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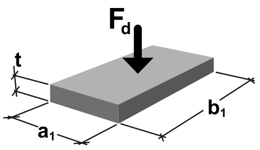
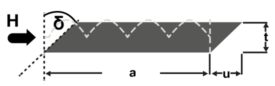
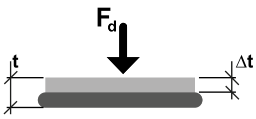
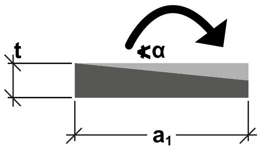
# bi-Trapez Bearing®

Structural bearing for static structural members and impact sound insulation

## Design values

The bearings are dimensioned according to the national technical approval up to a compressive stress $\sigma_{R,d} = 17{,}4\,N/mm^2$.
The design concept is based on the shape factor. Holes, cut-outs and the required edge distances must be taken into account according to DIN EN 1992.

### TYPE OF LOAD ACTING

| Design value of bearing resistance | All. shear deformation | Deflection | Allowable rotation |
|---|---|---|---|
|  |  |  |  |
| **FORMULA** | | | |
| $\sigma_{R,d} =$<br>$1{,}095 \times S^{1{,}543} \leq 17{,}4$ [N/mm²]<br><br>Shape factor S see page 2 | Thickness t<br>$t = 10$ mm: all. $u = 4$ mm<br>$t = 15$ mm: all. $u = 5{,}5$ mm<br>$t = 20$ mm: all. $u = 8$ mm<br><br>Horizontal force $H_d$ =<br>$c_{s(t)} \cdot u \cdot A_E / 20000$ [kN]<br><br>A minimum compressive stress of 1 N/mm² is required to prevent the bearing from slipping.<br><br>$c_{s(t)}$ values and boundary conditions, see page 5 | see page 4 | Thickness t<br>$t = 10$ mm:<br>all. $\alpha = 3000/a_1$ [‰]<br>$t = 15$ mm:<br>all. $\alpha = 5000/a_1$ [‰]<br>$t = 20$ mm:<br>all. $\alpha = 6500/a_1$ [‰]<br>(Rectangular bearing)<br><br>Additional rotation acc. to technical approval:<br>• 10 ‰ from obliquity<br>• $\frac{625}{a_1}$ from unevenness<br><br>see also booklet 600, DAfStb |

### LEGEND FORMULA SYMBOLS

| | |
|---|---|
| $F_d$ | Vertical force |
| $H_d$ | Horizontal force |
| $A_E$ | Bearing area |
| $S$ | Shape factor, Ratio of pressed bearing surface $A_E$ to unloaded lateral surface |
| $a_1$ | Short side of bearing |
| $b_1$ | Long side of bearing |
| $a$ | Component width |
| $b$ | Component length |
| $\sigma_{R,d}$ | Design value of the load capacity |
| $\sigma_{E,d}$ | Design compressive stress from load |
| $\alpha$ | Bearing rotation |
| $c_{s(t)}$ | Shear stiffness |
| $u$ | Shear deformation of the bearing |
| $t$ | Thickness of bearing |
| $\Delta t$ | Bearing deflection |

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# Design of the shape factor

For the design of unreinforced elastomeric bearings, the shape factor S is defined as the ratio of the compressed to the freely deformable surface. The shape factor S is used to calculate the permissible compressive stress as a function of the bearing dimensions.

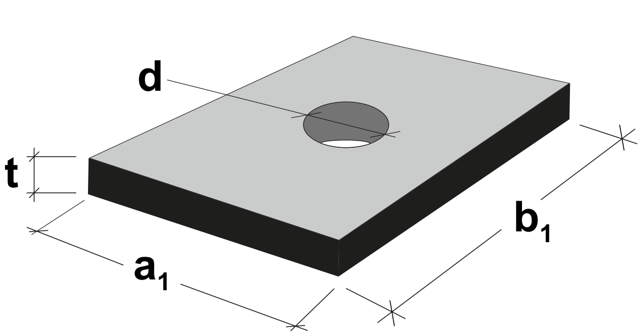
### SHAPE FACTOR FOR RECTANGULAR BEARING

