INTERNATIONAL STANDARD

ISO 21929-1

First edition
2011-11-15

Sustainability in building construction — Sustainability indicators —

Part 1:
Framework for the development of indicators and a core set of indicators for buildings

Développement durable dans la construction — Indicateurs de développement durable —

Partie 1: Cadre pour le développement d'indicateurs et d'un ensemble d'indicateurs principaux pour le bâtiment

Reference number
ISO 21929-1:2011(E)

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.

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 21929-1 was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 17, *Sustainability in buildings and civil engineering works*.

This first edition of ISO 21929-1 cancels and replaces ISO/TS 21929-1:2006, which has been technically revised.

ISO 21929 consists of the following parts, under the general title *Sustainability in building construction — Sustainability indicators:*

— *Part 1: Framework for the development of indicators and a core set of indicators for buildings*

A part 2 dealing with the framework for development of indicators for civil engineering works is under development.

Introduction

This part of ISO 21929 describes and gives guidelines for the development of sustainability indicators related to buildings and defines the aspects of buildings to consider when developing systems of sustainability indicators.

These guidelines form a basis for the suite of ISO/TC 59 standards intended to address specific issues and aspects of sustainability relevant to construction works. The issue of sustainable development is broad and of global concern, and, as such, involves all communities and interested parties. Both current and future needs define the extent to which economic, environmental and social aspects are considered in a sustainable development process.

The built environment (buildings and civil engineering works) is a key element in determining quality of life, and contributes to cultural identity and heritage. As such, it is an important factor in the appreciation of the quality of the environment in which society lives and works.

The building and construction sector is highly important for sustainable development because

— it is a key sector in national economies;

— it has a significant interface with poverty reduction through the basic economic and social services provided in the built environment and the potential opportunities to engage the poor in construction, operation and maintenance;

— it is one of the single largest industrial sectors and, while providing value and employment, it absorbs considerable resources, with consequential impacts on economic and social conditions and the environment;

— it creates the built environment, which represents a significant share of the economic assets of individuals, organizations and nations, providing societies with their physical and functional environment;

— it has considerable opportunity to show improvement relative to its economic, environmental and social impacts.

Over their life cycle, construction works absorb considerable resources and contribute to the transformation of areas. As a result, they can have considerable economic consequences, and impacts on the environment and human health.

While the challenge of sustainable development is global, the strategies for addressing sustainability in building construction are essentially local and differ in context and content from region to region. These strategies reflect the context, the preconditions and the priorities and needs, not only in the built environment, but also in the social environment. This social environment includes social equity, cultural issues, traditions, heritage issues, human health and comfort, social infrastructure and safe and healthy environments.

It can, in addition, particularly in developing countries, include poverty reduction, job creation, access to safe, affordable and healthy shelter, and loss of livelihoods.

This part of ISO 21929 defines a framework for the development of sustainability indicators for buildings based on the premise that sustainable development of buildings brings about the required performance and functionality with minimum adverse environmental impact, while encouraging improvements in economic and social (and cultural) aspects at local, regional and global levels. This part of ISO 21929 follows the general principles presented in ISO 15392.

Indicators are figures or other qualitative or descriptive measures that enable information on a complex phenomenon, like environmental impact, to be simplified into a form that is relatively easy to use and understand.

The three main functions of indicators are quantification, simplification and communication. Targets can also be set with the help of indicators. Changes in a building over time, and the development of changes in relation to stated objectives, can be monitored with the help of indicators. One of the important functions of an indicator with reference to decision-making is its potential to show a trend.

Sustainability indicators for construction works are required by a number of parties interested in the building and construction sector. Indicators are required in decision-making by

— developers and owners of buildings;

— designers;

— contractors;

— administrative bodies;

— users and property managers.

The building and construction sector requires sustainability indicators both for its own decision-making within design, production and management of buildings, as well as for indicating to the public and to clients the overall economic, environmental or social impact of buildings, building products and related processes.

Indicators, as well as sets and systems of indicators, for the specification, assessment and representation of the contribution of individual buildings to sustainable development can be used in many different ways. For example, among others, their application can support the following:

— design and decision-making process(es) during the planning phase of a building (e.g. design for environment, design for sustainability);

— development and application of assessment methods and certification systems (e.g. labelling);

— indicating the building performance (e.g. signalling, marketing);

— specification and verification of requirements in the context of procurement (e.g. green procurement, sustainability procurement);

— monitoring or evaluating the achievement of objectives over time (i.e. periodic review);

— accepting responsibility for impacts on the environment and society (e.g. social responsibility);

— representation of activities and results in the context of responsibility towards the economy, environment and society (e.g. sustainability reporting).

NOTE The monitoring and evaluation of objectives can contribute to the continual improvement related to a specific building or group of buildings.

This part of ISO 21929 is one in a suite of International Standards dealing with sustainability in building construction that includes the following:

a) ISO 15392, *Sustainability in building construction — General principles*;

b) ISO/TR 21932, *Building construction — Sustainability in building construction — Terminology*;

c) 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*;

d) ISO 21930, *Sustainability in building construction — Environmental declaration of building products*;

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

This part of ISO 21929 deals with sustainability indicators and includes a core system of indicators for buildings. The relationship among the International Standards is elaborated in Figure 1.

	Environmental Aspects	Economic Aspects	Social Aspects
Methodological basics	ISO 15392: **General principles** ISO/TR 21932: **Terminology**		
	ISO 21929-1: **Sustainability indicators – Part 1: Framework for the development of indicators and a core set of indicators for buildings**		
Buildings	ISO 21931-1: **Framework for methods of assessment of the environmental performance of construction works – Part 1: Buildings**		
Building products	ISO 21930: **Environmental declaration of building products**		

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

Sustainability in building construction — Sustainability indicators —

Part 1: Framework for the development of indicators and a core set of indicators for buildings

1 Scope

This part of ISO 21929 establishes a core set of indicators to take into account in the use and development of sustainability indicators for assessing the sustainability performance of new or existing buildings, related to their design, construction, operation, maintenance, refurbishment and end of life. Together, the core set of indicators provides measures to express the contribution of a building(s) to sustainability and sustainable development. These indicators represent aspects of buildings that impact on areas of protection related to sustainability and sustainable development.

The object of consideration in this part of ISO 21929 is a building or a group of buildings and the external works within the site (curtilage).

This part of ISO 21929 follows the principles set out in ISO 15392 and, where appropriate, is intended for use in conjunction with, and following the principles set out in, ISO 26000, ISO 14040 and the family of International Standards that includes ISO 14020, ISO 14021, ISO 14024 and ISO 14025. Where deviation occurs or where more specific requirements are stated, this part of ISO 21929 takes precedence.

This part of ISO 21929

- adapts general sustainability principles for buildings;
- includes a framework for developing sustainability indicators for use in the assessment of economic, environmental and social impacts of buildings;
- determines the aspects for consideration when defining a core set of sustainability indicators for buildings;
- establishes a core set of indicators;
- describes how to use sustainability indicators;
- gives rules for establishing a system of indicators.

This part of ISO 21929 does not give guidelines for the weighting of indicators or the aggregation of assessment results.

NOTE In addition to the core set of indicators defined in this part of ISO 21929, the use of other sustainability indicators can be relevant in the local context when assessing or setting targets for a building's contribution to sustainability. Examples and information about these other sustainability indicators are given in Annex A.

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 6707-1, *Building and civil engineering — Vocabulary — Part 1: General terms*

ISO 14020, *Environmental labels and declarations — General principles*

ISO 14021, *Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling)*

ISO 14024, *Environmental labels and declarations — Type I environmental labelling — Principles and procedures*

ISO 14025, *Environmental labels and declarations — Type III environmental declarations — Principles and procedures*

ISO 14040, *Environmental management — Life cycle assessment — Principles and framework*

ISO 14050, *Environmental management — Vocabulary*

ISO 15392, *Sustainability in building construction — General principles*

ISO 21930, *Sustainability in building construction — Environmental declaration of building products*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1, ISO 15392, ISO 14040, ISO 14050, and the following apply. Where differences or conflicts occur, the definitions given in 3.1 to 3.39 take precedence.

NOTE 1 Several terms and definitions from these other sources have been repeated below for ease of reference.

NOTE 2 ISO/TR 21932 is another source of terminological data on concepts related to sustainability in buildings and sustainable development that is applicable to the different aspects of both the construction (process) and use of a building and the effect of the building on sustainability.

3.1
access to services
availability and accessibility of services outside the building

NOTE Services can include public transportation, parking, entertainment, health-care, water and energy supply, etc.

[ISO 15392:2008]

3.2
accessibility
ability to enter a space with ease

NOTE 1 Requirements for accessibility depend on the users' requirements, as well as on activities during the life cycle of the building, e.g. construction work, maintenance and deconstruction.

NOTE 2 “Barrier-free use of buildings” relates to requirements for accessibility by users with reduced mobility.

NOTE 3 Adapted from ISO 6707-1:2004, 9.3.80.

3.3
acoustic comfort
reaction of occupants to the indoor acoustical environment, described in terms of sound pressure level and audibility

[ISO 16813:2006]

3.4
adaptability
ability to be changed or modified to make suitable for a particular use

[ISO 6707-1:2004]

3.5
areas of protection
protection area
issue of concern
aspect(s) of the economy, the environment or society that can be impacted by construction works, goods or services

EXAMPLES Asset value, cultural heritage, resources, human health and comfort, social infrastructure.

NOTE Adapted from ISO 15392:2008, 3.3.

3.6
building
construction works that have 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

[ISO 6707-1:2004, 3.1.3]

3.7
built environment
collection of man-made or induced physical objects located in a particular area or region

NOTE 1 When treated as a whole, the built environment typically is taken to include buildings, external works (landscaped areas), infrastructure and other construction works within the area under consideration.

NOTE 2 Adapted from ISO 6707-1:2004, 10.3.

3.8
disposal
⟨status change⟩ transfer of ownership of, or responsibility for, the object of consideration

3.9
disposal
⟨end of life⟩ transformation of the state of a building or facility that is no longer of use

NOTE Transformation can include, either individually or in some combination, the decommissioning, deconstruction, recycling and demolition of the object of consideration.

