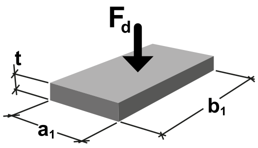
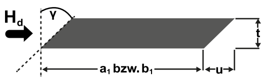
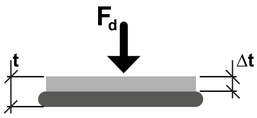
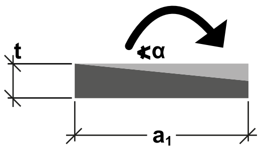
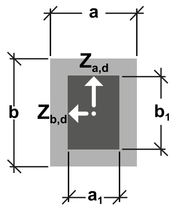
COMPACT BEARING CR 2000

Structural bearing for static structural members

Design values

The bearings are dimensioned according to the general building authority approval up to a compressive stress $\sigma_{R,d} = 28\,N/mm^2$. 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	Transverse tensile forces*
				
FORMEL				
$\sigma_{R,d} = 6 \cdot S^{1.44} \le 28$ [N/mm²] Note: Formula in the data sheet in the sense of a simpler application slightly modified Shape factor S see page 2	all. $u = 0.6 \cdot (t-3)$ [mm] Horizontal force $H_d = c_{s(t)} \cdot u \cdot A_E / (19000\,mm^2)$ A minimum compressive stress of 2 N/mm² is required to prevent the bearing from slipping. $c_{s(t)}$ values and boundary conditions, see page 8	See page 6	all. $\alpha = \frac{400 \cdot t}{a_1} \le 40$ [‰] (Rectangular bearing) Additional rotation acc. to technical approval: • 10 ‰ from obliquity • $\frac{625}{a_1}$ ‰ from unevenness see also booklet 600, DAfStb	$Z_{a,d} = 1.5 \cdot F_d \cdot t / b_1$ [kN] (perpendicular to bearing short side) $Z_{b,d} = 1.5 \cdot F_d \cdot t / a_1$ [kN] (perpendicular to bearing long side) *see also booklet 339, DAfStb

LEGENDE FORMELZEICHEN

F_d	Vertical force
H_d	Horizontal force
$Z_{a,d}$, $Z_{b,d}$	Transverse tensile 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
γ	Push angle
t	Thickness of bearing
Δt	Bearing deflection

COMPACT BEARING CR 2000

Structural bearing for static structural members

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.

