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**Maintenance and repair of concrete  
structures —**

**Part 1:  
General principles**

*Entretien et réparation des structures en béton —*

*Partie 1: Principes généraux*  
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# Contents

Page

<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Basis of maintenance and repair</b> .....	<b>4</b>
4.1 General.....	4
4.2 Procedure of maintenance and repair.....	5
4.3 Competence of personnel.....	5
<b>5 Maintenance plan</b> .....	<b>5</b>
5.1 General.....	5
5.2 Timing of maintenance planning for structure.....	6
5.3 Selection of maintenance category.....	6
5.4 Final determination of maintenance plan.....	6
<b>6 Assessment</b> .....	<b>6</b>
6.1 General.....	6
6.2 Assessment plan.....	7
6.3 Investigation.....	8
6.4 Registration of condition.....	8
6.5 Evaluation and judgment.....	8
<b>7 Repair including prevention</b> .....	<b>9</b>
7.1 General.....	9
7.2 Planning and design.....	9
7.3 Execution.....	12
<b>8 Recording</b> .....	<b>13</b>
8.1 General.....	13
8.2 Period of preservation.....	14
8.3 Method of recording.....	14
<b>Annex A (informative) Extended hierarchy of “Standards for maintenance and repair of concrete structures” with national legislation and other related International Standards</b> .....	<b>15</b>
<b>Annex B (informative) Hierarchy of terms</b> .....	<b>16</b>
<b>Annex C (informative) Category of maintenance</b> .....	<b>17</b>
<b>Bibliography</b> .....	<b>19</b>

## 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*.

ISO 16311 consists of the following parts under the general title *Maintenance and repair of concrete structures*:

- *Part 1: General principles*
- *Part 2: Assessment of existing concrete structures*
- *Part 3: Design of repairs and prevention*
- *Part 4: Execution of repair and prevention*

## Introduction

In the context of this part of ISO 16311, maintenance and repair are two closely related activities aimed at securing that a concrete structure (hereinafter referred to as “structure”) is retained in a state in which it can perform its required functions, while in an acceptable and safe condition. Maintenance will be used as a general term that also covers repair as a distinct activity to restore worn, damaged, or deteriorated parts. For a well-designed and well-executed concrete structure with proper maintenance, repair should not be necessary within the service life of the structure.

This part of ISO 16311 covers the activities necessary to retain the performance of the structure above the required levels during its service life, such as:

- maintenance planning for existing structures;
- assessment of structure including inspection/investigation and evaluation of the performance of structure;
- planning and designing repair in case it is required due to damage, deterioration, or wear;
- execution of repair including preparation, execution, and documentation.

The main scope of this part of ISO 16311 is the maintenance and repair of existing structures. The goal of maintenance and repair strategies is to plan and execute systematic routines that minimize degradation of performance and serviceability of a structure during its service life in the most cost-effective manner.

This part of ISO 16311 does not address newly built structures for which it is recommended that a maintenance plan should be established at the design stage. However, a so called “birth certificate” for newly built structures will be useful in later planning of maintenance and repair. Reference is given to ISO 16204, where this is covered.

“Part 1: General principles” provides the framework of maintenance activities for all structures or their components and gives general principles of each activity. As shown in [Figure 1](#), this part of ISO 16311 is the first of four parts dealing with maintenance and repair of concrete structures. The subsequent three parts, namely “Assessment of existing structures”, “Design of repairs and prevention”, and “Execution of repairs and prevention” are the operational parts of this set of International Standards giving detailed requirements and guidelines (an extended hierarchy of the parts and other related International Standards are shown in [Annex A](#)).

