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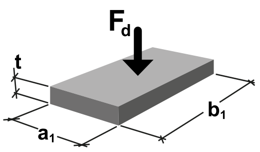
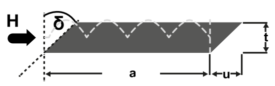
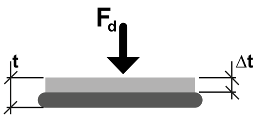
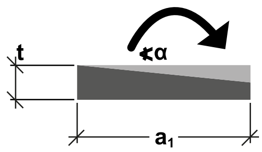
bi-Trapez Bearing

Structural bearing for static structural members and impact sound insulation

Design values

The bearings are dimensioned according to the national technical approval up to a compressive stress $\sigma_{R,d} = 17{,}4\ N/mm^2$.
The design concept is based on the shape factor. Holes, cut-outs and the required edge distances must be taken into account according to DIN EN 1992.

TYPE OF LOAD ACTING

Design value of bearing resistance	All. shear deformation	Deflection	Allowable rotation
			

FORMULA

$\sigma_{R,d} =$ $1{,}095 \times S^{1{,}543} \leq 17{,}4\ [N/mm^2]$ Shape factor S see page 2	Thickness t t = 10 mm: all. u = 4 mm t = 15 mm: all. u = 5,5 mm t = 20 mm: all. u = 8 mm Horizontal force H_d = $c_{s(t)} \cdot u \cdot A_E / 20000$ [kN] A minimum compressive stress of 1 N/mm^2 is required to prevent the bearing from slipping. $c_{s(t)}$ values and boundary conditions, see page 5	see page 4	Thickness t t = 10 mm: all. $\alpha = 3000/a_1$ [‰] t = 15 mm: all. $\alpha = 5000/a_1$ [‰] t = 20 mm: all. $\alpha = 6500/a_1$ [‰] (Rectangular bearing) Additional rotation acc. to technical approval: • 10 ‰ from obliquity • $\frac{625}{a_1}$ from unevenness see also booklet 600, DAfStb

LEGEND FORMULA SYMBOLS

F_d	Vertical force
H_d	Horizontal force
A_E	Bearing area
S	Shape factor, Ratio of pressed bearing surface A_E to unloaded lateral surface
a_1	Short side of bearing
b_1	Long side of bearing
a	Component width
b	Component length
$\sigma_{R,d}$	Design value of the load capacity
$\sigma_{E,d}$	Design compressive stress from load
α	Bearing rotation
$c_{s(t)}$	Shear stiffness
u	Shear deformation of the bearing
t	Thickness of bearing
Δt	Bearing deflection

bi-Trapez Bearing

Structural bearing for static structural members and impact sound insulation

Design of the shape factor

For the design of unreinforced elastomeric bearings, the shape factor S is defined as the ratio of the compressed to the freely deformable surface. The shape factor S is used to calculate the permissible compressive stress as a function of the bearing dimensions.

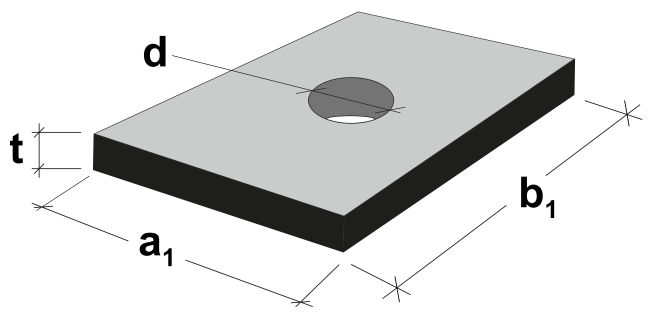
SHAPE FACTOR FOR RECTANGULAR BEARING

Without drilled holes

$$S = \frac{b_1 \cdot a_1}{2 \cdot t\,(b_1 + a_1)}$$

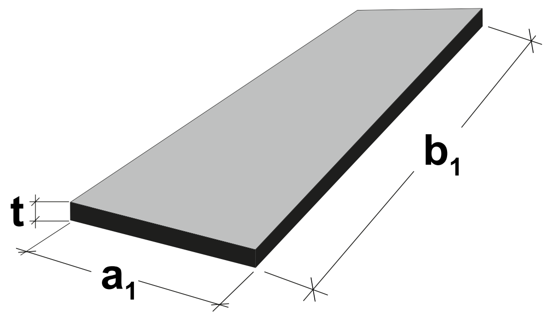
With drilled holes, $n \leq 4$

$$S = \frac{a \cdot b - \frac{\pi}{4} n \cdot d^2}{2 \cdot t\,(a + b) + t \cdot \pi \cdot n \cdot d}$$



SHAPE FACTOR FOR BEARING STRIP

$$S = \frac{a_1}{2 \cdot t} \qquad b_1 >> a_1$$



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Structural bearing for static structural members and impact sound insulation

Thickness: 10 mm

The following tables show the design value of the load capacity and the allowable angle of distortion as a function of the bearing dimensions. Intermediate values may be interpolated.