3.10
economic indicator
sustainability indicator related to an economic impact

3.11
environmental indicator
sustainability indicator related to an environmental impact

3.12
functional performance
type and level of functionality that is required by stakeholders of a facility, building or other constructed asset, or of an assembly, component or product thereof, or of a movable asset, for a specific function

[ISO 15686-10:2010]

3.13
functionality
suitability or usefulness for a specific purpose or activity

[ISO 15686-10:2010]

3.14
heat island effect
phenomenon of elevated temperatures in urban and suburban areas compared to their outlying rural surroundings

NOTE The temperatures can be influenced by various aspects, including the presence of denuded landscaping, impermeable surfaces, massive buildings, heat-generating vehicles and machines and pollutants.

3.15
impact category
class representing an economic, environmental or social issue(s) of concern (areas of protection) to which analysis (assessment) results may be assigned

NOTE 1 Issues of concern can involve either impacts or aspects related to the economy, the environment or society.

NOTE 2 Adapted from ISO 14040:2006, 3.40.

3.16
indicator
quantitative, qualitative or descriptive measure representative of one or more impact categories

NOTE 1 Periodic evaluation and monitoring using indicators can show direction of any impact.

NOTE 2 Adapted from ISO 14040:2006, 3.40.

3.17
indoor air quality
quality of air inside a building, described in terms of odour, chemical and biological pollutants

NOTE 1 Indoor air quality is directly related to the ventilation rate, air distribution patterns and pollution sources.

NOTE 2 Indoor air quality is important in ensuring human health, olfactory comfort and perceived comfort.

NOTE 3 Adapted from ISO 16813:2006, 3.21. The definition has been simplified to refer to a building in general, versus only non-industrial buildings, and the non-essential but relevant characteristics are now referenced in notes.

3.18
interested party
person or group concerned with or affected by the environmental performance of a building

[ISO 21931-1:2010]

3.19
level of functionality
number indicating the relative functionality required for a user group or customer for one topic on a predetermined demand scale from the level of the least (functionality) to the level of the most (functionality)

NOTE The level of functionality can be the consequence of several distinct functions required to act in combination.

EXAMPLE Scale of integers from 0 to 9.

[ISO 15686-10:2010]

3.20
level of serviceability
number indicating the relative serviceability (capability of a facility) for a user group or customer for one topic on a predetermined supply scale from the level of the least (serviceability) to the most (serviceability)

NOTE The level of serviceability can be the consequence of several distinct physical features acting in combination.

EXAMPLE Scale of integers from 0 to 9.

[ISO 15686-10:2010]

3.21
life cycle
consecutive and interlinked stages of the object of consideration

NOTE 1 For consideration of environmental impacts and environmental aspects, the life cycle is comprised of all stages, from raw material acquisition or generation of natural resources to final disposal.

NOTE 2 For consideration of economic impacts and economic aspects, in terms of costs, the life cycle is comprised of all stages from construction to decommissioning. A period of analysis can be chosen to be different from the life cycle; see ISO 15686-5.

NOTE 3 Adapted from ISO 14040:2006, 3.1.

3.22
life-cycle cost
LCC
cost(s) of an asset or its parts throughout its life cycle, while fulfilling its performance requirements

[ISO 15686-1:2000]

3.23
life-cycle costing
methodology for systematic economic evaluation of life-cycle costs over a period of analysis, as defined in the agreed scope

NOTE 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.

[ISO 15686-5:2008]

3.24
maintainability
ability to retain a building in a state in which it can perform its required functions or to restore a building to such a state when a fault occurs

NOTE Adapted from ISO 6707-1:2004, 9.3.89. The definition has been simplified to refer to a building in general, versus specific components or construction.

3.25
non-renewable resource
resource that exists in a fixed amount that cannot be replenished on a human time scale

[ISO 21930:2007]

3.26
performance
ability to fulfil required functions under intended use conditions or behaviour when in use

NOTE 1 The required functions address both the functionality requirements as well as the technical requirements.

NOTE 2 Adapted from ISO 6707-1:2004, 9.1.1.

3.27
period of analysis
period of time over which life-cycle costs or whole-life costs are analysed

NOTE The period of analysis is determined by the client.

[ISO 15686-5:2008]

3.28
renewable resource
resource that is grown, naturally replenished or cleansed on a human time scale

EXAMPLE Trees in forests, grasses in grasslands and fertile soil.

NOTE A renewable resource is capable of being exhausted but can last indefinitely with proper stewardship.

[ISO 21930:2007]

3.29
serviceability
capability of a facility, building or other constructed asset, or of an assembly, component or product thereof, or of a movable asset, to support the function(s) for which it is designed, used, or required for use

[ISO 15686-10:2010]

3.30
set of indicators
non-structured list of indicators

3.31
social indicator
sustainability indicator related to a social impact

3.32
stakeholder
individual or group that has an interest in any decision or activity of an organization

[ISO 26000:2010, 2.20]

3.33
sustainability indicator
indicator related to economic, environmental, or social impacts

3.34
system of indicators
structured list of indicators

3.35
thermal comfort
condition of mind derived from satisfaction with the thermal environment

NOTE Thermal comfort is the combined thermal effect of environmental parameters including air temperature, vapour pressure, air velocity, mean radiant temperature (fixed factors) and clothing and activity level of occupants (variable factors).

[ISO 16813:2006]

3.36
visual comfort
occupant satisfaction with the indoor visual environment, described in terms of illumination level, glare, visibility, reflection and psychological and physiological content with natural and artificial illumination

[ISO 16813:2006]

3.37
waste
substances or objects that the original holder has disposed of or intends to or is required to dispose of

NOTE 1 In this part of ISO 21929 this concept is not confined to hazardous waste.

NOTE 2 Adapted from the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* (22 March 1989), Article 2 Definitions, Item 1. The wording has been simplified and the reference to national law as the basis for any requirements has been removed.

3.38
whole-life cost
all significant and relevant initial and future costs and benefits of an asset, throughout its life cycle, while fulfilling the performance requirements

[ISO 15686-5:2008]

3.39
whole-life costing
methodology for systematic economic consideration of all whole life costs and benefits over a period of analysis, as defined in the agreed scope

NOTE 1 The projected costs or benefits may include external costs (including, for example, finance, business costs, income from land sale, user costs).

NOTE 2 Whole-life costing can address a period of analysis that covers the entire life cycle or (a) selected stage(s) or periods of interest thereof.

NOTE 3 This definition should be contrasted with that for life-cycle costing.

[ISO 15686-5:2008]

4 Framework of sustainability indicators

4.1 General

An indicator is a quantitative, qualitative or descriptive measure representative of an aspect of building that impacts one or more areas of protection.

The core set of indicators described in this part of ISO 21929 is considered essential from the view point of assessing the contribution of a building(s) to sustainability and sustainable development.

NOTE 1 The use of other sustainability indicators can be relevant in the local context when assessing or setting targets for a building's contribution to sustainability. Examples and information about these other indicators are given in Annex A.

Indicators have a relationship to both the concerns of the interested parties and the overall assessment goal. The selection of the relevant system or set of indicators shall reflect the concerns of interested parties and the proper representation of the assessment goal.

There is a number of issues that shall be considered when expressing or describing an assessment of the contribution of a building to sustainability and sustainable development with the help of indicators.

The results of the assessment of the sustainability performance of a building are directly influenced by the point of the assessment within the building life cycle and the life-cycle phases/stages addressed. The character, quality and availability of relevant information are all dependent on the phase/stage of the building life cycle at which these different issues are being considered. During the design phase, issues of concern are dealt with in terms that are different from those used during the actual use and operation (in-use) stage of a building, when more specific information is available about the building. Indicators for addressing an issue during the design phase initially relate to predicted values, while during the actual use and operation stage, indicators addressing that same issue of concern are based on measurements, enquiries concerning user satisfaction, etc.

The core set of indicators represents those performance aspects of buildings that potentially impact on the core areas of protection. Technical solutions and systems in the building, such as the selection of a heating, ventilation and air conditioning system (HVAC system), can affect the economic and environmental impacts of buildings and guidelines on the selection of materials, products and systems can be given as practical recommendations. However, these solutions (measures) shall not be dealt with as indicators.

NOTE 2 The validity of practical recommendations can be assessed with the help of sustainability indicators. Practical recommendations, which favour choosing a certain type of technical solution, can depend on geographical and technological circumstances, especially when it comes to the local climate as well as certain building technological and energy technological facilities. Indicators, however, are more generic in nature, although the acceptable (benchmark) values related to some indicators can be site-specific.

4.2 Relationship to ISO 15392 and other general principles

4.2.1 In addition to the requirements of this part of ISO 21929, the principles and procedures set out in ISO 15392, ISO 14040, ISO 14020, ISO 14021, ISO 14024 and ISO 14025 shall apply. The principles set out in ISO 26000 should also be taken into consideration, where appropriate. Where this part of ISO 21929 provides more specific requirements than these International Standards, the more specific requirements shall be followed.

ISO 15392 presents six objectives for applying the concept of sustainability to buildings and at the same time promoting sustainable development. These are

— improvement of the construction sector and the built environment;

— reduction of adverse impacts while improving value, where impacts as well as value may be judged against any combination of the three primary aspects of sustainability;

— stimulation of a proactive approach;

— stimulation of innovation;

— decoupling of economic growth from increasing adverse impacts on the environment and/or society;

— reconciliation of contradictory interests or requirements arising from short-term and long-term planning or decision-making.

4.2.2 ISO 15392 also lists nine general principles applied to reach these objectives. These general principles are, in alphabetical order,

- continual improvement;
- equity;
- global thinking and local action;
- holistic approach;
- involvement of interested parties;
- long-term consideration;
- precaution and risk;
- responsibility;
- transparency.

The link of the core indicators to the nine general principles listed in ISO 15392 is explained in Clause 6.

4.2.3 ISO 26000 presents guidance on social responsibility relative to organizations and is intended to assist organizations in contributing to sustainable development. It describes seven high-level underlying general principles related to social responsibility that an organization should respect and address, including

- accountability;
- transparency;
- ethical behaviour;
- respect for stakeholder interests;
- respect for the rule of law;
- respect for international norms of behaviour;
- respect for human rights.

It also identifies lower-level principles specific to a number of core subjects (issues), such as human rights, the environment, consumer issues and community development.

In assessing the contribution of a building to sustainable development, how and when these different International Standards and their principles apply varies, depending on the issue of concern under consideration. It also depends on the goods and services (products) used, and the different activities and decisions that the various stakeholders use or undertake, during the life cycle of the building.

