ELASTOMER SERVICE ZENTRALE
WILFRIED BECKER GMBH

ESZ type 100

Unreinforced elastomeric bearing
with building authority **approval** Z-16.32-482

Load capacity up to **14 N/mm²**

General information	*Product description*
Deformation behaviour	*Compression characteristic and bulging behaviour* *Compression characteristic curve* *Bulging behaviour of the bearing*
Planning tools	*Design tables t=10 mm* *Design tables t=15 mm* *Design tables t=20 mm* *Tender texts*
Design	*Dimensions - Shape factor - Boreholes* *Load capacity and rotation* *Rotation - twisting surcharge* *Transverse tensile forces*
Calculation example	*Load capacity under rotation*
Bearing use in practice	*Installation instructions*

ESZ type 100 | for static component bearing
Technical documentation

Special advantages

- Load-bearing capacity up to 14 N/mm² (depending on format)
- Material > Vulcanisate based on EPDM rubber
- Proven in practice for decades
- DIBt approval Z-16.32-482
- Can be used as a point or strip bearing
- Maintenance-free and very durable
- Low creep behaviour
- Very good mechanical-physical characteristics

Intended use

The **ESZ type 100** is a compact elastomeric bearing for use as static bearing of structural elements, like steelworks, wood constructions or especially in precast concrete construction. It is used in accordance with the provisions of the general building inspectorate **approval Z-16.32-482**.

Deformation

Depending on the nature of the contact surfaces, an average bearing deflection of ≤ 40 % can be expected at maximum permissible loads.

Delivery form

- **Precast concrete construction**

Available as cuttings for all standard bearing dimensions in precast concrete construction with boreholes, cut-outs and bevelled cuts.
Nominal bearing thicknesses: 10, 15, 20, 25 and 30 mm.

- **Use for in-situ concrete**

The bearing can be supplied pre-fabricated with a dummy formwork for use in in-situ concrete. The formwork can be produced for strip and point bearings. This applies to all available bearing thicknesses of 10, 15, 20, 25 and 30 mm for in-situ concrete use.

Temperature range

The temperature application range is between -25 °C and +50 °C.
The bearings may be exposed to temperatures of up to +70 °C for short, recurring periods of less than 8 hours.
The **ESZ type 100** elastomeric bearing can be used both indoors and outdoors.

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The following pages show **pressure compression characteristic curves** and the **bulging behaviour** for selected bearing formats in diagram form.

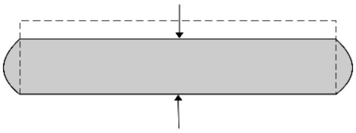

Figure 1

The orientation diagrams make it possible to estimate the deflection as a function of the existing compressive stress. The characteristic curves were determined on reinforced concrete contact surfaces and with centric load application. The diagrams each show the evaluation at the third load on the bearing. In construction practice, the deflection may deviate from the values of the compressive compression characteristics given here as examples, depending on the characteristic of the substrate, deviations of the contact surfaces from plane parallelism and any rotations/offsets that occur.
The deflection decreases with increasing bearing footprint sizes.

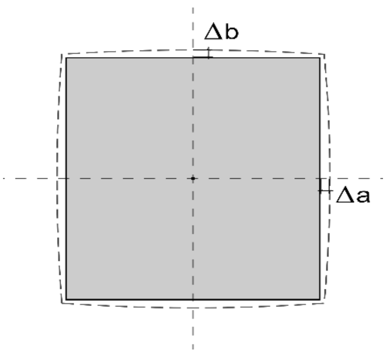

Figure 2

The bulging behaviour depends on the nominal bearing thickness and the permissible design compressive stress. The expansion dimensions in the diagrams shown refer to one side of the bearing, as shown in Figure 2.

The bulging behaviour is largely dependent on the **roughness** of the contact surfaces. The roughness of the concrete contact surfaces from these tests was analysed in accordance with DIN EN ISO 4287.
The arithmetic mean roughness value Ra was determined from 4 individual measurement strips > Ra = 808.5μm.

Typical roughness values are:
Concrete (200-900 μm); steel (1-50 μm)

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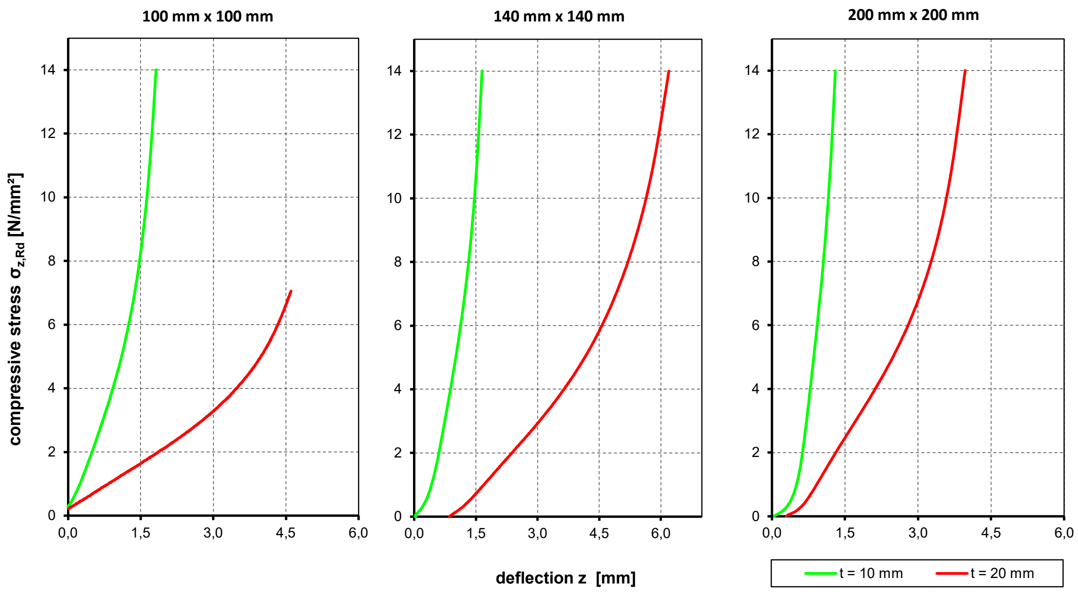
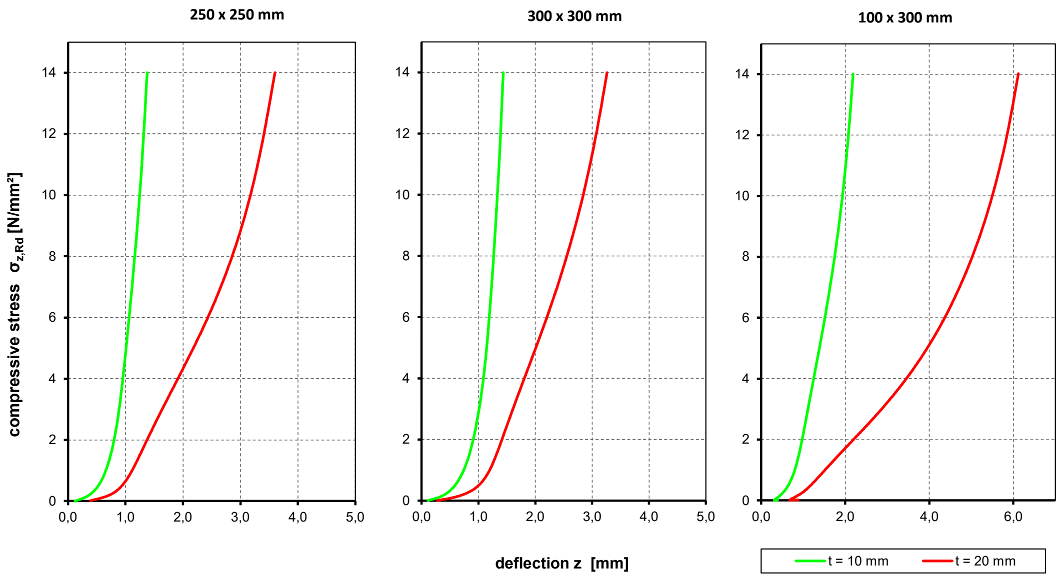
ESZ type 100 | for static component bearing
t = 10 mm and 20 mm
(exemplary formats, concrete contact surface)





