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Buildings and constructed assets — Service life planning —

Part 7: Performance evaluation for feedback of service life data from practice

Bâtiments et biens immobiliers construits — Prévision de la durée de vie —

Partie 7: Évaluation de la performance de l'information en retour relative à la durée de vie, issue de la pratique

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 15686-7 was prepared by Technical Committee ISO/TC 59, *Building construction*, Subcommittee SC 14, *Design life*.

ISO 15686 consists of the following parts, under the general title *Buildings and constructed assets — Service life planning*:

— *Part 1: General principles*

— *Part 2: Service life prediction procedures*

— *Part 3: Performance audits and reviews*

— *Part 5: Whole life costing*

— *Part 6: Procedures for considering environmental impacts*

— *Part 7: Performance evaluation for feedback of service life data from practice*

— *Part 8: Reference service life*

Introduction

ISO 15686, with the general title *Buildings and constructed assets — Service life planning*, of which this document is Part 7, is an important contribution to the development of a policy for design life. A major impetus for the preparation of the parts of ISO 15686 is the current concern over the inability to predict service life, costs of ownership and maintenance of buildings and constructed assets. Common methods and standards for performance assessment and proper feedback of data from practice are decisive in order to make experience data from the building stock consistent and comparable. The purpose of this part of ISO 15686 is therefore to describe the principles for service life performance surveys and evaluation with an emphasis on technical recommendations. It aims to describe a generic methodology, including the terms to be used, that provide guidance on the planning, documentation and inspection phases, as well as on analysis and interpretation of performance evaluations, both on the object (single building) and network (stock of buildings) level. Maintenance planning is outside the scope of this part of ISO 15686.

ISO 15686-7 is intended for all members of a building team, i.e. building owners and developers, professional advisors, constructors, assessors, manufacturers of building products, managers of both publicly and privately owned constructed assets.

Buildings and constructed assets — Service life planning —

Part 7: Performance evaluation for feedback of service life data from practice

1 Scope

This part of ISO 15686 provides a generic basis for performance evaluation for feedback of service life data from existing buildings and constructed assets, including a definition of the terms to be used and the description of how the (technical) performance can be described and documented to ensure consistencies.

2 Normative references

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

ISO 6241:1984, *Performance standards in building — Principles for their preparation and factors to be considered*

ISO 15686-1:2000, *Buildings and constructed assets — Service life planning — Part 1: General principles*

ISO 15686-2:2001, *Buildings and constructed assets — Service life planning — Part 2: Service life prediction procedures*

ISO 15686-8:—[1)], *Buildings and constructed assets — Service life planning — Part 8: Reference service life*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15686-1, ISO 15686-2 and the following apply.

3.1
consequence degree
expression of the seriousness of consequences in relation to a defined reference level

3.2
network level
stock of objects (facilities, e.g. bridges, tunnels, power plants, buildings) under management and maintenance of an owner

1) In preparation.

3.3
object level
basic unit of the network serving a specific function

3.4
performance survey
total survey (defining of the task, planning, examination, evaluation and reporting) at a given time in accordance with this part of ISO 15686

3.5
performance assessment
all material that accounts for an item's performance throughout its service life

3.6
performance degree
expression of the performance of an item in relation to a defined reference level

3.7
performance control
comparison between performance and defined requirements

3.8
refurbishment
modification and improvements to an existing item to bring it up to an acceptable condition

[ISO 6707-1]

3.9
repair
return a product/component/assembly/system to an acceptable condition by renewal, replacement or mending of worn, damaged or degraded parts

[ISO 6707-1]

3.10
renewal
demolition and rebuilding of an existing item

3.11
replacement
change of parts of an existing item to regain its functionality

3.12
risk
probability of an event (e.g. failure, damage) multiplied by its consequences (e.g. cost, fatalities, exposure to personal or environmental hazard)

3.13
symptom
indicator of the loss of performance of an item

3.14
in-use condition
any circumstance that contributes to or causes the degradation of a building/constructed assets or a part of it under normal use

NOTE In order to encompass all of the seven factor classes of the Factor method, this definition has been extended relative to that given in ISO 15686-2:2001, 3.3.5, thus being in accordance with ISO 15686-1:2000, 3.1.2, where "in-use condition" is referred to as influencing any of the seven factors.

3.15
usage conditions
in-use conditions due to users of a building/constructed assets, and human activity adjacent to a building/constructed assets

NOTE In this part of ISO 15686, the Factor class F is designated “usage conditions” rather than “in-use condition” as used but not defined in ISO 15686-1. This is called for in order to distinguish the factor class from the term “in-use condition” as defined in ISO 15686-2 as “environmental condition under normal use”.

3.16
factor class
label of an in-use condition indicating which factor of the Factor method the condition will influence

3.17
in-use condition grading
act of collective judgement of all qualitative information of in-use conditions within a factor class

3.18
in-use condition grade
outcome of an in-use condition grading

4 Methodological framework

4.1 Service life planning

In ISO 15686-1, the concept of reference service life (RSL) is defined as the “service life of a product/component/assembly/system that is known to be expected under a particular set, i.e a reference set, of in-use conditions and which may form the basis of estimating the service life under other in-use conditions”.

