

EUROCODE 5 - A HALFTIME SUMMARY OF THE REVISION PROCESS

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ABSTRACT: This document provides an introduction to the review process of Eurocode 5, the structure of the work and the committee and the targets of the revision progress. In addition, a short excursus is given on 'Ease-of-Use' and legitimate 'National Determined Parameters' (NDP). It gives the frame and introduction for the other presentations in the mini-symposium MS4-04. This paper and the complete mini-symposium will provide colleagues from abroad and Europeans not familiar with standardisation with a clear overview of structures, targets and processes and should be a starting point for further coordination and cooperation with engineers and standard writers all over the world.

KEYWORDS: Standardization, Eurocode 5 – Design of Timber Structures, CEN/TC 250 – Structural Eurocodes

1 INTRODUCTION

The standard Eurocode 5 - or better all parts of EN 1995 - Design of Timber Structures - with Part 1-1: General - Common rules and rules for buildings, Part 1-2: General - Structural fire design and Part 2: Bridges - was published in 2004 after a long historical development starting in 1983 with a CIB report "Structural Timber Design Code". Eurocode 5 is part of the family of Structural Eurocodes providing common European design rules for the design of structures with all main building materials creating the built environment. The Eurocodes are nowadays implemented and applied in all European countries. They are especially helpful in Member States where no or few design rules were available, which was true in many cases for timber structures.

The Eurocodes are of high importance for a common European building market and therefore for planners, industry and craftsmanship working more and more cross borders. Finally they should provide a common level of safety in buildings, as there is no reason from the human perspective to provide different safety levels in Vienna, Berlin, Helsinki or Lisbon. But – 'the safety of the built environment' is under the responsibility of the European countries and 'safety' is sometimes related to costs, tradition, etc. Therefore, the Eurocodes provide the instrument of so called 'National Determined Parameters' (NDP) to be able to make adjustments to the foreseen national level. In addition, NDP's are e.g. necessary to allow adaptations to climate related loads. The NDP's are published in 'National Annexes' (NA) to the national editions of the Eurocodes by the responsible National Standardization Body (NSB), like AFNOR (France), BS (UK), DIN (Germany) or SIS (Sweden).

The European Commission has a strong interest on the further development of the Eurocodes to achieve a further matching of design rules in Europe. But it is recognized that there are nowadays high variations of NDP's and - in addition - a high number of 'Non-Contradictory Information' (NCI) given in the published NA's, demonstrating that rules are missing in the Eurocodes. In general, design rules need to be improved or to be expanded and, at the same time, additional design rules need to comply with the 'state-of-the-art'. Therefore - beside other targets - a main aim is a further harmonization and evolution of the European design rules for buildings to enable additional improvement of the European construction and engineering sector and a sustainable development of the built environment.

2 EUROPEAN STANDARDIZATION

2.1 THE STRUCTURAL EUROCODES COMMITTEE CEN/TC 250 AND OTHER LIAISONS

First of all, it should be described how the Eurocode 5 standardization committee is arranged within the whole standardization body and which standardization committees affect the work of the Eurocode 5 standardization committee and vice-versa.

The home of European standardization is the European Committee for Standardization, in short CEN (Comité Européen de Normalisation). CEN is responsible for developing and defining standards at European level and it is officially recognized by the European Union and the European Free Trade Association (EFTA). [1]

Within CEN different fields are included and several technical committees (TC) deal with different subjects. The technical committee working on the development and

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definition of the design rules of common building and civil engineering structures has been numbered as CEN/TC 250.

The built environment is affected by several other technical committees dealing with product standards, environmental subjects or fire safety aspects, influencing the development of the Eurocodes. With regard to timber structures, the CEN technical committees shown in Figure 1 have an influence on the design of timber structures and therefore are exemplary liaison committees of CEN/TC 250.

