Eurocode 3: Design of Steel Structures "ready for practice"

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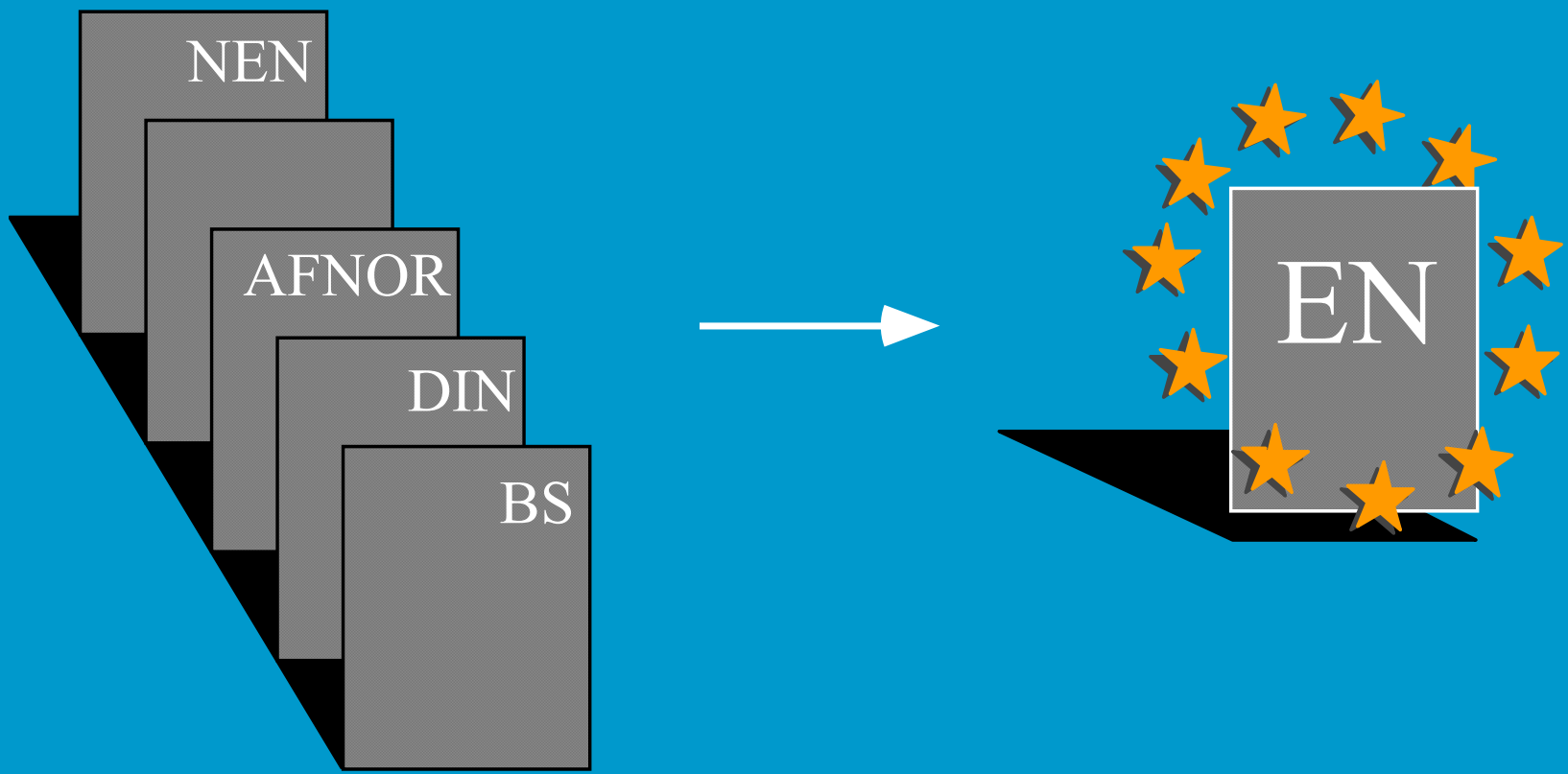
History and Context of Eurocode 3 Design of Steel Structures



