JCSS

Joint Committee
on Structural Safety

Workshop on Assessment of Existing Structures

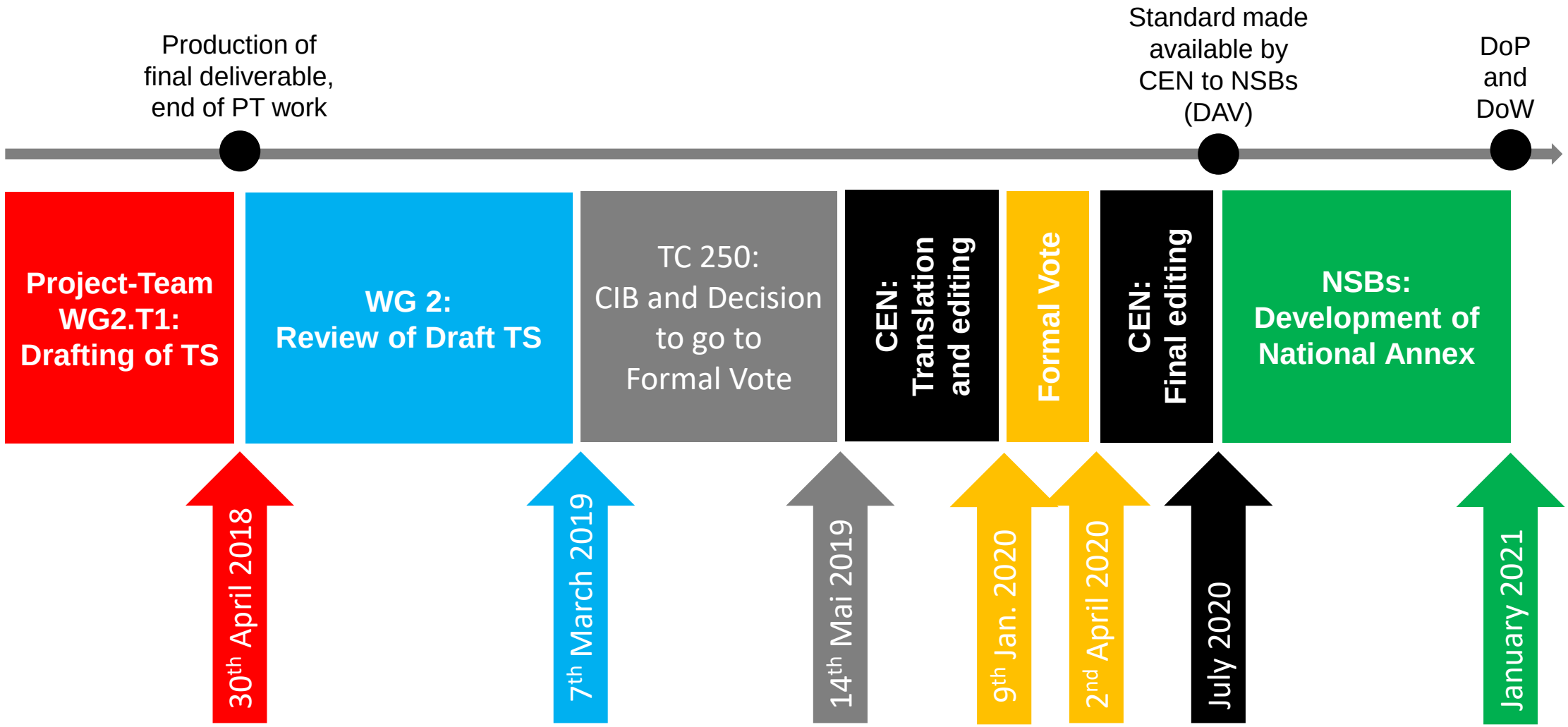
28th and 29th January 2021

Standardization for Assessment of Existing Structures
Evolution from TS to Eurocode

Part 1 – Finalization of Technical Specification

Thomas P. Lang
Thomas Lang Consulting GmbH

Timeline


Production of final deliverable, end of PT work
Standard made available by CEN to NSBs (DAV)
DoP and DoW
Project-Team WG2.T1: Drafting of TS
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TC 250: CIB and Decision to go to Formal Vote
CEN: Translation and editing
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30th April 2018
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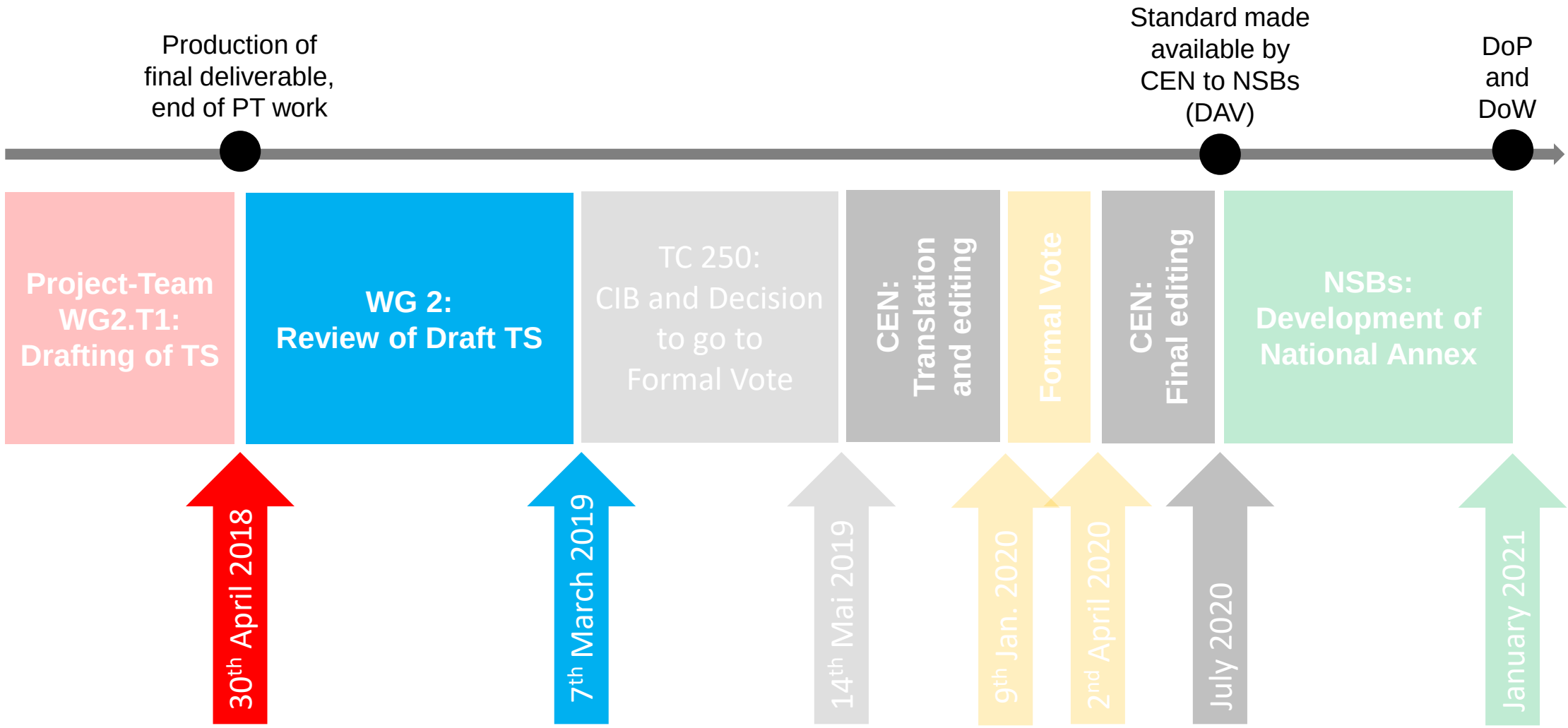
Timeline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WG 2: Review of Draft TS

