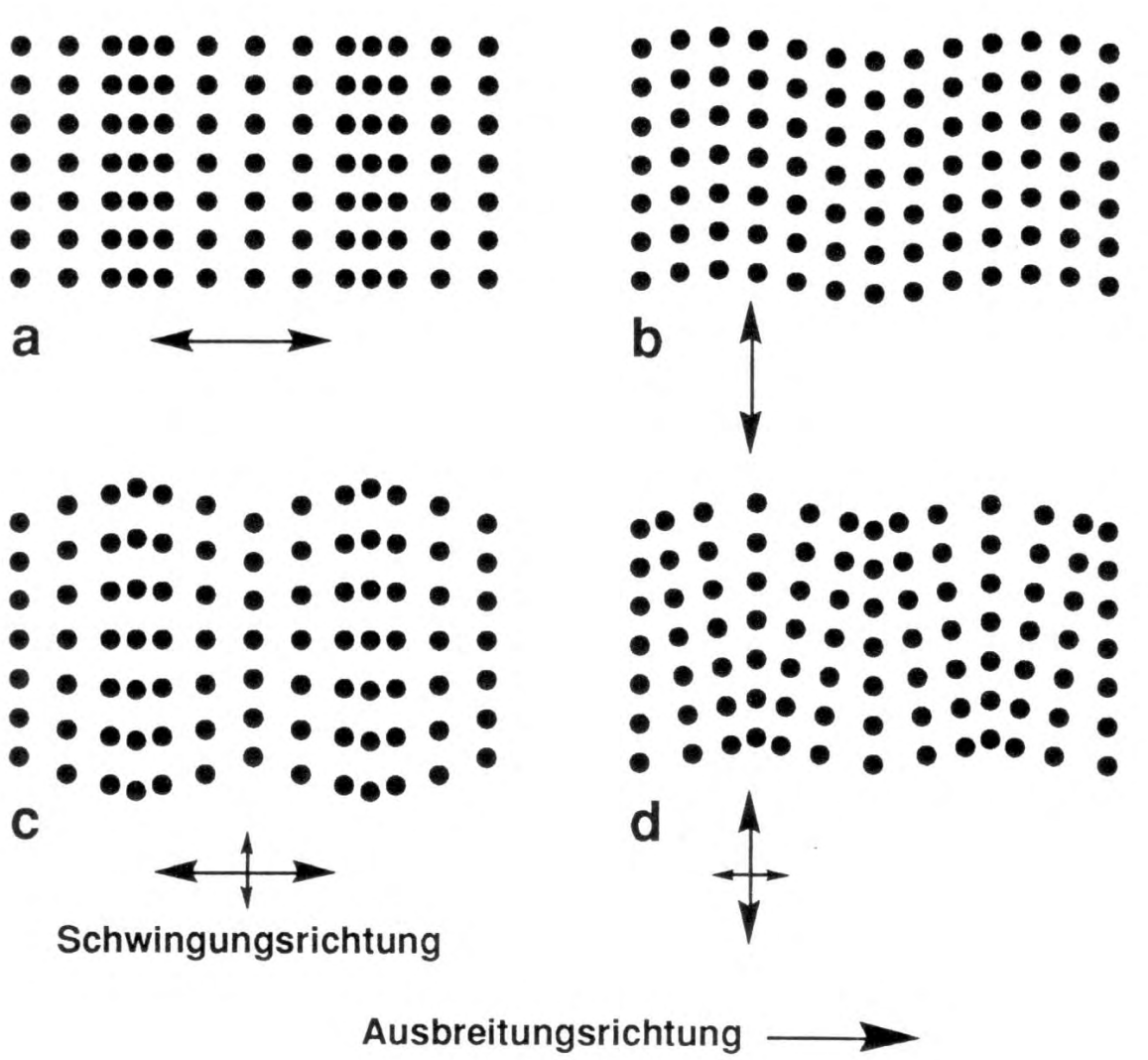
Κύκλος διαλέξεων ακουστικής

Ηχομόνωση δομικών στοιχείων
Συχνότητες συντονισμού
Πλευρική μετάδοση του ήχου

Το φαινόμενο της σύμπτωσης



a Διαμήκες κύμα
Longitudinalwelle

b Εγκάρσιο κύμα
Transversalwelle

c Διαστολικό κύμα
Dehnwelle

d Καμπτικό κύμα
Biegewelle

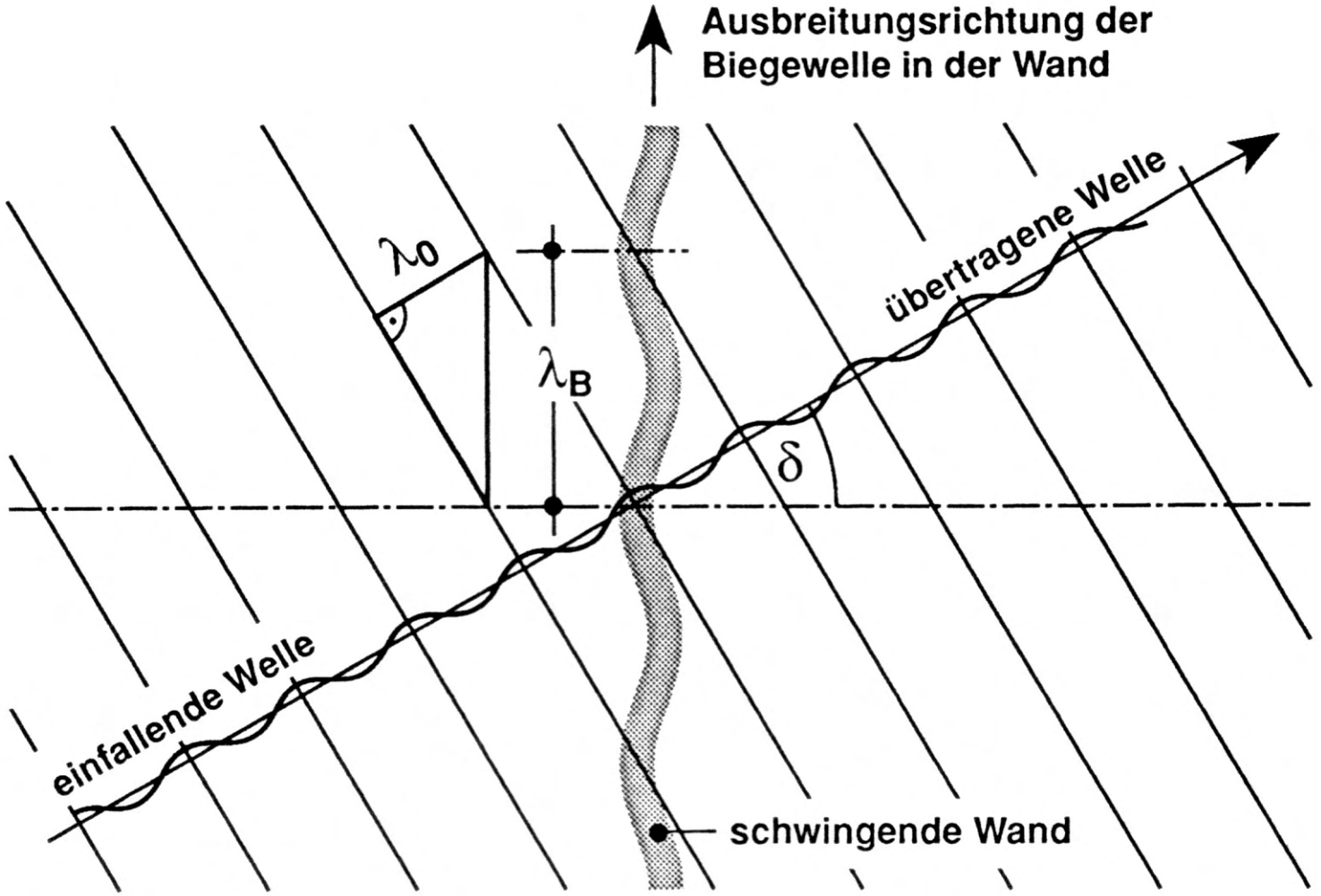


Bild 5.16 *Prinzipdarstellung der Entstehung der Koinzidenz*

mit

$$f_c = \frac{c_{air}^2}{2\pi}\sqrt{\frac{m'}{B'}} = \frac{c_{air}^2}{2\pi t}\sqrt{\frac{12\rho(1-\mu^2)}{E}}$$