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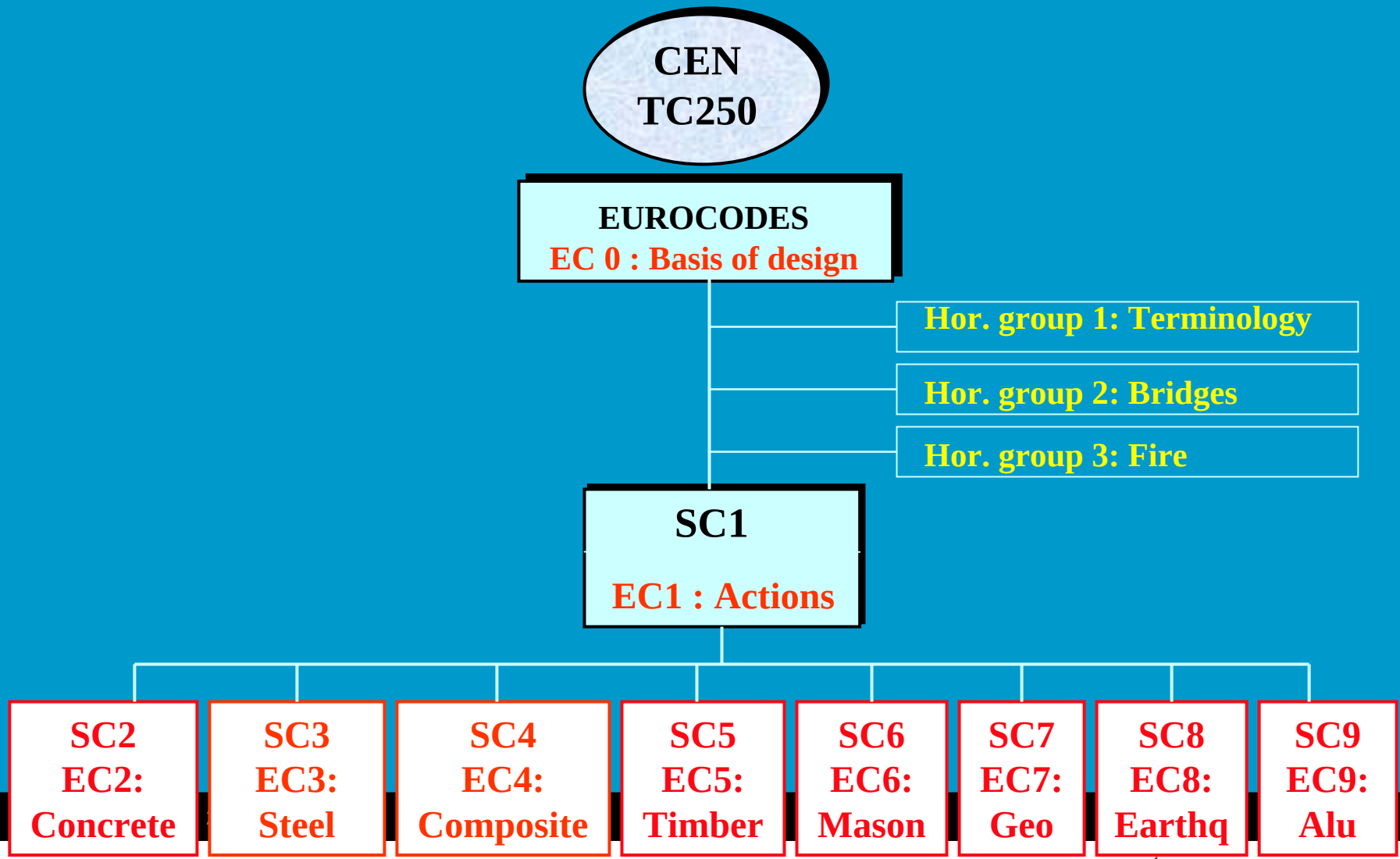
History and Context of Eurocode 3 Design of Steel Structures

- Design in one country followed by erection in another country
- Standard building rules for whole Euro-market
- Easier to work in other countries
- More efficient transfer of research results in rules
- Harmonized core material for local handbooks, design aids and educational material

History and Context of Eurocode 3 Design of Steel Structures

"CHALLENGE FOR EUROCODES"

- Ensure structurally safe and serviceable structures
- Provide rules which are sufficiently detailed to avoid disputes
- Facilitate international competition on an even playing field
- Permit innovation in accordance with essential principles


