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Buildings and civil engineering works — Principles, framework and guidance for resilience design —

Part 1:
Adaptation to climate change

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Contents

Page

Foreword

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This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*.

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

Introduction

Adaptation to climate change has become an urgent need globally. According to the United Nations Environment Programme (UNEP)'s Adaptation Gap Report 2022, "the world must urgently increase efforts to adapt to the impacts of climate change that are already here and to those that are to come".

In the context of global climate change, buildings and civil engineering works with service lives of decades or even centuries will face new climate challenges. These challenges include the increase of frequency and intensity in extreme weather events such as heatwaves, wildfires and floods, as well as chronic changes such as sea level rise. This can result in increase of vulnerability in built assets designed based on the climate of the past decades, risking human health and well-being, and causing economic loss and social impacts. Therefore, adaptation to climate change in buildings and civil engineering works should be considered in a timely manner.

This document provides a design approach called the resilience design adaptive to climate change (RDACC), which offers specific guidance on how to produce buildings and civil engineering works with climate change resilience. It is a method for adaptation to climate change at the engineering level.

The typical actions of RDACC include:

— identifying changes in climatic impact-drivers;

— identifying resilience limits and decision making on strategies;

— monitoring and optimization;

— decommissioning.

This document is useful to stakeholders including asset owners and users, investors, authorities, standards developers, meteorologists, engineers, architects, manufacturers, builders, and other parties involved in the RDACC.

Buildings and civil engineering works — Principles, framework and guidance for resilience design —

Part 1: Adaptation to climate change

1 Scope

The document provides principles, framework, and guidance for resilience design adaptive to climate change (RDACC) in buildings and civil engineering works. RDACC is applicable to both new construction and retrofits.

RDACC does not address:

— adaptation to climate change in the production and procurement of building materials, components and devices;

— adaptation to climate change in construction processes;

— climate change mitigation in buildings and civil engineering works;

— emergency management related to climate change in buildings and civil engineering works.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
adaptation to climate change
climate change adaptation
process of adjustment to actual or expected *climate* (3.3) and its effects

Note 1 to entry: In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities.

Note 2 to entry: In some natural systems, human intervention can facilitate adjustment to expected climate and its effects.

[SOURCE: ISO 14090:2019, 3.1]

3.2
asset
whole building or structure or unit of construction works, or a system or a component or part thereof

[SOURCE: ISO 15686-5:2017, 3.4.1]

3.3
climate
statistical description of the weather in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years

[SOURCE: ISO 14050:2020, 3.8.1]

3.4
climate change
change in *climate* (3.3) that persists for an extended period, typically decades or longer

[SOURCE: ISO 14050:2020, 3.8.3]

3.5
climate change mitigation
human intervention to reduce greenhouse gas emissions or enhance greenhouse gas removals

[SOURCE: ISO 14050:2020, 3.8.6]

3.6
climate projection
simulated response of the *climate* (3.3) system to a scenario of future emissions or concentrations of greenhouse gases (GHGs) and aerosols and changes in land use, generally derived using climate models

[SOURCE: IPCC, 2022]

3.7
climatic impact-driver
CID
physical *climate* (3.3) system condition (e.g. means, events, extremes) that affects an element of society or ecosystems

[SOURCE: IPCC, 2022, modified]

3.8
constraint
factor that makes it harder to plan and implement adaptation actions

[SOURCE: IPCC, 2014, modified]

3.9
existing resilience
resilience (3.17) that an *asset* (3.2) currently designed can achieve in face of the *CID* (3.7) changing to a certain magnitude

3.10
global climate model
GCM
complex mathematical representation of the major *climate* (3.3) system components (atmosphere, land surface, ocean, and sea ice) and their interactions

[SOURCE: GFDL]

3.11
global warming level
global climate-change emissions relative to pre-industrial levels, expressed as global surface air temperature

[SOURCE: IPCC, 2022]

3.12
impact
result of a change or existing condition that may be adverse, neutral or beneficial

[SOURCE: ISO 15392:2019, 3.17]

3.13
maladaptation
actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas (GHG) emissions, increased or shifted vulnerability to *climate change* (3.4), more inequitable outcomes, or diminished welfare, now or in the future

[SOURCE: IPCC, 2022]

3.14
projected climatic design parameter
PCDP
meteorological parameter for buildings and civil engineering design base on *climate projections* (3.6)

3.15
Representative Concentration Pathway
RCP
scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover

[SOURCE: IPCC, 2022]

3.16
required resilience
resilience (3.17) that an *asset* (3.2) is desired to have in face of a *CID* (3.7)

3.17
resilience
adaptive capacity in a complex and changing environment

[SOURCE: ISO 31073:2022, 3.3.39, modified — "of an organization" has been removed.]