Without drilled holes

$$S = \frac{b_1 \cdot a_1}{2 \cdot t\,(b_1 + a_1)}$$

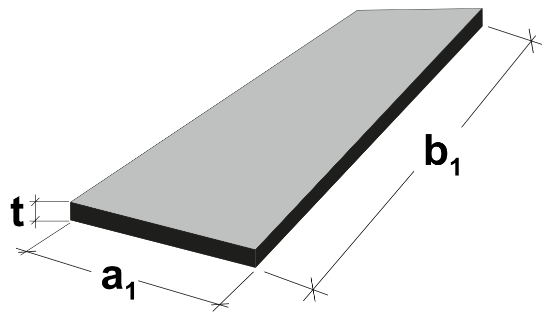
With drilled holes, $n \leq 2$

$$S = \frac{a \cdot b - \frac{\pi}{4} n \cdot d^2}{2 \cdot t\,(a + b) + t \cdot \pi \cdot n \cdot d}$$




### SHAPE FACTOR FOR BEARING STRIP

$$S = \frac{a_1}{2 \cdot t} \qquad b_1 >> a_1$$



# bi-Trapez Bearing®

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## Thickness: 10 mm

The following tables show the design value of the load capacity and the allowable angle of distortion as a function of the bearing dimensions. Intermediate values may be interpolated.

| BEARING | | | DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [mm] | α [‰] | [mm] | BEARING LENGTH [mm] | | | | | | | | | | | | | | | | | | |
| Thick-ness | all. rotation | Width | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 | 450 | 500 |
| 10 | 40 | 50 | – | – | – | 2,4 | 2,5 | 2,6 | 2,7 | 2,8 | 2,9 | 3,1 | 3,2 | 3,3 | 3,4 | 3,5 | 3,5 | 3,7 | 3,8 | 3,8 | 3,9 |
| | 30 | 100 | 3,3 | 3,8 | 4,1 | 4,5 | 4,8 | 5,1 | 5,4 | 5,7 | 6,0 | 6,5 | 7,0 | 7,4 | 7,8 | 8,1 | 8,4 | 8,9 | 9,3 | 9,6 | 9,9 |
| | 20 | 150 | 4,2 | 4,8 | 5,4 | 6,0 | 6,5 | 7,0 | 7,5 | 8,0 | 8,4 | 9,4 | 10,3 | 11,2 | 11,9 | 12,5 | 13,1 | 14,1 | 15,0 | 15,7 | 16,4 |
| | 15 | 200 | 4,8 | 5,5 | 6,3 | 7,0 | 7,7 | 8,4 | 9,1 | 9,7 | 10,3 | 11,8 | 13,1 | 14,3 | 15,4 | 16,5 | 17,4 | 17,4 | 17,4 | 17,4 | 17,4 |

## Thickness: 15 mm

| BEARING | | | DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²] | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [mm] | α [‰] | [mm] | LBEARING LENGTH [mm] | | | | | | | | | | | | | | | | | | |
| Thick-ness | all. rotation | Width | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 | 450 | 500 |
| 15 | 40 | 50 | – | – | – | 1,3 | 1,4 | 1,4 | 1,5 | 1,5 | 1,5 | 1,6 | 1,7 | 1,8 | 1,8 | 1,9 | 1,9 | 2,0 | 2,0 | 2,0 | 2,1 |
| | 40 | 100 | 1,9 | 2,0 | 2,2 | 2,4 | 2,6 | 2,8 | 2,9 | 3,1 | 3,2 | 3,5 | 3,8 | 4,0 | 4,2 | 4,3 | 4,5 | 4,8 | 5,0 | 5,1 | 5,3 |
| | 33,3 | 150 | 2,4 | 2,6 | 2,9 | 3,2 | 3,5 | 3,8 | 4,0 | 4,3 | 4,5 | 5,0 | 5,5 | 6,0 | 6,4 | 6,7 | 7,0 | 7,6 | 8,0 | 8,4 | 8,8 |
| | 25 | 200 | 2,8 | 3,0 | 3,4 | 3,8 | 4,1 | 4,5 | 4,9 | 5,2 | 5,5 | 6,3 | 7,0 | 7,7 | 8,3 | 8,8 | 9,3 | 10,2 | 10,9 | 11,6 | 12,2 |