m' ΕΠΙΦ. ΜΑΖΑ $[kg/m^2]$

B' BENDING STIFFNESS

t ΠΑΧΟΣ ΤΗΣ ΠΛΑΚΑΣ

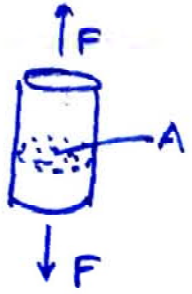
ρ ΠΥΚΝΟΤΗΤΑ ΤΟΥ ΥΛΙΚΟΥ

μ ΛΟΓΟΣ ΤΟΥ POISSON

E E-Modul
ΜΕΤΡΟ ΤΟΥ YOUNG $\quad E = \frac{\sigma}{\varepsilon}$

μ = Poisson's Number $\quad (0,1 \div 0.4)$

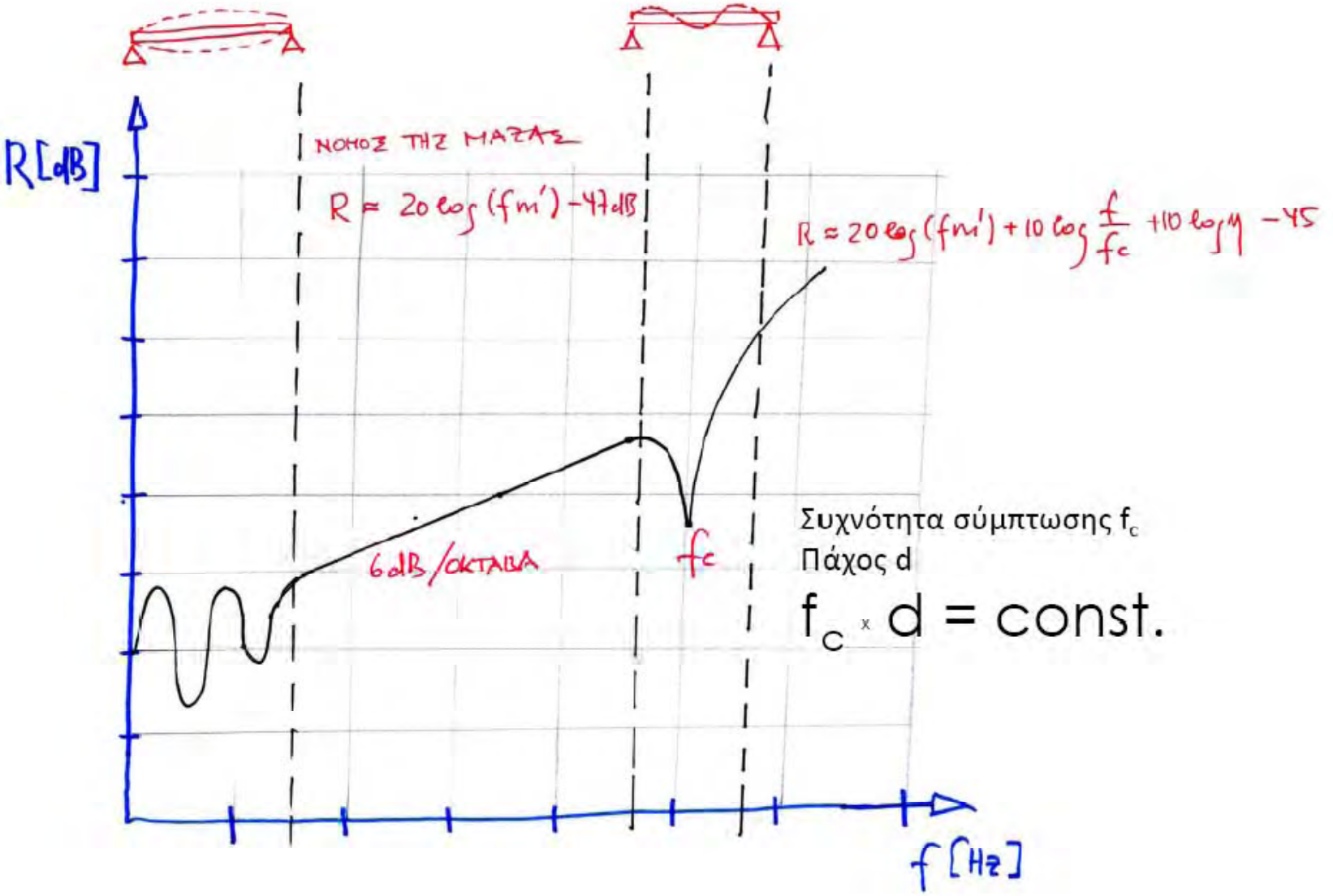
$$\frac{\Delta d/d}{\Delta l/l}$$



$$\sigma = \frac{F}{A}$$

$$\varepsilon = \frac{\Delta l}{l}$$

Μονοκέλυφα χωρίσματα



Συχνότητα σύμπτωσης f_c

Πάχος d

$$f_c \times d = \text{const.}$$

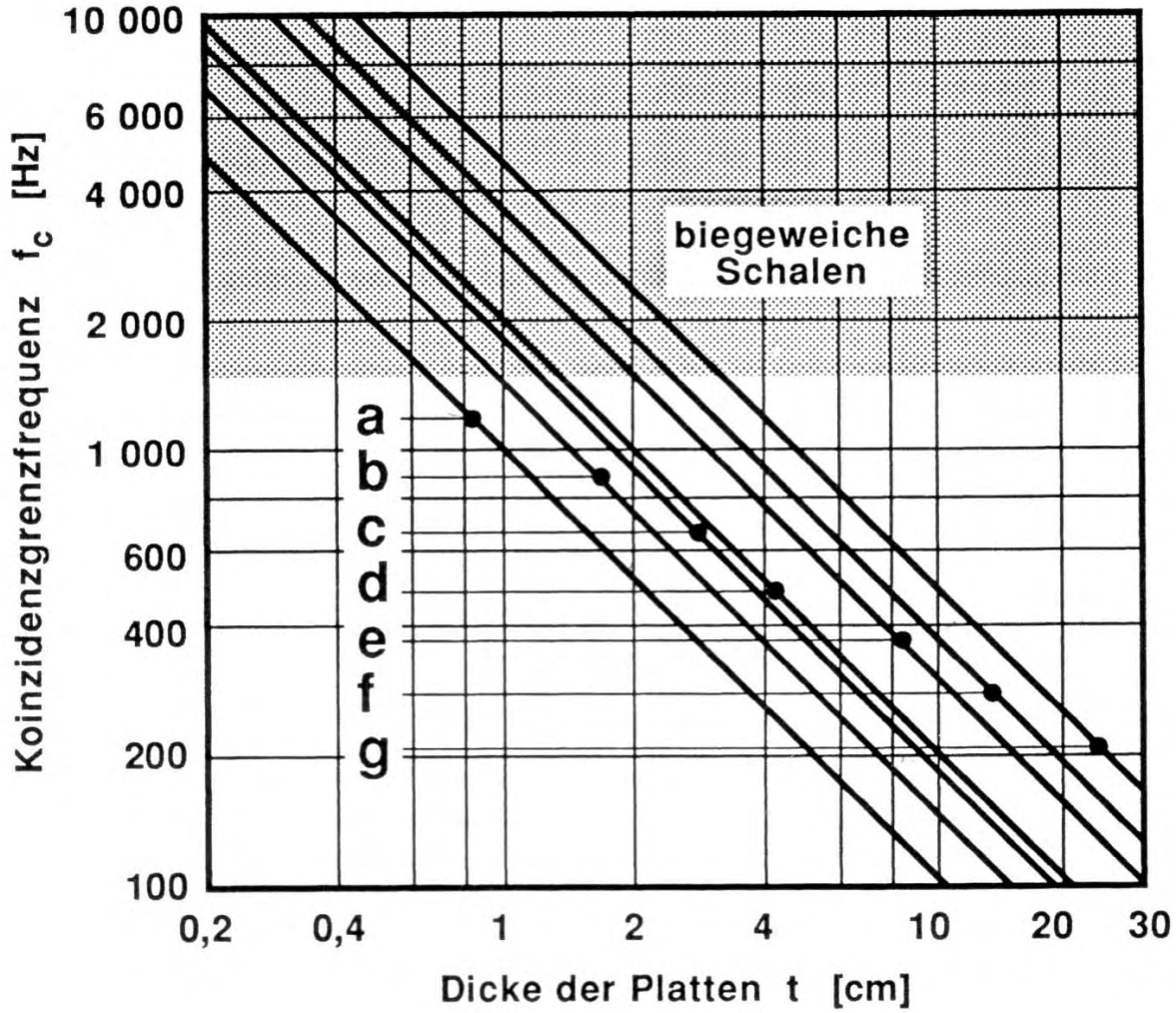


Bild 5.17 *Koinzidenzgrenzfrequenz f_c verschiedener Materialien in Abhängigkeit von der Plattendicke t [1]*

a Glas
b Schwerbeton
c Sperrholz
d Vollziegel
e Gips, Gipskarton
f Hartfaser
g Leichtbeton

Γυαλί	1200 Hz cm	→	0,4 cm	f_c = 3000 Hz
Σκυρόδεμα	1700 Hz cm	→	10 cm	f_c = 170 Hz
Κοντραπλακέ	1800 Hz cm	→	0,5 cm	f_c = 3600 Hz
Τούβλα (συμπαγής)	2600 Hz cm	→	20 cm	f_c = 130 Hz
Γυψοσανίδα	3100 Hz cm	→	1,2 cm	f_c = 2600 Hz
Plexiglass	3100 Hz cm	→	3 cm	f_c = 1030 Hz
Μολύβι	4900 Hz cm	→	0,3 cm	f_c = 16333 Hz

Element Type: monolithic wall

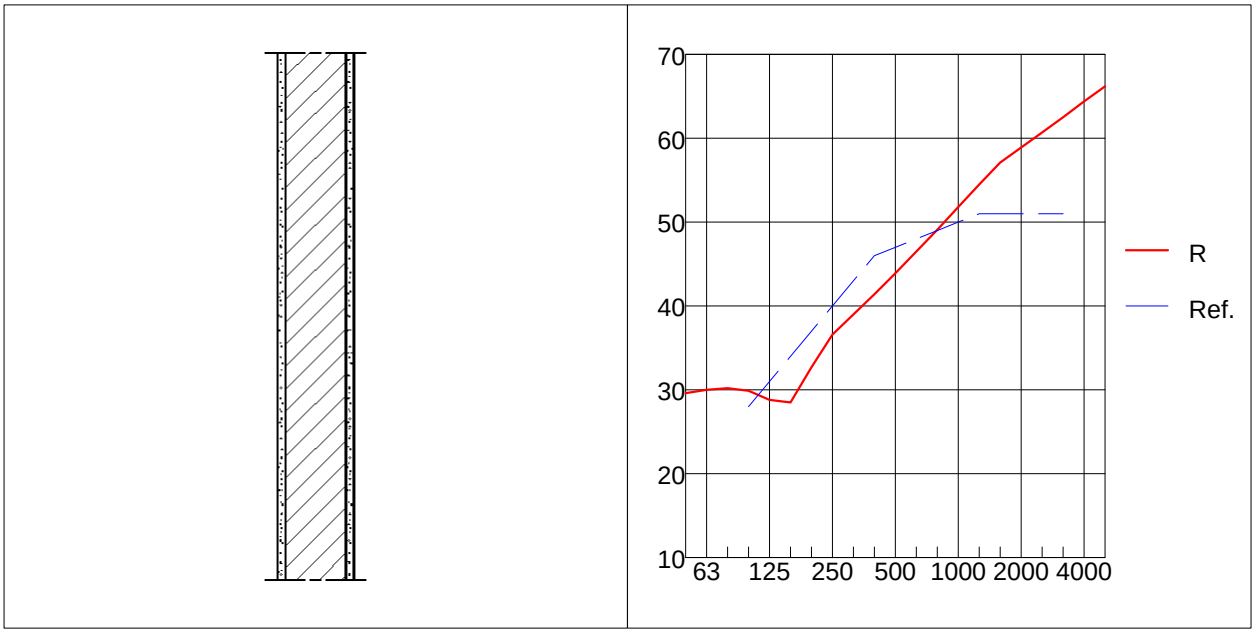
Country: D

Construction Name:
BAST: brick (1200 kg/m³) 115 mm, render 2x15 mm

Additional Information:
-

Material Data:
m''1 (kg/m²): 188
m''2 (kg/m²): 0
fc,1 (Hz): 223
fc,2 (Hz): 0
Eta_int: 0.0150

Geometry Data:
h_lab (m): 0.00
l_lab (m): 0.00
S_F,lab (m²): 0.00
S_f,lab (m²): 0.00
d (m): 0.14



X	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
R	29.6	30.0	30.2	29.9	28.8	28.5	32.7	36.6	39.0	41.4	43.9	46.5	49.1	51.8	54.5	57.1	58.9	60.7	62.5	64.4	66.2

Single-Numbers:
Rw (C; Ctr; C100-5000; Ctr,100-5000; C50-5000; Ctr,50-5000) = 47 (-2; -6; -1; -6; -1; -7)
STC 47
OITC 38

Element Type: monolithic wall

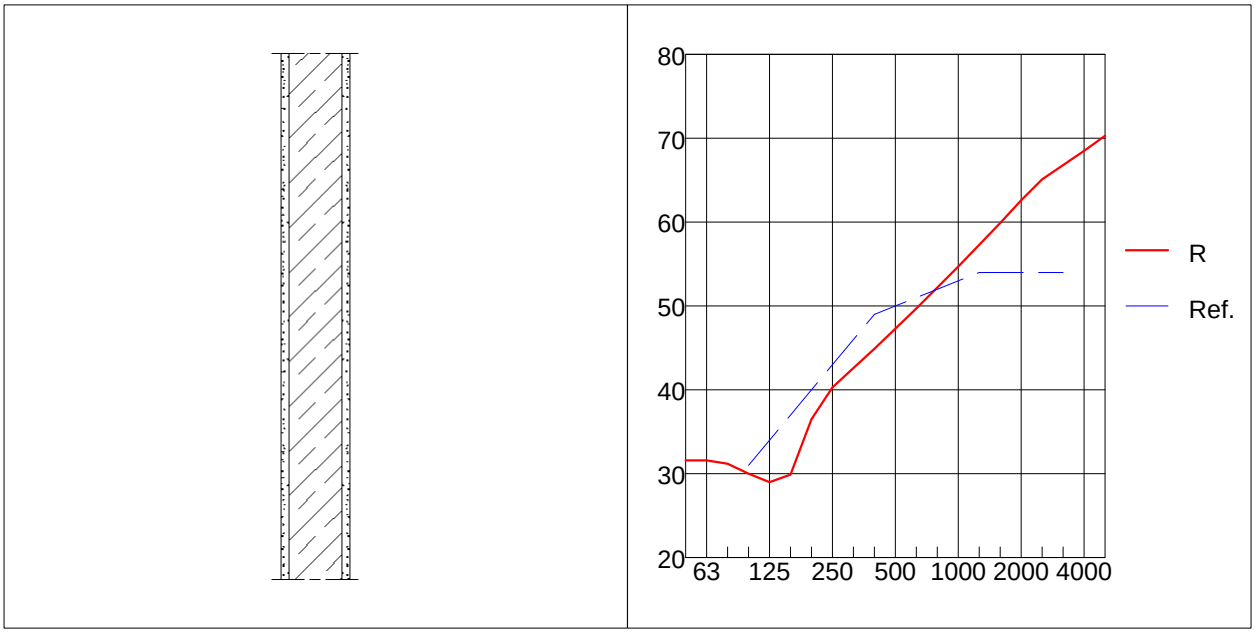
Country: D

Construction Name:
BAST: concrete (2400 kg/m³) 100 mm, render 2x15 mm

Additional Information:
-

Material Data:
m''1 (kg/m²): 290
m''2 (kg/m²): 0
fc,1 (Hz): 183
fc,2 (Hz): 0
Eta_int: 0.0060

Geometry Data:
h_lab (m): 0.00
l_lab (m): 0.00
S_F,lab (m²): 0.00
S_f,lab (m²): 0.00
d (m): 0.13



X	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
R	31.6	31.6	31.2	30.0	29.0	29.9	36.5	40.3	42.6	44.9	47.3	49.7	52.2	54.7	57.3	59.9	62.6	65.1	66.8	68.5	70.3