CEN
TC250
EUROCODES
EC 0 : Basis of design
Hor. group 1: Terminology
Hor. group 2: Bridges
Hor. group 3: Fire
SC1
EC1 : Actions
SC2
EC2:
Concrete
SC3
EC3:
Steel
SC4
EC4:
Composite
SC5
EC5:
Timber
SC6
EC6:
Mason
SC7
EC7:
Geo
SC8
EC8:
Earthq
SC9
EC9:
Alu

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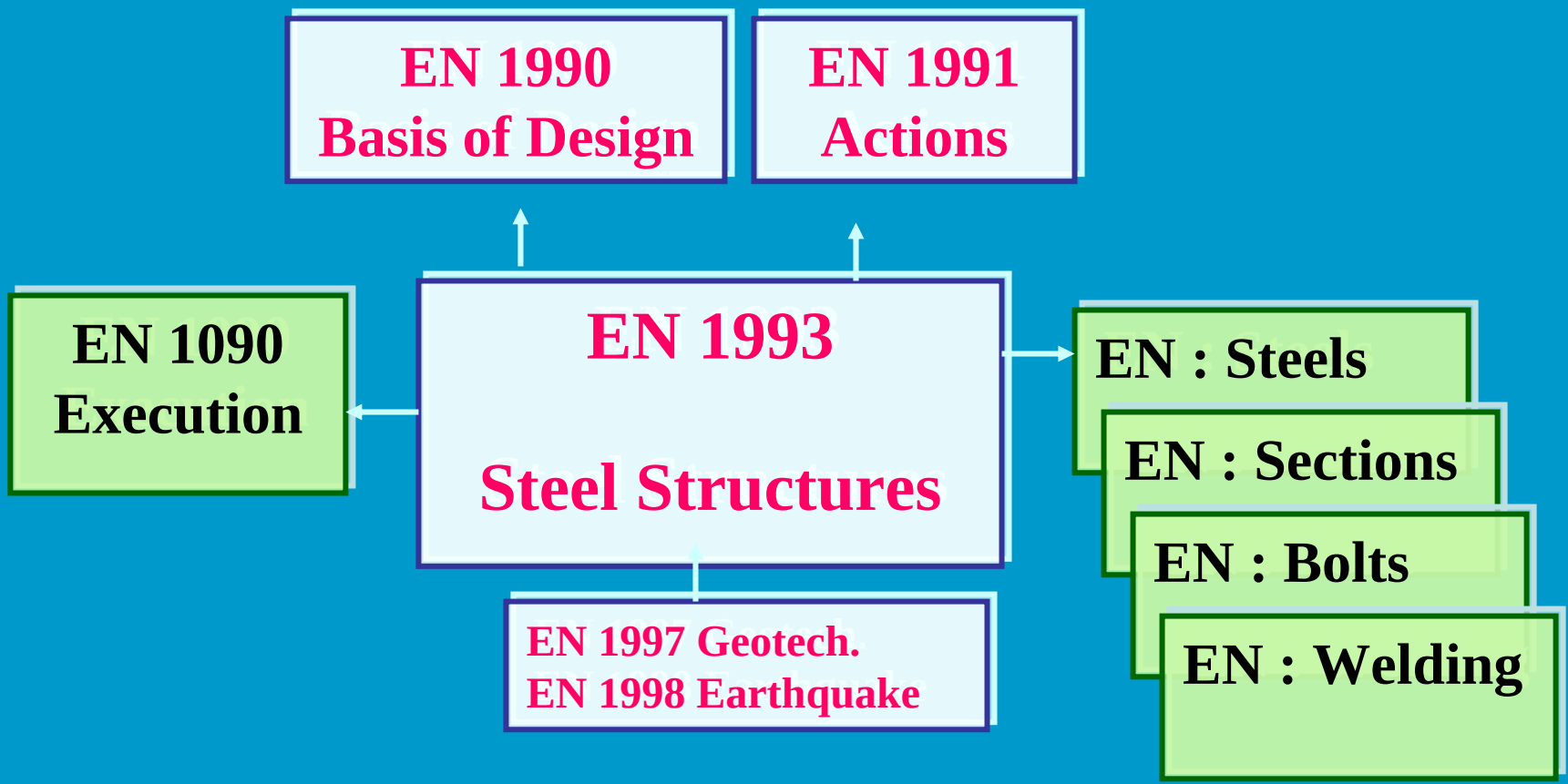
RELATION WITH OTHER EN's