The bearing thicknesses 10 mm and 20 mm are each summarised in a diagram, where t = 10 mm is shown in green and t = 20 mm in red.

On request, we will be happy to determine the deflection and the bulging of not shown bearing formats according to our technical capabilities.

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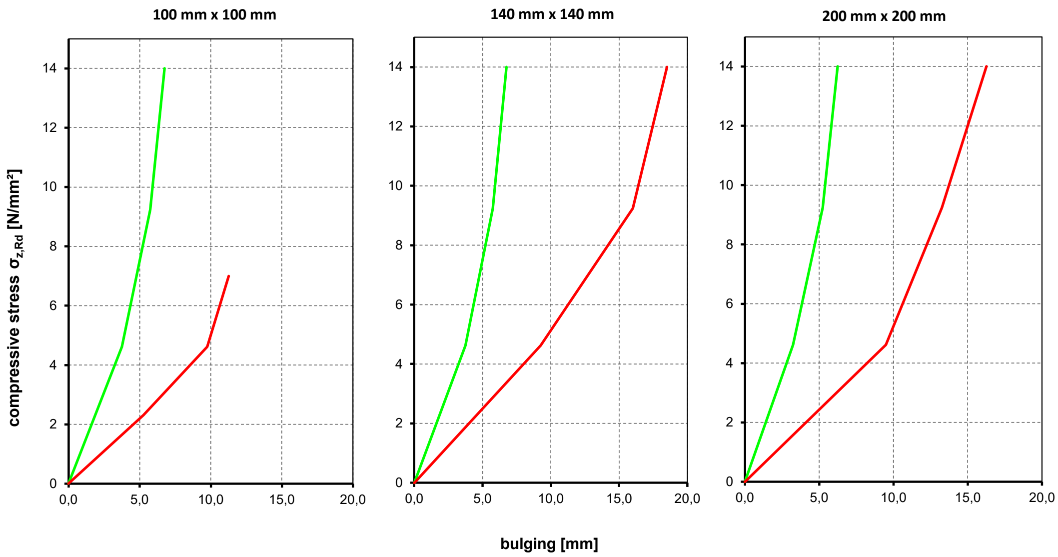
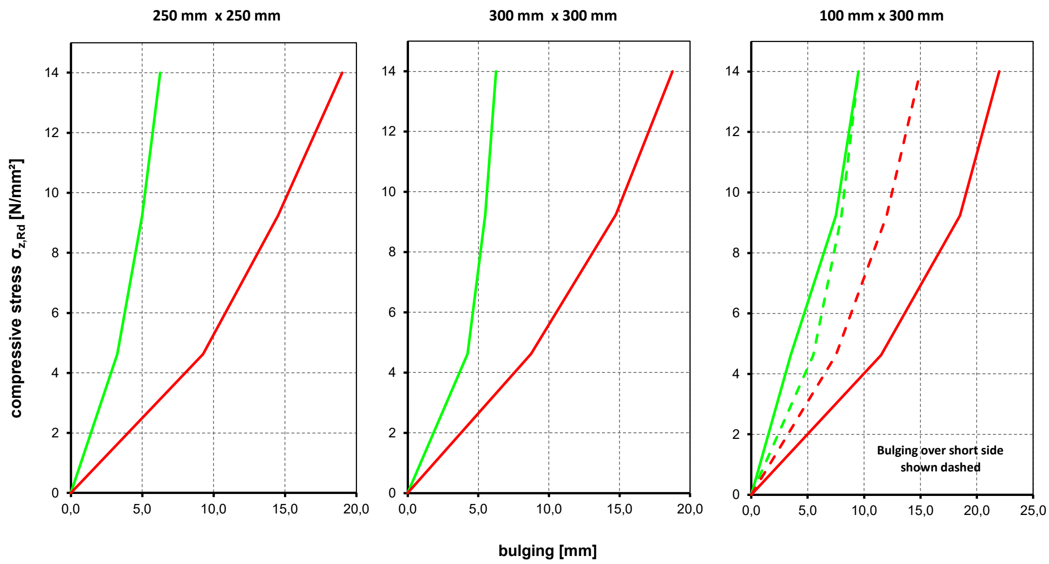
t = 10 mm and 20 mm
(exemplary formats, concrete contact surface)





The bearing thicknesses 10 mm and 20 mm are each summarised in a diagram, where t = 10 mm is shown in green and t = 20 mm in red.

