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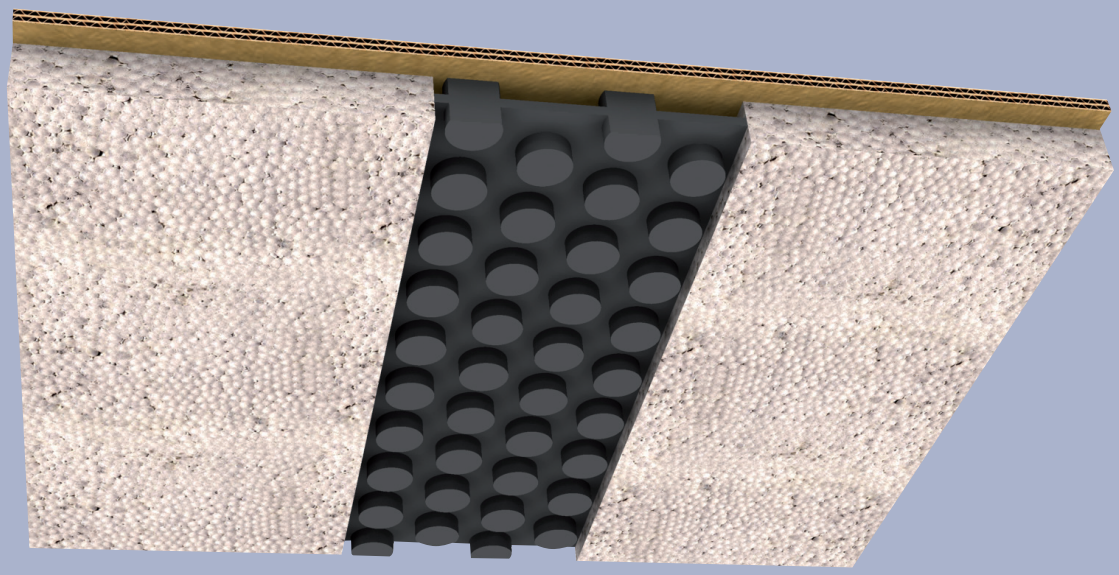
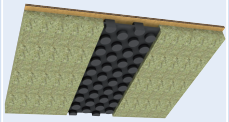
CIGULAR®-SLAB BEARING





Elastomeric flexible bearing – with low shear resistance

No maintenance and lubricants needed, highly ageing resistant

planmäßig elastisch lagern

Product Description

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Product Description

The Calenberg Cigular®-Slab Bearing is a thermally insulated, permanently elastic element with shear deformation properties that has been developed for the bearing of reinforced concrete slabs on load bearing structures according to DIN 18 530.
It consists of a studded elastomeric mat with cylindrical compression elements which at half height are connected by an elastic membrane. In order to comply with the requirements of the fire resistance class F90 or F120 according to DIN 4102 part 2, the Cigular®-Slab Bearing has to be encased by a Ciflamon fire-proofing plate according to the fire safety assessment no. 3799/7357-AR-. If no fire protection is required the bearing is encased with polystyrene as standard. A strong card board top layer provides the bearing with the required stiffness. The butt joints are closed with adhesive tape.

