EUROCODE 6

Design of masonry structures

EUROCODE 6

Part 2: Design, selection of materials and execution of masonry

John Haynes BSc(Eng) CEng FIStructE MICE MCIOB MRICS FIMS
Principal Engineer, NHBC Standards & Technical, UK

Drafting of Part 2

Apr-93: **1st joint meeting of Project Team and CEN/TC125 Task Group**
(30 delegates from 13 countries)

Feb-98: **ENV 1996-2 approved by CEN**
(54 pages)

Jul-01: **Project Team for conversion to EN**

Dec-03: **CEN/TC 250/SC6 agreement**
(8th draft EN - slimmed version, 34 pages)

Nov-05: **EN 1996-2 approved by CEN**

Part 2 - Contents

Common clauses

(NDPs allowed for 2 no. clauses and specific references to NCCI permitted for 3 no. clauses)

1 General

2 Design Considerations

3 Execution

Annexes (3 no. Informative)

Scope of Part 2

As in Part 1-1

Basic rules for the selection of materials and execution of masonry to enable it to comply with design assumptions in other Parts of EC6

Excludes

- Aspects not covered in other Parts of Eurocode 6
- Aesthetic aspects
- Applied finishes
- Health and safety of persons engaged in design or execution
- Environmental effects of masonry structures on surroundings

Definitions

design specification (documents describing designer's requirements for the construction)

macro conditions (site exposure to weather)

micro conditions (local environment and position)

applied finish (bonded to the masonry)

cladding (in front of the masonry)

Factors affecting durability of masonry

Classification of micro conditions of exposure taking into account macro conditions

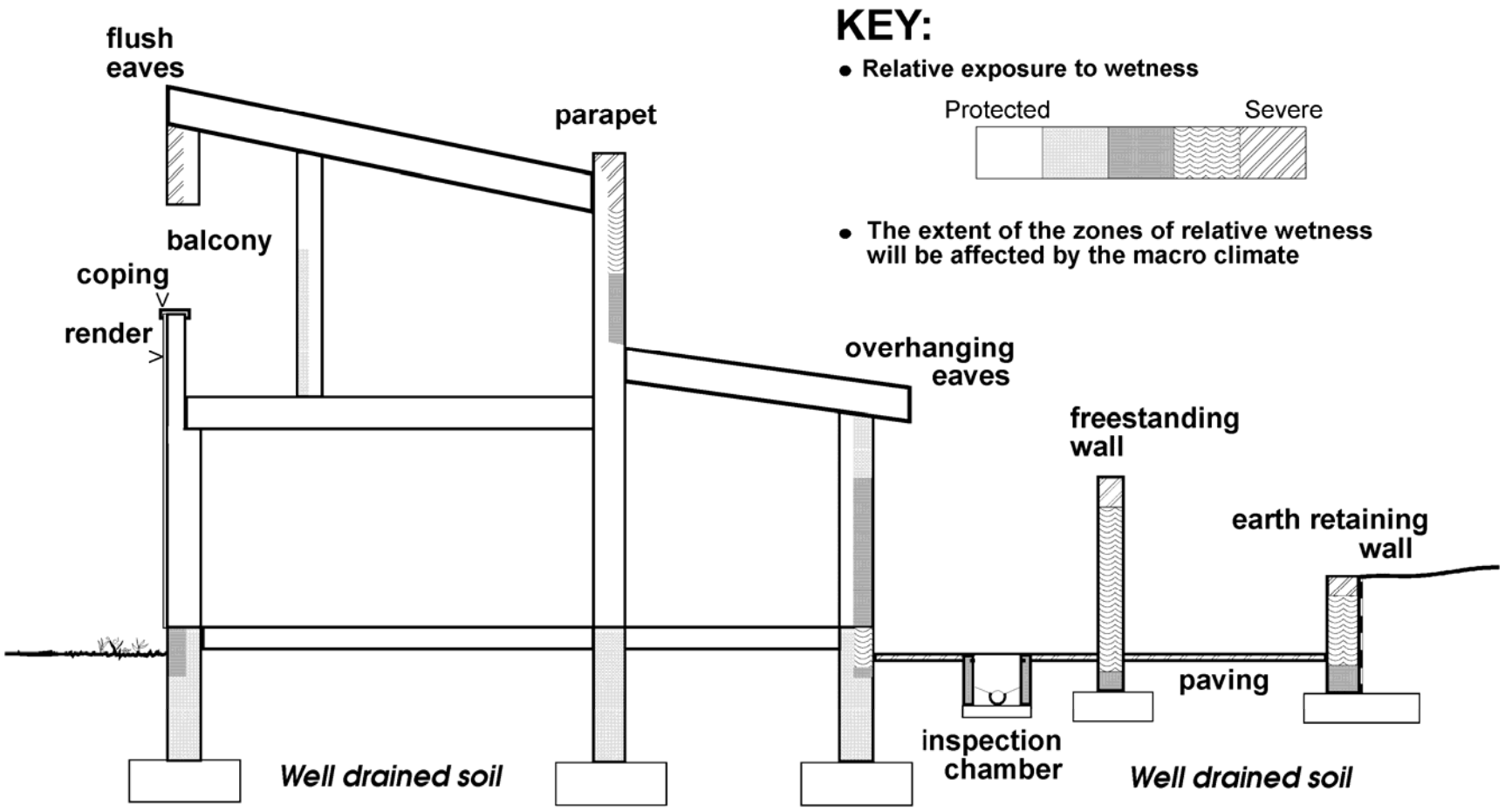
MX1 - In a dry environment;