NOTE 1 Work on a guidance document for applying the general principles described in ISO 15392 is under development.

NOTE 2 The purpose of any sustainability assessment of a building is influenced by the specific scenario and different stakeholders involved. ISO 21931-1:2010, Annex B, provides guidance on the intended use, life cycle consideration and the application and/or purpose of assessments of the environmental performance of buildings.

Sustainability indicators provide a means for addressing the different principles related to sustainability and aid the implementation of these principles.

4.3 Description of framework

4.3.1 The development of indicators for the specification and assessment of the contribution of a given building to sustainability and sustainable development requires knowledge about the areas of protection, the dimensions and complex interdependencies of sustainable development in general, and how these are applied to buildings in particular.

Indicators shall represent the aspects of a building that have a potential impact on protection areas of sustainable development. The core areas of protection relevant to a building are

— ecosystem;

— natural resources;

— health and well-being;

— social equity;

— cultural heritage;

— economic prosperity;

— economic capital.

NOTE 1 The division of protection areas along the lines of three pillars (social, economic, environmental) is not explicit, thereby indicating the importance of integrating pillars.

NOTE 2 The selection of the core areas of protection uses the general understanding about issues of concern (such as those addressed by the UN's CSD[6]) as a starting point and considers the relevance of building with regard to the different issues of concern.

The main aspects of a building that are seen as having an impact on the areas of protection are categorized as follows:

a) emissions to air;

b) use of non-renewable resources;

c) fresh water consumption;

d) waste generation;

e) change of land use;

f) access to services;

g) accessibility;

h) indoor conditions and air quality;

i) adaptability;

j) costs;

k) maintainability;

l) safety;

m) serviceability;

n) aesthetic quality.

4.3.2 Table 1 outlines the framework consisting of

— core areas of protection of sustainable development most relevant to a building;

— aspects of a building that affect these areas of protection;

— core indicators that represent these aspects.

All life-cycle stages of a building shall be considered in the development of the indicators of buildings and their measurement (calculation) methods. When some stages are not considered or are excluded from consideration, the reasons for such omission or exclusion shall be clearly explained in the documentation.

NOTE For example, when indicating the environmental performance of existing buildings, it can be justified to exclude the impacts from the original construction stage.

4.3.3 The environmental indicators addressing the environmental impacts over the life cycle of the building shall, as a minimum, maintain the distinction between

— production stage;

— construction stage;

— in-use stage;

— end of life stage.

The quality of the processes and activities related to design, construction and operation of the building may also be used as an indicator related to environmental impacts.

4.4 Types of indicators

4.4.1 Indicators, when they are developed and applied , are generally systematized with regard to different aspects, including the following:

a) by object of assessment, such as location-related indicators, site-related indicators, building-related indicators, process-related indicators;

b) by the complete record of the building life cycle, such as indicators typical for new buildings, indicators that show a stage of the life cycle, e.g. the use stage (operational phase), indicators typical for existing buildings;

c) by the type of assessed information, such as indicators that are based on planned or calculated values, indicators that are based on measured or other actual data;

d) by the degree of the influence, either direct or indirect;

e) by complexity, such as indicators that are represented by one parameter, indicators that are described only through various parameters;

f) by the character of the assessment process, such as quantitative, descriptive, qualitative (see Annex B);

g) by spatial system boundaries, such as global, regional, local, or spatial;

h) by temporal system boundaries, such as record effects over the next 100 years (GWP 100), short-term effects.

Table 1 — Framework — Core areas of protection, aspects of a building that impact on these areas of protection and indicators that represent these aspects[a]

	Aspect	Core indicators	Core areas of protection						
			Ecosystem	Natural resources	Health and well-being	Social equity	Cultural heritage	Economic prosperity	Economic capital
1	Emissions to air	Global warming potential	XX	—	X	X	—	X	—
		Ozone depletion potential	XX	—	X	—	—	X	—
2	Use of non-renewable resources	Amount of non-renewable resources consumption by type	X	XX	—	—	—	X	—
3	Fresh water consumption	Amount of fresh water consumption	X	XX	—	X	—	X	—
4	Waste generation	Amount of waste generation by type	X	XX	X	—	—	—	—
5	Change of land use	Indicator measures the changes in land use caused by the development of the built environment with help of a list of criteria	X	XX	—	—	X	—	—
6	Access to services	Indicator measures the access to services by type with help of a list of criteria	X	—	X	XX	—	—	X
7	Accessibility	Indicator measures the accessibility of building and its curtilage with help of a list of criteria	—	—	—	XX	—	—	—
8	Indoor conditions and air quality	A set of indicators that measure the air quality and sub-aspects of indoor conditions with help of a list of measurable parameters	—	—	XX	—	—	X	—
9	Adaptability	Indicator measures the flexibility, convertibility and adaptability to climate change with help of a list of criteria	—	X	X	—	—	—	XX
10	Costs	Life cycle costs	—	—	—	—	—	X	XX
11	Maintainability	Indicator measures the maintainability against the results of service life assessment and with help of a list of criteria or with help of expert judgement	—	X	—	—	X	—	XX
12	Safety	Indicator measures the sub-aspects of safety against the results of simulations or fulfilment of the safety-related building regulations	—	—	XX	—	—	—	X
13	Serviceability	Indicator measures serviceability with help of a list of criteria or with help of post-occupancy evaluation	—	—	—	—	—	XX	—
14	Aesthetic quality	Indicator measures the aesthetic quality against the fulfilment of local requirements or with help of stakeholder judgement	—	—	—	—	XX	—	—

[a] The number of Xs indicates the importance of the potential impact: XX indicates primary (or direct) influence and X secondary (or indirect) influence.

4.4.2 The core indicators shall be described in terms of the

— name of the indicator;

— definition and measurement;

— potential impact on one or more areas of protection;

— information/data requirements;

— data availability and sources.

4.4.3 Indicators shall be

— informative and significant;

— clearly related to one or several areas of protection;

— based on data that are available and easy to obtain;

— agreed upon by the stakeholders.

Indicators shall be developed such that double counting is avoided. However, if an indicator is relevant to more than one area of protection and accounted for accordingly, this should not be regarded as double counting, but represents a multi-effect approach.

5 Core indicators

5.1 Introduction

This part of ISO 21929 establishes a set of performance aspects of a building that impact on the areas of protection of sustainable development. This part of ISO 21929 gives guidelines for the formulation of the indicators with the help of which these aspects can be either quantitatively expressed or comparably described using performance levels. This group of indicators is referred to as core indicators.

Core indicators are

— essential from the view point of assessing the contribution of a building to sustainability and sustainable development;

— not necessarily a comprehensive system of indicators; additional indicators can be required depending on the nature of the case;

— relevant for both new buildings and existing buildings.

The core indicators are given for three levels relative to a building(s) and its curtilage (object of assessment):

a) location-specific indicators;

b) site-specific indicators;

c) building-specific indicators.

Table 1 shows the framework of core areas of protection and the related aspects and core indicators. Table 2 shows the overall list of core indicators and the objects of assessment: location-related indicators, site-related indicators, building-related indicators or process-related indicators).

Table 2 — Core indicators

Number	Indicator	Object of assessment
1	Global warming potential Ozone depleting potential	Building Building
2	Amount of non-renewable resources consumption by type (natural raw materials and non-renewable energy)	Building
3	Amount of fresh water consumption	Building
4	Amount of waste generation by type (hazardous and non-hazardous wastes)	Building
5	Change of land use, assessed with help of criteria	Site
6	Access to services by type, assessed with help of criteria: — public modes of transportation — personal modes of transportation — green and open areas — user-relevant basic services	Location
7	Accessibility, assessed with help of criteria: — accessibility of the building site (curtilage) — accessibility of the building	 Site Building
8	Indoor conditions and air quality, assessed with help of criteria: — indoor thermal conditions — indoor visual conditions — indoor acoustic conditions — indoor air quality	Building
9	Adaptability, assessed with help of criteria — change of use or user needs — adaptability for climate change	Building
10	Life cycle costs	Building
11	Maintainability, assessed with help of criteria	
12	Safety, assessed with help of criteria — structural stability — fire safety — safety in use	Building
13	Serviceability, assessed with help of criteria	Building
14	Aesthetic quality, assessed with help of criteria	Building

5.2 Description of performance aspects and core indicators

5.2.1 Emissions to air

5.2.1.1 Global warming potential

This indicator measures the greenhouse gas (GHG) emissions that have a potential impact on the climate. The release of such gases can result from the production of building products, as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building and final disposal.

The total amount of GHG emissions shall be assessed on the basis of life-cycle assessment methods and/or information modules following the basic principles given in ISO 21930 and ISO 21931-1.

Consideration of the construction stage might not be necessary when assessing the contribution to sustainability and sustainable development of existing buildings.

Measurement (calculation) in the design phase is accomplished by assessing the material and energy flows during the entire life cycle, with special consideration required with regard to the estimated service life of the building and end-of-life actions. Measurement in the in-use stage is accomplished by assessing the material flows caused by the different uses and operations occurring, including maintenance, and monitoring the energy flows.

NOTE 1 In considering impacts of the end-of life stage, the possible actions that can be undertaken include deconstruction (i.e. disassembly, demolition), recovery (i.e. for energy or reuse), recycling, and/or final disposal as waste.

The indicated area of protection is ecosystem.

The potential impacts are also economic and social impacts on a global level.

NOTE 2 Increasing emissions of GHGs due to human activities have led to an increase in atmospheric concentrations of the long-lived GHG gases [carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons, sulfur hexafluoride and ozone-depleting substances (chlorofluorocarbons, hydrochlorofluorocarbons, halons)]. The human-induced radiative forcing of the earth's climate is largely due to the increases in these concentrations. Building and the use of buildings is one of the sectors that has the greatest impact on the release of GHG emissions. It has also been assessed that the building sector is one of the sectors that has the greatest potential to reduce GHG emissions. Measures to reduce GHG emissions from buildings include three main categories: reducing energy consumption and embodied energy in buildings, switching to low-carbon fuels including a higher share of renewable energy, or controlling the emissions of non-CO_2 GHG gases[8].

NOTE 3 Indicator “Access to services” indirectly indicates the release of GHGs because of mobility related to the use of the building.

