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DEUTSCHE NORM

September 1984

Structural bearings

Bearing systems for buildings

DIN 4141 Part 3

Lager im Bauwesen; Lagerung für Hochbauten

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

This standard has been prepared by Section *Einheitliche Technische Baubestimmungen*. It has been recommended to the *Laender* building inspectorates by the *Institut für Bautechnik* (Institute for Building Technology), Berlin, for inclusion in the *Laender* building regulations.

The following standards form part of the DIN 4141 series:

DIN 4141 Part 1 Structural bearings; general design rules

DIN 4141 Part 2 Structural bearings; bearing systems for civil engineering structures forming part of traffic routes (bridges)

DIN 4141 Part 3 Structural bearings; bearing systems for buildings

DIN 4141 Part 4*) Structural bearings; transport, intermediate storage and installation

DIN 4141 Part 14*) Structural bearings; laminated elastomeric bearings

Further Parts of this standard are in course of preparation.

Contents

1 Field of application

This standard applies to bearing systems as employed in building construction to support structural components or entire structures. Wherever design similarities exist between such structures and bridges, a check shall be made as to whether compliance with relevant specifications in DIN 4141 Part 2 is required.

2 Concept

A bearing system is the combination of all structural measures designed to transmit from one structural component into another the stress resultants (forces, moments) derived from structural analysis, and at the same time to facilitate the design deformations of the structural components at these locations.

*) At present at the stage of draft.

3 Bearing system classes

3.1 Bearing system class 1

Bearing system class 1 comprises all bearing systems which require verification by calculation, and in which the stability of the structure is liable to be endangered in the event of overstressing or bearing failure. Only standardized bearings, or bearings which have been granted a general building inspectorate approval for this class, may be used for class 1 bearing systems.

3.2 Bearing system class 2

Bearing system class 2 comprises all bearing systems not belonging to bearing system class 1. The precondition for inclusion in class 2 is that adjoining structural components are only negligibly stressed by bearing reactions other than the theoretical compression in the corresponding bearing joint, and that the stability of the

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structure is not endangered in the event of overstressing or bearing failure. Apart from the bearings referred to in subclause 3.1, other types of bearings may also be used for class 2 bearing systems, if their suitability for the proposed application has been verified, by testing carried out by an accredited testing agency for example.

4 General principles of bearing systems

4.1 Fixed points

In the case of structural components supported on bearings designed for horizontal movement, it shall be checked whether fixed points or fixed zones are to be arranged in order to fix the zero point of the movement of the structural component to be supported.

It shall be borne in mind that the support of structural components may be adversely affected by unintentional fixed points.

4.2 Joint design

Each structural component shall be separated by joints from the adjoining structural components in both the horizontal and the vertical direction in such a way that the proposed bearing system is capable of functioning correctly. It shall be taken into account that even supposedly soft joint fillings are capable of significantly impairing design deformations (see table 1).

5 Verification of bearing systems

5.1 Bearing system class 1

The magnitude, location and direction of the forces acting on the bearing shall be derived from the structural analysis of the structural components to be supported.

Verification of the anticipated movements and bearing deformations shall also be provided.

The restoring forces, restoring moments, frictional forces and transverse tensile forces which act at the bearing joints, and the displacements of the load application shall be analysed insofar as they affect the adjoining structural components and the structure as a whole. In addition, the spring effect of bearings capable of vertical deflection (bearing Nos. 1 to 6 listed in table 1 in the September 1984 edition of DIN 4141 Part 1) shall be taken into account. Their settlement shall be as even as possible.

5.2 Bearing system class 2

As far as this bearing system is concerned, the compressive stresses shall be verified on the basis of the vertical loads to be transmitted, and the remaining stresses on the basis of estimated values. Suitable constructional measures (for example transverse pull reinforcements, edge distances) shall be taken in order to prevent any possible local damage to the adjoining structural components (such as crack formation and spalling).

6 Structural design and installation instructions

Where requirements relating to structural design and installation of bearings have not already been specified in other Parts of this standard, the following conditions shall be fulfilled:

a) The environmental effects shall be checked as to whether they are likely to cause bearing deterioration.

b) Replaceability of bearings shall not, as a general rule, be specified. For bearings of the class 1 bearing system, a check shall be made in each case as to whether provision for the replacement of bearings is to be made.

c) The surface finish and the design setting of the support surfaces shall be inspected. If necessary, the support surfaces shall be refinished in order to satisfy the specified requirements.