MX2 - Exposed to moisture or wetting;

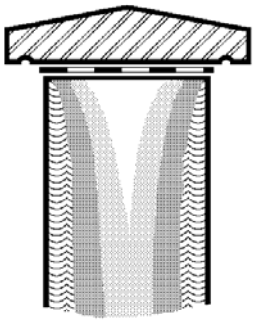
MX3 - Exposed to moisture or wetting plus freeze/thaw cycling;

MX4 - Exposed to saturated salt air or seawater;

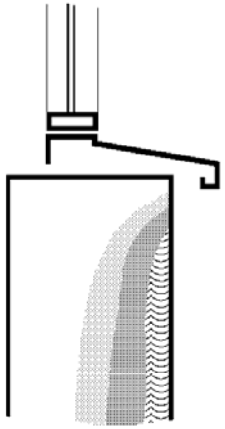
MX5 - In an aggressive chemical environment.

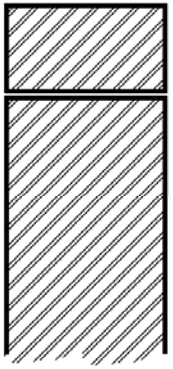

flush eaves
parapet
balcony
coping
render
overhanging eaves
freestanding wall
earth retaining wall
paving
inspection chamber
Well drained soil
Well drained soil
KEY:
• Relative exposure to wetness
Protected
Severe
• The extent of the zones of relative wetness will be affected by the macro climate

Section 2 Design Considerations

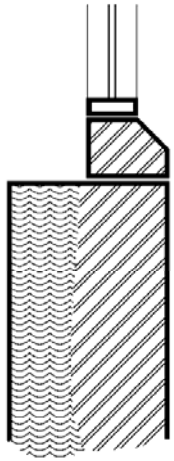


Copings and sills with overhang



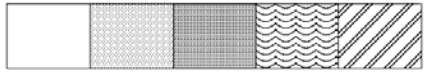


Copings and sills without overhang



Relative exposure to wetness

Protected Severe



Selection of materials

Materials incorporated in the works shall be able to resist the actions to which they are exposed

Only materials and products with established suitability (A NOTE explains the hierarchy)

Clauses refer to:

- Product specifications for masonry units, mortars etc.
- Local practice and experience
- Acceptable specifications for masonry units and mortars in Annex B

Selection of materials – Masonry units

Extract from Table B.1 Acceptable specifications of masonry units for durability

Table B.1 relates the exposure classes and the product characteristics as specified in the EN 771 standards.