A person working with the service life planning (SLP) of a design object is faced with the problem of forecasting the service life of its components. Even if there are certain service life data available, i.e. RSLs, these can rarely be used directly. This is because the project-specific in-use conditions, to which the object's components are subjected, are usually different from those under which the service life data are valid, i.e. the reference in-use conditions.

In ISO 15686-1:2000, Clause 9, the Factor method is described as a means to overcome this problem. The Factor method is used to modify an RSL to obtain an estimated service life (ESL) of the components of a design object, while considering the difference between the project-specific and the reference in-use conditions. This is carried out by multiplying the RSL by a number of factors, each of which reflect the difference between the two sets of in-use conditions within a particular factor class:

$$\text{ESL} = \text{RSL} \times \text{Factor A} \times \text{Factor B} \times \text{Factor C} \times \text{Factor D} \times \text{Factor E} \times \text{Factor F} \times \text{Factor G}$$

The factor classes are given in Table 1.

NOTE The Factor method will be moved to ISO 15686-8 when ISO 15686-1:2000 is revised.

Table 1 — Factor classes of the Factor method

Factor classes of the Factor method	
Factor class	**Designation**
A	quality of components
B	design level
C	work execution level
D	indoor environment
E	outdoor environment
F	usage conditions
G	maintenance level

The evaluation of an ESL according to the Factor method requires the input of an RSL as well as the numbers of the Factor classes A to G. A proper choice of the numbers of the factors depends on the difference between the project-specific and the reference in-use conditions. Therefore, in order to enable estimations of the Factor classes A to G jointly with RSL, the reference in-use conditions in terms of the factor classes should, as far as possible, be included when providing data.

Currently, there are a limited number of systematic studies on service life prediction and there is an urgent need for data. For the provision of RSL data, the capturing of existing data of any kind is acceptable.

4.2 Performance assessment of service life in the course of the construction life cycle

4.2.1 Relation to service life design and reference service life (RSL)

The performance levels of the construction and its components change during the life cycle of the construction (see Figure 1). The in-use conditions can also be subject to change. Therefore, a proper assessment of the service life during the construction life cycle should include a thorough assessment of the existing in-use conditions, and record any changes to the levels used in the design process, if applicable.

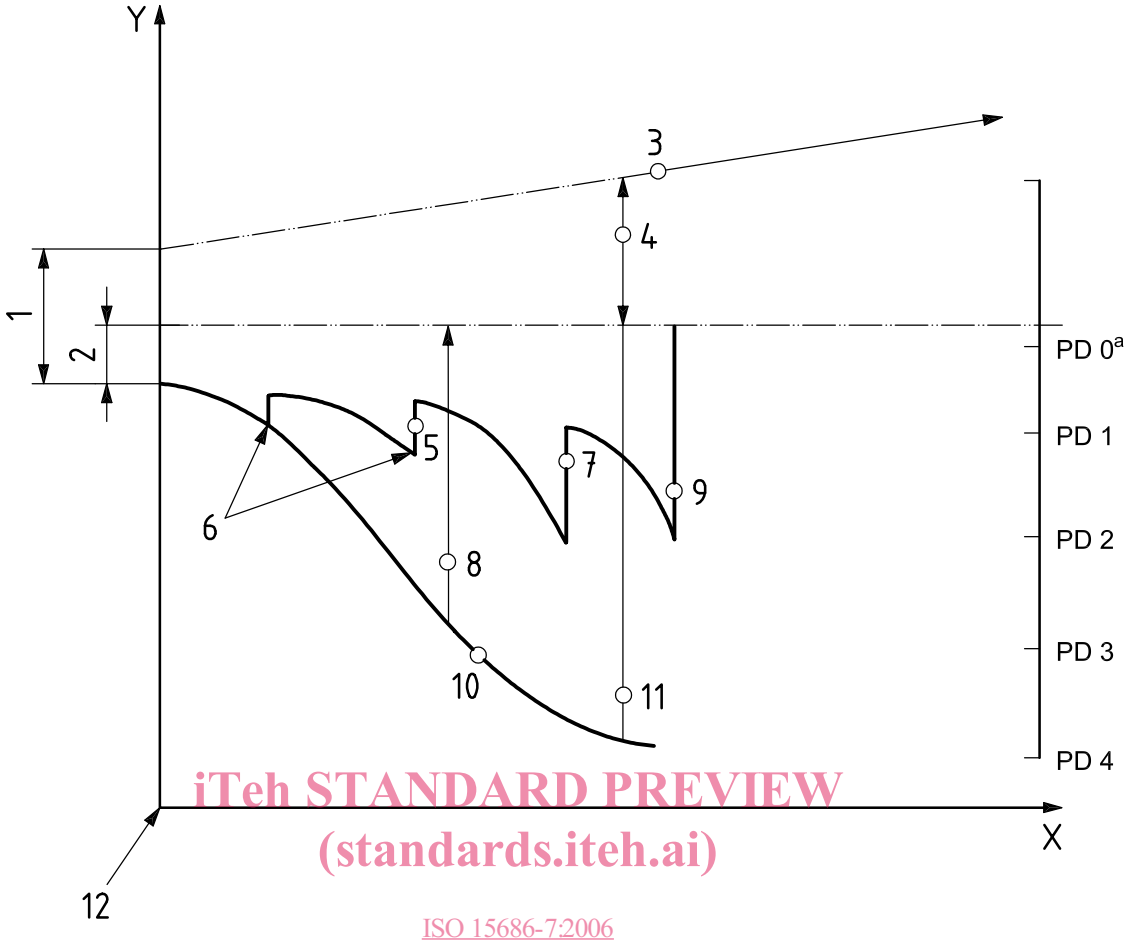
A main objective of this part of ISO 15686 is to provide a basis for objective assessment and to describe how information retrieved during performance assessments can become new input in the RSL data, as described in ISO 15686-8. As such, this part of ISO 15686 adds further to the data generating method of inspection of the building specified in ISO 15686-1:2000, 8.2.5 b).

