SLOVENSKI STANDARD
SIST-TS CEN/TS 17440:2020

01-oktober-2020

Ocenjevanje in obnova obstoječih stavb

Assessment and retrofitting of existing structures

Bewertung und Ertüchtigung von bestehenden Tragwerken

Evaluation et rénovation des structures existantes

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Ta slovenski standard je istoveten z: **CEN/TS 17440:2020**

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TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

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CEN/TS 17440

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Assessment and retrofitting of existing structures

Évaluation et rénovation des structures existantes

Bewertung und Ertüchtigung von bestehenden Tragwerken

This Technical Specification (CEN/TS) was approved by CEN on 3 May 2020 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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SIST-TS CEN/TS 17440:2020

Contents

Page

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1e375f-deb4-4969-af4d-e8294d59c465/sist-ts-cen-ts-17440-2020

SIST-TS CEN/TS 17440:2020

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-[illegible]c465/sist-ts-cen-ts-17440-2020

SIST-TS CEN/TS 17440:2020

European foreword

This document (CEN/TS 17440:2020) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI. CEN/TC 250 is responsible for all Structural Eurocodes and has been assigned responsibility for structural and geotechnical design matters by CEN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under Mandate M/515 issued to CEN by the European Commission and the European Free Trade Association.

This document has been drafted to be used in conjunction with relevant execution, material, product and test standards, and to identify requirements for execution, materials, products and testing that are relied upon by this document.

This document recognizes the responsibility of each Member State and has safeguarded their right to determine values related to regulatory safety matters at national level through the use of National Annexes.

The presentation, in Notes to clauses, of national choice in this Technical Specification, does not everywhere accord with the guidance established by CEN/TC 250 for use in the Eurocode ENs. The presentation of National choice will be in accordance with the TC’s guidance in formal ENs.

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SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c373f-deb4-49b9-af4d-e8294d59e465/sist-ts-cen-ts-17440-2020

SIST-TS CEN/TS 17440:2020

Introduction

General

The Eurocodes comprise rules that are primarily intended for the design of new structures, although the principles of EN 1990 can also be applied for existing structures, with additional or amended provisions. CEN/TS 17440 is intended to supply those additional or amended provisions that can enable EN 1990 to be applied to the structural assessment of existing structures.

Extending the life of existing structural assets is a key challenge for structure owners worldwide. Investment in accurately assessing the resistance of structures can deliver substantial environmental, economic and socio-political benefits. In order to fully realize these benefits, it is often necessary in assessment to go beyond the simple, conservative methods typically used for design, so that reliability of structures can be more accurately assessed.

In the design of new structures, it is generally necessary to use conservative values for basic variables, and it is typical to use conservative models for structural analysis. However, when assessing an existing structure, there is an opportunity to obtain updated data regarding the structure, including its geometry, its material properties, the actions and environmental influences, and measures relating to its structural behaviour. There can be significant benefits to be gained from using updated data in the assessment, and by considering alternative structural analysis models that represent more accurately the limit states being assessed. CEN/TS 17440 includes provisions related to using updated data and updated structural models in assessment.

Older structures were often designed and constructed in a way that would not conform with modern standards for structural design, material products or execution. They can often exhibit deterioration or damage. A particular challenge in assessment is therefore how to accurately assess structures taking account of the actual detailing arrangements, material properties, execution tolerances, and the structural condition. CEN/TS 17440 includes principles for the assessment of structural resistance.

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SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1a375f-deb4-4969-af4d-e8294d59c465/sist-ts-cen-ts-17440-2020

Often, an older structure could need to be modified, extended, repurposed, strengthened or retrofitted in a way that reuses retained structural elements in combination with new structural elements. In such schemes, there will be a need to assess the retained elements of the structure, which might not conform to all the requirements for new design. CEN/TS 17440 includes provisions for the assessment of retained elements, as well as for the assessment of complete structures.

This document is based on the recommendation of JRC Science and Policy Report on assessment and retrofitting of existing structures. Upon the agreement of CEN/TC 250, this document can be converted into a new Eurocode Part.

Verbal forms used in this Technical Specification

The verb “shall” expresses a requirement strictly to be followed and from which no deviation is permitted in order to comply with the Eurocodes.