5.2.1.2 Ozone depletion potential

This indicator measures the release of gases that have a potential impact on the stratospheric ozone layer. The release of such gases can result from the production of building products, as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building.

The total amount of ozone-depleting substances shall be assessed on the basis of life-cycle assessment methods and/or information modules following the principles given in ISO 21930 and ISO 21931-1.

Consideration of the construction stage might not be necessary when assessing the contribution to sustainability and sustainable development of existing buildings.

Measurement (calculation) in the design phase is accomplished by assessing the material and energy flows during the entire life cycle, with special consideration required with regard to the estimated service life of the building and end-of-life actions. Measurement in the in-use stage is accomplished by assessing the material flows caused by the different uses and operations occurring, including maintenance, and monitoring the energy flows.

The indicated areas of protection are

- ecosystem;
- health and well-being.

NOTE Stratospheric ozone protects earth's flora and fauna against the sun's ultraviolet (UV) radiation. An excess of UV radiation increases the risk of cancer or ocular diseases. UV radiation also reduces animals' and humans' resistance, and curbs the growth of plants both on land and in the sea. The cause of the chemical ozone depletion is the presence of chlorine and bromine originating in man-made freons and halogen compounds. For half a century, they have been used among other things in producing refrigerators, air conditioning devices and insulating materials. More recently, international agreements have been made that reduce and forbid the use of such chemical compounds destructive to the ozone[9].

5.2.2 Amount of non-renewable resources consumption by type

5.2.2.1 Consumption of non-renewable raw materials

This indicator measures the consumption of non-renewable raw materials that has a potential impact on the depletion of non-renewable resources. The consumption of such resources can result from the production of building products, as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building.

The total amount of non-renewable material resources consumed shall be assessed on the basis of life-cycle assessment methods and/or information modules following the basic principles given in ISO 21930 and ISO 21931-1. The consumption of non-renewable material resources shall be described in a disaggregated way, per resource type.

NOTE 1 The relative importance of this indicator can be assessed on the basis of scarcity.

Consideration of the construction stage might not be necessary when measuring the use of non-renewable resources for existing buildings.

Measurement (calculation) in the design phase is accomplished by assessing the material flows during the entire life cycle, with special consideration required with regard to the estimated service life of the building and end-of-life actions. Measurement in the in-use stage is accomplished by assessing the material flows caused by the different uses and operations occurring, including maintenance, and monitoring the energy flows.

NOTE 2 In considering impacts of the end-of life stage, the possible actions that can be undertaken include deconstruction (i.e. disassembly, demolition), recovery (i.e. for energy or reuse), recycling, and/or final disposal as waste.

The indicated areas of protection on the global, regional and local levels are

— natural resources;

— ecosystem.

NOTE 3 Building and construction activities worldwide consume a significant share of all non-renewable raw materials. The use of raw materials also causes associated impacts because of the extraction, transport, processing, fabrication, installation and disposal of materials. Measures to reduce such use include the use of renewable materials, recycling and reuse, improved material efficiency and minimizing material losses.

NOTE 4 This indicator is partly overlapping with the indicator “waste generation”; see 5.2.4.

5.2.2.2 Consumption of non-renewable energy

This indicator measures the consumption of non-renewable primary energy that has a potential impact on the depletion of energy resources.

The total amount of non-renewable primary energy shall be assessed on the basis of life-cycle assessment methods and/or information modules following the basic principles given in ISO 21930 and ISO 21931-1.

Consideration of the construction stage might not be necessary when measuring the use of non-renewable energy for existing buildings.

Measurement (calculation) in the design phase is accomplished by assessing the energy flows during the entire life cycle, with special consideration required with regard to the estimated service life of the building and end-of-life actions. Measurement in the in-use stage is accomplished by assessing the energy flows caused by the different uses and operations occurring, including maintenance, and monitoring the energy flows.

NOTE 1 In considering impacts of the end-of life stage, the possible actions that can be undertaken include deconstruction (i.e. disassembly, demolition), recovery (i.e. for energy or reuse), recycling, and/or final disposal as waste.

The indicated areas of protection on the global, regional and local levels are

- natural resources;
- ecosystem.

NOTE 2 The building and construction sector significantly affects the use of fossil and nuclear energy sources. Measures to reduce the use of non-renewable energy sources include improved energy-efficiency, lowered consumption and lower embodied energy in buildings, and switching to a higher share of renewable energy.

5.2.3 Amount of fresh water consumption

This indicator measures the consumption of fresh water resources that has a potential impact on the depletion of fresh water resources. The consumption of such resources results from the production of building products, as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building.

The total amount of fresh water resources consumed shall be assessed on the basis of life-cycle assessment methods and/or information modules following the basic principles given in ISO 21930 and ISO 21931-1.

Measurement (calculation) in the design phase is accomplished by assessing the estimated consumption of fresh water during the entire life cycle, with special consideration required with regard to the user of the building.

The indicated areas of protection are

- natural resources;
- ecosystem.

5.2.4 Amount of waste generation by type

This indicator measures the production of the total volume of non-hazardous and hazardous wastes that has a potential impact on the generation of waste for disposal. The generation of such waste can result from the production of building products, as well as construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building. The total amount of waste includes all wastes to final disposal including, for example, material losses, construction and demolition wastes and solid municipal wastes that are not reused or recycled.

In accordance with ISO 21930 and ISO 21931-1, waste shall be classified as either hazardous waste or non-hazardous waste. The division between the two categories should be expressed in percentage terms.

The consideration of the production stage of the original building product or the construction stage might not be necessary when measuring the waste production for existing buildings.

Measurement (calculation) in the design phase is accomplished by assessing the estimated total waste amounts, for each stage and type of waste, produced during the entire life cycle with special consideration needed with regard to the

- service life of the building and building products;
- use/users of the building;
- possibility for segregation and recycling of wastes;
- possibility to compost organic waste;
- plans for maintenance and renovation;
- end-of-life actions.

NOTE 1 In considering impacts of the end-of life stage, the possible actions that can be undertaken include deconstruction (i.e. disassembly, demolition), recovery (i.e. for energy or reuse), recycling, and/or final disposal as waste.

Measurement in the in-use stage is accomplished by assessing the actual amount and types of the waste formation.

The indicated area of protection on global, regional and local levels is natural resources.

NOTE 2 Waste produced from building materials during the construction stage and demolition phase and solid municipal wastes that are produced during the operational stage of buildings are the sources of a significant proportion of all wastes generated in the world. The final disposal of wastes to landfill occupies land, decomposition of organic wastes and generation of methane and carbon dioxide causes climate change, and the escape of hazardous substances from wastes to the local environment has potential adverse effects on the deterioration of eco-systems. The amount of waste also indicates the use of natural resources.

5.2.5 Change of land use

This indicator measures the avoidance of consuming of greenfield lands through the reuse of brownfield and derelict areas, refurbishment, using infill sites and re-development of existing built environment.

NOTE 1 A greenfield area represents an area of land that is not covered by artificial surfaces; a brownfield area is either part of the developed or urbanized land, covered with artificial surfaces and no longer in use for housing, industry or services, or a part of land affected by levels of pollution of the soil or subsoil that are high enough to require remediation before safe reuse is possible.

NOTE 2 A brownfield can also be ecologically valuable.

This indicator measures the re-development of the built environment both by making use of and re-developing derelict industrial, warehouse, port and dumping areas by decontaminating and rebuilding, and by making use of and re-developing old/existing office, retail and residential areas by repairing and refurbishing, using infill sites and extending and integrating new building within existing areas. This indicator also measures the utilization of existing infrastructure and networks.

Assessment and grading should be made on the basis of a classification that takes into account the type(s) of reuse of land and the type(s) of brownfield use, and percentage of true greenfield versus brownfields.

Measurement in the design phase and in-use stage is accomplished by verifying the real process: development of greenfield versus existing built environment versus brownfield.

The indicated areas of protection are

— ecosystem;

— natural resources.

NOTE 3 Reuse of brownfields directly affects the possibilities to maintain greenfield areas. Development of greenfields versus brownfields affects the consumption of land and space, soil pollution and biodiversity. Development of greenfields can cause increased fragmentation and thus affect the ability of species and populations to survive. Fragmentation of territories can destroy species more than corresponding true decrease of the areas of territories. Fragmentation causes diminishing of original natural environments and isolation of areas. Avoiding the use of greenfields for building also affects the preservation of ecologically productive land.

NOTE 4 This indicator emphasizes the selection of locations and sites so that it is possible to make use of existing built environments, brownfields and derelict areas by decontaminating and redeveloping, refurbishing and by extending and integrating new building. In addition, it means the selection of locations so that the existing infrastructure and networks can be utilized.

NOTE 5 The potential to affect surface drainage is sometimes considered as an additional impact category of land use for evaluation (see A.9).

5.2.6 Access to services by type

5.2.6.1 Public modes of transportation

This indicator measures the quality and proximity of access to public transport around the building.

Proximity relates to distance. Possible measures include walking time and/or walking distance. Quality refers to the frequency, variety of types, and the extent of possible destinations and networks. The local and regional public transports to consider include bus, underground railway, tramway and other railway connections. Measurement is accomplished by determining the travel time and/or actual distances, as well as frequencies and number of different types.

The indicated areas of protection are

— ecosystem;

— social equity;

— economic capital.

NOTE 1 Examples of possible measures are travel time to access, i.e. 15 min on foot; physical distance to access, i.e. 300 m or 500 m; frequency, i.e. once per hour; types, i.e. two bus lines and one tramway.

NOTE 2 Accessibility of public transport typically reduces the requirement for mobility by private motorized transport. This has important environmental advantages especially in terms of reducing GHG emissions. The use of public transportation can also be an element of social equity. Citizens in the poorest parts of the city often have the lowest car ownership rates. Thus access to public transportation can also measure the access to services, including education, employment, leisure and goods, irrespective of the users' ownership of a private vehicle.

5.2.6.2 Personal modes of transportation

This indicator measures the quality and proximity of the traffic network and covers all private modes of transportation. The access to and range of pavements (sidewalks), pedestrian footways and cycle tracks (bicycle paths) and networks, the quality of these paths or ways and the availability of facilities that facilitate the use of bicycles, are considered relevant from the environmental point of view. From the social and economic point of view, access to the traffic network in general can be relevant.