- Further elaboration of WG2.T1-Draft of TS in order to be ready to issue it to WG 2 for approval during 13th meeting on 7th March 2019:
  - Reach consensus on technical content
  - Fulfil formal requirements according to CEN Internal Regulations and TC 250 policy guidelines
- Constitution of Convenor's Advisory Panel (CAP) within WG 2:
  - Convenor and 4 members of WG 2
- Supported by:
  - Chairman of TC 250
  - Technical Reviewer of TC 250

WG 2: Review of Draft TS

1. Scope
   - setting the link with **EN 1990:2002**
   - clarifying what the CEN/TS provides in terms of actions for assessment complementing **EN 1991** and principles for the assessment of the structural resistance
   - clarifying that rules on how to initiate the assessment and undertake interventions are **not** covered

Content

WG 2: Review of Draft TS

4. Principles of assessment
   - Reliability management
   - Methods of assessment (clear distinction between assessment by calculation and assessment based on past performance)
   - Assessment situations
   - Using available information
   - Updating available information
   - Structures with new elements and retained elements (new principles for approaches to projects comprising both new elements and retained elements from an existing structure)
   - Assessment of heritage structures

Content

WG 2: Review of Draft TS

5. Assessment process
   - Initiating the assessment
   - Agreeing the assessment scope and objectives
   - Developing the assessment approach
   - Establishing the structural condition
   - Undertaking the assessment (preliminary assessment, detailed assessment and plausibility check)
   - Reporting the assessment findings (including identification of need for interventions)

Content

WG 2: Review of Draft TS

6. Assessment based on past performance
   (new separate section)
7. Assessment by calculation
   (separate from section 6)
8. Basic variables and updating
   (restructured to follow EN 1990:2002 structure)
   - geometrical data
   - actions and environmental influences
   - material and product properties

Content

WG 2: Review of Draft TS

9. Structural modelling, updating and analysis
   (including load testing and monitoring)
10. Verifications
    - Partial factor method
    - Assessment value method
    - Probabilistic method
    - Risk assessment method
11. Intervention
    (including immediate interventions)

Content

WG 2: Review of Draft TS

Annexes (all informative):

A Flowchart of assessment process and intervention
(updated)

B Updating procedure
(editorial update)

C Target reliability and partial factors
(updated according to section 10)

D Assessment of heritage structures
(aligned to the main text)

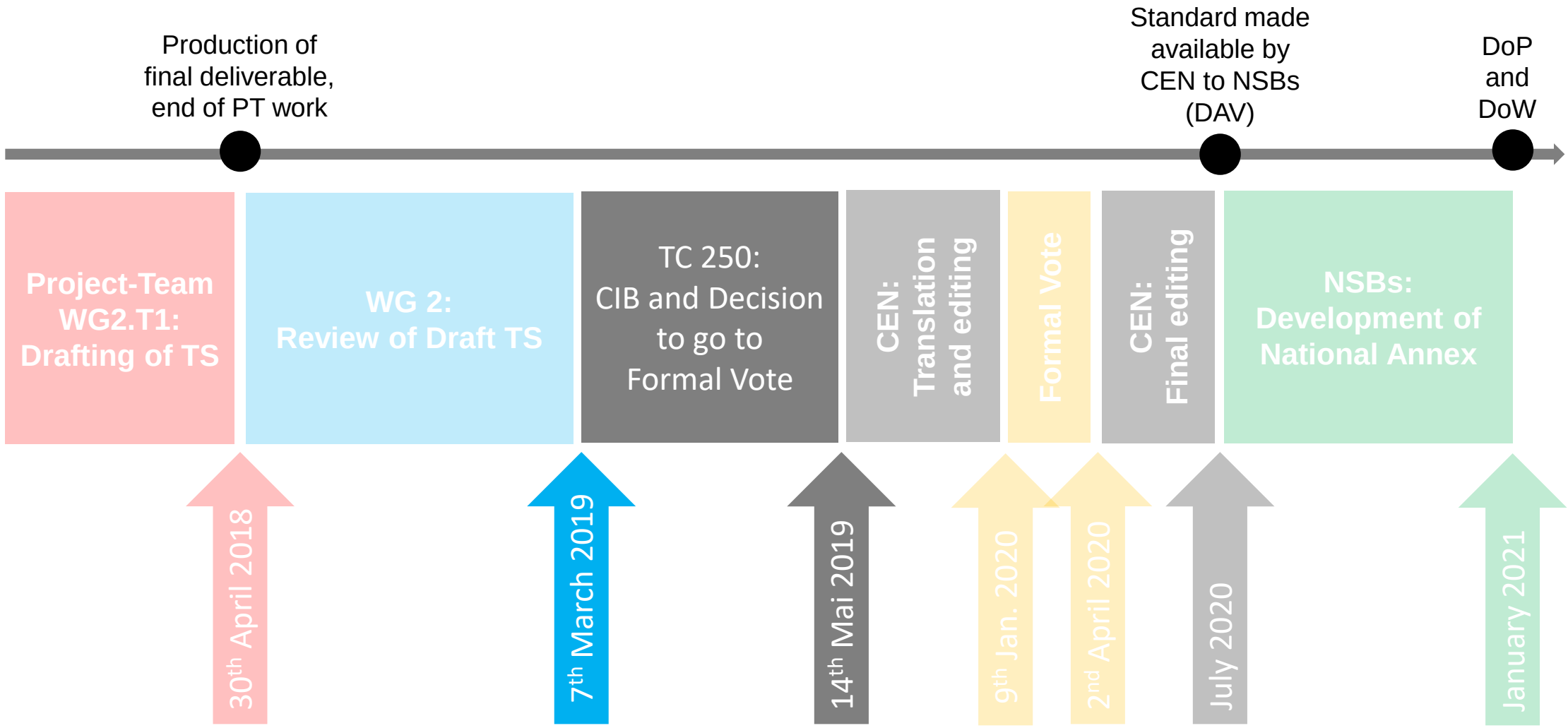
Content

WG 2: Review of Draft TS

- Main topics under discussion:
  - Definition of existing structure
  - Structures with new an retained elements
  - Standardization of assessment process
  - Assessment based on past performance
  - Practical use of verification methods other than partial factor method
- WG 2 agreed to issue New Draft of TS to TC 250 to proceed to **Formal Vote**

