CALENBERG INGENIEURE

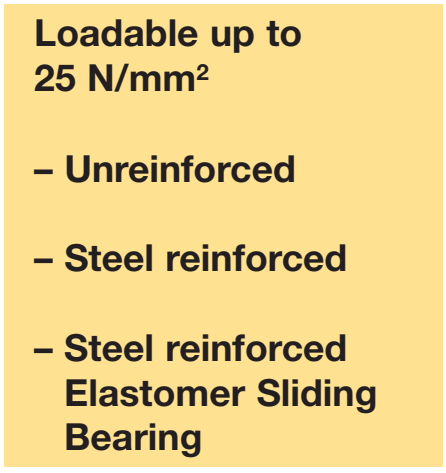
CALENBERG
PERFORATED BEARING 205

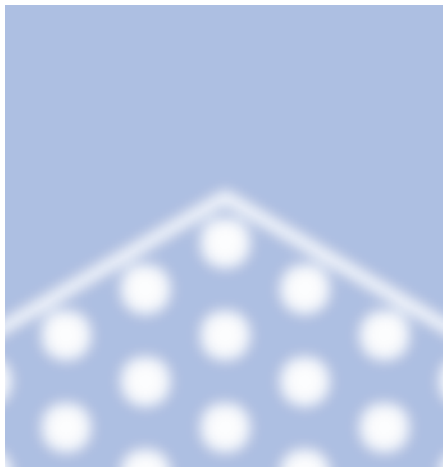
Loadable up to 25 N/mm²

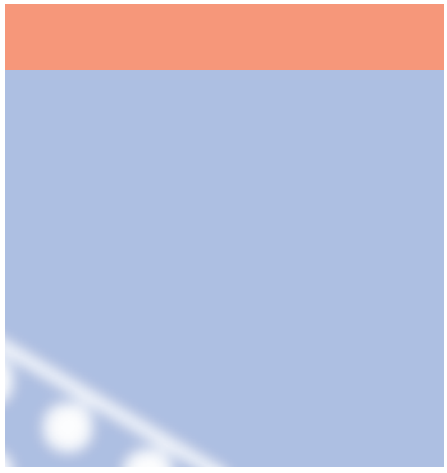
– Unreinforced

– Steel reinforced

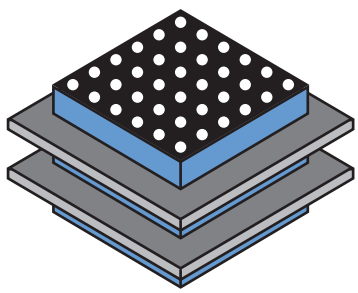
– Steel reinforced Elastomer Sliding Bearing