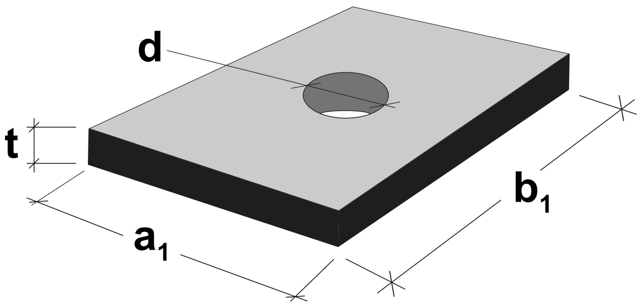
SHAPE FACTOR FOR RECTANGULAR BEARING

Without drilled holes

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

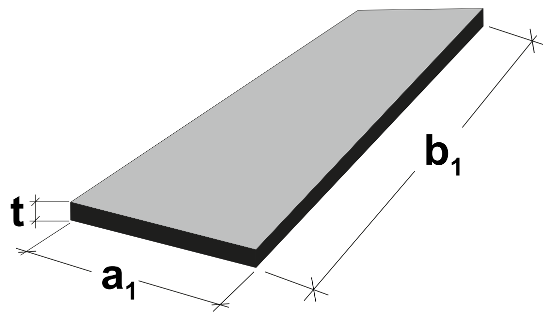
With drilled holes, $n \leq 4$

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



SHAPE FACTOR FOR BEARING STRIP

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



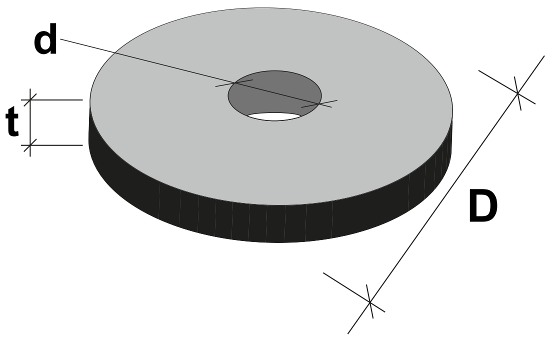
SHAPE FACTOR FOR CIRCULAR BEARING

Without drilled holes

$$S = \frac{d}{4 \cdot t}$$

With drilled holes

$$S = \frac{D^2 - d^2}{4 \cdot t \cdot (D + d)}$$



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COMPACT BEARING CR 2000

Structural bearing for static structural members

Thicknesses: 11 and 16 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 [mm] Thick-ness	α [‰] all. rotation	[mm] Width	DESIGN VALUE OF THE LOAD CAPACITY. $\sigma_{R,d}$ [N/mm²] BEARING LENGTH [mm] 70	80	90	100	110	120	130	140	150	175	200	225	250	275	300	350	400	450	500
	40.0	50	–	–	–	10.9	11.4	11.9	12.2	12.6	12.9	13.6	14.2	14.7	15.1	15.4	15.7	16.1	16.5	16.8	17.1
	40.0	60	–	–	–	12.9	13.6	14.2	14.7	15.2	15.7	16.6	17.4	18.1	18.7	19.2	19.6	20.3	20.8	21.2	21.6
	40.0	70	11.7	12.8	13.9	14.8	15.6	16.4	17.1	17.7	18.3	19.6	20.6	21.5	22.3	22.9	23.5	24.4	25.2	25.8	26.3
	40.0	80	12.8	14.2	15.4	16.5	17.5	18.5	19.3	20.1	20.8	22.4	23.7	24.8	25.8	26.7	27.4				
	40.0	90	13.9	15.4	16.8	18.1	19.3	20.4	21.4	22.3	23.2	25.1	26.7								
	40.0	100	14.8	16.5	18.1	19.6	20.9	22.2	23.3	24.4	25.4	27.7									
	40.0	110	15.6	17.5	19.3	20.9	22.4	23.9	25.2	26.4	27.6										
	36.7	120	16.4	18.5	20.4	22.2	23.9	25.4	26.9												
11	33.8	130	17.1	19.3	21.4	23.3	25.2	26.9													
	31.4	140	17.7	20.1	22.3	24.4	26.4														
	29.3	150	18.3	20.8	23.2	25.4	27.6														
	27.5	160	18.8	21.5	24.0	26.4															
	25.1	175	19.6	22.4	25.1	27.7															
	22.0	200	20.6	23.7	26.7																
	17.6	250	22.3	25.8																	
	14.7	300	23.5	27.4																	
	13.3	330	24.1																		

28.0

Use in in-situ concrete: Embedding in polystyrene
Use in fire resistance class F90 / F120: If necessary. embedding in Ciflamon fire protection panel