Exposure class (see Table A.1)	**Clay masonry units** conforming to EN771-1	**Calcium silicate masonry units** conforming to EN771-2	**Aggregate concrete masonry units** conforming to EN771-3		**Autoclaved aerated concrete masonry units** conforming to EN771-4	**Manufactured stone masonry units** conforming to EN771-5	**Natural stone masonry units** conforming to EN771-6
			Dense aggregate	Lightweight aggregate			
MX1[a]	Any	Any	Any	Any	Any	Any	Any
MX2.1	F0, F1 or F2 / S1 or S2	Any	Any	Any	Any	Any	Any
MX2.2	F0, F1 or F2 / S1 or S2	Any	Any	Any	≥ 400 kg/m^3	Any	Any
MX3.1	F1 or F2 / S1 or S2	Freeze/thaw resistant	Freeze/thaw resistant	Freeze/thaw resistant	≥ 400 kg/m^3	Any	Consult manufacturer

Selection of materials - Mortars

No European durability test method yet agreed

Meanwhile use established local experience

Masonry mortar may be specified for durability using the terms defined in EN 998-2:

P ~ masonry subjected to passive exposure;
M ~ masonry subjected to moderate exposure;
S ~ masonry subjected to severe exposure.

Section 2 Design Considerations

Selection of materials - Mortars

Factory made masonry mortars (EN 998-2)

- **designed mortars** (declared performance)
- **prescribed mortars** (declared proportions plus compressive strength declared using publicly available references)

In exposure classes MX4 and MX5 seek manufacturer's advice

Site-made mortars

- **prescribed mortars** (batched and mixed to give the performance required by the design specification on the basis of either trial mixes or publicly available references)

Selection of materials – Ancillary components

Extract from Table C.3 Corrosion protection systems for bed joint reinforcement

Table C.3 relates the exposure classes to the references for the material specifications given in the EN 845-3, indicating whether the use is U (unrestricted), R (restricted) or X (not recommended).

Material [a]	Ref. No.	Exposure class				
		MX1	MX2	MX3	MX4	MX5
Austenitic stainless steel (molybdenum chrome nickel alloys)	R1	U	U	U	U	R
Austenitic stainless steel (chrome nickel alloys)	R3	U	U	U	R	R
Zinc coated (265 g/m²) steel wire	R13	U	R	R	X	X
Zinc coated (60 g/m²) steel wire with organic coating over all surfaces of finished component	R18	U	U	U	R	X
Zinc coated (105 g/m²) steel wire	R19	U	R	R	X	X
Zinc coated (60 g/m²) steel wire	R20	U	X	X	X	X

Masonry

- **Detailing** (local practice and experience)
- **Joint finishes** (compatible pointing and jointing mortars)
- **Masonry movement** (allow for it)
- **Movement joints** (horizontal spacing is an NDP)
- **Permissible deviations** (should be specified in the design specification. Table 3.1 gives limiting values in relation to Eurocode 6 design assumptions)
- **Resistance to moisture penetration through external walls** (where there is a need for greater resistance use applied finishes or ventilated cladding)

Section 3 Execution

Two General Principles:

(1)P All materials used and all work constructed shall be in accordance with the design specification

(2)P Precautions shall be taken to ensure the overall stability of the structure or of individual walls during construction

Acceptance, handling & storage of materials

Such that the materials are not damaged so as to become unsuitable for their purpose.

Different materials should be stored separately

Where required by the design specification, materials should be sampled and tested.