The verb “should” expresses a highly recommended choice or course of action. Subject to national regulation and/or any relevant contractual provisions, alternative approaches could be used/adopted where technically justified.

The verb “may” expresses a course of action permissible within the limits of the Eurocodes.

The verb “can” expresses possibility and capability; it is used for statements of fact and clarification of concepts.

SIST-TS CEN/TS 17440:2020

National annex for CEN/TS 17440

This document gives values within notes indicating where national choices can be made. Therefore, a national document implementing CEN/TS 17440 can have a National Annex containing all Nationally Determined Parameters to be used for the assessment of buildings and civil engineering works in the relevant country.

National choice is possible in CEN/TS 17440 through the following clauses:

4.1(1), 4.1(3), 4.4(2), 4.6(3), 5.3(1), 5.3(2), 5.3.(3), 6.1(2), 6.3(2), 7.1(5), 7.3.1(4), 7.3.8(1), 7.3.9(1), 7.3.9(2), 7.4.1.4(1), 9.2(1), 9.3(2), 9.3(3), 9.4(4), 9.4(5), 9.5(2), 10(1), D.3.1(1).

National choice is possible in CEN/TS 17440 on the application of the following informative annexes:

- Annex A,
- Annex B,
- Annex C,
- Annex D.

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SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-e8294d59c465/sist-ts-cen-ts-17440-2020

SIST-TS CEN/TS 17440:2020

1 Scope

1.1 Scope of CEN/TS 17440

(1)This document provides additional or amended provisions to EN 1990 to cover the assessment of existing structures (see EN 1990:2002, 1.1(4)), and the retained parts of existing structures that are being modified, extended, strengthened or retrofitted.

NOTE 1 The assessment of an existing structure is, in many aspects, different from the design of a new structure, see Introduction.

NOTE 2 There can be some aspects of EN 1990 that are required for design but are not applicable for assessment. The definition of those aspects of EN 1990 that are not applicable can be included in the definition of the assessment objectives and the approach to the assessment, see Clause 5.

NOTE 3 This document is based on the general requirements and principles of structural reliability provided in Eurocodes EN 1990 and EN 1991.

(2) This document covers general principles regarding actions for assessment complementing EN 1991.

NOTE Supplementary provisions for seismic actions due to earthquake are provided in EN 1998.

(3) This document includes general principles for the assessment of the structural resistance of existing structures.

NOTE The specific models used to assess resistance are not provided in this document and will depend on the materials and structure types.

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(4) This document does not provide specific rules for initiation of assessment.

(5) This document does not provide specific rules on how to undertake interventions that can be carried out as a result of an assessment.

SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-c829d59e4e3/sist-ts-cen-ts-17440-2020

(6) This document does not cover the design of new elements that will be integrated into an existing structure.

NOTE For the design of new elements, see EN 1990.

1.2 Assumptions

(1) The general assumptions of CEN/TS 17440 are:

- the assessment of the structure is made by appropriately qualified and experienced personnel;
- adequate supervision and quality control is provided during the assessment process;
- the structure will be used in accordance with the assessment assumptions;
- the structure will be maintained in accordance with the assessment assumptions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1990:2002, *Eurocode —Basis of structural design*

EN 1991, *Eurocode 1: Actions on structures*

SIST-TS CEN/TS 17440:2020

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1990 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
assessment
set of activities performed in order to verify the reliability of an existing structure

[SOURCE: ISO 13822:2010, 3.1 — modified]

3.1.2
assessment situation
physical conditions that could occur during a certain time period for which the assessment is intended to demonstrate, with sufficient reliability, that relevant limit states are not exceeded

3.1.3
assessment value
value of a variable applied in the analysis and verification of the structural performance of an existing structure determined from a characteristic or another representative value combined with partial and/or conversion factors, or also directly defined values

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SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-e8294d59c465/sist-ts-cen-ts-17440-2020

3.1.4
damage
unfavourable change in the condition of a structure that can adversely affect structural performance

[SOURCE: ISO 13822:2010, 3.2 — modified]

3.1.5
defect
deficiency of a structure resulting from errors during design, construction, prior intervention or lack of maintenance

3.1.6
deterioration
process that adversely affects the structural performance, including reliability, over time, for example due to:

- naturally occurring chemical, physical or biological actions;
- repeated actions such as those causing fatigue;
- wear due to use

[SOURCE: ISO 13822:2010, 3.3 — modified]

SIST-TS CEN/TS 17440:2020

3.1.7
deterioration model
mathematical model that describes structural performance as a function of time, taking deterioration into account

3.1.8
existing structure
structure that physically (materially) exists, including its foundation and soil

3.1.9
heritage structure
existing structure or structural component that has been recognized by the relevant authorities for its architectural or historical value

Note 1 to entry: Heritage structures can include all kinds of buildings, bridges and civil engineering works, including their foundations.

