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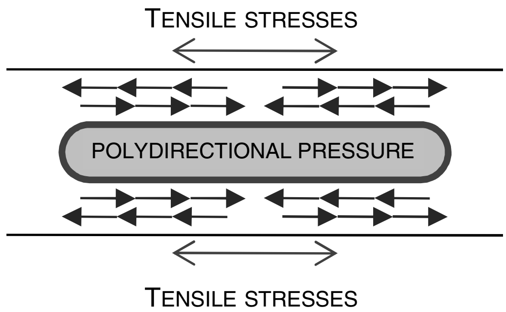
ESZ pyramid bearing

Unreinforced profiled elastomer bearing
with general supervisory approval

Load perpendicular to the plane of the bearing:
INFORMATION ABOUT TRANSVERSE TENSILE FORCES IN THE BEARING JOINT

The ESZ pyramid bearing is practically incompressible.
Hence, it follows that the pyramid bearing expands transversely to the compressive load while the volume remains constant. The bearing is hindered in this transverse expansion to a greater or lesser degree by the adjacent structural elements. (Surface friction). If the adjacent surfaces now prevent the lateral expansion of the elastomer, this must inevitably result in shear stresses in the joint, which leads to tensile stresses in the adjacent material and to compressive stresses in the rubber.
These so-called adhesive tensile stresses in the adjacent material are unwanted. They become larger with increasing elastomer thickness and must not be confused with splitting tensile stresses, which only take effect at a certain depth and occur with all forms of partial area loading. The reinforcement for the transverse tensile forces in reinforced concrete elements is to be arranged as close as possible to the bearing. Attention must still be paid to concrete coverage, however.



CALCULATION OF THE TRANSVERSE TENSILE FORCES IN THE BEARING JOINT

Bearing class 2 according to DIN 4141-3:

For simplicity's sake we assume here that the supporting force is transmitted into the adjacent structural elements distributed to a 0.3xa deep strip at the exterior edge of the bearing. The transverse tensile force resulting from the lateral expansion of the elastomer may be calculated as follows:

$$Zq = 1{,}5 \times F \times t \times a \times 10^{-5}$$

with a and t in [mm]
[DIN 4141-15 5.3 (2)].

The transversely-directed tensile forces Z_q thus determined must be verified in the adjacent structural elements: e.g. through appropriate reinforcement in the case of reinforced concrete.

Design example:

The determination is as follows for an ESZ pyramid bearing with dimensions of 150x150x10 mm and with an applied load of 8.9 N/mm²:

F= 200 kN
a= 150 mm
t_b= 7 mm (reduced calculatory thickness, see general supervisory approval)

$$Zq = 1{,}5 \times 200kN \times 7mm \times 150 \times 10^{-5}$$

$$Zq = 3{,}15\ kN$$

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CALCULATION OF THE TRANSVERSE TENSILE FORCES IN THE BEARING JOINT

Bearing class 1 according to DIN 4141-3:

When using the ESZ pyramid bearing as an elastomer bearing for bearing class 1, the transverse tensile force may be determined with the help of the data in issue 339 of the DAfStB in accordance with DIN 4141-15 5.3. In deviation from the calculation of the transverse tensile forces in the case of bearing class 2, the forces here are strongly dependent on the bearing thickness t, the form factor S_o and the bearing tilt a. The values determined through tests produced the following curves.

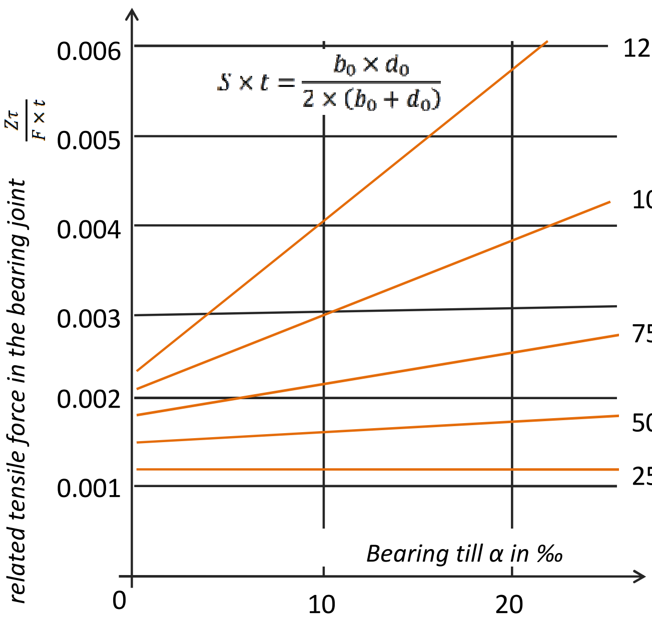

FIG. 38: [ISSUE 339 DAFSTB] DEPENDENCE OF THE RELATED TENSILE FORCE IN THE BEARING JOINT ON THE BEARING TILT α, THE FORM FACTOR S AND THE BEARING THICKNESS t.

Since the tests resulted in a linear dependence on the bearing thickness t, the transverse tensile force was related to F **and** t.

Design example:

The determination is as follows for an ESZ pyramid bearing with dimensions of 150x150x10 mm, an applied load of 8.9 N/mm² and a twist of 20.0 ‰:

F= 200 kN

a= 150 mm = b_0
b= 150 mm = d_0
t_b= 7 mm
a= 20‰

Coefficient according to issue 339 DAfStB:

$$S \times t = \frac{b_0 \times d_0}{2 \times (b_0 + d_0)}$$

$$S \times t = \frac{150 \times 150}{2 \times (150 + 150)} = \mathbf{37,5}$$

FIG. 38: where α= 20 ‰ and 37.5

$$\frac{Z\tau}{F \times t} = 0{,}00145 \frac{1}{mm}$$

The transverse tensile stress in the bearing joint thus equates to:

$$Z\tau = F \times t \times \frac{Z\tau}{F \times t}$$

$$Z\tau = F \times t \times \frac{Z\tau}{F \times t} = 200kN \times 7mm \times 0{,}00145 \frac{1}{mm}$$

$$Z\tau = 2{,}03\ kN$$