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.

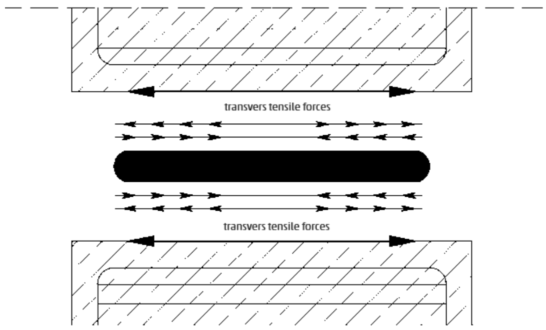

Fig.1 : Representation of the transverse tensile

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.

Weilerhöfe 1
41564 Kaarst-Büttgen
Phone: +49 2131 75 81 00
Fax: +49 2131 75 81 11
info@esz-becker.de

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

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

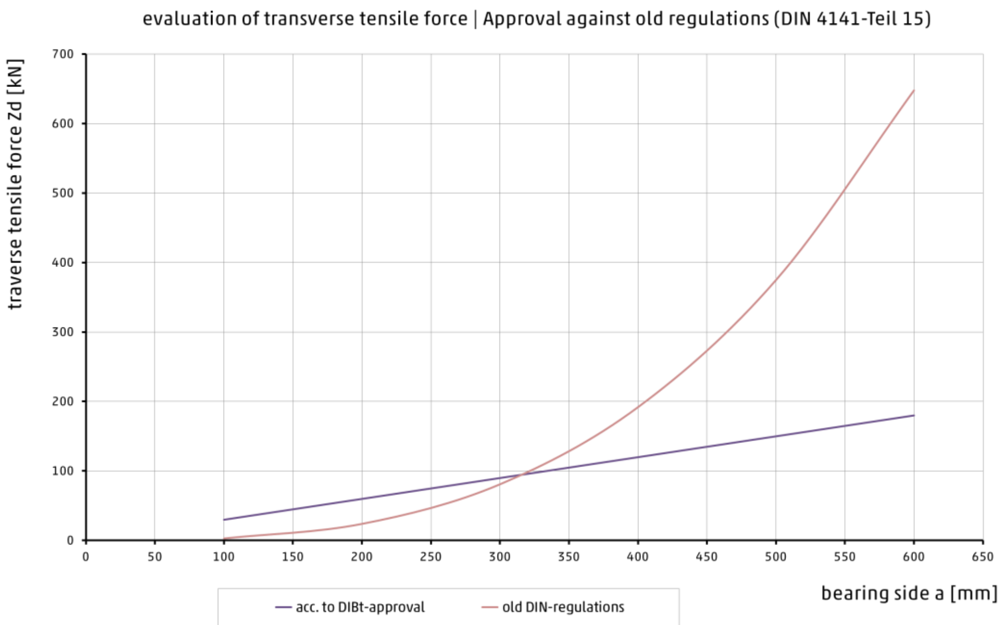
Calculation of transverse tensile forces according to DIBt approval

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

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]
$F_{z,max,d}$	=	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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