Content

Timeline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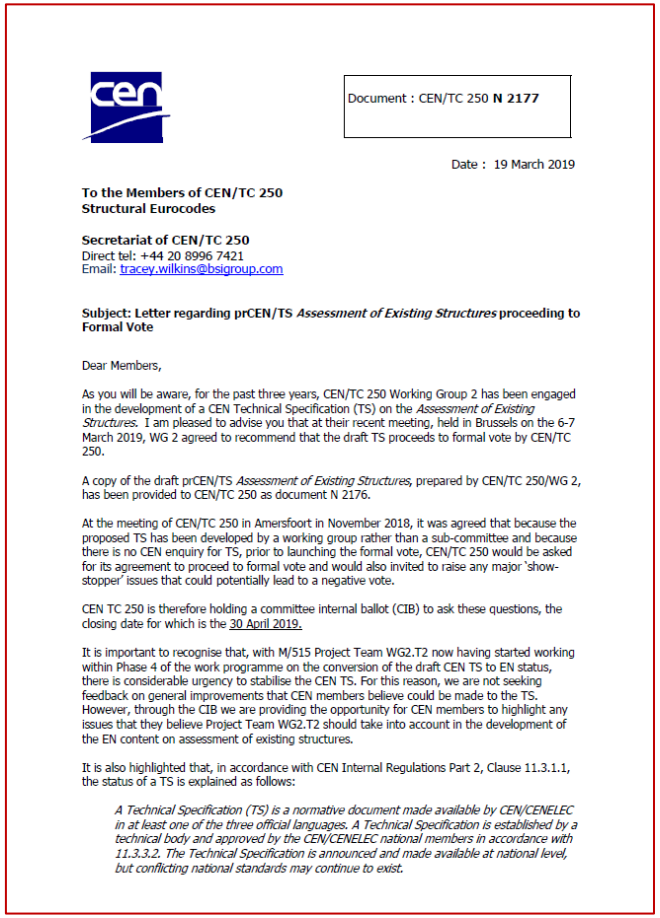
TC 250: CIB and Decision to go to Formal Vote

- According to CEN IR, for TS:
  - **NO** public enquiry
  - Directly go to Formal Vote
- Decision of Chairman of TC 250 to hold a **CIB** before going to Formal Vote



Document : CEN/TC 250 **N 2177**

Date : 19 March 2019

To the Members of CEN/TC 250
Structural Eurocodes

Secretariat of CEN/TC 250
Direct tel: +44 20 8996 7421
Email: tracey.wilkins@bsigroup.com

Subject: Letter regarding prCEN/TS *Assessment of Existing Structures* proceeding to Formal Vote

Dear Members,

As you will be aware, for the past three years, CEN/TC 250 Working Group 2 has been engaged in the development of a CEN Technical Specification (TS) on the *Assessment of Existing Structures*. I am pleased to advise you that at their recent meeting, held in Brussels on the 6-7 March 2019, WG 2 agreed to recommend that the draft TS proceeds to formal vote by CEN/TC 250.

A copy of the draft prCEN/TS *Assessment of Existing Structures*, prepared by CEN/TC 250/WG 2, has been provided to CEN/TC 250 as document N 2176.

At the meeting of CEN/TC 250 in Amersfoort in November 2018, it was agreed that because the proposed TS has been developed by a working group rather than a sub-committee and because there is no CEN enquiry for TS, prior to launching the formal vote, CEN/TC 250 would be asked for its agreement to proceed to formal vote and would also invited to raise any major 'show-stopper' issues that could potentially lead to a negative vote.

CEN TC 250 is therefore holding a committee internal ballot (CIB) to ask these questions, the closing date for which is the 30 April 2019.

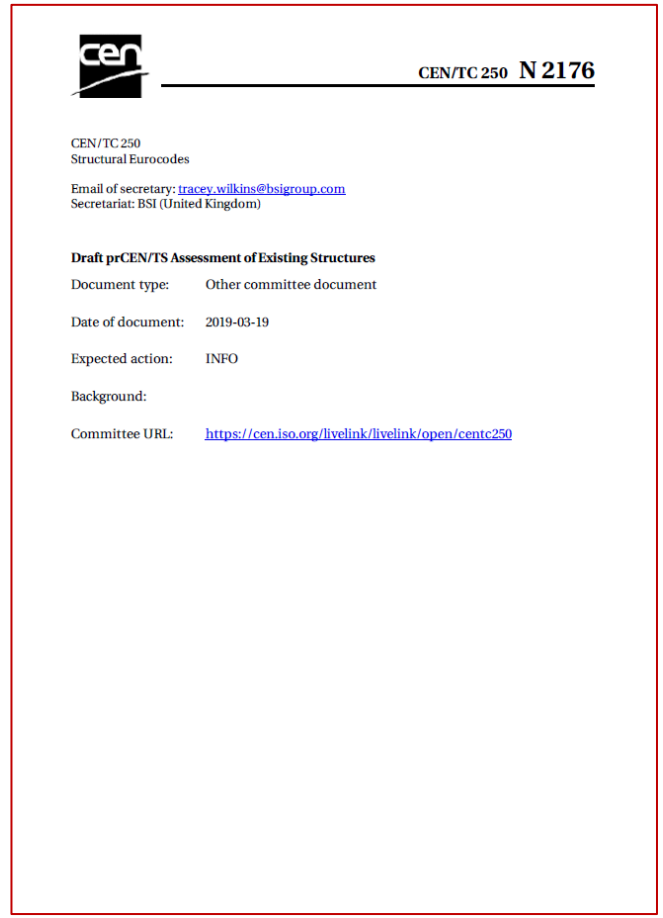
It is important to recognise that, with M/515 Project Team WG2.T2 now having started working within Phase 4 of the work programme on the conversion of the draft CEN TS to EN status, there is considerable urgency to stabilise the CEN TS. For this reason, we are not seeking feedback on general improvements that CEN members believe could be made to the TS. However, through the CIB we are providing the opportunity for CEN members to highlight any issues that they believe Project Team WG2.T2 should take into account in the development of the EN content on assessment of existing structures.

It is also highlighted that, in accordance with CEN Internal Regulations Part 2, Clause 11.3.1.1, the status of a TS is explained as follows:

> *A Technical Specification (TS) is a normative document made available by CEN/CENELEC in at least one of the three official languages. A Technical Specification is established by a technical body and approved by the CEN/CENELEC national members in accordance with 11.3.3.2. The Technical Specification is announced and made available at national level, but conflicting national standards may continue to exist.*

TC 250: CIB and Decision to go to Formal Vote

- Questions to be answered in **CIB**:
  - Do you agree that the draft CEN TS (…) may proceed to formal vote?
  - Are there any major technical concerns with the draft CEN TS that could lead you to vote negatively (…)? If so, please provide details.
  - Are there any matters that you would like CEN/TC 250/WG 2 to take into account in its ongoing work to convert the TS text to EN status? If so, please provide details



CEN/TC 250 N 2176

CEN/TC 250
Structural Eurocodes

Email of secretary: tracey.wilkins@bsigroup.com
Secretariat: BSI (United Kingdom)