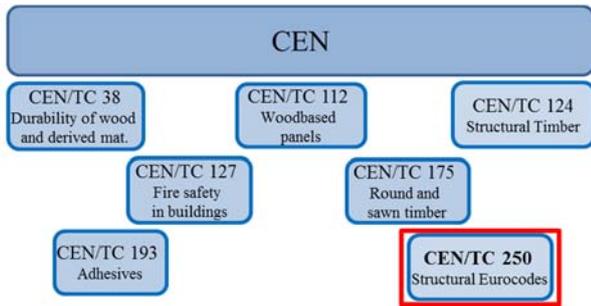


Figure 1: CEN technical committees connected to timber structures

For matters of coordination and flow of information, liaisons between CEN/TC 250 and these TC's are crucial.

2.2 THE TECHNICAL COMMITTEE ON STRUCTURAL EUROCODES CEN/TC 250

CEN/TC 250 is additionally structured into different subcommittees.

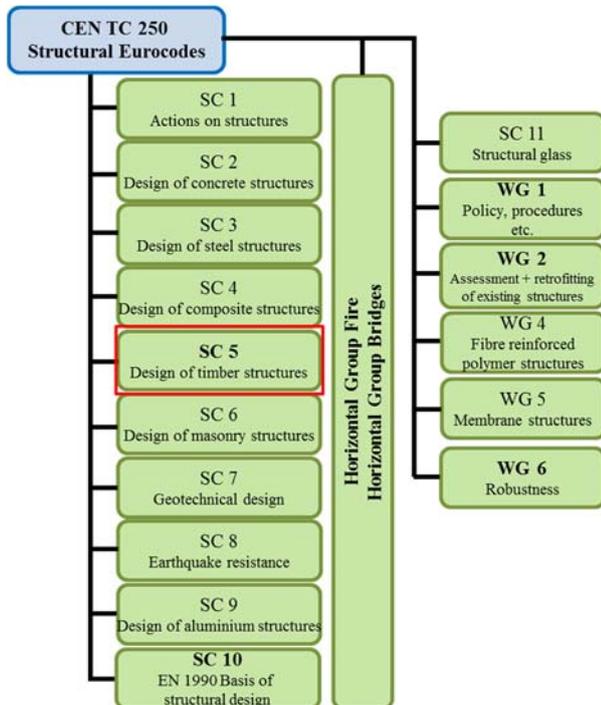


Figure 2: Structure of CEN/TC 250 Structural Eurocodes

As shown in Figure 2, established subcommittees (SC) represent the work with regard to the existing 10

Eurocodes (EC) and the upcoming Eurocode 11 for structural glass. The number of the subcommittee represents the number of the Eurocode, like SC 5 for Eurocode 5 - Design of timber Structures. Working groups (WG) provide support in different subjects, like policy guidelines, assessment and retrofitting of structures or robustness. Horizontal groups (HG) on fire and bridges combine all subcommittees of the Eurocodes.

CEN/TC 250 itself works as coordinating leader and surveys the work of all SC's, WG's and HG's. The secretariat for CEN/TC 250 is held by BSI, the British Standards Institution, and supports the CEN/TC 250 Chairman. Members of CEN/TC 250 are the SC, WG and HG Chairmen or Chairwomen as well as delegates from the different National Standardization Bodies of the Member States and representatives of some related European organizations.

2.3 THE SUBCOMMITTEE ON EUROCODE 5 – DESIGN OF TIMBER STRUCTURES - CEN/TC 250/SC 5

Every SC dealing with the further development of a Eurocode has its own structure. Below SC level, supporting working groups (WG) are established in order to divide the work into concrete subjects and to define responsibilities clearly. The SC 5 plenary decided to structure the work for the next generation of EC 5 into ten WG's. Figure 3 shows the ten WG's with their subjects and their WG Convenors.