BEARING [mm] Thick-ness	α [‰] all. rotation	[mm] Width	DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²] BEARING LENGTH [mm] 80	90	100	110	120	130	140	150	175	200	225	250	275	300	350	400	450	500
	40.0	80	8.3	9.0	9.6	10.2	10.8	11.3	11.7	12.1	13.1	13.8	14.5	15.1	15.5	16.0	16.7	17.3	17.7	18.1
	40.0	90	9.0	9.8	10.6	11.2	11.9	12.5	13.0	13.5	14.6	15.6	16.4	17.1	17.7	18.2	19.1	19.9	20.5	21.0
	40.0	100	9.6	10.6	11.4	12.2	12.9	13.6	14.2	14.8	16.1	17.3	18.2	19.1	19.8	20.5	21.6	22.4	23.2	23.8
	40.0	110	10.2	11.2	12.2	13.1	13.9	14.7	15.4	16.1	17.6	18.9	20.0	21.0	21.9	22.6	24.0	25.0	25.9	26.7
	40.0	120	10.8	11.9	12.9	13.9	14.8	15.7	16.5	17.3	19.0	20.5	21.7	22.9	23.9	24.8	26.3	27.6		
	40.0	130	11.3	12.5	13.6	14.7	15.7	16.6	17.5	18.4	20.3	22.0	23.4	24.7	25.8	26.9				
	40.0	140	11.7	13.0	14.2	15.4	16.5	17.5	18.5	19.4	21.6	23.4	25.0	26.5	27.8					
	40.0	150	12.1	13.5	14.8	16.1	17.3	18.4	19.4	20.5	22.8	24.8	26.6							
16	40.0	160	12.5	14.0	15.4	16.7	18.0	19.2	20.3	21.4	23.9	26.1								
	36.6	175	13.1	14.6	16.1	17.6	19.0	20.3	21.6	22.8	25.5									
	32.0	200	13.8	15.6	17.3	18.9	20.5	22.0	23.4	24.8										
	25.6	250	15.1	17.1	19.1	21.0	22.9	24.7	26.5											
	21.3	300	16.0	18.2	20.5	22.6	24.8	26.9												
	18.3	350	16.7	19.1	21.6	24.0	26.3													
	16.0	400	17.3	19.9	22.4	25.0	27.6													
	14.2	450	17.7	20.5	23.2	25.9														
	13.3	480	18.0	20.8	23.6	26.4														

28.0

Use in in-situ concrete: Embedding in polystyrene
Use in fire resistance class F90 / F120: If necessary, embedding in Ciflamon fire protection panel

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COMPACT BEARING CR 2000

Structural bearing for static structural members

Thickness: 21 mm

BEARING [mm]	α [‰]	[mm]	DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²]														
Thickness	all. rotation	Width	BEARING LENGTH [mm]														
			110	120	130	140	150	175	200	225	250	275	300	350	400	450	500
21	40.0	110	8.8	9.4	9.9	10.4	10.9	11.9	12.8	13.5	14.2	14.8	15.3	16.2	16.9	17.5	18.0
	40.0	120	9.4	10.0	10.6	11.2	11.7	12.8	13.8	14.7	15.5	16.2	16.8	17.8	18.6	19.4	20.0
	40.0	130	9.9	10.6	11.3	11.9	12.4	13.7	14.8	15.8	16.7	17.5	18.2	19.4	20.4	21.2	21.9
	40.0	140	10.4	11.2	11.9	12.5	13.1	14.6	15.8	16.9	17.9	18.8	19.6	20.9	22.1	23.0	23.8
	40.0	150	10.9	11.7	12.4	13.1	13.8	15.4	16.8	18.0	19.1	20.0	20.9	22.4	23.7	24.8	25.7
	40.0	160	11.3	12.2	13.0	13.7	14.5	16.2	17.7	19.0	20.2	21.3	22.2	23.9	25.4	26.6	27.6
	40.0	175	11.9	12.8	13.7	14.6	15.4	17.3	18.9	20.5	21.8	23.0	24.2	26.1	27.8		
	40.0	200	12.8	13.8	14.8	15.8	16.8	18.9	20.9	22.7	24.4	25.8	27.2				
	33.6	250	14.2	15.5	16.7	17.9	19.1	21.8	24.4	26.7							
	28.0	300	15.3	16.8	18.2	19.6	20.9	24.2	27.2								
	24.0	350	16.2	17.8	19.4	20.9	22.4	26.1									
	21.0	400	16.9	18.6	20.4	22.1	23.7	27.8									
	18.7	450	17.5	19.4	21.2	23.0	24.8										
	16.8	500	18.0	20.0	21.9	23.8	25.7										
	14.0	600	18.8	20.9	23.0	25.1	27.2										
	13.3	630	19.0	21.2	23.3	25.4	27.6										