Draft prCEN/TS Assessment of Existing Structures

Document type: Other committee document

Date of document: 2019-03-19

Expected action: INFO

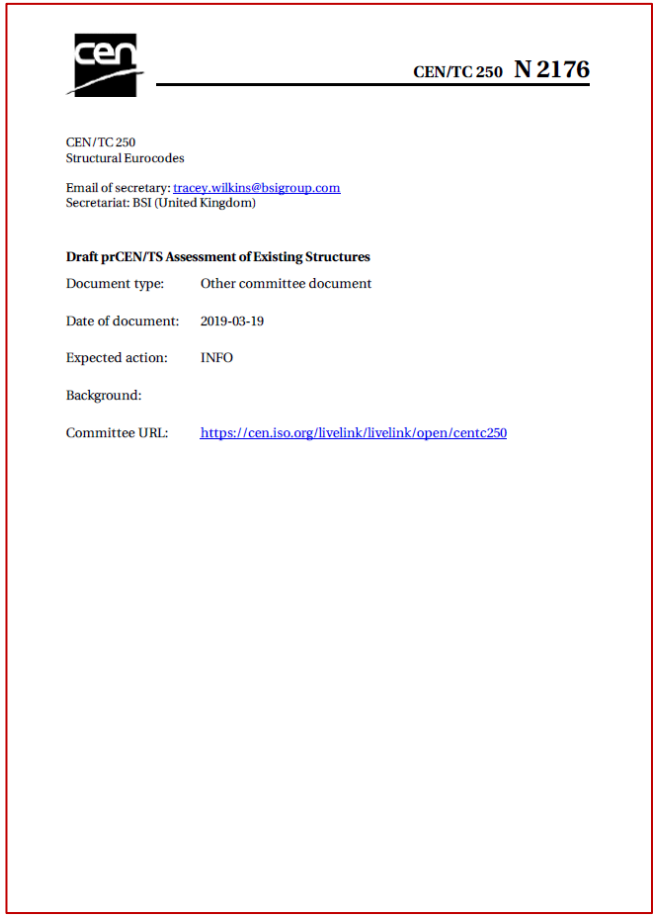
Background:

Committee URL: https://cen.iso.org/livelink/livelink/open/centc250

TC 250: CIB and Decision to go to Formal Vote

- Result of **CIB**:
  - National Members **unanimously** agreed to go to Formal Vote
  - 1 National Member raised a major concern (conflict with National Building Regulations)
  - 9 National Members submitted comments (consistency with EN1990, definitions, target reliability levels, assessment methods, etc.)
- Decision of Chairman of TC 250:

  Go to **Formal Vote**



CEN/TC 250 N 2176

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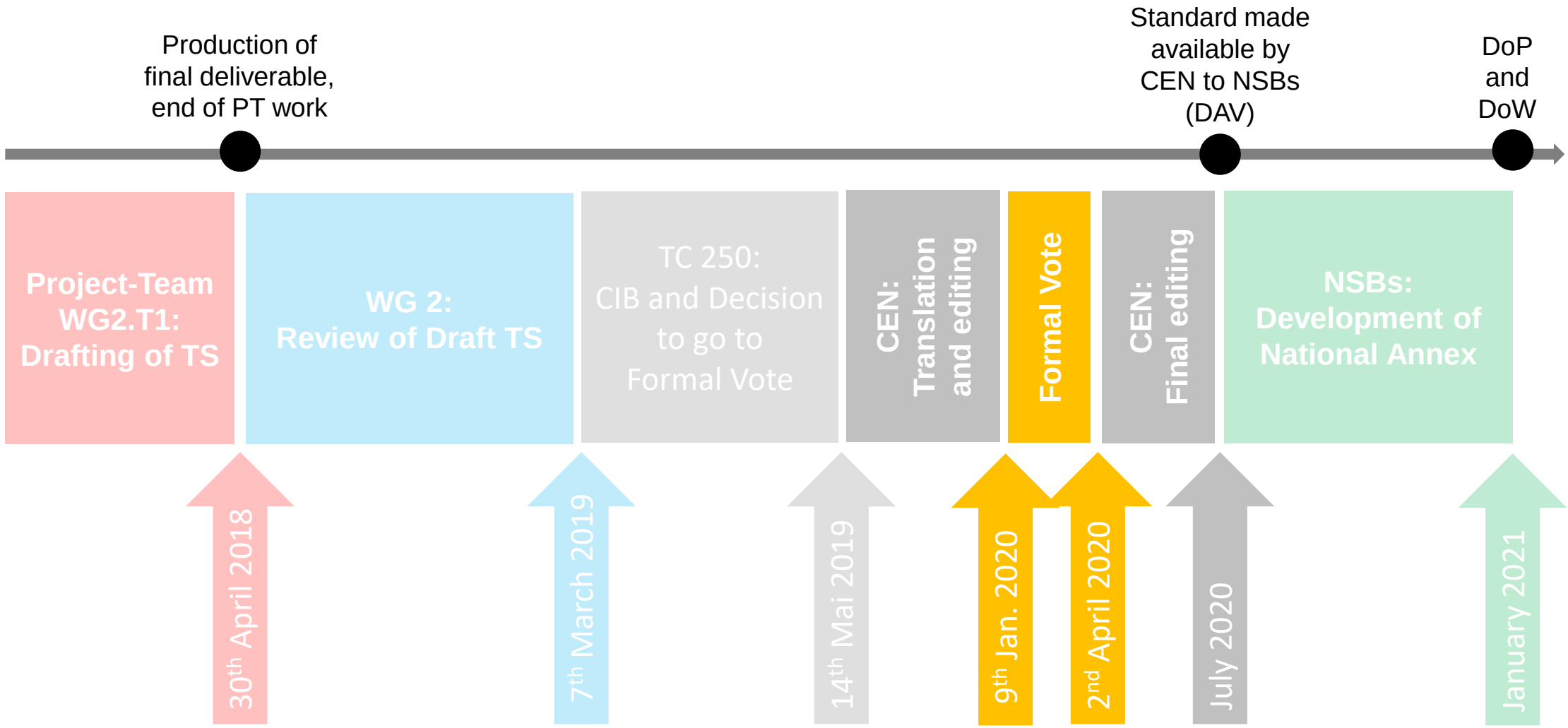
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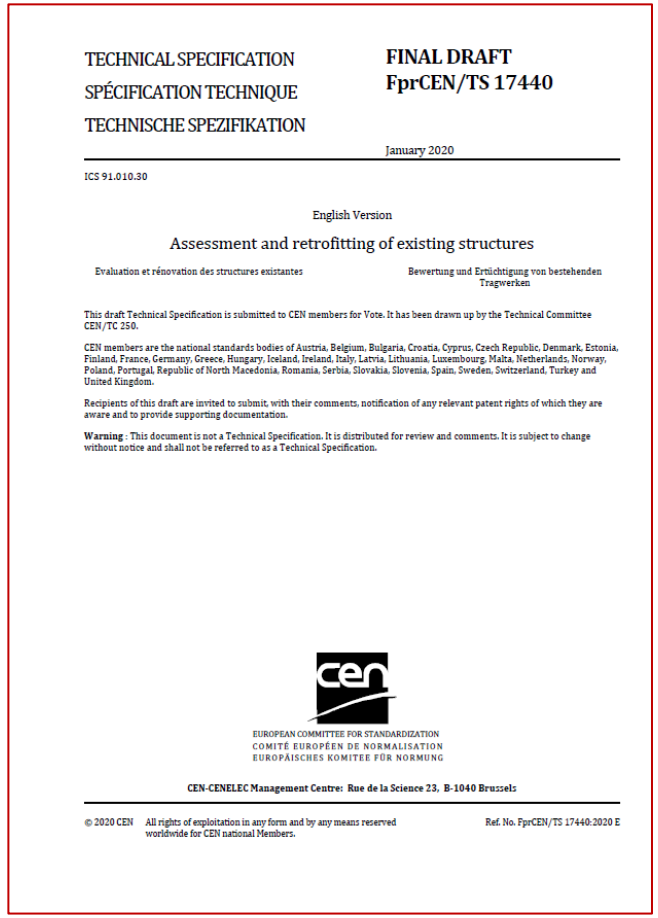
Formal Vote