3.1.10
inspection
on-site non-destructive examination of a structure and/or its components with the objective of establishing the present condition of the structure and updating information as relevant

[SOURCE: ISO 13822:2010, 3.5 — modified]

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3.1.11
investigation
collection and evaluation of information through inspection, document search, measurements, material testing, load testing and other testing

SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-e82...-sist-ts-cen-ts-17440-2020

[SOURCE: ISO 13822:2010, 3.6 — modified]

3.1.12
load testing
test of a structure or part thereof by loading to evaluate its behaviour or properties, to predict or determine its load-bearing capacity

[SOURCE: ISO 13822:2010, 3.7 — modified]

3.1.13
material properties
mechanical, physical or chemical attributes of construction materials

[SOURCE: ISO 13822:2010, 3.9 — modified]

3.1.14
material testing
test of construction material to evaluate, or to predict its mechanical, physical or chemical properties

3.1.15
monitoring
frequent or continuous observation or measurement of structural conditions or actions

[SOURCE: ISO 13822:2010, 3.10 — modified]

SIST-TS CEN/TS 17440:2020

3.1.16
reference period
chosen period of time which is used as a basis for determining values of variable actions, time-dependent material properties and relevant reliability

[SOURCE: ISO 13822:2010, 3.11 — modified]

3.1.17
rehabilitation
structural intervention (repair, upgrade) to reach compliance with required structural performance

3.1.18
reliability
the ability of a structure or a structural member to fulfil the specified requirements during its remaining working life

[SOURCE: EN 1990:2002 — modified]

3.1.19
remaining working life
period for which an existing structure is intended/expected to operate with planned maintenance

[SOURCE: ISO 13822:2010, 3.13 — modified]

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3.1.20
structural performance
qualitative or quantitative measure of structural behaviour under expected circumstances in terms of its safety, serviceability, durability or robustness

SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-e8294d59c465/sist-ts-cen-ts-17440-2020

3.1.21
target reliability level
the value of reliability that is specified to be achieved in the assessment, indicating that a structure is able to fulfil its specified requirements over the remaining working life

3.1.22
updating
process of supplementing existing knowledge with new information for assessment

3.1.23
upgrading
modifications to an existing structure to improve its structural performance

[SOURCE: ISO 13822:2010, 3.18]

3.1.24
utilization plan
plan containing the intended use (or uses) during the remaining working life of an existing structure, and listing the operational conditions of the structure including maintenance requirements, and the corresponding performance requirements

[SOURCE: ISO 13822:2010, 3.19 — modified]

SIST-TS CEN/TS 17440:2020

3.2 Symbols

For the purposes of this document, the following symbols apply.

3.2.1 Latin upper-case letters

E_a	is the assessment value of the effect of actions
$G_{k,j}$	characteristic value of permanent action
P_{ft}	target probability of failure for a given reference period
P_k	characteristic value of prestress action
$Q_{k,1}$	characteristic value of the leading variable action
$Q_{k,i}$	characteristic value of accompanying variable actions
R_a	is the assessment value of the resistance
V	coefficient of variation
$X_{k,i}$	characteristic values of the material or product properties

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3.2.2 Latin lower-case letters

a_a	assessment values of the geometrical data
k	independence period
n	reference period
x_i	basic variable i
x_{ki}	characteristic value of the basic variable x_i
x_{ai}	assessment value of the basic variable x_i

SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-e8294d59c465/sist-ts-cen-ts-17440-2020

3.2.3 Greek upper-case letters

ϕ	cumulative distribution function of the normal distribution
ϕ^{-1}	inverse cumulative distribution function of the normal distribution

3.2.4 Greek lower-case letters

α_E	sensitivity factor for load effect
α_R	sensitivity factor for resistance
β_t	target reliability index
γ_{ai}	partial factor of the variable x_i

