INTERNATIONAL STANDARD

ISO 20887

First edition
2020-01

Sustainability in buildings and civil engineering works — Design for disassembly and adaptability — Principles, requirements and guidance

Développement durable dans les bâtiments et ouvrages de génie civil — Conception pour la démontabilité et l'adaptabilité — Principes, exigences et recommandations

Reference number
ISO 20887:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 17, *Sustainability in buildings and civil engineering works*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Applying the principles of design for disassembly and adaptability (DfD/A) to the service life planning of buildings and civil engineering works can make a positive contribution to sustainable development. While service life planning is a design process that seeks to ensure that the service life of a constructed asset will equal or exceed its design life, design for disassembly and adaptability is a strategy to optimize both the service life and the design life. The strategy does not suggest overbuilding to meet a vast number of unknowns that a constructed asset might encounter.

Introducing aspects of design for disassembly can be used to reduce and/or prevent waste and increase resource efficiency by encouraging alternative considerations at the project definition phase. The application of adaptability concepts and principles can minimize the need for unnecessary removal and new construction, by repurposing or modifying constructed assets to renew their service life, and result in constructed assets that are able to accommodate a larger variety of uses. From a broader perspective, the recovery and subsequent reuse or recycling of disassembled construction materials and components will support the evolving concept of a circular economy.

The design and construction industry has often trusted/depended upon traditional assembly methods, products, and processes that typically do not consider deconstruction. As such, during a renovation or demolition project, products and materials are often not easily salvaged for reuse, recycling or energy recovery, and therefore, become waste that is landfilled.

Incorporating DfD/A concepts early in the planning and design phase will increase the likelihood that activities during the stages of use, maintenance (including repair, replacement, refurbishment), and end-of-life (e.g., disassembly, reuse, recycling, disposal) will be conducted more efficiently from a total resource perspective (i.e., time and associated costs, labour costs, materials, and energy).

Design for disassembly devises explicit methods, prior to construction, for optimal recovery of specific products and materials without damaging either that which is being removed or surrounding components. The adaptability aspects of DfD/A support the continued use of constructed assets by allowing for and accommodating substantial change (e.g., demographics, social, economic, and technological conditions and physical surroundings and needs) within an existing or expanded physical asset. Designing for adaptability means designing for both present and future uses, encouraging the use of phased developments and matching supply with demand in a timely fashion. The decision to use these methods is usually considered in conjunction with the investment rate of return over time and risk.

Successful application of DfD/A principles will require their integration into the early phases of a project, when it is still cost-effective to do so. Implementation of DfD/A will require compromises and trade-offs to make choices that can be constrained by factors such as technical complexity, lack of resources and time, risk of obsolescence and limited information on costs or relative environmental burdens over the total life cycle. Therefore, it is important that all parties involved in the design, product supply, construction, commissioning, operation and decommissioning aspects have sufficient knowledge and understanding to implement the intended results. Designers have the major role in considering DfD/A to facilitate the best technical, economic and environmental opportunities. Clients often drive the design team to consider and implement DfD/A elements within a project. The supporting supply chain, including product suppliers, constructors, facility managers and those decommissioning constructed assets also need to adapt their approaches to optimize the design intentions which relate to DfD/A.

This document is intended to provide a framework of the DfD/A principles and the key issues that should be considered by the different actors, particularly designers involved in the project. It is equally important that this knowledge base is continually added to by those implementing these principles, and associated activities, for example, by knowledge sharing through the creation of case studies and associated journal articles.

This document is one in a suite of documents dealing with sustainability in construction works that includes the following, in addition to this document:

a) ISO 15392, *Sustainability in buildings and civil engineering works — General principles*;

b) ISO/TS 12720, *Sustainability in buildings and civil engineering works — Guidelines on the application of the general principles in ISO 15392*;

c) ISO/TR 21932, *Sustainability in buildings and civil engineering works — A review of terminology*;

d) ISO 21929-1, *Sustainability in building construction — Sustainability indicators — Part 1: Framework for the development of indicators and a core set of indicators for buildings*;

e) ISO/TS 21929-2, *Sustainability in building construction — Sustainability indicators — Part 2: Framework for the development of indicators for civil engineering works*;

f) ISO 21931-1[1)], *Sustainability in building construction — Framework for methods of assessment of the environmental performance of construction works — Part 1: Buildings*;

g) ISO 21931-2, *Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment — Part 2: Civil engineering works*;

h) ISO 16745-1, *Sustainability in buildings and civil engineering works — Carbon metric of an existing building during use stage — Part 1: Calculation, reporting and communication*;

i) ISO 16745-2, *Sustainability in buildings and civil engineering works — Carbon metric of an existing building during use stage — Part 2: Verification*;

j) ISO 21930, *Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services*;

k) ISO 21678[2)], *Sustainability in buildings and civil engineering works — Indicators and benchmarks — Principles, requirements and guidelines*.