7 Documentation

7.1 Location drawings

The following details shall be indicated for each bearing on the location drawings prepared in the course of the structural analysis:

Table 1. **Guideline values for the resistance of joint fillings**

Joint fillings	Shear resistance S_G with $\tau = S_G \cdot \text{tg}\,\gamma$ N/mm²	Resistance to elongation S_E (compression/tension) with $\sigma = S_E \cdot \varepsilon$ N/mm²
Joint fillers made of: polysulfide (see DIN 18 540 Part 2) silicone (see DIN 18 540 Part 2) polyurethane (see DIN 18 540 Part 2) polyacrylate	0,5	1,0
PUR foam round section	0	0,2 [1]
Slabs made of: type W foam, in accordance with DIN 18 164 Part 1 porous wood fibre (see DIN 68 750)	No guideline values can be specified.	0,3 [1] 15,0 [1]

[1] Only suitable for compressive stress; $S_E = 0$ in the case of tensile stress.

a) precise location in the structure;
b) graphical symbol of the bearing in accordance with DIN 4141 Part 1 (applies only to class 1 bearing systems);
c) direction of movements (applies only to class 1 bearing systems).

The location of the fixed points or fixed zones shall also be stated.

7.2 Working drawings

The following details shall be entered for each bearing in the working drawings:

a) precise location in the structure;
b) clear identification;
c) flatness tolerances for the support surfaces (please refer to subclause 8.2);
d) tolerances on parallelism for the support surfaces (please refer to subclause 8.2);
e) references to the installation instructions.

8 Additional data for particular applications

8.1 Solid flat roofs and similar structural components

DIN 18 530 shall be complied with in respect of design and construction [1]).

If accurate verification is not carried out, the displacement of the ceiling slab in relation to the walls can, as a general rule, be determined for bearing design purposes with the aid of the following theoretical values:

- coefficient of thermal expansion α_t = 0,01 mm/mK (applies to all types of concrete and masonry);
- temperature difference between ceiling slab and subjacent wall and floor, $\Delta T = \pm 20$ K;
- theoretical values of shrinkage in accordance with table 2.

Table 2. **Theoretical values of shrinkage, in mm/m**

	max.	min.
Cast in situ concrete	0,6	0,2
Precast concrete components	0,4	0,1
Brickwork	0,2	−0,2
Sand-lime brickwork	0,4	0,1
Gas concrete masonry	0,4	0,1
Pumice concrete masonry	0,6	0,2

8.2 Additional data for precast concrete components and support surfaces

The data referred to below concern the mounting of precast reinforced concrete and prestressed concrete components. They also apply, as appropriate, to prefabricated components made of other materials, such as timber or steel and to support surfaces in concrete construction.

The flatness tolerance for the support surfaces shall be given on the working drawings as a uniform value of 2,5 mm for all bearing sizes. Higher degrees of accuracy required for certain types of bearing are specified in the relevant Parts of this standard. Checking of the given tolerances shall be based on the specifications of DIN 18 202 Part 5.

Deviations from parallelism of mating or associated support surfaces as a result of manufacturing or erection tolerances shall be taken into consideration in the structural analysis by means of an allowance of not less than 1 % and treated like design rotational movements in the calculation.

To protect the bearings, the support surfaces shall be carefully deburred.

8.3 Installation aids

Installation aids shall be designed to facilitate the installation and ensure the correct design setting of the bearings or structural components.

It may be necessary to carry out a check with the aid of gauge points marked on the base of the bearing. The gauge points shall be provided as datum references for checking the direction of placing and parallelism of the bearing planes.

Installation aids shall be capable of bearing the structural component to be supported for as long as is necessary until the bearing has become fully operative. This means that the installation aids shall be capable of holding the bearing or the structural components in their design position during the various stages of construction (placing the concrete, stripping the formwork, mounting, etc.) and of preventing any skewing or eccentricity.

When the installation aids are removed, any sudden transference of load onto the installed bearing shall be prevented. Resilient bearings shall not be restrained in respect of the free deformation of the side faces after the installation aids have been removed.

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[1]) More detailed information, especially as regards the calculation of deformation, will be found in [1] and [2].

Standards and other documents referred to

DIN 4141 Part 2 Structural bearings; bearing systems for civil engineering structures forming part of traffic routes (bridges)

DIN 18 164 Part 1 Plastic foams for use as insulating materials in building; insulating materials for thermal insulation

DIN 18 202 Part 5 Dimensional tolerances in building construction; flatness tolerances for the surface of floors, ceilings and walls

DIN 18 530 Solid ceiling structures for roofs; code of practice for design and construction

DIN 18 540 Part 2 Sealing of exterior wall joints in building construction using joint sealants; joint sealants, requirements and testing

DIN 68 750 Wood fibre building board; porous and hard wood fibre building board; quality conditions

[1] Pfefferkorn, W. *Konstruktive Planungsgrundsätze für Dachdecken und ihre Unterkonstruktionen* (Basic design principles relating to roof decks and their substructures). *Verlagsgesellschaft Rudolf Müller*, Köln.