BEARING			DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²]																		
[mm]	α [‰]	[mm]	BEARING LENGTH [mm]																		
Thick-ness	all. rotation	Width	70	80	90	100	110	120	130	140	150	175	200	225	250	275	300	350	400	450	500
10	40	50	–	–	–	2,4	2,5	2,6	2,7	2,8	2,9	3,1	3,2	3,3	3,4	3,5	3,5	3,7	3,8	3,8	3,9
	30	100	3,3	3,8	4,1	4,5	4,8	5,1	5,4	5,7	6,0	6,5	7,0	7,4	7,8	8,1	8,4	8,9	9,3	9,6	9,9
	20	150	4,2	4,8	5,4	6,0	6,5	7,0	7,5	8,0	8,4	9,4	10,3	11,2	11,9	12,5	13,1	14,1	15,0	15,7	16,4
	15	200	4,8	5,5	6,3	7,0	7,7	8,4	9,1	9,7	10,3	11,8	13,1	14,3	15,4	16,5	17,4	17,4	17,4	17,4	17,4

Thickness: 15 mm

BEARING			DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²]																		
[mm]	α [‰]	[mm]	LBEARING LENGTH [mm]																		
Thick-ness	all. rotation	Width	70	80	90	100	110	120	130	140	150	175	200	225	250	275	300	350	400	450	500
15	40	50	–	–	–	1,3	1,4	1,4	1,5	1,5	1,5	1,6	1,7	1,8	1,8	1,9	1,9	2,0	2,0	2,0	2,1
	40	100	1,9	2,0	2,2	2,4	2,6	2,8	2,9	3,1	3,2	3,5	3,8	4,0	4,2	4,3	4,5	4,8	5,0	5,1	5,3
	33,3	150	2,4	2,6	2,9	3,2	3,5	3,8	4,0	4,3	4,5	5,0	5,5	6,0	6,4	6,7	7,0	7,6	8,0	8,4	8,8
	25	200	2,8	3,0	3,4	3,8	4,1	4,5	4,9	5,2	5,5	6,3	7,0	7,7	8,3	8,8	9,3	10,2	10,9	11,6	12,2

Thickness: 20 mm

BEARING			DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²]															
[mm]	α [‰]	[mm]	BEARING LENGTH [mm]															
Thick-ness	all. rotation	Width	100	110	120	130	140	150	175	200	225	250	275	300	350	400	450	500
20	40	100	1,5	1,7	1,8	1,9	2,0	2,0	2,2	2,4	2,6	2,7	2,8	2,9	3,1	3,2	3,3	3,4
	32,5	200	2,4	2,7	2,9	3,1	3,3	3,5	4,0	4,5	4,9	5,3	5,6	6,0	6,5	7,0	7,4	7,8

STRIP BEARINGS						
BEARING WIDTH a_1 [mm]	BI-TRAPEZ BEARING®					
	BEARING THICKNESSES					
	10 mm		15 mm		20 mm	
	$F_{R,d}$ [kN/m]	α [‰]	$F_{R,d}$ [kN/m]	α [‰]	$F_{R,d}$ [kN/m]	α [‰]
50	225	40	120	40	-	-
100	1312	30	702	40	450	40
150	2610	20	1968	33,3	-	-
200	3480	15	3480	25	2624	32,5