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ESZ type 100 | for static component bearing

$R_{\perp d}$ [N/mm²] | Bearing thickness t = 10 mm

Important note:

The table shows the maximum permissible values of the load-bearing capacity with corresponding rotational capacity parallel to side b (α_b) in accordance with the approval conditions and is only intended as a guide. In our opinion, the interaction between compressive stress and rotation is not taken into account in a practical manner.

As soon as holes are drilled in the bearing, the shape factor changes and therefore the entire basis for design changes.

You can conveniently carry out a specific dimensioning for your application using the ESZ dimensioning tool online.

Calculating online

α_b [‰]	side a [mm]	side b [mm] 70	80	90	100	110	120	130	140	150	160	170	180	190	200	230	250	270	300
40,0	50	-	-	-	8,3	8,6	8,8	9,1	9,3	9,4	9,6	9,7	9,9	10,0	10,1	10,4	10,6	10,7	10,9
40,0	60	-	-	-	9,4	9,8	10,1	10,4	10,6	10,9	11,1	11,3	11,5	11,6	11,8	12,4	12,8	13,2	13,7
40,0	70	8,8	9,4	9,9	10,4	10,9	11,2	11,6	11,9	12,5	13,0	13,5	13,8	14,0	14,0	14,0	14,0	14,0	14,0
40,0	80		10,1	10,7	11,3	11,8	12,6	13,4	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	90			11,5	12,3	13,4	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	100				13,7	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	110					14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
37,5	120						14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
34,6	130							14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
32,1	140								14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
30,0	150									14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
28,1	160										14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
26,5	170											14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
25,0	180												14,0	14,0	14,0	14,0	14,0	14,0	14,0
23,7	190													14,0	14,0	14,0	14,0	14,0	14,0
22,5	200														14,0	14,0	14,0	14,0	14,0
21,4	210															14,0	14,0	14,0	14,0
20,5	220															14,0	14,0	14,0	14,0
19,6	230															14,0	14,0	14,0	14,0
18,8	240																14,0	14,0	14,0
18,0	250																14,0	14,0	14,0
17,3	260																	14,0	14,0
16,7	270																	14,0	14,0
16,1	280																		14,0
15,5	290																		14,0
15,0	300																		14,0

Bearing thickness t = 10 mm: Limit dimension of shorter bearing side a_{max} = 300 mm

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$F_{d,max}$ [kN] | bearing thickness t = 10 mm

Important note:

The table shows the maximum permissible values of the load-bearing capacity with corresponding rotational capacity parallel to side b (α_b) in accordance with the approval conditions and is only intended as a guide. In our opinion, the interaction between compressive stress and rotation is not taken into account in a practical manner.

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Calculating online

α_b [‰]	side a [mm]	side b [mm]																	
		70	80	90	100	110	120	130	140	150	160	170	180	190	200	230	250	270	300
40,0	50	-	-	-	42	47	53	59	65	71	77	83	89	95	101	120	132	144	163
40,0	60	-	-	-	57	65	73	81	89	98	106	115	124	132	141	171	193	214	246
40,0	70	43	53	63	73	84	94	105	117	131	146	160	174	186	196	225	245	265	294
40,0	80		65	77	90	104	121	140	157	168	179	190	202	213	224	258	280	302	336
40,0	90			93	111	133	151	164	176	189	202	214	227	239	252	290	315	340	378
40,0	100				137	154	168	182	196	210	224	238	252	266	280	322	350	378	420
40,0	110					169	185	200	216	231	246	262	277	293	308	354	385	416	462
37,5	120						202	218	235	252	269	286	302	319	336	386	420	454	504
34,6	130							237	255	273	291	309	328	346	364	419	455	491	546
32,1	140								274	294	314	333	353	372	392	451	490	529	588
30,0	150									315	336	357	378	399	420	483	525	567	630
28,1	160										358	381	403	426	448	515	560	605	672
26,5	170											405	428	452	476	547	595	643	714
25,0	180												454	479	504	580	630	680	756
23,7	190													505	532	612	665	718	798
22,5	200														560	644	700	756	840
21,4	210															676	735	794	882
20,5	220															708	770	832	924
19,6	230															741	805	869	966
18,8	240																840	907	1008
18,0	250																875	945	1050
17,3	260																	983	1092
16,7	270																	1021	1134
16,1	280																		1176
15,5	290																		1218
15,0	300																		1260

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ESZ type 100 | for static component bearing

$R_{\perp d}$ [N/mm²] | Bearing thickness t = 15 mm

Important note:

The table shows the maximum permissible values of the load-bearing capacity with corresponding rotational capacity parallel to side b (α_b) in accordance with the approval conditions and is only intended as a guide. In our opinion, the interaction between compressive stress and rotation is not taken into account in a practical manner.

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α_b [‰]	side a [mm]	side b [mm]																				
		80	90	100	110	120	130	140	150	160	170	180	190	200	230	250	270	300	350	400	450	500
40,0	80	6,5	6,9	7,3	7,7	8,0	8,2	8,5	8,7	8,9	9,1	9,3	9,4	9,6	10,0	10,2	10,4	10,7	11,0	11,3	11,5	11,7
40,0	90		7,4	7,8	8,2	8,6	8,9	9,2	9,4	9,7	9,9	10,1	10,3	10,5	10,9	11,2	11,5	11,8	12,5	13,2	13,7	14,0
40,0	100			8,3	8,7	9,1	9,5	9,8	10,1	10,4	10,6	10,9	11,1	11,3	11,8	12,4	13,0	13,7	14,0	14,0	14,0	14,0
40,0	110				9,2	9,6	10,0	10,4	10,7	11,0	11,3	11,6	11,8	12,3	13,5	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	120					10,1	10,5	10,9	11,3	11,6	12,0	12,6	13,2	13,7	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	130						11,0	11,4	11,8	12,5	13,2	13,8	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	140							11,9	12,8	13,6	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	150								13,7	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	160									14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
39,7	170										14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
37,5	180											14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
35,5	190												14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
33,8	200													14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
32,1	210														14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
30,7	220														14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
29,3	230														14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
28,1	240															14,0	14,0	14,0	14,0	14,0	14,0	14,0
27,0	250															14,0	14,0	14,0	14,0	14,0	14,0	14,0
26,0	260																14,0	14,0	14,0	14,0	14,0	14,0
25,0	270																14,0	14,0	14,0	14,0	14,0	14,0
24,1	280																	14,0	14,0	14,0	14,0	14,0
23,3	290																	14,0	14,0	14,0	14,0	14,0
22,5	300																	14,0	14,0	14,0	14,0	14,0
19,3	350																		14,0	14,0	14,0	14,0
16,9	400																			14,0	14,0	14,0
15,0	450																				14,0	14,0