## Thickness: 20 mm

| BEARING | | | DESIGN VALUE OF THE LOAD CAPACITY, $\sigma_{R,d}$ [N/mm²] | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [mm] | α [‰] | [mm] | BEARING LENGTH [mm] | | | | | | | | | | | | | | | |
| Thick-ness | all. rotation | Width | 100 | 110 | 120 | 130 | 140 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 350 | 400 | 450 | 500 |
| 20 | 40 | 100 | 1,5 | 1,7 | 1,8 | 1,9 | 2,0 | 2,0 | 2,2 | 2,4 | 2,6 | 2,7 | 2,8 | 2,9 | 3,1 | 3,2 | 3,3 | 3,4 |
| | 32,5 | 200 | 2,4 | 2,7 | 2,9 | 3,1 | 3,3 | 3,5 | 4,0 | 4,5 | 4,9 | 5,3 | 5,6 | 6,0 | 6,5 | 7,0 | 7,4 | 7,8 |

| STRIP BEARINGS | | | | | | |
|---|---|---|---|---|---|---|
| BEARING WIDTH | BI-TRAPEZ BEARING® | | | | | |
| $a_1$ | BEARING THICKNESSES | | | | | |
| | 10 mm | | 15 mm | | 20 mm | |
| | $F_{R,d}$ | α | $F_{R,d}$ | α | $F_{R,d}$ | α |
| [mm] | [kN/m] | [‰] | [kN/m] | [‰] | [kN/m] | [‰] |
| 50 | 225 | 40 | 120 | 40 | – | – |
| 100 | 1312 | 30 | 702 | 40 | 450 | 40 |
| 150 | 2610 | 20 | 1968 | 33,3 | – | – |
| 200 | 3480 | 15 | 3480 | 25 | 2624 | 32,5 |

# bi-Trapez Bearing®

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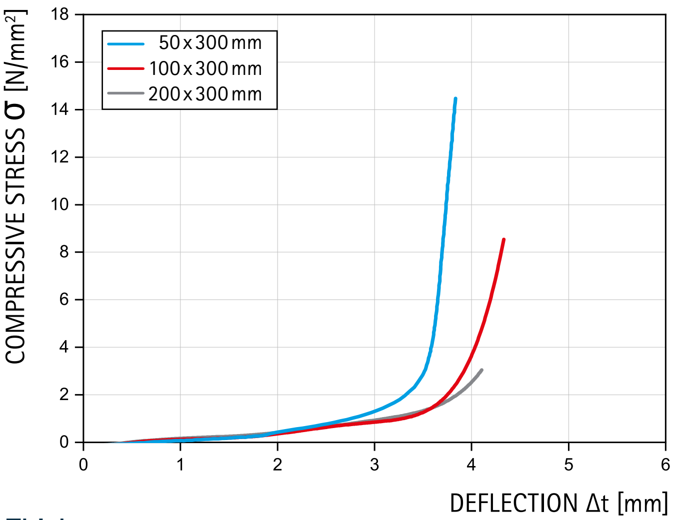
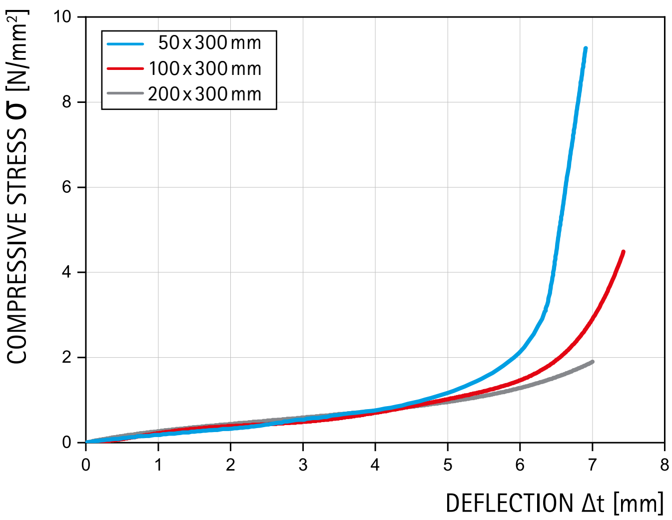
## Load deflection curves