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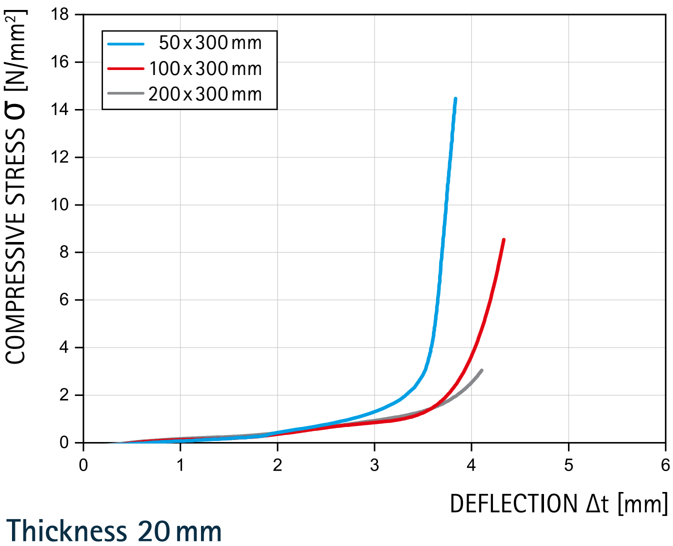
bi-Trapez Bearing

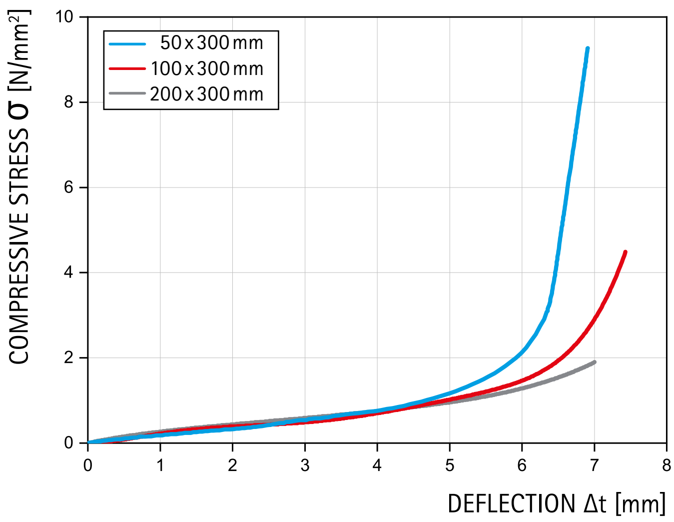
Structural bearing for static structural members and impact sound insulation

Load deflection curves

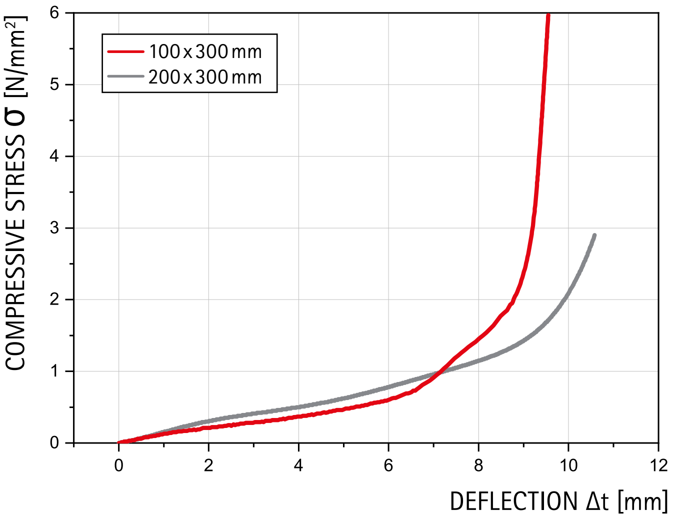
Thickness 10 mm



Thickness 15 mm

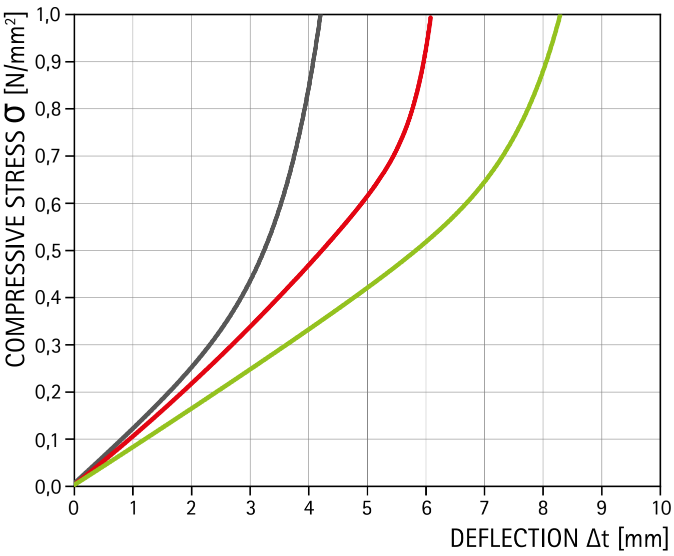


Thickness 20 mm



Load deflection curve up to the design value of load capacity acc. to the approval for a bearing of this type with high shape factor.