SIST-TS CEN/TS 17440:2020

$\gamma_{g,j}$ partial factor for permanent actions, taking account of unfavourable deviations of the action values from the representative values

$\gamma_{G,j}$ partial factor for permanent actions, equal to $\gamma_{Sa}\gamma_{g,j}$

$\gamma_{m,i}$ partial factors to take account of the possibility of an unfavourable deviation of a material or product property from its characteristic value and the random part of the conversion factor η

$\gamma_{M,i}$ partial factors for the material or product properties, equal to $\gamma_{Ra}\gamma_{m,i}$

γ_{p} partial factor for prestress actions, taking account of unfavourable deviations of the action values from the representative values

γ_{P} partial factor for prestress actions, equal to $\gamma_{Sa}\gamma_{p}$

$\gamma_{q,1}$ partial factor for the leading variable action, taking account of unfavourable deviations of the action values from the representative values

$\gamma_{q,i}$ partial factor for accompanying variable actions, taking account of unfavourable deviations of the action values from the representative values

$\gamma_{Q,1}$ partial factor for the leading variable action, equal to $\gamma_{Sa}\gamma_{q,1}$

$\gamma_{Q,i}$ partial factor for accompanying variable actions, equal to $\gamma_{Sa}\gamma_{q,i}$

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γ_{Ra} partial factor for assessment (corresponding to γ_{Rd} for design) covering uncertainty in the resistance model, plus geometric deviations if these are not modelled explicitly

SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/37...-8294d59c465/sist-ts-cen-ts-17440-2020

γ_{Sa} partial factor for assessment (corresponding to for γ_{Sd} design) taking account of uncertainties in modelling the effects of actions, or, in some cases, in modelling the actions

η_{i} mean values of the conversion factors, taking into account volume and scale effects, effects of moisture and temperature and any other relevant parameters, which can in some cases be incorporated in $\gamma_{M,i}$ or included in $X_{k,i}$

μ_{Xi} the mean of the basic variable x_i

σ_{Xi} the standard deviation of the basic variable x_i

$\psi_{0,i}$ combination factors for assessment relevant to the accompanying variable actions

SIST-TS CEN/TS 17440:2020

4 Principles of assessment

4.1 Reliability management

(1) When assessing an existing structure, it shall be verified whether the structure has an adequate level of reliability.

NOTE 1 For assessment of existing structures, the target value of reliability index β_t related to a reference period, can be set by the National Annex for use in a country.

NOTE 2 When assessing an existing structure, the target reliability is not necessarily the same as for the design of a new structure.

NOTE 3 Additional information concerning target reliability levels is given in Annex C.

(2) Different levels of reliability may be adopted for assessment of structural safety and serviceability.

(3) When assessing an existing structure, the risks associated with the structure being damaged to an extent disproportionate to the original cause by events such as explosion, impact, the consequences of human errors, or other unforeseen events, should be identified.

NOTE Requirements for the identification and control of risks associated with the structure being damaged to an extent disproportionate to the original cause in a country can be set by the National Annex for use in a country.

4.2 Methods of assessment

(1) The method of assessment of an existing structure at the relevant limit states shall be either:

- assessment by calculation, or
- assessment based on past performance.

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SIST-TS CEN/TS 17440:2020
https://standards.iteh.ai/catalog/standards/sist/cd1c375f-deb4-4969-af4d-e8294d59c465/sist-ts-cen-ts-17440-2020

NOTE 1 For assessment by calculation, see Clause 6.

NOTE 2 For assessment based on past performance, see Clause 10.

NOTE 3 The use of testing and monitoring can form part of the assessment using either assessment method (see 7.4, 8.4 and Annex B).

(2) The method of assessment at the relevant limit states should be as agreed for a specific project by the relevant parties.

4.3 Assessment situations

(1) Assessment situations relevant to the structure and its assessment shall cover the critical conditions and hazards that can reasonably be foreseen for the remaining working life of the structure.

(2) Assessment situations shall be classified as follows:

- persistent assessment situation (relating to the assessment of the structure according to the normal conditions of use over the remaining working life);
- transient assessment situation (relating to temporary conditions, e.g. during structural interventions or modifications);
- accidental assessment situation (relating to accidental actions such as impact, explosion, fire).