Bearing thickness t = 15 mm: Limit dimension of shorter bearing side a_{max} = 450 mm

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$F_{d,max}$ [kN] | Bearing thickness t = 15 mm

Important note:
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Calculating online

α_b [‰]	side a [mm]	side b [mm]																				
		80	90	100	110	120	130	140	150	160	170	180	190	200	230	250	270	300	350	400	450	500
40,0	80	42	50	59	67	76	86	95	104	114	124	134	144	154	184	204	225	256	309	362	415	469
40,0	90		60	71	81	93	104	116	127	139	151	164	176	189	227	252	278	318	393	474	554	630
40,0	100			83	96	110	123	137	152	166	181	196	211	226	272	311	350	410	490	560	630	700
40,0	110				111	127	143	160	177	194	212	230	247	270	341	385	416	462	539	616	693	770
40,0	120					146	164	184	203	224	246	273	301	328	386	420	454	504	588	672	756	840
40,0	130						186	208	231	261	292	323	346	364	419	455	491	546	637	728	819	910
40,0	140							234	268	304	333	353	372	392	451	490	529	588	686	784	882	980
40,0	150								308	336	357	378	399	420	483	525	567	630	735	840	945	1050
40,0	160									358	381	403	426	448	515	560	605	672	784	896	1008	1120
39,7	170										405	428	452	476	547	595	643	714	833	952	1071	1190
37,5	180											454	479	504	580	630	680	756	882	1008	1134	1260
35,5	190												505	532	612	665	718	798	931	1064	1197	1330
33,8	200													560	644	700	756	840	980	1120	1260	1400
32,1	210														676	735	794	882	1029	1176	1323	1470
30,7	220														708	770	832	924	1078	1232	1386	1540
29,3	230														741	805	869	966	1127	1288	1449	1610
28,1	240															840	907	1008	1176	1344	1512	1680
27,0	250															875	945	1050	1225	1400	1575	1750
26,0	260																983	1092	1274	1456	1638	1820
25,0	270																1021	1134	1323	1512	1701	1890
24,1	280																	1176	1372	1568	1764	1960
23,3	290																	1218	1421	1624	1827	2030
22,5	300																	1260	1470	1680	1890	2100
19,3	350																		1715	1960	2205	2450
16,9	400																			2240	2520	2800
15,0	450																				2835	3150

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$R_{\perp d}$ [N/mm²] | Bearing thickness t = 20 mm

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α_b [‰]	side a [mm]	side b [mm]																						
		80	90	100	110	120	130	140	150	160	170	180	190	200	230	250	270	300	350	400	450	500	550	600
40,0	80	4,7	5,0	5,3	5,6	5,8	6,0	6,2	6,4	6,5	6,7	6,8	6,9	7,0	7,3	7,5	7,6	7,8	8,1	8,3	8,5	8,6	8,7	8,8
40,0	90		5,4	5,7	6,0	6,3	6,5	6,7	6,9	7,1	7,3	7,4	7,6	7,7	8,0	8,2	8,4	8,7	9,0	9,2	9,4	9,6	9,8	9,9
40,0	100			6,1	6,4	6,7	6,9	7,2	7,4	7,6	7,8	8,0	8,2	8,3	8,7	9,0	9,2	9,4	9,8	10,1	10,4	10,6	10,7	10,9
40,0	110				6,7	7,1	7,4	7,6	7,9	8,1	8,3	8,5	8,7	8,9	9,4	9,6	9,9	10,2	10,6	11,0	11,2	11,5	11,7	11,9
40,0	120					7,4	7,7	8,0	8,3	8,6	8,8	9,0	9,2	9,4	10,0	10,3	10,5	10,9	11,4	11,8	12,3	12,8	13,3	13,7
40,0	130						8,1	8,4	8,7	9,0	9,3	9,5	9,7	9,9	10,5	10,9	11,1	11,5	12,3	13,2	13,9	14,0	14,0	14,0
40,0	140							8,8	9,1	9,4	9,7	9,9	10,2	10,4	11,1	11,4	11,7	12,5	13,7	14,0	14,0	14,0	14,0	14,0
40,0	150								9,4	9,8	10,1	10,4	10,6	10,9	11,6	12,0	12,7	13,7	14,0	14,0	14,0	14,0	14,0	14,0
40,0	160									10,1	10,4	10,7	11,0	11,3	12,2	13,0	13,8	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	170										10,8	11,1	11,4	11,7	13,1	13,9	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	180											11,5	11,8	12,3	13,9	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	190												12,4	13,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	200													13,7	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	210														14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
40,0	220														14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
39,1	230														14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
37,5	240															14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
36,0	250															14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
34,6	260																14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
33,3	270																14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0
32,1	280																	14,0	14,0	14,0	14,0	14,0	14,0	14,0
31,0	290																	14,0	14,0	14,0	14,0	14,0	14,0	14,0
30,0	300																	14,0	14,0	14,0	14,0	14,0	14,0	14,0
25,7	350																		14,0	14,0	14,0	14,0	14,0	14,0
22,5	400																			14,0	14,0	14,0	14,0	14,0
20,0	450																				14,0	14,0	14,0	14,0
18,0	500																				14,0	14,0	14,0	14,0
16,4	550																				14,0	14,0	14,0	14,0
15,0	600																				14,0	14,0	14,0	14,0

Bearing thickness t = 20 mm: Limit dimension of shorter bearing side a_{max} = 600 mm

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ESZ type 100 | for static component bearing

$F_{d,max}$ [kN] | bearing thickness t = 20 mm

Important note:

The table shows the maximum permissible values of the load-bearing capacity with corresponding rotational capacity parallel to side b (α_b) in accordance with the approval conditions and is only intended as a guide. In our opinion, the interaction between compressive stress and rotation is not taken into account in a practical manner.