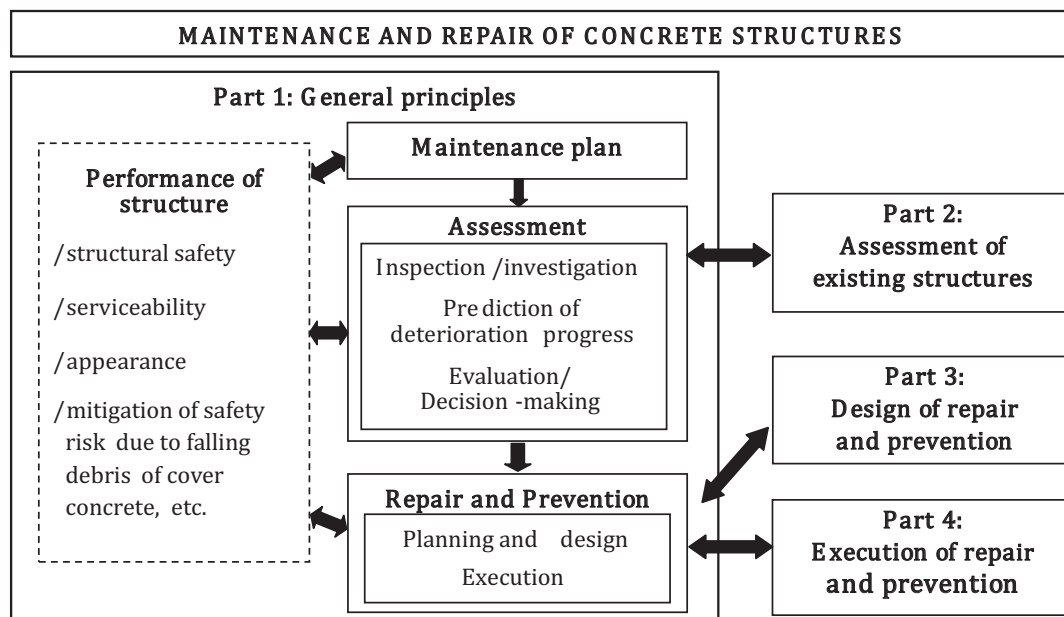


Figure 1 — Relationship between each part of this International Standard

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# Maintenance and repair of concrete structures —

## Part 1: General principles

### 1 Scope

This part of ISO 16311 presents the framework and general principles for maintenance and repair of all kinds of existing concrete structures — un-reinforced and reinforced concrete, prestressed concrete and steel-concrete composite structures, or their structural members.

In this part of ISO 16311, deterioration is clearly distinguished from damage occurring in a short period and not developing over subsequent time, such as cracking and scaling due to earthquakes or impact loading, etc. Deterioration is mainly dealt with as a target for the maintenance activities.

This part of ISO 16311 also provides the basic concept of repair and preventions carried out to restore structural performance of existing structures.

This part of ISO 16311 does not cover those aspects of maintenance and repair that are related to serviceability and esthetics without direct impact on durability and service life, e.g. cleaning of drains, removal of vegetation, refreshment of paint, etc.

This International Standard also does not cover repair of defects during execution of new structures.

### 2 Normative references

[ISO 16311-1:2014](#)

[https://www.iso.org/standards/catalog/standards/sist/f668d069-69de-4669-9f38-b08a24dc57b8/iso-16311-1-2014](#)

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.

ISO 16311-2, *Maintenance and repair of concrete structures — Part 2: Assessment of existing concrete structures*

ISO 16311-3, *Maintenance and repair of concrete structures — Part 3: Design of repairs and prevention*

ISO 16311-4, *Maintenance and repair of concrete structures — Part 4: Execution of repairs and prevention*

ISO 19338:2007, *Performance and assessment requirements for design standards on structural concrete*

### 3 Terms and definitions

For the purpose of this International Standard, the following terms and definitions shall apply with those in ISO 19338.

#### 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 amended service life

revised service life period of a structure-in-service during which it meets prescribed performance requirements for duration specified by the owner, possibly representing an amendment of the original design service life

Note 1 to entry: A change from the original design service life can arise from changing owner requirements, accelerated deterioration of a structure or its components such that they do not meet prescribed performance requirements, a usage change affecting performance requirements, or the owner's selection of maintenance and repair scenarios that might shorten or extend the original design service life period.

Note 2 to entry: See [Figure 2](#).

### 3.3 design service life

period of time specified in design of structure for which a structure or its members is to be used for its intended purpose without major repair being necessary

Note 1 to entry: See [Figure 2](#).