Proximity implies having immediate access to pedestrian and bicycle lanes and routes and other relevant traffic networks. Also, the quality of the networks shall be considered and classified according to local context and conditions.

Provisions that facilitate the use of bicycles include, for example, public parking racks. With regard to quality, the maintenance of the services should be considered, especially for the winter season in cold climate regions.

Measurement is accomplished by confirming the proximity, number and lengths of networks and assessing the actual quality of routes and lanes.

The indicated areas of protection are

— ecosystem;

— social equity;

— economic capital;

— health and well-being.

NOTE 1 Access to personal modes of transportation contributes to reducing the impact of transport on the environment. This can be important especially from the view point of potential climate change because motorized transport is responsible for a significant share of GHG emissions.

NOTE 2 Supporting the use of bicycles can be considered a matter of equity because private motorized transport is not affordable for all. The indicator also contributes to promoting alternatives accessible to all or many people and reducing the necessity for private motorized transport.

NOTE 3 Access to personal modes of transportation can also contribute to health and its consequences, such as peoples' availability/attendance at work. Access to the traffic network can also be relevant from the general view points of economic value and productivity.

5.2.6.3 Green and open areas

This indicator measures the quality and proximity of green and open areas. Green and open areas include natural areas and parks, gardens or open spaces accessible to the public.

Proximity relates to distance. Possible measures include walking/cycling time and/or walking/cycling distance. Measurement is accomplished by determining the actual distance and/or time to access the space.

The indicated areas of protection are

— ecosystem;

— social equity;

— health and well-being.

NOTE 1 Examples of possible measures are travel time to access, i.e. 15 min on foot or 5 min by cycling; physical distance to access, i.e. 500 m or 1 km.

NOTE 2 Access to public open areas can be essential for the quality of life and comfort. From the view point of single buildings, the accessibility to open areas can affect the possibilities for recreation, sport and physical exercise and thus also for the quality of life, comfort and health of the occupants. The availability of open areas can also affect the occupants' equity; the access to open areas is important for all user groups.

5.2.6.4 User-relevant basic services

This indicator measures the presence (availability), quality (number and type) and proximity of basic services required by the users of the building.

The quality (types) of basic services required depends on the building type. Such services may include primary public health services, schools, kindergartens, food shops (i.e. bakeries and groceries), spaces and structures for cultural and leisure activities [i.e. theatres, cinemas (movie theatres), civic centres, libraries, sports complex], and restaurants, workplaces/residential areas.

The list of basic services required, including number and type, and required proximity shall be locally defined.

Proximity relates to travel distance and should consider different modes of travel, i.e. walking, cycling, public/private vehicle. Possible measures include travel time (for each mode of movement) and/or actual travel distance. Measurement is accomplished by determining the actual distances and the number and types of basic services available.

The indicated areas of protection are

— ecosystem;

— social equity.

NOTE 1 Easy and ready access to basic services is important in terms of all user groups' and occupants' equity. Access to basic services can be essential for the quality of life. Easy and ready access also affects the user's car-dependency, which subsequently affects the potential environmental impact from using motorized transport.

NOTE 2 Location of property and especially the vicinity of growing neighbourhoods and services is the most important issue that indicates the market value of the property.

5.2.7 Accessibility

5.2.7.1 Accessibility of the building site (curtilage)

This indicator describes the possibilities for barrier-free use of all relevant parts of the building site (or curtilage), including yards and gardens.

Measurement (assessment) considers that different classes of accessibility are described.

Measurement is accomplished in the design phase and also in the in-use stage with help of an assessment against performance criteria of sub-aspects. Sub-aspects may include, for example, issues such as maximum inclines and level differences, adequate notations, light and contrast.

The indicated area of protection is social equity.

NOTE 1 This indicator is generally considered to be especially important for residential buildings, schools and public buildings.

NOTE 2 The isolation of sites or portions of sites on the basis of prosperity and wealth differences is sometimes considered as an additional impact category of building design to be evaluated.

5.2.7.2 Accessibility of the building

This indicator describes the ability to enter a space with ease by all users of the building.

Measurement (assessment) considers that different classes of accessibility are described. Classification criteria may include, for example, issues like the availability of elevators, minimum dimensions, maximum inclinations and level differences, adequate notations, light and contrast.

Measurement is accomplished in the design phase and also in the in-use stage with the help of an assessment against the classification criteria.

The indicated area of protection is social equity.

NOTE 1 Accessibility for all users of the building affects the equity of the users.

NOTE 2 Accessibility, as it relates to a building(s) and its curtilage, is addressed under Article 9 of the *UN Convention on the Rights of Persons with Disabilities* (2006), which promotes the concept of universal design, namely the design of products, environments, programmes and services to be usable by all people to the greatest extent possible, without the need for adaptation or specialized design. The Convention also emphasizes, in Article 19, the opportunity of persons with disabilities to choose their place of residence and where and with whom they live on an equal basis with others and to not be obliged to live in a particular living arrangement[7].

5.2.8 Indoor conditions and air quality

Different spaces within a building vary with regard to indoor conditions and air quality and they also vary with regard to time (i.e. night and day, season). The performance shall be assessed space by space and an aggregation should be used in order to express the final result on the building level.

NOTE Indoor thermal, acoustical and visual conditions can be important social aspects related to the contribution of a building to sustainability and sustainable development because temperature, noise and illumination, and the possibilities to adjust them, can affect the comfort of users and thus satisfaction and productivity.

5.2.8.1 Indoor thermal conditions

This indicator measures the quality of indoor thermal conditions that have a potential impact on the thermal comfort of users of the building.

Sub-aspects of indoor thermal conditions included in this part of ISO 21929 are

— air temperature;

— mean-radiant temperature;

— vapour pressure;

— humidity;

— air movement (velocity).

This indicator considers normal conditions, temperature stratification, stability, and the possibility to adjust the indoor thermal conditions. The use of the indicator requires that different classes of indoor thermal conditions be described with reference to temperature range, etc., and that there be an understanding about the effect on the thermal comfort of the user. In the highest class, the possibility to adjust may also be taken into consideration.

Measurement (assessment) in the design phase is accomplished with the help of expertise and simulation of the indoor thermal environment design.

Measurement in the in-use stage is accomplished by measuring and monitoring of real conditions and comparing against described classes. During the in-use stage, a post-occupancy evaluation that directly measures user satisfaction in terms of thermal comfort with regard to aspects of indoor thermal conditions should also be used.

The indicated area of protection is health and well-being.

5.2.8.2 Indoor visual conditions

This indicator measures the quality of indoor visual conditions that have a potential impact on the visual comfort of users of the building.

Sub-aspects of indoor visual conditions included in this part of ISO 21929 are

— illumination level;

— glare;

— visibility;

— reflection;

— daylight factor;

— satisfaction with both artificial as well as natural illumination.

This indicator considers normal conditions and the possibility to adjust the indoor illumination conditions. The use of the indicator requires that different classes of indoor visual conditions be described and there is an understanding about the effect on the visual comfort of the user. In the highest class, the possibility to adjust may also be taken into consideration.

Measurement (assessment) in the design phase is accomplished with the help of expertise and simulation of the indoor illumination design.

Measurement in the in-use stage is accomplished by measuring and monitoring of real conditions and comparing them against the described classes. During the in-use stage, a post-occupancy evaluation that directly measures user satisfaction in terms of visual comfort with regard to indoor visual conditions should also be used.

The indicated area of protection is health and well-being.

5.2.8.3 Indoor acoustic conditions

This indicator measures the quality of indoor acoustic conditions that have a potential impact on the acoustic comfort of users of the building.

Sub-aspects of indoor acoustic conditions included in this part of ISO 21929 are

- noise level;
- speech intelligibility.

This indicator considers normal conditions and the possibility to adjust the indoor acoustic conditions. The use of the indicator requires that different classes of indoor acoustical conditions be described with reference to noise levels, etc., and that there be an understanding about the effect on the acoustic comfort of the user. In the highest class, the possibility to adjust may also be taken into consideration.

Measurement (assessment) in the design phase is accomplished with the help of expertise and simulation of the indoor acoustic environment design.

Measurement in the in-use stage is accomplished by measuring and monitoring of real conditions and comparing them against described classes. During the in-use stage, a post-occupancy evaluation should also be used, which directly measures user satisfaction in terms of acoustic comfort with regard to aspects of indoor acoustical conditions.

The indicated area of protection is health and well-being.

5.2.8.4 Indoor air quality

This indicator measures the quality of indoor air that has a potential impact on the human health, olfactory comfort and perceived comfort of users of the building.

Sub-aspects of indoor air quality included in this part of ISO 21929 are

- odour;
- chemical and biological pollutants [such as concentrations of carbon dioxide, carbon monoxide, formaldehyde, particulates, volatile organic compounds (VOCs), and microbial matter], ventilation rate;
- air distribution patterns;
- pollution sources.

This indicator considers levels of acceptable concentrations.

Measurement (assessment) in the design phase is accomplished with the help of expertise and based on simulation. Measurement in the in-use stage should take place through the measurement and monitoring of real conditions.

The indicated area of protection is health and well-being.

NOTE 1 Indoor air pollution affects the health of many people. Registered increased incidences of allergies, respiratory symptoms and asthma among children have been associated with indoor allergens, moisture or mould-contaminated environments and combustion sources, including environmental tobacco smoke. Emissions can also come from some building materials, finishing products, cleaning products and indoor activities.

NOTE 2 There is evidence that indoor air quality substantially influences both health and productivity. Poor quality of indoor air affects productivity indirectly through its impact on short-term sick leave due to infectious diseases, but also directly.

5.2.9 Adaptability

5.2.9.1 Change of use or user needs

This indicator measures the quality of space design, construction method, and capacity, as well as building services that have a potential impact on the adaptability in terms of changed user requirements and changed use/purpose.

Adaptability includes aspects of flexibility and convertibility.

The adaptation of buildings relates to the following partial goals:

— to accommodate individual user requirements;

— to accommodate the change of user requirements;

— to accommodate technical innovation;

— to accommodate the change of use.

Measurement (assessment) considers that different classes of adaptability are described.

The indicated areas of protection are

— natural resources;

— economic capital.

NOTE 1 Certain social trends emphasize the importance of adaptability. These include, for example, the demographic development and ageing.

