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Structural bearings – Guidance on the use of structural bearings

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Summary of pages

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Foreword

Publishing information

This Published Document is published by BSI and came into effect on 31 August 2009. It was prepared by Technical Committee B/522, *Structural bearings*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

This Published Document gives non-contradictory complementary information and additional guidance for use in the UK with BS EN 1337 (all parts), *Structural bearings*.

Use of this document

As a guide, this Published Document takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Presentational conventions

The provisions in this Published Document are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a Published Document cannot confer immunity from legal obligations.

0 Introduction

When there is a need for guidance on a subject that is not covered by a European Standard, a country can choose to publish documents that contain non-contradictory complementary information that supports the European Standard.

Where BS EN 1337 (all parts) refers to Eurocodes, the Eurocodes (BS EN 1990 to BS EN 1999 inclusive) once published are deemed to include their UK National Annexes.

Eurocodes apply to design, not to assessment. Where bearings are required to be replaced on an existing highway structure, their capacity may, with the agreement of the overseeing organization, be chosen to accommodate the assessment loading based on UK assessment standard BD 21, *The assessment of highway bridges and structures* [1], with appropriate partial factors of safety for loading.

Attention is drawn to the requirements in BS EN 1337 (all parts) of CE marking under the Construction Products Directive [2] enabling bearings to be legally placed on the market in any EU Member State.

The requirements of BS EN 1337 (all parts) are augmented by BS EN 1993-2:2006, Annex A.

The requirements of BS EN 1337-10 are to be implemented in accordance with the Highways Agency's *Inspection manual for highway structures* [3].

1 Scope

This Published Document contains non-contradictory complementary information and additional guidance for use in the UK with BS EN 1337 (all parts). It covers the design, testing and installation of structural bearings.

In addition to those bearings covered by BS EN 1337, this Published Document gives guidance on knuckle and leaf bearings and composite roller bearings.

NOTE Annex A gives a typical bearing schedule, which has been extended from that given in BS EN 1337-1:2000, B.1, to cover UK practice.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 3416, *Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water*

BS 5350-A1, *Methods of test for adhesives – Part A1: Adherend preparation*

BS 5400-2, *Steel, concrete and composite bridges – Part 2: Specification for loads*

BS 6949, *Specification for bitumen-based coatings for cold application excluding use in contact with potable water*

BS EN 1011-4, *Welding – Recommendations for welding of metallic materials – Part 4: Arc welding of aluminium and aluminium alloys*

BS EN 1337-1:2000, *Structural bearings – Part 1: General design rules*
BS EN 1337-2:2004, *Structural bearings – Part 2: Sliding elements*
BS EN 1337-3:2005, *Structural bearings – Part 3: Elastomeric bearings*
BS EN 1337-4, *Structural bearings – Part 4: Roller bearings*
BS EN 1337-5, *Structural bearings – Part 5: Pot bearings*
BS EN 1337-6, *Structural bearings – Part 6: Rocker bearings*
BS EN 1337-7, *Structural bearings – Part 7: Spherical and cylindrical PTFE bearings*
BS EN 1337-8, *Structural bearings – Part 8: Guide bearings and restraint bearings*
BS EN 1337-9, *Structural bearings – Part 9: Protection*
BS EN 1337-10, *Structural bearings – Part 10: Inspection and maintenance*
BS EN 1337-11:1997, *Structural bearings – Part 11: Transport, storage and installation*
BS EN 1464, *Adhesives – Determination of peel resistance of high-strength adhesive bonds – Floating roller method*
BS EN 1600, *Welding consumables – Covered electrodes for manual metal arc welding of stainless and heat resisting steels – Classification*
BS EN 1990:2002+A1:2005, *Eurocode – Basis of structural design*
BS EN 1993-1-8, *Eurocode 3: Design of steel structures – Part 1-8: Design of joints*
BS EN 10204:2004, *Metallic products – Types of inspection documents*

3 Terms and definitions

For the purposes of this Published Document, the terms and definitions given in BS EN 1337 (all parts) apply.

4 Design

4.1 Function

To achieve the required degree of freedom in the function of a specific bearing, it might be necessary to combine the characteristics of different types of bearing, the resultant bearing as a whole providing the required movements and load resistance, e.g. a plane sliding bearing, to allow translation, combined with a pot bearing, to provide for rotation.

4.2 Durability

Bearings should be detailed to exclude crevices, which allow moisture and dirt to be trapped. Skirts should be provided where specified by the overseeing organization, but the requirements of BS EN 1337-9 should not be modified as a result of skirt provision.