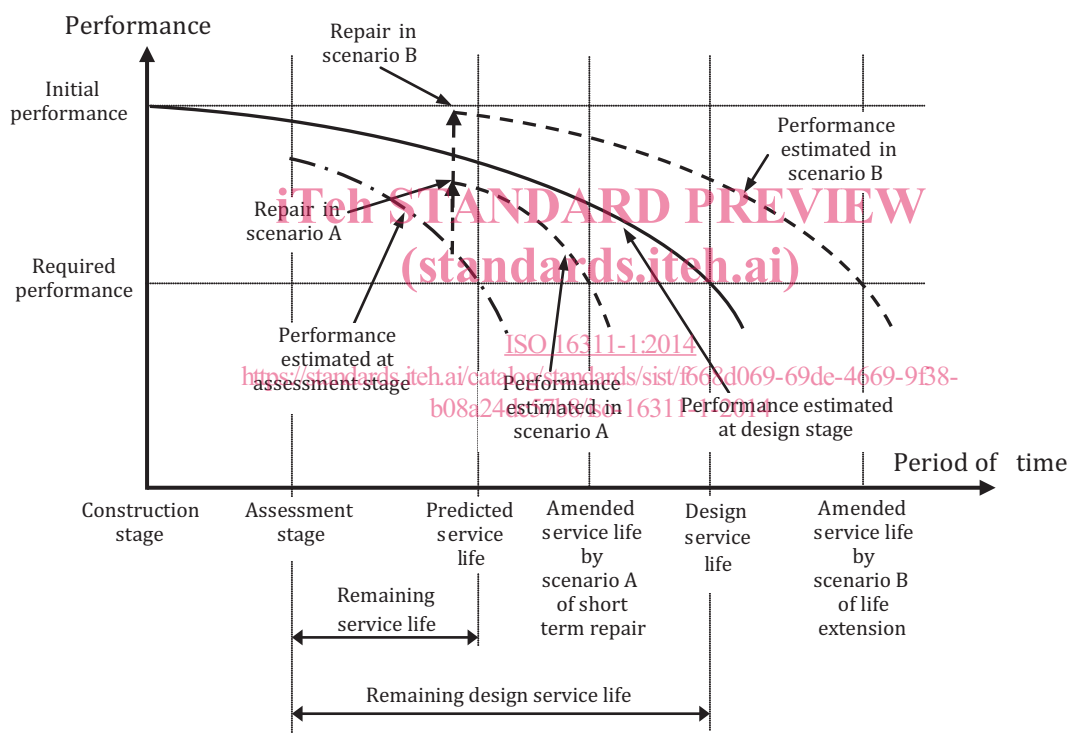


Figure 2 — Definitions of service life

### 3.4 deterioration

process that adversely affects the performance of a structure, including reliability over time due to defects and damages caused by

- naturally occurring chemical, physical, biological, or other environmental actions,
- repeated mechanical actions such as those causing fatigue,
- wear due to use, abuse, and others, and
- improper operation and maintenance of the structure

[SOURCE: ISO 13822:2010]



**3.5****durability**

capability of a structure or any of its members to satisfy, with planned maintenance, the required performance over a specified period of time under the influence of the environmental action

[SOURCE: ISO 13823:2008]

Note 1 to entry: “durability” is often used as qualitative term to express condition in which structure maintains its required performance, such as structural safety, serviceability, and appearance, during the service life.

**3.6****inspection**

conformity evaluation by observation and judgment accompanied as appropriate by measurement, testing, or gauging

[SOURCE: ISO 16311-2]

Note 1 to entry: For structures, this evaluation consists of actions collecting information on the current state of a structure through observation and simplified non-destructive or destructive testing supplemented with materials and structural testing, as required.

**3.7****investigation**

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

**3.8****maintenance**

set of activities taken to check, evaluate the performance of a structure, and preserve/restore it so as to satisfy performance requirements in service

**3.9****maintenance category**

class of maintenance depending on importance, service life, environmental conditions, maintainability of the structures, etc

**3.10****maintenance plan**

plan realizing maintenance strategy in order to ensure that the structure retain the performance within the specified tolerances throughout its service life

Note 1 to entry: This includes planning not only for assessment but also for repair or other remedial actions.

**3.11****monitoring**

frequent or continuous, normally long-term, observation or measurement with recording of appropriate data for deterioration and/or performance of structure using appropriate equipment

**3.12****predicted service life**

period of time estimated based on activities of assessment, such as recorded performance, previous experience, tests, or modeling

Note 1 to entry: See [Figure 2](#).

**3.13****prevention**

remedial action to prevent or slow down the further deterioration of a structure or structural member and to reduce the possibility of damage to the user or any third party, inhibiting the progress of deterioration, and proactively preventing deterioration

**3.14**

**rehabilitation**

work required to repair and possibly upgrade an existing structure

[SOURCE: ISO 13822:2010]

**3.15**

**remaining design service life**

period from the time of a given inspection of a structure till the end of its design service life

Note 1 to entry: See [Figure 2](#).

**3.16**

**remaining service life**

period from the time of a given assessment of a structure until the end of its predicted service life

Note 1 to entry: See [Figure 2](#).

**3.17**

**remedial action**

action carried out with the objective of arresting or slowing down the deterioration process, restoring or improving the performance of structure, or reducing the danger of damage or injury to the user or any third party

**3.18**

**repair**

restoration of a structure or its components to an acceptable condition by the renewal or replacement of worn, damaged, or deteriorated components

[SOURCE: ISO 13823:2008]

Note 1 to entry: Repair is adopted to restore structural performance and to mitigate safety risks up to the initially required design level and to achieve the intended service life.