[2] Schubert, P. and Wesche, K. *Verformung und Rißsicherheit von Mauerwerk* (Deformation and crack resistance of masonry). *Mauerwerks-Kalender* (Masonry Calender) 1981, *Verlag W. Ernst & Sohn*, Berlin.

Other relevant standards and documents

DIN 18 203 Part 1 Dimensional tolerances in building construction; prefabricated parts of concrete and reinforced concrete

[3] Kanning, W. *Elastomer-Lager für Pendelstützen – Einfluß der Lager auf die Beanspruchung der Stützen* (Elastomeric bearings for socketed stanchions; influence of the bearings on the stressing of the stanchions) *Der Bauingenieur* (The Civil Engineer) 55 (1980), page 455.

[4] J. Müller-Rodeholz. *Einfluß der Steifigkeit von Fugenmassen* (Influence of stiffness of joint fillers. *IfBt* research report. Az: IV/1-5-206/79). Obtainable from the *RAUM und BAU Informationszentrum* (Information Centre) of the *Fraunhofer-Gesellschaft*, Nobelstraße 12, D-7000 Stuttgart 80.

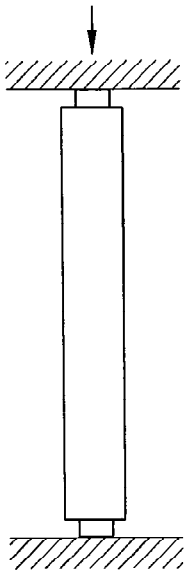
[5] Frank Müller, H. Rainer Sasse, Uwe Thormahlen. *Stützenstöße im Stahlbeton-Fertigteilbau bei unbewehrten Elastomerlagern* (Column joists in precast reinforced concrete structures using non-reinforced elastomeric bearings). Volume 339 of the *DAfStb; Verlag W. Ernst & Sohn*, Berlin 1982.

[6] Kessler, E. and Schwerm, D. *Unebenheiten und Schiefwinkligkeiten der Auflagerflächen für Elastomerlager bei Stahlbeton-Fertigteilen* (Unevenness and skewness of support surfaces for elastomeric bearings on precast reinforced concrete components). *Betonwerk + Fertigteiltechnik* (Concrete construction and precast component construction) 49 (1983), *fertigteilbau forum* Supplement 13/83, pp 1–5.

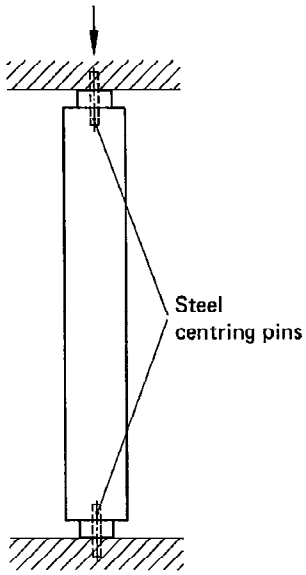
Explanatory notes

The most important feature of the present standard is its classification of bearing systems into two classes. This classification is, in fact, the standardized form of a distinction which has been made in practice for many years, the significant difference being that in this form such practice is placed on a coherent, and hence less arbitrary footing. In future, verification of the suitability of a bearing for the application intended will be required before its use may be considered compliant with the standard or in accordance with the accepted rules of good engineering practice. It will generally prove more economical to mount buildings on class 2 bearing systems, even when standardized or approved bearings are used in them.

The difference between the two bearing system classes is clearly recognizable in the design of socket stanchions [3], as illustrated below:



Bearing system class 1
(unstable if the restoring forces are ignored)



Bearing system class 2
(if torsional rigidity is disregarded)

Table 1, which assigns static characteristics to various joint fillers, is a new development. It is the result of a research project sponsored by the *Institut für Bautechnik* [4], and is only intended to provide rough guideline values.

Plain elastomeric bearings are included in the field of application of this standard; a separate standard dealing with these bearings is in the course of preparation. For CR mixtures, the ETB guidelines remain valid for the present, and for other bearings, e.g. for EPDM bearings, the corresponding approvals are applicable.

Column joints represent a particular type of bearing system. The influence of elastomeric bearings in column joints on the design of such joints has been investigated. The results, together with formulae for dimensioning purposes, have been published [5]. A special standardization of column joints is not under consideration at present.

The data given in subclause 8.2 with regard to tolerances on flatness and parallelism are based on a large number of measurements which are described in [6].

International Patent Classification

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