As soon as holes are drilled in the bearing, the shape factor changes and therefore the entire basis for design changes.

You can conveniently carry out a specific dimensioning for your application using the ESZ dimensioning tool online.

Calculating online

α_b [‰]	side a [mm]	side b [mm]																						
		80	90	100	110	120	130	140	150	160	170	180	190	200	230	250	270	300	350	400	450	500	550	600
40,0	80	30	36	43	49	56	62	69	76	83	91	98	105	113	135	150	165	188	227	266	305	345	385	424
40,0	90		44	51	59	68	76	85	93	102	111	120	129	139	167	186	205	234	283	332	382	432	483	533
40,0	100			61	70	80	90	101	111	122	133	144	155	166	201	224	247	283	343	404	466	528	590	653
40,0	110				82	93	105	118	130	143	156	169	182	196	237	265	293	336	408	482	556	631	706	782
40,0	120					107	121	135	150	165	180	195	211	226	275	308	341	392	477	565	664	770	878	984
40,0	130						137	153	170	187	205	222	240	259	315	353	391	450	560	686	810	910	1001	1092
40,0	140							172	191	210	230	250	271	292	356	400	444	525	670	784	882	980	1078	1176
40,0	150								212	234	257	280	303	326	399	451	516	615	735	840	945	1050	1155	1260
40,0	160									259	284	309	335	362	449	522	595	672	784	896	1008	1120	1232	1344
40,0	170										312	340	369	398	512	592	643	714	833	952	1071	1190	1309	1428
40,0	180											371	403	443	574	630	680	756	882	1008	1134	1260	1386	1512
40,0	190												446	495	612	665	718	798	931	1064	1197	1330	1463	1596
40,0	200													547	644	700	756	840	980	1120	1260	1400	1540	1680
40,0	210														676	735	794	882	1029	1176	1323	1470	1617	1764
40,0	220														708	770	832	924	1078	1232	1386	1540	1694	1848
39,1	230														741	805	869	966	1127	1288	1449	1610	1771	1932
37,5	240															840	907	1008	1176	1344	1512	1680	1848	2016
36,0	250															875	945	1050	1225	1400	1575	1750	1925	2100
34,6	260																983	1092	1274	1456	1638	1820	2002	2184
33,3	270																1021	1134	1323	1512	1701	1890	2079	2268
32,1	280																	1176	1372	1568	1764	1960	2156	2352
31,0	290																	1218	1421	1624	1827	2030	2233	2436
30,0	300																	1260	1470	1680	1890	2100	2310	2520
25,7	350																		1715	1960	2205	2450	2695	2940
22,5	400																			2240	2520	2800	3080	3360
20,0	450																				2835	3150	3465	3780
18,0	500																				3150	3500	3850	4200
16,4	550																				3465	3850	4235	4620
15,0	600																				3780	4200	4620	5040

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ESZ type 100 | for static component bearing
Technical documentation

- for use between precast reinforced concrete elements

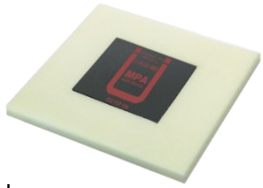
Supply and installation of unreinforced elastomeric bearings with national technical approval between precast reinforced concrete elements. Can be used up to a compressive stress of 14 N/mm² depending on the format.
The proof of the usability of the bearings must be provided.

Bearing type:	**ESZ type 100** with national technical approval Z-16.32-482
Bearing thickness (10/15/20/25/30):	______ mm
Format a x b:	______ mm x ______ mm
Boreholes:	Number ______ Diameter _______
Quantity:	______ Piece
Proof of purchase:	ESZ Wilfried Becker GmbH Weilerhöfe 1, 41564 Kaarst Phone: +49 2131 75 81 00; info@esz-becker.de

- for use as an in-situ concrete point bearing

Supply and installation of non-reinforced elastomeric bearings with national technical approval as in-situ concrete point bearings. Can be used up to a compressive stress of 14 N/mm² depending on the format.
The proof of the usability of the bearings must be provided.

Bearing type:	**ESZ type 100** with national technical approval Z-16.32-482
Bearing thickness (10/15/20/25/30):	______ mm
Format a x b:	______ mm x ______ mm
Format incl. blank formwork aG x aG:	______ mm x ______ mm
Boreholes:	Number ______ Diameter _______
Quantity:	______ Piece
Proof of purchase:	ESZ Wilfried Becker GmbH Weilerhöfe 1, 41564 Kaarst Phone: +49 2131 75 81 00; info@esz-becker.de



- for use as an in-situ concrete strip bearing

Supply and installation of unreinforced elastomeric bearings with national technical approval as in-situ concrete strip bearings. Can be used up to a compressive stress of 14 N/mm² depending on the format.
The mathematical proof of the usability of the bearings must be provided.

Bearing type:	**ESZ type 100** with national technical approval Z-16.32-482
Bearing thickness (10/15/20/25/30):	______ mm
Format a:	______ mm
Format incl. blind formwork aG:	______ mm
Boreholes:	Number ______ Diameter _______
Quantity:	______ metres
Proof of purchase:	ESZ Wilfried Becker GmbH Weilerhöfe 1, 41564 Kaarst Phone: +49 2131 75 81 00; info@esz-becker.de

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ESZ type 100 | with national technical approval
General information and calculation basis

Conditions > Dimensions of the bearings and permissible bores (according to abZ section 2.1.1)

Thickness of the bearing t = 10 to 30 mm

t ≤ a/5 **with t_{max} = 30 mm**
t ≥ a/30 **with t_{min} = 10 mm**

The following applies to rectangular, point bearings:

a ≥ 70 mm, b ≥ 70 mm
The following applies to strip-shaped bearings:
a ≥ 50 mm, b ≥ 100 mm
The following applies to round bearings:
r ≥ 40 mm

with
t thickness of the unloaded bearing
a shorter side of the bearing
b longer side of the bearing

In Table 1 of the general technical approval, the load-bearing capacities are assigned to different shape factor ranges as a design function.