Single-Numbers:
Rw (C; Ctr; C100-5000; Ctr,100-5000; C50-5000; Ctr,50-5000) = 50 (-2; -7; -1; -7; -2; -8)
STC 50
OITC 39

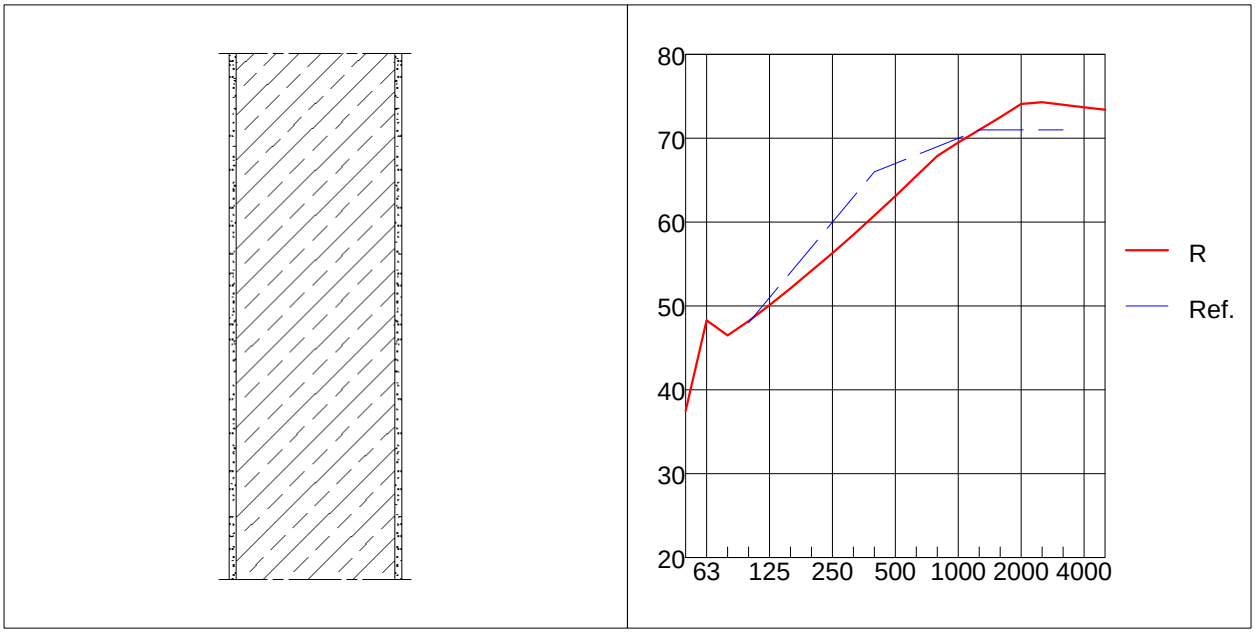
Element Type: monolithic wall Country: D

Construction Name:
BAST: concrete (2400 kg/m³) 300 mm, render 2x15 mm

Additional Information:
-

Material Data:
m''1 (kg/m²): 770
m''2 (kg/m²): 0
fc,1 (Hz): 61
fc,2 (Hz): 0
Eta_int: 0.0060

Geometry Data:
h_lab (m): 0.00
l_lab (m): 0.00
S_F,lab (m²): 0.00
S_f,lab (m²): 0.00
d (m): 0.33



X	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
R	37.5	48.3	46.5	48.2	50.1	52.1	54.2	56.3	58.5	60.8	63.1	65.5	67.9	69.5	71.0	72.5	74.1	74.3	74.0	73.7	73.4

Single-Numbers:
Rw (C; Ctr; C100-5000; Ctr,100-5000; C50-5000; Ctr,50-5000) = 67 (-2; -6; -1; -6; -1; -9)
STC 67
OITC 58

Sound Insulation Prediction (v6.1)

Margin of error is generally within +/- 3Rw

Job Name:

Notes:

Job No.:

Page No.:

Date: 4 Mar 10

Initials:

File Name:insul

1 x 12.5 mm Gypsum plasterboard

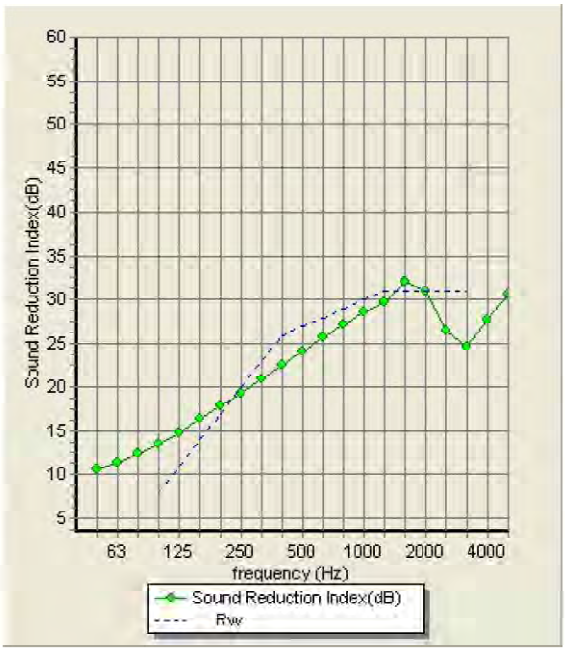
Rw 27
C -1
Ctr -3

Surface Mass 8.6 kg/m2

Critical Freq 3038 Hz

damping 0.01
Panel Size 2.7x4 m

frequency (Hz)	TL(dB)	TL(dB)
50	11	
63	11	11
80	12	
100	14	
125	15	15
160	16	
200	18	
250	19	19
315	21	
400	23	
500	24	24
630	26	
800	27	
1000	29	28
1250	30	
1600	32	
2000	31	29
2500	27	
3150	25	
4000	28	27
5000	31	



Sound Insulation Prediction (v6.1)

Margin of error is generally within +/- 3Rw

Job Name: Notes:

Job No.: Page No.:

Date: 4 Mar 10 Initials:

File Name:insul

1 x 50.0 mm Gypsum plasterboard

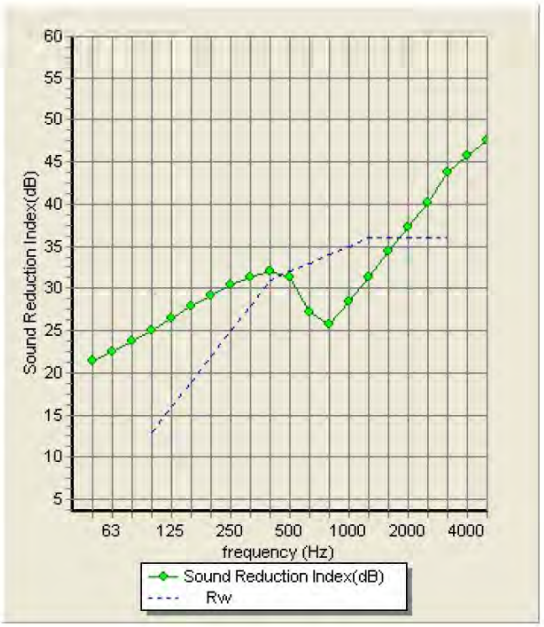
Rw 32
C -1
Ctr -2

Surface Mass 34.5 kg/m2

Critical Freq 759 Hz

damping 0.01
Panel Size 2.7x4 m

frequency (Hz)	TL(dB)	TL(dB)
50	21	
63	22	22
80	24	
100	25	
125	26	26
160	28	
200	29	
250	30	30
315	31	
400	32	
500	31	30
630	27	
800	26	
1000	29	28
1250	31	
1600	34	
2000	37	37
2500	40	
3150	44	
4000	46	45
5000	48	



Sound Insulation Prediction (v6.1)

Margin of error is generally within +/- 3Rw

Job Name:

Notes:

Job No.:

Page No.:

Date: 4 Mar 10

Initials:

File Name:insul

4 x 12.5 mm Gypsum plasterboard

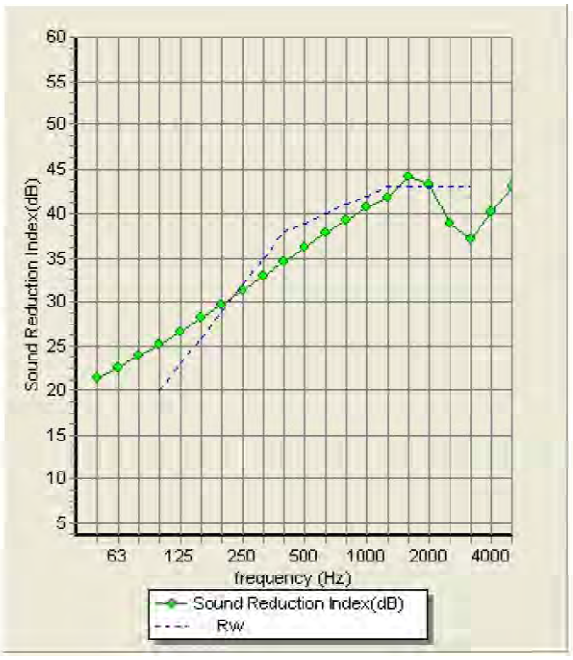
Rw 39
C -1
Ctr -3

Surface Mass 34.5 kg/m2

Critical Freq 3038 Hz

damping 0.01
Panel Size 2.7x4 m

frequency (Hz)	TL(dB)	TL(dB)
50	21	
63	23	23
80	24	
100	25	
125	27	27
160	28	
200	30	
250	31	31
315	33	
400	35	
500	36	36
630	38	
800	39	
1000	41	40
1250	42	
1600	44	
2000	43	41
2500	39	
3150	37	
4000	40	39
5000	43	



Sound Insulation Prediction (v6.1)

Margin of error is generally within +/- 3Rw

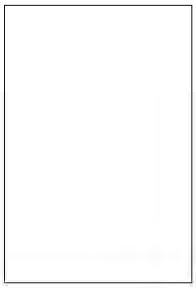
Job Name: Notes:

Job No.: Page No.:

Date: 4 Mar 10 Initials:

File Name:insul

1 x 150.0 mm Concrete



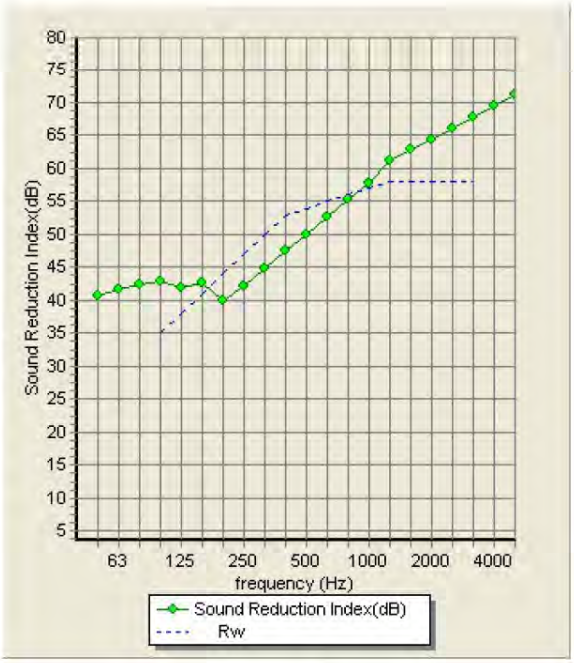
Rw 54
C -1
Ctr -4

Surface Mass 345.0 kg/m2

Critical Freq 203 Hz

damping 0.01
Panel Size 2.7x4 m

frequency (Hz)	TL(dB)	TL(dB)
50	41	
63	42	42
80	42	
100	43	
125	42	42
160	43	
200	40	
250	42	42
315	45	
400	48	
500	50	50
630	53	
800	55	
1000	58	57
1250	61	
1600	63	
2000	64	64
2500	66	
3150	68	
4000	69	69
5000	71	