28.0

Use in in-situ concrete: Embedding in polystyrene

Use in fire resistance class F90 / F120: If necessary, embedding in Ciflamon fire protection panel

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COMPACT BEARING CR 2000

Structural bearing for static structural members

STRIP BEARINGS

BEARING WIDTH a	COMPACT BEARING CR 2000					
	BEARING THICKNESSES					
	t = 11 mm		t = 16 mm		t = 21 mm	
	$F_{R,d}$	max. α	$F_{R,d}$	max. α	$F_{R,d}$	max. α
[mm]	[kN/m]	[‰]	[kN/m]	[‰]	[kN/m]	[‰]
50	978	40.0	–	–	–	–
60	1527	40.0	–	–	–	–
70	1960	40.0	–	–	–	–
80	2240	40.0	1796	40.0	–	–
90	2520	40.0	2394	40.0	–	–
100	2800	40.0	2800	40.0	–	–
110	3080	40.0	3080	40.0	2640	40.0
120	3360	36.7	3360	40.0	3265	40.0
130	3640	33.8	3640	40.0	3640	40.0
140	3920	31.4	3920	40.0	3920	40.0
150	4200	29.3	4200	40.0	4200	40.0
160	4480	27.5	4480	40.0	4480	40.0
170	4760	25.9	4760	37.6	4760	40.0
180	5040	24.4	5040	35.6	5040	40.0
190	5320	23.2	5320	33.7	5320	40.0
200	5600	22.0	5600	32.0	5600	40.0
210	5880	21.0	5880	30.5	5880	40.0
220	6160	20.0	6160	29.1	6160	38.2
230	6440	19.1	6440	27.8	6440	36.5
240	6720	18.3	6720	26.7	6720	35.0
250	7000	17.6	7000	25.6	7000	33.6

Use in in-situ concrete: Embedding in polystyrene
Use in fire resistance class F90 / F120: If necessary, embedding in Ciflamon fire protection panel

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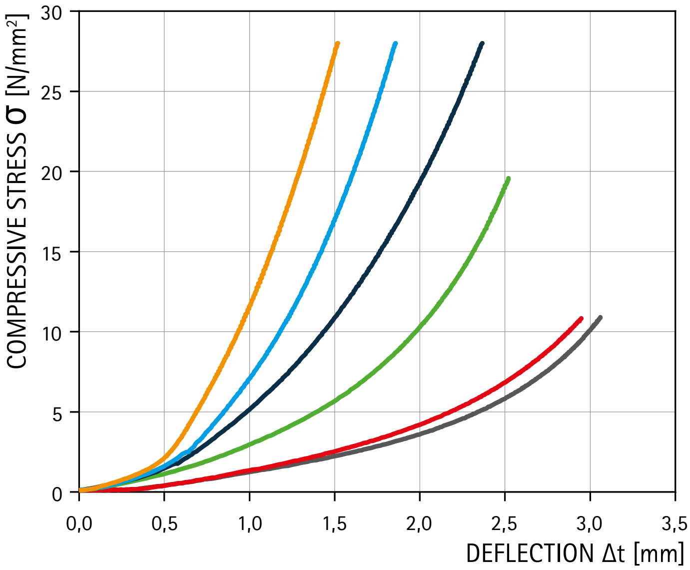
COMPACT BEARING CR 2000

Structural bearing for static structural members

Load deflection curves

The following diagrams show the compression behaviour for different formats when used between concrete surfaces (precast elements).