4.3 Uplift

If uplift can occur, bearings and their fixings should limit separation of the components to a value agreed with the overseeing organization and should resist the consequent forces. (See also BS EN 1337-1:2000, A.1, second list point.)

4.4 Loads and load effects

4.4.1 Compatibility with an existing structure

To ensure compatibility with an existing structure, replacement bearings should resist the loads and load effects specified in BS 5400-2 or the assessment-loading standard required by the overseeing organization and, where applicable, the effects of creep, shrinkage and pre-stress. Due allowance should be made for any eccentricities and specified dimensional tolerances in the application or distribution of loading.

The design loads Q^* on the bearings should be the nominal loads multiplied by the appropriate values of γ_{fL} , all as specified in BS 5400-2. Design load effects S^* at the serviceability limit state (SLS) and ultimate limit state (ULS) should be obtained by multiplying the effects of the design load Q^* by γ_{f3} . Values of γ_{f3} should be taken as 1.0 for the SLS and 1.1 for the ULS unless otherwise stated.

4.4.2 Restraints against translation

Where restraints are provided on bearings to resist translational movements, they should be designed to resist either the design load effects or 5% of the permanent vertical design load on the bearing, whichever is the greater.

If restraint against translation (resistance to a horizontal force) is to be shared by several bearings, consideration should be given to:

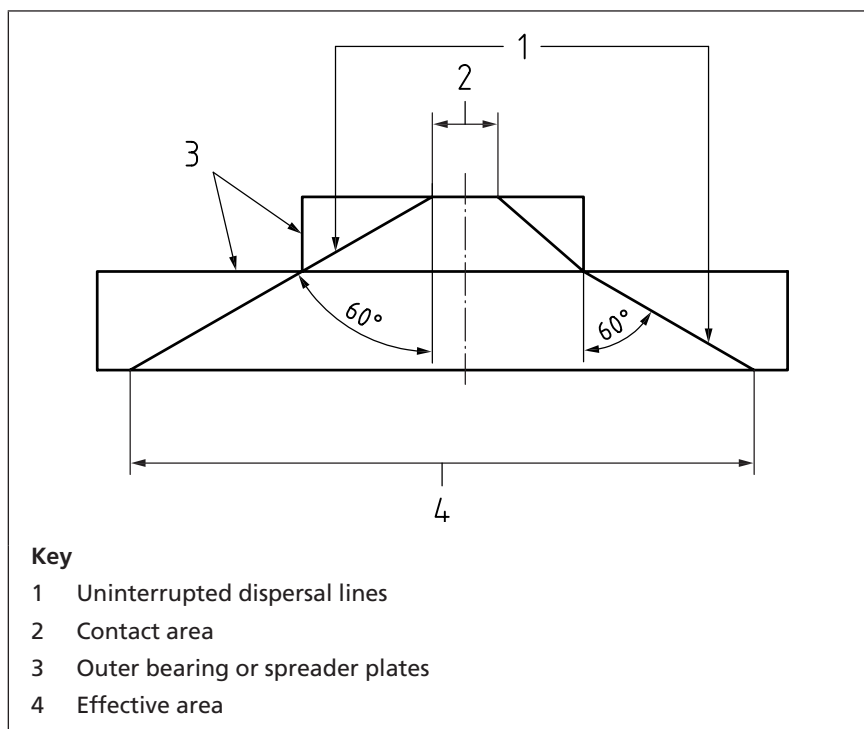
- the effects of any clearance between working parts of the bearings and their guides during their service life; and
- the effects of the stiffness of the structure on the distribution of the resulting loads between the bearings. (See also BS EN 1337-1:2000, 7.1.4.)

4.4.3 Proportions of bearing plates

The bearings should be so proportioned that concentrated loads are distributed to ensure that the permissible pressures on the adjacent bridge structure are not exceeded.

The effective area for distributing the load may be taken as that between uninterrupted dispersal lines drawn from the bearing contact area at a maximum of 60° to the line of application of the bearing reaction (see Figure 1). Where the adjacent structure is likely to deform significantly under load, the interaction of the structure and the bearing should be considered in the design of both. (See also BS EN 1337-2:2004, 6.9.)

Figure 1 Load distribution



4.5 Tolerances

NOTE Tolerances given in this document are suitable for bearings in normal use. In special circumstances of unusual loading or movement, different tolerances might be necessary.

The tolerances in **10.3** should be drawn to the attention of fabricators providing plates.

Tolerances for holes for fixing bolts should be related to the function of the bolts and the likely conditions prevailing at the time of installation of the bearings. As a guide, holes for fixing bolts or locating devices should be ± 1 mm from the positions shown on the design drawings. Their diameter should be 2 mm larger than the nominal diameter of the bolt or locating key for fixing bearings to steel or precast concrete members, and 3 mm larger than the nominal diameter of bolt or shear key for replacement. For bolts or locating devices required to resist horizontal forces in shear, a close tolerance fit might be necessary.