- First deliverable within Mandate **M/515** going for formal vote
- Formal Vote period: **12 weeks** (9/1/2020 – 2/4/2020)
- Result of Formal Vote on **FprCEN/TS 17440** Assessment and retrofitting of existing structures:
  - National Members approving: 22
  - National Members disapproving: 0
  - Number of Members approving: 100 % (requirement ≥ 55 %)
  - Weighted percentage of Population approving: 100 % (requirement ≥ 65 %)
  - Approval of implementation period



TECHNICAL SPECIFICATION
SPÉCIFICATION TECHNIQUE
TECHNISCHE SPEZIFIKATION

FINAL DRAFT
FprCEN/TS 17440

January 2020

ICS 91.010.30

English Version

Assessment and retrofitting of existing structures

Evaluation et rénovation des structures existantes

Bewertung und Ertüchtigung von bestehenden Tragwerken

This draft Technical Specification is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 250.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a Technical Specification. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a Technical Specification.

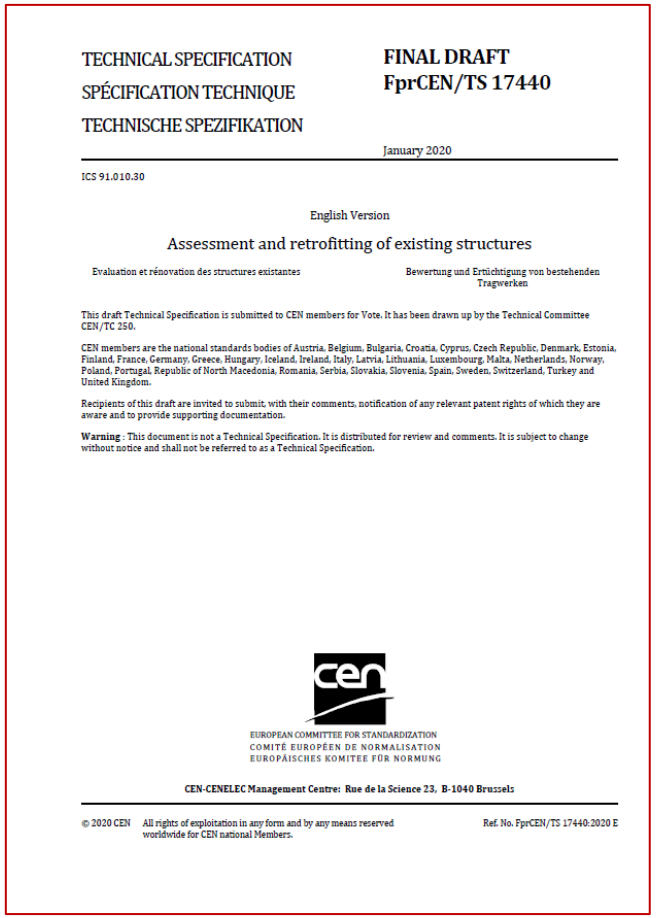
EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. FprCEN/TS 17440:2020 E

Formal Vote

- 4 National Members submitted comments (only editorial)
- The definitive text of **CEN/TS 17440** was made available after incorporation of editorial comments in July 2020 (DAV).
- NSBs have an opportunity to provide a National Annex.



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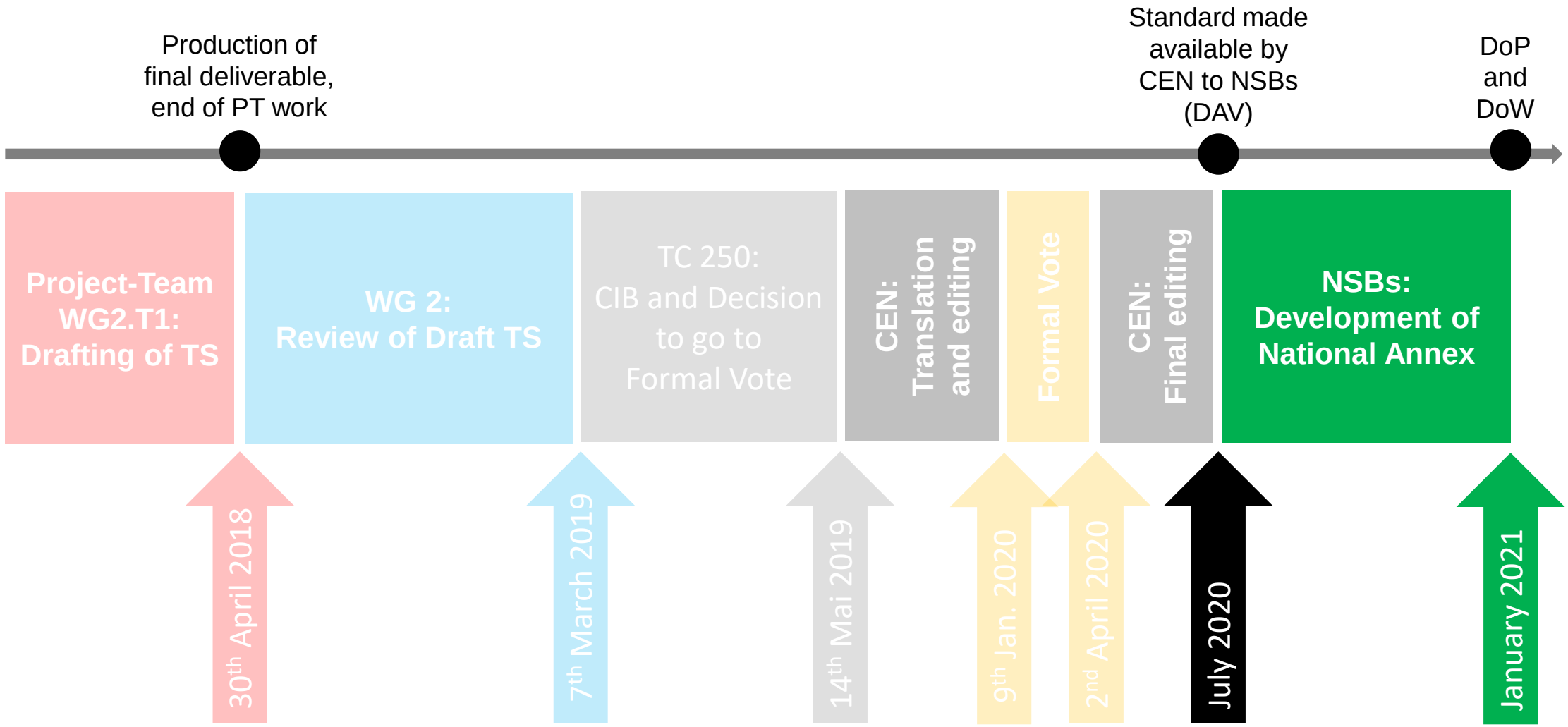
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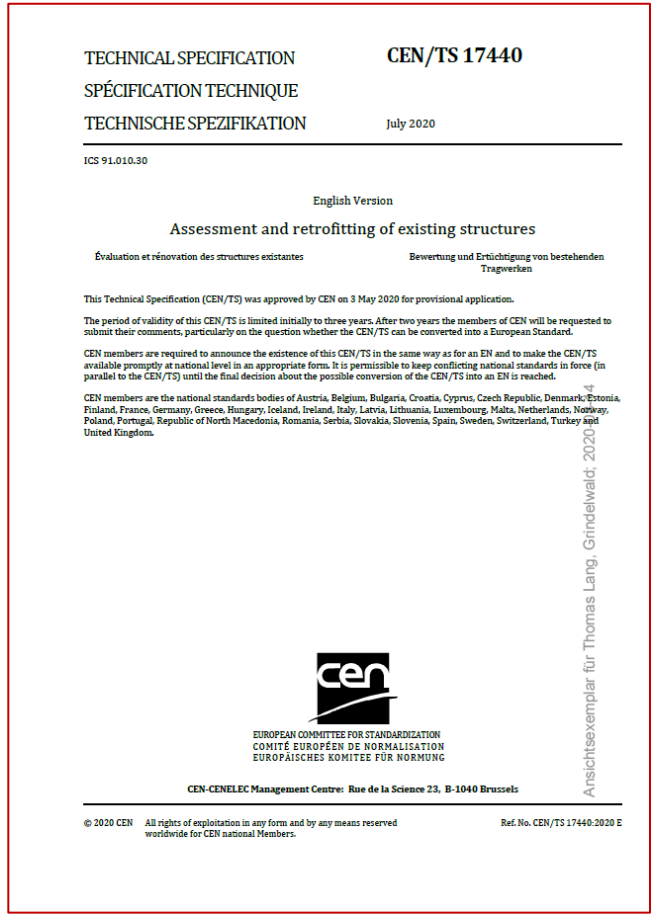
NSBs: Development of National Annex