Load deflection curve for different bearing thicknesses



Bearing deflection in the lower, acoustically relevant compressive stress range, orientation diagram

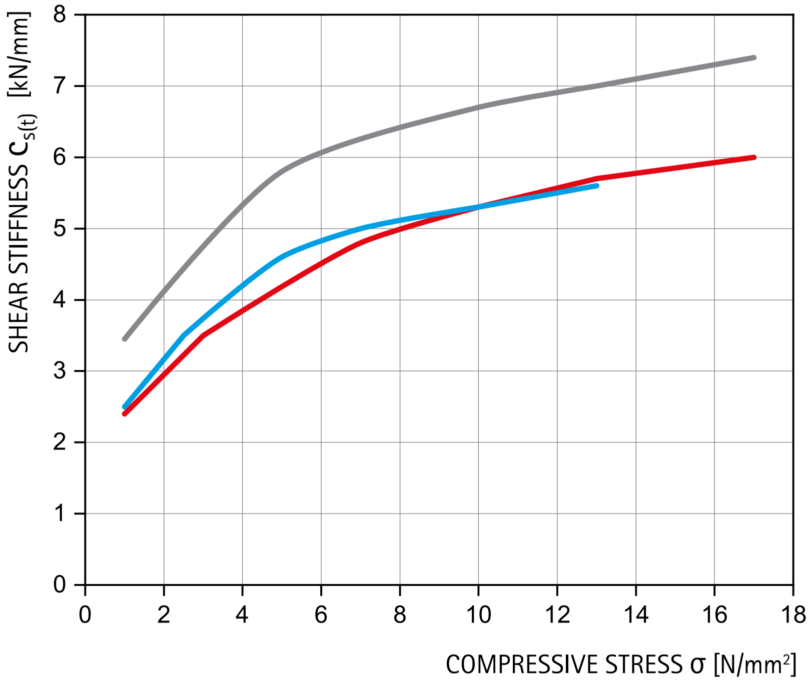
bi-Trapez Bearing

Structural bearing for static structural members and impact sound insulation

Shear stiffness

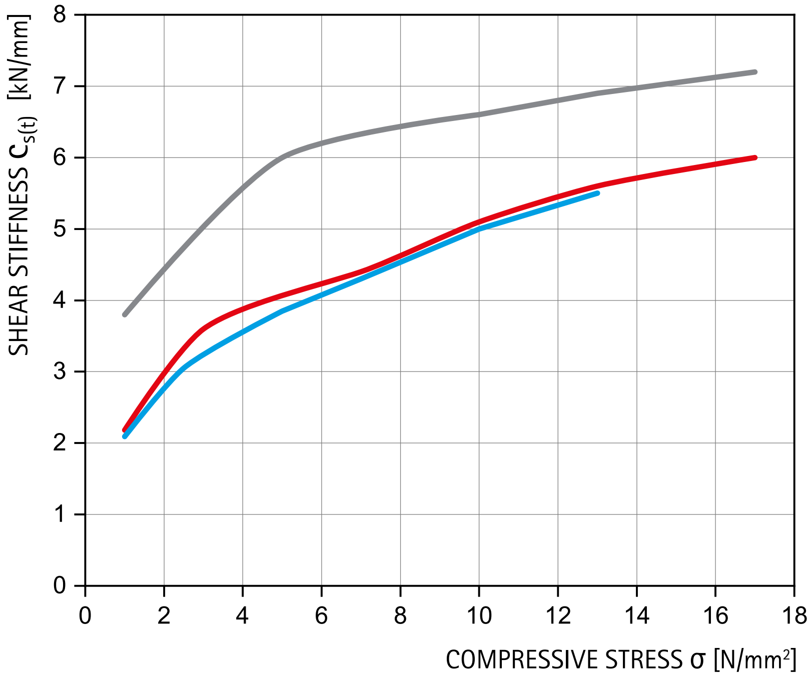
SHEAR STIFFNESS CURVE

Perpendicular to profile.



—	t = 10 mm
—	t = 15 mm
—	t = 20 mm

Parallel to profile.