This document deals with environmental, social and economic aspects of sustainability. The relationship among the suite of documents is elaborated in Figure 1.

1) Revision under preparation.

2) Under preparation. Stage at the time of publication: ISO/FDIS 21678:2020.

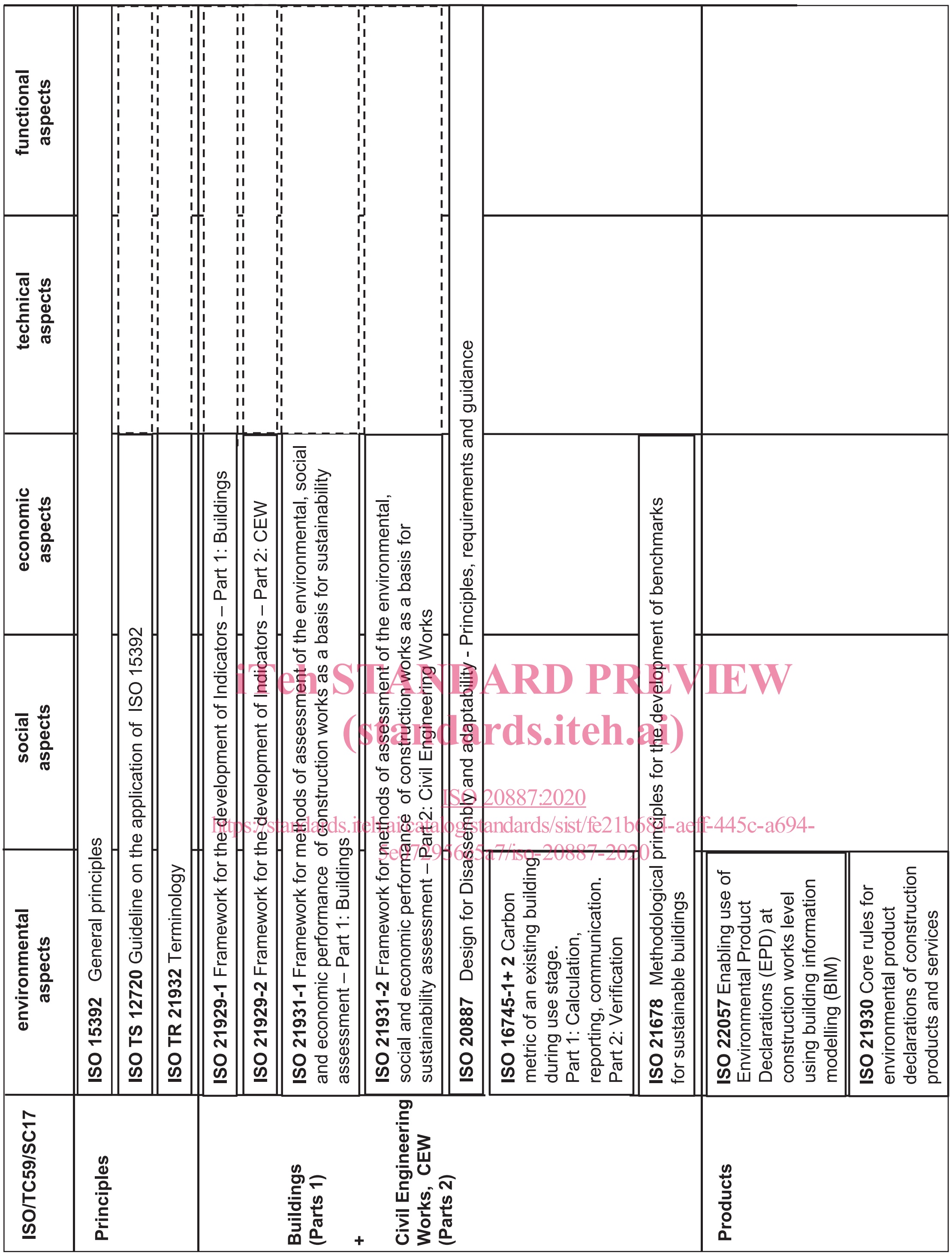

Figure 1 — Suite of related documents for sustainability in buildings and civil engineering works

Sustainability in buildings and civil engineering works — Design for disassembly and adaptability — Principles, requirements and guidance

1 Scope

This document provides an overview of design for disassembly and adaptability (DfD/A) principles and potential strategies for integrating these principles into the design process. This document provides information for owners, architects, engineers, and product designers and manufacturers to assist in their understanding of potential DfD/A options and considerations, and for other parties who are responsible for financing, regulating, constructing, transforming, deconstructing, or demolishing construction works.