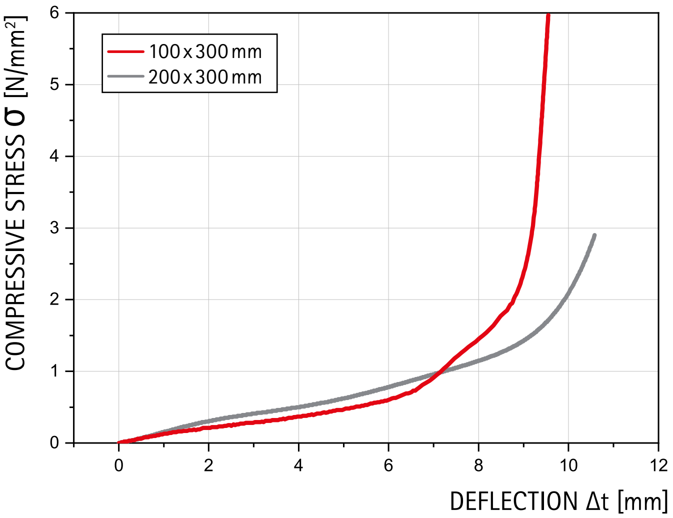
### Thickness 10 mm




### Thickness 15 mm

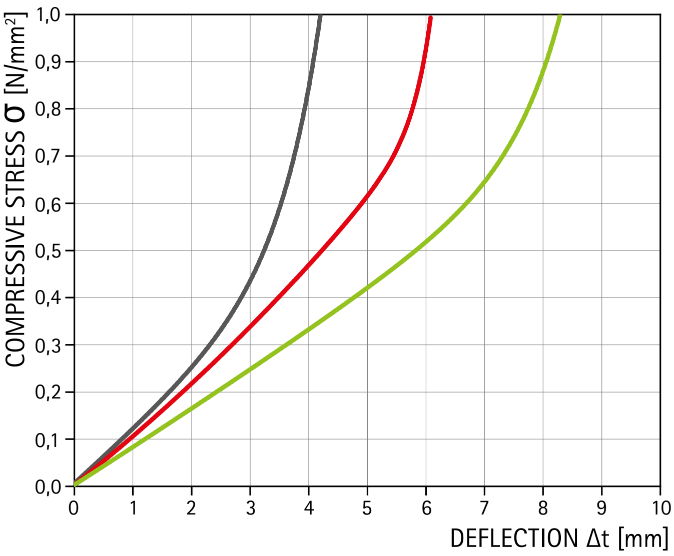



### Thickness 20 mm




Load deflection curve up to the design value of load capacity acc. to the approval for a bearing of this type with high shape factor.

### Load deflection curve for different bearing thicknesses




Bearing deflection in the lower, acoustically relevant compressive stress range, orientation diagram