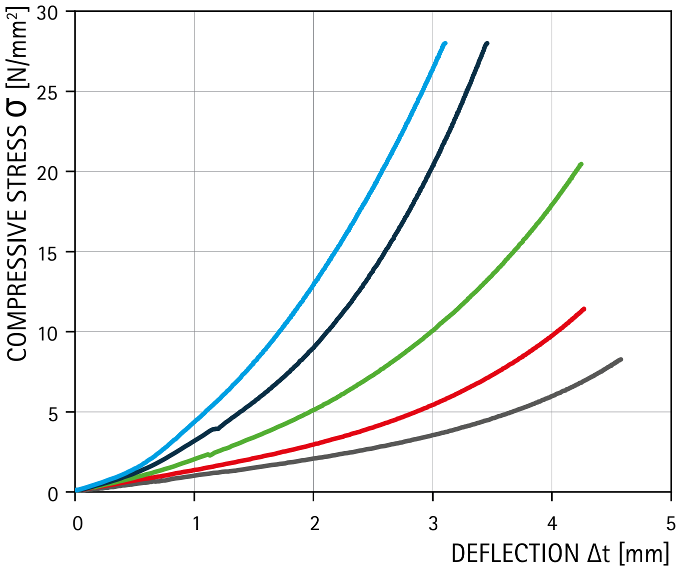
Thickness 11 mm



LEGEND

- 50 mm x 100 mm
- 70 mm x 70 mm
- 100 mm x 100 mm
- 150 mm x 150 mm
- 200 mm x 200 mm
- 250 mm x 200 mm

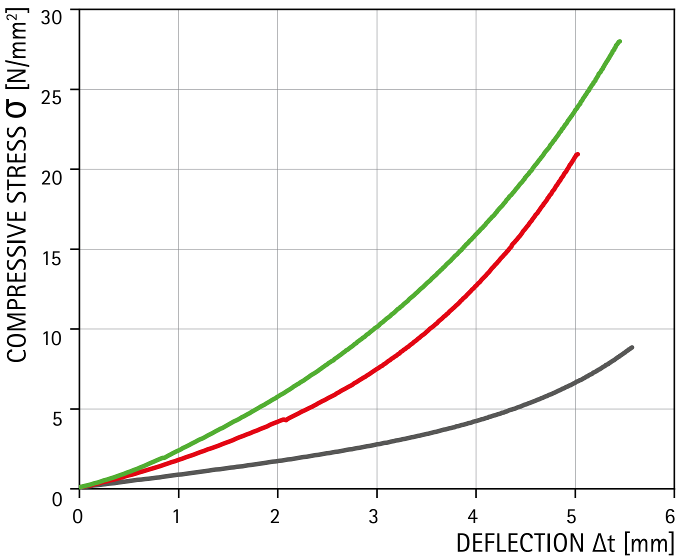
Thickness 16 mm



LEGEND

- 80 mm x 80 mm
- 100 mm x 100 mm
- 150 mm x 150 mm
- 200 mm x 200 mm
- 250 mm x 250 mm

Thickness 21 mm



LEGEND

- 110 mm x 110 mm
- 200 mm x 200 mm
- 250 mm x 250 mm

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COMPACT BEARING CR 2000

Structural bearing for static structural members

Design example

Given: $F_{E,d} = 1250$ kN, bearing rotation $\alpha = 12$ ‰, horizontal deformation $u = 3$ mm

