



Cross laminated timber BBS[®]

introduction



Cross laminated timber BBS ...

... is multilayered, completely and solidly made of wood. Due to the gluing of longitudinal and transverse layers, the „working“ of the wood is reduced to a negligible degree. Thus, the standards of a modern building material are assured.

BBS is a solid pre-fabricated element made of wood that insulates heat and can simultaneously carry loads. It is fireproof and has a sound absorbing effect. It can be constructed fast and dry and has a positive effect on the well being of humans.

99.4 % timber and 0.6 % glue that is BBS, a monolithic building material. Thus, a piece of timber. It is therefore easy to plan and built. All details are simple to solve. The planned building physics can easily be realised and monitored. No complexity of the construction. No foils. No complicated details. Built as easy as planned.

Many design engineers and construction companies consider the options of prefabrication, dry construction and shorter assembly times to be essential advantages.

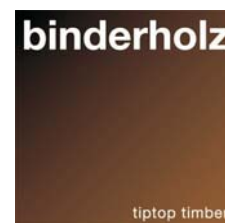
BBS constructions meet the requirements of environmental and passive energy standards with reduced construction thicknesses, thereby enabling more space to be gained.

The increased use of wood as a sustainable building material, with its energy-saving and neutral Co2 level properties, represents an active contribution to climate protection.

BBS is produced and marketed by Binderholz Bausysteme GmbH, a Binderholz Group company. In the timber business, the Binderholz name is synonymous with tradition and reliability, as well as high technology and innovation

... the material for your ideas

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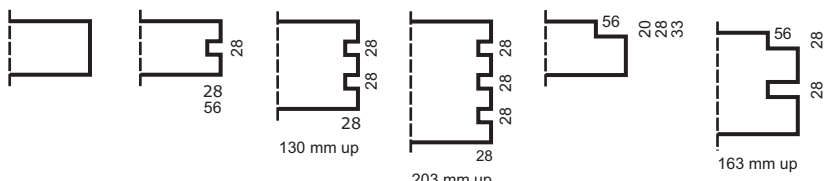
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BBS technical data

construction	multilayered crossed 3-, 5-, 7 ply
wood species	spruce larch arolla pine douglas silver fir
moisture content	12 % +/- 2 %
quality of top layer	visible AB visible BC non visible, C
surfaces AB BC	smoothly glued without grooves every longitudinal layer = single-ply board planed on both sides sanded or brushed on one side optional
sizes	width 125 cm length length up to 24 m [general finger joint GFJ] thickness 66 mm - 341 mm
longitudinal edges	all longitudinal edges slightly chamfered [~ 3 mm] standard profiles on both sides 
gluing	single-ply board: MUF E1, weatherproof, transparent glue groove BBS: PU formaldehyde-free
dimensional change	in element longitudinal direction 0.010 % per percentage change in moisture content in element cross direction 0.025 % per percentage change in wood moisture content
weight	spruce $\rho[12\%] \sim 470$ kg/m ³ larch $\rho[12\%] \sim 590$ kg/m ³
heat insulation	heat conductance $\lambda_R = 0.13$ W/mK [DIN] $\lambda_{\text{measured}} = 0.097$ W/mK [98 mm BBS] specific thermal capacity $c = 2.10$ kJ/kgK thermal diffusivity $a = 1.317 \times 10^{-7}$ m ² /s [$\rho = 470$ kg/m ³ ; $\lambda = 0.13$ W/mK]
sound insulation	solid soundproofing thanks to solid construction certificate available on request
fire protection	certificate for REI 30-90 available on request
diffusion	open to diffusion, vapour barrier diffusion resistance coefficient $\mu \sim 70$
approvals	European Technical Approval ETA-06/0009 CE marking German Technical Approval Z-9.1-534



BBS characteristic values

cross section

layers	thickness [mm]	construction [mm]							ℓ_{eff} [m]	characteristic values				
										A_{eff} [cm ²]	$A_{V,\text{eff}}$ [cm ²]	W_{eff} [cm ³]	I_{eff} [cm ⁴]	i_{eff} [cm]
3	66 ¹⁾	20	26	20					2	400	648	659	1988	2.23
									4		710	676	2177	2.33
									6		723	679	2217	2.35
	78	20	38	20					2	400	756	858	2922	2.70
									4		862	887	3332	2.89
									6		885	892	3422	2.92
	90	27	36	27					2	540	806	1189	4568	2.91
									4		944	1244	5355	3.15
									6		976	1255	5534	3.20
	100 ²⁾	37	26	37					2	740	858	1533	6667	3.00
									4		996	1610	7737	3.23
									6		1027	1625	7980	3.28
	110 ²⁾	36	38	36					2	720	897	1771	7966	3.33
									4		1103	1889	9797	3.69
									6		1154	1914	10244	3.77
	130 ²⁾	43	44	43					2	860	968	2404	12077	3.75
									4		1263	2622	15747	4.28
									6		1341	2669	16720	4.41
5	100	20	20	20	20	20			2	600	963	1273	5458	3.02
									4		1107	1308	6270	3.23
									6		1138	1315	6449	3.28
	110	20	21	28	21	20			2	680	1039	1482	6912	3.19
									4		1199	1518	7979	3.43
									6		1235	1525	8216	3.48
	130	20	26	38	26	20			2	780	1175	1896	10027	3.59
									4		1393	1938	11893	3.90
									6		1443	1946	12323	3.97
	147	41	22	21	22	41			2	1030	1123	2976	16689	4.03
									4		1464	3211	21748	4.60
									6		1553	3260	23071	4.73
	163	42	21	37	21	42			2	1210	1242	3626	22449	4.31
									4		1610	3880	29116	4.91
									6		1706	3933	30850	5.05
	181	42	38	21	38	42			2	1050	1163	3958	23052	4.69
									4		1748	4437	34663	5.75
									6		1933	4541	38323	6.04
	203	42	38	43	38	42			2	1270	1290	4844	31063	4.95
									4		1937	5351	46641	6.06
									6		2141	5459	51552	6.37
	213	42	43	43	43	42			2	1270	1291	5127	32905	5.09
									4		2010	5712	51216	6.35
									6		2248	5838	57272	6.72