- Implementation period:
  - Date of Availability (DAV) : July 2020
  - Date of Publication (DOP) : DAV+6 Months
  - Date of Withdrawal (DOW) : DAV+6 Months
- Frontpage of TS:
  CEN members are required (…) 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)…
- Only UK and FR are working on NA to the TS so far



TECHNICAL SPECIFICATION **CEN/TS 17440**

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION July 2020

ICS 91.010.30

English Version

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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Standardisation for Assessment of Existing Structures
Evolution from Technical Specification to Eurocode

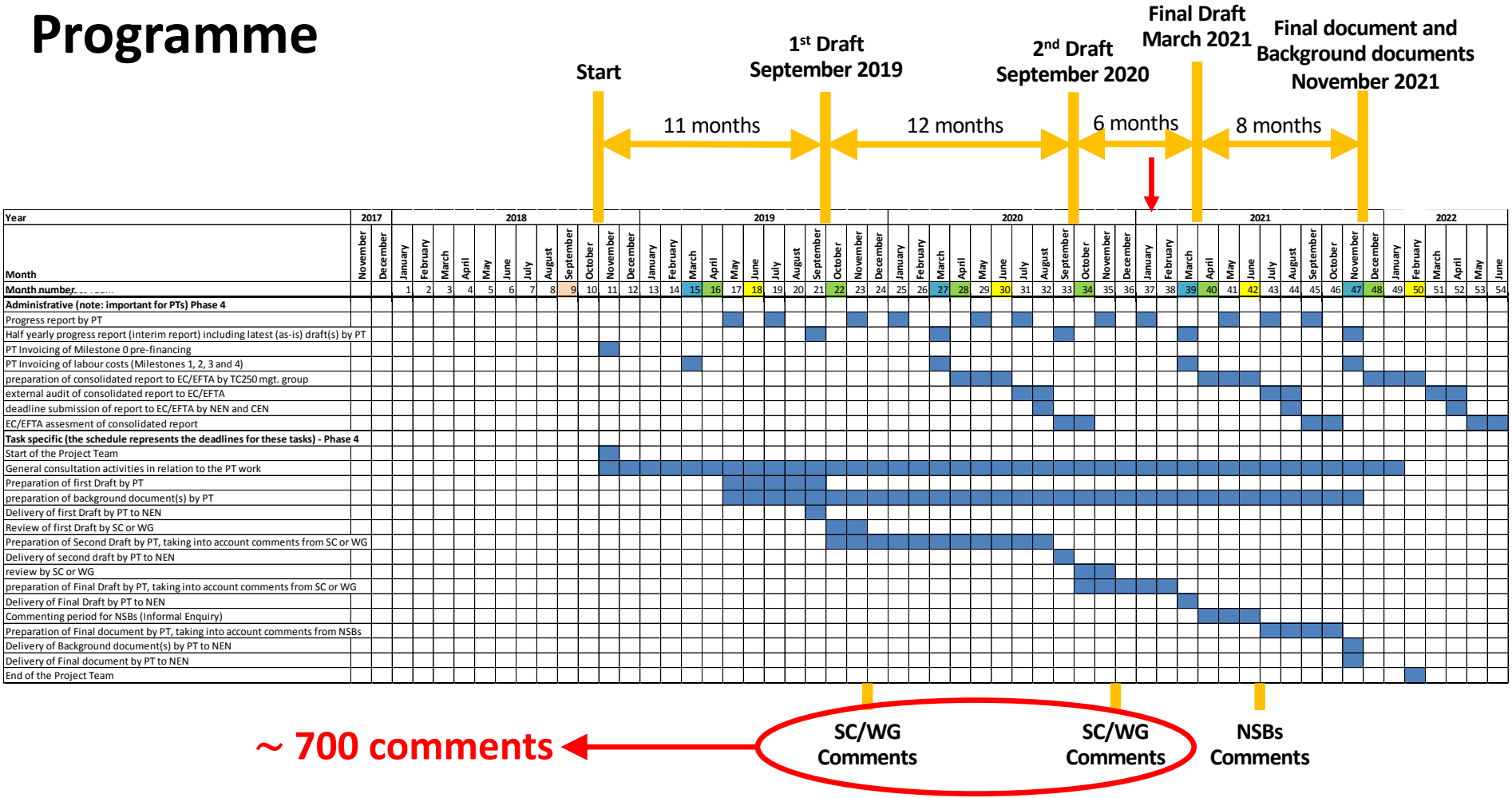
Part 2 – new Eurocode

Fabrizio Palmisano
ppvconsulting

Members of Project Team CEN/TC 250/WG 2/WG2.T2

PT role	Name	Affiliation	Country
Leader	Fabrizio Palmisano	PPV Consulting	Italy
Member	Dimitris Diamantidis	Ostbayerische Technische Hochschule (OTH) Regensburg	Germany
Member	Alan O'Connor	Trinity College Dublin	Ireland
Member	Jon Shave	WSP	UK
Member	Peter Tanner	CESMA Ingenieros	Spain
WG2 Convenor	Thomas Lang	Thomas Lang Consulting GmbH	Switzerland