Element Type: monolithic wall

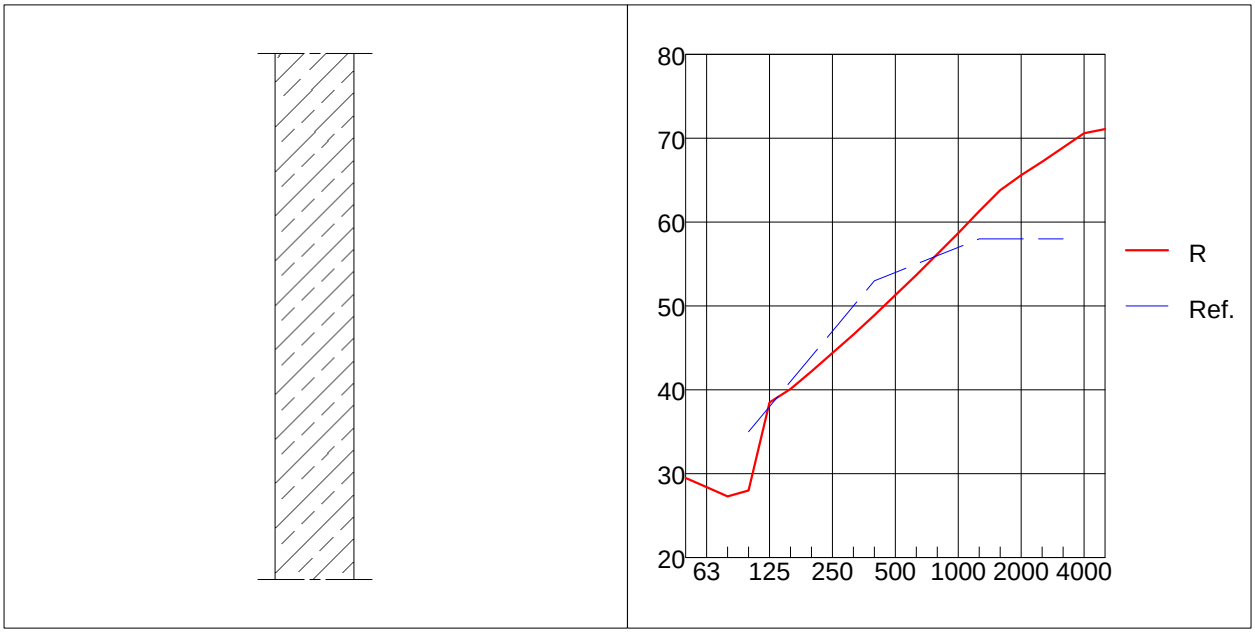
Country: D

Construction Name:
BAST: concrete (2300 kg/m³) 150 mm

Additional Information:
-

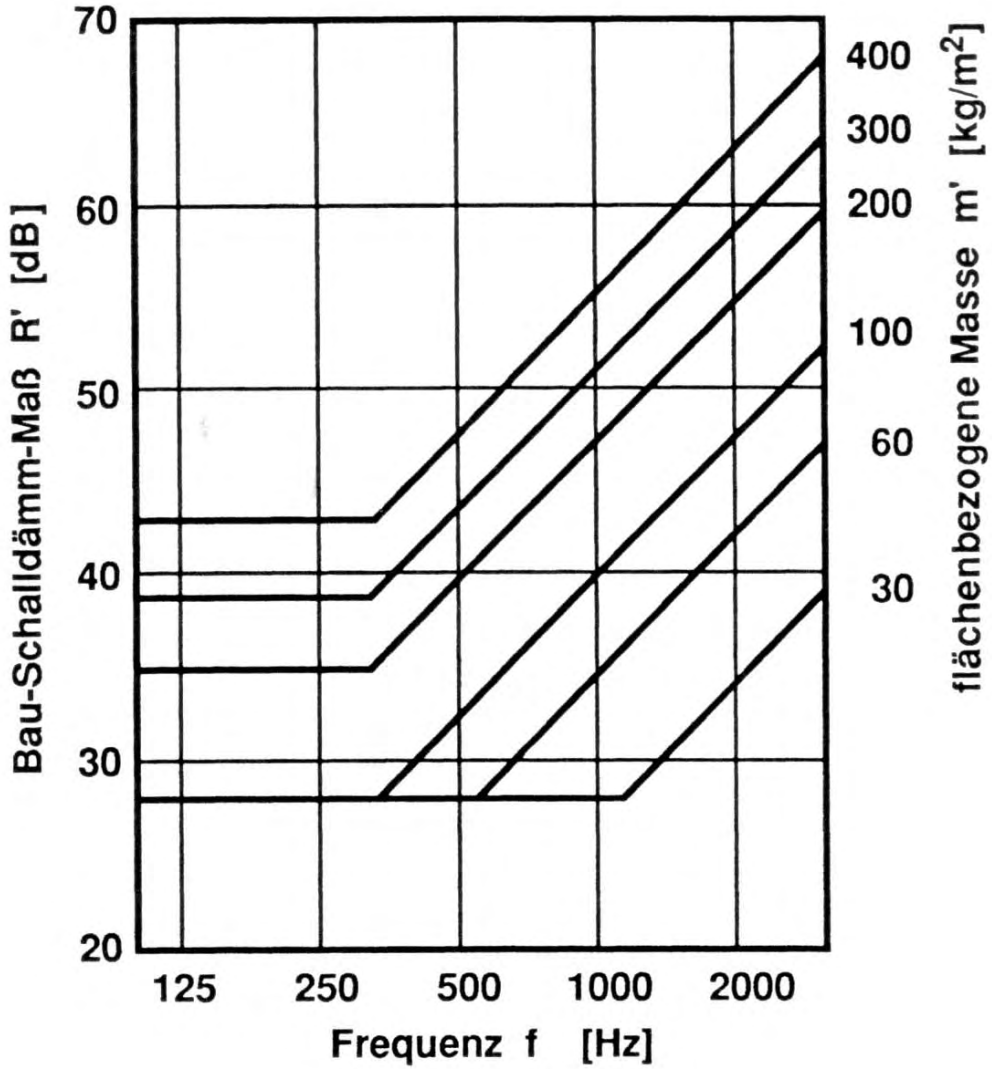
Material Data:
m''1 (kg/m²): 345
m''2 (kg/m²): 0
fc,1 (Hz): 122
fc,2 (Hz): 0
Eta_int: 0.0060

Geometry Data:
h_lab (m): 0.00
l_lab (m): 0.00
S_F,lab (m²): 0.00
S_f,lab (m²): 0.00
d (m): 0.15



X	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
R	29.5	28.4	27.3	28.0	38.5	40.1	42.2	44.4	46.6	48.9	51.3	53.7	56.2	58.7	61.3	63.8	65.6	67.2	68.9	70.6	71.1

Single-Numbers:
Rw (C; Ctr; C100-5000; Ctr,100-5000; C50-5000; Ctr,50-5000) = 54 (-2; -8; -1; -8; -2; -11)
STC 55
OITC 42


70
60
50
40
30
20
Bau-Schalldämm-Maß R' [dB]
125
250
500
1000
2000
Frequenz f [Hz]
400
300
200
100
60
30
flächenbezogene Masse m' [kg/m²]

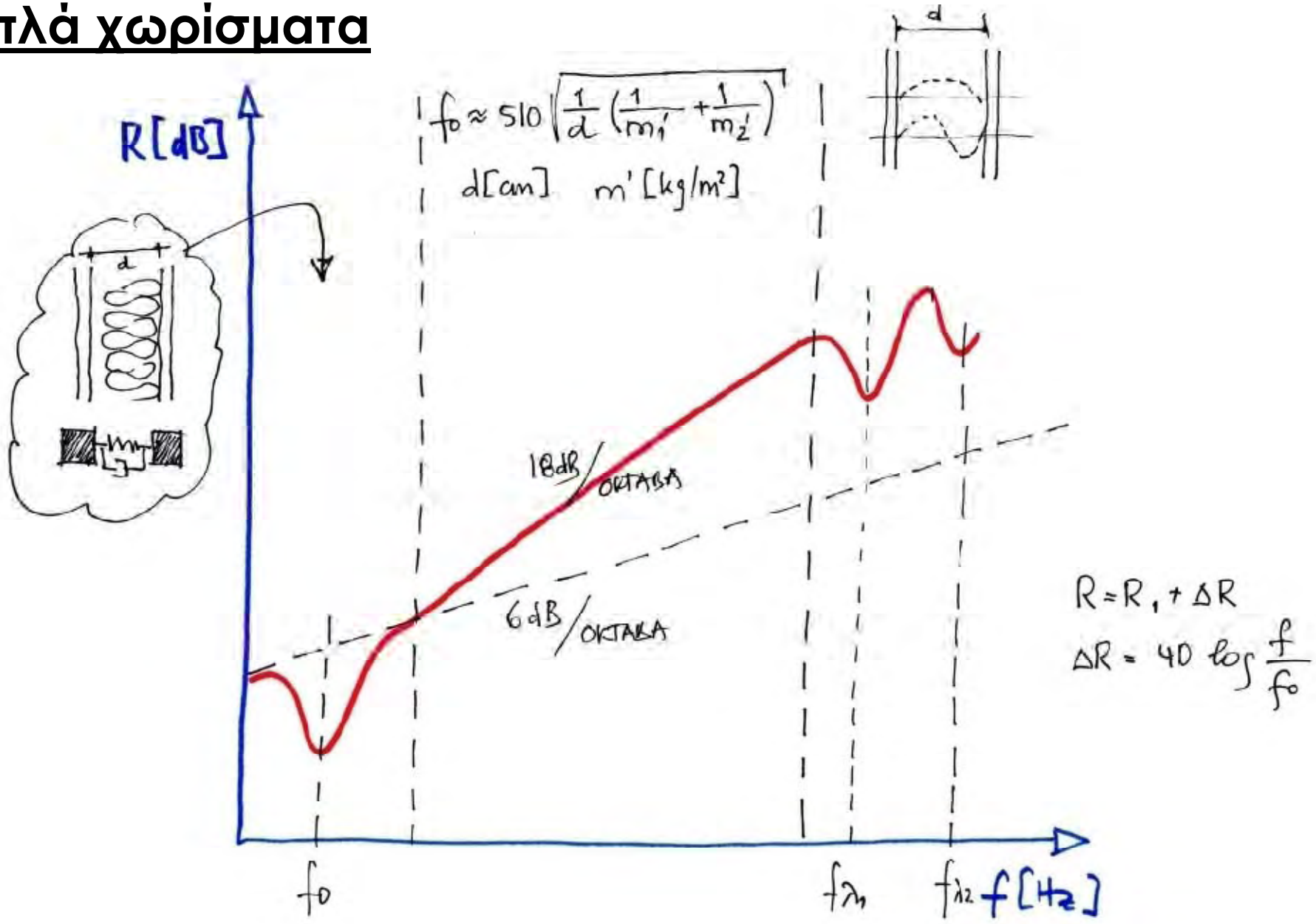
R_W

$m' > 150 kg/m^2$

save average

			200 g/m²	500 g/m²
		$R_W = 37,5 \log(m'/m_0') - 42 dB$	44,3	59,2
A	$m' \geq 100 kg/m^2$	$R_W = 32,4 \log(m'/m_0') - 26 dB$	48.5	61,4
F	$m' \geq 150 kg/m^2$	$R_W = 40 \log(m'/m_0') - 45 dB$	47,0	63,0
GB	$m' \geq 50 kg/m^2$	$R_W = 27,65 \log(m'/m_0') - 2,3 dB$	47,5	56,7

