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ESZ Type 200

Unreinforced elastomer bearing with general supervisory approval

CALCULATION EXAMPLE

PRINCIPLES

According to TOPALOFF's linear-elastic theory, the calculatory shear stress (t) belonging to the average bearing compression and the total bearing torsion is limited. Corresponding values can be found in the approval for the ESZ type 200. The shear stresses from the vertical compression (1) and the torsion (2) are overlaid. The h_2 values depend of the aspect ratio b/a. The linear interpolation of intermediate values is allowed. The bearing side a is always the shorter of the bearing sides.

$$\max \tau = \frac{\sigma_m \cdot t}{\eta_2 \cdot a} \quad (1)$$

$$\max \tau = \alpha \cdot G \cdot 0{,}5 \cdot \left(\frac{a}{t}\right)^2 \quad (2)$$

$$\Rightarrow \max \sigma_m = \left(\max \tau - \alpha \cdot \frac{G}{2} \cdot \left(\frac{a}{t}\right)^2 \right) \cdot \frac{a}{t} \cdot \eta_2 \quad (3)$$

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

Equations (1), (2), (3) and table from Beton Kalender (Concrete Calendar) 1995 p. 712 or Lager im Bauwesen 2. Auflage (Bearings in the Construction Industry 2nd Edition) p. 208/210 [Eggert, Kauschke]

NUMERICAL EXAMPLE

- Verification of the permissible bearing stress $\sigma_{perm,m}$

The following boundary conditions are given:
(Calculation for characteristic values)
Bearing side: a= 120 mm
Bearing side: b= 150 mm
Bearing thickness: t= 15 mm
Torsion from statics: α= 6 ‰ (here over b= 150 mm)
Torsion from standard specification 10 ‰

Total torsion angle: α= 16 ‰ ≙ 0,016

b/a = 1.25 Þ h_2= 0.2195 (interpolated from table)
Shear modulus G= 1.5 N/mm² (from approval)
Shear stress t_{perm}= 7.5 N/mm² (from approval)
Bearing area A= 18000 mm²
G_k= 100 kN & Q_k= 60 kN Þ bearing class 1
$F_{z,max}$= 160 kN
σ_{exist} = 8.89 N/mm²

Insert all values into equation (3):

$$\max \sigma_m = \left(7{,}5 - 0{,}016 \cdot \left(\frac{1{,}5}{2}\right) \cdot \left(\frac{150}{15}\right)^2 \right) \cdot \frac{120}{15} \cdot 0{,}2195 \overset{!}{\geq} \frac{F_{z,max}}{A}$$

$$\max \sigma_m = 11{,}06 N/mm^2 \overset{!}{\geq} 8{,}89 N/mm^2$$

The permissible surface compression of 11.06 N/mm² for the type 200 is larger than the existing compression of 8.89 N/mm²; verification is therefore provided.
An ESZ type 200 with the dimensions 120x150x15 mm can be used with a total torsion of 16 ‰ with a characteristic applied load of 160 kN.