¹⁾ only available with a length of 4.95 m, without general finger joint

²⁾ only available in non visible C

BBS characteristic values

cross section

layers	thickness [mm]	construction [mm]							ℓ_{eff} [m]	characteristic values				
										A_{eff} [cm ²]	$A_{V,\text{eff}}$ [cm ²]	W_{eff} [cm ³]	I_{eff} [cm ⁴]	i_{eff} [cm]
7	233	42	21	43	21	43	21	42	2	1700	1382	6672	49630	5.40
									4		2047	7304	73502	6.58
									6		2252	7439	80872	6.90
	248	42	26	43	26	43	26	42	2	1700	1344	7111	52036	5.53
									4		2114	7901	81878	6.94
									6		2372	8073	91880	7.35
	284	42	38	43	38	43	38	42	2	1700	1276	8160	58025	5.84
									4		2258	9336	102700	7.77
									6		2645	9605	120325	8.41
	299	42	43	43	43	43	43	42	2	1700	1254	8596	60582	5.97
									4		2311	9935	111630	8.10
									6		2752	10245	132953	8.84
	341	63	43	43	43	43	43	63	2	2120	1163	11168	82199	6.23
									4		2374	14087	167858	8.90
									6		2976	14849	210399	9.96

cross section values for elastically connected longitudinal layers after the Gamma-method

$$A_{v,eff} = 1,5 \frac{D_{eff}}{l_{eff} \cdot b} \quad (b = 100 \text{ cm})$$

- 
 ... longitudinal layer
 ... cross layer
- A_{eff} cross section area (only longitudinal layers)
 $A_{v,eff}$... surface for shear proof
 I_{eff} torque of inertia
 W_{eff} ... section modulus
 ℓ_{eff} length

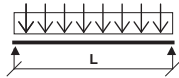
material

kind of loading	EN 1995-1-1 EN 338	
	[N/mm ²]	
E-modulus bending	$E_{0,mean}$	11,000
bending right angled to plane	$f_{m,k}$	18
modulus of shear	G_{mean}	690
modulus of rolling shear	$G_{R,mean}$	50
thrust from lateral force	$f_{R,k}$	0.70
pressure in plane	$f_{c,0,k}$	21
normal pressure to plane	$f_{c,90,k}$	2.5
tension on plane	$f_{t,0,k}$	9.80

material values for dimensioning according to DIN on request

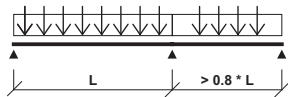
BBS predimensioning

simple span



g _{1,k} +n _k	span width																		
	3.0 m		3.5 m		4.0 m		4.5 m		5.0 m		5.5 m		6.0 m						
	permitted deflection																		
	I/250	I/350	I/250	I/350	I/250	I/350	I/250	I/350	I/250	I/350	I/250	I/350	I/250	I/350					
2.0	78	78	90	90	90	110-5s	110-5s	130-5s	130-5s	147	147	147	163						
2.5		90	90	100-5s	110-5s	130-5s	130-5s	147	163			181							
3.0				110-5s								203							
3.5	90	90	100-5s	130-5s	130-5s	147	147	147	163	181	181	203							
4.0	90	100-5s	110-5s										130-5s	147	147	163	181	203	213
4.5		110-5s																	
5.0		100-5s	130-5s	130-5s	147	147	163	163	181	203	233								
5.5	130-5s											147	147	163	181	203	233		
6.0																		147	163
6.5		147	163	181	203	233													
7.0	147						163	181	203	233									
7.5											147	163	181	203	233				
8.0		147	163	181	203	233													

duel span



The length of the shorter field is between 80 % and 100 % of the longer field.

g _{1,k} +n _k	span width longer field																			
	3.0 m		3.5 m		4.0 m		4.5 m		5.0 m		5.5 m		6.0 m							
	permitted deflection																			
	l/250	l/350	l/250	l/350	l/250	l/350	l/250	l/350	l/250	l/350	l/250	l/350	l/250	l/350						
2.0	78	78	78	78	90	90	100-5s	100-5s	130-5s	110-5s	130-5s	130-5s	130-5s							
2.5				90	100-5s	100-5s	130-5s	110-5s		147										
3.0					110-3s	110-5s		130-5s												
3.5			90	100-5s	110-5s	130-5s	147													
4.0								90	100-5s	110-5s	130-5s	147								
4.5	90	90	100-5s	110-5s	130-5s	147	163													
5.0								100-5s	110-5s	130-5s	147	163								
5.5													110-5s	130-5s	147	163				
6.0																	130-5s	147	163	203
6.5																				
7.0	100-5s	130-5s	147	203																
7.5					110-5s	130-5s	147	203												
8.0									100-5s	130-5s	147	203								

R30	3s... 3-layers
R60	5s... 5-layers
R90	

dimensioning according to Eurocode 5 and European Technical Approval (EN 1995-1-1:2004 und ETA/0009:2006)

requirements:

- * service class 1 (interior space $k_{ser}=0.6$)
- * self weight $g_{1,k}$: is dead load without dead load of BBS
- * imposed load n_k : service classes A und B (living and office space: $\psi_1=0.7$ $\psi_2=0.5$ $\psi_3=0.3$ middle load duration, $k_{mod}=0.8$)
- * dimensioning in the case of fire according to EN 1995-1-2 and survey IBS-08012901:2008-06 (characteristical combustion rate for ceilings $\beta_s=0.74\text{mm/min}$)
- * imposed load amounts to 50 % of the total load

limiting values for deflection for serviceability limit states:

- * appearance: permitted long-term bending with a quasi-permanent design situation $I/250$ respectively $I/350$

cross section values:

calculation of BBS cross sections according to the Gamma-method. For continuous beam $l_{cr}=4/5 \cdot l$

These tables may be used for predimensioning BBS and do not replace static calculations. The strain is to be seen as evenly divided area load.