—	t = 10 mm
—	t = 15 mm
—	t = 20 mm

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bi-Trapez Bearing
Structural bearing for impact sound insulation

Impact sound levels

Measured according to DIN 7396 in the compressive stress range σ = 0.1 N/mm^2 - 0.7 N/mm^2.

IMPACT SOUND LEVELS						
Bearing thickness [mm]	Bearing width [mm]	Eff. vertical load [kN/m]	$\Delta L^*_{w,flight}$ max. [dB]	$\Delta L_{w,flight}$ max. [dB]	$\Delta L^*_{n,w}$ max. [dB]	Deflection [mm]
10	50	5-35	20	22	23	0.8-3.8
	100	10-70				
	150	15-105				
	200	20-140				
15	50	5-35	22	24	25	0.9-5.5
	100	10-70				
	150	15-105				
	200	20-140				
20	100	10-70	23	25	26	1.2-7.4
	200	20-140				

LEGEND

$\Delta L^*_{w,flight}$ Rated flight impact sound level difference as per DIN 7396 for certification in compliance with DIN 4109-2
$\Delta L_{w,flight}$ Rated flight impact sound level difference as per DIN 7396 for certification in compliance with ISO 12354-2
$\Delta L^*_{n,w}$ Rated impact sound level difference for rigid connection and with decoupling in compliance with DIN 7396, product parameter

Example of the sound insulation certificate
in compliance with DIN 4109 Part 2

For apartment buildings:
Single-skin, bend-proof staircase wall

Stair flight on a single-skin, bend-proof
staircase wall as per DIN 4109-32: $L_{n,eq,0,w} \leq 60$ dB

Rated flight impact sound level difference
bi-Trapez Bearing t = 15 mm, b = 50 mm, measured as per DIN 7396: $\Delta L^*_{w,Lauf} \geq 22$ dB

Certificate
$L'_{n,w} = L_{n,eq,0,w} - \Delta L^*_{w,Lauf} = 60$ dB - 22 dB = 38 db
$L'_{n,w} + u_{Prog} = 38$ dB + 3 dB = 41 dB

The following requirements are thus met:
DIN 4109, strict requirement $L'_{n,w} \leq 47$ dB
DEGA, Class B $L'_{n,w} \leq 43$ dB
VDI 4100, SSt III $L'_{n,w} \leq 44$ dB

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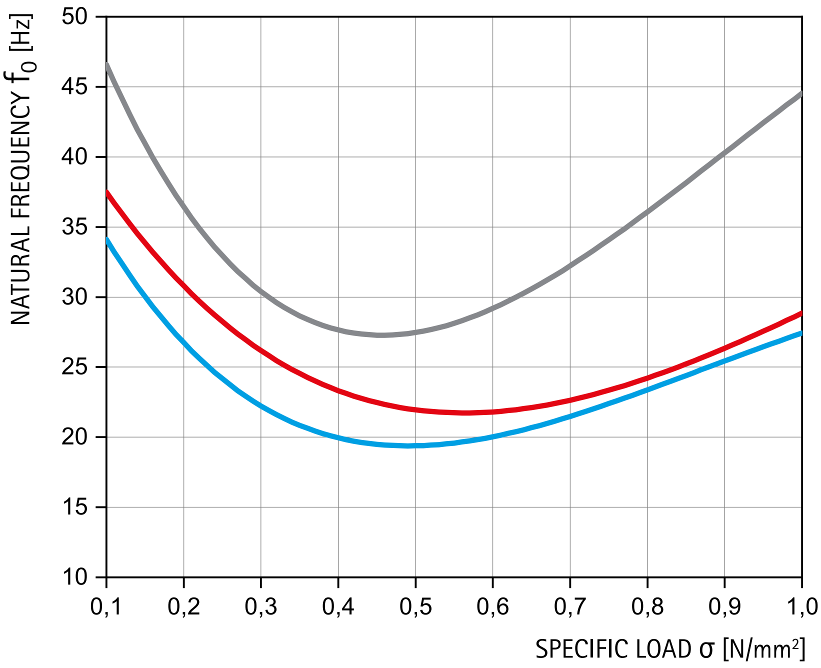
bi-Trapez Bearing