This document is applicable to all types of buildings (e.g. commercial, industrial, institutional, and residential), civil engineering works (e.g., dams, bridges, roads, railways, runways, utilities, pipelines) and their constituent parts. It can be used for new construction, refurbishment and renovation, and in the design of incremental improvements in, or complete redesign of, buildings, building systems, civil engineering works, and their constituent parts.

This document also provides guidance on measuring performance regarding each DfD/A principle and related objectives.

This document is intended to be used in conjunction with and following the principles set out in ISO 15392 and the ISO 15686 series.

This document does not set specific levels of performance for the disassembly or adaptability of constructed works, however, it does include requirements that are mandatory for the implementation of specific DfD/A principles that are applicable when these principles are adopted.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 15392, *Sustainability in buildings and civil engineering works — General principles*

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

ISO/TR 21932, *Sustainability in buildings and civil engineering works — A review of terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1, ISO/TR 21932 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
accessibility
ability for ease of access to *components* (3.7) for *disassembly* (3.12), *refurbishment* (3.29), *replacement* (3.32), or upgrade

Note 1 to entry: Within the context of this document, this definition does not directly apply to accessibility for people with additional, specialized needs.

3.2
adaptability
ability to be changed or modified to make suitable for a particular purpose

[SOURCE: ISO 6707-1:2017, 3.7.3.79]

3.3
assembly
set of related *components* (3.7) attached to each other

Note 1 to entry: Examples of assemblies include the total building envelope or the individual walls, roofs, or parapets and bearing or cable assemblies for bridges.

[SOURCE: ISO 6707-1:2017, 3.3.5.5, modified — Note 1 to entry has been added.]

3.4
building
construction works (3.9) that has the provision of shelter for its occupants or contents as one of its main purposes, usually partially or totally enclosed and designed to stand permanently in one place

[SOURCE: ISO 6707-1:2017, 3.1.1.3, modified — Note 1 to entry has been removed.]

3.5
circular economy
economy that is restorative and regenerative by design, and which aims to keep products, *components* (3.7) and materials at their highest utility and value at all times, distinguishing between technical and biological cycles

[SOURCE: ISO 20400:2017, 3.1]

3.6
civil engineering works
infrastructure
civil engineering project, US
construction works (3.9) comprising a structure, such as a dam, bridge, road, railway, runway, utilities, pipeline, or sewerage system, or the result of operations such as dredging, earthwork, geotechnical processes, but excluding a *building* (3.4) and its associated site works

Note 1 to entry: Associated site works related to buildings are sometimes considered as civil engineering projects, for example particularly in the US.

[SOURCE: ISO 6707-1: 2017, 3.1.1.2, modified — "infrastructure" has been added as an admitted term; Note 1 to entry has been modified.]

3.7
component
product manufactured as a distinct unit to serve a specific function or functions

EXAMPLE Nails, cladding anchors, reinforcing bars and membranes (basic units) or reinforced concrete slabs, windows and doors (complex units).

Note 1 to entry: Components can be manufactured, prefabricated, or built or formed on site, and can be basic or complex units.

Note 2 to entry: A complex unit can also be considered an *assembly* (3.3), depending on the context.

3.8
constructed asset
anything of value that is constructed or results from construction operations

[SOURCE: ISO 15686-1:2011, 3.2]

3.9
construction works
everything that is constructed or results from construction operations

Note 1 to entry: This includes *buildings* (3.4), *civil engineering works* (3.6), structures, landscaping, external works, and other types of construction works within a built environment.

Note 2 to entry: From an economic perspective, completed construction works are typically referred to as a *constructed asset* (3.8).

[SOURCE: ISO 6707-1:2017, 3.1.1.1, modified — The original Note 1 to entry has been removed; two notes to entry have been added; the US synonym 'construction' has been deleted as an admitted term.]

3.10
convertibility
ability to accommodate a substantial change(s) in user needs by making modifications

3.11
demolition
removal by destructive methods

EXAMPLE Demolition by pushing or pulling, fragmenting by crushing or shearing, implosion or rapid progressive failure of *construction works* (3.9) or their component parts.

3.12
disassembly
non-destructive taking-apart of a *construction works* (3.9) or *constructed asset* (3.8) into constituent materials or *components* (3.7)

Note 1 to entry: This process can be applied to a product, *module* (3.23), system, component, or *assembly* (3.3).

[SOURCE: ISO 15392:—, 3.11, modified — Note 1 to entry has been added.]

3.13
design for disassembly
approach to the design of a product or *constructed asset* (3.8) that facilitates *disassembly* (3.12) at the end of its useful life, in such a way that enables *components* (3.7) and parts to be reused, recycled, recovered for energy or, in some other way, diverted from the waste stream

Note 1 to entry: The definition is derived from ISO 14021:2016, 7.4.1.