BBS grading

top layer

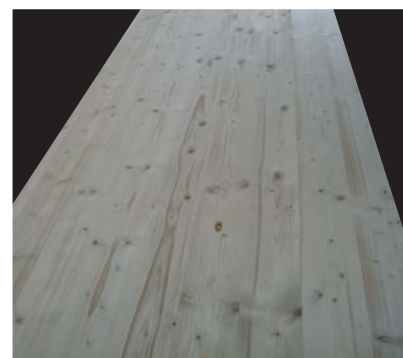
extract from the European standard DIN EN 13017-1 surface classification of BBS			
characteristics	A	B	C
adhesion	no open glued joints	open joints < 100 mm/m glued joint permitted	open joints < 100 mm/m glued joints permitted
visual appearance and colour	well balanced in colour and texture	considerably balanced in colour and texture	no requirements
texture	rough texture permitted	rough texture permitted	no requirements
knots	healy, strongly grown spruce knots: up to 40 mm $\varnothing$ larch knots: up to 60 mm $\varnothing$ and sporadic black knots	healthy, strongly grown knots and sporadic black knots permitted	permitted
dowel ²	natural branch dowel permitted	permitted	permitted
resin pocket	sporadic up to 3 mm x 40 mm perm.	sporadic up to 5 mm x 50 mm perm.	permitted
repaired resin pockets	permitted	permitted	permitted
ingrowing bark	not permitted	permitted if sporadic	permitted
shake	sporadic surface shakes permitted	surface and end-shakes up to 50 mm length, permitted if sporadic	permitted
pith	sporadic up to 400 mm length permitted	permitted	permitted
compression wood	permitted if sporadic	permitted	permitted
insect attack	not permitted	not permitted	small sporadic holes from non-active larvae permitted
discolouring	not permitted	slight discolouring permitted	permitted
decay	not permitted	not permitted	not permitted
sapwood	with larch, narrow stripes up to 20 % of the laminated width permitted	permitted	permitted
quality of the surface finish	small sporadic flaws permitted	sporadic flaws permitted	no requirements

² measurements of oval dowels as by knots

example



visible AB

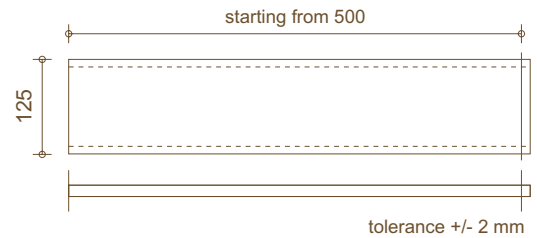


visible BC

BBS charging

standard

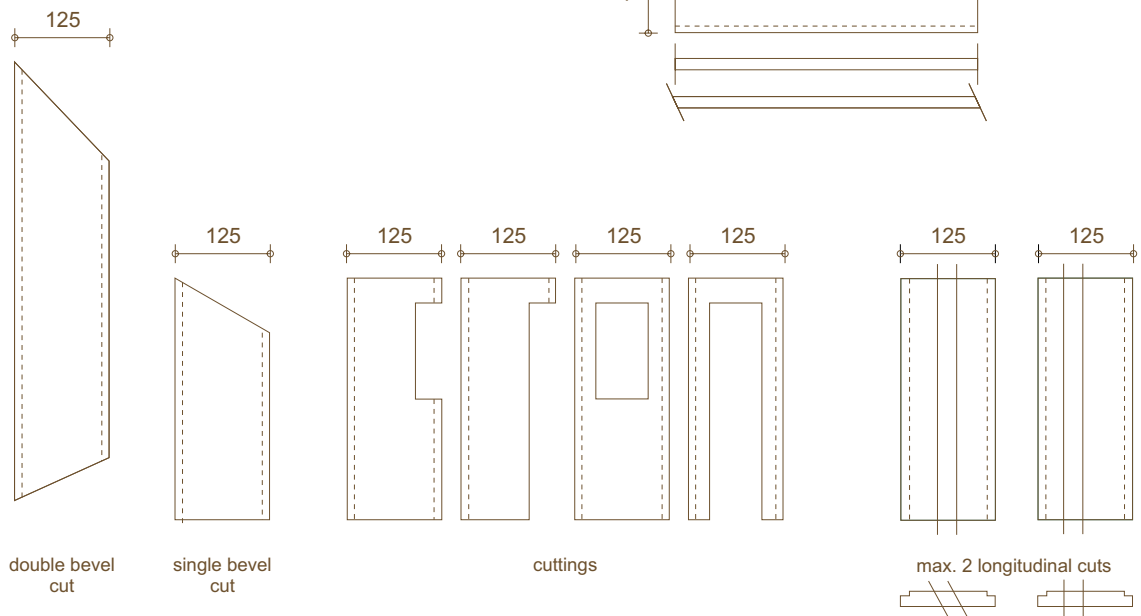
longitudinal edges standard profiles on both sides
transverse edges cut right-angled | tolerance +/- 2 mm