CEN/TC 250/SC 5		
CLT	WG 1	Wiegand (DE)
TCC	WG 2	Dias (PT)
Cluster	WG 3	de Proft (BE)
Fire	WG 4	Frangi (CH)
Connections	WG 5	Munch-Andersen (DK)
Bridges	WG 6	Malo (NO)
Reinforcement	WG 7	Dietsch (DE)
Seismic design	WG 8	Fragiacomo (IT)
Execution	WG 9	Lawrence (UK)
Basis of design and materials	WG 10	Marcroft (UK)

Figure 3: Structure of CEN/TC 250/SC 5 Timber Structures

For the division into several subjects, the main focus has been to divide into already existing parts of EC 5 (e.g. 'Fire' and 'Bridges'), to distinguish between timber design in general and design of timber connections ('Cluster' and 'Connections') and to concentrate on the new design items ('CLT', 'TCC' and 'Reinforcement'). Cross-laminated timber (CLT), timber concrete composites (TCC) as well as reinforcement are topics

missing in the current EC 5 and need to be included to comply with the 'state-of-the-art'. WG 8 'Seismic design' has been established to support and expand the work of the technical committee on Eurocode 8, CEN/TC 250/SC 8. This working group - CEN/TC 250/SC 5/WG 8 - is working officially under SC 8 - 'Seismic Design' as CEN/TC 250/SC 8/WG 3 - the members are identically. WG 9 is dealing with the subject 'execution' which focuses on minimum requirements for fabrication, transport, erection, treatment and finishes. WG 10 is a recently established working group – first named TG 1 (task group) - working on the first two main chapters of EC 5 covering basis of design and material properties. Focusing on the home countries of the WG Convenors, it is obvious that CEN/TC 250/SC 5 has made a good example on national variety and geographic coverage of Member States. The secretariat for CEN/TC 250/SC 5 is held by SIS, the Swedish Standards Institute.

3 PROCESS OF THE MANDATED WORK

3.1 RESPONSE TO THE MANDATE M/515

In December 2012, Mandate M/515 had been finalized by the European Commission (EC) inviting CEN to develop a detailed standardisation work programme for the publication of the second generation of Eurocodes. This work programme has been sent to the EC as 'Response to Mandate M/515'. Besides user confidence (see Section 4.1) and reduction of National Determined Parameters (see Section 4.4) the work programme focuses on further harmonisation and inclusion of 'state-of-the-art' [2].

CEN/TC 250 leads the execution of the Mandate M/515 with regard to the design of construction works and, consequently, is responsible for the successful development of the second generation of the Eurocodes by using the support of the EC [2].

The work programme is divided into four overlapping phases including certain tasks defined by task description, task reference and deliverables and differentiated by SC's, WG's and HG's of CEN/TC 250.

2015 ↓ End 2016	<u>Phase 1</u> SC5.T1 - CLT and Reinforcement (NEW) SC5.T2 - Timber Concrete Composites (NEW)
2016 ↓ End 2017	<u>Phase 2</u> SC5.T3 - Racking strength, floor vibrations, stability of members etc.
2017 ↓ End 2018	<u>Phase 3</u> SC5.T4 - Fire (add rules for CLT and TCC, connections in fire, etc.) SC5.T5 - Connections, block shear, glued in rods
2018 ↓ End 2019	<u>Phase 4</u> SC5.T6 - Bridges

Figure 4: Structure and current timeline of CEN/TC 250/SC 5 tasks

The 'Response to Mandate M/515' prescribes which tasks have to be taken into account in which phase.

In Figure 4 the structure of tasks connected to CEN/TC 250/SC 5 (SC5.T1 – SC5.T6) is shown for the current timeline from 2015 until 2020. The different phases demonstrate that it is foreseen to deal with new design items at first, before starting the process of the revision of existing items. The further evolution of Eurocode 5 in the field of CLT or TCC starts before the modification and completion of the parts of EN 1995 - Design of Timber Structures - with Part 1-1: General - Common rules and rules for buildings, Part 1-2: General - Structural fire design and Part 2: Bridges.