Διπλά χωρίσματα



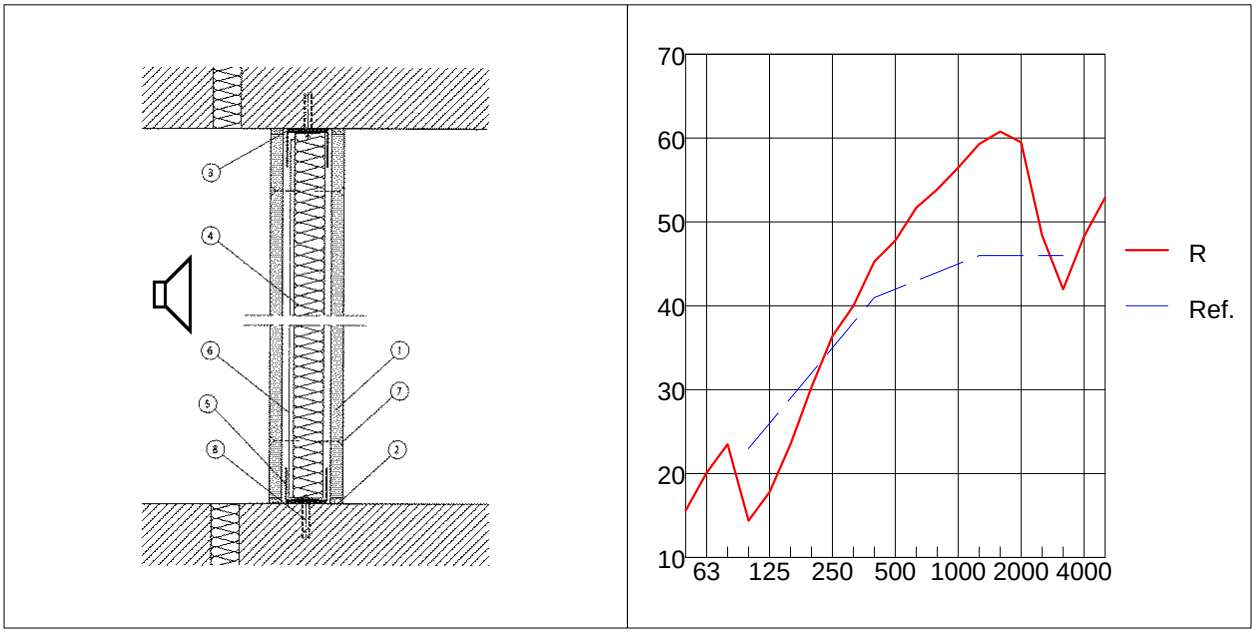
Element Type: lightweight double wall, metal frame Country: D

Construction Name:
Rigi: gypsum brd. 12.5 mm, Akustic TF 40 mm (studs CW 50), gypsum brd. 12.5 mm (2000)

Additional Information:
metal studs CW 50x50x06-100, at 625 mm centres, total thickness 75 mm, gypsum brds.: m' = 8,7 (+/-
0,2) kg/m², screwed, joints plastered, mineral wool: r = 6 kPa s/m², boards not screwed to floor/ceiling
profiles, sealing at test frame by 5 mm textile felt (compressed to 3 mm)

Material Data:
m''1 (kg/m²): 9
m''2 (kg/m²): 0
fc,1 (Hz): 2780
fc,2 (Hz): 0
Eta_int: 0.0120

Geometry Data:
h_lab (m): 0.00
l_lab (m): 0.00
S_F,lab (m²): 0.00
S_f,lab (m²): 0.00
d (m): 0.07



X	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
R	15.6	20.1	23.5	14.4	17.8	23.5	30.3	36.4	40.0	45.3	47.8	51.7	53.9	56.5	59.3	60.8	59.5	48.4	42.0	48.3	52.9

Single-Numbers:
Rw (C; Ctr; C100-5000; Ctr,100-5000; C50-5000; Ctr,50-5000) = 42 (-3; -10; -2; -10; -3; -11)
STC 41
OITC 28

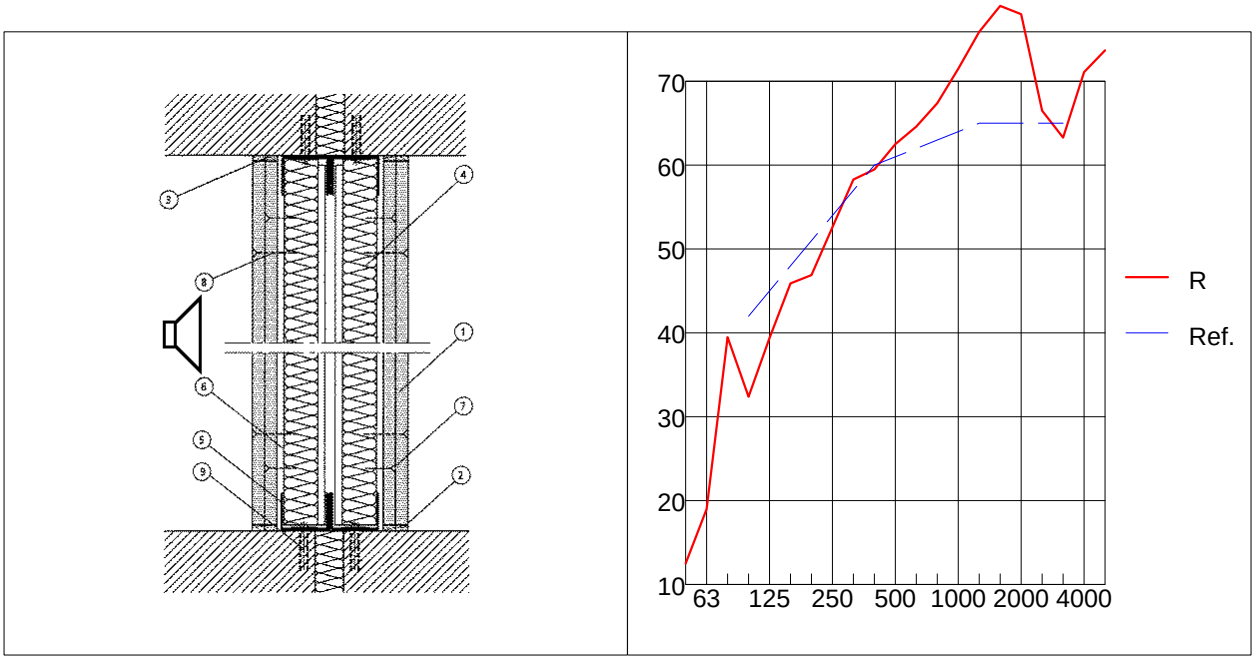
Element Type: lightweight double wall, metal frame Country: D

Construction Name:
Rigi: gypsum brd. 2x12.5 mm, Akustic TF 2x40 mm (studs 2xCW 50), gypsum brd. 2x12.5 mm (2000)

Additional Information:
metal studs 2xCW 50x50x06-100, at 625 mm centres, total thickness 155 mm, gypsum brds.: m' = 8,7
(+/- 0,2) kg/m², screwed, joints plastered, mineral wool: r = 6 kPa s/m², boards not screwed to floor/ceiling
profiles, sealing at test frame by 5 mm textile felt (compressed to 3 mm)

Material Data:
m''1 (kg/m²): 17
m''2 (kg/m²): 0
fc,1 (Hz): 2780
fc,2 (Hz): 0
Eta_int: 0.0120

Geometry Data:
h_lab (m): 0.00
l_lab (m): 0.00
S_F,lab (m²): 0.00
S_f,lab (m²): 0.00
d (m): 0.16



X	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
R	12.5	19.0	39.5	32.4	39.4	45.9	46.9	52.6	58.3	59.5	62.5	64.6	67.4	71.5	75.9	79.0	78.0	66.5	63.3	71.1	73.7

Single-Numbers:
Rw (C; Ctr; C100-5000; Ctr,100-5000; C50-5000; Ctr,50-5000) = 61 (-3; -10; -2; -10; -10; -25)
STC 63
OITC 48

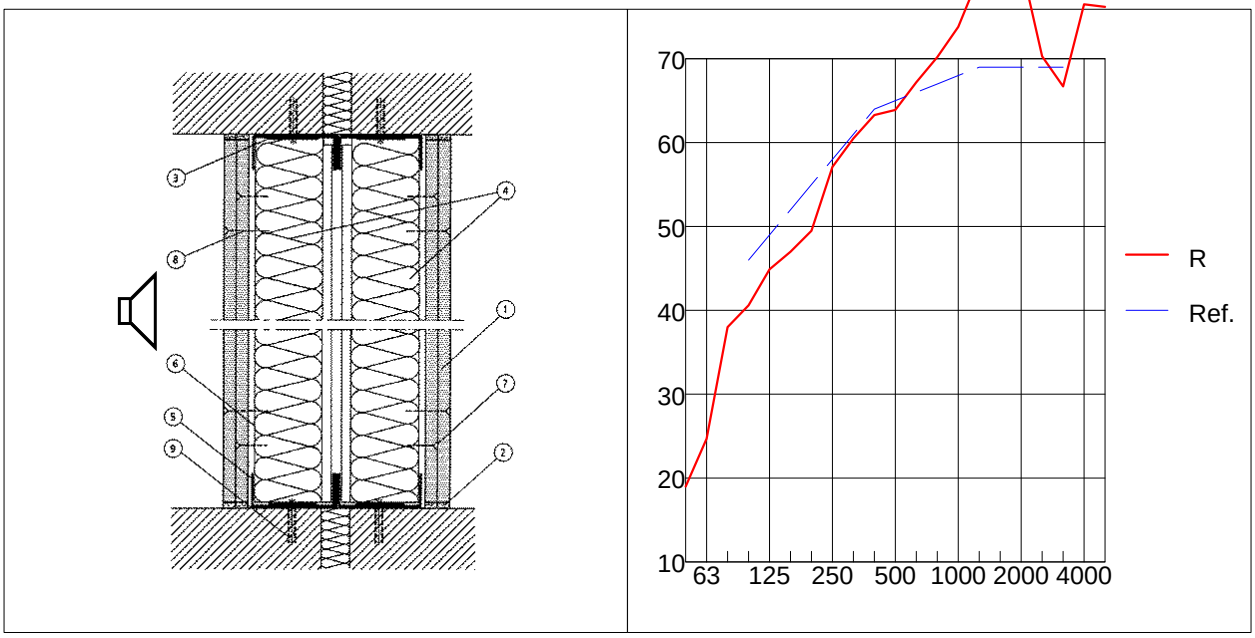
Element Type: lightweight double wall, metal frame Country: D

Construction Name:
Rigi: gypsum brd. "Die Blaue" 2x12.5 mm, Akustic TF 2x80 mm (studs 2xCW 100), gypsum brd. "Die
Blaue" 2x12.5 mm (2000)

Additional Information:
metal studs 2xCW 100x50x06-100, at 625 mm centres, total thickness 255 mm, gypsum brds.: m' = 8,7
(+/- 0,1) kg/m², screwed, joints plastered, mineral wool: r = 7 kPa s/m², boards not screwed to floor/ceiling
profiles, sealing at test frame by 5 mm textile felt (compressed to 3 mm)

Material Data:
m''1 (kg/m²): 17
m''2 (kg/m²): 0
fc,1 (Hz): 2780
fc,2 (Hz): 0
Eta_int: 0.0120

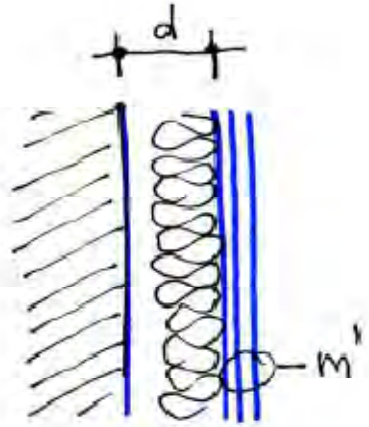
Geometry Data:
h_lab (m): 0.00
l_lab (m): 0.00
S_F,lab (m²): 0.00
S_f,lab (m²): 0.00
d (m): 0.26



X	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
R	19.0	24.7	38.0	40.6	44.9	47.0	49.5	57.1	60.5	63.3	63.9	67.2	70.2	73.8	79.9	82.7	81.3	70.3	66.7	76.5	76.2

Single-Numbers:
Rw (C; Ctr; C100-5000; Ctr,100-5000; C50-5000; Ctr,50-5000) = 65 (-2; -8; -1; -8; -8; -23)
STC 66
OITC 53

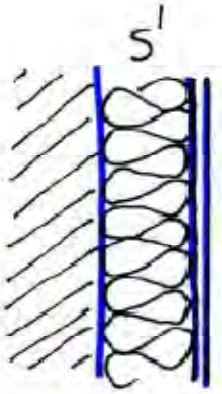
Επένδυση τοίχου



$$f_0 = 510 \sqrt{\frac{1}{m' \cdot d}}$$

d [cm]

m' [kg/m^2]



$$f_0 = 160 \sqrt{\frac{s'}{m'}}$$

s' [MN/m^3]

m' [kg/m^2]