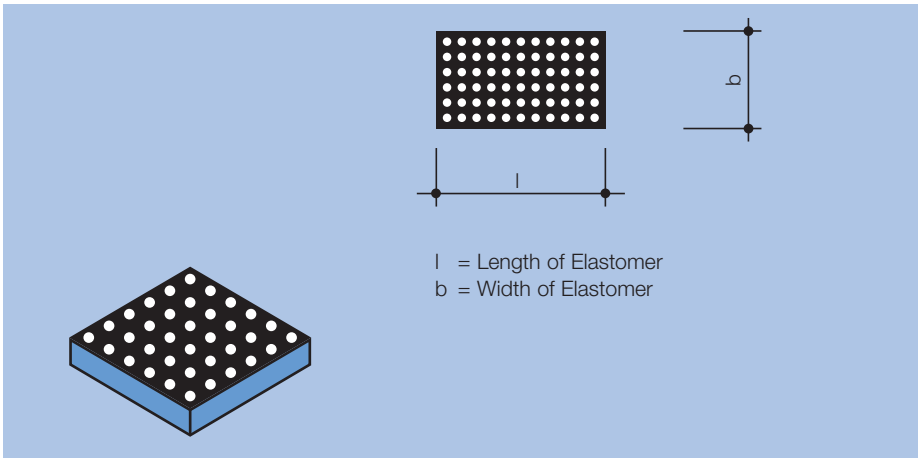
Official Certificate No. P-852.0290-1



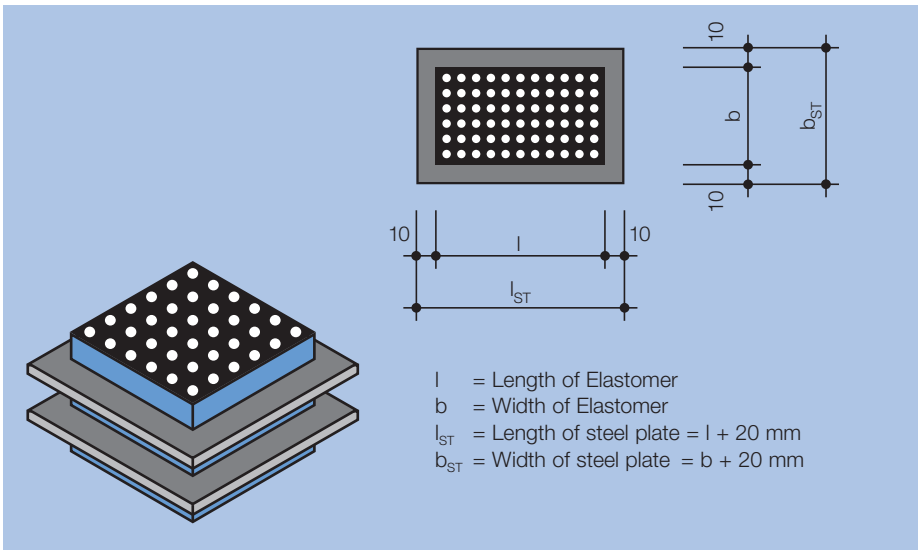
planmäßig elastisch lagern

CALENBERG
INGENIEURE

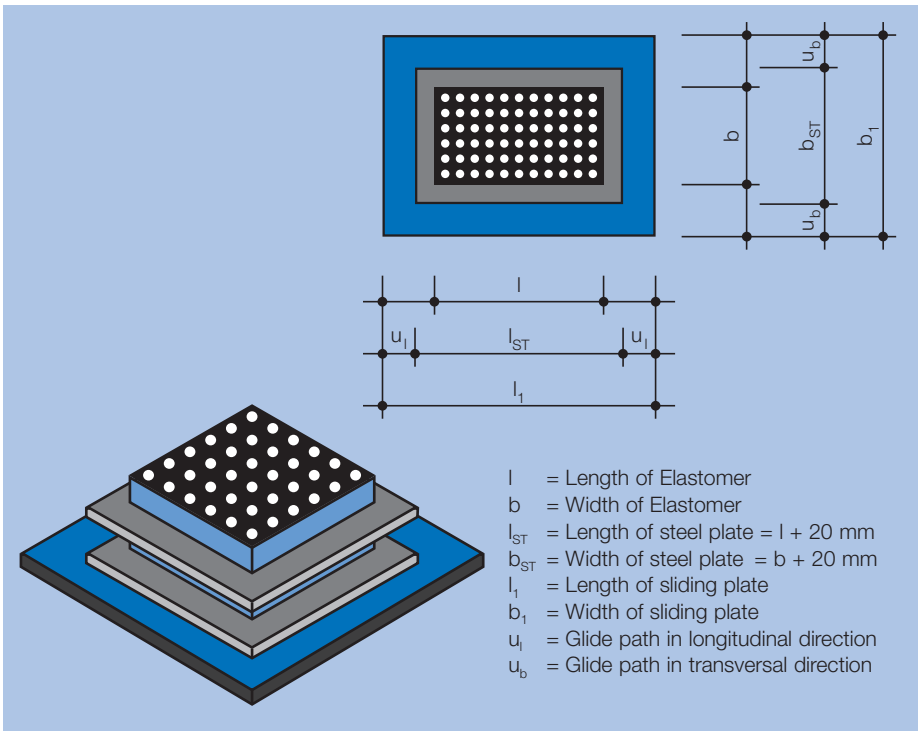
Contents



Picture 1: *Perforated Bearing 205, unreinforced*



Picture 2: *Perforated Bearing 205-ST, steel reinforced*



Picture 3: *Perforated Sliding Bearing*

General Topics

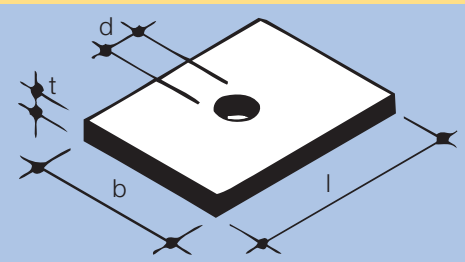
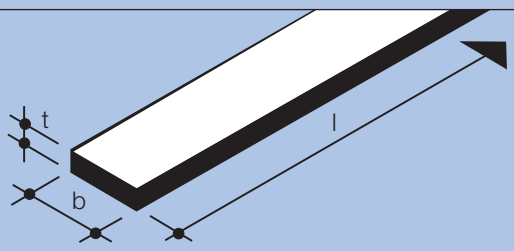
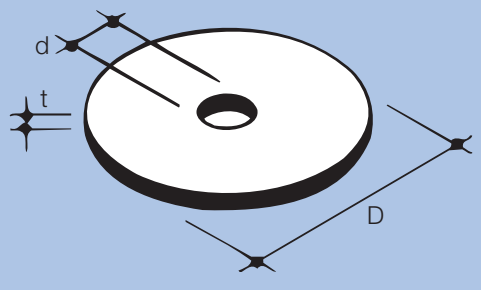
The Perforated Bearing 205 is a high loadable bearing which is mainly used where high forces shall be induced into relative small areas. It consists of elastomer based on synthetic Chloroprene rubber (CR) of 65±5 Shore A hardness according to DIN 4141 part 14/15.
The perforation enables a good adjustment to inaccuracies of adjoining components due to their installation and manufacturing. This helps to avoid stress concentration.
Cross- and splitting tensile forces are reduced compared with homogeneous elastomer bearings.

The pictures 1 to 3 show the different bearing designs.

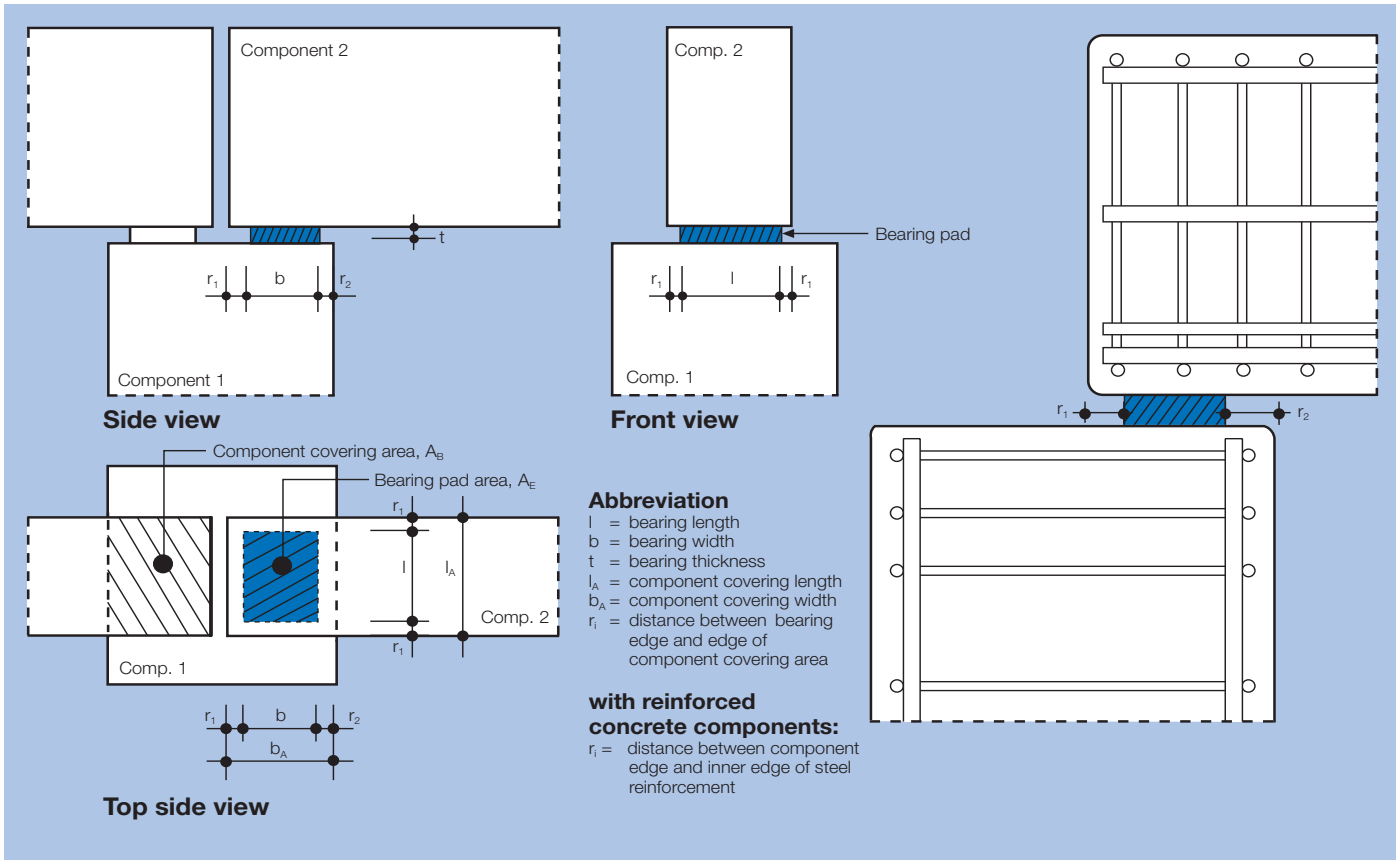
When choosing a type of bearing the following criteria have to be considered:

- Load
- Angular Distortion
- Horizontal Displacement

Shape Factors

Bearing Format	Shape Factor
	**Rectangular bearing pad** ● without hole: $S = \frac{l \cdot b}{2 \cdot t\,(l + b)}$ ● with round hole: $S = \frac{4 \cdot l \cdot b - \pi \cdot d^2}{4 \cdot t\,(2 \cdot l + 2 \cdot b + \pi \cdot d)}$
	**Rectangular bearing strip** $S \approx \frac{b}{2 \cdot t}$
	**Circular bearing pad** ● without hole: $S = \frac{D}{4 \cdot t}$ ● with round hole: $S = \frac{D - d}{4 \cdot t}$

Picture 4: *Shape factors of different formats*



Picture 5: *Maximum area of elastomer bearing pad in reinforced concrete construction (edge distance). The elastomer bearing pad must be enclosed by the reinforcement. With timber or steel components the edge distance of the pad should be at least 4 cm.*

CALENBERG
INGENIEURE

Product Description Perforated Bearing 205, unreinforced

The unreinforced Perforated Bearing 205 has an even grid of round holes over the total area, share of holes 20%, diameter of holes 5 mm.
It is mainly used to induce high loads into small areas, whereas angular distortion and horizontal displacement are minor.

With larger angular distortion the Perforated Bearing 205-ST, with larger horizontal displacement the Perforated Sliding Bearing is used.