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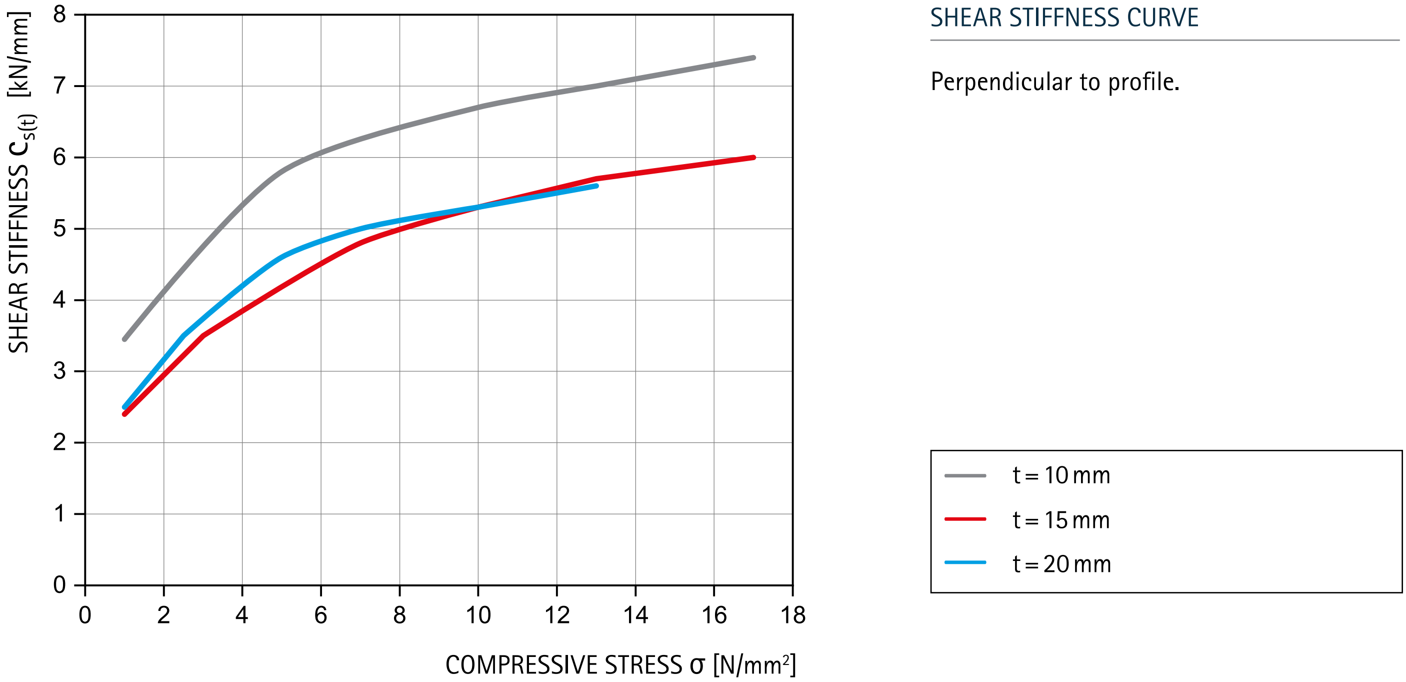
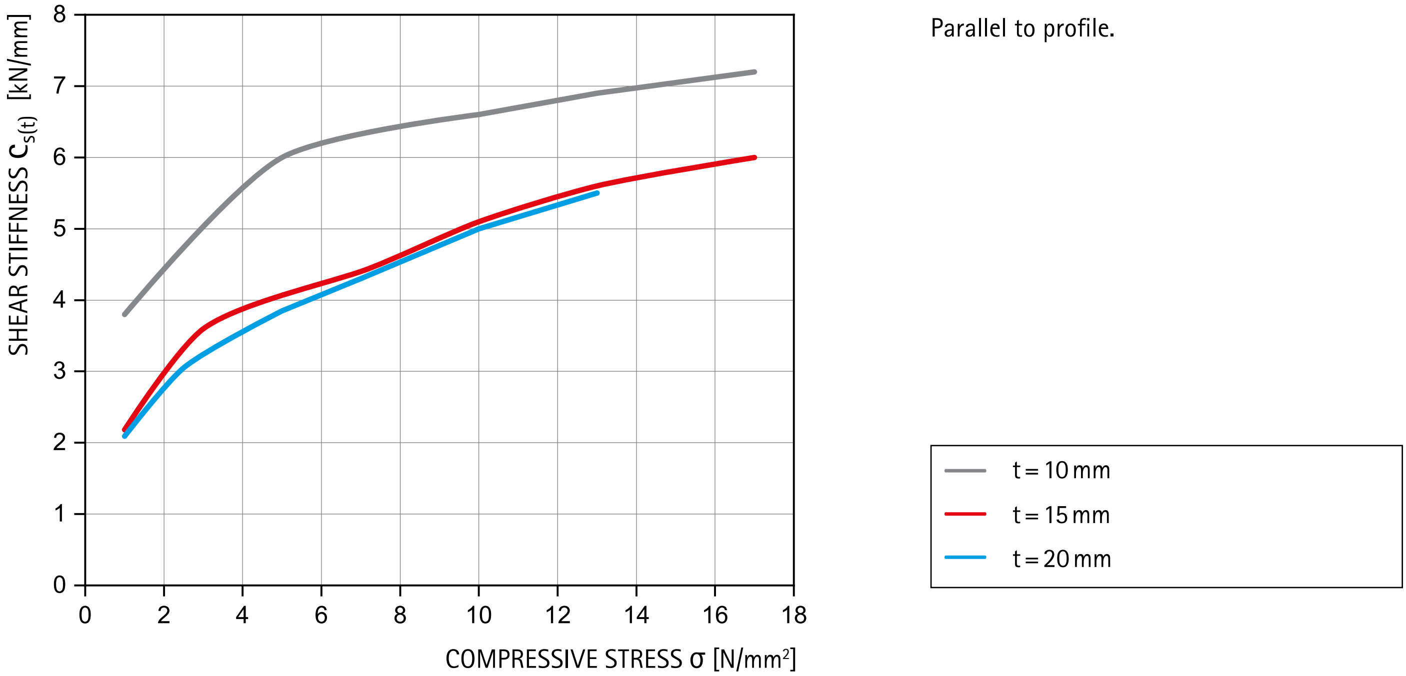
## Shear stiffness

### SHEAR STIFFNESS CURVE

Perpendicular to profile.