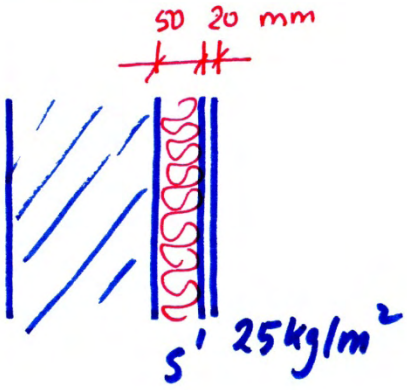
s' ΔΥΝΑΜΙΚΗ ΑΚΑΜΨΙΑ $[MN/m^3]$

ΓΙΑ ΑΕΡΑ ΜΕ ΗΧΟΑΠΟΡΡΟΦΗΤΙΚΟ ΥΛΙΚΟ $s' \approx \frac{10}{d_L/cm}\ MN/m^3$

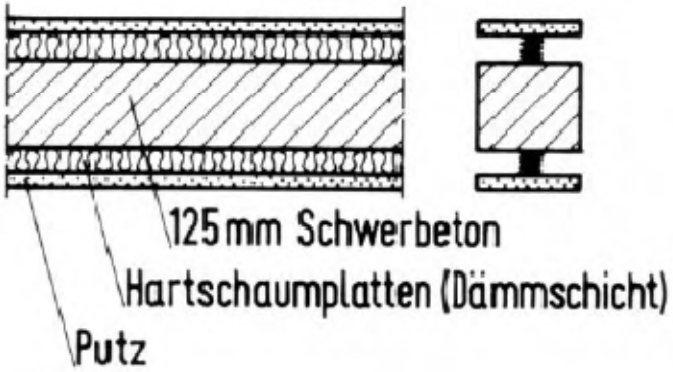
ΟΡΥΚΤΟΒΑΜΒΑΚΑΣ $s' = 5 - 25\ MN/m^3$

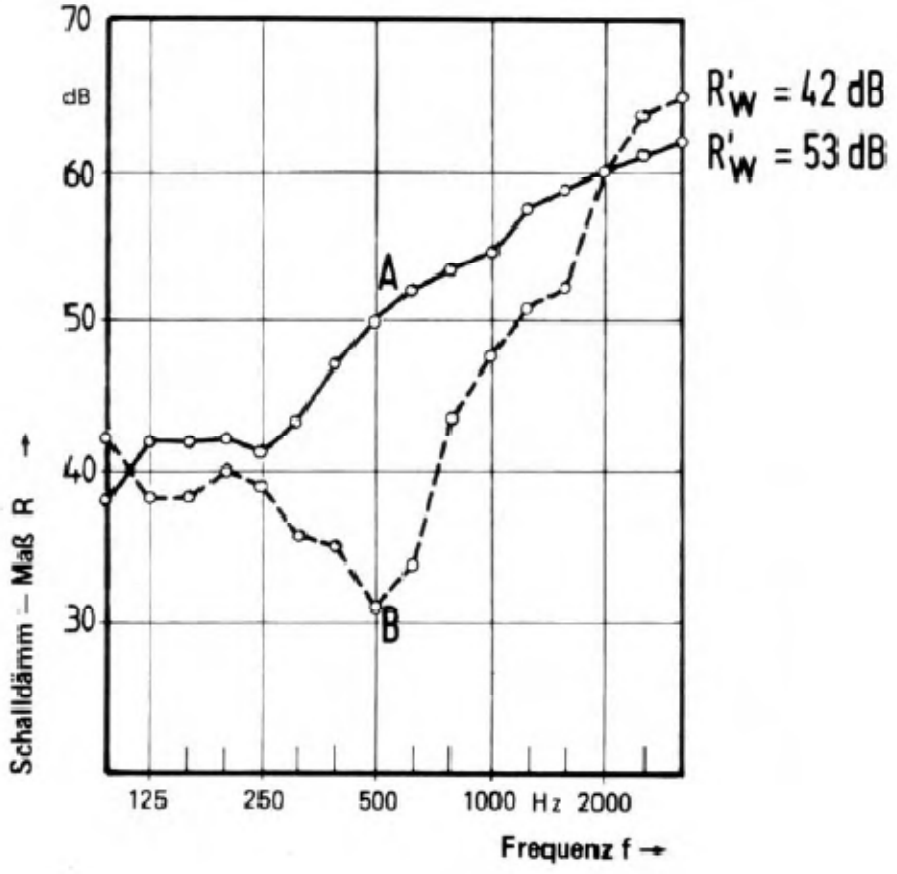
ΠΕΤΡΟΒΑΜΒΑΚΑΣ $s' = 30 - 50\ MN/m^3$

POLYSTYROL $s' = 200 - 700\ MN/m^3$



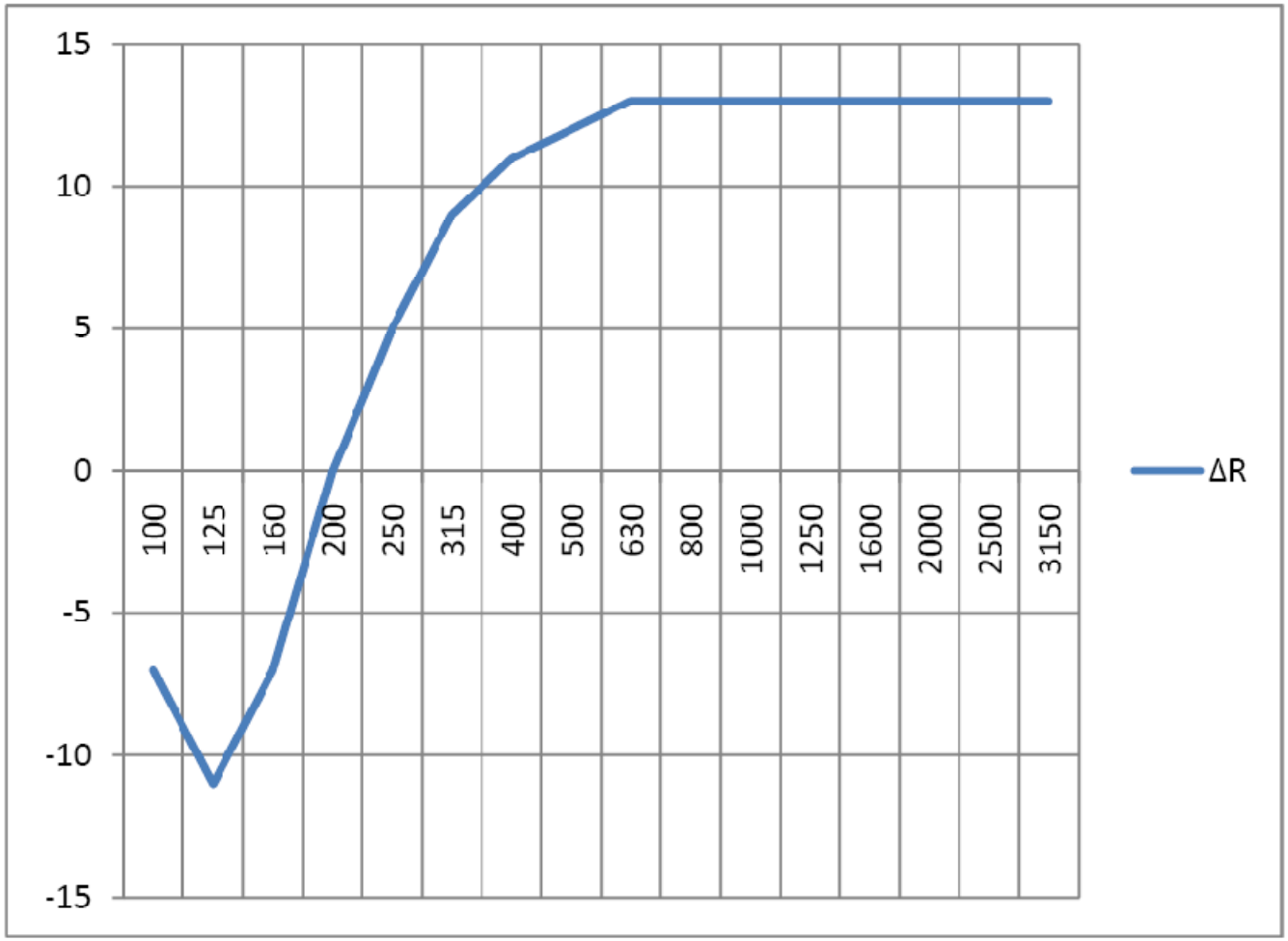
		25 kg/m²	50 kg/m²
		f_0	
ΟΡΥΚΤΟΒΑΜΒΑΚΑΣ	$s' = 20\ MN/m^3$	143 Hz	101 Hz
ΠΕΤΡΟΒΑΜΒΑΚΑΣ	$s' = 50\ MN/m^3$	226 Hz	160 Hz
POLYSTYROL	$s' = 500\ MN/m^3$	716 Hz	506 Hz
ΑΕΡΑΣ ΜΕ ΗΧΟΑΠΟΡΡ.	$s' = 2\ MN/m^3$	45 Hz	32 Hz


125 mm Schwerbeton
Hartschaumplatten (Dämmschicht)
Putz

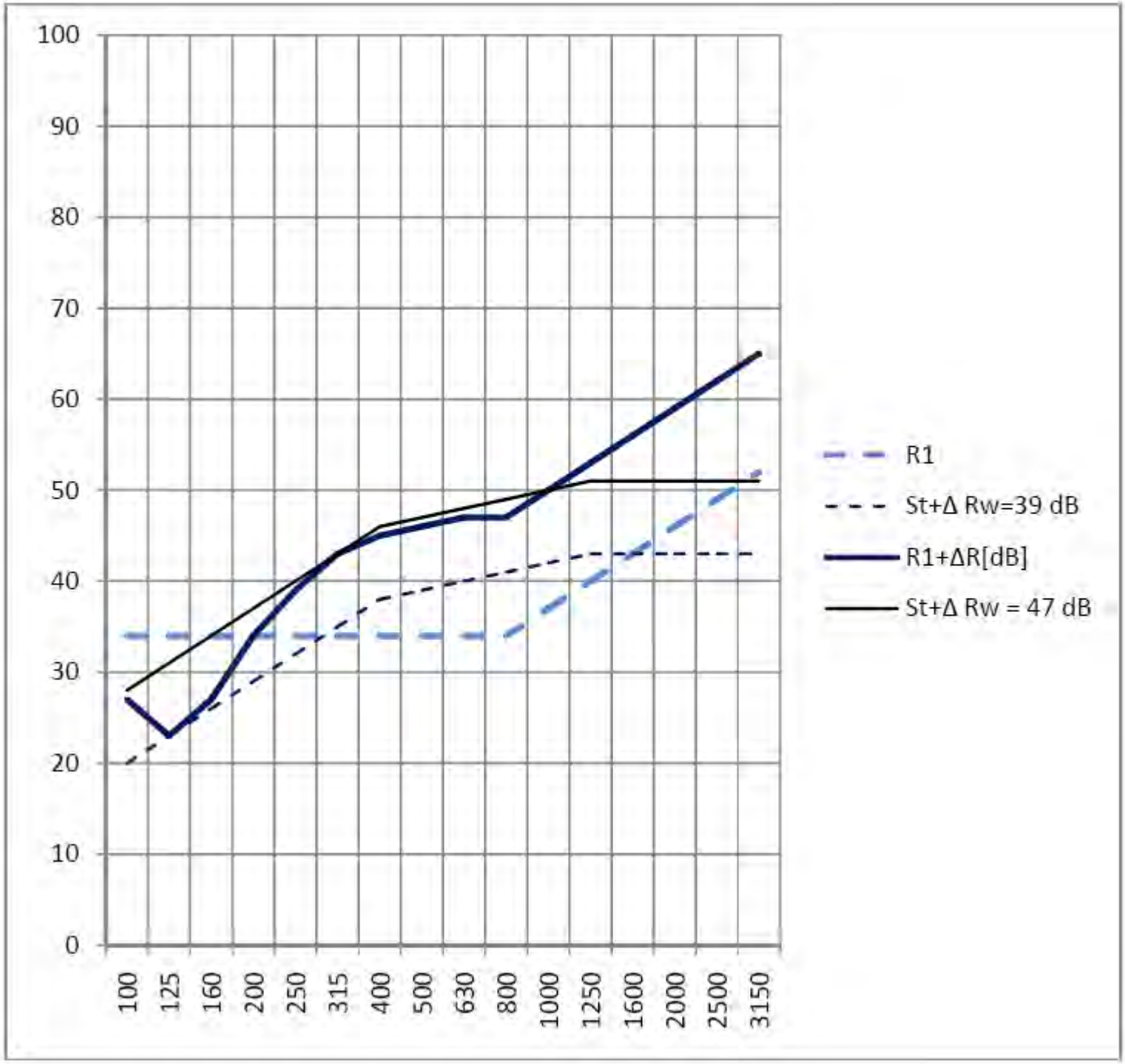

70
dB
60
50
40
30
A
B
R'w = 42 dB
R'w = 53 dB
Schalldämm – Maß R →
125
250
500
1000 Hz 2000
Frequenz f →