Selected dimensions:	$a = 150$ mm, $b = 320$ mm, $t = 16$ mm
Shape factor:	$S = \dfrac{150 \text{ mm} \times 320 \text{ mm}}{2 \times 16 \text{ mm} \times (150 \text{ mm} + 320 \text{ mm})} = 3.2$
Load capacity:	$\sigma_{R,d} = 6 \text{ N/mm}^2 \times 3.2^{1.44} = 32 \text{ N/mm}^2 > 28.0 \text{ N/mm}^2$ $\longrightarrow \sigma_{R,d} = 28 \text{ N/mm}^2$ $F_{R,d} = \sigma_{R,d} \times A = 28.0 \text{ N/mm}^2 \times 150 \text{ mm} \times 320 \text{ mm} = 1344$ kN $F_{R,d} \geq F_{E,d} \longrightarrow$ Load capacity of the bearing is sufficient
Bearing distortion from component deflection:	$\alpha = 12$ ‰
Additional twisting from obliquity:	10 ‰
Additional twisting from unevenness:	625 (mm*‰) / a (mm) = 625 / 150 = 4.1 ‰
Total rotation to be measured:	$\alpha = 12$ ‰ + 10 ‰ + 4.1 ‰ = 32.9 ‰ max. α = 400 ‰ x t / a = 400 ‰ x 16 mm / 150 mm = 42.7 ‰ > 40 ‰ $\longrightarrow$ max. α = 40 ‰ max. $\alpha \geq \alpha \longrightarrow$ Angle of twist for rotation is sufficient
Horizontal deformation of structural members:	$u = 3$ mm max. $u = 0.6 \times (t-3) = 7.8$ mm max. $u \geq u \longrightarrow$ Shear deformability of the bearing is sufficient

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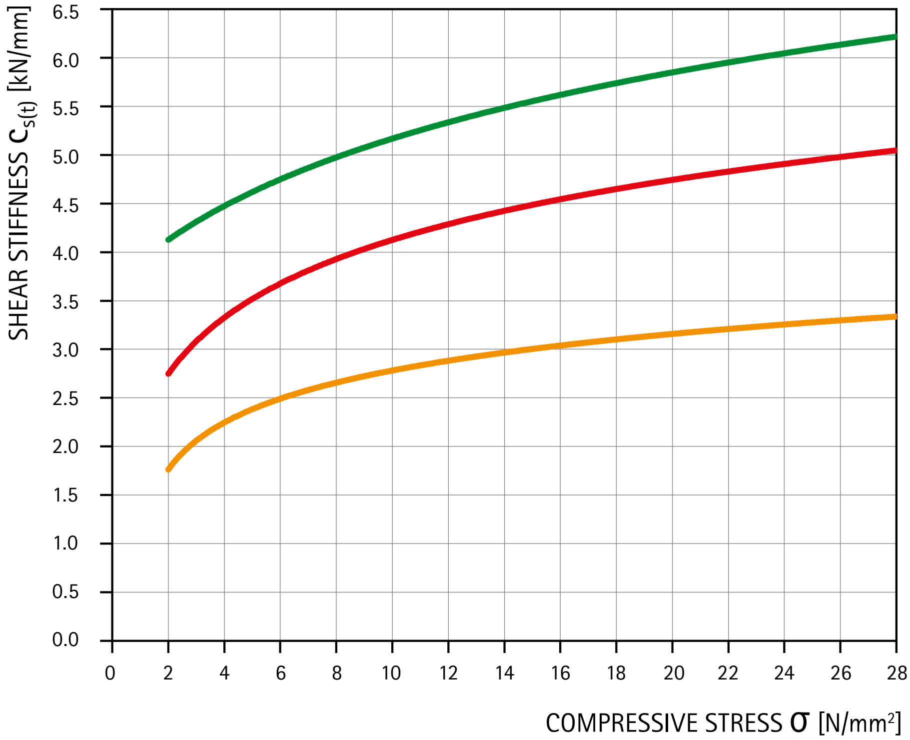
COMPACT BEARING CR 2000

Structural bearing for static structural members

Shear stiffness



LEGEND

- 21 mm
- 16 mm
- 11 mm

DIAGRAM

For the horizontal shear deformation from uniquely acting horizontal forces, no verification is required, since uniquely slight sliding does not lead to any damaging changes in the structural layout. If the thrust deflection is to be a „pure" shear deformation, a vertical bearing compressive stress $\sigma_{E,d}$ of at least 2 N/mm^2 is required.