CNC-machining

regular CNC-machining

longitudinal edges standard profiles on both sides
transverse edges cut right-angled or angled



special CNC-machining

every machining, except those illustrated in regular CNC-machining,
e.g.:
machining at transverse edges [notches, millcuttings, flatterings,...]
cuttings < 25 cm
round respectively cured machining
drillings, slots,...

on request | surcharge

general

charging

charging width = 125 cm | 62.5 cm
lengths are rounded up to full cm
the circumlocutory rectangle sets the standard

minimum size

BBS minimum width: 25 cm | minimum surface: 0.5 m²

tools

5-axial chain saw and circular saw | max. cutting depth = 35 cm
milling cutter | diameter 40 mm (on request), 80 mm, 100 mm
special tools on request

BBS references

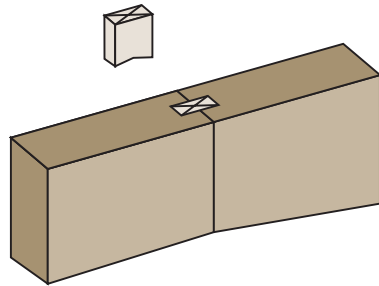
Binderholz Germany, Woodcenter

location	Ingolstadt GERMANY
project	office block
BBS use	all BBS elements in visible AB external wall 256 mm
energy cons.	low-energy standard with a ventilation system
assembly	approx. 3 weeks



BBS constructions

wall



BBS one storey wall



BBS multi storey wall



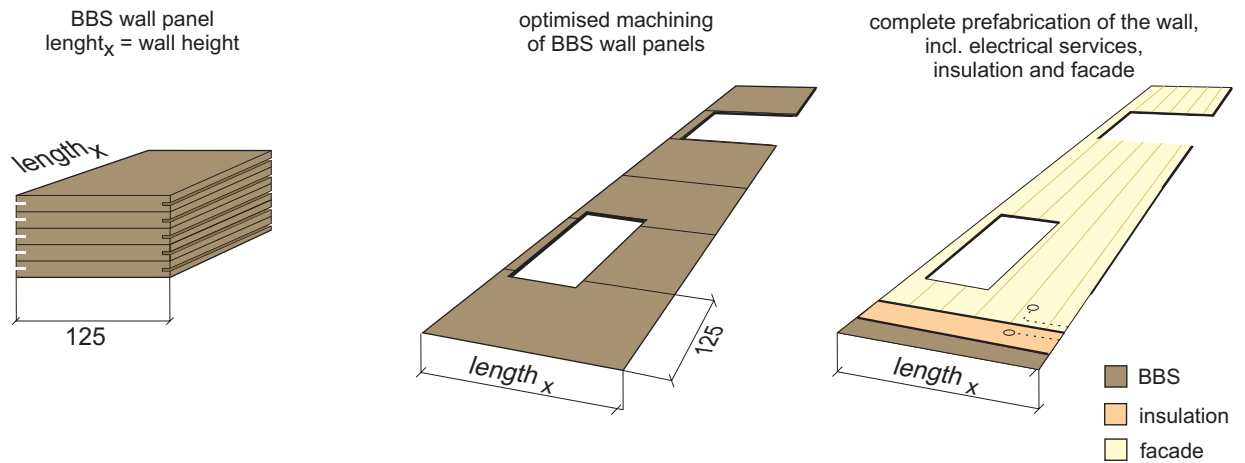
prefabricated BBS-wall including electrical services, insulation and facade



BBS horizontal wall

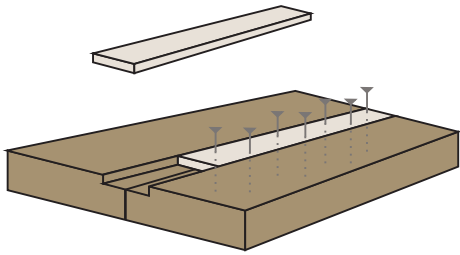
BBS constructions

prefabricated wall | by timber construction company

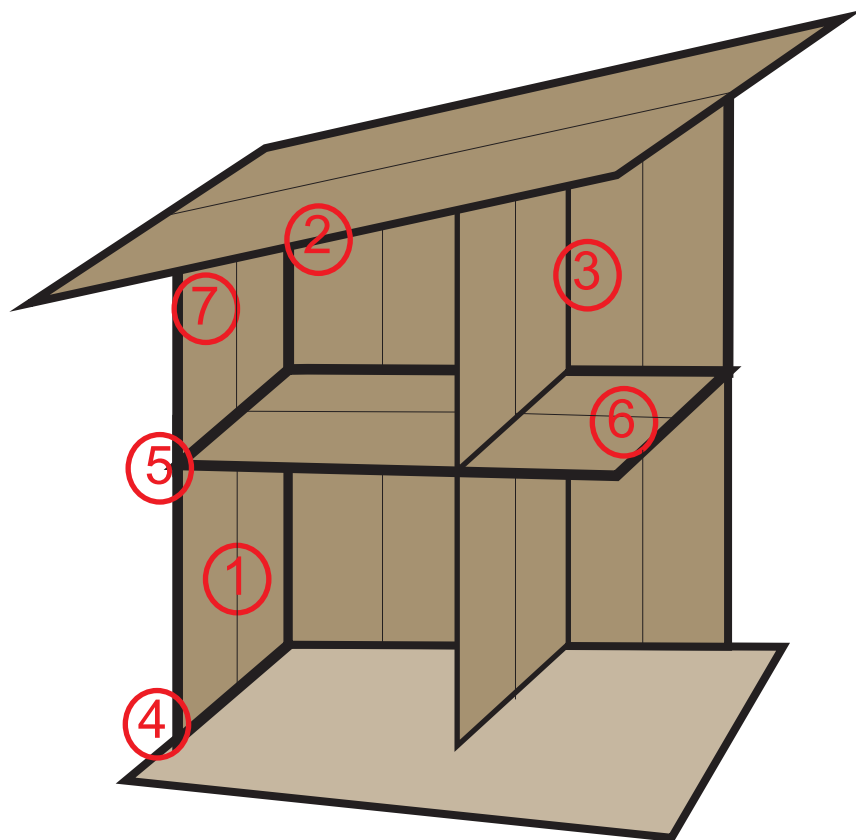


value added:

- optimised machining
- maximum seasonal benefits
- independent of weather conditions
- reduced investment costs

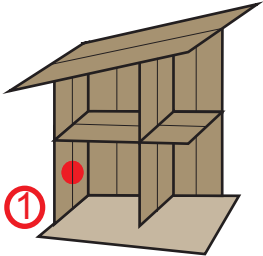


BBS details



BBS details

wall | wall



standard	variant
construction 3-ply board	electrical services connection (screws)
building physics OUTSIDE seal Trelleborg B 8 INSIDE	adhesive tape

BBS details

wal | wall corner joint



standard	variant
----------	---------

construction

~400 mm

Ø 8-10 mm

coverboard

building physics

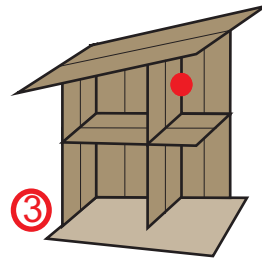
INSIDE

seal
Trelleborg P 12

OUTSIDE

BBS details

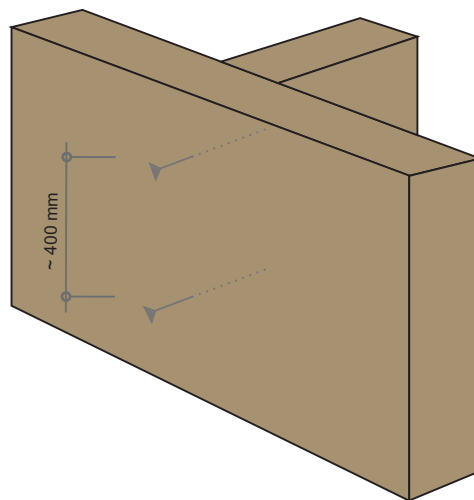
wall | internal wall



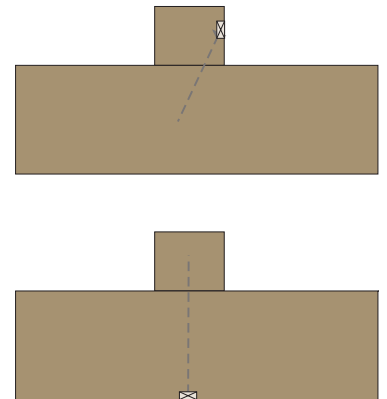
standard

variant

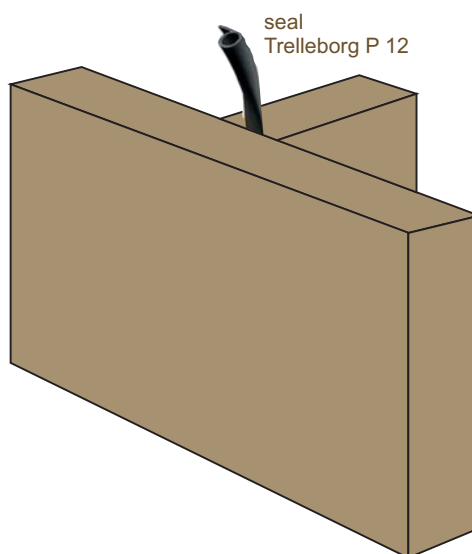
construction



Ø 8-10 mm



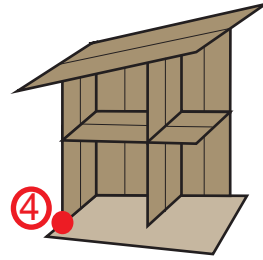
building physics



seal
Trelleborg P 12

BBS details

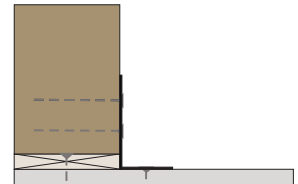
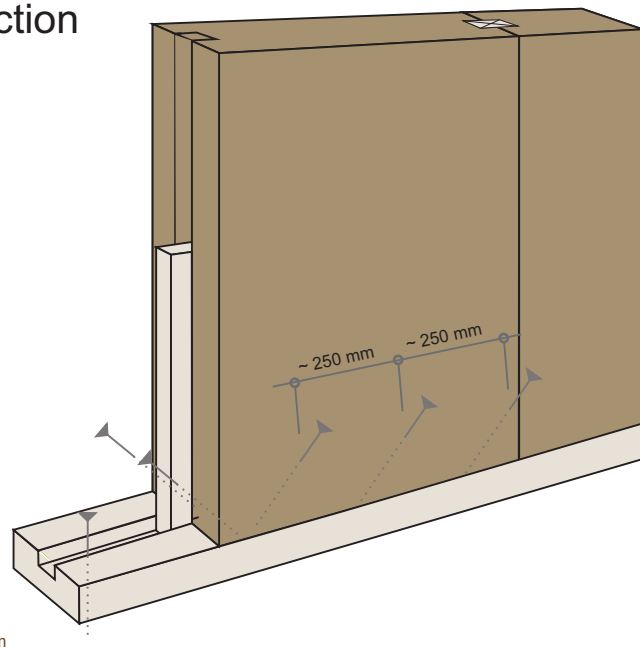
fundament | wall