It is evident that the tasks are directly connected to the work of the SC 5/WG's listed in Figure 3. As a consequence, the division of CEN/TC 250/SC 5 work into working groups is inspired by the defined SC 5 tasks (see Figure 5).

2015 ↓ End 2016	<u>Phase 1</u> SC5.T1 - CLT + Reinforcement SC5.T2 - TCC	WG 1 + WG 7 WG 2
2016 ↓ End 2017	<u>Phase 2</u> SC5.T3 - Cluster	WG 3
2017 ↓ End 2018	<u>Phase 3</u> SC5.T4 - Fire SC5.T5 - Connections	WG 4 WG 5
2018 ↓ End 2019	<u>Phase 4</u> SC5.T6 - Bridges	WG 6

Figure 5: CEN/TC 250/SC 5 tasks connected to SC 5/WG's

3.2 TEAM WORK / RESPONSIBILITIES

3.2.1 CEN/TC 250/SC 5 Working Groups (SC 5/WGs)

Working groups on new, revised and additional items in the field of timber structures are established within the subcommittee CEN/TC 250/SC 5. Experts from building authorities, key industry bodies and from the field of research and development of all Member States are members of these groups – sometimes even since the first generation of Eurocodes – and bring their knowledge as technical input into the working process. The technical proposals and discussions within the working groups started already in advance to the mandated phases, shown in Figure 5.

Figure 6 demonstrates how national mirror committees include representatives of interested parties and send them to participate in European standardization work as appointed members. Certain appointed members are sent as delegates - with one person being head of delegation – or observers to CEN/TC 250/SC 5 plenary meetings. It is of importance that the head of delegation represents only national opinions and matters and that only the head of delegation gives a national vote. Observers need a permission for attendance and observing the meeting. Additional members are sent or motivated to participate in SC 5/WG's as experts expected to give their technical input to achieve the objectives of the working groups.

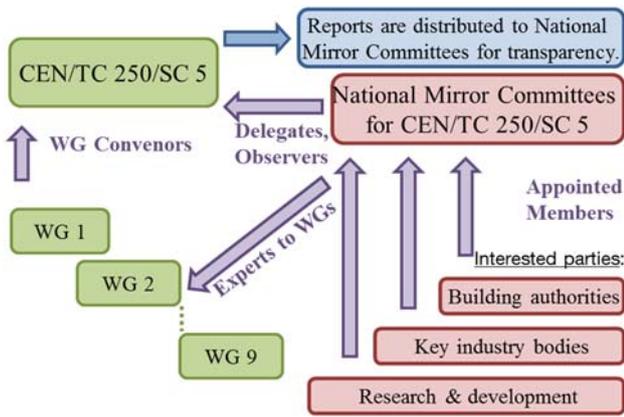


Figure 6: Delegations and experts of CEN/TC 250/SC 5

The WG Convenors are responsible to inform the WG members about subjects discussed within CEN/TC 250/SC 5 which are relevant for the work of their group. The WG Convenors attend as WG representatives in SC 5 plenary meetings.

For reasons of transparency reports and important information are distributed in national mirror committees and, additionally, the heads of delegation are responsible for the flow of information between European and national level.

To score the flow of information within CEN/TC 250, reports are required for each meeting, written and sent by working groups and subcommittees. In Figure 7 these interrelations are summarized graphically.

