



EUROCODES

EN 1996

Design of masonry structures



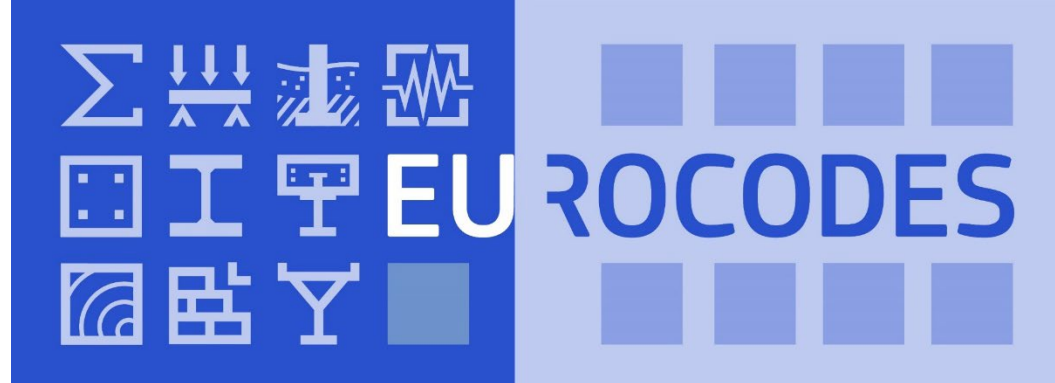
Rob van der Pluijm

EUROCODE Conference | Berlin | 24 May 2023

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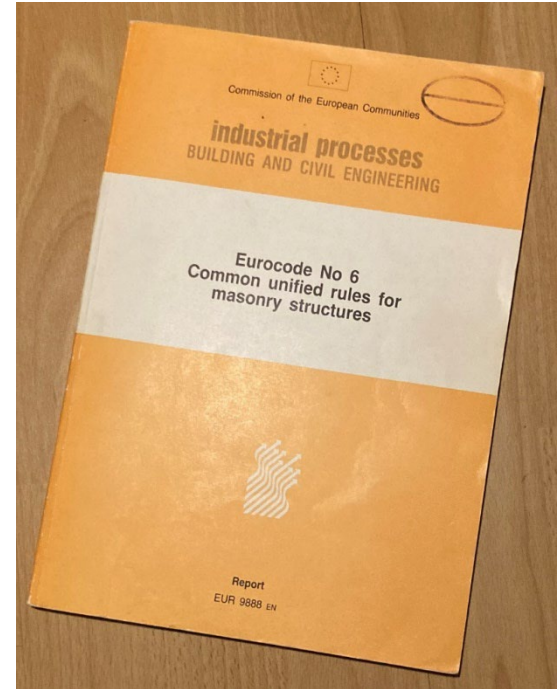
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Eurocodes - Development

- 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
- 2005/2006:
Publication of the 1st Generation - 58 Eurocode parts
- 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

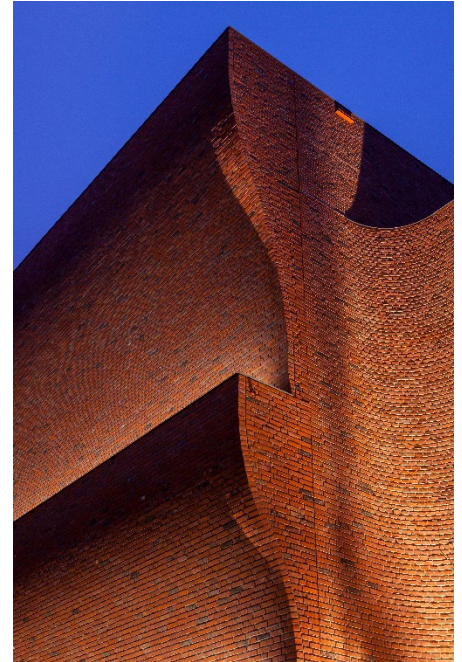
- Eurocode 6 Design of masonry structures
 - Part 1-1: General rules for reinforced and unreinforced masonry structures
 - 2nd generation published by CEN in April 2022
 - Part 1-2: Structural fire design
 - 2nd generation content ready,
 - Part 2: Design considerations, s
 - 2nd generation content ready, F
 - Part 3: Simplified calculation met structures
 - 2nd Generation: FV running until 2



