

Guide to

Evaluation of the response of occupants of fixed structures, especially buildings and offshore structures, to low-frequency horizontal motion (0.063 Hz to 1 Hz)

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- British Internal Combustion Engine Manufacturers' Association
- British Ship Research Association
- British Steel Corporation
- Department of Trade and Industry (National Engineering Laboratory)
- Electricity Supply Industry in England and Wales
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- Institution of Mechanical Engineers
- Ministry of Defence
- Motor Industry Research Association
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Foreword

This British Standard has been prepared under the direction of the General Mechanical Engineering Standards Committee. The guidance contained in this standard is technically equivalent to ISO 6897:1984 *“Guidelines for the evaluation of the response of occupants of fixed structures, especially buildings and off-shore structures, to low-frequency horizontal motion (0,063 to 1 Hz)”*, which was prepared by Technical Committee ISO/TC 108 of the International Organization for Standardization (ISO) and in the development of which the United Kingdom played an active part. The only difference is that this standard refers to BS 6472 where the International Standard refers to ISO 2631.

For ease of reproduction the text of the International Standard has been used, amended to incorporate the difference outlined above. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Attention is drawn to the bibliography of supporting data included in this standard and it is recommended that reference is also made to ISO 2041 *“Vibration and shock — Vocabulary”* and ISO 5805 *“Mechanical vibration and shock affecting man — Vocabulary”*. BS 3015 *“Glossary of terms relating to mechanical vibration and shock”* is a British Standard related to ISO 2041, but there is no British Standard corresponding to ISO 5805.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, 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.

0 Introduction

Until this century, buildings were seldom more than a few storeys high and the few tall buildings which did exist were usually of a heavy gravity design which did not readily respond to wind or other forces. Also, tall buildings constructed in the late nineteenth century and early this century generally had vertical load-bearing frames with massive granite infills which provided another generation of unresponsive buildings.

This history of unresponsive building structures has led people to expect buildings to provide nearly stationary accommodation, even under storm conditions, and the occupants of buildings are prepared to accept only extremely low levels of motion.

In contrast to these unresponsive structures, more modern buildings have tended, for reasons of economy of space, foundation requirements, material outlay, speed of erection and elegance, to be formed from more slender sections such that these much lighter buildings are more responsive to dynamic forces than their predecessors. This British Standard proposes magnitudes of low-frequency horizontal motion that should produce only minimum adverse comment from people working or living in buildings.

Similarly, off-shore fixed structures were, until recently, generally of a non-habitable form or of an unresponsive design. Modern mineral exploitation and production structures founded on the seabed are of such large proportions and subject to such extreme wind and wave action that the dynamic response of both the overall structures and their component parts has become the focus of much attention from the view-point of the motion transmitted to those operating and living on the structures. Also, although outside the scope of this British Standard, the structural integrity, material fatigue and operation of off-shore fixed structures in storm conditions receive much attention. This British Standard therefore proposes magnitudes of low-frequency horizontal motion which should prove satisfactory to those living on and operating off-shore fixed structures. Allowances are made for the fact that wind and waves shall be expected to cause motion of these structures which, in addition, are generally manned by trained personnel who are prepared to accept some degree of motion so long as it does not present a health hazard or interfere with the efficient operation of the installation.

Often the likely motion of a planned structure has to be calculated in order to assess the probable response, to the vibration, of those who will use the structure. The probable motion of a proposed structure can generally be found by structural dynamics using the structure stiffness and mass, the wind or wind and wave spectra, the structure shape, aspect and roughness, and the appropriate topographical parameters. Wind tunnel and wave tank studies using aerodynamic and fluid dynamic models can also be used to determine the likely motion of structures.

In some forms of tall building construction, poor construction joints allow inter-storey drift in the structure and, when assessing the probable response of such structures, an allowance should be made for the effects of inter-storey movements.

Guidance on satisfactory magnitudes of vibration for specific situations is given in the Annex.

1 Scope and field of application

1.1 This British Standard relates to typical responses of people to the horizontal motion of structures in the frequency range 0,063 to 1 Hz. The recommendations are categorized in accordance with the use of the structures and, in the case of off-shore fixed structures, with the nature of work being carried out.

Injury of occupants due to structural vibration is outside the scope of this British Standard.

1.2 Whole-body motion caused by structural vibrations induced by infrequent external environmental forces is considered separately from whole-body motion resulting from structural vibrations caused by frequently occurring force actions. Frequently occurring force actions may arise from external sources, machinery or structure services such as elevators, fans, air conditioners, heating units and plumbing. Both perceptible magnitudes of low-frequency horizontal motion of structures and magnitudes likely to raise minimum adverse comment are included.

NOTE 1 Visual perception of building motion, the influence of torsional oscillations of structures and the effects of noise may influence the subjective response to vibrations of structures but no quantitative assessment is made.

NOTE 2 Blasting, earthquakes and similar events are excluded from the scope of this British Standard.

NOTE 3 An off-shore fixed structure is one founded on the sea bed, such as a gravity platform or a steel jacket with a piled foundation. Floating structures, tension leg and articulated platforms are excluded from the scope of this British Standard.

NOTE 4 In buildings, the response of people is for a normal adult population and, although it is known that levels of vibration considered acceptable vary with age groups and sex, no definite correction factors can be put forward at present to adjust the acceleration magnitudes for these influences. On off-shore fixed structures, the recommendations only apply to trained personnel.