Βελτίωση της ηχομονωτικής ικανότητας

$\Delta R = 40 \log(f/f_0)$



ΔR_w


100
90
80
70
60
50
40
30
20
10
0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
R1
St+Δ Rw=39 dB
R1+ΔR[dB]
St+Δ Rw = 47 dB

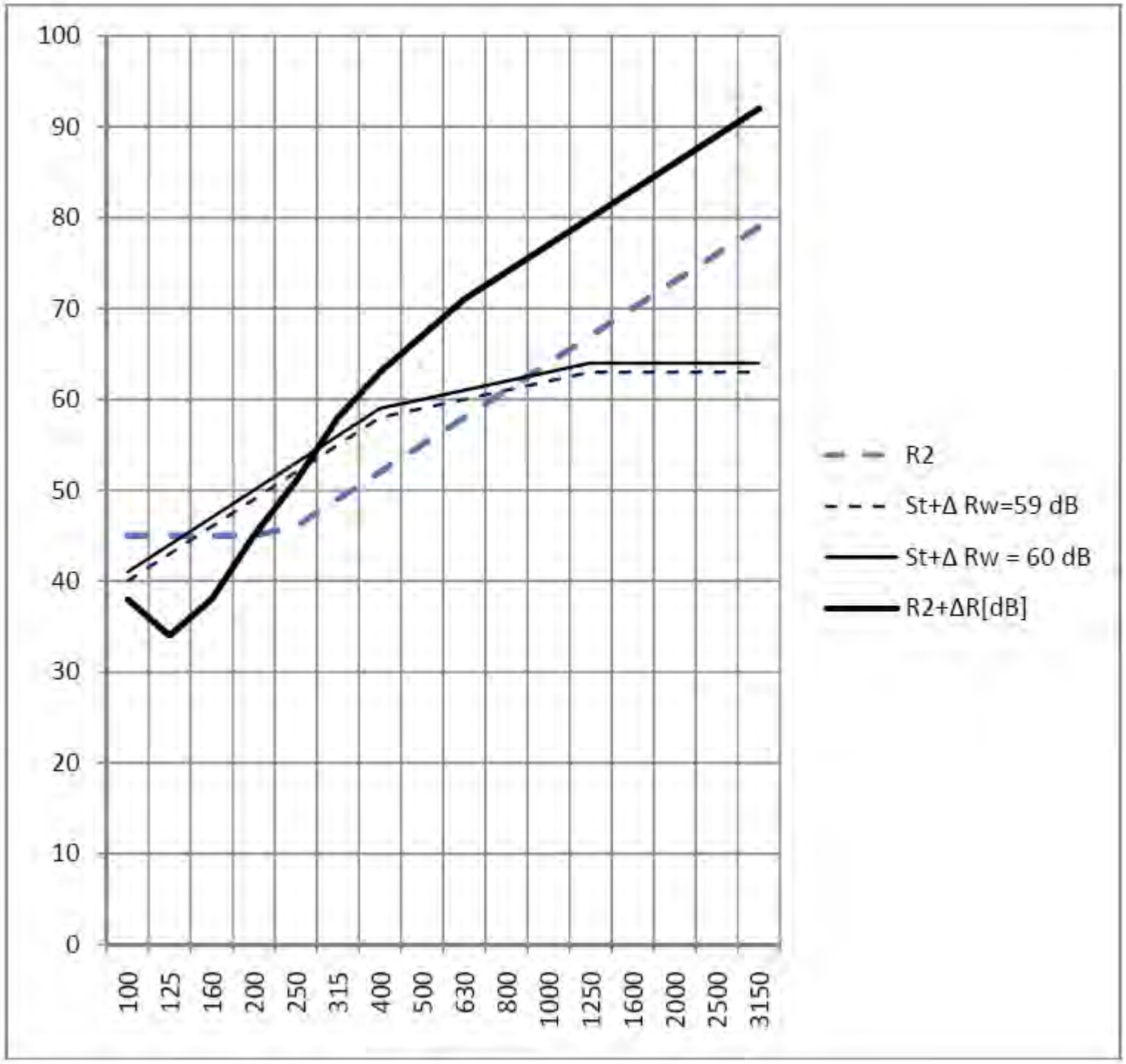

100
90
80
70
60
50
40
30
20
10
0
100
125
160
200
250
315
400
500
630
800
1000
1250
1600
2000
2500
3150
R2
St+Δ Rw=59 dB
St+Δ Rw = 60 dB
R2+ΔR[dB]

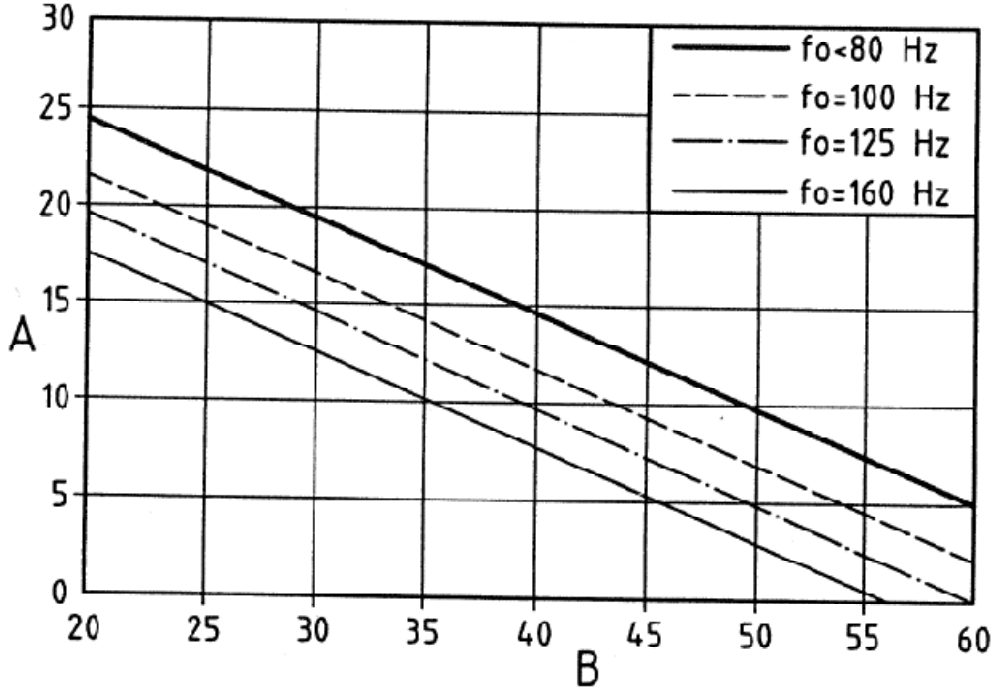
Table D.3 — Weighted sound reduction index improvement by a lining, depending on the resonance frequency

Resonance frequency f_o of the lining Hz	ΔR_w dB
≤ 80	35 - $R_w/2$
100	32 - $R_w/2$
125	30 - $R_w/2$
160	28 - $R_w/2$
200	- 1
250	- 3
315	- 5
400	- 7
500	- 9
630 – 1 600	- 10
> 1 600	- 5

NOTE 1: For resonance frequencies below 200 Hz, the minimum value of ΔR_w is 0 dB.

NOTE 2: Values for intermediate resonance frequencies can be deduced by linear interpolation over the logarithm of the frequency.

NOTE 3: R_w denotes the weighted sound reduction index of the bare wall or floor in dB.



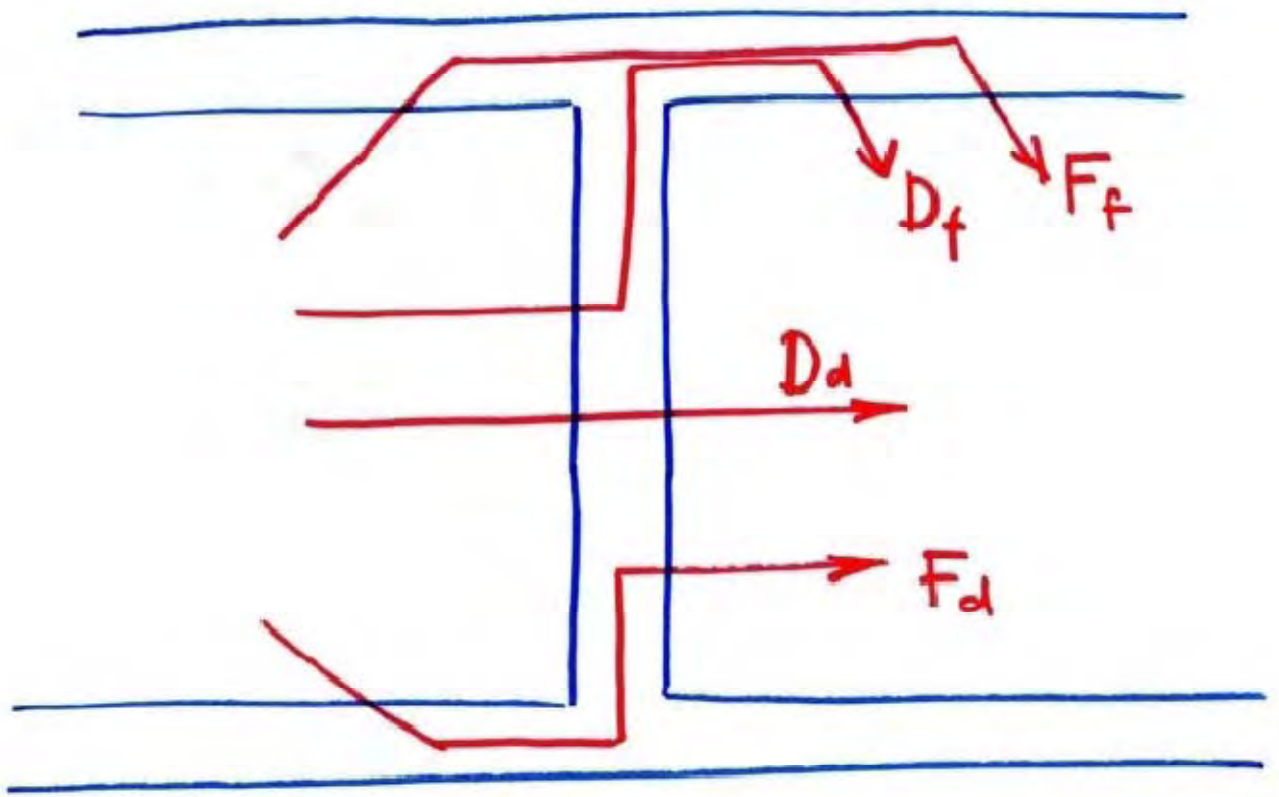
Legend

A Weighted sound reduction index improvement ΔR_w (dB)

B Weighted sound reduction index of the bare wall or floor (dB)

Figure D.1 — Weighted sound reduction index improvement by an additional layer with resonance frequency below 200 Hz, as function of R_W for the bare structural element

Πλευρική μετάδοση του ήχου

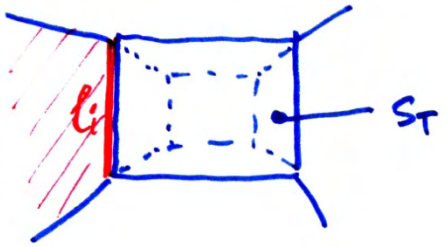


→ EN 12354

DIN 4109, Bbl.1, 1989, Skelettbau

$$R'_{W,R} = -10 \log\left(10^{\frac{-R_{W,R}}{10}} + \sum_{i=1}^{n} 10^{\frac{-R'_{L,W,Ri}}{10}}\right)$$

$$R'_{L,W,R,i} = R_{L,W,R,i} + 10 \log \frac{S_T}{S_0} - 10 \log \frac{\ell_i}{\ell_0}$$