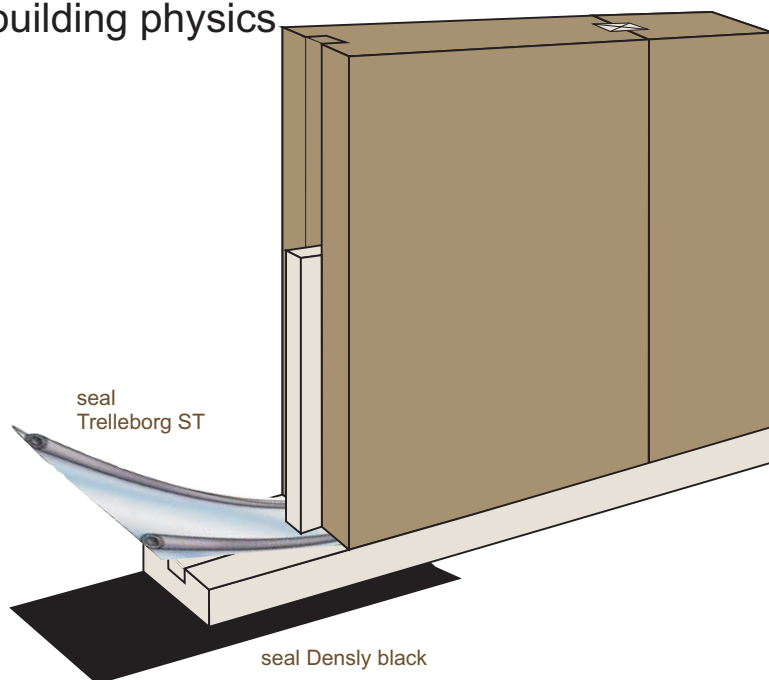
standard

variant

construction



building physics

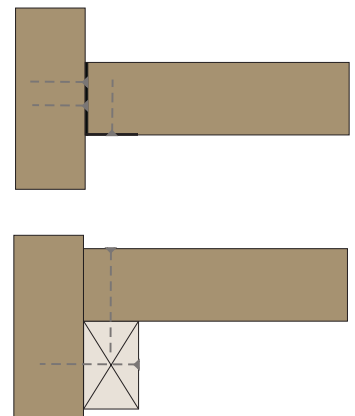
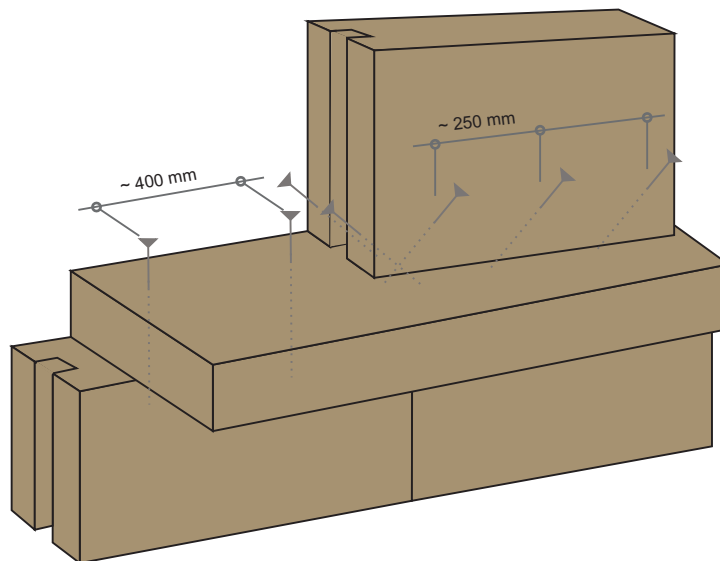