How to Specify

Supply Calenberg Perforated Bearing 205, unreinforced elastomer bearing with even grid of round holes, according to DIN 4141 part 3, support class 2, format dependant loadable up to a mean compression stress of 25 N/mm², Official Certificate No. P-852.0290-1.

a) general

Length: ..... mm

Width: ..... mm

Thickness: ..... mm

Quantity: ..... piece(s)

Price: ..... €/piece

b) embedded in Polystyrene or Ciflamon fire protection plate

Total length: ..... mm

Total width: ..... mm

Length of bearing: ..... mm

Width of bearing ..... mm

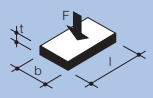
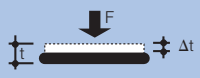
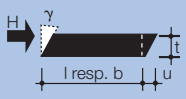
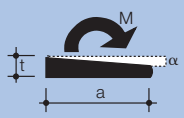
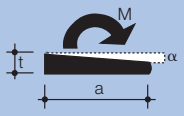
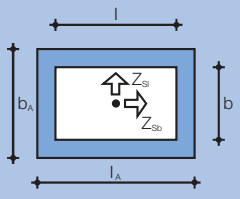
Thickness: ..... mm

Quantity: ..... piece(s) resp. m

Price: ..... €/piece resp. €/m

Supplier:
Calenberg Ingenieure GmbH
Am Knübel 2-4
D-31020 Salzhemmendorf
Tel. +49(0)5153/9400-0
Fax. +49(0)5153/9400-49

Calculation Formulae Perforated Bearing 205, unreinforced

Kind of stress	Symbol	Formulae
Permissible mean load, vertical to bearing area 	□ ○	perm. $\sigma = \frac{S^2 + S + 1}{0{,}95} \leq 25$ [N/mm²] Shape factor S see picture 4
Deflection Δt 	□ ○	see picture 11
Permissible shear deformation, parallel to bearing area 	□ ○	perm. u = 0,55 (t - 1,9) [mm] To avoid sliding of the bearing a minimum compression stress of 2 N/mm² is required
Restoring force due to shear deformation	□ ○	$H_R = \frac{C_S \cdot u \cdot l \cdot b}{10^4}$ [kN]
Shear spring stiffness	□ ○	see picture 14
Permissible angular distortion 	□	perm. $\alpha = \frac{160 \cdot t}{l \text{ resp. } b}$ [‰]
	○	perm. $\alpha = \frac{180 \cdot t}{D}$ [‰]
Restoring moment due to distortion 	□	$M_R = \frac{2 \cdot l^5 \cdot b \cdot \alpha}{10^{11} \cdot t^3}$ [kNm]
	▭	$M_R = \frac{2 \cdot b^5 \cdot l \cdot \alpha}{10^{11} \cdot t^3}$ [kNm]
	○	$M_R = \frac{D^6 \cdot \alpha}{10^{11} \cdot t^3}$ [kNm]
Splitting tensile forces* 	□	exist. $Z_{Sl} = 0{,}25 \cdot F \left(1 - \frac{b}{b_A}\right)$ [kN]
	▭	exist. $Z_{Sb} = 0{,}25 \cdot F \left(1 - \frac{l}{l_A}\right)$ [kN]
		* more detailed proof according to booklet 339, DAfStb. Regarding the arrangement of the required reinforcement see page 10

l, l_A, b, b_A, t, u, D in mm; F in kN; α in ‰; C_s in kN/mm; S dimensionless

Calculation Table 1: Perforated Bearing 205, unreinforced; 5 and 8 mm thick

Thick-ness of bearing [mm]	Perm. angular distortion [‰]	Width of bearing [mm]	Compression stress, perm. σ_m [N/mm²]																	
			Length of bearing l [mm]																	
			50	**60**	**70**	**80**	**90**	**100**	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**350**	**400**	**450**	**500**
5	26.7	**30**	6.7	7.4	7.9	8.4	8.8	9.1	9.8	10.3	10.7	11.0	11.2	11.4	11.6	11.8	12.0	12.2	12.3	12.5
	20.0	**40**	8.6	9.6	10.6	11.3	12.0	12.7	13.9	14.9	15.6	16.3	16.8	17.2	17.6	17.9	18.4	18.8	19.1	19.4
	16.0	**50**	10.3	11.8	13.1	14.3	15.3	16.3	18.2	19.8	21.1	22.1	23.0	23.7	24.3	24.9				
	13.3	**60**	11.8	13.7	15.4	17.0	18.5	19.8	22.6	24.9										
	11.4	**70**	13.1	15.4	17.6	19.7	21.5	23.2												
	10.0	**80**	14.3	17.0	19.7	22.1	24.4													
	8.9	**90**	15.3	18.5	21.5	24.4														
	8.0	**100**	16.3	19.8	23.2															
	7.3	**110**	17.1	21.0	24.8															
	6.7	**120**	17.9	22.1																
	6.2	**130**	18.6	23.1																
	5.7	**140**	19.2	24.0																
	5.3	**150**	19.8	24.9																
	5.0	**160**	20.3																	
	4.7	**170**	20.8																	
8	32.0	**40**	4.5	5.0	5.4	5.7	6.0	6.3	6.8	7.2	7.6	7.8	8.0	8.2	8.4	8.5	8.7	8.9	9.0	9.1
	25.6	**50**	5.3	5.9	6.5	7.0	7.4	7.8	8.6	9.3	9.8	10.3	10.6	10.9	11.2	11.4	11.8	12.1	12.3	12.5
	21.3	**60**	5.9	6.7	7.5	8.1	8.8	9.3	10.5	11.4	12.2	12.8	13.4	13.9	14.3	14.6	15.2	15.7	16.1	16.4
	18.3	**70**	6.5	7.5	8.4	9.2	10.0	10.7	12.3	13.6	14.6	15.5	16.3	16.9	17.5	18.0	18.9	19.6	20.1	20.6
	16.0	**80**	7.0	8.1	9.2	10.3	11.2	12.1	14.0	15.7	17.1	18.2	19.3	20.1	20.9	21.6	22.8	23.7	24.5	
	14.2	**90**	7.4	8.8	10.0	11.2	12.3	13.4	15.8	17.8	19.5	21.0	22.3	23.4	24.4					
	12.8	**100**	7.8	9.3	10.7	12.1	13.4	14.6	17.4	19.8	21.9	23.7								
	11.6	**110**	8.2	9.8	11.4	12.9	14.4	15.8	19.0	21.8	24.3									
	10.7	**120**	8.5	10.3	12.0	13.7	15.3	16.9	20.5	23.7										
	9.8	**130**	8.8	10.7	12.6	14.4	16.2	17.9	21.9											
	9.1	**140**	9.1	11.1	13.1	15.1	17.0	18.9	23.3											
	8.5	**150**	9.3	11.4	13.6	15.7	17.8	19.8	24.7											
	8.0	**160**	9.5	11.8	14.0	16.3	18.5	20.7												
	7.5	**170**	9.7	12.1	14.4	16.8	19.2	21.5												
	7.1	**180**	9.9	12.3	14.8	17.3	19.8	22.3												
	6.7	**190**	10.1	12.6	15.2	17.8	20.4	23.0												
	6.4	**200**	10.3	12.8	15.5	18.2	21.0	23.7												
	6.1	**210**	10.4	13.1	15.8	18.7	21.5	24.4												
	5.8	**220**	10.6	13.3	16.1	19.1	22.0													
	5.6	**230**	10.7	13.5	16.4	19.4	22.5													
	5.3	**240**	10.8	13.7	16.7	19.8	23.0													
	5.1	**250**	10.9	13.9	16.9	20.1	23.4													
	4.9	**260**	11.0	14.0	17.2	20.5	23.8													
	4.7	**270**	11.1	14.2	17.4	20.8	24.2													
	4.6	**280**	11.2	14.3	17.6	21.1	24.6													
	4.4	**290**	11.3	14.5	17.8	21.3	25.0													
	4.3	**300**	11.4	14.6	18.0	21.6														
	4.1	**310**	11.5	14.8	18.2	21.9														
	4.0	**320**	11.6	14.9	18.4	22.1														
	3.9	**330**	11.7	15.0	18.6	22.3														
	3.8	**340**	11.7	15.1	18.7	22.6														
	3.7	**350**	11.8	15.2	18.9	22.8														
	3.6	**360**	11.9	15.3	19.0	23.0														
	3.5	**370**	11.9	15.4	19.2	23.2														
	3.4	**380**	12.0	15.5	19.3	23.4														
	3.3	**390**	12.0	15.6	19.4	23.5														
	3.2	**400**	12.1	15.7	19.6	23.7														
	3.1	**410**	12.2	15.8	19.7	23.9														
	3.0	**420**	12.2	15.8	19.8	24.0														
	3.0	**430**	12.2	15.9	19.9	24.2														
	2.9	**440**	12.3	16.0	20.0	24.3														
	2.8	**450**	12.3	16.1	20.1	24.5														

25.0

25.0

CALENBERG
INGENIEURE

Product Description Perforated Bearing 205-ST

The steel reinforced Perforated Bearing 205-ST consists of several elastomer layers and intermediate layers of weather-proof steel WTSt 52-3, arranged one by one, being connected with each other. Due to the variable thickness of the bearing, additional to high vertical forces angular distortions of different range can be taken up as well.