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Structure of Eurocode 3
General Parts

- EN 1993-1-1: General rules and rules for buildings

Rules for strength and stability

Rules specific for Buildings

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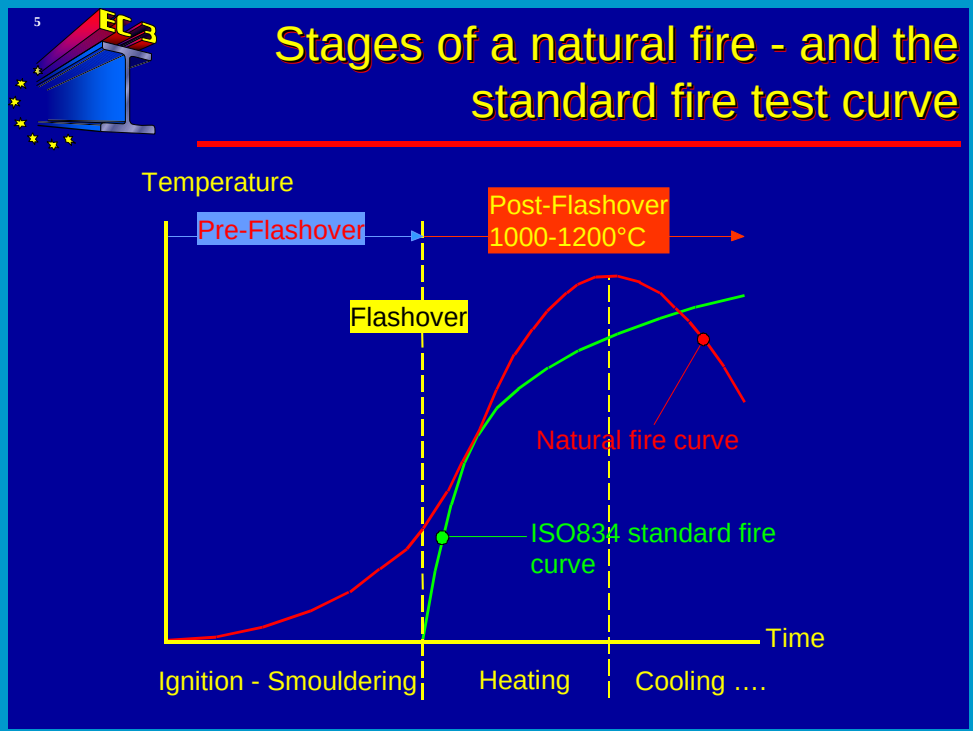
Structure of Eurocode 3 General Parts

- EN 1993-1-2: Structural fire design



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Structure of Eurocode 3
General Parts

- prEN 1993-1-3: Supplementary rules for cold formed members and sheeting

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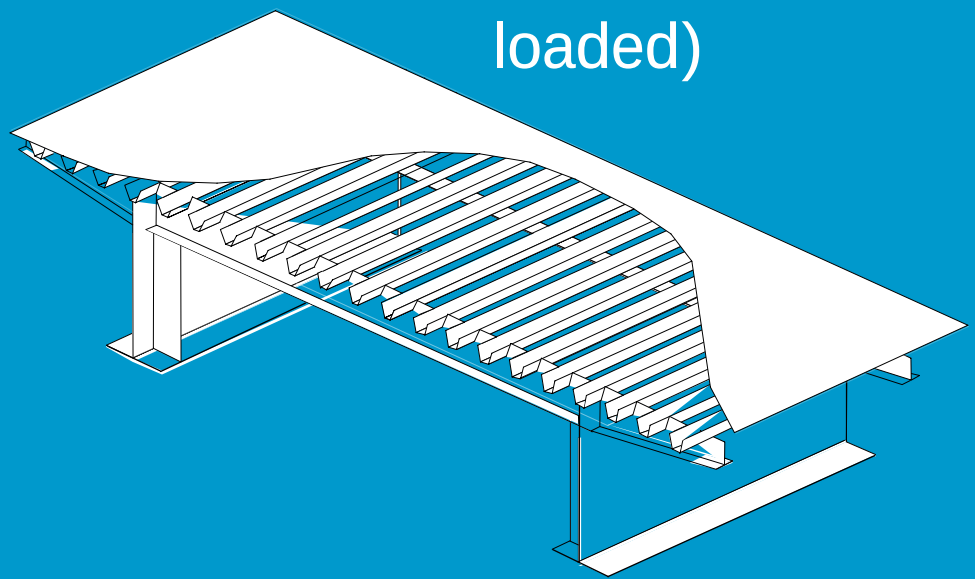
Structure of Eurocode 3
General Parts

