AS 5104:2017
ISO 2394:2015

AS 5104:2017

Australian STANDARD

General principles on reliability for structures

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General principles on reliability for structures

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Preface

This Standard was prepared by the Standards Australia Committee BD-006, General Design Requirements and Loading on Structures, to supersede AS 5104—2005, *General principles on reliability for structures.*

The objective of this Standard is to provide a risk and reliability-informed foundation for decision making concerning design and assessment of structures in the context of specific projects. This Standard describes how the principles of risk and reliability can be utilized to support decisions related to the design and assessment of structures and systems involving structures over their service life. Three different but related levels of approach are facilitated, namely, a risk-informed, a reliability-based, and a semi-probabilistic approach.

This Standard addresses societal functionality and sustainable societal development which may exceed the current objectives of the National Construction Code (NCC) and the Australian Building Codes Board Intergovernmental Agreement (IGA) that establishes the ABCB. For buildings to which the NCC applies, the objective requirements of the IGA and NCC apply.

This Standard encompasses precautionary principles which may lead to outcomes which would not meet the ABCB and COAG best practice regulation principles. As appropriate, the designer may apply the concept of so far as is reasonably practicable (SFAIRP).

Australian Standards commonly use the load resistance factor design method (LRFD) in the determination of reliability when using the semi-probabilistic methods outlined in Clause 9.4 of this Standard.

This Standard is identical with, and has been reproduced from ISO 2394:2015, *General principles on reliability for structures.*

As this Standard is reproduced from an International Standard, the following applies:

(a) In the source text 'this International Standard' should read 'this Australian Standard'.

(b) A full point substitutes for a comma when referring to a decimal marker.

None of the normative references in the source document have been adopted as Australian or Australian/New Zealand Standards.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the annex to which they apply. A 'normative' annex is an integral part of a Standard, whereas an 'informative' annex is only for information and guidance.

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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).

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).

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 98, *Bases for design of structures*, SC 2, *Reliability of structures*.

This fourth edition cancels and replaces the third edition (ISO 2394:1998), which has been technically revised.

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Introduction

The present fourth edition of this International Standard is intended to reflect advances in the common basis for decision making related to load-bearing structures relevant to the construction industry. Advances range from the development of systematic and rational treatment of risk to implementation of reliability-based design through codes and standards.

Compliance with this International Standard should therefore promote harmonization of design practice internationally and unification between the respective codes and standards such as for actions and resistances for the respective structural materials.

The principles and appropriate instruments to ensure adequate levels of reliability provide for special classes of structures or projects where the common experience base need to be extended in a rational manner.

In particular, a risk framework has been introduced which is scenario based, facilitates unified modelling approaches over different applications, accounts for consequences of both a direct and indirect nature, and has emphasis on robustness.

Whereas requirements to safety and reliability in the previous edition of this International Standard took their basis in efficiency requirements of a heuristic character, these are now based on risk considerations and socio-economics. This, in turn, facilitates a more relevant use of the International Standard in the context of sustainable societal developments and adaptation for application of the International Standard in different nation states in accordance with economic capacity and preferences.

The present International Standard, thus, enables the possibility to regulate, verify, and document the adequate safe performance of structures and also to consider them in a broader sense as part of societal systems. The International Standard provides for approaches at three levels, namely the following:

— risk informed;

— reliability based;

— semi-probabilistic.

The methodical basis for this edition of ISO 2394 is described in the Probabilistic Model Code[8] and Risk Assessment in Engineering — Principles, System Representation and Risk Criteria[9] by the Joint Committee on Structural Safety (JCSS), and EN 1990 (2007), where the reader will find additional information of relevance for its use.

Informative Annexes are included to this International Standard as a support to its users in the interpretations and use of the principles contained in its clauses.

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Australian Standard®

General principles on reliability for structures

1 Scope

This International Standard constitutes a risk- and reliability-informed foundation for decision making concerning design and assessment of structures both for the purpose of code making and in the context of specific projects.

The principles presented in this International Standard cover the majority of buildings, infrastructure, and civil engineering works, whatever the nature of their application and use or combination of the materials used[1)]. The application of this International Standard will require specific adaptation and detailing in special cases where there are potentially extreme consequences of failure[2)].

This International Standard is intended to serve as a basis for those committees responsible for the task of preparing international standards, national standards, or codes of practice in accordance with given objectives and context in a particular country.

The present International Standard describes how the principles of risk and reliability can be utilized to support decisions related to the design and assessment of structures and systems involving structures over their service life. Three different but related levels of approach are facilitated, namely, a risk-informed, a reliability-based, and a semi-probabilistic approach.

The general principles are applicable to the design of complete structures (buildings, bridges, industrial structures, etc.), the structural elements and joints making up the structures and the foundations. The principles of this International Standard are also applicable to the successive stages in construction, the handling of structural elements, their erection, and all work on-site, as well as the use of structures during their design working life, including maintenance and rehabilitation, and decommissioning.

Risk and reliability are concepts accounting for and describing actions, structural response, durability, life-cycle performance, consequences, design rules, workmanship, quality control procedures, and national requirements, all of which are mutually dependent.

The application of this International Standard necessitates knowledge beyond what is contained in the Clauses and the Annexes. It is the responsibility of the user to ensure that this knowledge is available and applied.

2 Terms and definitions

2.1 General terms

2.1.1
structure
organized combination of connected parts including geotechnical structures designed to provide resistance and rigidity against various actions

2.1.2
structural member
physically distinguishable part of a structure, e.g. column, beam, plate, foundation

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1) The present International Standard is completely general from the perspective of basic principles and can be applied for any structure below, on, and over the surface of the Earth.

2) This concerns, for example, structures of nuclear power plants and offshore oil and gas facilities in highly sensitive environments.

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2.1.3
system
bounded group of interrelated, interdependent, or interacting members forming an entity that achieves a defined objective in its environment through interaction of its parts and interactions of its parts with the environment

2.1.4
structural system
load-bearing members of a building or civil engineering structure and the way in which these members function together and interact with the environment

2.1.5
requirement
demand with respect to structural aspects like safety for people and environment, functionality, usage, and commitment of resources and cost efficiency

2.1.6
compliance
fulfilment of specified requirements

2.1.7
life cycle
life cycle incorporates initiation, project definition, design, construction, commissioning, operation, maintenance, refurbishment, replacement, deconstruction, and ultimate disposal, recycling, or re-use of the structure (or parts thereof), including its components, systems, and building services

2.1.8
reliability
ability of a structure or structural member to fulfil the specified requirements, during the working life, for which it has been designed.

Note 1 to entry: Reliability is often expressed in terms of probability.

Note 2 to entry: Reliability covers safety, serviceability, and durability of a structure.

2.1.9
structural safety
ability (of a structure or structural member) to avoid exceedance of ultimate limit states, including the effects of specified accidental phenomena, with a specified level of reliability, during a specified period of time

2.1.10
durability
capability of a structure or any structural member to satisfy with planned maintenance the design performance requirements over a specified period of time under the influence of the environmental actions

2.1.11
exposure events
events which may cause damage or otherwise affect the performance indicators for the structure

2.1.12
assessment
total set of activities performed in order to verify the reliability of an existing structure

2.1.13
upgrading
modifications of an existing structure, construction works, and procedures to improve its structural performance or facilitate its use for new purposes

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