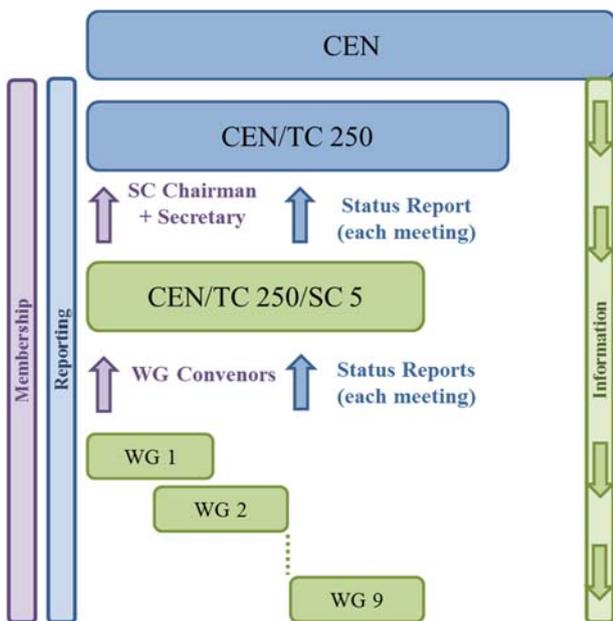


Figure 7: Organization and reporting within CEN

Convenors, Chairmen and Chairwomen attend meetings of one higher level as representatives of their group. Vice versa, requirements are transmitted and information is distributed one level lower.

3.2.2 Project Teams

In order to fulfil the objects of the work programme, groups of experts – so-called Project Teams (PT) – are established in a tender process launched parallel to the start of a new phase. The PT's consist of five members and one leader. They are responsible for a certain task of the work programme (e.g. SC5.T1 as shown in Figure 5) and therefore connected to a certain SC, WG or HG of CEN/TC 250.

They are responsible for the whole writing process of the new standards. This “editorial” work has to be proceeded in very close cooperation with the work of the SC/WG's to achieve Eurocode drafts in compliance with the Mandate. In addition, the PT's shall provide background documents giving clarification and verification (e.g. scientific background) of proposed clauses, equations and design provisions. References to relevant sources like scientific papers, research projects or national standards shall help to record the input of this scientific background. [3]

Needed qualifications of PT members are on the one hand sufficient expertise with regard to the development of standards and on the other hand professional background and experience in the corresponding field [4]. The tender process is coordinated by NEN, the Netherlands Standardization Institute.

For matters of coordination and flow of information communication between SC/WG's and PT's is decisive to proceed successfully. While WG's are discussing about technical contents – design approaches, simplifications and the contents' structure - the PT's draft with the help of these contents the standard text and process the delivered background information. The work process and the draft process need be coordinated with one another to guarantee the compliance of the mandated timeline.

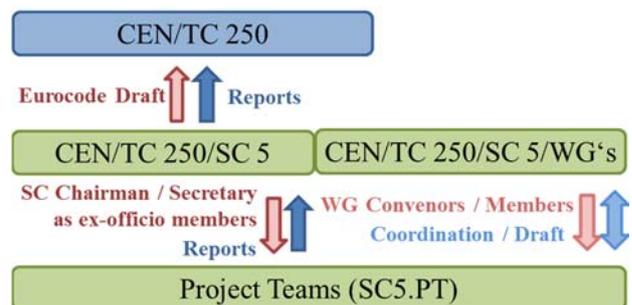


Figure 8: Responsibilities within CEN/TC 250/SC 5

The CEN/TC 250 policy guidelines [3] prescribe responsibilities of the different groups. Like already mentioned, SC 5/WG's and PT's should collaborate closely to enable a fruitful outcome. Consequently, WG Convenors and WG members may be included in Project Teams, as indicated in Figure 8.

The PT's for the different SC 5 tasks report directly to the SC 5 plenary, while SC 5 Chairman and Secretary are to be informed about upcoming PT meetings, which they can attend as ex-officio members.

CEN/TC 250/SC 5 reports directly to the CEN/TC 250 plenary, including information of the ongoing work of the Project Teams.