The **shape factor S** for rectangular bearings is calculated as follows:

$$S = \frac{a \cdot b}{2 \cdot t \cdot (a + b)}$$

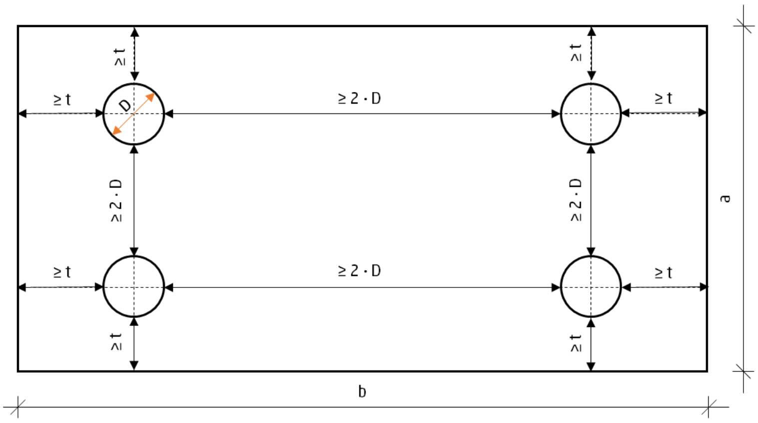
The **shape factor S** for round bearings is calculated as follows:

$$S_{mod} = \frac{r}{\sqrt{8} \cdot t}$$

Boreholes (base area and lateral surfaces) must still be taken into account (=deducted) in the calculation!

Up to four boreholes are permitted per bearing, whereby the area of the boreholes may not exceed 10 % of the total area of the bearing.

The distance between the holes must be at least 2 x D. A minimum edge distance of the bearing thickness t must be maintained for the holes. The maximum diameter of the hole is D = 50 mm.



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ESZ type 100 | with national technical approval
General information and calculation basis

Calculation of the load-bearing capacity and consideration of the angle of rotation incl. surcharges

The load-bearing capacity of the **ESZ type 100** is limited by the manufacturer to **14 N/mm²**, although significantly higher load-bearing capacities are specified according to the design function in Table 1 of the approval, depending on the shape factor.

The vertical load on an elastomeric bearing leads to a **centric** load concentration and, in conjunction with a support torsion, to an **eccentric** load concentration.
The simultaneous occurrence of compressive stress and rotation must be taken into account when dimensioning an elastomeric bearing and its suitability for use must be verified accordingly.
The resulting effects on the neighbouring components must also be considered.
For the bearing design, the shear stresses from the vertical compression and the torsion are superimposed.
Elastomeric bearings allow shear deformation, but they must not be used to **absorb constant external shear forces.**

The angle of rotation of the adjacent components must be determined by adding the following influences:

- obliqueness with 10 ‰
- unevenness with 625/a ‰

In the case of torsion across both sides of the bearing, the allowances for angular torsion are added proportionally to the respective design data (torsion due to component deformations) from the structural analysis.

In addition to the regulations listed in the approval, the following formula are used for the design of the **ESZ type 100** to calculate the load-bearing capacity, taking into account support torsion (if the entire support situation is known, modifications are possible after consultation with ESZ):

Rectangular bearing

$$\sigma_{z,Rd} = \left[f_{tRd} - \alpha_{bd} \cdot \frac{G}{2} \cdot \left(\frac{a}{t}\right)^2 - \alpha_{ad} \cdot \frac{G}{2} \cdot \left(\frac{b}{t}\right)^2\right] \cdot \frac{c}{t} \cdot \eta_2$$

Round bearing

$$\sigma_{z,Rd} = \left[f_{tRd} - \alpha_d \cdot \frac{3 \cdot G}{8} \mathrm{N/mm^2} \cdot \left(\frac{d}{t}\right)^2\right] \cdot \frac{d}{t} \cdot \eta_2$$

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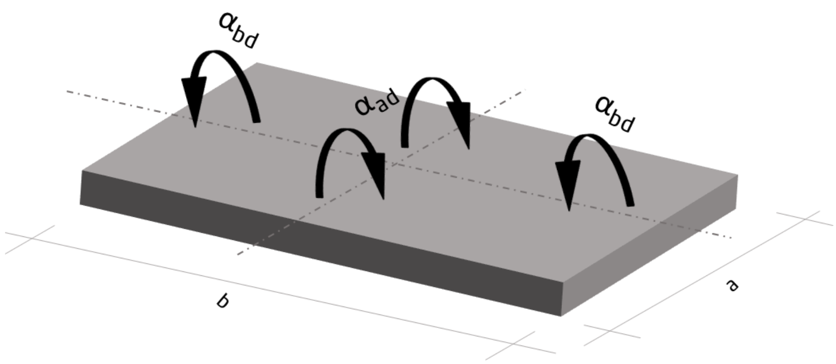
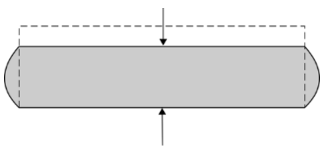


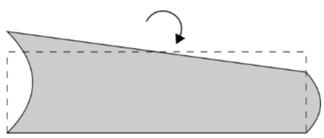
$$\alpha_{b,max} = \frac{450 \cdot t}{a} \leq 48\ ‰ \qquad \alpha_{a,max} = \frac{450 \cdot t}{b} \leq 48\ ‰$$

$$\alpha_{Resultierende} = \sqrt{\alpha_{a,max}{}^2 + \alpha_{b,max}{}^2} \leq 48\ ‰$$



The interaction of load action and angular torsion leads to a reduction in the load-bearing capacity, which must be verified by a mathematical analysis.

Deviations from the plane parallelism and unevenness of the contact surfaces of the adjacent components are treated mathematically as planned rotations. Geometric imperfections and deviations from the plane parallelism of the contact surfaces must be recognised with at least 0.01 rad [= 10 ‰] and added to the calculated value of the bearing torsion.



If no more precise verification is provided, unevenness of the contact surfaces must be taken into account with 625/a [‰] and considered mathematically in the same way as planned rotations. Bearing side a is always the shorter bearing side.
If a cast-in-place concrete component is concreted onto the bearing or the contact surface is steel, this value can be halved.