4.2.2 Life cycle performance of construction

Figure 1 illustrates scenarios in the development of the performance (bold line) of construction works from delivery through the maintenance and operation phase. There is a deviation (gap) in performance from the client's expectations and requirements from the brief (initial) phase until the delivery ("as built") phase, often due to failures or damage during fabrication. The expectation gap is increased further due to the continuous rise in new requirements and upgrading, business development, etc.

After the delivery, performance decreases during operation, due to wear and tear, or simply the age factor, if left with no maintenance. Therefore, the construction and its components are subjected to various corrective actions, or maintenance, in order to keep up with required performance. These actions can be proactive, which is preferred, or reactive, which is largely the current practice. In both cases, inspections and performance assessments should be the basis for maintenance planning. This applies to all functionalities.

This part of ISO 15686 defines a generic protocol and terms for how to evaluate the service life performance during this life cycle. Maintenance planning is outside the scope of this part of ISO 15686, but for the sake of illustration, Figure 1 relates the assessed performance levels to various known maintenance actions, as defined in ISO 15686-1. The content of, and relations between, such levels and actions should be defined by users separately.



Key

Y	quality/function	5	preventative and periodic maintenance
X	operation and management of building over time	6	limit states
1	expectation/achievement gap	7	refurbishment
2	building failure/damage	8	repair
3	new requirements — public — market — business	9	replacement
		10	performance without preventative actions
		11	renewal
4	development upgrading	12	“as built”

[a] Performance degrees (PD) are defined in 5.3.4.2.2.

Figure 1 — Life cycle performance of construction

5 Performance surveys

5.1 General

The main purpose of this part of ISO 15686 is to be an aid in the planning and preparation of required general and specific working documents for the performance survey of items of various character and different purpose. General and specific working documents supplementary to carrying out performance surveys can be described in three levels, as given in Table 2.

Table 2 — Overview of document levels

Document	Main function	Content
This part of ISO 15686	Provides a standardized framework for planning and for terms and methods	Definitions, method and content
General working documents for performance surveys	Provides agreed (objective) fixed terms (reference level) for the performance of a building product or construction method	Specific symptom lists and/or illustrated catalogues, for example: — concrete; — masonry; — external wood; — steel; — ventilation ducts. Checklists for likely locations of failure prepared on the basis of this part of ISO 15686
Specific working documents for performance surveys	Provides specific directions on how a type of item should be handled. Should also provide the reference level for performance degrees for the relevant type of item	Complete work guidance for the performance survey of a type of item, for example: — bridges; — old town buildings; — stave churches; — ventilation systems. These should be prepared by those who request the survey for a type of item (facility manager, property owner, etc.) on the basis of the standard and general working documents

This part of ISO 15686 can be used

a) directly as an aid for performance surveys when no other working documents exist, or as a supplement when the working documents are incomplete;

b) to prepare general working documents;

c) to prepare specific working documents.

5.2 Registration level and user-oriented types of inspection

There are three levels of registration as follows:

a) level 1 (preliminary): Performance registration of a general character consisting of visual observations combined, if necessary, with simple measurements.

b) level 2 (regular): Performance registration of a general character, but more exhaustive and detailed than Level 1. It includes examination of supporting data, e.g. drawings, specifications and other documentation. More extensive registrations or measurements should be carried out to establish the construction and performance of the item when required.

c) level 3 (detailed): Performance registration of a special character that includes only specific items (building elements, construction elements, work sections) or specific problems. Such performance registration implies the application of especially accurate measurement or test methods and, if appropriate, laboratory testing.

Types of inspection should be designed from these various levels of registration according to user needs and required competence of inspectors, as given in Table 3.