NOTE 2 Well-designed adaptability can save environmental and economic resources. However, it is difficult to model in such a way that the effects can be included directly in assessing environmental impacts or life-cycle costs.

NOTE 3 The indicator is particularly relevant for office and retail buildings.

NOTE 4 The adaptability of buildings is the prerequisite for a long utilization and service life and contributes to the avoidance of the technical and functional obsolescence. A long utilization/service life of buildings offers advantages in the evaluation of the economic and environmental performance at the same time as a change in the technical and functional requirements.

5.2.9.2 Adaptability for climate change

This indicator measures the ability of the building to provide shelter that has a potential impact on the users and occupants of the building and also on the ability to maintain the value of the property, in terms of unexpected loadings resulting from projected climate change.

The use of the indicator requires that the change of loadings due to climate change be locally assessed.

Measurement (assessment) in design phase should take place with help of expert assessment and/or simulation of the design against the performance level required for this aspect. Measurement in the in-use stage should take place with the help of expert assessment and/or simulation of the building model.

The indicated areas of protection are

— natural resources;

— economic capital;

— health and well-being.

NOTE Climate change can cause phenomena that require specific efforts to address in building design.

5.2.10 Life cycle costs

This indicator measures the costs of the building, including initial costs, operation and maintenance costs and end-of-life costs, that have a potential impact on the affordability and value of the building.

The aspect of costs included in this part of ISO 21929 are the life-cycle costs and whole-life costs. Both life-cycle costs and short-term costs may be considered. Life-cycle costs may be in the interest of the owner, while shorter term costs may be important for other actors, like tenants.

Measurement in the design phase is accomplished with the help of an assessment, using life cycle costing, on the basis of investment cost and the estimated costs related to the operation, maintenance and refurbishment of the building. Measurement in the in-use stage should take place with the help of assessment, using life cycle costing, on the basis of estimated cost related to the maintenance and refurbishment and verified cost of operation.

NOTE 1 ISO 15686-5 establishes guidelines for performing life-cycle cost analyses of buildings and constructed assets and their parts.

The indicated area of protection is economic capital.

NOTE 2 Costs also affect affordability. Affordability measures the ability of a community to purchase or rent a dwelling. It may be expressed as a ratio or as a percentage of a community. It is generally applied to housing, and represents the cost of housing, in terms of rent or mortgage repayments, in relation to median household income in the area. Affordability has a potential impact on social equity and economic prosperity. Costs affect market value and rent and, thus, also the affordability in relation to the ability of the population of the area to purchase or rent a dwelling or some space in the building.

NOTE 3 Life-cycle costing is a technique for estimating the cost of buildings, systems and/or building components and materials, and for monitoring the costs incurred throughout the life cycle. The technique can assist decision-making in building investment projects. Life-cycle costing is used to evaluate the costs of a building throughout its life cycle, including acquisition, development, operation, management, repair, disposal and decommissioning.

NOTE 4 When the evaluation is based on whole-life costs, additional consideration is given to a broader set of cash flow categories, e.g. income stream.

5.2.11 Maintainability

The indicator measures the quality of design, building and its structures and surfaces and the quality of maintenance plan that has a potential impact on the maintainability in terms of the comfort of the users and in the ability of the building to function.

NOTE 1 The environmental impacts and life-cycle costs of maintenance are assessed in relation to a maintenance scenario and with use of life-cycle assessment and life-cycle costing.

Measurement (assessment) considers that different classes of maintainability are described.

Measurement (assessment) in the design phase should take place with the help of an expert assessment of the design. Measurement in the in-use stage should take place with the help of an expert assessment and interviews of the users of the building.

The indicated area of protection is economic capital.

NOTE 2 This indicator partly overlaps with the indicators GWP and ODP (see 5.2.1), amount of non-renewable resources consumption (see 5.2.2), amount of fresh water consumption (see 5.2.3), amount of waste generation (see 5.2.4) and life cycle costs (see 5.2.10).

NOTE 3 The type, scale and timing of maintenance measures influence the building performance and, thus, can also affect the life-cycle costs and market value of the property, and the comfort and productivity of the users of buildings. With the help of good maintainability, along with careful and systematic building maintenance, it is possible to affect the comfort of the users of the building and the neighbourhood, while preserving the existing built environment and the related cultural value/economic value of constructed assets, and also reducing the use of material and energy resources.

5.2.12 Safety

NOTE In terms of structural stability, resistance to weather, fire safety, and safety in use, inadequate safety forms an evident danger towards users and occupants of the building and also towards the property. In many cases, acceptable "levels" of safety considered and supplied in a building are established through the adoption of national or local building and fire safety regulations (codes).

5.2.12.1 Structural stability

Stability against loading expresses the ability of the building to provide safe and resistant shelter that has a potential impact on the safety for the users and occupants of the building and also on the ability to maintain the value of the property.

The sub-aspect of safety included in this part of ISO 21929 is the resistance to loadings considering exceptional loadings arising from earthquake, explosion and exceptional loading from weather conditions such as strong wind, heavy rains, snow and flooding, when relevant.

Measurement (assessment) requires that considered levels in different classes be described.

Measurement in the design phase is accomplished with the help of expert assessment and/or simulation of the structural design. Measurement in the in-use stage is accomplished with the help of expert assessment and/or simulation of the building model.

The indicated area of protection is health and well-being.

5.2.12.2 Fire safety

Fire safety expresses the ability of the building to provide safe and resistant shelter that has a potential impact on the safety for the users and occupants of the building and also on the ability to maintain the value of the property, in terms of fire safety.

The sub-aspect of safety included in this part of ISO 21929 is the resistance to fire loadings and provisions for early warning and means of escape, considering different fire scenarios, when relevant.

Measurement (assessment) requires that considered levels in different classes be described.

Measurement in the design phase is accomplished with the help of expert assessment and/or simulation of the fire safety design. Measurement in the in-use stage is accomplished with the help of expert assessment and/or simulation of the building model and different fire scenarios.

The indicated area of protection is health and well-being.

5.2.12.3 Safety in use

Safety in use expresses the ability of the building to provide a safe useable environment that has a potential impact on the safety for the users and occupants of the building.

The sub-aspect of safety included in this part of ISO 21929 is the usability of the building while limiting the potential risk of tripping, falling and other types of accidents.

Measurement (assessment) requires that required levels in different classes be described.

Measurement in the design phase is accomplished with the help of expert assessment and/or simulation of the design. Measurement in the in-use stage is accomplished with the help of expert assessment and/or simulation of the building model.

The indicated area of protection is health and well-being.

5.2.13 Serviceability

Serviceability expresses the fitness for purpose of the building that has a potential impact on the ability of a building to fulfil the user requirements, from the functionality point of view.

Serviceability, as it is referred to in this part of ISO 21929, is limited to space design and information and communication technological services of the building in relation to the intended use and user requirements.

NOTE 1 Other aspects are dealt with under other indicators.

Measurement (assessment) in the design phase is accomplished by comparing the user-specified functional performance requirements (demand profiles) with the serviceability of the design and/or technical solutions (supply profiles).

Measurement in the in-use stage is accomplished with the help of expert assessment and post-occupancy evaluation considering the required levels of functionality that are being compared to the available levels of serviceability.

NOTE 2 ISO 15686-10 establishes when to specify or verify functional performance requirements during the service life of buildings.

The indicated area of protection is economic prosperity.

NOTE 3 User satisfaction depends on usability and serviceability. The better the building corresponds to the requirements of the owner and the requirements of the users and the better the future requirements have been able to be foreseen, the longer the building can be used without the requirement for changes and, thus, any requirement for demolition and/or reconstruction.

NOTE 4 Reduction in energy consumption, GHG emissions and costs can be sought with the help of effective space use. In order to maintain and improve the quality of buildings as places to work and live, the focus can be directed not only to decreasing environmental impact but also to improving the usability and serviceability of buildings.

NOTE 5 In addition to indoor climate and other indoor conditions, space design affects the comfort and, thus, the satisfaction and productivity of the occupants.

NOTE 6 Important aspects of space design for an office building can include possibilities for undisturbed work and spontaneous interaction, possibilities for meeting and spaces for break.

5.2.14 Aesthetic quality

The indicator measures the aesthetic quality of the building with help of the following criteria:

— integration and harmony of the building with the surroundings;

— impact of a new building or renovation of an existing building on the cultural value of a site (curtilage), neighbourhood, local heritage and built environment;

— consideration during the planning and design phases of the requirements of various interested parties for aesthetic quality.

The indicator is a qualitative indicator. The assessment in the design phase and the in-use stage should be executed and established as objectively as possible. The size, importance and architectural and social relevance of the building or the development should be taken into account when defining the assessment procedure and complexity. In some cases, being in accordance with local building and urban planning regulations is sufficient. In other cases, processes such as expert assessment, architectural competitions or stakeholder commissions can be required.

This impact shall be evaluated in order to protect and add to the existing architectural and cultural value of the surrounding area.

The indicated area of protection is cultural heritage.

NOTE 1 Aesthetic quality is relevant to the attractiveness of a site (curtilage), municipality or city and can contribute to the well-being and quality of life of people who live, work or visit there. Creating and maintaining aesthetic quality can contribute to well-being and quality of life of communities, can help to mitigate the impacts of cultural globalization and can become an incentive for sustainable economic development.

NOTE 2 Construction activities and creating and preserving aesthetic quality can be in conflict if they are not considered together at the initial planning phase of developments.

NOTE 3 The cultural value and local heritage concepts are different from the architectural quality. The cultural value and local heritage usually comes from the presence of historical buildings or sites and have an intrinsic historical or cultural importance, while architectural quality of a building(s) results from a mix of several evaluation criteria including aesthetic quality, functionality, serviceability, technical features, etc. The architectural quality of the existing built environment can be preserved, while providing for the creation of today's architectural quality to constitute the cultural heritage of tomorrow.

6 Development and use of a system of sustainability indicators

6.1 General

This part of ISO 21929 provides guidance and rules for establishing individual, as well as a set(s) of, indicators, that are used either separately or together to indicate various aspects of buildings that contribute to sustainability and sustainable development.

Focussing on one particular indicator or only a few indicators can be helpful for users to define objectives or monitor progress towards certain goals or objectives in a non-structured way. However, it is not intended by this part of ISO 21929 to use any such individual or group of indicators as a basis to assess the contribution of a building to sustainability or sustainable development.