standard

variant

construction

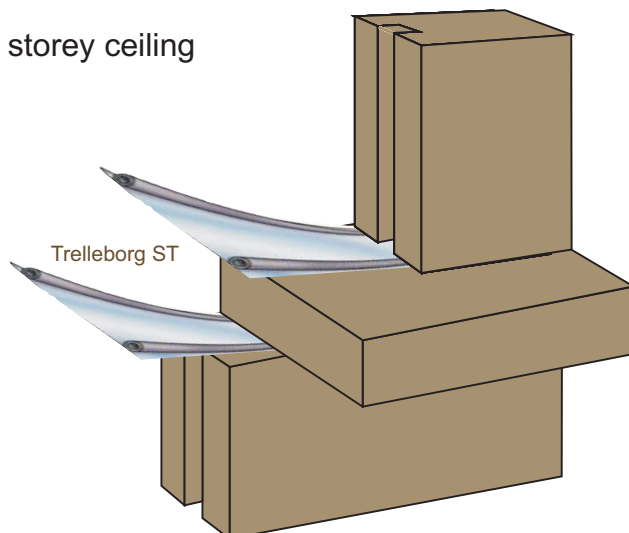


Ø 6-8 mm

Ø 8-10 mm

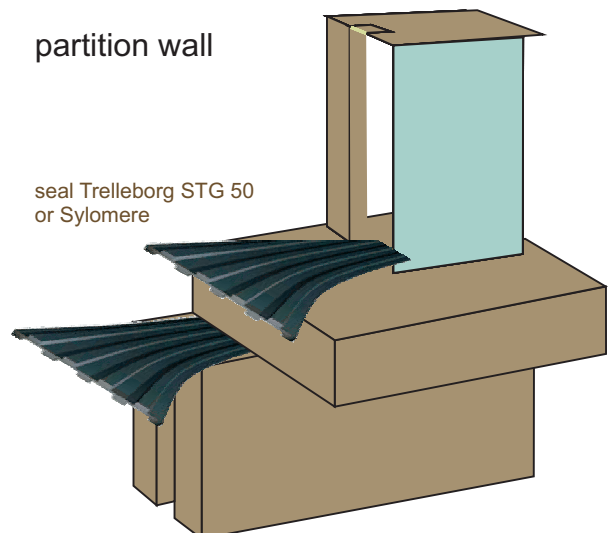
building physics

storey ceiling

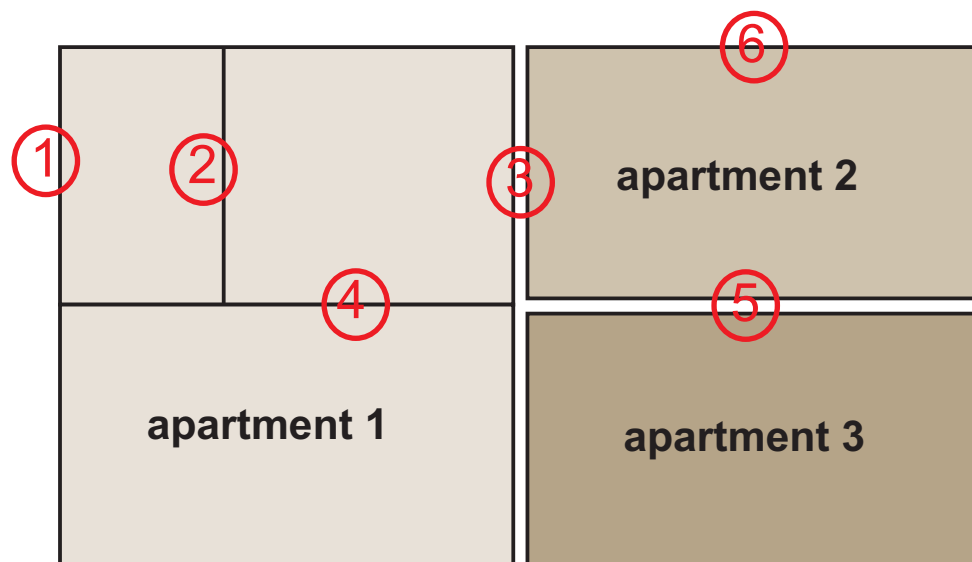


partition wall

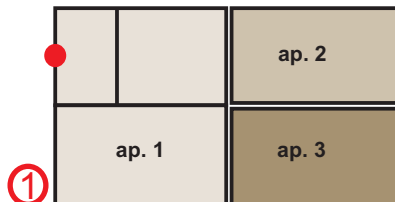
seal Trelleborg STG 50
or Sylomere



BBS superstructures



BBS superstructures

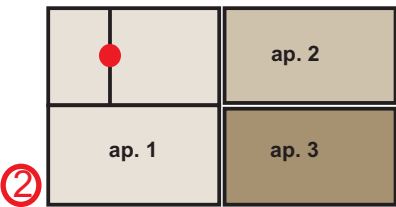


external wall	construction design		thickness [mm]	Rw [dB]	U - value [W/mK]	fire protection
	[mm]	[material]				
	90 140 22 40 19	BBS spruce GUTEX Thermowall GUTEX Multiplex-top lathing 60/40 vertical composite board 3-ply, spruce	311	44 [measured]	0,20 [calculated]	REI 30 [tested]
	12,5 (50) 60 10 90 140 22 40 19	GF, Rigidur H ISOVER Akusto 5.0 lathing 60/60 Rigips adjusting clip (space) BBS spruce GUTEX Thermowall GUTEX Multiplex-top lathing 60/40 vertical composite board 3-ply, spruce	383,5	58 [measured]	0,16 [calculated]	REI 60 [expert's report]
	12,5 12,5 60 (50) 10 90 120 6	Rigips fire protection board Rigips fire protection board lathing 60/60 ISOVER Akusto 5.0 Rigips adjusting clip (space) BBS spruce GUTEX Thermowall plaster	301	57 [measured]	0,19 [calculated]	REI 90 [expert's report]
	12,5 12,5 60 (50) 10 90 (160) 160 60 6	Rigips fire protection board Rigips fire protection board lathing 60/60 ISOVER Akusto 5.0 Rigips adjusting clip (space) BBS spruce ISOVER Uniroll constr. timber, spruce 60/160 ISOVER Integra ZUB GUTEX Thermowall plaster	401	63 [measured]	0,12 [calculated]	REI 90 [expert's report]

All the superstructures were tested in a joint research project in corporation with Saint - Gobain Rigips Austria GmbH.

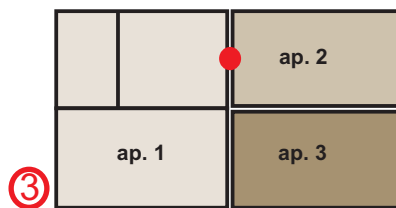
C... correction factor on request

BBS superstructures



internal wall	construction design		thickness [mm]	Rw [dB]	fire protection
	[mm]	[material]			
	100 15	BBS 5- layers spruce Rigidur H gypsum fibreboard	115	> 38 [calculated]	REI 60 [expert's report]
	78	BBS spruce	78	> 34 [calculated]	—
	15 90 15	Rigidur H gypsum fibreboard BBS spruce Rigidur H gypsum fibreboard	120	> 36 [calculated]	REI 60 [expert's report]