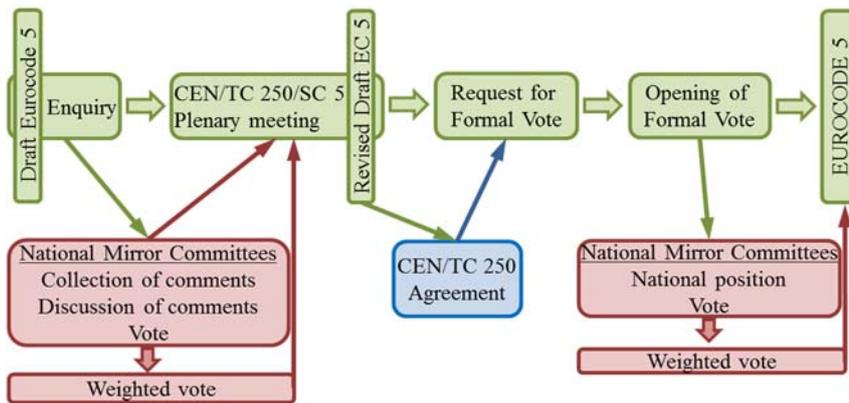


Figure 9: Official procedure after finalizing the EC drafts

The Eurocode Draft or the different parts of the Eurocode Draft are written by the PT's after coordination with the SC 5/WG's and reviewed by the SC 5 plenary. In the end, CEN/TC 250/SC 5 gives acceptance of the Eurocode drafts to the PT's and sends the draft to CEN/TC 250.

Figure 9 demonstrates graphically the official procedure after finalizing the Eurocode draft [5].

When starting the enquiry process the national mirror committees are asked to collect and discuss comments on the Eurocode draft as well as to give a national vote. Approval of the enquiry requires simple majority and at least 71% positive weighted vote (abstentions not counted). The largest weightings are connected to the Member States France, Germany, Italy, Turkey and United Kingdom, in each case a weighting of 29 points out of 405. Iceland and Malta have the least weightings with in each case 7 points out of 405. [6]

The enquiry timeframe lasts three months. Afterwards, the comments have to be answered by CEN/TC 250/SC 5 and are used to create a revised Eurocode draft. CEN/TC 250/SC 5 is responsible for the finalization of the drafting process by sending the revised draft again to CEN/TC 250. CEN/TC 250 takes the final decision to accept the new Eurocode 5 parts in coordination with all other Eurocodes and agrees to open the Formal Vote (FV). A positive assessment is needed during the enquiry otherwise a second enquiry has to be organized.

The FV asks the national mirror committees to give their vote as national position – this time – just as acceptance or rejection of the revised Eurocode draft. Only editorial comments are allowed during the FV. Again a weighted vote, requiring simple majority and 71% approval (abstentions not counted), is needed.

4 THE FUTURE DEVELOPMENT OF EUROCODE 5

4.1 ENHANCING 'EASE-OF-USE'

After an intensive discussion within CEN/TC 250 a clear definition is now available to whom the Eurocodes are addressed. The Eurocodes are addressed to “Competent civil, structural and geotechnical engineers, typically

qualified professionals able to work independently in relevant fields” [7].

This definition is included in a CEN/TC 250 document called ‘Position paper on enhancing ease of use of the Structural Eurocode’ [7] created to improve the ‘Ease-of-Use’ of the Eurocodes for practical users. This discussion point is relevant in order to improve harmonisation between the Eurocodes and to achieve long term confidence by the users. Examples for principles listed in the document are as follows:

- Clarity and understandability
- ‘Ease-of-navigation’
- ‘State-of-the-art’
- No fundamental changes to the approach to design and to the structure of the Eurocodes
- Consistency with product standards and standards for ‘execution’ [7]

On the one hand, the keywords ‘clarity’ and ‘understandability’ may give the idea of restructuring Eurocode 5. On the other hand, it is clearly described that fundamental changes to the approach to structure of the Eurocodes are to be avoided. Discussing the content of the new Eurocode 5 generation brought the question up how the content with regard to simplified rules, scientifically based design methods and tabulated data should be balanced.