When the contribution of a building to sustainability and sustainable development is expressed with the help of relevant indicators, a system of indicators, which includes the core set of indicators as a minimum, shall be used in any such assessment.

When making claims about the conformance of an assessment method with this part of ISO 21929, the assessment method shall, as a minimum, include the core set of indicators described in this part of ISO 21929.

The use of a system of indicators helps to implement a number of the general principles described in ISO 15392. This is reflected in the application of the core set of indicators, as follows.

- Consideration throughout the building's life cycle of the different aspects related to the core set of indicators provides an instrument for “long-term consideration” by the different users (owners, developers, designers, contractors, administrative bodies) for “continual improvement” and monitoring, while “involving interested parties”.
- Consideration of all the different individual indicators within the core set of indicators embodies the principle of a “holistic approach”.
- Consideration of a number of the different individual indicators within the core set of indicators reflects expression of social, economic and environmental responsibility involving “global thinking with local action”.
- Consideration and compliance with the guidelines and requirements described in this clause regarding the core set of indicators ensures the “transparency” of the process.
- Consideration of a number of different individual indicators within the core set of indicators related to access and accessibility shows concern as it relates to improved “equity”.

6.2 Rules for establishing a system of indicators

Establishing a system of indicators consists of

a) choosing relevant indicators;

b) developing and/or finding suitable methods and information to measure or assess the values of individual indicators.

The choice of relevant indicators depends on the requirements of interested parties, decision-making bodies, the building and its (local) context and the availability of information.

The other step is to develop and describe measurement methods and gather information and use the relevant methods in order to assign values to the selected indicators.

The following general requirements shall apply when establishing a system of indicators for buildings.

- The system of indicators shall contain indicators that are representative of the aspects of building that impact on one or more of the areas of protection.
- The process of selection, development and application of indicators and the qualitative, quantitative or descriptive methods of assessing individual indicators shall be capable of being transparently reported.
- The selection of indicators that are not defined as core indicators in this part of ISO 21929 shall be motivated by, and explained with reference to, both the local and global context, as appropriate.

NOTE When establishing a system of indicators for use in a single country, the building and construction of which is regulated by common building regulations, it can be that some indicators (such as safety and accessibility) are adequately covered by existing building regulations, considering the general view points of sustainability and sustainable development.

6.3 Usability of sustainability indicators

In order to be usable, an indicator shall be accompanied by an explanation that describes how to assign the value of the indicator. Indicators also should have a source of information that provides the basis on which the value of an indicator is calculated.

With indicators being used to simplify and communicate complex information, they are useful for

- assessment (for example, against stated target values);
- diagnosis (for example, to point out affecting factors);
- comparison (of alternative buildings);
- monitoring [for example, the change (of impacts) over time].

NOTE 1 The usefulness of indicators can be increased by creating a benchmark against which the value of an indicator can be compared.

NOTE 2 Intended uses of a system of indicators for assessing overall sustainability can include

- evaluation of options for
  - procurement of a building,
  - design and construction of a new building,
  - the analysis of the performance of an existing building,
  - improving operation of an existing building,
  - designing for retrofit and refurbishment during the operating stage,
  - the deconstruction and disposal at the end of the operating stage;
- use as the basis for benchmarking;
- communication to third parties.

Weighting of indicators and aggregating of results is sometimes applied in practice, either implicitly through the choice of indicators or explicitly through the application of weights. As the aggregation of results typically relates to subjective value choices, and as there are no commonly agreed methods for weighting, clear and transparent documentation should be provided where weighting methods are applied.

NOTE 3 This part of ISO 21929 does not otherwise address subjects related to weighting of indicators or aggregation of results.

Sustainability indicators are often used for the comparison of design options or buildings. The users of indicators shall always ensure that the basis of comparison is consistent, appropriate and adequately defined.

6.4 Users of indicators

The application of indicators varies according to users, the related requirements of those users, and the applicable life-cycle stage/phase. Developers of indicators should be aware of the context of their intended application. The context relates to the field of application (assessment, diagnosis, comparison, monitoring), the stakeholders' scope, the decision-maker's scope, the phase(s)/stage(s) of the life cycle of the object and the availability of information.

NOTE The role of interested parties varies from one country to another, which can affect how these different parties use the different indicators.

- Developers and owners of buildings

  Indicators help developers and owners of buildings to state sustainability-related requirements and objectives. Indicators and related methods help to show the conformity of the design or the construction with stated requirements. Owners or asset managers also apply indicators in marketing plans to show the contribution of the building to sustainability and sustainable development.

— Designers

Indicators aid design by identifying critical aspects related to sustainability, such as consumption of energy, release of GHG, or accessibility. This ensures that the designer is able to recognize the design features that can have an effect on the chosen indicators. Using indicators and corresponding assessment methods and tools allows for comparison of alternative designs and verifying conformity of a design against stated objectives.

— Contractors

Contractors should be aware of stated sustainability-related requirements for the building in terms of indicators. In addition, contractors may apply sustainability indicators in order to monitor the construction process.

— Administrative bodies

Administrative bodies use indicators to state and show sustainability-related requirements on buildings. They also use indicators to evaluate sustainability-related performance of buildings. Administrative bodies may also relate incentives to certain indicator-related performance aspects, possibly in line with their policy objectives.

— Users and property managers

Sustainability indicators provide parameters for monitoring the use stage of buildings and allow for decision-making relative to corrective actions, if needed.

Annex A
(informative)

Indicators relevant to the assessment of the contribution of a building to sustainability and sustainable development

This annex describes additional aspects and indicators that can be relevant when assessing the contribution of a building to sustainability and sustainable development.

A.1 Emissions to water — Eutrophication potential

This indicator measures the potential impact on the eutrophication of water bodies. The emissions to water can result from the production of building products as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building.

The indicator's value is assessed with the help of life cycle assessment of the building by assessing the total magnitude(s) of those emissions to water that potentially affect eutrophication and by expressing the result in terms of PO_4 equivalent.

This indicator is a building-specific indicator. The indicated area of protection is ecosystem.

NOTE 1 Eutrophication happens when water systems receive excess nutrients that cause excessive plant growth (such as algae). Eutrophication can lead to a local increase in biodiversity; for example birds can be attracted to lakes and wetlands affected by eutrophication. Where eutrophication becomes predominant, overall diversity is likely to decline.

NOTE 2 Users of buildings and operation of buildings can affect eutrophication especially because of defective or missing waste-water systems and sewage treatment.

A.2 Emissions to land or water — Acidification potential

The indicator measures the potential impact on the acidification of land and water resources. The emissions to land or water can result from the production of building products, as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building.

The indicator's value is assessed with the help of life cycle assessment of the building by assessing the total magnitude(s) of those emissions that potentially affect acidification and by expressing the result in terms of SO_2 equivalent.

This indicator is a building-specific indicator. The indicated area of protection is ecosystem.

NOTE Acidification occurs when the capacity of the soil or water bodies to resist or neutralize acidifying atmospheric deposition begins to decline. Acidifying compounds can fall to the ground with rain or snow as wet deposition, or in the form of particles or gases as dry deposition. Ecosystems can eventually lose their neutralizing or buffering capacity completely, if acid deposition rates persistently exceed their levels of tolerance.

Buildings affect acidification, especially on the basis of the building-related energy use, when the sources of energy are fossil fuels and when there is no efficient de-sulfurization.

A.3 Emissions to air — Tropospheric ozone formation potential

This indicator measures the potential impact on the formation of tropospheric ozone (O_3). The emissions to air can result from the production of building products, as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building.

The indicator's value is assessed with the help of life cycle assessment of the building by assessing the total magnitude(s) of those emissions that potentially affect the formation of tropospheric ozone and by expressing the result in terms of ethylene equivalent.

This indicator is a building-specific indicator. The indicated areas of protection are

— health and well-being;

— ecosystem.

NOTE 1 Ozone is the primary ingredient of photochemical smog. Ozone is a harmful pollutant because it affects health and especially the respiratory system. Ozone levels in urban areas during pollution events can be high enough to affect human health. Ozone is also harmful because it can affect both forests and agricultural crops.

NOTE 2 The building sector affects the tropospheric ozone formation, especially through the use of fossil energy sources, solvent-based paints and plastics.

A.4 Use of renewable resources

This indicator measures the use of renewable material and energy resources. The use of such resources, and subsequent material and energy flows, can result from the production of building products, as well as the construction, use and subsequent deconstruction (i.e. disassembly, demolition) of the building.

The total amount of renewable resources used may be assessed on the basis of life-cycle assessment methods and/or information modules following the basic principles given in ISO 21930 and ISO 21931-1.

The consideration of construction stage might not be necessary when assessing the sustainability of existing buildings.

Measurement (calculation) in the design phase is accomplished by assessing the material and energy flows during the entire life cycle, with special consideration required with regard to the estimated service life of the building and end-of-life actions. Measurement in the in-use stage can also be accomplished by monitoring the energy flows.

NOTE In considering impacts of the end-of life stage, the possible actions that can be undertaken include deconstruction (i.e. disassembly, demolition), recovery (i.e. for energy or reuse), recycling, and/or final disposal as waste.

This indicator is a building-specific indicator. The indicated area of protection is

— ecosystem;

— natural resources.

A.5 Value stability

The indicator measures the expected/future value development of a building in the categories of a building's value stability or value growth potential, respectively. In the positive direction, the building's value shall remain stable or increase appropriately.

In order to assess and evaluate a building's value stability, two options exist. On the one hand, the risk associated with a particular property can be assessed by making use of so-called property rating techniques (similar to credit rating procedures applied within the financial services industry). This risk (expressed through a rating score) directly impacts on the future marketability – and thus, market value – of a building, influences its expected value development and, therefore, provides an indication of a building's likely value stability.

In addition, or as an alternative, a building's future value development can be evaluated by performing financial scenario analyses and/or so-called Monte-Carlo-Simulations. The application of such techniques allows providing an indication of both the direction as well as the extent of an expected deviation from the building's current value under different, future conditions.

In exceptional cases, it is also possible, using indirect replacement indicators, to provide an indication of a building's value stability. Such replacement indicators are, for example, functionality, flexibility and adjustability, which can, in return, be expressed as the building's usability for third parties as well as its modernization/refurbishment capacities.