- prEN 1993-1-4: Supplementary rules for stainless steels
- prEN 1993-1-5: Plated structural elements (in-plane loaded)



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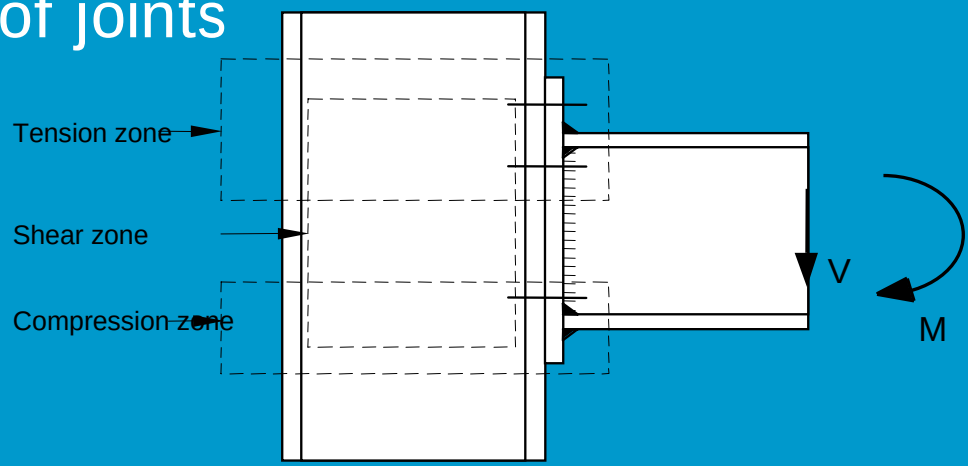
Structure of Eurocode 3
General Parts

- prEN 1993-1-6: Strength and stability of shells
- prEN 1993-1- 7: Plated structural elements (transversely loaded)
- EN 1993-1- 8: Design of joints



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Structure of Eurocode 3
General Parts

- EN 1993-1- 9: Fatigue
- EN 1993-1-10: Material toughness and through-thickness properties
- prEN 1993-1-11: Design of structures with tension elements
- prEN 1993-1-12: Additional rules for the extension of EN 1993 up to steel grades S700

Structure of Eurocode 3 Application Parts

- prEN 1993-2: Steel bridges

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Structure of Eurocode 3 Application Parts

- prEN 1993-3-1: Towers and Masts

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Structure of Eurocode 3 Application Parts

- prEN 1993-3-2: Chimneys
- prEN 1993-4-1: Silos
- prEN 1993-4-2: Tanks
- prEN 1993-4-3: Pipelines