How to Specify

Supply Calenberg Perforated Bearing 205-ST, steel reinforced elastomer bearing with even grid of round holes, according to DIN 4141 part 3, support class 2, format independant loadable up to a mean compression stress of 25 N/mm², Official Certificate No. P-852.0290-1.

a) general

Length : ..... mm

Width : ..... mm

Thickness: ..... mm

Quantity: ..... piece(s)

Price: ..... €/piece

b) embedded in Polystyrene or Ciflamon fire protection plate

Total length: ..... mm

Total width: ..... mm

Length of bearing: ..... mm

Width of bearing: ..... mm

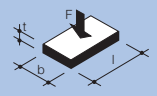
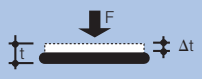
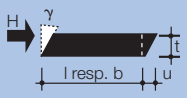
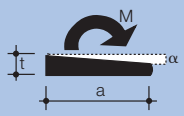
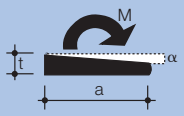
Thickness: ..... mm

Quantity: ..... piece(s)

Price: ..... €/piece

Supplier:
Calenberg Ingenieure GmbH
Am Knübel 2-4
D-31020 Salzhemmendorf
Tel. +49(0)5153/9400-0
Fax. +49(0)5153/9400-49

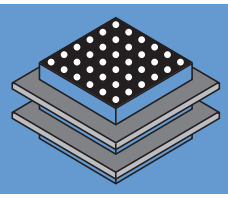
Calculation Formulae Perforated Bearing 205-ST

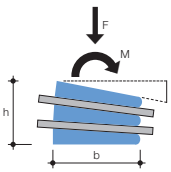
Kind of stress	Symbol	Formulae
Permissible mean load, vertical to bearing area 	□ ○	see calculation table 2
Deflection Δt 	□ ○	see picture 12
Permissible shear deformation, parallel to bearing area 	□ ○	perm. u = 0,55 (T - 1,9) [mm]
Restoring force due to shear deformation	□ ○	$H_R = \frac{C_S \cdot u \cdot l \cdot b}{10^4}$ [kN]
Shear spring stiffness	□ ○	see picture 15
Permissible angular distortion 	□	perm. $\alpha = \frac{200 \cdot T}{l \text{ resp. } b} \leqq 40$ [‰]
	○	perm. $\alpha = \frac{225 \cdot T}{D} \leqq 40$ [‰]
Restoring moment due to distortion 	▯	$M_R = \frac{2 \cdot l^5 \cdot b \cdot \alpha}{10^{11} \cdot t^3 \cdot n}$ [kNm]
	▭	$M_R = \frac{2 \cdot l \cdot b^5 \cdot \alpha}{10^{11} \cdot t^3 \cdot n}$ [kNm]
	○	$M_R = \frac{2 \cdot D^6 \cdot \alpha}{10^{11} \cdot t^3 \cdot n}$ [kNm]
Number of layers n required	▯	requ. $n_l = \frac{\text{exist. } \alpha \cdot l}{200 \cdot t}$
	▭	requ. $n_b = \frac{\text{exist. } \alpha \cdot b}{200 \cdot t}$
	○	requ. $n_D = \frac{\text{exist. } \alpha \cdot D}{225 \cdot t}$
Splitting tensile forces		The splitting tensile forces have to be calculated according to booklet 339, DAfStb under consideration of DIN 4141 part 14 paragraph 5.2. Regarding the arrangement of the required reinforcement see page 10

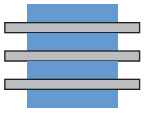
t = thickness of a single elastomer layer, T = total thickness of all elastomer layers, l, b, t, T, u, D in mm; α in ‰; M_R in kNm; C_s in kN/mm; n dimensionless

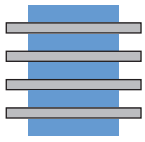
CALENBERG INGENIEURE

Calculation Table 2: Perforated Bearing 205-ST









h	14		20		22		31		30		42		38		53	
T	10		16		15		24		20		32		25		40	
b	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α
50	15.0	40.0	15.0	40.0												
60	15.0	33.3	15.0	40.0	15.0	40.0										
70	20.0	28.6	20.0	40.0	20.0	40.0	15.0	40.0	15.0	40.0						
80	25.0	25.0	20.0	40.0	20.0	37.5	20.0	40.0	20.0	40.0						
90	25.0	22.2	25.0	35.6	25.0	33.3	20.0	40.0	20.0	40.0	15.0	40.0	15.0	40.0		
100	25.0	20.0	25.0	32.0	25.0	30.0	25.0	40.0	25.0	40.0	20.0	40.0	20.0	40.0		
110	25.0	18.2	25.0	29.1	25.0	27.3	25.0	40.0	25.0	36.4	20.0	40.0	20.0	40.0	15.0	40.0
120	25.0	16.7	25.0	26.7	25.0	25.0	25.0	40.0	25.0	33.3	25.0	40.0	25.0	40.0	20.0	40.0
130	25.0	15.4	25.0	24.6	25.0	23.1	25.0	36.9	25.0	30.8	25.0	40.0	25.0	38.5	20.0	40.0
140	25.0	14.3	25.0	22.9	25.0	21.4	25.0	34.3	25.0	28.6	25.0	40.0	25.0	35.7	25.0	40.0
150	25.0	13.3	25.0	21.3	25.0	20.0	25.0	32.0	25.0	26.7	25.0	40.0	25.0	33.3	25.0	40.0
160	25.0	12.5	25.0	20.0	25.0	18.8	25.0	30.0	25.0	25.0	25.0	40.0	25.0	31.3	25.0	40.0
170	25.0	11.8	25.0	18.8	25.0	17.6	25.0	28.2	25.0	23.5	25.0	37.6	25.0	29.4	25.0	40.0
180	25.0	11.1	25.0	17.8	25.0	16.7	25.0	26.7	25.0	22.2	25.0	35.6	25.0	27.8	25.0	40.0
190	25.0	10.5	25.0	16.8	25.0	15.8	25.0	25.3	25.0	21.1	25.0	33.7	25.0	26.3	25.0	40.0
200	25.0	10.0	25.0	16.0	25.0	15.0	25.0	24.0	25.0	20.0	25.0	32.0	25.0	25.0	25.0	40.0
210	25.0	9.5	25.0	15.2	25.0	14.3	25.0	22.9	25.0	19.0	25.0	30.5	25.0	23.8	25.0	38.1
220	25.0	9.1	25.0	14.5	25.0	13.6	25.0	21.8	25.0	18.2	25.0	29.1	25.0	22.7	25.0	36.4
230	25.0	8.7	25.0	13.9	25.0	13.0	25.0	20.9	25.0	17.4	25.0	27.8	25.0	21.7	25.0	34.8
240	25.0	8.3	25.0	13.3	25.0	12.5	25.0	20.0	25.0	16.7	25.0	26.7	25.0	20.8	25.0	33.3
250	25.0	8.0	25.0	12.8	25.0	12.0	25.0	19.2	25.0	16.0	25.0	25.6	25.0	20.0	25.0	32.0
260	25.0	7.7	25.0	12.3	25.0	11.5	25.0	18.5	25.0	15.4	25.0	24.6	25.0	19.2	25.0	30.8
270	25.0	7.4	25.0	11.9	25.0	11.1	25.0	17.8	25.0	14.8	25.0	23.7	25.0	18.5	25.0	29.6
280	25.0	7.1	25.0	11.4	25.0	10.7	25.0	17.1	25.0	14.3	25.0	22.9	25.0	17.9	25.0	28.6
290	25.0	6.9	25.0	11.0	25.0	10.3	25.0	16.6	25.0	13.8	25.0	22.1	25.0	17.2	25.0	27.6
300	25.0	6.7	25.0	10.7	25.0	10.0	25.0	16.0	25.0	13.3	25.0	21.3	25.0	16.7	25.0	26.7
350	25.0	5.7	25.0	9.1	25.0	8.6	25.0	13.7	25.0	11.4	25.0	18.3	25.0	14.3	25.0	22.9
400	25.0	5.0	25.0	8.0	25.0	7.5	25.0	12.0	25.0	10.0	25.0	16.0	25.0	12.5	25.0	20.0
450	25.0	4.4	25.0	7.1	25.0	6.7	25.0	10.7	25.0	8.9	25.0	14.2	25.0	11.1	25.0	17.8
500	25.0	4.0	25.0	6.4	25.0	6.0	25.0	9.6	25.0	8.0	25.0	12.8	25.0	10.0	25.0	16.0
550	25.0	3.6	25.0	5.8	25.0	5.5	25.0	8.7	25.0	7.3	25.0	11.6	25.0	9.1	25.0	14.5
600	25.0	3.3	25.0	5.3	25.0	5.0	25.0	8.0	25.0	6.7	25.0	10.7	25.0	8.3	25.0	13.3