Programme


Start
1st Draft
September 2019
2nd Draft
September 2020
Final Draft
March 2021
Final document and
Background documents
November 2021
11 months
12 months
6 months
8 months
Year
2017
2018
2019
2020
2021
2022
Month
November
December
January
February
March
April
May
June
July
August
September
October
November
December
Month number
Administrative (note: important for PTs) Phase 4
Progress report by PT
Half yearly progress report (interim report) including latest (as-is) draft(s) by PT
PT Invoicing of Milestone 0 pre-financing
PT Invoicing of labour costs (Milestones 1, 2, 3 and 4)
preparation of consolidated report to EC/EFTA by TC250 mgt. group
external audit of consolidated report to EC/EFTA
deadline submission of report to EC/EFTA by NEN and CEN
EC/EFTA assesment of consolidated report
Task specific (the schedule represents the deadlines for these tasks) - Phase 4
Start of the Project Team
General consultation activities in relation to the PT work
Preparation of first Draft by PT
preparation of background document(s) by PT
Delivery of first Draft by PT to NEN
Review of first Draft by SC or WG
Preparation of Second Draft by PT, taking into account comments from SC or WG
Delivery of second draft by PT to NEN
review by SC or WG
preparation of Final Draft by PT, taking into account comments from SC or WG
Delivery of Final Draft by PT to NEN
Commenting period for NSBs (Informal Enquiry)
Preparation of Final document by PT, taking into account comments from NSBs
Delivery of Background document(s) by PT to NEN
Delivery of Final document by PT to NEN
End of the Project Team
~ 700 comments
SC/WG Comments
SC/WG Comments
NSBs Comments

Tasks of WG2.T2

Development of new harmonised European technical rules for the assessment and retrofitting of existing structures, which are related to the principles and fundamental requirements of the EN Eurocodes.

The technical rules for existing structures are not self-standing rules but they complement those of relevant EN Eurocodes by identifying and distinguishing the differences between the design of new structures and the assessment and retrofitting of existing ones.

Tasks of WG2.T2

New Eurocode

3 Tasks:

Sub Task 1: EN Eurocode for Existing Structures - General rules

Sub Task 2: EN Eurocode for Existing Structures – Actions

Sub Task 3: Report on requirements and guidance on the development of material-specific assessment and retrofit provisions

New Eurocode: main challenge

different countries had developed in the past different products, approaches and codes of practice

the new Eurocode on existing structures should account for these differences and, hence, should give Countries a wider possibility to add specific rules for different peculiarities

New Eurocode: general

Additional provisions to EN 1990 to cover the assessment of existing structures and the retained elements of existing structures that are being retrofitted

New Eurocode: general

- Provisions related to using **updated data** for basic variables and updated structural models
- General principles regarding **actions** for assessment complementing EN 1991

New Eurocode: general

- ✕ No specific rules for initiation of assessment
- ✕ No specific rules on how to undertake interventions that may be carried out as a result of an assessment
- ✕ No material-specific technical provisions for the assessment and retrofitting of existing structures
- ✕ No provisions for design of new elements that will be integrated into an existing structure (see EN 1990)
- ✕ No provisions for seismic assessment and retrofitting of existing structures (see EN 1998-3)

New Eurocode: list of contents

What is an existing structure?

What is an existing structure?

prEN 1990

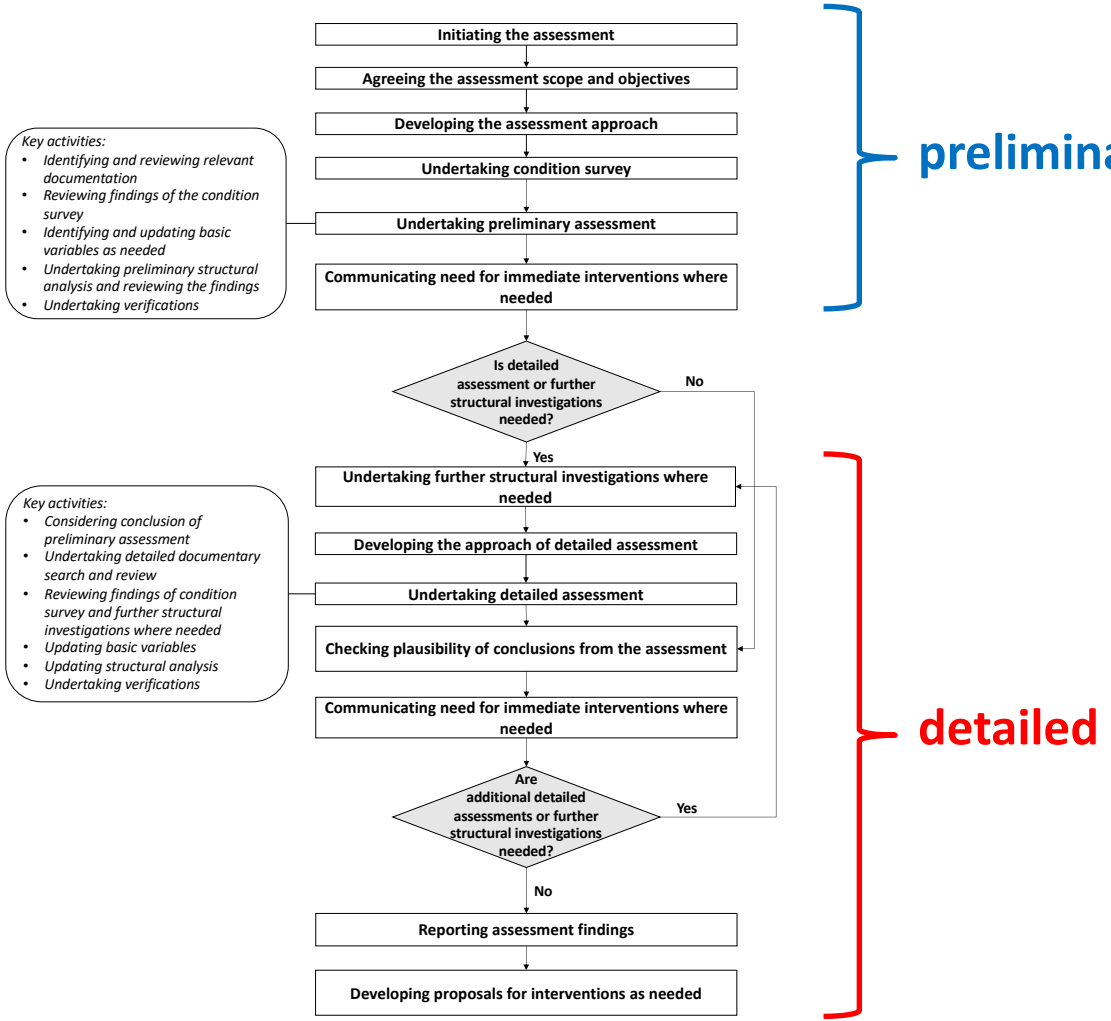
structure: part of the construction works that provides stability, resistance, and rigidity against various actions