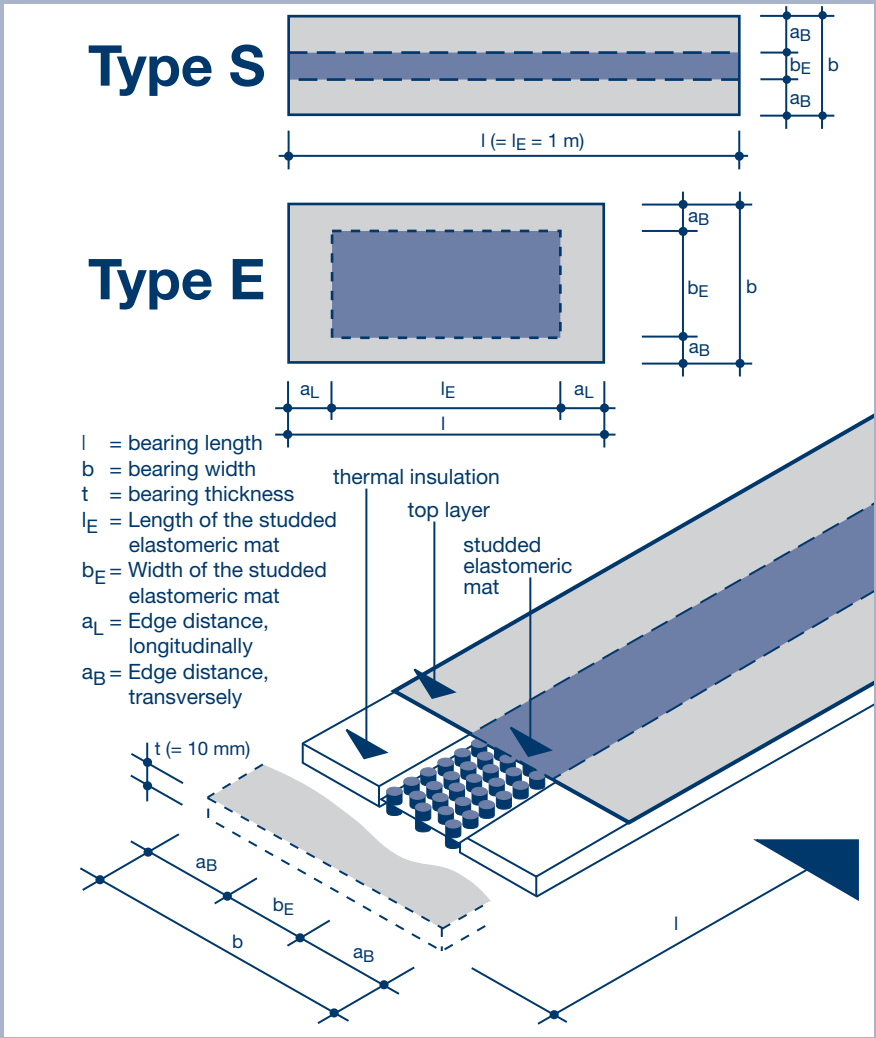


Figure 1: Product Components

Support for Reinforced Concrete Slabs

A concrete slab supported on brick walls or on reinforced concrete walls is inevitably continuously subject to load redistributions. These are caused by changes in length due to temperature variation, deflections, creep and shrinkage, but can also be caused by vibration.

Damage to concrete roof slabs is particularly noticeable if as a result of insufficient thermal insulation the slab deformation causes shear cracks due to considerable changes in length.

For years attempts were made to compensate shear deformations with as little constraint as possible i.e. low friction, relative movements between slab and wall. However, these were carried out with inadequate materials e.g. thin thermo-plastic sheets (anti-friction layers). No consideration was given to the fact that these movements cannot happen in a continuous, even, smooth and horizontal wall joint due to the geometrical shape of the supporting structural element.

It is very theoretical to assume such conditions; practically there do not exist such joints. Furthermore, thin layers of sheets are not suited to compensate uncontrollable load redistributions and increasing edge pressures which go together with slab deflections and hence prevent the danger of edge failure and chipping.

Only after a consequent investigation into the causes of the cracks and their behaviour with regard to building physics could the technical development of a permanently elastic “deformation joint“ be started. The stresses were put in relation to practical tests, parameters for an engineering design were determined and the exact load transfer was studied.

Since 1976 Calenberg Cigular®-Slab Bearing effectively prevents structural defects in many different structures and buildings.