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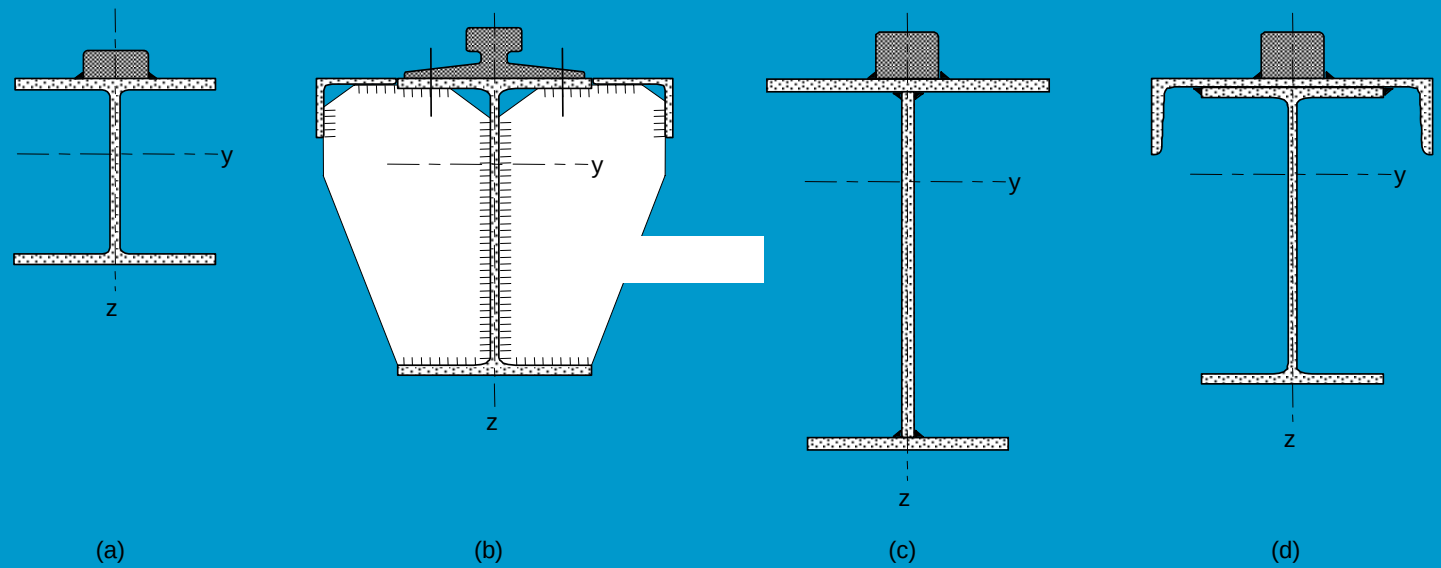
Structure of Eurocode 3 Application Parts

- prEN 1993-5: Piling
- prEN 1993-6: Crane supporting structures



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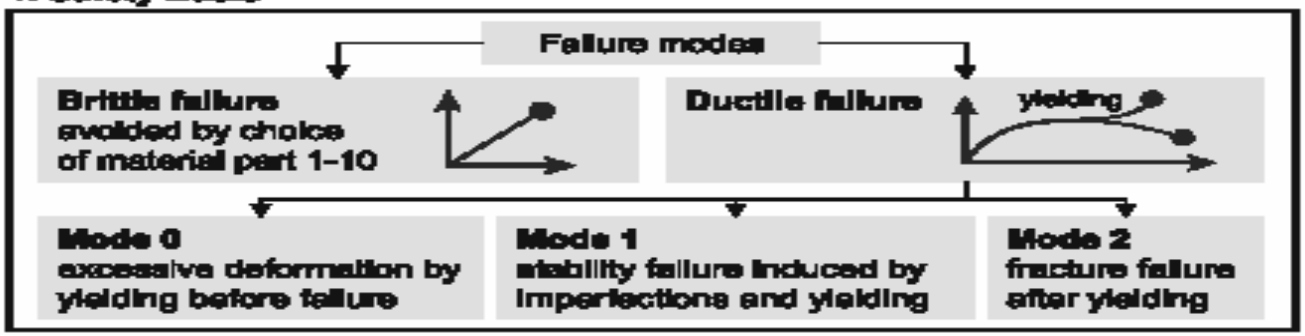
Determination of characteristic values R_K in Eurocode 3 and 4

1. Safety Basis



2. Reliability assumptions

$$R_d = m_R \cdot \exp(-\alpha_R \beta \sigma_R - 0.5\,\sigma_R^2)$$

with $\alpha_R \beta = 3{,}04$ e.g. from $\alpha_R = 0{,}8$ and $\beta = 3.8$

3. Use of annex D to EN 1990 to determine R_d

1st Step: Test-Eval.

$$R_d = m_R \cdot \exp(-3.040\,\sigma_R - 0.5\,\sigma_R^2)$$
$$R_{ki} = m_R \cdot \exp(-1.645\,\sigma_R - 0.5\,\sigma_R^2)$$
$$\gamma_{Mi} = R_{ki} / R_d$$

2nd Step: Classification of all γ_M values to

$\gamma_{M0} = 1.0$ for failure mode 0
$\gamma_{M1} = 1.1$ for failure mode 1
$\gamma_{M2} = 1.25$ for failure mode 2

3rd Step: Determination of classified R_K-values

$R_K = R_{d0} \cdot \gamma_{M0}$ for failure mode 0
$R_K = R_{d1} \cdot \gamma_{M1}$ for failure mode 1
$R_K = R_{d2} \cdot \gamma_{M2}$ for failure mode 2