New Eurocode

existing structure: any structure that physically (materially) exists

Assessment process

Stepwise process with increasing levels of detail and accuracy



Methods of assessment

Quantitative assessment based on calculations, or

Qualitative assessment based on past performance, or

a combination of quantitative and qualitative assessment

Restrictions on the use of the assessment based on past performance can be set by the National Annex

Requirements at ULS

Assessment based on past performance

- No evidence of significant damage, distress, defect, excessive deformation, displacement or deterioration
- the structural system is understood
- satisfactory performance for a sufficiently long period of time
- any predicted deterioration would not be expected to affect the safety
- the risk (likelihood and consequence) associated with local failures can be classified as acceptable

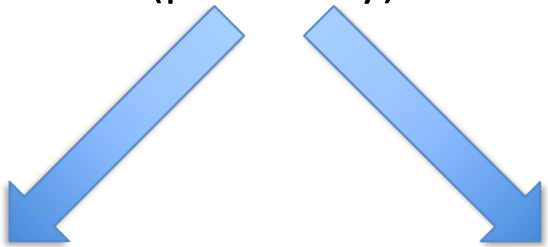
Detailed structural investigation needed for the limit state being assessed

Verification methods

partial factor method

\+

(possibility)



reliability-based method

risk-informed method

Partial factor method

$$E_a \leq R_a$$

$$E_a = \gamma_{Sa} E\left\{\sum(\gamma_f \psi F_k);\ a_a;\ X_{Ra}\right\}$$

$$R_a = \frac{1}{\gamma_{Ra}} R\left\{\frac{\eta X_k}{\gamma_m};\ a_a;\ \sum F_{Ea}\right\}$$

$$E_a = E\left\{\sum F_a;\ a_a;\ X_a\right\} = E\left\{\sum(\gamma_F \psi F_k);\ a_a;\ X_{Ra}\right\}$$

$$R_a = R\left\{X_a; a_a;\ \sum F_{Ea}\right\} = R\left\{\frac{\eta X_k}{\gamma_M};\ a_a;\ \sum F_{Ea}\right\}$$

fixed partial factors

(cluster of cases)

adjusted partial factors

(individual case)

Reliability-based approach

$$P_f = \mathrm{P}\{g(x) < 0\} \leq P_{ft}$$

P_{ft} (NDP) is the target probability of failure for a given reference period

Reference period: period of time that is used as a basis for statistically assessing extreme realizations of variable actions and possibly for accidental actions

Reliability-based approach

$$P_f = \mathrm{P}\{g(x) < 0\} \leq P_{ft}$$

The target reliability for an existing structure should take account of the relevant factors, including:

- the possible cause and /or mode of attaining a limit state
- the possible consequences of failure in terms of risk to life, injury, potential economical losses
- the relative costs of safety measures to increase reliability
- the reference period

The target reliability for an existing structure may be specified in one or both of the following ways:

- by the classification of the structure as a whole
- by the classification of its members

Reliability-based approach

$$\beta = -\Phi^{-1}(P_f) > \beta_t$$

Where annual target reliability indices are used, they should be fulfilled in each sub sequent year of the remaining service life of the structure

Interventions

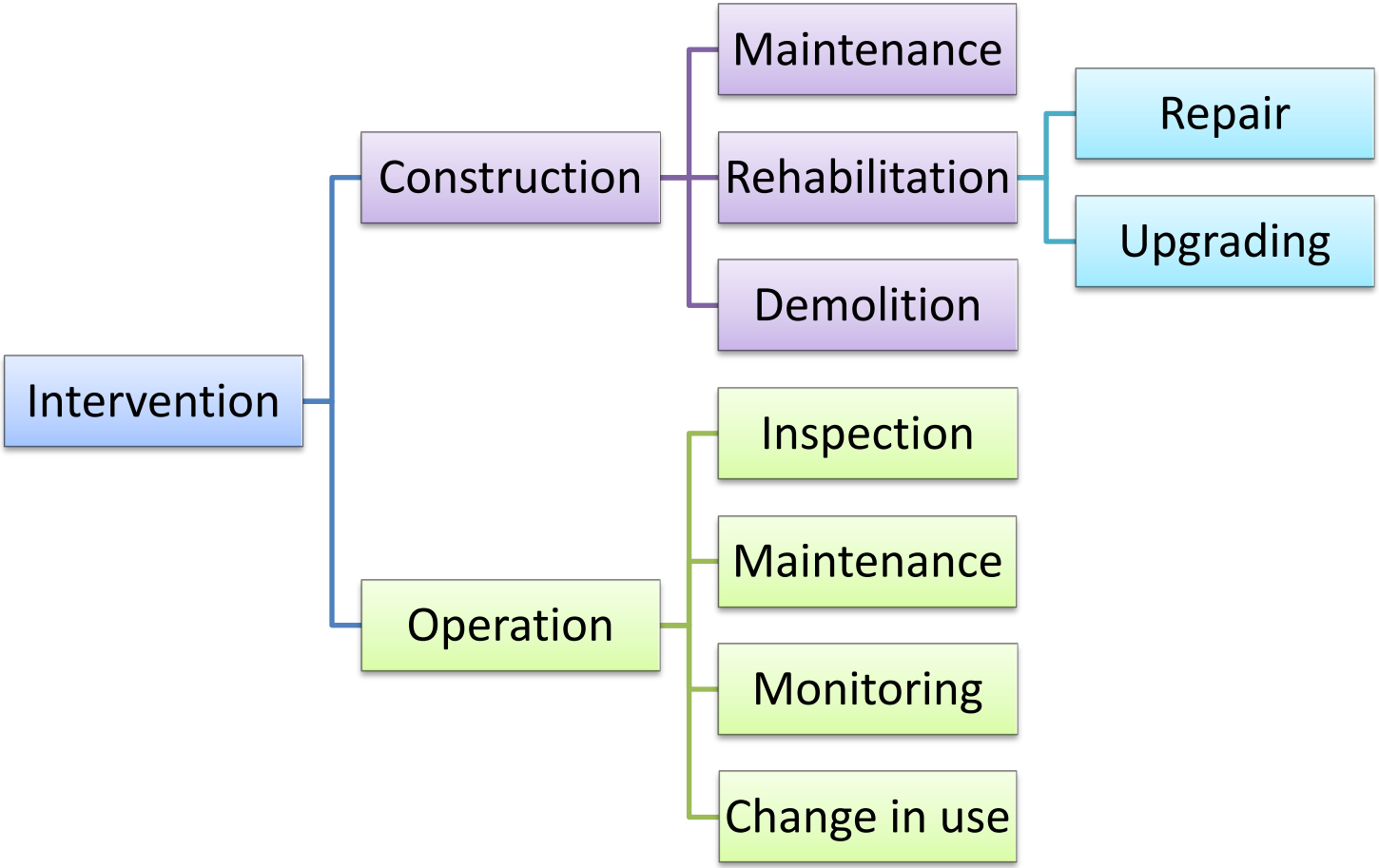
Proposal for interventions should be given in the conclusions of the assessment

Interventions

Interventions should be defined taking account of the following:

- the type and importance of the structure
- the specific requirement that is not met
- possible cause and mode of attaining a limit state
- expected consequences of failure
- options of interventions that are available

Options of interventions



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