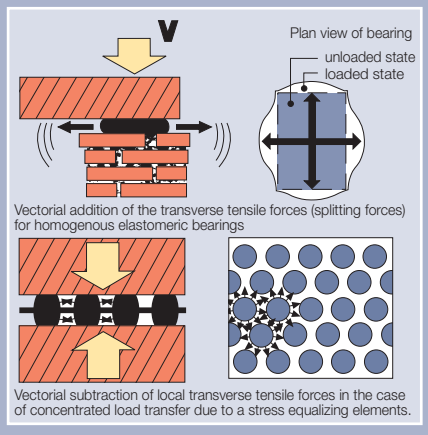


Figure 2: Effect of transverse tensile forces

above: Homogenous unreinforced elastomeric bearing
below: Elastomeric element of Cigular®-Slab Bearings

Design Examples

Example 1:

Line load: $q_{V,actual}$ = 65 kN/m

Expected horizontal displacement of bearing: Δl = 8 mm

Selected elastomer width according to design chart 1: b_E = 60 mm

Design check for line load:
$q_{V,allow}$ = 67 kN/m > $q_{V,actual}$ = 65 kN/m

Ratio of horizontal force to vertical force according to Figure 5: H/V = 0.39

Horizontal restoring force:
$q_{H,actual} = 0.39 \cdot q_{V,actual} = 0.39 \cdot 65$ kN/m = 25.35 kN/m

Example 2:

Line load: $q_{V,actual}$ = 28 kN/m

Expected horizontal displacement of bearing: Δl = 5 mm

Selected elastomer width according to design chart 1: b_E= 35 mm

Design check for line load:
$q_{V,allow}$ = 39 kN/m > $q_{V,actual}$ = 28 kN/m

Ratio of horizontal force to vertical force according to Figure 5: H/V = 0.35

Horizontal restoring force:
$q_{H,actual} = 0.35 \cdot q_{V,actual} = 0.35 \cdot 28$ kN/m = 9.80 kN/m

Design

Design Chart 1

Design of Bearings

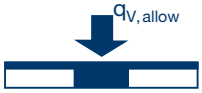
In design chart 1 the allowable stresses are given for strip support applications i.e. **Bearing Type S** for a standard length of 1m.

For point support applications i.e. **Bearing Type E**, which is mainly used for the support of slabs on short wall elements, for instance brick piers, the required area of the bearing can be determined from design chart 2.

Cigular®-Slab Bearing applies:

- Supporting permanent vertical loads; strip or point support.
- Supporting loads due to constraints and short-term external loads (e. g. wind).
- Supporting rotations due to elastic deflections and plastic deformations of the structural members as well as non-plane and skew support areas.

Cigular®-Slab Bearing Type S

allowable vertical force  q_{allow} [kN/m]	Width of elastomeric flexible element  b_E [mm]	Allowable angle of rotation over b_E  α_{allow} [‰]
39	35	34.3
52	47	25.5
67	60	20.0
79	71	16.9
92	83	14.5
104	94	12.8
118	106	11.3
131	118	10.1
144	130	9.2
158	142	8.5
171	154	7.8
183	165	7.3
196	177	6.8
209	188	6.3
222	200	6.0

Allowable horizontal deformation in all directions

$u_{allow} = \pm 10$ mm

Horizontal force (restoring force due to horizontal deformation of bearing)	See Figure 5 and design examples
Bearing thickness	10 mm

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Cigular®-Slab Bearing Type E	
allowable compressive stress σ_{allow}	σ_{allow} = 1.11 N/mm²
allowable vertical force 	V_{allow} [kN] = 1.11; l_E [mm]; b_E [mm]
Area of elastomeric bearing required	$A_{E,\,requ} = l_E \_ b_E = V_{actual} / \sigma_{allow}$
Allowable angle of rotation over 	α_{allow} = 1200 / a [‰] a Area of bearing is perpendicular to axis of rotation l_E or b_E
Allowable horizontal deformation in all directions 	u_{allow} = ± 10 mm
Horizontal force (restoring force due to horizontal deformation of bearing)	See Figure 5 and design examples
Bearing thickness	10 mm
l_E, b_E, a, u in mm; α in ‰	

Text of Tender Document

Supply profiled, highly ageing resistant EPDM-spring element; ozone resistant up to 200 pphm; with casing, 10 mm thick, general building authority test certificate No. P-20040369

