

Australian Standard™

**Basis for design of structures—
Assessment of existing structures
(ISO 13822:2001, MOD)**



This Australian Standard was prepared by Committee BD-006, General Design Requirements and Loading on Structures. It was approved on behalf of the Council of Standards Australia on 3 March 2005.
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Australian Steel Institute
Cement and Concrete Association of Australia
Concrete Masonry Association of Australia
CSIRO, Building, Construction and Engineering
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STANDARDS AUSTRALIA

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OF

AS ISO 13822—2005

**Basis for design of structures—Assessment of existing structures
(ISO 13822:2001, MOD)**

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NOTES

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PREFACE

This Standard was prepared by the Standards Australia Committee BD-006, General Design Requirements and Loading on Structures.

This Standard has been adopted with national modifications and has been reproduced from ISO 13822:2001, *Bases for design of structures—Assessment of existing structures*. The national modifications link the use of this Standard to the structural design Standards required for use in Australia.

This Standard provides owners, maintainers and designers of structures with general guidance on assessment of existing structures for safety and serviceability to facilitate structural design of additions or alterations to, changes of use of, or maintenance of such structures. It is intended to be used as further background to the AS/NZS 1170 series of Standards. It is not expected to be referred to by any regulations.

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<i>Reference to International Standard</i>	<i>Australian Standard</i>
ISO	AS
2394 General principles on reliability for structures	5104 General principles on reliability for structures

The national modifications to the text, as reproduced from ISO 13822, are given in annex ZA and the clauses to be modified are marked with margin bars.

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INTRODUCTION

The continued use of existing structures is of great importance because the built environment is a huge economic and political asset, growing larger every year. The assessment of existing structures is now a major engineering task. The structural engineer is increasingly called upon to devise ways for extending the life of structures whilst observing tight cost constraints. The establishment of principles for the assessment of existing structures is needed because it is based on an approach that is substantially different from the design of new structures, and requires knowledge beyond the scope of design codes. This document is intended not only as a standard of principles and procedures for the assessment of existing structures but also as a guide for use by structural engineers and clients. Engineers can apply specific methods for assessment in order to save structures and to reduce a client's expenditure. The ultimate goal is to limit construction intervention to a strict minimum, a goal that is clearly in agreement with the principles of sustainable development.

The basis for the reliability assessment is contained in the performance requirements for safety and serviceability of ISO 2394. Economic, social, and sustainability considerations, however, result in a greater differentiation in structural reliability for the assessment of existing structures than for the design of new structures

NOTES

AUSTRALIAN STANDARD

Basis for design of structures—Assessment of existing structures (ISO 13822:2001, MOD)

1 Scope

1.1 This International Standard provides general requirements and procedures for the assessment of existing structures (buildings, bridges, industrial structures, etc.) based on the principles of structural reliability and consequences of failure. It is based on ISO 2394.

1.2 It is applicable to the assessment of any type of existing structure that was originally designed, analysed and specified based on accepted engineering principles and/or design rules, as well as structures constructed on the basis of good workmanship, historic experience and accepted professional practice. The assessment can be initiated under the following circumstances:

- an anticipated change in use or extension of design working life;
- a reliability check (e.g. for earthquakes, increased traffic actions) as required by authorities, insurance companies, owners, etc.;
- structural deterioration due to time-dependent actions (e.g. corrosion, fatigue);
- structural damage by accidental actions (see ISO 2394).

NOTE 1 This International Standard is applicable to historical structures, provided additional considerations are taken into account concerning the preservation of the historical appearance of the structure and the preservation of its historical materials.

1.3 This International Standard is applicable to existing structures of any material, although specific adaptation can be required depending on the type of material, such as concrete, steel, timber, masonry, etc.

1.4 This International Standard provides principles regarding actions and environmental influences. Further detailed consideration will be necessary for accidental actions such as fire and earthquake.

NOTE 2 Fire resistance requires properties different from those for structural safety and integrity. Also fire hazards can be created by change in use. Special requirements are necessary for seismic hazards, taking the dynamic action and structural response into account.

1.5 This International Standard is intended to serve as a basis for preparing national standards or codes of practice in accordance with current engineering practice and the economic conditions.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2394:1998, *General principles on reliability for structures*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 2394 and the following apply. (See also annex A.)

3.1

assessment

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

3.2

damage

unfavourable change in the condition of a structure that can affect structural performance

3.3

deterioration

process that adversely affects the structural performance, including reliability over time due to

- naturally occurring chemical, physical or biological actions,
- repeated actions such as those causing fatigue,
- normal or severe environmental influences,
- wear due to use, or
- improper operation and maintenance of the structure

3.4

deterioration model

mathematical model that describes structural performance as a function of time, taking deterioration into account

3.5

inspection

on-site non-destructive examination to establish the present condition of the structure

3.6

investigation

collection and evaluation of information through inspection, document search, load testing and other testing

3.7

load testing

test of the structure or part thereof by loading to evaluate its behaviour or properties, or to predict its load-bearing capacity

3.8

maintenance

routine intervention to preserve appropriate structural performance

3.9

material properties

mechanical, physical or chemical properties of structural materials

3.10

monitoring

frequent or continuous, normally long-term, observation or measurement of structural conditions or actions

3.11 reference period

chosen period of time which is used as a basis for assessing values of variable actions, time-dependent material properties, etc.