4th Step: $R_d = R_K / \gamma_M$

where γ_M - value = National decision

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Safety Level

- In applying the rules in Eurocode 3 a structural safety is reached of not less than the reliability index

$$\beta = 3{,}8$$

- Member states are entitled to choose their own safety level for structures

Safety Level

- The rules are set up such that they contain safety elements of which the value can be chosen by the individual member state.
- These safety elements are for instance the partial (safety) factors for the resistance (limit states) of structural elements.
- For these safety elements in the Eurocodes so-called recommended values are given in notes accompanying the clauses containing these safety elements.

Safety Level

- To promote harmonization of design rules throughout Europe the Commission strongly advises to choose the

recommended values

for these safety elements.

Introduction of Eurocode 3 in the Design Practice

- Criticism: Eurocode 3 is very advanced but it is complex to use

- To help the designer in practice there is a need for:
  -Background information
  -Introduction courses with worked examples
  -User-friendly software (“expert-systems”)

Introduction of Eurocode 3 in the Design Practice

- Criticism: Eurocode 3 is very advanced but it is complex to use

- Not “simple rules sell steel” but
  “Simple TOOLS sell Steel”

Conclusions

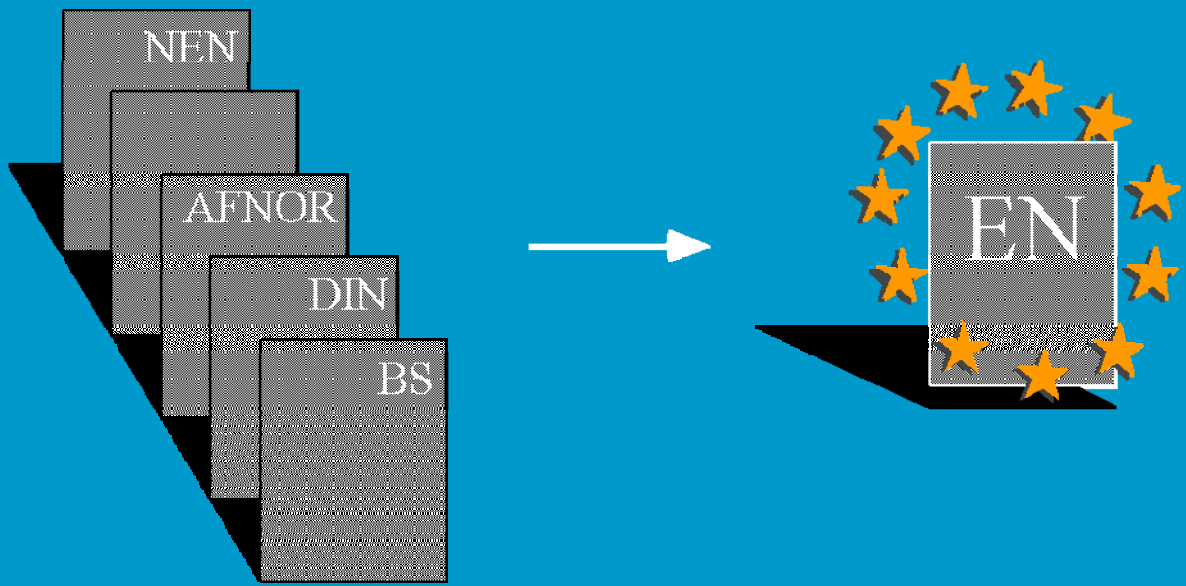
- The process of harmonization of design standards of the member countries of CEN did take a period of about three decades. Compared to the “life time” of an existing code in a country of about 15 years, for the Eurocodes this period is not so bad.

- Eurocode 3 “Design of Steel Structures” comprises a fairly complete set of design codes for uniquely designed structures and for a wide range of structural steel products.

Conclusions

- The introduction of the Eurocodes in the design practice needs great care. Design examples, guide lines, design tools (special software) should be developed in the various countries. Explanations of differences and the justification for these changes should be supplied to support the acceptation of the Eurocodes.

- To support these local activities in the various member states, background documents need to be drafted on which local design tools and examples need be based.



THANK YOU FOR YOUR ATTENTION