Structural bearing for impact sound insulation

Natural Frequency

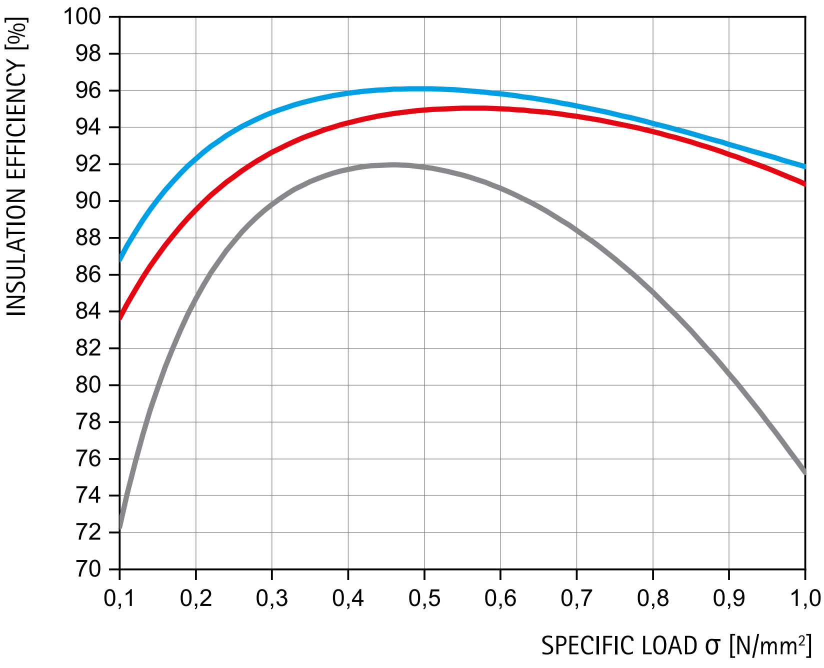


NATURAL FREQUENCY CURVE

The figure shows the natural frequency of a single-degree-oscillator with bi-Trapez Bearing as an elastic bearing for an excitation with a velocity amplitude between 0,1 and 1,0 N/mm^2.
In this range, bi-Trapezlager is suitable for the impact sound and structure-borne noise insulation due to its soft spring characteristics.

- t = 10 mm
- t = 15 mm
- t = 20 mm

Insulation efficiency



DIAGRAM

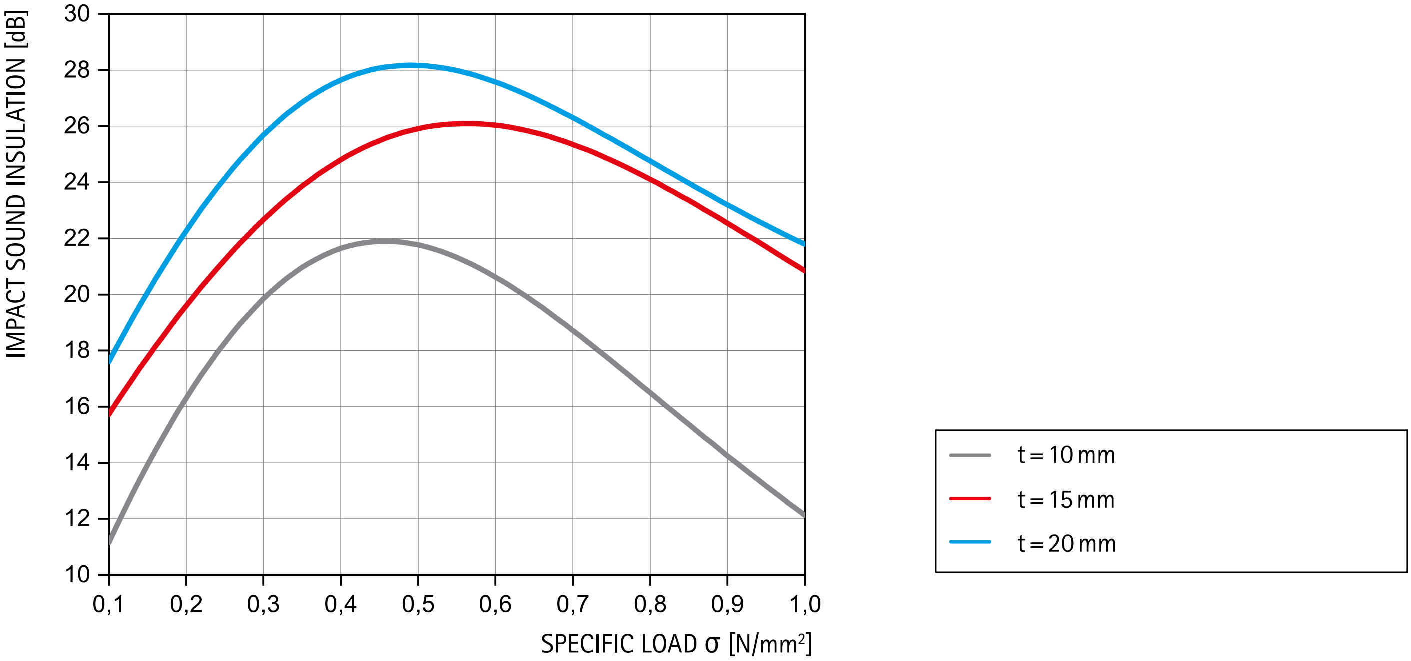
The two diagrams show the possible effect of bi-Trapez Bearing when used for the insulation of structure-borne noise. Decisive for the structure-borne sound insulation is the ratio of the occurring excitation frequency to the natural frequency shown above. The larger this is, the better the insulation. As can be seen in the diagrams, an insulation effect of over 90 % is possible even with an excitation frequency of 100 Hz. This corresponds to an impact sound insulation of 20 dB. Excitation frequencies above 100 Hz are shielded to an even higher degree.