EN 1996-1-1

General rules for reinforced and unreinforced masonry structures

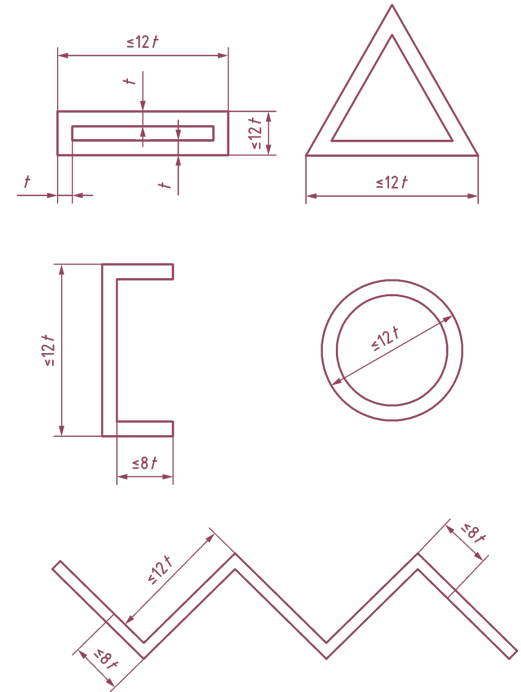
- Evolution no Revolution
- Reduction NDPs (only 21 in 2005 version)
 - 2 NDPs removed
- New chapter layout for all volumes -1-1
- Ease of use: Restructuring of paragraphs and more consistency throughout the document



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

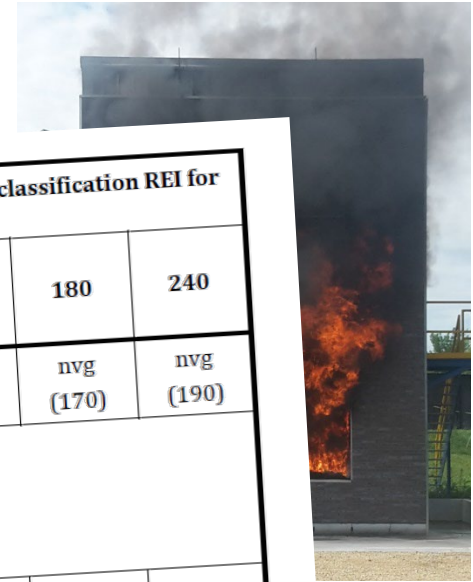
- Reduction of number of NDPs from 9 to 4
 - Tabulated design data: all values are NDP

- Ease of use
- Harmonisation
- Eurocode

Major changes

- Withdrawal
- Upgrade (masonry)
- New Annex
- Replacement

Row number	Material properties: unit strength f_b (N/mm ²) gross dry density ρ (kg/m ³) combined thickness ct (% of wall thickness)	Minimum wall thickness (mm) t_F for fire resistance classification REI for time (minutes) $t_{R,d}$						
		30	45	60	90	120	180	240
2.2.3	$\mu_0 \leq 0,42$	nvg	nvg	nvg	nvg	nvg	nvg	nvg
2.2.4		(90)	(90)	(90)	(100)	(100)	(170)	(190)
2.3	mortar: general purpose, thin layer and lightweight							
	$5 \leq f_b \leq 25$ $500 < \rho \leq 900$ $16\% \leq ct < 25\%$							
2.3.1	$\mu_0 \leq 0,7$	nvg	nvg	nvg	nvg	nvg	nvg	nvg
2.3.2		(90)	(90)	(90)	(140)	(140)	(365)	nvg
2.3.3	$\mu_0 \leq 0,42$	190	190	190	190	190	190	190
2.3.4		(90)	(90)	(90)	(100)	(140)	(190)	(190)
3	Group 3 units mortar: general purpose, thin layer and lightweight							



EN 1996-2

Design considerations, selection of materials and execution

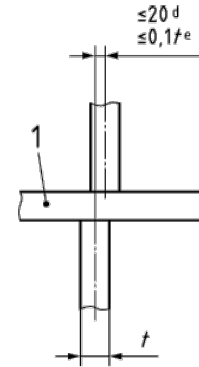
- Reduction of number of NDPs from 2 to 1
- Ease of use: Enhanced by the clarification of wording and improved drawings
- **Major changes:**
- Permissible deviations have been made consistent with EN 1996-1-1
- Relative exposure of masonry to wetting has been clarified
- Specification of masonry units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



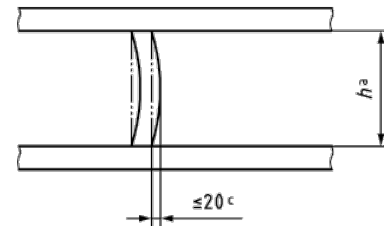
EN 1996-2

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).



b) Deviations between centres



c) Straightness/flatness -
Curvature of the wall in the vertical
direction



EN 1996-3

Simplified calculation methods for unreinforced masonry structures

- Scope enhanced: buildings up to 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 similar revision of all Eurocode parts a model for the future?



3rd Gen: continuous development needed





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