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**Seismic assessment and retrofit of  
concrete structures**

*Évaluation sismique et réhabilitation de structures en béton*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 7, *Maintenance and repair of concrete structures*.

## Introduction

Earthquakes bringing damage to structures have occurred frequently in many areas of the world. Heavy damage caused by earthquakes are concentrated on vulnerable structures. Due to these damaging earthquakes, human lives are lost and confusion in everyday life and stagnation of economic activities occur.

As the result of the direct action of earthquakes, structures may collapse or overturn in earthquake-prone areas. However, given a main shock occurs, it is expected that through seismic assessment and retrofit of concrete structures, human life losses, economical losses, and structural collapses could be mitigated and/or prevented and quick recovery could be attained.

In some nations, such as Japan and USA, the framework for the identification of vulnerable structures before and after an earthquake, seismic retrofit decision-making and construction exists. In addition, the standards for seismic assessment technology and for seismic retrofit technology are already established in those nations. Furthermore, technical manuals, in order to apply the standards to practical work, are established. Therefore, based on these standards, the social system is built where a country, a district and a local administrative agency (authorities), the owner of the structure, a user, a retrofit designer, a retrofit work supervisor, a retrofit work supplier, and other people concerned on this matter share a purpose of the seismic retrofit and the information about the effect of seismic retrofit, and the owner of the structure can judge the necessity of appropriate retrofit, and a seismic retrofit execution is carried out smoothly.

However, it is not so frequent that a huge earthquake disaster occurs in a specific country or an area. These conditions disturb conducting seismic assessment, seismic retrofit work, and smooth social decision making to conduct seismic retrofit. As a result, it is feared that the earthquake disaster will expand and the recovery from the disaster will be delayed when a large earthquake disaster happens once.

Therefore, it is necessary to establish a principle of seismic assessment, decision making for seismic retrofit, the framework of the procedure for screening the vulnerable structures, and seismic retrofit execution. This International Standard provides comprehensive principle on the evaluation of the seismic damage/expected damage of existing reinforced concrete structures and repair/retrofit. In other words, this International Standard provides the standard work items related to seismic assessment and retrofit, and standard procedures in each stage, and makes contents and the scope of each duty clear.

In this International Standard, the seismic performance of existing reinforced concrete structures is expressed in terms of the intensity of earthquake motions that will lead the structures to the safety limit state<sup>1)</sup> in principle. As the result, whether the existing RC structures fulfill the provisions of the design standard in the specific country or area does not matter. That is the feature of this International Standard.

The retrofit can be also conducted based on seismic performance, not on whether the seismic retrofit meets an existing standard. Because this International Standard set such a rational performance requirement mentioned above, the vulnerable parts which should be reinforced are clearly identified.

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1) Ultimate limit state is mainly considered. However, other limit states may be considered such as seismic damage control limit state when time history analysis is used.



# Seismic assessment and retrofit of concrete structures

## 1 Scope

The purpose of this International Standard is to reduce the risk of seismic damage by structural collapse or turnover during a seismic event.

This International Standard provides frameworks and principles of methods of detailed seismic assessment and the judgment, seismic retrofit plan and design, seismic retrofit execution of existing reinforced concrete structures before the occurrence of a severe earthquake and of the structures struck by an earthquake.

This International Standard is applicable to reinforced concrete structures and pre-stressed concrete structures that have been designed on the basis of the structural design criteria set in a specific country or region. It is not applicable to either unreinforced concrete structures or masonry structures.

## 2 Normative references

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

There are no normative references.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

#### **assessment**

set of activities performed in order to verify the reliability of an existing structure for future use

[SOURCE: ISO 13822:2010]

### 3.2

#### **collapse**

loss of the load-carrying capacity of a component or member within a structure or of the structure itself

### 3.3

#### **damage control limit state**

ability of a structure or structural element to be repaired physically and economically when damaged under the effects of considered actions

### 3.4

#### **design documents**

results of structural calculation and design drawings

### 3.5

#### **design service life**

period for which the structure is assumed to be in adequate condition for its intended purpose or function with anticipated maintenance but without requiring substantial repair being necessary