- t = 10 mm
- t = 15 mm
- t = 20 mm

bi-Trapez Bearing

Structural bearing for impact sound insulation

Impact sound insulation



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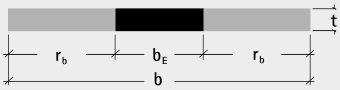
bi–Trapez Bearing

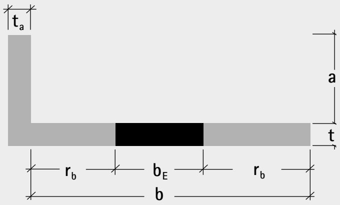
Structural bearing for impact sound insulation

Impact Sound Stop stair element for cast-in-place concrete applications

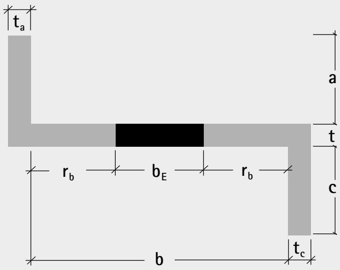
CROSS-SECTION TYPE I



CROSS-SECTION TYPE L



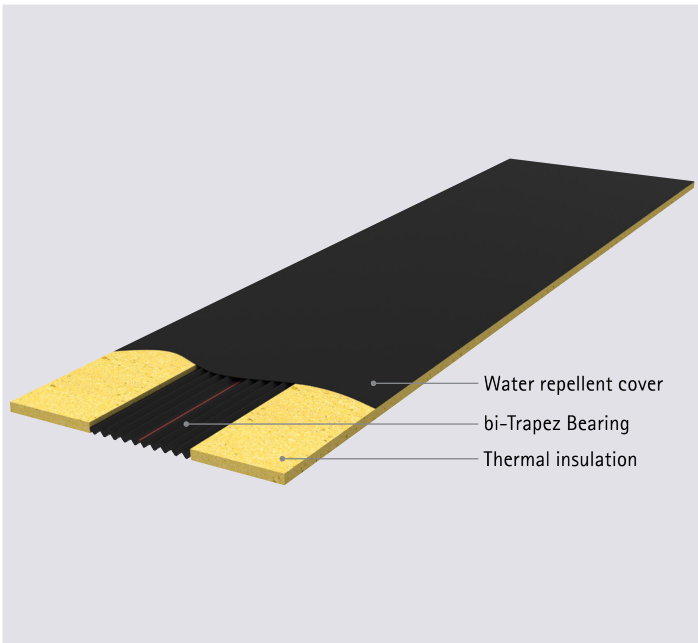
CROSS-SECTION TYPE Z



MEASUREMENTS

l	Overall length
b	Overall width
t	Overall thickness
a	Web length top
c	Web length bottom
t_a	Web thickness top
t_c	Web thickness bottom
b_E	bi-Trapez Bearing width
r_b	Edge width

IMPACT SOUND STOP STAIR ELEMENT		
Bearing thickness [mm]	Bearing width [mm]	Cross-section type
10	50	I
		L
		Z
10	100	I
		L
		Z
15	50	I
		L
		Z
15	100	I
		L
		Z
20	100	I
		L
		Z



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