Type S / Type S – F 90/120

Bearing length l: 1 m
Bearing width b: ..... mm
Elastomer width b_E: ..... mm
Length: ..... m
Price: ..... €/m

Type E / Type E – F 90/120

Bearing length l: ..... mm
Bearing width b: ..... mm
Elastomer length l_E: ..... mm
Elastomer width b_E: ..... mm
Edge distance, transversely a_B: ..... mm
Edge distance, longitudinally a_L: ..... mm
Number: ..... items
Price: ..... €/items

Supplier:
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Design Chart 2

Characteristics

Characteristics

In contrast to standard sliding bearings where bearing components are subject to frictional movements Cigular®-Slab Bearings transmit movements of structural members by deformations of the flexible elastomeric material with low shear resistance (Figure 3). The bearing reacts spontaneously to horizontal forces with low shear resistance. The bearings work without slip agents or lubricants and are independent of temperature.

Practically, this means:

- The ratio H/V is zero when the horizontal movement starts (Figure 6). Static friction which in sliding bearings attributes to most of the shear resistance need not to be overcome.
- Load transfer with centric stress relieving effect to the adjacent structural members is ensured.
- The Cigular®-Slab Bearing can take shear deformations in any direction in particular in the case of dangerous slab deformations of supporting, load bearing members underneath (e.g. brick masonry) in longitudinal direction of the wall.
- Safety is not influenced by slightly non-parallel, uneven and rough contact areas of the support (wall/slab). The load bearing elastomeric elements elastically compensate small geometric imperfections and misalignments.
- Compressive stress, horizontal displacement and angular rotation can be calculated and verified.
- The joint between slab and wall is thermally insulated.
- Transverse tensile forces do not occur in adjacent structural members but they virtually cancel each other vectorially due to the individual action of single elements (Figure 2).
- The Cigular®-Spring Element offers excellent protection against vibration; penetration of structure-borne noise is largely prevented.

Types of Delivery

Calenberg Cigular®-Slab Bearing is cut according to strip or point support application into the required bearing elements (see Figure 1) and delivered. Type E bearings can be supplied with holes, cut-outs etc. such that bolts or dowels can be fed through.

Edge Distance

The minimum edge distance of the elastomeric elements to the outer edge of the structural member has to be 30 mm.

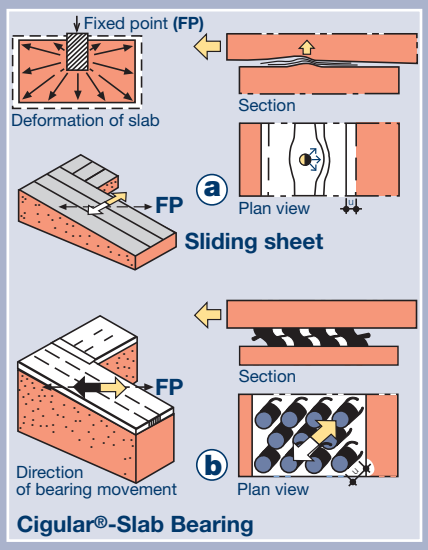

Figure 3: Functioning of a slip foil (a) and Cigular®-Slab Bearing (b).