$S_0 = 10 m^2$

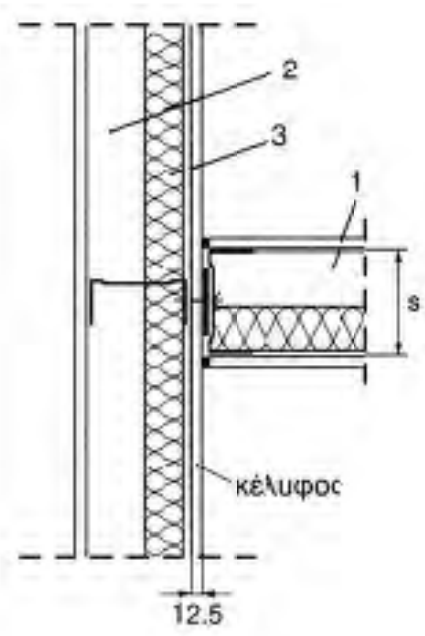
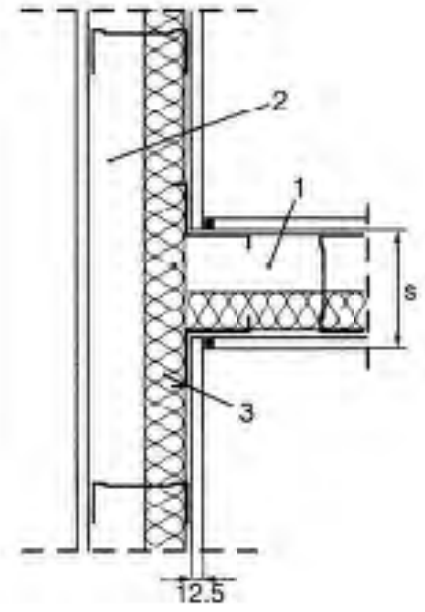
$\ell_0 = 4.5 m$ ΟΡΟΦΕΣ ΔΑΠΕΔΑ

$2.8 m$ ΤΟΙΧΟΙ

Πίνακας 25. Σταθμισμένο μέτρο πλευρικής ηχομόνωσης $R_{L,w,R}$ βαρέων πλευρικών δομικών στοιχείων (τιμές υπολογισμού)

	1	2	3
	Επιφανειακό βάρος M' kg/m^2	$R_{L,w,R}$ dB	
		Οροφές	Τοίχοι
1	100	41	43
2	200	51	53
3	300	56	58
4	350	58	60
5	400	60	62

Πίνακας 32. Σταθμισμένο μέτρο πλευρικής ηχομόνωσης RL,w,R ελαφρών χωρισμάτων από γυψοσανίδες 12,5 mm με ορθοστάτες κατά DIN 18183 (τιμές υπολογισμού, διαστάσεις σε mm)

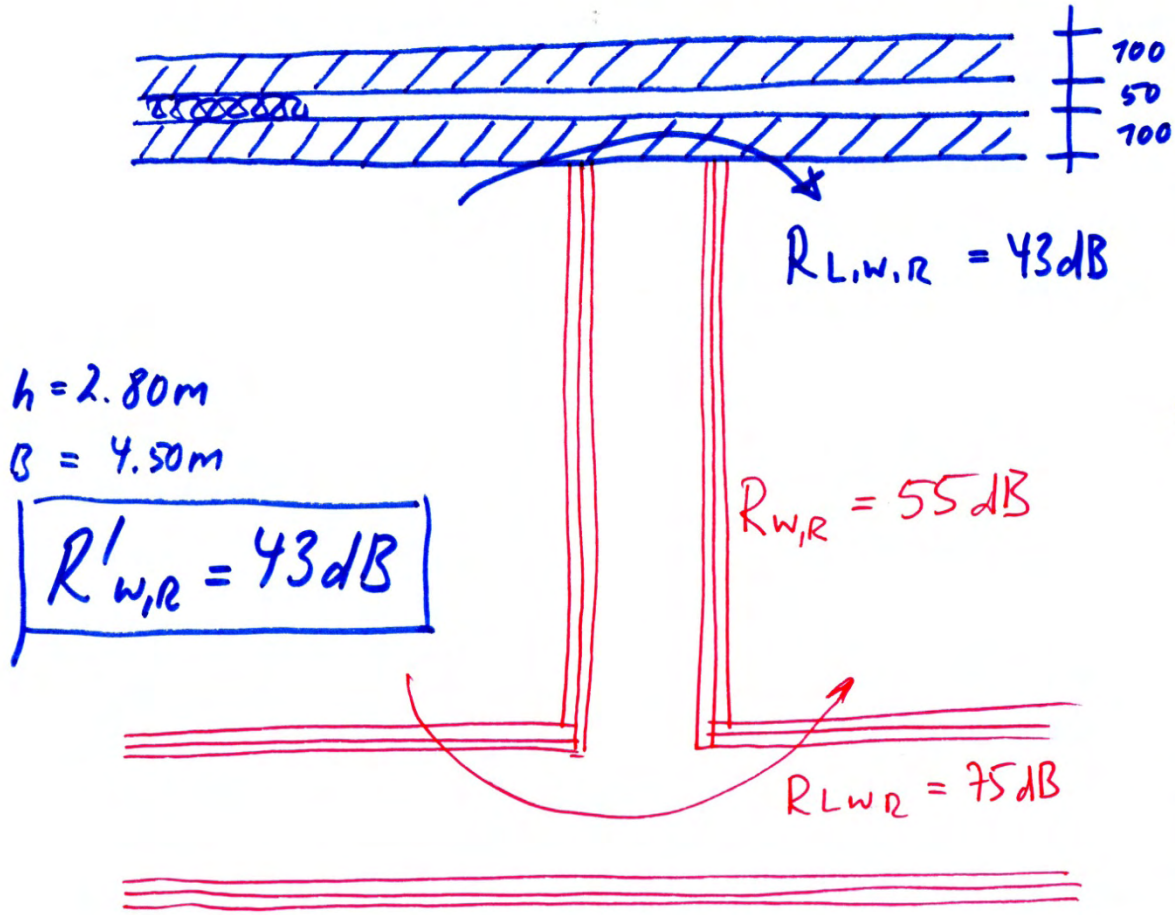
	1	2	3
	Τρόπος σύνδεσης	Αριθμός στρώσεων της εσωτερικής πλευράς του πλευρικού τοίχου	$R_{L,w,R}$ dB
1	Συνεχής διάστρωση του πλευρικού τοίχου 	1	53
2		2	57[1]
3	Διακοπτόμενη διάστρωση και σύνθεση ορθοστατών 	1	73
4		2	> 75

1) Διαχωριστικός τοίχος με μονό ή διπλό ορθοστάτη κατά DIN 18183

2) Πλευρικός τοίχος με μονό ή διπλό ορθοστάτη, μετά τη διπλή γυψοσανίδα κατά DIN 18180, πάχους 12,5 mm, εφαρμογή κατά DIN 18181 με σφράγισμα στη σύνδεση με τον πλευρικό τοίχο. Απόσταση κελυφών ≥ 50 mm

3) Πλάκες ορυκτών ινών κατά DIN 18165, μέρος 1, με κατά μήκος αντίσταση ροής Ξ ≥ 5 kN s/m^4

4) Για $R_{L,w,R}$ > 55 dB πρέπει να διακόπτεται η επένδυση στο σημείο σύνδεσης με τον διαχωριστικό τοίχο με αρμό



h = 2.80m

B = 4.50m

$R'_{w,R}$ = 43dB

ΤΟΥΒΛΟ 750 kg/m³

75 kg/m²

ΣΟΒΑΖ 25 kg/m²

100 kg/m²

ΟΡΟΦΗ/ΔΑΠΕΔΟ:

200mm οπλ. ΣΚΥΡ

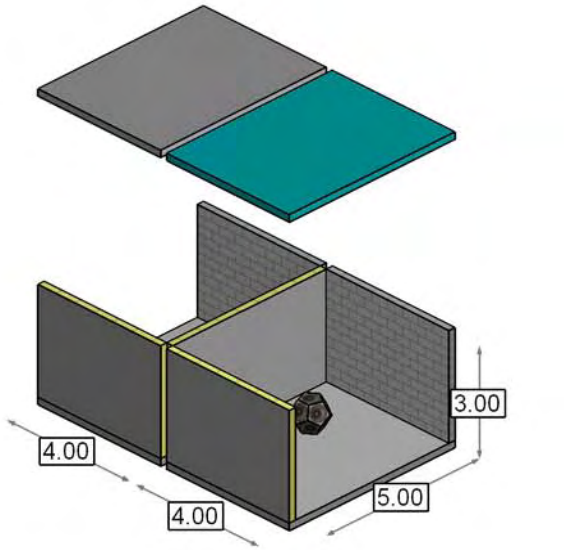
480 kg/m²

$R_{L,w,R}$ = 60dB

Project Info

Project Name: IEMA
Worksheet: Worksheet 1 [DM Ts (1)]
Program: BASTIAN V 2.3

Room View



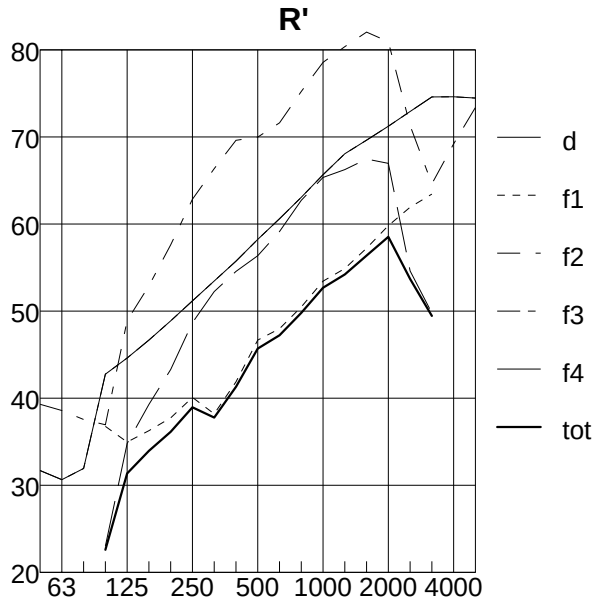
Worksheet-Table

		Sending Room		Junctio	Receiving Room		R'w		L'n,w	
M	t	Basic Element	Additional	Type-I	Basic Element	Additional	dB	%	dB	%
X	d	Rigi: gypsum brd. 2x12.5 mm, Akustic TF 60 mm (studs CW 75), gypsum brd. 2					54.4	26		
X	f1	ISOV: lightweight brick 1.2 115 mm, render 2x15 mm		18	ISOV: lightweight brick 1.2 115 mm, render 2x15 mm		50.4	65		
X	f2	Rigi: gypsum brd. "Die Blaue" 2x12.5 mm, Akustic TF 40 mm (studs CW 50), gy		20	Rigi: gypsum brd. "Die Blaue" 2x12.5 mm, Akustic TF 40 mm (studs CW 50), gy		69.0	1		
X	f3	BAST: concrete floor (2400 kg/m³) 200 mm		18	BAST: concrete floor (2400 kg/m³) 200 mm		62.4	4		
X	f4	BAST: concrete floor (2400 kg/m³) 200 mm		18	BAST: concrete floor (2400 kg/m³) 200 mm		62.4	4		
						Total:	48.1	100		

Elements / Constructions

tau	Room	Element	Construction
d	SR	lightweight double wall, metal frame	Rigi: gypsum brd. 2x12.5 mm, Akustic TF 60 mm (studs CW 75), gypsum brd. 2x12.5 mm (2000)
f1	SR	monolithic wall	ISOV: lightweight brick 1.2 115 mm, render 2x15 mm
f1	RR	monolithic wall	ISOV: lightweight brick 1.2 115 mm, render 2x15 mm
f2	SR	lightweight double wall, metal frame	Rigi: gypsum brd. "Die Blaue" 2x12.5 mm, Akustic TF 40 mm (studs CW 50), gypsum brd. "Die Blaue" 2x12.5 mm (2000)
f2	RR	lightweight double wall, metal frame	Rigi: gypsum brd. "Die Blaue" 2x12.5 mm, Akustic TF 40 mm (studs CW 50), gypsum brd. "Die Blaue" 2x12.5 mm (2000)
f3	SR	monolithic floor	BAST: concrete floor (2400 kg/m³) 200 mm
f3	RR	monolithic floor	BAST: concrete floor (2400 kg/m³) 200 mm
f4	SR	monolithic floor	BAST: concrete floor (2400 kg/m³) 200 mm
f4	RR	monolithic floor	BAST: concrete floor (2400 kg/m³) 200 mm

Resulting Diagram



R'w = 48
R'w + C = 46
R'w + Ctr = 40