Total bearing thickness h, bearing width b in mm; permissible mean compression stress σ_m in N/mm²; permissible angular distortion α in ‰

CALENBERG
INGENIEURE

Product Description Perforated Sliding Bearing

The Perforated Sliding Bearing consists of several elastomer layers and intermediate layers of weatherproof steel WTSt 52-3. The top steel layer is provided with a sheet of polytetrafluor-ethylene (PTFE). The bearing is completed by a separate plate of glas fibre reinforced plastic (GRP). PTFE and GRP put together are able to take up even large horizontal displacements by sliding on each other. Restoring forces are minimized. All this adds to the benefits of the Perforated Bearing 205-ST.

Values of static friction see picture 16.

How to Specify

Supply Calenberg Perforated Sliding Bearing, steel reinforced elastomer bearing with even grid of round holes, according to DIN 4141 part 3, support class 2, format independant loadable up to a mean compression stress of 25 N/mm², Official Certificate No. P-852.0290-1.

a) general

l/l_1 x b/b_1 x t =

...../..... x ...../..... x ..... mm
l, b = length, width of bearing
l_1, b_1 = length, width of sliding plate
t = total thickness

Quantity: ..... piece(s)

Price: ..... €/piece

b) embedded in Polystyrene or Ciflamon fire protection plate

Total length: ..... mm

Total width: ..... mm

Length of bearing: ..... mm

Width of bearing: ..... mm

Length of sliding plate: ..... mm

Width of sliding plate: ..... mm

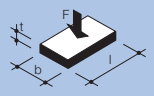
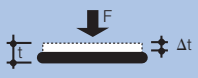
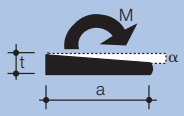
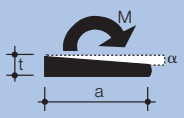
Thickness: ..... mm

Quantity: ..... piece(s)

Price: ..... €/piece

Supplier:
Calenberg Ingenieure GmbH
Am Knübel 2-4
D-31020 Salzhemmendorf
Tel. +49(0)5153/9400-0
Fax. +49(0)5153/9400-49

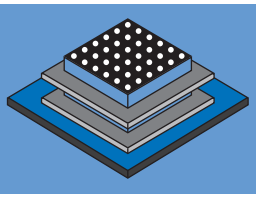
Calculation Formulae Perforated Sliding Bearing

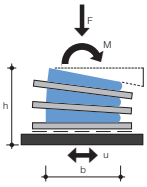
Kind of stress	Symbol	Formulae
Permissible mean load, vertical to bearing area 	□ ○	see calculation table 3
Deflection Δt 	□ ○	see picture 13
Permissible angular distortion 	□	perm. $\alpha = \frac{200 \cdot T}{l \text{ resp. } b} \leqq 40$ [‰]
	○	perm. $\alpha = \frac{225 \cdot T}{D} \leqq 40$ [‰]
Restoring moment due to distortion 	□	$M_R = \frac{2 \cdot l^5 \cdot b \cdot \alpha}{10^{11} \cdot t^3 \cdot n}$ [kNm]
	□	$M_R = \frac{2 \cdot l \cdot b^5 \cdot \alpha}{10^{11} \cdot t^3 \cdot n}$ [kNm]
	○	$M_R = \frac{2 \cdot D^6 \cdot \alpha}{10^{11} \cdot t^3 \cdot n}$ [kNm]
Number of layers n required	□	requ. $n_l = \frac{\text{exist. } \alpha \cdot l}{200 \cdot t}$
	□	requ. $n_b = \frac{\text{exist. } \alpha \cdot b}{200 \cdot t}$
	○	requ. $n_D = \frac{\text{exist. } \alpha \cdot D}{225 \cdot t}$
Splitting tensile forces		The splitting tensile forces have to be calculated according to booklet 339, DAfStb under consideration of DIN 4141 part 14 paragraph 5.2. Regarding the arrangement of the required reinforcement see page 10

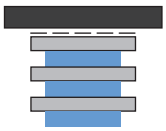
t = thickness of a single elastomer layer, T = total thickness of all elastomer layers, l, b, t, T, D in mm; α in ‰; M_R in kNm; n dimensionless

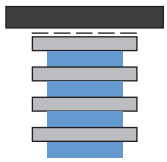
Hint: **When planning the size of the sliding plate, the 20 mm excess length of the steel plates must be considered additionally to the given size of the horizontal displacement (see picture 3)**

