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**Bases for design of structures — Serviceability
of buildings against vibration**

*Bases du calcul des constructions — Aptitude au service des bâtiments
sous vibrations*



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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 10137 was prepared by Technical Committee ISO/TC 98, *Bases for design of structures*, Sub-Committee SC 2, *Reliability of structures*.

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

Introduction

Economic use of high-strength and lightweight materials has resulted in a trend towards more dynamically responsive structures. This trend is exacerbated by the emergence of new sources of vibration acting on buildings, and is compounded by an increasing demand for "vibration-free" environments for proper functioning of industrial and laboratory processes and instruments, and for work efficiency and personal comfort. In the past, vibrations in buildings have largely been controlled by specified loads or limitation of static deflections, or they have simply not occurred because of the massive nature of buildings. A number of unsatisfactory vibration levels in buildings have been observed, however, and this seems to indicate that the indirect criteria are no longer adequate. Hence, this International Standard was developed with the objective of presenting the principles for predicting vibrations at the design stage, in addition to assessing the acceptability of vibrations in existing structures.

The recommendations presented here are for serviceability and not for safety. It is, however, possible that some vibrations (usually associated with resonance) can become a safety hazard. Therefore, for severe dynamic loading, a check on the possible occurrence of resonance and associated limit stresses, deflections and fatigue effects should be carried out. The vibration effects discussed here represent a serviceability limit state in accordance with ISO 2394.

The serviceability limit state for vibrations is described by constraints, generally consisting of vibration amplitudes (displacement, velocity or acceleration), usually in combination with frequency or a frequency range and possibly with other parameters. The constraints can also be connected to stress, strain, cracking occurrence and duration. The constraints can be determined statistically, but are generally prescribed in codes deterministically.

The design or evaluation criteria employed for achieving satisfactory vibration behaviour of buildings in the serviceability limit state should consider, among others, the following aspects:

- a) variability of tolerance of human occupants due to cultural, regional or economic factors;
- b) sensitivity of building contents to vibrations and changing use and occupancy;
- c) emergence of new dynamic loadings which are not explicitly addressed by this International Standard;

- d) use of materials whose dynamic characteristics may change with time;
- e) impracticality of analysis due to complexity of the structure or complexity of the loading;
- f) social or economic consequences of unsatisfactory performance.

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Bases for design of structures — Serviceability of buildings against vibration

1 Scope

This International Standard gives recommendations on the serviceability of buildings against vibrations.

It covers three recipients of vibrations:

- a) human occupancy in buildings and on pedestrian bridges;
- b) the contents of the building;
- c) the structure of the building.

This International Standard applies to buildings, pedestrian bridges and walkways found within buildings or connecting them. It does not include bridges that carry vehicular traffic, even in conjunction with pedestrian traffic, nor the design of foundations or supporting structures of machinery.

NOTE 1 For the purposes of this International Standard, it is assumed that the building structure responds linearly to the applied loads. This means that the structure does not yield or fail, nor is it subject to significant non-linear effects.

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 2041:1990, *Vibration and shock — Vocabulary*.

ISO 2372:1974, *Mechanical vibration of machines with operating speeds from 10 to 200 rev/s — Basis for specifying evaluation standards*.

ISO 2394:1986, *General principles on reliability for structures*.

ISO 2631-1:1985, *Evaluation of human exposure to whole-body vibration — Part 1: General requirements*.

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 3898:1987, *Bases for design of structures — Notations — General symbols*.

ISO 3945:1985, *Mechanical vibration of large rotating machines with speed range from 10 to 200 r/s — Measurement and evaluation of vibration severity in situ*.

ISO 4866:1990, *Mechanical vibration and shock — Vibration of buildings — Guidelines for the measurement of vibrations and evaluation of their effects on buildings*.

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)*.

ISO 8569:1989, *Mechanical vibration — Shock-and-vibration-sensitive electronic equipment — Methods of measurement and reporting data of shock and vibration effects in buildings*.

ISO 8930:1987, *General principles on reliability for structures — List of equivalent terms*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 2041 and ISO 8930 and the following definitions apply. See also ISO 3898.