NOTE The remaining working life or the minimum standard period for safety of an existing structure can be taken as reference period (see annex F).

3.12 rehabilitation

work required to repair, and possibly upgrade, an existing structure

3.13 remaining working life

period for which an existing structure is intended/expected to operate with planned maintenance

3.14 repair, verb

⟨of a structure⟩ improve the condition of a structure by restoring or replacing existing components that have been damaged

3.15 safety plan

plan specifying the performance objectives, the scenarios to be considered for the structure, and all present and future measures (design, construction, or operation, such as monitoring) to ensure the safety of the structure

3.16 structural performance

qualitative or quantitative representation of the behaviour of a structure (e.g. load-bearing capacity, stiffness) in terms of its safety and serviceability

3.17 target reliability level

level of reliability required to ensure acceptable safety and serviceability

3.18 upgrading

modifications to an existing structure to improve its structural performance

3.19 utilization plan

plan containing the intended use (or uses) of the structure, and listing the operational conditions of the structure including maintenance requirements, and the corresponding performance requirements

4 General framework of assessment

4.1 Objectives

The objective of the assessment of an existing structure in terms of its required future structural performance shall be specified in consultation with the client (the owner, the authority, insurance companies, etc.) based on the following performance levels.

- a) Safety performance level, which provides appropriate safety for the users of the structure.
- b) Continued function performance level, which provides continued function for special structures such as hospitals, communication buildings or key bridges, in the event of an earthquake, impact, or other foreseen hazard.

- c) Special performance requirements of the client related to property protection (economic loss) or serviceability. The level of this performance is generally based on life cycle cost and special functional requirements.

4.2 Procedure

The assessment procedure is composed in general of the following steps so that the assessment is carried out taking into account the actual conditions of the structures (see the flowchart in annex B). The procedure depends on the assessment objectives (see 4.1), and on specific circumstances (e.g. the availability of the design documents, the observation of damage, the use of the structure). A site visit is recommended prior to initiating the procedure.

- a) Specification of the assessment objectives.
- b) Scenarios.
- c) Preliminary assessment:
 - 1) study of documents and other evidence;
 - 2) preliminary inspection;
 - 3) preliminary checks;
 - 4) decisions on immediate actions;
 - 5) recommendation for detailed assessment.
- d) Detailed assessment:
 - 1) detailed documentary search and review;
 - 2) detailed inspection and material testing;
 - 3) determination of actions;
 - 4) determination of properties of the structure;
 - 5) structural analysis;
 - 6) verification.
- e) Results of assessment:
 - 1) report;
 - 2) conceptual design of construction interventions;
 - 3) control of risk.
- f) Repeat the sequence if necessary.

The procedure outlined above may be applied to both the assessment of one specific structure and the assessment of a group of structures.

4.3 Specification of the assessment objectives

At the outset, the objective of the assessment of the structure shall be clearly specified in terms of its future performance in an agreement between the client, the authorities when relevant and the assessing engineer (see 4.1). The required future performance shall be specified in the utilization plan and safety plan.

4.4 Scenario

Scenarios related to a change in structural conditions or actions should be specified in the safety plan in order to identify possible critical situations for the structure. Each scenario is characterized by a predominant process or action and, where appropriate, by one or more accompanying processes or actions. The identification of scenarios represents the basis for the assessment and design of interventions to be taken to ensure structural safety and serviceability.

4.5 Preliminary assessment

4.5.1 Study of documents and other evidence

Design and inspection documents contain important information that is necessary for a thorough assessment of an existing structure. It shall be verified that the documents are correct, and that they are updated to include information of any previous intervention to the structure. Other evidence, such as the occurrence of significant environmental or seismic actions, large actions, changes in soil conditions, corrosion, and misuse of the structure, shall be recorded and documented.

4.5.2 Preliminary inspection

The aim of a preliminary inspection is to identify the structural system and possible damage to the structure by visual observation with simple tools. The information collected is related to aspects such as surface characteristics, visible deformations, cracks, spalling, corrosion. The results of the preliminary inspection are expressed in terms of a qualitative grading of structural conditions (e.g. none, minor, moderate, severe, destructive, unknown) for possible damage.

4.5.3 Preliminary checks

The purpose of the preliminary checks is to identify the critical deficiencies related to the future safety and serviceability of the structure with a view to focussing resources on these aspects in subsequent assessment. Based on these results, it is then judged whether a further investigation is necessary or not.

4.5.4 Decisions on immediate actions

When the preliminary inspections and/or checks clearly indicate that the structure is in a dangerous condition, it is necessary to report to the client that interventions should be taken immediately to reduce the danger with respect to public safety. If there is uncertainty, the critical deficiencies should be assessed immediately and actions taken, if necessary.

4.5.5 Recommendations for detailed assessment

The preliminary checks may clearly show the specific deficiencies of the structure, or that the structure is reliable for its intended use over the remaining working life, in which case a detailed assessment is not required. Where there is uncertainty in the actions, action effects or properties of the structure, a detailed assessment should be recommended in accordance with 4.6.