Parallel to profile.



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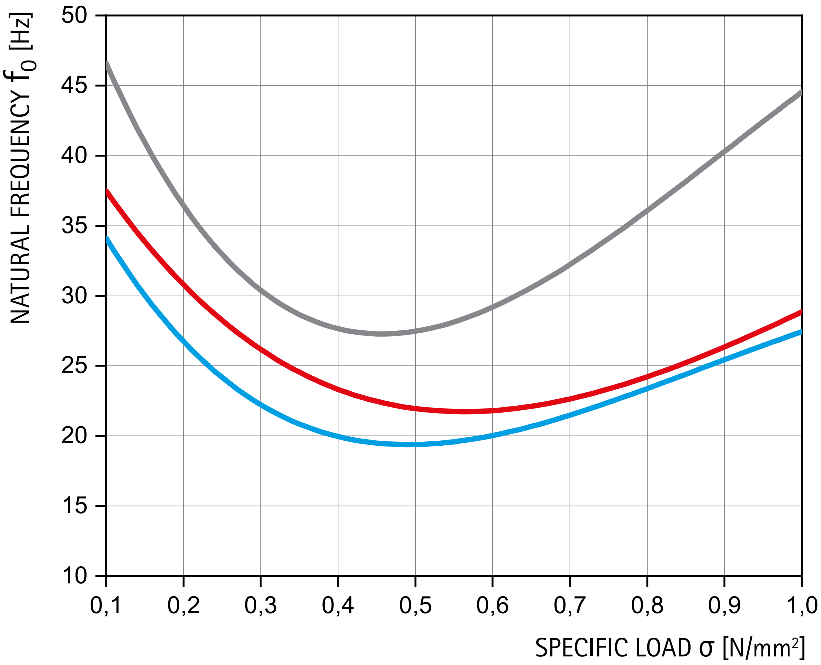
| BI-TRAPEZ BEARING® IMPACT SOUND STOP FOR USE IN STAIRWAY CONSTRUCTION | | | | | |
|---|---|---|---|---|---|
| Bearing thickness [mm] | Bearing width [mm] | Eff. vertical load (charact. values) [kN/m] | Impact sound mitigation (as per DIN 52210-4) in the compressive stress range between 0.3 and 0.7 N/mm² (charact. values) [dB] | Insulation effect [%] | Deflection [mm] |
| 10 | 50 | 15-35 | 23 | 87 | 2,3 - 2,8 |
| | 100 | 30-70 | 23 | 87 | 2,3 - 2,8 |
| 15 | 50 | 15-35 | 27 | 91 | 2,8 - 5,5 |
| | 100 | 30-70 | 27 | 91 | 2,8 - 5,5 |
| 20 | 100 | 30-70 | 28 | 93 | 3,8 - 7,4 |

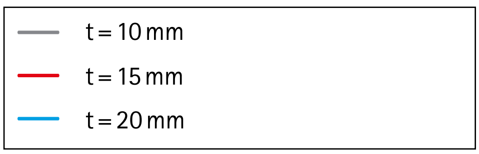
bi-Trapez Bearing® can be used as strip or rectangular bearing for impact sound insulation in stairs. The table shows the compressive stress range for the application as well as the impact sound improvement factor according to DIN 52210-4.

## Natural Frequency




### NATURAL FREQUENCY CURVE

The figure shows the natural frequency of a single-degree-oscillator with bi-Trapez Bearing® as an elastic bearing for an excitation with a velocity amplitude between 0,1 and 1,0 N/mm².
In this range, bi-Trapezlager® is suitable for the impact sound and structure-borne noise insulation due to its soft spring characteristics.