Calculation Table 3: Perforated Sliding Bearing



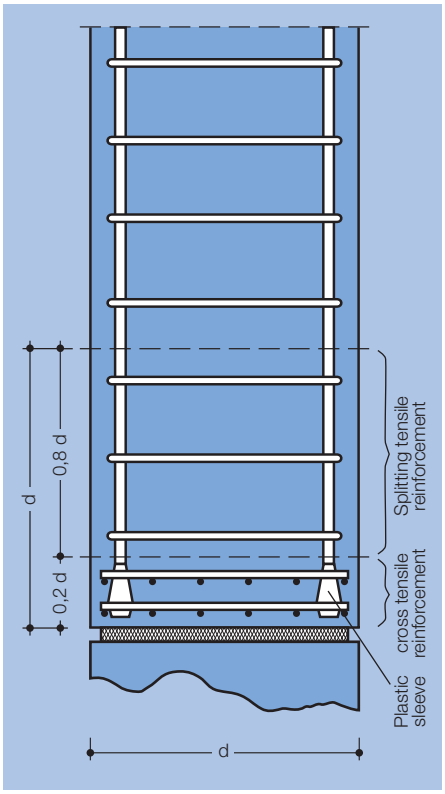




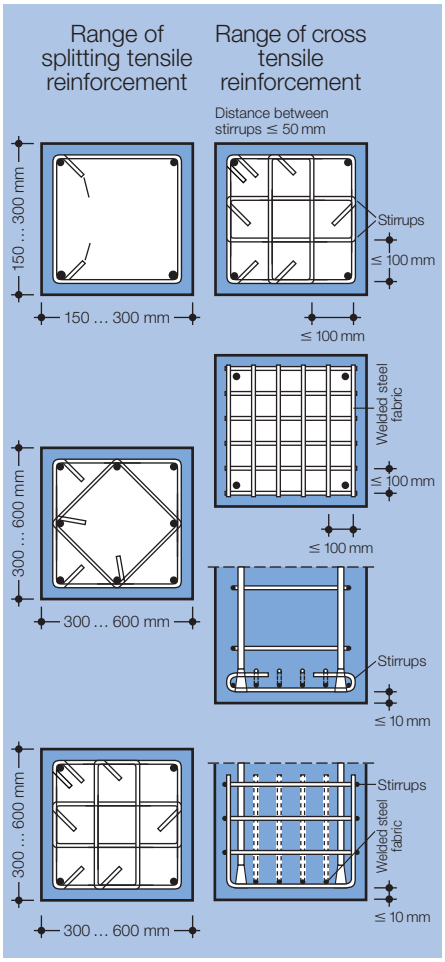


h	14		17		22		28		30		39		38		50	
T	5		8		10		16		15		24		20		32	
b	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α	σ_m	α
50	15.0	20.0	15.0	32.0	15.0	40.0	15.0	40.0								
60	15.0	16.7	15.0	26.7	15.0	33.3	15.0	40.0	15.0	40.0						
70	20.0	14.3	20.0	22.9	20.0	28.6	20.0	40.0	20.0	40.0	15.0	40.0	15.0	40.0		
80	25.0	12.5	20.0	20.0	25.0	25.0	20.0	40.0	20.0	37.5	20.0	40.0	20.0	40.0		
90	25.0	11.1	25.0	17.8	25.0	22.2	25.0	35.6	25.0	33.3	20.0	40.0	20.0	40.0	15.0	40.0
100	25.0	10.0	25.0	16.0	25.0	20.0	25.0	32.0	25.0	30.0	25.0	40.0	25.0	40.0	20.0	40.0
110	25.0	9.1	25.0	14.5	25.0	18.2	25.0	29.1	25.0	27.3	25.0	40.0	25.0	36.4	20.0	40.0
120	25.0	8.3	25.0	13.3	25.0	16.7	25.0	26.7	25.0	25.0	25.0	40.0	25.0	33.3	25.0	40.0
130	25.0	7.7	25.0	12.3	25.0	15.4	25.0	24.6	25.0	23.1	25.0	36.9	25.0	30.8	25.0	40.0
140	25.0	7.1	25.0	11.4	25.0	14.3	25.0	22.9	25.0	21.4	25.0	34.3	25.0	28.6	25.0	40.0
150	25.0	6.7	25.0	10.7	25.0	13.3	25.0	21.3	25.0	20.0	25.0	32.0	25.0	26.7	25.0	40.0
160	25.0	6.3	25.0	10.0	25.0	12.5	25.0	20.0	25.0	18.8	25.0	30.0	25.0	25.0	25.0	40.0
170	25.0	5.9	25.0	9.4	25.0	11.8	25.0	18.8	25.0	17.6	25.0	28.2	25.0	23.5	25.0	37.6
180	25.0	5.6	25.0	8.9	25.0	11.1	25.0	17.8	25.0	16.7	25.0	26.7	25.0	22.2	25.0	35.6
190	25.0	5.3	25.0	8.4	25.0	10.5	25.0	16.8	25.0	15.8	25.0	25.3	25.0	21.1	25.0	33.7
200	25.0	5.0	25.0	8.0	25.0	10.0	25.0	16.0	25.0	15.0	25.0	24.0	25.0	20.0	25.0	32.0
210	25.0	4.8	25.0	7.6	25.0	9.5	25.0	15.2	25.0	14.3	25.0	22.9	25.0	19.0	25.0	30.5
220	25.0	4.5	25.0	7.3	25.0	9.1	25.0	14.5	25.0	13.6	25.0	21.8	25.0	18.2	25.0	29.1
230	25.0	4.3	25.0	7.0	25.0	8.7	25.0	13.9	25.0	13.0	25.0	20.9	25.0	17.4	25.0	27.8
240	25.0	4.2	25.0	6.7	25.0	8.3	25.0	13.3	25.0	12.5	25.0	20.0	25.0	16.7	25.0	26.7
250	25.0	4.0	25.0	6.4	25.0	8.0	25.0	12.8	25.0	12.0	25.0	19.2	25.0	16.0	25.0	25.6
260	25.0	3.8	25.0	6.2	25.0	7.7	25.0	12.3	25.0	11.5	25.0	18.5	25.0	15.4	25.0	24.6
270	25.0	3.7	25.0	5.9	25.0	7.4	25.0	11.9	25.0	11.1	25.0	17.8	25.0	14.8	25.0	23.7
280	25.0	3.6	25.0	5.7	25.0	7.1	25.0	11.4	25.0	10.7	25.0	17.1	25.0	14.3	25.0	22.9
290	25.0	3.4	25.0	5.5	25.0	6.9	25.0	11.0	25.0	10.3	25.0	16.6	25.0	13.8	25.0	22.1
300	25.0	3.3	25.0	5.3	25.0	6.7	25.0	10.7	25.0	10.0	25.0	16.0	25.0	13.3	25.0	21.3
350	25.0	2.9	25.0	4.6	25.0	5.7	25.0	9.1	25.0	8.6	25.0	13.7	25.0	11.4	25.0	18.3
400	25.0	2.5	25.0	4.0	25.0	5.0	25.0	8.0	25.0	7.5	25.0	12.0	25.0	10.0	25.0	16.0
450	25.0	2.2	25.0	3.6	25.0	4.4	25.0	7.1	25.0	6.7	25.0	10.7	25.0	8.9	25.0	14.2
500	25.0	2.0	25.0	3.2	25.0	4.0	25.0	6.4	25.0	6.0	25.0	9.6	25.0	8.0	25.0	12.8
550	25.0	1.8	25.0	2.9	25.0	3.6	25.0	5.8	25.0	5.5	25.0	8.7	25.0	7.3	25.0	11.6
600	25.0	1.7	25.0	2.7	25.0	3.3	25.0	5.3	25.0	5.0	25.0	8.0	25.0	6.7	25.0	10.7

Total bearing thickness h, bearing width b in mm; permissible mean compression stress σ_m in N/mm²; permissible angular distortion α in ‰



Picture 6: *Arrangement of the reinforcement at the end of columns according to booklet 339 DAfStb*



Picture 7: *Recommended kinds of transverse reinforcement at the end of columns according to booklet 339 DAfStb*

Arrangement of cross- and splitting tensile reinforcement at the nodal point girder-column when mounting an elastomer bearing

A load transmitting contact between longitudinal reinforcement and bearing area must be avoided by suitable measures (e.g. plastic sleeves preventing a transmission of peak pressure, see picture 8).

The longitudinal reinforcement has to be enclosed by reinforcement arranged crosswise. Joints of the reinforcement have to be done in a way that their failure is not possible (e.g. opening of stirrups).

Picture 7 shows different kinds of stirrups which have proven to be extra suitable in various tests.
Within the splitting tensile reinforcement the distance between the transverse mounted re-bars shall not be more than 300 mm, within the cross tensile reinforcement not more than 100 mm.

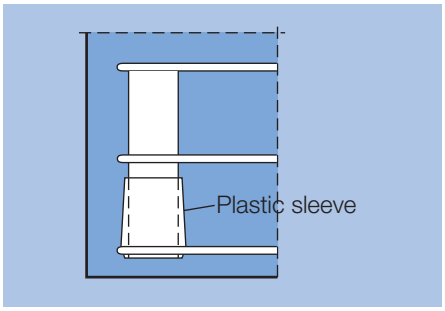
The distance between the stirrups in longitudinal direction of the column shall not be more than 100 mm (splitting tension) resp. 50 mm (cross tension) to avoid buckling of the longitudinal reinforcement due to high bearing distortion.

Pictures 6 and 7 show the arrangement of reinforcement according to booklet 339 DAfStb, pictures 9 and 10 according to proposal of Dr.-Ing. M. Flohrer and Dipl.-Ing. E. Stephan.