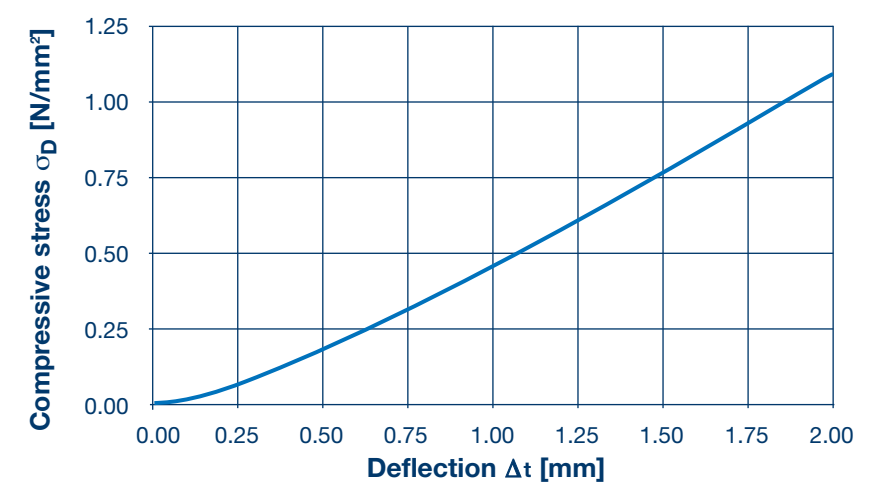

Figure 4: Compression deflection characteristics; concrete compression area; bearing width: 35 up to 200 mm

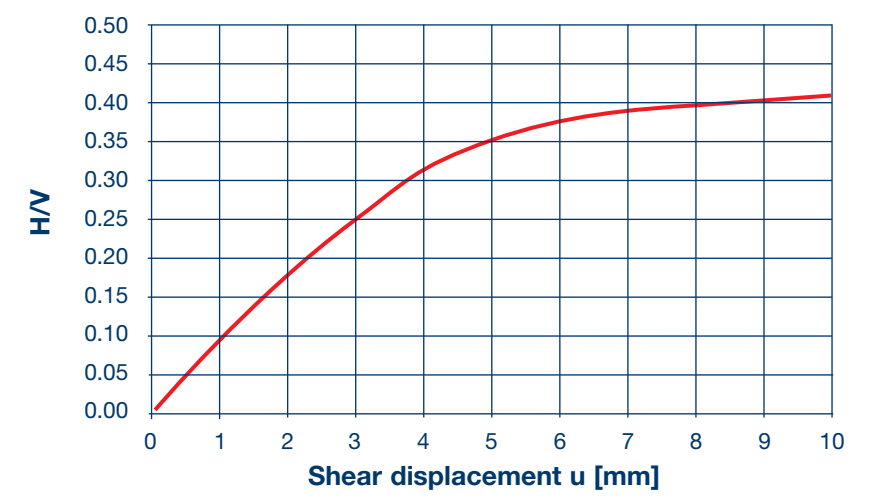

Figure 5: Ratio of horizontal to vertical force

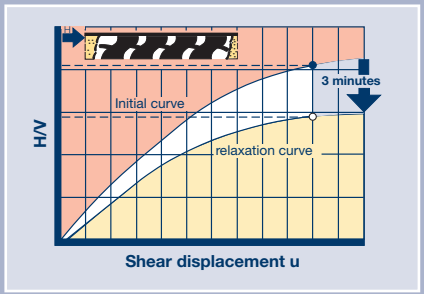

Figure 6: Shear resistance of Cigular®-Slab Bearing as a function of the shear displacement for a compressive stress of 1.11 N/mm²; schematic diagram

Installation of Bearing

Cigular®-Slab Bearing is butt jointed with the marked cardboard cover facing upwards and placed on the support area of the load bearing structure. The butt joint is covered by the strip which projects on the one side (Figure 7). The projecting strip has to be pressed onto the bearings which have been placed previously such that they are being closed during subsequent concreting and retain their functionality.

The support areas have to be smooth, plane, clean, dry and free of grease. Edges are to be removed, holes to be closed. In windy conditions lifting of the Cigular®-Slab Bearing has to be prevented.

Deflection

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Test Certificates

Test Certificates, Tests for Suitability

- Test certificate no. P-20040369: Compression and shear testing; Institute for Materials Science and Testing of the Technical University of Hanover, Accredited Testing Authority for Civil Engineering; January 2004

- Fire safety assessment no. 3799/7357-AR; assessment of Calenberg elastomeric bearings regarding classification into the fire resistance class F 90 or F 120 according to DIN 4102 part 2 (issued 9/1977); accredited Testing Authority for Civil Engineering at the Institute for Construction Materials, Reinforced Concrete Construction and Fire protection, Technical University Braunschweig; March 2005

- Research reports no. 2616/873, 2220/883-1, 2220/883-2: Measurement of natural frequency, structure-borne noise and impact sound insulation; Accredited Testing Authority for Civil Engineering, at the Institute for Materials, Reinforced Concrete Construction and Fire protection, Technical University Braunschweig; Oktober 1993.