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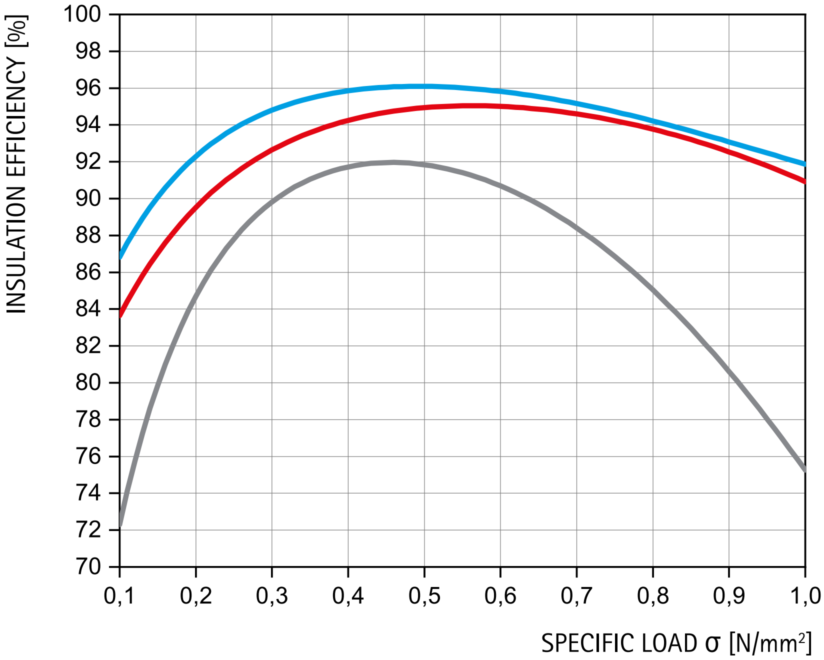
## Insulation efficiency

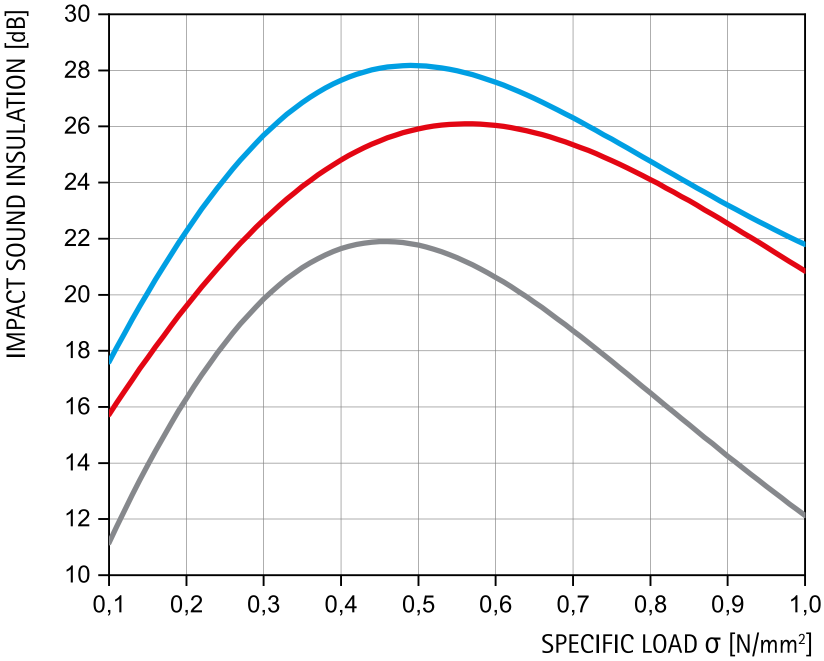



### DIAGRAM

The two diagrams show the possible effect of bi-Trapez Bearing® when used for the insulation of structure-borne noise. Decisive for the structure-borne sound insulation is the ratio of the occurring excitation frequency to the natural frequency shown above. The larger this is, the better the insulation. As can be seen in the diagrams, an insulation effect of over 90 % is possible even with an excitation frequency of 100 Hz. This corresponds to an impact sound insulation of 20 dB. Excitation frequencies above 100 Hz are shielded to an even higher degree.

| | |
|---|---|
| grey line | t = 10 mm |
| red line | t = 15 mm |
| blue line | t = 20 mm |

## Impact sound insulation




| | |
|---|---|
| grey line | t = 10 mm |
| red line | t = 15 mm |
| blue line | t = 20 mm |





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