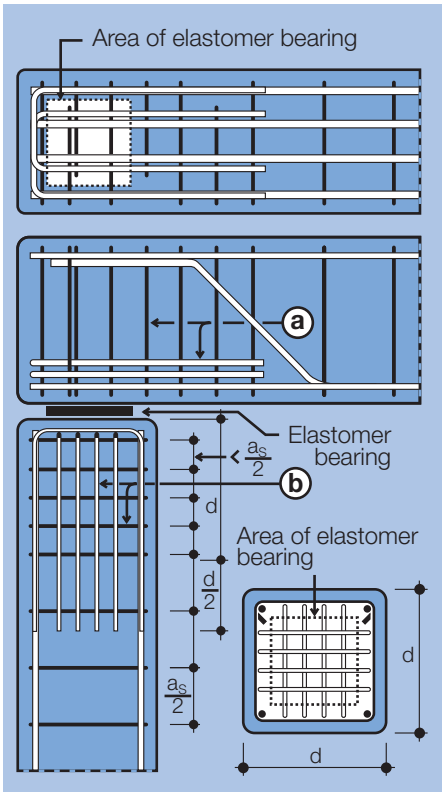
Further literature:

1) H. R. Sasse; F. Müller; U. Thormählen; German committee for steel concrete; Column joints in pre fabricated steel concrete construction with unreinforced elastomer bearings; Booklet 339; 1982

2) M. Flohrer; E. Stephan; Calculation diagrams for cross tensile forces with elastomer bearings; Bautechnik, Booklet 9 and 12, 1975

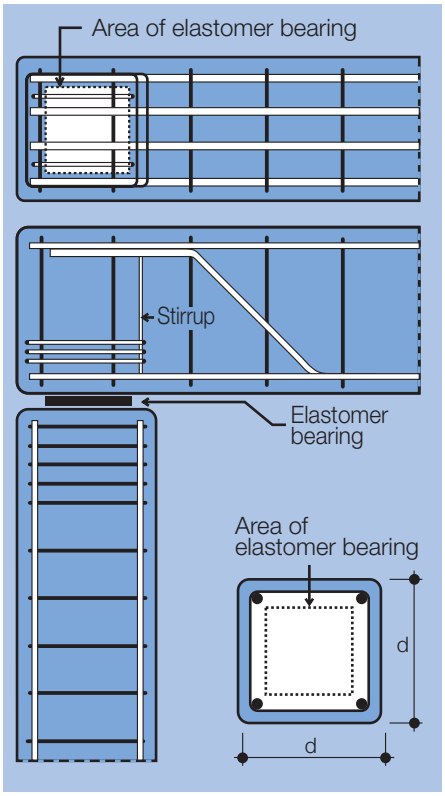


Picture 8: *Detail*

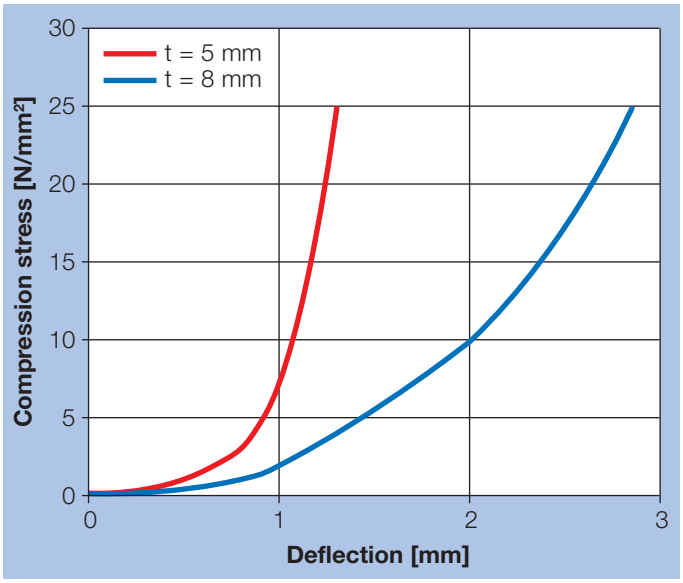


Picture 9: Method A: *The cross tensile forces are taken up by reinforcement directly at the place where they occur.*
a) Cross tensile reinforcement of girders: horizontal loops and additional stirrups
b) Cross tensile reinforcement of columns: vertical loops and additional stirrups, arranged crosswise

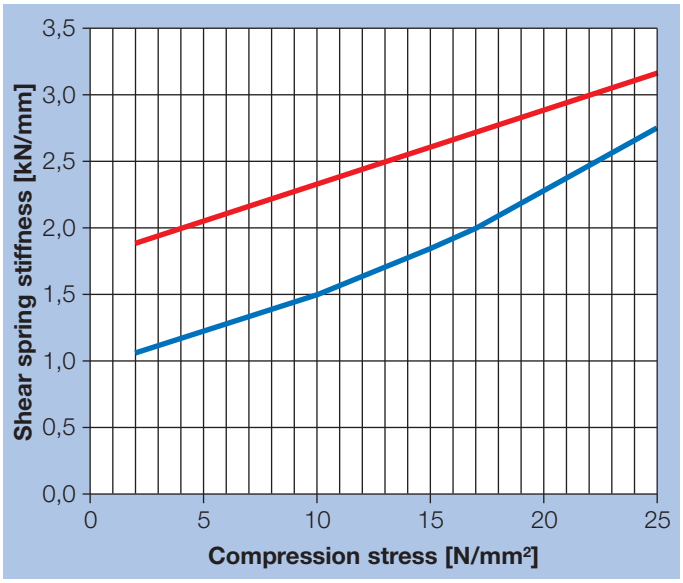
A_B = Distance between stirrups; d = Width of column



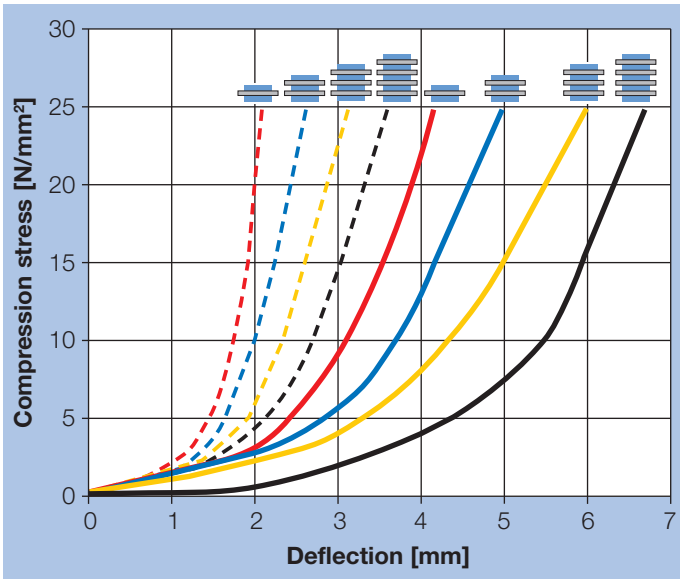
Picture 10: Method B: *The cross tensile forces are taken up by reinforcement enclosing the bearing area ring-shaped*



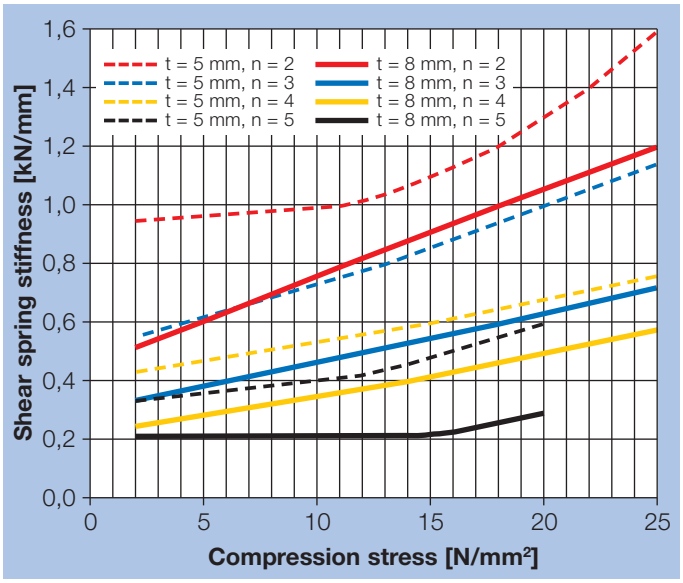
Picture 11: *Perforated Bearing 205, unreinforced, deflection (approximately)**