**3.19**

**repair plan**

plan for establishing the method and level of repair, determining the materials, sectional dimensions, and execution methods, specifying the control items during execution in consideration of the policy and level of repair

**3.20**

**safety risks due to falling debris**

hazards of damage and/or injury caused by concrete fragments and surface coating (finishing) materials, etc. falling from a deteriorated structure

**3.21**

**service life**

actual period during which a structure meets the prescribed performance requirement

**3.22**

**strengthening**

measures taken to improve structural performance relating to load bearing capacity and deformation of an existing structure and/or its members

## **4 Basis of maintenance and repair**

### **4.1 General**

A concrete structure shall retain the required performance for its service life by providing necessary maintenance and repair activities, such that its performance is always above the required performance

level with adequate reliability under an appropriate maintenance plan. A qualified person (design professional, engineer, etc.) shall develop a proper maintenance plan that could permit a structure to retain its required performance

## 4.2 Procedure of maintenance and repair

A general flow of maintenance procedure is shown in Figure 3. The overall maintenance activities shall encompass the maintenance plan, assessment (including investigation/inspection, prediction of progress of deterioration, and evaluation of structural integrity/decision-making), and shall be followed by repair, prevention, or other remedial actions (if required). Results of these activities shall be recorded with an easily accessible format.

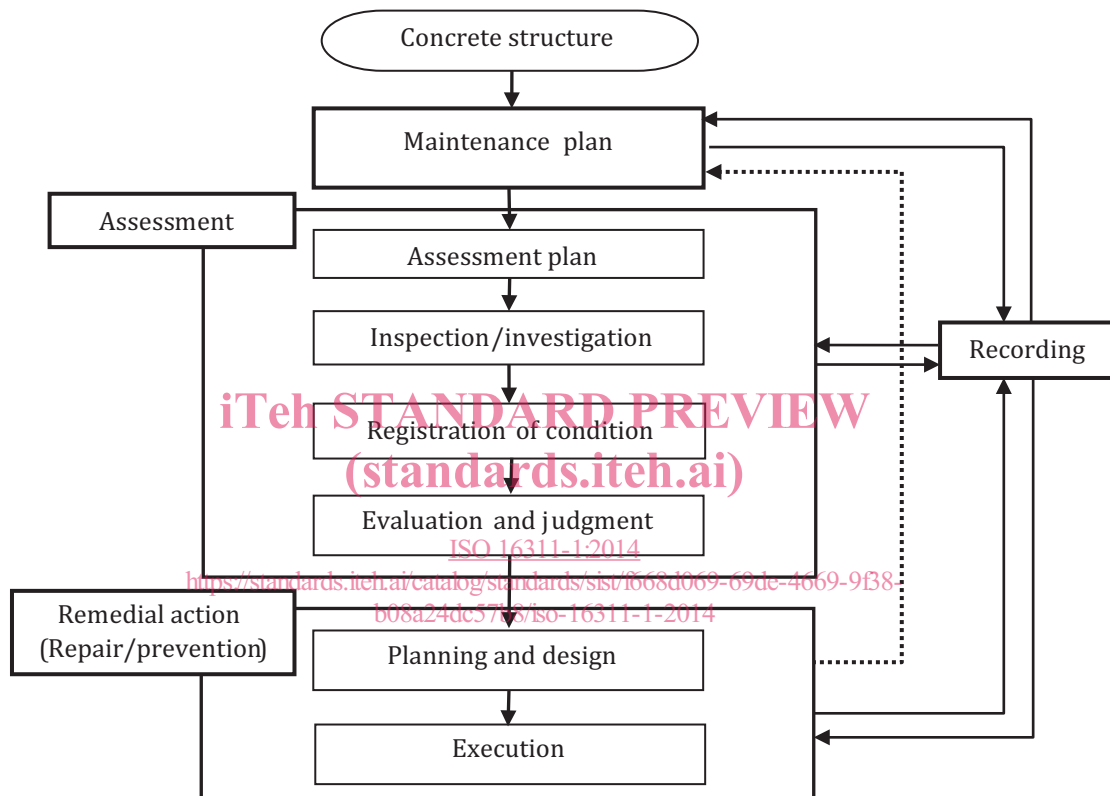


Figure 3 — General maintenance procedure

## 4.3 Competence of personnel

All activities of maintenance and repair shall be carried out by a team of qualified persons having the adequate knowledge of design, construction, maintenance, and repair of concrete structures.

NOTE In some countries, there are special requirements regarding the level of knowledge, training, and experience of persons involved in the different tasks.

## 5 Maintenance plan

### 5.1 General

For accomplishing overall maintenance activities, an adequate maintenance plan shall be formulated taking into account the maintenance category selected provisionally in accordance with 5.3, remaining service life, life-cycle cost, and other considerations particular to the structure.