Tabulated data (e.g. factors and fixed values) or diagrams - developed to find results on the safe side - are easy to apply. They could be useful for preliminary design, but have the disadvantage of increasing the amount of pages. Furthermore, the results are restricted to the boundary conditions of the tables. [13]

Simplified design methods for standard applications have the advantage of being easy to understand – also for non-daily users -, easy to apply and short with regard to the amount of text. But simplified rules predict conservative results and sometimes they are even restricted to certain applications or within certain boundary conditions.

General scientifically based design methods have the advantage of being more advanced as well as more accurate and economic. They are often applicable also to new developments, but require higher effort for the user. In general, there is always a clash of interests between the wish of industry being able to optimize design parts with high iteration factor as far as possible and the wish of engineers to have available simplified methods for daily

use. A standard should be able to deliver solutions for both directions. A limitation or shortage of pages is for sure not a target of the revision, especially since in the case of Timber Structures the pleasant development of the 'state-of-art' has to be mirrored.

CEN/TC 250/SC 5 decided therefor that regulations and general design approaches shall remain in the main part giving the best knowledgeable information and making economically designed timber structures possible. Simplified rules and tabulated data might be additionally provided in the Annexes of EC 5 or in commented versions of EC 5.

Design rules which are used only by a limited number of specialists, like the design of trussed rafters with punched metal plate fasteners, will be given in Annexes to enable a better overview in the main part by concentrating on the most used cases (20% of the design rules - relevant for 80% of daily use design). This strategy should enable a neatly arranged structure of the main part, as mentioned before, to ease the Eurocode' use for engineers not using the relevant parts every day. Most of the complaints received during systematic review processes about 'difficult-to-use' were more related to navigation in the Eurocode than to technical issues.

4.2 REVISION OF EXISTING PARTS

Systematic reviews of the existing parts were realised for all parts of Eurocode 5 in 2014 and 2015. Comments from all National Standardization Bodies (NSB's) on the first generation of Eurocodes were collected. This feedback gives indications which design rules need to be improved or to be expanded for the second generation of Eurocodes. Besides a long list on additional subjects, the following subjects will be taken into account as most important items.

- **Vibration of floors:** In the case of vibration of floors more general methods - also applicable for new developments as CLT or TCC – are needed.
- **Compression perpendicular to the grain:** For the design of compression perpendicular to the grain additional design requirements are to be added.
- **Racking resistance of walls:** Only one method instead of two different methods should be found within Eurocode 5 regarding racking resistance of walls.
- **Element stability:** More precise information on element stability need to be included.
- **Timber failure capacity in connections:** In the case of timber failure capacity of connections, it should be clearly differentiated between failure modes of one single fastener, a group of fasteners and the timber capacity surrounding the connection.
- **Rules for the 'execution' of timber structures:** Additionally needed rules for the 'execution' of timber structures is part of the work program of SC 5/WG 9.

4.3 NEW ITEMS

Additional design rules need to be included to comply with the 'state-of-the-art' which is based in commonly accepted results of research that has been validated through sufficient practical experience.

The following subjects are to be included as most important new Eurocode 5 items.

- **Cross Laminated Timber (CLT):** This subject is outlined in the presentation of Tobias Wiegand 'Design of cross-laminated timber – another new section of Eurocode 5' [8].
- **Timber Concrete Composites (TCC):** This subject is outlined in the presentation of Alfredo Dias 'Timber Concrete Composites - a new part in Eurocode 5' [9].
- **Reinforcement:** This subject is outlined in the presentation of Philipp Dietsch 'Reinforcement of Timber Structures - a new section for Eurocode 5' [10].

In addition, it is of great importance to reach a further harmonization between the product-, test-, value- and 'execution'-standards. This situation is described by the presentation of Tomi Toratti 'The standardization chain in Europe: Material - Design - Execution' [11].

Ad Leijten will present actual developments in the area of compression perpendicular to the grain - 'The bearing strength capacity prediction by Eurocode 5 and potential design code models' [12].

