Design of masonry structures

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Eurocodes - Development

- Start in 1974 from 1975 supported by the European Commission
- 1988: Publication of the ‘zero‘ generation by the European Commission
- 1989: Further development handed over to CEN
- 2012/2013:
  - Mandate M515 from the Commission
  - TC250 response: ‘Towards a second generation of EN Eurocodes’
Eurocodes - Development

- December 2014: 1st phase of program approved by the Commission
- Common goals
  - Evolve Eurocodes to the state of the art
  - Improve ease of use
  - Reduce the number of nationally determined parameters (NDPs)
- Present: ‘Finalization’ of the 2nd generation of Eurocodes
Eurocode 6 parts

- Eurocode 6 Design of masonry structures
  - Part 1-1: General rules for reinforced and unreinforced masonry structures
    - 2nd generation published by CEN in April 2022
  - Part 1-2: Structural fire design
    - 2nd generation content ready, Formal Vote expected in April 2024
  - Part 2: Design considerations, selection of materials and execution
    - 2nd generation content ready, FV running until 2024
  - Part 3: Simplified calculation methods for unreinforced masonry structures
    - 2nd Generation: FV running until 22 June 2023
EN 1996-1-1
General rules for reinforced and unreinforced masonry structures

- Evolution no Revolution
- Reduction NDPs (only 21 in 2005 version)
  - 2 NDPs removed
- New chapter layout for all volumes -1-1
- Ease of use: Restructuring of paragraphs and more consistency throughout the document
EN 1996-1-1

Major changes

- Masonry units with innovative geometric properties allowed
- Verification under combined loading
- Capacity reduction factor for slenderness and eccentricity
- Global building imperfection brought in line with EN 1992-1-1.
- Addition of coefficient of friction for out-of-plane shear
- Addition of rules for confined masonry
- Informative Annex for complex shapes
- Informative appendix for average material properties
EN 1996-1-2
Structural fire design

- Reduction of number of NDPs from 9 to 4
  - Tabulated design data: all values are NDP

- Ease of use:
  - Structure and the table of contents was harmonized with the fire parts of the other material related Eurocodes

Major changes:
- Withdrawal of calculation methods (former annexes C and D)
- Upgrade of Annex A “Tabulated Data” with new test evidence (masonry materials, suitable surface finishes)
- New Annex B “Input parameters for calculation models”, replacing old Annexes C and D
EN 1996-2
Design considerations, selection of materials and execution

- Reduction of number of NDPs from 2 to 1
- Ease of use: Enhanced by the clarification of wording and improved drawings
- **Major changes:**
  - Permissible deviations have been made consistent with EN 1996-1-1
  - Relative exposure of masonry to wetting has been clarified
  - Specification of masonry units and mortar for durable masonry in various exposure condition has been updated
EN 1996-2
Design considerations, selection of materials and execution

- Major changes continued

- Detailing of the spacing of movement joints has been revised;

- Tolerance specifications for masonry to be used with thin layer mortar have been developed

- Pointing of masonry has been substantially reviewed;

- Updated information on durability for ancillary components (new materials from EN 845 series added).
EN 1996-3
Simplified calculation methods for unreinforced masonry structures

- Scope enhanced: buildings up 20 m height and floors spanning up to 7 m
- Reduction of number of NDPs from 7 to 5

**Major Changes**

- Made consistent with changes to EN 1996-1-1 especially in relation to rules for capacity reduction factor for slenderness and eccentricity;
- New capacity reduction factors for the design to cover wall-slab interaction including partially supported slabs
- Replacing the duplication of EN 1996-1-1 shear rules by a simplified method in Annex A;
EN 1996-3
Simplified calculation methods for unreinforced masonry structures

Major Changes continued

- New design concept for basement walls regarding the actual earth pressure coefficient;
- Simplification of the design rules for walls under concentrated loads;
- Improvement of the design rules for walls under mainly bending due to horizontal loads (required minimum normal force).

Remaining issue

- Load capacity of walls with partially supported slabs, however in correspondence with EN 1996-1-1
Some thoughts

- Do not wait with development of National Annexes
- Goals achieved?
  - State of the art
  - NDPs
  - Ease of Use
- New Eurocode 6 suit can / may be used with current generation
- Is a simultaneous revision of all Eurocode parts a model for the future?

3rd Gen: continuous development needed
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