

Guide to

Selection and use of elastomeric bearings for vibration isolation of buildings —

(Formerly DD 47)

UDC 699.842:69.021:678.074

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

Cooperating organizations

The Civil Engineering and Building Structures Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

Aluminium Federation	Department of Transport
Association of Consulting Engineers	Federation of Civil Engineering Contractors
Brick Development Association	Health and Safety Executive
British Constructional Steelwork Association	Institution of Civil Engineers
British Precast Concrete Federation Ltd.	Institution of Municipal Engineers
British Steel Industry	Institution of Public Health Engineers
Cement and Concrete Association*	Institution of Structural Engineers*
Concrete Society Limited	Institution of Water Engineers and Scientists
Consumer Standards Advisory Committee of BSI	Ministry of Agriculture, Fisheries and Food
Convention of Scottish Local Authorities	National Federation of Building Trades Employers
County Surveyor's Society	National Water Council
Department of the Environment (PSA)*	Royal Institute of British Architects
Department of the Environment — Building Research Establishment*	Scottish Development Department
Department of the Environment — Housing and Construction	Timber Research and Development Association
Department of the Environment — Transport and Road Research Laboratory	Trades Union Congress
Department of the Environment — Water Engineering Division including Water Data Unit	

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

Department of the Environment — Noise, Clean Air and Wastes Directorate	Institute of Sound and Vibration Research
District Surveyors' Association	Malaysian Rubber Producers' Research Association
Federation of Piling Specialists	Society of Environmental Engineers
Institute of Acoustics	

This British Standard, having been prepared under the direction of the Civil Engineering and Building Structures Standards Committee, was published under the authority of the Board of BSI and comes into effect on 26 February 1982

© BSI 10-1999

The following BSI references relate to the work on this standard:
Committee reference CSB/44
Draft for comment DD 47

ISBN 0 580 12540 8

Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

	Page
Cooperating organizations	Inside front cover
Foreword	iii
Section 1. General	
1 Scope	1
2 References	1
3 Definitions	1
Section 2. Design	
4 Design considerations	1
4.1 General	1
4.2 Acceptable level of disturbance	2
4.3 Design of bearings	2
4.4 Structural safety and serviceability	3
4.5 Deflection of bearings	3
4.6 Bearing support surfaces	3
4.7 Side thrust bearings	4
4.8 Structural isolation	4
4.9 Avoidance of restraint	5
4.10 Drainage	5
4.11 Information and warning notices	5
Section 3. Bearings	
5 Types of bearings	5
5.1 Range of types	5
5.2 Plain elastomer bearing	5
5.3 Plain composite bearing	5
5.4 Elastomeric sandwich bearing	5
5.5 Multiple elastomeric sandwich bearing	5
5.6 Multiple composite sandwich bearing	5
6 Stability of bearings	6
7 Elastomeric components	6
7.1 Materials	6
7.2 Testing for type approval	7
7.3 Quality control	7
8 Non-elastomeric components	7
8.1 Bond of elastomer to reinforcement	7
8.2 Metal plates	7
8.3 Non-metallic reinforcement	7
8.4 Adhesives	7
9 Testing and identification of bearings	8
9.1 Selection of test samples	8
9.2 Elastomer-to-reinforcement bond	8
9.3 Safe carrying capacity	8
9.4 Stability	8
9.5 Static shear stiffness	8
9.6 Static compression stiffness	8
9.7 Identification of bearings	9
10 Storage and handling	9
Appendix A Literature references	10
Appendix B Shape factor	10

	Page
Appendix C Factors to be considered in the design of a mounting system	11
Figure 1 — Plain elastomer bearing	5
Figure 2 — Plain composite bearing	6
Figure 3 — Elastomeric sandwich bearing	6
Figure 4 — Multiple sandwich bearing	6
Publications referred to	Inside back cover

Foreword

This standard has been prepared under the direction of the Civil Engineering and Building Structures Standards Committee. This standard supersedes DD 47:1975, which has therefore been withdrawn.

As a result of the review of DD 47 it became apparent that the recommendations in it were sound and that, with a minimal amount of clarification, it could be published as a standard. The major additions are Appendix B on shape factors and the checklist in Appendix C. The latter is intended to provide some guidance on the type of factors that need to be taken into account when using elastomeric bearings, but should be read in conjunction with the other appendices and clauses of this standard.