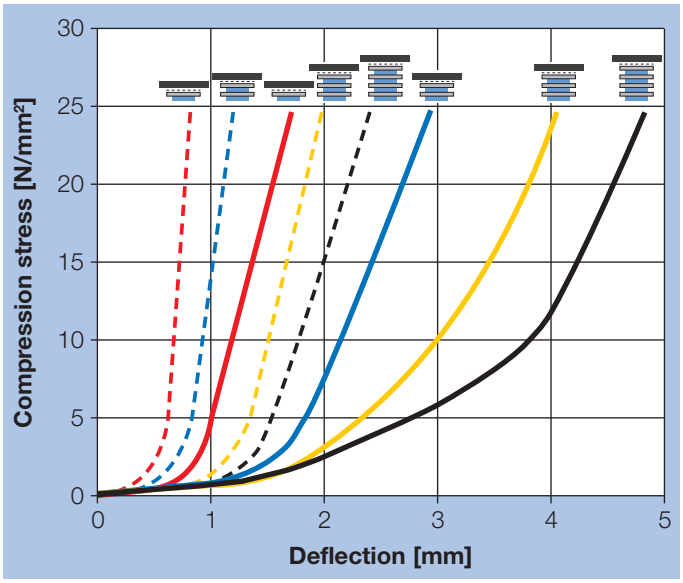
Picture 14: *Perforated Bearing 205, unreinforced, shear spring stiffness*



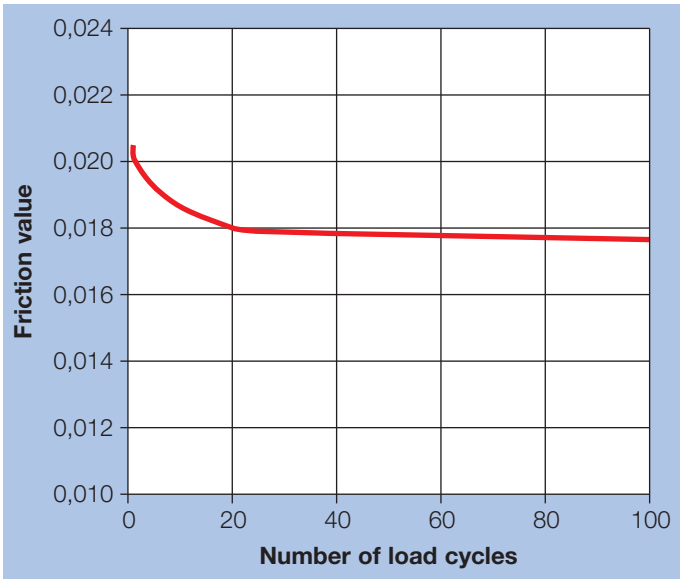
Picture 12: *Perforated Bearing 205-ST, deflection (approximately)**



Picture 15: *Perforated Bearing 205-ST, shear spring stiffness; n = number of elastomer layers*

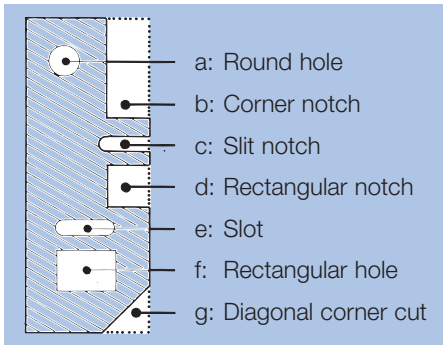


Picture 13: *Perforated Sliding Bearing, deflection (approximately)**



Picture 16: *Perforated Sliding Bearing, values of static friction depending on number of load cycles*

** referring to bearing size 150 mm x 150 mm*



Picture 17: *Standard notches*

Fire Behaviour

The minimum bearing dimensions required for the classification into fire resistance class F 90 and F 120 according to DIN 4102 part 2 are listed in the "Fire Protection Table" (Brandschutztechnische Beurteilung) no. 3799/7357-AR. Bearings of smaller dimensions need an at least 30 mm wide jacketing of Ciflamon fire protection plate to meet the conditions of the F 120-classification.

Design and Dimensions

Perforated Bearings 205 are tailor -made according to the particular project requirements.
In the case that bolts have to be put through a bearing, it can be provided with holes, notches, slots etc.(picture 17).For the use in construction of concrete cast in situ Perforated Bearings are available embedded in Polystyrene. For additional fire precaution reasons the bearings can be embedded in a Ciflamon fire protection plate which should be at least 30 mm wide. It has to be avoided that the support joint is covered in concrete anyway, so that the resilient effect of the bearing is maintained at any time.

Maximum Dimensions:

a) unreinforced
- Length: 1200 mm
- Width: 1200 mm
- Thickness: 5 and 8 mm

b) reinforced
- Length: 1200 mm
- Width: 1200 mm
- Thickness: 14, 20, 22, 30, 31, 38, 42, 53 mm

c) Sliding Bearing
- Length: 1200 mm
- Width: 1200 mm
- Thickness: 14, 17, 22, 28, 30, 38, 39, 50 mm

Mounting Instructions

In pre fabricated construction all various types of the Perforated Bearing are simply placed centrically to the support area without any additional measures. Concerning the Perforated Sliding Bearing it is irrelevant whether the bearing body is situated at the top or below. With reinforced concrete components the distance between bearing edge and component edge must be at least 40 mm, whereas the steel reinforcement has to enclose the bearing area. Chamfered component edges have to be considered as well when determining the edge distance (picture 5).

Please note:

- **Both, slide direction of the bearing and the component´s direction of movement have to correspond.**
- **Slide joints of concrete components cast in situ must not be covered in concrete.**
- **The slide ability of the bearing must not be restricted.**
- **Steel- and timber components require an edge distance of 40 mm.**

Certificate, Suitability Proof

- Official Certificate No. P-852.0290-1, basic tests on bearings according to DIN 4141 part 3, Testing Institute for Mechanical Engineering Materials and Plastics, University of Hannover, 2003

- Fire protection judgement no. 799/7357-AR; Judgement of Calenberg elastomer bearings regarding a classification into fire resistance class F 90 resp. F 120 according to DIN 4102 part 2 (edition 9/1977); Official Material Testing Institute of Civil Engineering and Building Construction, Institute for Building Materials, Massive Structure and Fire Protection, Technical University of Braunschweig; Nov. 1997

References (in extracts)

Perforated Bearing 205

- Central stadium, Leipzig
- MDR building, Erfurt
- Media centre, Köln-Ossendorf
- Hansecenter, Stralsund
- Elb-gallery, Riesa
- BMW, Dingolfing
- Allee-Center, Magdeburg
- Dreirosen bridge, Basel (CH)

Perforated Bearing 205-ST

- Max-Planck-Institute, Dresden
- Stadium centre VfL Bochum
- Stute, Paderborn
- Saarpark-Center, Neunkirchen
- Infineon, Dresden
- Port-Event-Center, Düsseldorf
- Maxdata Computer, Marl
- MCC - Smart, Böblingen
- Walle-Center, Bremen
- Cargo City Süd, Frankfurt/Main
- SIMEC, Dresden
- Logistic centre Stahlgruber, Sulzbach
- Goldsteig dairy, Cham
- Würth, Bad Mergentheim
- Post gallery, Karlsruhe
- Eurocopter, Donauwörth
- Service-Park, Dortmund-West
- Technical department store, Celle
- St. Vinzenz hospital, Altena
- Congress centre, Bochum
- Casualty hospital, Tübingen
- Bodensee thermal spa, Überlingen
- Commerzbank, Luxembourg
- Printer's ink factory, Höver

Perforated Sliding Bearing

- Multi-City-Center, Berlin
- Children´s hospital Brandenburg
- Max-Planck-Institute, Dresden
- Shopping-Center, Wolfsburg
- IKEA Barendrecht (NL)
- EKZ-KOHAKE, shopping centre, Hannover
- FEZ, shopping centre, Nürnberg
- Deutsche Lufthansa, Frankfurt/Main

Calenberg Ingenieure, planmäßig elastisch lagern GmbH
Am Knübel 2-4
D-31020 Salzhemmendorf
Tel. +49 (0) 51 53/94 00-0
Fax +49 (0) 51 53/94 00-49
E-Mail: info@calenberg-ingenieure.de
http://www.calenberg-ingenieure.de

PIB 11.4.03/02/0120 – 1. Edition – Reprint, photocopy or duplication – even in extracts – only with written permission of Calenberg Ingenieure GmbH. Subject to change.