

# INTERNATIONAL STANDARD

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## **Mechanical vibration and shock — Vibration of buildings — Guidelines for the measurement of vibrations and evaluation of their effects on buildings**

*Vibrations et chocs mécaniques — Vibrations des bâtiments — Lignes  
directrices pour le mesurage des vibrations et évaluation de leurs effets  
sur les bâtiments*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 4866 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*.

Annexes A, B, C and D of this International Standard are for information only.

## Introduction

It is increasingly recognized that buildings must sustain vibrations, and recognition of this is needed both in design for structural integrity, serviceability and environmental acceptability, and in the preservation of historic buildings.

Measurement of vibration in a building is carried out for a variety of purposes:

— **Problem recognition**

Where it is reported that a building is vibrating at such a level as to cause concern to occupants, it may be necessary to establish whether or not the levels warrant concern for structural integrity.

— **Control monitoring**

Where maximum permitted vibration levels have been established by some agency and those vibrations have to be measured and reported.

— **Documentation**

Where dynamic loading has been recognized in design and measurements are made to verify the predictions of response and provide new design parameters. These may use ambient or imposed loading. Strong motion seismographs, for example, may be installed so as to indicate whether or not the responses to earthquake warrant changes on operating procedure in a structure.

— **Diagnosis**

Where it has been established that vibration levels require further investigation, measurements are made in order to provide information for mitigation procedures.

Another diagnostic procedure is to use structural response to ambient or imposed loading to establish structural condition, for example, after a severe loading, such as an earthquake.

Such diverse purposes call for a variety of measuring systems ranging from the simple to the sophisticated, deployed in different types of investigation (see 9.2).

Technical guidance is needed by many interested parties on the most appropriate ways of measuring, characterizing and evaluating those vibrations that affect buildings. This applies both to buildings already in existence, which may be subjected to some new or changed source of excitation, and to the design of buildings to be erected in an environment where the building may be excited significantly.

The effects of vibration may also be taken into account by calculation (see 9.1).

Although the material in this International Standard may be used in appraising the relative severity of structural vibration, it is not to be regarded as suggesting acceptable or non-acceptable levels. Nor does it consider economic and social aspects, which would be dealt with, as appropriate, by national regulatory bodies.

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# Mechanical vibration and shock — Vibration of buildings — Guidelines for the measurement of vibrations and evaluation of their effects on buildings

## 1 Scope

This International Standard establishes the basic principles for carrying out vibration measurement and processing data, with regard to evaluating vibration effects on buildings. It does not cover the source of excitation except insofar as the source dictates dynamic range, frequency or other parameters. The evaluation of the effects of building vibration is primarily directed at structural response, and includes appropriate analytical methods where the frequency, duration and amplitude can be defined. This International Standard only deals with the measurement of structural vibration and excludes the measurement of airborne sound pressure and other pressure fluctuations although response to such excitations is taken into consideration.

A building, for the purposes of this International Standard, is defined as any above-ground structure, which man frequently inhabits. This excludes from consideration certain items of plant, for example columns, stacks, headframe, containments, even though they may receive intermittent visits from operating staff.

The structural response of buildings depends upon the excitation; to this end this International Standard examines the methods of measurements as affected by the source, i.e. frequency, duration, and amplitudes as induced by any source, such as earthquakes, explosions, wind effects, sonic booms, internal machinery, traffic, construction activities and others.

**NOTE 1** There are differences between earthquakes and man-made vibrations which affect recording conditions. Earthquake-fault-rupture sources are large in size and much deeper than most man-made sources. They can cause damage at great distances, have much greater energy flux and duration and a different pattern of wave propagation. Consequently, for the same parameter value (for example peak particle velocity), the effects on buildings are different.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2041:1975, *Vibration and shock — Vocabulary.*

ISO 2631-2:1989, *Evaluation of human exposure to whole-body vibration — Part 2: Continuous and shock-induced vibrations in buildings (1 to 80 Hz).*

ISO 4356:1977, *Bases for the design of structures — Deformations of buildings at the serviceability limit states.*

ISO 5348:1987, *Mechanical vibration and shock — Mechanical mounting of accelerometers.*

IEC 68-2-27:1987, *Environmental testing — Part 2: Tests — Test Ea and Guidance: Shock.*

## 3 Source-related factors to be considered

### 3.1 Characteristics of vibration responses in buildings

The types of vibration can be classified as

a) deterministic,

b) random,

and further subdivided as given in 8.2.