3.18
resilience design adaptive to climate change
RDACC
design approach to produce an *asset* (3.2) with *resilience* (3.17) to adapt to changing climatic conditions due to *climate change* (3.4) throughout its *service life* (3.20)

3.19
resilience limit
maximum magnitude of the *CID* (3.7) that the asset can adapt to, beyond which there is no feasible strategy

3.20
service life
period of time after installation during which a facility or its component parts meet or exceed the performance requirements

[SOURCE: ISO 15686-1:2011, 3.25]

3.21
Shared Socioeconomic Pathway
SSP
different levels of emissions and *climate change* (3.4) along the dimension of the *RCPs* (3.15) explored against the backdrop of different socio-economic development pathways on the other dimension in a matrix

[SOURCE: IPCC, 2022]

4 Principles

4.1 Change-oriented perspective

In the context of global climate change, buildings and civil engineering works can face different climatic conditions which are beyond initial anticipations during their service lives. Extreme weather events such as heatwaves and floods are projected to occur more frequently and intensely in some areas, while slow-onset changes such as sea level rise and permafrost thawing will gradually emerge in some areas over time. To address these changes, RDACC should adopt a change-oriented perspective for asset to adapt to future environment.

NOTE See Annex A for Global Building Resilience Guidelines capturing principles for incorporating future focused climate risk into building codes and standards.

4.2 Preparing for uncertainty with certainty

Although there are some uncertainties in climate projections, this should not be an excuse for inaction. RDACC should take innovative measures to mitigate the impacts of uncertainties.

4.3 Synergy between adaptation to and mitigation of climate change

RDACC should take into account the synergistic effects of adaptation and mitigation of climate change. Actions which can achieve both adaptation and mitigation should be prioritized; and maladaptation should be avoided.

EXAMPLE Better thermal performance of buildings can reduce energy consumption and provide protection from heatwaves in summer.

4.4 Synergy with community and urban resilience

RDACC should work within the framework of community and urban resilience, serving as the fundamental resilience element.

NOTE Improving the drainage capacity of individual buildings is part of a comprehensive approach to dealing with urban waterlogging and stormwater discharge. It demands coordination at community and city levels over, for example, rainwater storage of a building which serves as a cushion for community discharge systems.

4.5 Equity

RDACC should take into account the needs of assets users of all ages, gender, financial means, ethnicities, education, and physical abilities to ensure equitable reduction of risk and vulnerability[1].

4.6 Sustainability

RDACC should be carried out within the framework of sustainable development. Climate, economic, social and environmental factors should be considered when adopting an adaptation strategy.

5 Framework

RDACC involves a series of actions integrated into the asset's lifecycle, including design, operation, and decommissioning phases (see Figure 1):

— In design phase, identify how the climatic conditions at the asset's location may change during its service life (see Clause 6). Next, identify the resilience limit and determine appropriate adaptation strategies (see Clause 7).

  These actions can be applied to a specific project with the following guidelines.

  — When no projected climatic design parameter (PCDP) sets are available to quantify magnitude of changes in CIDs at the asset's location, RDACC should start from identifying changes in CIDs (see Clause 6).

  — When the PCDP sets are available, but no resilience limits are specified in current standards, specification, etc., RDACC should start from identifying resilience limits (see 7.1 to 7.4).

  — When both PCDP sets and resilience limits are available, RDACC can directly start from adaptation strategies design (see 7.3) and decision making (see 7.5).

— During operation phase, monitor the changes in CIDs and effectiveness of implemented strategies, and embrace the latest climate knowledge and technological advancements to optimize strategies (see Clause 8).

— Decommissioning is required when assets are no longer fit for purpose, and further adaptation is not a viable option (see Clause 9).

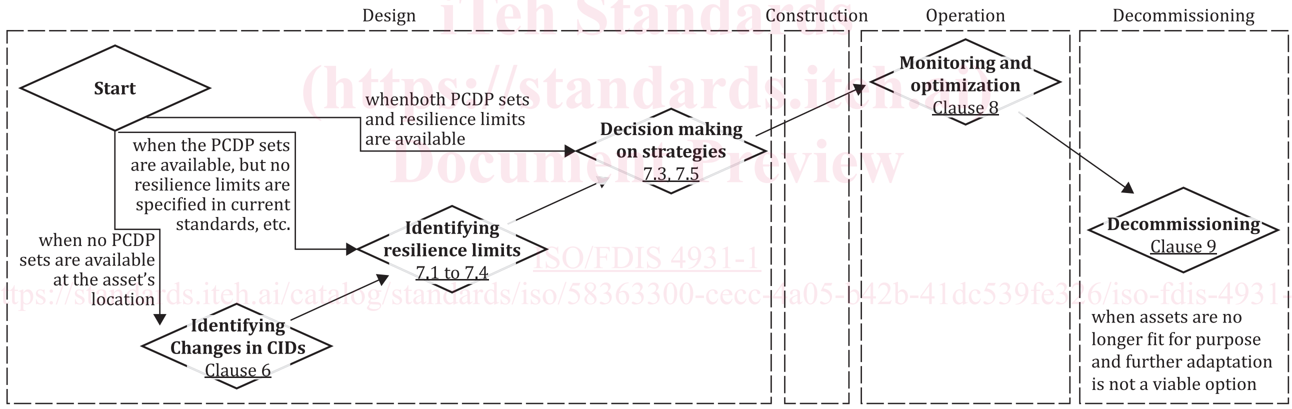

Figure 1 — Framework of RDACC in an asset's life cycle

Given the complex and multidisciplinary nature of RDACC, a professional team comprised of architects, engineers, meteorologists, hydrologists, economists, etc. may be required to work with the asset owners.

6 Identifying changes in climatic impact-drivers

6.1 General

Global climate change results in changes in intensity and frequency of climatic impact-drivers (CIDs) (see 6.2), which can affect the built assets designed based on current climatic design parameters.