The effects of variation in dimensions within the permitted tolerances of the bearing, including those of spacer, spreader and taper plates above and below the bearings, should be considered in the design of bearings, their connections and the associated structure.

5 Structural design considerations

5.1 Positioning of bearings

The position of bearings should be such that they are able to operate as assumed in the design of the structure. Any secondary effects resulting from either eccentric loading or movement not truly along a major axis of the bearing should be taken into account in the design of the bearing and surrounding structural elements.

Bearings should be located so as to avoid the accumulation of dirt and debris likely to interfere with their performance and the structure detailed so that water is prevented from reaching the bearings.

Space should be provided around bearings to facilitate their inspection and maintenance. Consideration should be given in the design of the structure to the means of access to the bearings.

5.2 Use of different types of bearing

When bearings with differing characteristics are used on the same line of support, the resulting interactive effects should be considered both in the design of the bearings and the structure.

NOTE Here, the "same line of support" is normally taken to mean transverse to the span direction.

5.3 Provision for resetting and replacement of bearings (BS EN 1337-1:2000, 7.6)

Facilities for correcting the effects of any differential settlement and tilt should be provided in the design of the structure, e.g. by providing jacking points, unless the structure has been designed to accommodate such effects.

A strategy for bearing replacement should be devised at the design stage of the structure, including any load restrictions required, and incorporated in the maintenance manual. The design should allow for live loading to be taken by the propped structure. In some instances it might be necessary to limit traffic during jacking but once the jacks are locked off, or supports installed, the bridge can be fully opened. The strategy should include the capacity and dimensions of jacks required and the provision, where necessary, of temporary guide and/or restraint bearings during bearing replacement.

The structure should be capable of being lifted sufficiently to permit bearing replacement without the need to break out concrete to remove or replace holding down bolts. Provision should be made for jacking points of adequate size, strength, separation, accessibility and safety on the substructure and superstructure. Separation between jacking points should allow for the provision of sliding plates combined with the jacks, where required. Anchorage points for temporary guides and restraints should also be provided, as necessary.

Jacking is not covered in BS EN 1337 (all parts). Typical aspects to be addressed include ensuring that:

- the jacks exert acceptable pressures on horizontal surfaces;
- jacking loads are adequately distributed across the structure;
- deck joints are not damaged on lifting;
- temporary fixity is provided when replacing fixed or guided bearings;
- jacking loads and movements are monitored for structural safety;
- voids are eliminated from bearing re-bedding and no excessive deflection is registered when jacking back down on the bedded bearing; and
- holding down bolts are greased and nuts locked tight by approved means.

When assessing the effects of jacking operations on the structure, the potential effects of a failure of a jack, or components, should be considered. Where multiple jacks are connected by a common component, e.g. a manifold or a hose, the failure of this component should also be considered. Designers should note that a failure can occur in jacking up or down operations. If jacking or monitoring is carried out remotely, consideration should be given to the time taken to address any failure. The principle of the assessment is to ensure that if a component fails, and the loads are redistributed, the effects of this have been taken into account and no damage or settlement will occur to the structure.

Where bearing replacement might be required during the life of a structure, the provision of a movement restraint (e.g. dowels) through the bearings can cause difficulties, and alternative location of the restraint(s) should be considered.

5.4 Effects of bearings on other parts of the structure

The design of other elements of the structure, including expansion joints, parapets and services, should take into consideration the effect of any change in the geometrical configuration of the bearings. (For replacement bearings, see also 4.4.)

6 Manufacture

6.1 Materials

6.1.1 General

Where more than one quality of material is specified in the relevant British Standard or more than one British Standard is referred to in this document, the quality should be that specified or approved by the overseeing organization.

6.1.2 Dissimilar materials

Care should be taken to prevent electrolytic action between dissimilar metals in contact by the use of suitable insulation and the prevention of moisture penetration. (See also 10.7.1 and 10.7.3.)

6.1.3 Protection of aluminium alloy components.

Where aluminium would otherwise be in contact with Portland cement concrete, the former should be suitably protected. (See also 10.7.3.)

6.2 Surface finish on metal elements

Metal-to-metal contact surfaces within bearings should be prepared either by machining or fine grinding. As far as practicable, machining should be carried out after any welding has been finished. Machining of rolling contact surfaces of roller bearings or sliding contact surfaces should be carried out only in the principal direction of movement. Care should be taken to remove abrasive materials from finished surfaces, which should also be cleaned with a degreasing agent.