Generally, the indicator value stability is a quantitative indicator. However, in exceptional cases, it can also be expressed as a qualitative indicator by making use of replacement indicators.

The indicator is applicable for both new and existing buildings.

This indicator is a property-specific indicator (building and site). The indicated area of protection is economic capital.

NOTE Buildings and constructed assets have a large share in the capital stock and in invested capital. For this reason, there is a societal interest in maintaining and preserving this capital. One important aspect in this regard is the systematic maintenance and modernization of the building stock, to which the durability, maintainability and adaptability of single buildings contribute.

A.6 Protection of rare species and valuable individual natural features on-site (within the curtilage)

This indicator measures the potential impact on rare species of flora and fauna appearing on the building site (within the curtilage) or specific valuable natural features and specific individual trees, rocks, etc.

The indicator is more relevant for new developments than for existing buildings.

The measurement can take place with the help of expert assessment by assessing local biodiversity and the existence of rare species.

This indicator is a site-specific indicator. The indicated area of protection is ecosystem.

NOTE Buildings can have a critical effect on the disappearance of individual natural features.

A.7 Ecological quality of the site (within the curtilage)

This indicator describes the use of such land areas for a building that are valuable from the viewpoint of nature protection. Valuable areas can include beaches and other areas that are especially important in terms of nature protection.

This indicator is a qualitative indicator. The valuable areas can be defined locally.

This indicator is more relevant for new developments than for existing buildings.

Measurement (assessment) in design phase can take place by assessing the building site (curtilage) against the definition of valuable areas with regard to nature protection.

This indicator is a site-specific indicator. The indicated area of protection is ecosystem.

NOTE Building is among the most important sectors that affect the impoverishment of natural environments. Certain types of areas, like beach fronts, can have an important effect on nature protection and biodiversity.

A.8 Potential to affect surface drainage

This indicator measures the area of land covered by marginally or non-permeable layers associated with buildings, paved areas, roads, vehicle parks and other constructed assets.

This indicator is measured by comparing the useable floor area of the building to the building footprint and associated non-permeable, paved areas (yards, parking areas, etc.) less allowances for any swales, detention ponds and green roofs.

This indicator is a site-specific indicator. The indicated area of protection is ecosystem.

NOTE 1 Soil sealing of earth takes place as a result of covering with marginally permeable or non-permeable layers created by constructed assets (roads, buildings etc.). Avoiding soil sealing is important in order to preserve ecologically productive land, to avoid changes in the quality of soil and water economy, to maintain and protect valuable natural areas and to avoid reduction of biodiversity.

NOTE 2 The significance of sealing can increase because the foreseen threats with regard to climate change and increasing risks of significant weather changes.

A.9 Nuisance caused by the building on the neighbourhood

This indicator describes the effect of the building, and the related activities that occur during its construction, use, and end-of life actions, on the neighbourhood and local environment in terms of noise, odours, dust and other pollutants, shadow, open view, wind conditions, vibration and additional traffic.

NOTE 1 In considering impacts of the end-of life stage, the possible actions that can be undertaken include deconstruction (i.e. disassembly, demolition), recovery (i.e. for energy or reuse), recycling, and/or final disposal as waste.

This indicator does not cover effects on the architectural quality of the neighbourhood.

This indicator is a qualitative indicator. Grading can be made on the basis of a classification that takes into account the above-mentioned aspects of nuisance.

Measurement (assessment) in the design phase can take place with help of estimation. Assessment in the construction stage and in the in-use stage takes place with help of estimation, interviews and on the basis of the number of complaints.

This indicator is a site-specific indicator. The indicated area of protection is health and well-being.

NOTE 2 Buildings can cause significant changes in the local environment because of the initial construction and the ongoing use of buildings. Buildings that contribute to sustainability and sustainable development do not impair the quality of the built environment or cause significant nuisance for the neighbourhood.

A.10 Outdoor conditions

This indicator measures the quality of outdoor conditions of a building in terms of noise and air quality, wind and shading.

This indicator is a qualitative indicator that can be assessed against a classification. The classification is different for different kinds of buildings and it is especially relevant for kindergartens, schools and residential buildings.

Measurement (assessment) in the design phase and in the in-use stage can take place by measuring the noise levels, concentrations of impurities and other relevant parameters against the building-type-specific classification.

This indicator is a site-specific indicator. The indicated areas of protection are

— health and well-being;

— economic prosperity.

NOTE High noise and high concentrations of impurities in outdoor air in particular can cause health effects. PM10, O_3 and NO_2 are key indicators for air quality.

Noise and exposure to pollutants are especially caused by the proximity of nearby streets and motorways with high traffic levels. Avoidance is especially important with regard to buildings where children and occupants spend time in the outdoor yards and gardens.

A.11 Heat island effect

This indicator describes the potential of the building and the site (within its curtilage) to mitigate the heat island effect.

The importance of the indicator depends on the climatic conditions of the region in which the building is situated. The magnitude of the impact of urban heat islands varies with seasons, due to changes in the sun's intensity as well as ground cover and weather.

The use of the indicator requires that there be a system that describes the different levels of measures for heat-island mitigation. These may include issues such as vegetation, properties of surface materials (especially solar reflectance, thermal emittance and permeability), geometry (especially the effect of the building on the visible area of the sky from nearby surfaces) and heat losses from machines, electrical equipment, vehicles, etc.

Measurement (assessment) in the design phase and in the in-use stage can be done with help of expert assessment of the design, building and its options.

This indicator is a location- and site-specific indicator. The indicated areas of protection are

— health and well-being;

— natural resources.

NOTE Densely built-up areas can be significantly hotter than nearby rural areas. Elevated temperatures from urban heat islands can affect the environment and quality of life, especially during summer. Most of the effects are negative, while some impacts can be beneficial, such as lengthening the plant-growing season. Because of the heat-islands phenomenon, energy demand for cooling, air conditioning costs, air pollution and greenhouse gas emissions, and heat-related illness and mortality can increase[10].

This indicator is partly overlapping with the indicators soil sealing (see A.8) and nuisance caused by the building on the neighbourhood (see A.9).

A.12 Participation

Participation refers to the involvement of the users of the building and the surroundings and other stakeholders in the buildings project.

This indicator describes the degree of involvement in all phases/stages of the project and the efforts made in order to identify the stakeholders' requirements and to interpret these requirements in terms of the quality of site (within the curtilage) and the performance of the building.

This indicator is a qualitative measure and the use of it requires the development of classification for alternative levels of stakeholders' involvement.

This indicator is a process-specific indicator. The indicated area of protection is social equity.

NOTE Participation of stakeholders is effective if it allows the integration of the views, interests, values and requirements of both interested and affected parties into project decision-making. The benefits of participation include the promotion of equity and fairness, distribution of power, capacity building, integration of stakeholder knowledge, better understanding of contextual issues, greater commitment to project goals, as well as improved transparency and credibility of decision-making.

Annex B
(informative)

Development of qualitative indicators

B.1 This annex describes general principles for the development of qualitative indicators.

B.2 For certain issues, the development of a quantitative indicator is not possible. The reasons for this are various and can include the following.

— Direct measurement is not possible.

— Data for calculation or measurement are not available either totally or partially.

— The calculation or measurement method is very complex or expensive, and tools are not readily available.

— The calculation or measurement method is not validated (problem of validity), still under development (problem of availability), or not mature enough or widely recognized and accepted (lack of consensus).

— No overall model exists that can translate the various parameters into one figure.

— There are several quantitative sub-indicators dealing with the issue, but they cannot be added or aggregated through a calculation model (e.g. in acoustics).

— For improved relevance, quantitative and qualitative information have to be combined.

— The assessment of the issue implies a combination of descriptive characteristics, or going through a check-list, with few or no possibilities to quantify the different points.

— The assessment of the issue needs both a deterministic approach and a risk assessment approach.

— The assessment of the issue mixes product-oriented aspects and process-oriented aspects.

B.3 Approaches that can be considered when developing qualitative indicators include the following.

— Define influencing parameters/aspects regarding the issue.

— Establish the sensitivity of these parameters relative to each other.

— Define if some sub-calculations are possible for each parameter of groups of parameters.

— Organize the parameters into a structured list.

— Define an assessment or measurement method for each element of the list (calculation, description, enquiry, yes/no answers, etc.).

— Establish rules of normalization (through scales or points) and aggregation (after weighting the different elements according to their relative influence).

— Define a final scale (e.g. from 0 to 5) or several classes (e.g. A to G) in order to get a final result or score that is the numerical value of the indicator.

— Define certain points as crucial ones or as mandatory pre-requisites, leading to the given class or scale level (possibly the worst one) if related requirements are not met, whatever the other sub-assessment might be.

Regardless of which approach(es) is considered, it is important to ensure the transparency of this process, and to justify its validity.

Bibliography

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

[2] ISO 15686-5:2008, *Buildings and constructed assets — Service life planning —— Part 5: Life-cycle costing*

[3] ISO 15686-10:2010, *Buildings and constructed assets — Service life planning — Part 10: When to assess functional performance*

[4] ISO 16813:2006, *Building environment design — Indoor environment — General principles*

[5] ISO/TR 21932[1)], *Building construction — Sustainability in building construction — Terminology*

[6] *UN CSD The Indicators of Sustainable Development: Guidelines and Methodologies, Third Edition. 2007. UN publications*

[7] *UN Convention on the Rights of Persons with Disabilities (2006) (http://www.un.org/disabilities/convention/conventionfull.shtml*

[8] *IPCC Fourth Assessment Report: Climate Change 2007, Executive Summary http://www.ipcc.ch/publications_and_data/ar4/wg3/en/contents.html*

[9] *Heat Island Effect. U.S. Environmental Protection Agency, EPA. http://www.epa.gov/heatisland/*

[10] *Global Reporting Initiative, Sustainability Reporting Guidelines. http://www.globalreporting.org/ReportingFramework/G3Guidelines/*

[11] *International Workshop Agreement on Sustainable Business Districts. http://www.iso.org/iso/pressrelease.htm?refid=Ref1277*

[12] ISO 26000:2010, *Guidance on social responsibility*

[13] ISO/TR 14061:1998, *Information to assist forestry organizations in the use of Environmental Management System standards ISO 14001 and ISO 14004* (withdrawn)

[14] *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* (22 March 1989)

1) To be published.

ICS 91.040.01

Price based on 39 pages