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ESZ type 100 | with national technical approval
General information and calculation basis

Information on transverse tensile forces in the bearing joint

The **ESZ type 100** elastomeric bearing is practically incompressible. As a result, the bearing expands transversely under compressive load at constant volume. The bearing is more or less restricted in its transverse expansion by the neighbouring components - depending on the surface properties of the component.
Roughness and **surface friction** are decisive influencing factors here. If the adjacent surfaces now counteract the lateral expansion of the elastomer bearing, this inevitably results in shear stresses in the joint, which lead to tensile stresses in the adjacent material and compressive stresses in the rubber.
These so-called adhesive tensile stresses in the adjacent (concrete) component are unfavourable because they can lead to damage such as edge spalling.

They increase with increasing elastomer thickness and should not be confused with splitting tensile stresses, which only become effective at a certain depth and occur with any type of partial surface load.
The reinforcement for the transverse tensile forces in reinforced concrete components should therefore be arranged as close as possible to the bearing.

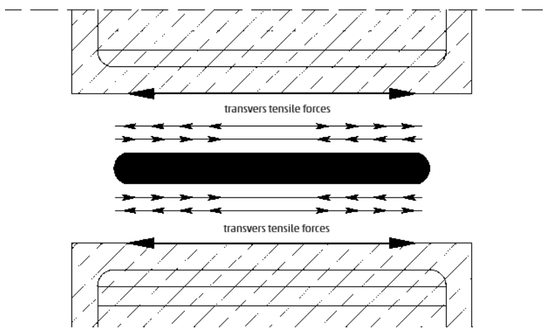

Fig.1 : Representation of the transverse tensile

Calculation of transverse tensile forces according to ESZ - Information on the calculation assumptions

When determining the transverse tensile forces, the formula equation differs from the "old" calculation according to DIN 4141-Part 15 to the formula equation according to DIBt approval. The function for the calculation according to DIBt approval is linear, the function according to the old DIN is progressive. From a bearing side length a of approx. 320 mm, the functional equations intersect, i.e. the distinction only becomes relevant from a bearing thickness > 15 mm. From this bearing side length, the course of the curve according to DIN assumptions becomes significantly less favourable than the course of the straight line according to DIBt approval. This means that the transverse tensile forces are correspondingly higher.
For this reason, ESZ considers both functional equations when calculating the transverse tensile forces and gives the less favourable one as a recommendation for the design of the reinforcement.

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Calculation of transverse tensile forces according to "old" DIN 4141 part 15

$Z_a = 1,5 \cdot F_{z,max,d} \cdot t \cdot b \cdot 10^{-5}$ $\quad Z_b = 1,5 \cdot F_{z,max,d} \cdot t \cdot a \cdot 10^{-5}$

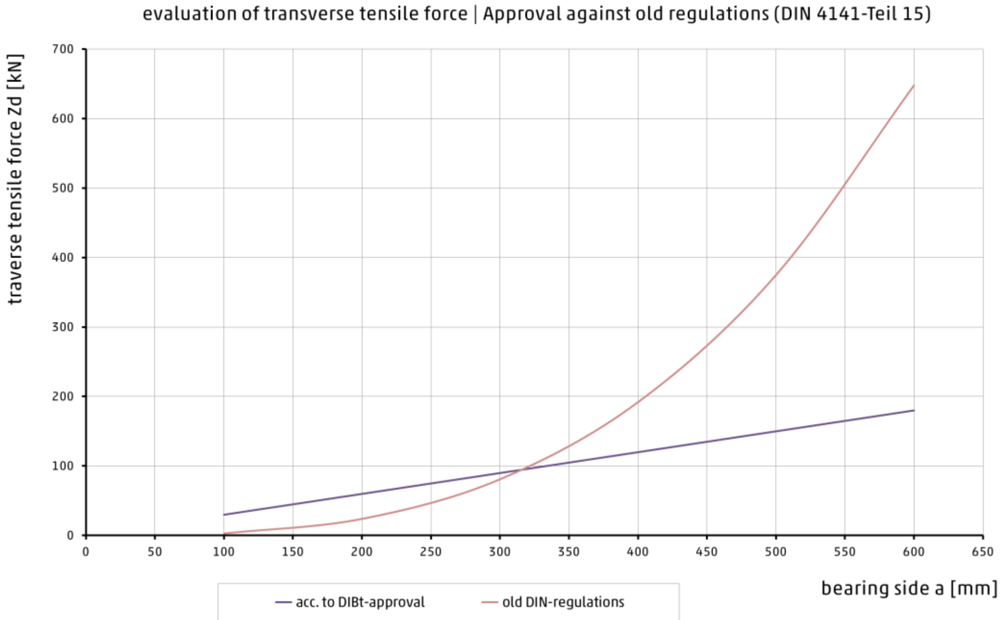
Calculation of transverse tensile forces according to DIBt approval

$Z_a = 1,5 \cdot E_{\perp d} \cdot a \cdot t \cdot 10^{-3}$ $\quad Z_b = 1,5 \cdot E_{\perp d} \cdot b \cdot t \cdot 10^{-3}$

Calculation of transverse tensile forces according to ESZ

$Z_a = \max(1,5 \cdot E_{\perp d} \cdot a \cdot t \cdot 10^{-3} ; 1{,}5/mm^2 \cdot F_{z,max,d} \cdot t \cdot b \cdot 10^{-5})$

$Z_b = \max(1,5 \cdot E_{\perp d} \cdot b \cdot t \cdot 10^{-3} ; 1{,}5/mm^2 \cdot F_{z,max,d} \cdot t \cdot a \cdot 10^{-5})$



Calculation example of the transverse tensile forces in the bearing joint with centric loading

Z_b	=	Transverse tensile force perpendicular to the longer side b of the bearing [kN]
$E_{\perp d}$	=	Load on the bearing perpendicular to the bearing plane [N/mm²]
$Fz_{,max,d}$	=	Design value of the maximum support force in the z-direction [N/mm²]
a	=	shorter bearing side [mm]
t	=	Bearing thickness [mm]

a = 100 mm
b = 200 mm
t = 15 mm

$F_{z,max,d}$ = 300 kN
$E_{\perp d}$ = 15 N/mm²

$Z_a = \max(1,5 \cdot 15 \cdot 100 \cdot 15 \cdot 10^{-3}; 1{,}5/mm^2 \cdot 300 \cdot 15 \cdot 200 \cdot 10^{-5})$