3.14
design life
service life (3.36) intended by the designer

Note 1 to entry: As stated by the designer to the client to support specification decisions.

[SOURCE: ISO 15686-1:2011, 3.3, modified — The abbreviated term "DL" and two deprecated terms have been removed.]

3.15
durability
ability of a *constructed asset* (3.8) or any of its *components* (3.7) to perform its required functions in its service environment over a specified period of time without unforeseen maintenance or *repair* (3.31)

Note 1 to entry: Preventive or routine maintenance are foreseen measures intended to increase functional *service life* (3.36).

[SOURCE: ISO 17738-1:2017, 3.6, modified — The word "building" has been replaced with "constructed asset"; the word "specified" has been added; the reference to "cost" has been deleted; Note 1 to entry has been added.]

3.16
expandability
ability of a design or the characteristic of a system to accommodate a substantial change that supports or facilitates the addition of new space, features, capabilities and capacities

Note 1 to entry: Expandability is a form of scalability. Similarly, contraction can also be a beneficial capability that is a form of scalability.

3.17
exposed connection
connection that is left accessible for *disassembly* (3.12) or modification

3.18
independence
quality that allows parts, *components* (3.7), *modules* (3.23) and systems to be removed or upgraded without affecting the performance of connected or adjacent systems

Note 1 to entry: This can relate to functional, physical and structural independence, as well as the degree of independence.

3.19
inherent finish
condition of material left in its most basic state without contamination by an applied finish

Note 1 to entry: An applied finish can reduce or prevent reuse or recycling.

3.20
life cycle assessment
compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle

Note 1 to entry: Core rules for the development of Type III environmental product declarations, based on life cycle assessment, for construction products are addressed in ISO 21930.

[SOURCE: ISO 14040:2006, 3.2, modified — The abbreviated term "LCA" has been removed; Note 1 to entry has been added.]

3.21
life cycle costing
methodology for systematic economic evaluation of life-cycle costs over a period of analysis, as defined in the agreed scope

Note 1 to entry: Life cycle costing can address a period of analysis that covers the entire life cycle or (a) selected stage(s) or periods of interest thereof.

[SOURCE: ISO 15686-5:2017, 3.1.8]

3.22
modular
composed of *modules* (3.23) for easy construction or arrangement and adaptation or *disassembly* (3.12)

[SOURCE: ISO 7176-26:2007, 4.8.11, modified — References to “modules”, “adaptation” and “disassembly” have been added.]

3.23
module
set of standardized parts or independent units

Note 1 to entry: Modularization can be key to *disassembly* (3.12) in many types of *civil engineering works* (3.6).

Note 2 to entry: A module could be a type of complex *assembly* (3.3).

3.24
obsolescence
loss of ability of an item to perform satisfactorily due to changes in *performance requirements* (3.25)

[SOURCE: ISO 15686-1:2011, 3.14]

3.25
performance requirement
performance criterion
minimum acceptable level of a critical property

[SOURCE: ISO 15686-1:2011, 3.19]

3.26
recyclability
ability of component parts, materials or both to be separated and reprocessed from products and systems and subsequently used as material input for the same or different use or function

3.27
recyclable
characteristic of a product or associated *component* (3.7) that can be diverted from the waste stream through available processes and programmes and can be collected, processed and returned to use in the form of raw materials or products

Note 1 to entry: Whilst many products, components and materials are technically recyclable, in practice, recycling facilities might not be readily available or economically feasible to use.

Note 2 to entry: Recycling infrastructure for the material should exist in at least 60 % of locations where the product is sold. See Reference [21].

Note 3 to entry: The definition is derived from ISO 14021:2016, 7.7.1.

3.28
refurbishability
ability to restore the aesthetic and functional characteristics of a product, *building* (3.4) or other *constructed asset* (3.8) to a condition suitable for continued use

3.29
refurbishment
modification and improvements to an existing *building* (3.4) or *civil engineering works* (3.6) in order to bring it up to an acceptable condition

[SOURCE: ISO 6707-1:2017, 3.5.1.45, modified — The GB synonym “renovation” has been deleted as an admitted term; reference to “plant” has been deleted.]

3.30
remanufacturability
ability of a product to be disassembled and refabricated at the end of its useful life in a manner that provides restoration to a condition suitable for resale

3.31
repair
returning a product, *component* (3.7), *assembly* (3.3), or system to an acceptable condition by renewal or *replacement* (3.32) of worn, damaged, or degraded parts

[SOURCE: ISO 6707-1:2017, 3.5.1.47, modified — The word “item” has been replaced with “product, component, assembly, or system”; “through the” has been replaced with “by”; reference to “mending” has been deleted.]