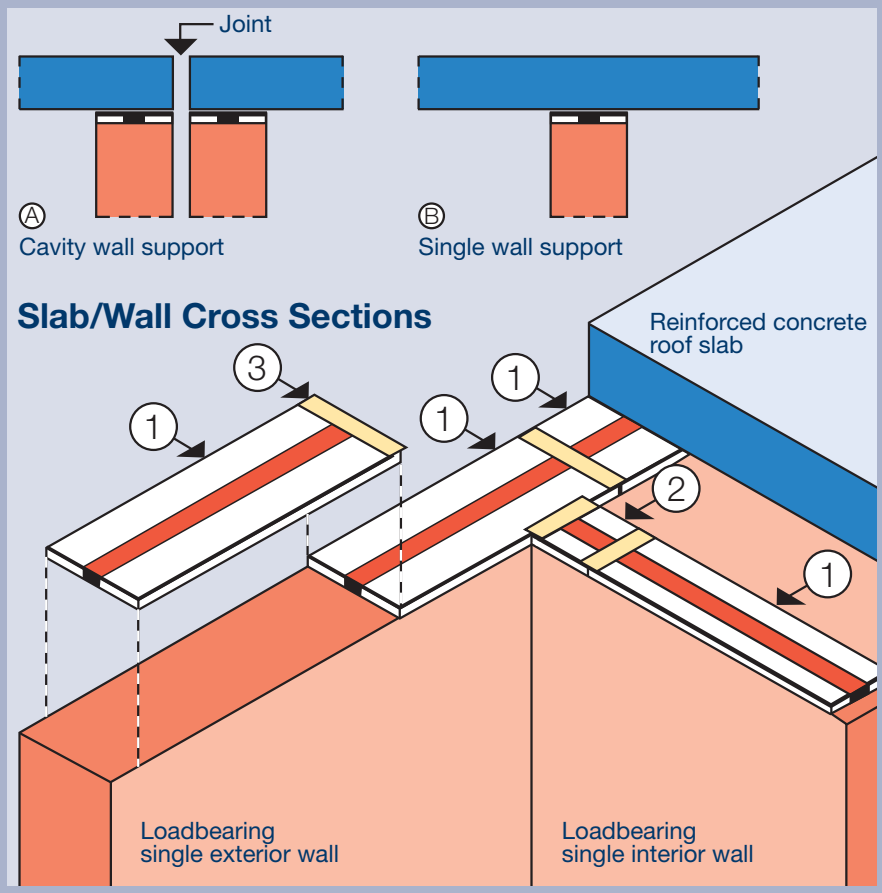

Figure 7: Installation of Cigular®-Slab Bearing
A) In the case of cavity walls, the slab (separated by the joint) has to be supported on either side of the joint; therefore, two bearing elements are required which have to be placed separately next to the joint.
B) Support of roof slabs on single walls, here with Cigular®-Slab Bearing, Type S.
1) Cigular®- Slab Bearing, Type S, standard length 1 m
2) Cigular®- Slab Bearing-special size, Type S; length to be cut on site according to special size.
3) Adhesive cover strip for butt joints; to be carefully pressed down after installation (butt joint seal)

Fire Behaviour

For all applications of elastomeric bearings which have to comply with fire protection requirements the fire safety assessment no. 3799/7357-AR- of the Technical University of Braunschweig applies. It specifies minimum dimensions and other measures in accordance with the specifications of DIN 4102-2, Brandverhalten von Baustoffen und Bauteilen (Fire behaviour of construction materials and components), 1977-09.

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