Ground borne vibration and noise within structures is becoming an increasing problem. In urban areas particularly, shortage of building land may lead to the development of sites hitherto considered unsuitable because of proximity to heavy rail or road traffic, vibrations from which could enter a structure via the foundations and then be transmitted through the structure itself. A structure may for instance be sited so close to an underground railway that its foundations may actually straddle the tunnel and provide a direct and effective path for the transmission of serious disturbances to the occupiers. Excessive vibration or noise may similarly arise from the presence of heavy machinery in the vicinity.

The increasing use of stronger materials and continuous construction in reinforced concrete or welded steelwork give rise to structures that are dynamically “lively”. Inherent vibration damping is reduced, and a modern building may respond to forms of excitation that would produce little or no effect on one of more traditional design. In the same way, modern lightweight continuous construction leads to the transmission of vibration and noise within a structure, so that unacceptable effects may occur in areas quite remote from the source of a disturbance.

The use of double glazing (particularly in the form of double windows) may reduce background noise levels in a building, but structure borne noise may in consequence become more noticeable and less acceptable. In this connection an unexpected noise, such as that from an underground train, may cause more disturbance than a louder but continuous background noise.

One method of reducing ground borne and structure borne vibrations is by mounting an entire structure on resilient supports. These supports (or “bearings”) are so designed as to attenuate undesirable effects without risk of violent synchronous vibration, and so arranged as to obviate any danger of collapse or undue deformation of the structure in the event of failure of one or more of them, for instance as a result of damage inflicted during a fire. Such bearings will isolate all or part of a structure from any supporting structure provided they are properly designed and placed and provided they are not bridged by any rigid connections.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

Many different types of vibration isolation device exist, but this standard is restricted to consideration of bearings of the type defined in 3.1. It deals principally with aspects of safety concerned directly with the design and use of those structural bearings for load bearing purposes in which the major component is an elastomer. It sets out guidance to ensure that when such resilient supports are used, the structure will be safely supported at all times, both during construction and subsequently. It does not set out in detail the modifications necessary in the architecture and the structure.

This standard reviews the practical aspects of providing adequate vibration isolation but does not develop the theoretical background necessary to ensure the effectiveness of the bearings as vibration isolators. The latter is a specialist design exercise and coverage is limited to an outline only to assist the non-specialist in understanding the general nature of the problem. Wherever the term “vibration” is used in this standard it should be taken to include structure borne “noise”.

Resilient mats (area isolators) are excluded from this standard although many of the considerations governing their use are similar. Bridge bearings, similar in construction to many of the vibration isolators described here, are not covered. For details of their use see, for example, BS 5400-9¹⁾.

For the mounting of machines reference should be made to CP 2012.

The special precautions to be taken to protect a structure from earthquake effects are not considered.

2 References

The titles of the publications referred to in this standard are listed on the inside back cover.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1

bearing

a vibration isolation support, or mounting, the resilient properties of which derive from the use of an elastomeric (i.e. rubberlike) substance or an elastomer based composite

3.2

bearing support surface

that load bearing part of the supporting or supported structure in contact with the bearing

3.3

design load

the combination of unfactored characteristic dead and imposed loads used in ordinary structural design (see CP 110 and CP 3:Chapter V-1)

3.4

estimated normal imposed load

the actual, unfactored, imposed load, neither overestimated nor underestimated, expected to obtain during the normal every day use of a structure

3.5

the engineer

the person responsible for the design and satisfactory completion of a structure isolated in accordance with this standard

3.6

mounting system

that part of the building structure immediately adjacent to the bearing and forming a part of the vibration isolation measures. Includes the bearing, the bearing support surfaces, fail safe devices, etc.

Section 2. Design

4 Design considerations

4.1 General. The incorporation of resilient bearings in a structure will form an integral part of the overall design, and should therefore be considered from the outset. For example, where continuous flat slab construction is used, additional care may need to be taken to ensure the flexural rigidity of the slabs supported on bearings in order that such slabs may behave effectively as a horizontal diaphragm for the purpose of transmitting lateral loadings to the adjacent shear walls.

Because of the complexity of the isolation problem, which entails modifying the frequency response characteristics of the ground borne vibrations, taking into account the various degrees of freedom in which the structure can oscillate, each case will generally require individual treatment involving local measurements and specialist advice. Appendix C indicates the various factors that may need to be taken into account in any particular design.

¹⁾ In course of preparation. In the interim, reference should be made to Department of Transport Publication BB 1/76.