$Z_a = 33,8\ kN$

$Z_b = \max(1,5 \cdot 15 \cdot 200 \cdot 15 \cdot 10^{-3}; 1{,}5/mm^2 \cdot 300 \cdot 15 \cdot 100 \cdot 10^{-5})$

$Z_b = 67,5\ kN$

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Character meanings in the formula

f_{tRd}	=	Calculated value of the internal resistance of the bearing [N/mm²]
G	=	Shear modulus [N/mm²]
a	=	shorter side of the bearing [mm]
b	=	Longer side of the bearing [mm]
t	=	Bearing thickness [mm]
α_{bd}	=	Angular rotation around the axis parallel to the bearing side b [‰]
α_{ad}	=	Angular rotation around the axis parallel to the bearing side a [‰]
c	=	Mainly loaded bearing side of a rectangular bearing [mm]
η_2	=	Aspect ratio coefficient

b/a	η_2
1	0,208
1,5	0,231
2	0,246
3	0,267
4	0,282
6	0,299
8	0,307
10	0,313
∞	0,333

Table 1:
η_2 as a function of the aspect ratio b/a as a table of values
(Intermediate values may be interpolated linearly)

$$f_{tRd} = \frac{R_{\perp d}}{\eta_2} \cdot \frac{t}{a}$$

f_{tRd} is the calculated value of the internal resistance of the bearing and is used to calculate the permissible compressive stress $\sigma_{z,Rd}$

	Shape factor range S (S, $S_{borehole}$ or S_{mod})	Function for determining the design value of the load-bearing capacity $R_{\perp d}$ [N/mm²]
Point and strip bearings	0.83 – 2.33	$R_{\perp d}$ = 5.3805 · S - 0.6536
	2.33 – 2.50	$R_{\perp d}$ = 10.635 · S - 12.89
	2.50 – 5.00	$R_{\perp d}$ = 8.4004 · S - 7.3293
	≥ 5.00	$R_{\perp d}$ = 34.7

Table 2:
$R_{\perp d}$ = Rated value of the associated load-bearing capacity of the bearing [N/mm²] perpendicular to the bearing plane as a function of the shape factor S at a compression ε = 40 %.

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General information and calculation basis

Initial assumptions

$F_{z,max,d}$	=	185	kN
f_{tRd}	=	Formula	N/mm²
a	=	130	mm
b	=	150	mm
t	=	15	mm
G	=	1.2	N/mm²
$\alpha_{Statics}$	=	5.2	‰
$\alpha_{Obliqueness}$	=	10	‰
$\alpha_{Unevenness}$	=	4.8	‰
$\alpha_{bd\ total}$	=	20	‰
η_2	=	0.215	

In this calculation example, a rotation around the axis parallel to the bearing side b (α_{bd}) is calculated. The bearing has no holes.

Calculation wax

$$S = \frac{130 \cdot 150}{2 \cdot 15 \cdot (130+150)} = \mathbf{2.32}$$

$$R_{\perp d} = 5.3805 \cdot S - 0.6536 = 17.17 \cdot 2.32 - 0.6536 = \mathbf{11.83\ N/mm^2}$$

$$f_{tRd} = \frac{11.83}{0.215} \cdot \frac{15}{130} = 6.35\ \mathrm{N/mm^2}$$

$$\sigma_{z,Rd} = \left[6.35 - 0.02 \cdot \frac{1.2}{2} \cdot \left(\frac{130}{15}\right)^2 - 0 \cdot \frac{1.2}{2} \cdot \left(\frac{150}{15}\right)^2\right] \cdot \frac{130}{15} \cdot 0.215 = \mathbf{10.15\ N/mm^2}$$

$$\sigma_{z,m} = \frac{185.000}{130 \cdot 150} = \mathbf{9.49\ N/mm^2}$$

$$\sigma_{z,Rd} = \mathbf{10.14\ N/mm^2} \geq \sigma_m = \mathbf{9.49\ N/mm^2} > \textbf{Proof provided!}$$

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- The environmental influences must be checked with regard to possible damage to the bearings.
- Elastomer bearings and bearing surfaces must be free of dirt. Loose particles are not permitted.
- The bearing surfaces must be free of ice and snow, grease, solvents, oils or release agents. This must be ensured by suitable measures.
- The bearing surfaces must be carefully deburred to protect the bearing.
- The alignment of the bearing surfaces must be checked. If necessary, the support surfaces must be reworked to bring them into the planned condition.
- The alignment of the bearing surfaces must be checked. If necessary, the support surfaces must be reworked to bring them into the planned condition.
- Individual surface imperfections must not exceed 100 mm² and must not deviate from the surrounding surface by more than 2.5 mm in depth. The total area of the surface imperfections must not exceed 10 %.
- The bearing areas must be designed in accordance with the design-specific technical specifications and standards. Generally, edge distances must be provided. The elastomeric bearing should always be located within the reinforcement, even after expansion due to compressive stress.
- When using the bearings on steel contact surfaces, the steel surfaces should be at least 25 mm larger all round than the bearing.
- If the elastomeric bearings are tamped underneath, particular attention must be paid to the quality of the mortar. Elastomeric bearings must not be overloaded at certain points. The load of the structure to be supported by the bearings must not be applied directly to the bearing solely via wedges, unless a sufficiently rigid steel plate is interposed to distribute the load. The wedges must be removed again once the padding material has hardened.
- The lateral surfaces of the bearings must not be hindered in their planned deformation.
- Each component must be separated horizontally and vertically from the neighbouring components by joints in such a way that the intended support (statics) can be effective. It should be noted that joint fillings, e.g. joint compounds, foam profiles or mineral wool or foam panels, can impair the deformability. In the case of in-situ concrete, proper production of the bed joint must be ensured.
- In the case of horizontally movable components, it must be checked whether fixed points or fixed zones must be arranged to determine the zero point of movement of the component to be stored. It should be noted that unintended fixed points can have a detrimental effect on component storage.
- The arrangement of several storage units on top of each other (stacking) is not permitted.

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