BBS superstructures

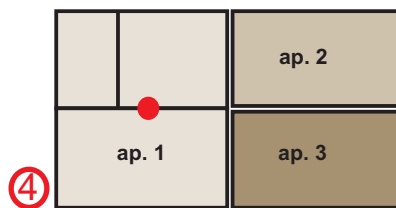


partition wall	construction design [mm] [material]	thickness [mm]	Rw [dB]	DnT,w [dB]	fire protection
	12,5 Rigips fire protection board 90 BBS spruce 10 space 50 ISOVER Domo-Twin 90 BBS spruce 12,5 Rigips fire protection board	265	55 [measured]	58 [measured]	REI 60 [expert's report]
	98 BBS, 5- layers 10 space 50 ISOVER Domo-Twin 90 BBS spruce 12,5 Rigips fire protection board	260,5	57 [measured]	59 [measured]	REI 60 [expert's report]
	12,5 Rigips fire protection board 12,5 Rigips fire protection board (75) ISOVER Akusto 7.5 75 Rigips wall-profiles 10 space 90 BBS spruce 12,5 Rigips fire protection board	212,5	62 [measured]	64 [measured]	REI 60 [expert's report]
	12,5 Rigips fire protection board 12,5 Rigips fire protection board 90 BBS spruce 10 space 50 ISOVER Domo-Twin 90 BBS spruce 12,5 Rigips fire protection board 12,5 Rigips fire protection board	290	61 [measured]	63 [measured]	REI 60 [expert's report]

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C... correction factor on request

BBS superstructures



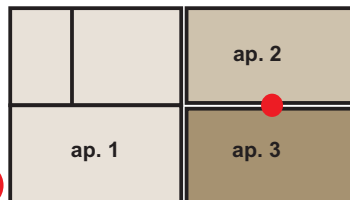
ceiling	construction design [mm] [Material]	thickness [mm]	Rw [dB]	DnT,w [dB]	fire protection
	25 Rigiplan dry screed 10 Mineral fibre subsonic insulation 60 Rigips chipping Leca 146 BBS spruce	241	56 [measured]	56 [measured]	REI 90 [expert's report]
	10 Rigidur H 10 gypsum fibreboard 25 Rigidur dry screed 20 ISOVER Akustic EP 3, Sd40 chipping 5/8, bonded with K102 146 BBS spruce	321	72 [measured]	72 [measured]	REI 90 [expert's report]
	60 cement screed 35 TPS 35 subsonic insulation 70 light concrete (Styrobeton) 146 BBS spruce	311	46 [tested SM 440]	0,20 [calculated]	REI 90 [expert's report]
	18 flooring boards 100 Leca chipping bulk load lathing 146 BBS spruce	264	51 [calculated]	0,23 [calculated]	REI 90 [expert's report]

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C... correction factor on request

BBS superstructures

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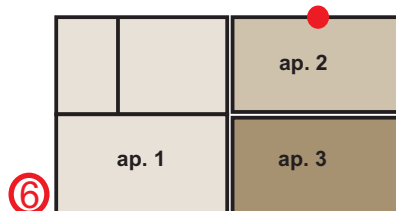
partition ceiling

	construction design [mm] [material]	thickness [mm]	L nT,w [dB]	Rw [dB]	DnT,w [dB]	fire protection
	50 cement screed 40 ISOVER Akustic EP 1, Sd6 chipping 5/8, bonded with K102 100 ISOVER Akustic EP 1, Sd6 chipping 5/8, bonded with K102 146 BBS spruce	336	35 [measured]	77 [measured]	77 [measured]	REI 90 [expert's report]
	10 Rigidur H 10 gypsum fibreb. 25 Rigidur dry screed 20 ISOVER Akustic EP 3, Sd40 chipping 5/8, bonded with K102 120 ISOVER Akustic EP 3, Sd40 chipping 5/8, bonded with K102 146 BBS spruce	321	41 [measured]	72 [measured]	72 [measured]	REI 90 [expert's report]
	25 Rigidur dry screed 12 ISOVER Akustic EP 3, Sd40 chipping 60 ISOVER Akustic EP 3, Sd40 chipping 146 BBS spruce 95 suspension + CD 60/27 (75 ISOVER Akusto 7.5) 12,5 Rigips fire protection board 12,5 Rigips fire protection board	363	34 [measured]	78 [measured]	78 [measured]	REI 90 [expert's report]
	25 Rigidur dry screed 10 wood fibre insulating panel 60 wood fibre insulating panel chipping 146 BBS spruce 95 suspension + CD 60/27 (75 ISOVER Akusto 7.5) 12,5 Rigips fire protection board 12,5 Rigips fire protection board	361	42 [measured]	74 [measured]	74 [measured]	REI 90 [expert's report]

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C... correction factor on request

BBS superstructures



roof	construction design [mm] [Material]	thickness [mm]	Rw [dB]	U - Wert [W/mK]	fire protection
	concrete roof tiles lathing 50/30 horizontal counter lathing 80/60 vertical sarking membrane GUTEX Multiplex- top GUTEX Thermosafe homogen BBS, 5-layers	390	54 [measured]	0,17 [calculated]	REI 60 [expert's report]
	concrete roof tiles lathing 50/30 horizontal counter lathing 80/60 vertical sarking membrane ISOVER Integra AP BBS, 5-layers Rigips fire protection board	380,5	52 [measured]	0,17 [calculated]	REI 90 [expert's report]
	concrete roof tiles lathing 50/30 horizontal counter lathing 80/60 vertical sarking membrane GUTEX Multiplex- top GUTEX Thermosafe homogen BBS, 5-layers Rigips adjusting clip CD profile 60/27 ISOVER Akusto 5.0 Rigips fire protection board	462,5	64 [measured]	0,14 [calculated]	REI 90 [expert's report]
	gravel (m' = 73,2 kg/m²) plastic foil BauderTec EPS 100 EPS 100 plastic foil BauderDuo BBS, 5-layers	399	57 [measured]	0,15 [calculated]	REI 90 [competed]

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