4.4 COLLECTION OF NATIONAL ANNEXES AND REVIEW OF NDP'S

The Eurocodes provide 'National Determined Parameters' (NDP) to be able to make adjustments to the foreseen national level. The responsible National Standard Bodies of the Member States published so-called 'National Annexes' (NA) as addition to the Eurocode parts where NDP's as well as 'Non-Contradictory Information' (NCI) are included.

CEN/TC 250 has been collecting National Annexes of most of the Members States. At the moment, NA's of 23 Members States have been collected. These will be made available to the corresponding subcommittees.

NDP's are used to allow adaptations to climate related loads, to define national partial safety factors for materials and actions or limit values and to choose between modification factors, coefficients or design approaches. For improvement of 'Ease-of-Use' a reduction of the number of NDP's is vital. Therefore, CEN/TC 250 provided recommendations as guidance for the drafting process of the second generation of Structural Eurocodes [14]. In this guidance document the definition and background of 'legitimate' and 'questionable' NDP's are explained. All in all, parameters connected to safety levels like partial safety factors or the time of fire exposure and classification of structures according to quality management requirements have to be kept as NDP's.

The CEN/TC 250 subcommittees shall now classify the NDP's. The following progress should be followed.

- Revision and categorization of NDP's
- Elimination of NDP's considered 'questionable'

- Report for rationalizing the retention or removal of NDP's

At the moment, the different subcommittees are working on this categorization and elimination in order to submit a NDP report to CEN/TC 250.

Furthermore, the collection of NA's can be used to analyze the deviation of existing NDP's and the amount of national NCI's. Demonstrating the different national choices and outlining certain tendencies give an overview of the actual status of NDP's and help to classify 'questionable' NDP's. The investigations and analysis regarding NA's to Eurocode 5 are realized and provided by the authors at Technische Universität München.

The collection of NA's and categorization or analysis of NDP's seems relatively undemanding in the case of timber structures when comparing the different Eurocodes with all its parts – Eurocode packages – and deducing the number of pages of NA's of Eurocode packages or the number of the corresponding NDP's. Figure 10 summarizes this numbers including also the number of pages of the Eurocode packages and demonstrating the amount of pages of the corresponding NA's by taking the associated German NA's.

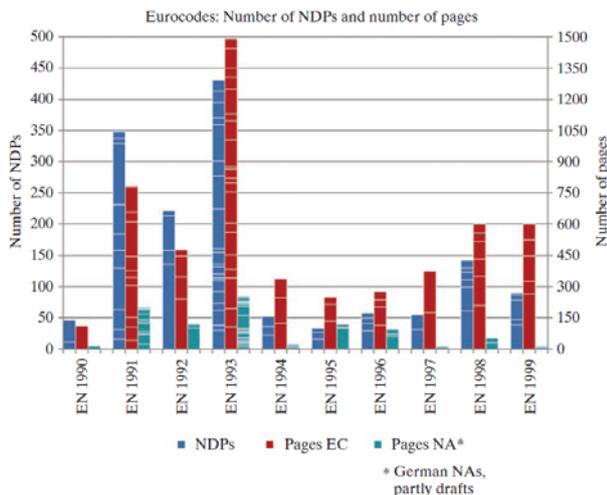


Figure 10: Number of NDP's, number of pages of the Eurocode packages and amount of pages of the associated German NA's [13]

5 CONCLUSIONS

The work on the new generation of Eurocode 5 started mainly in 2014. It profits from a high level of interest among the Member States and the wood related community of industry, engineers, trade and public. Fortunately, the culture of discussion in the timber sector is very much fact oriented, free of personal sensitivities and based on a high level of confidence, respect and in many cases friendship. Even though, it is a long way to finalize the revision until 2020, it is absolutely necessary to support the work from now until the end to enable an increased use of timber in the building sector.

ACKNOWLEDGEMENT

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