Reinforcement and prestressing materials to be free from deleterious substances, which may affect adversely the steel, concrete or mortar or the bond between them

Preparation of materials

Site-made mortars and concrete infill

- Chloride content
- Strength of mortar and concrete infill
- Admixtures and additions
- Gauging
- Mixing method and mixing time
- Workable life of mortars and concrete infill
- Mixing in cold weather

Factory mortars and ready mixed concrete infill

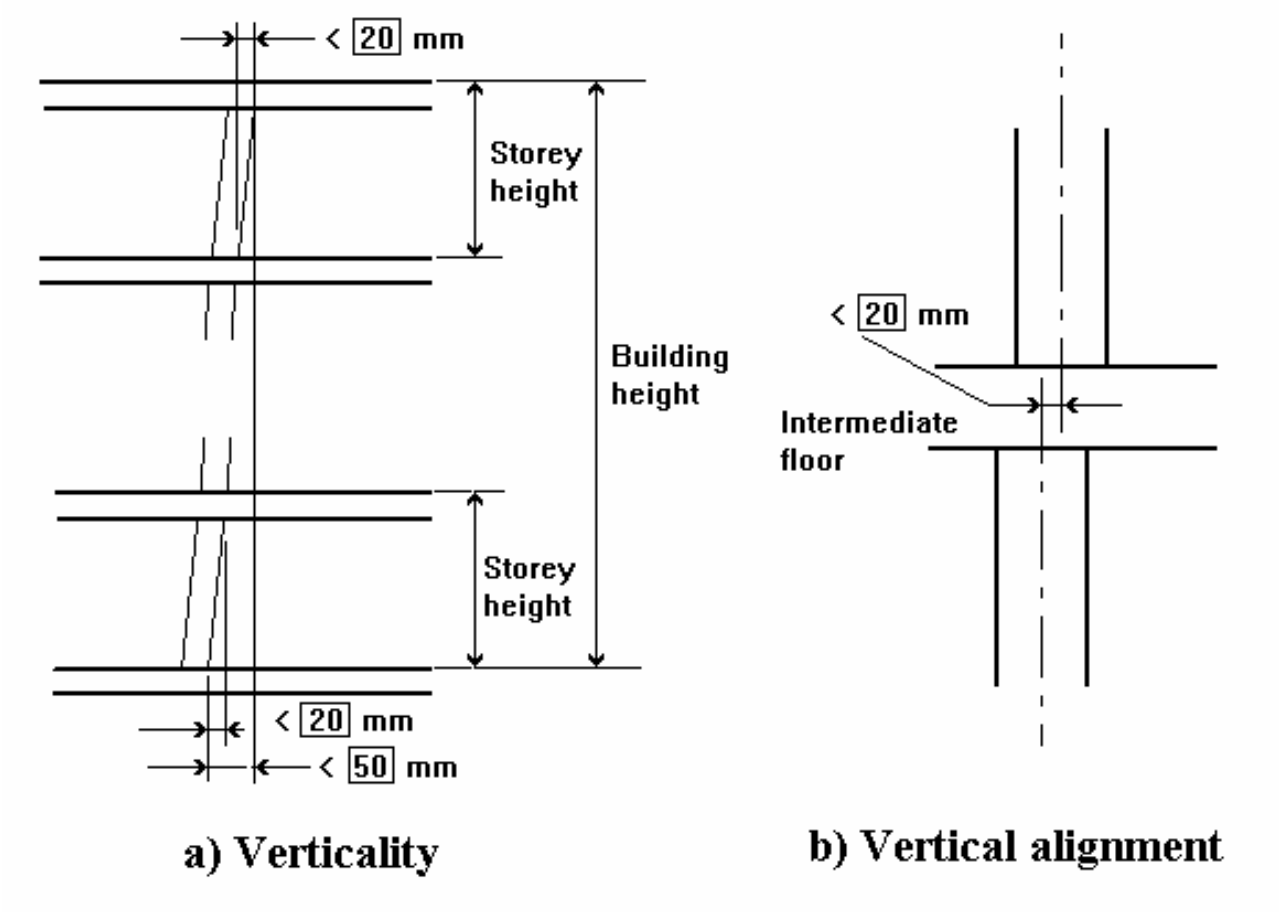
- In accordance with manufacturer’s instructions
- Use before the expiry date

Permissible deviations

Should not exceed the values given in the design specification.

Where values are not given in the design specification for any of the deviations listed in Table 3.1, flatness tolerances or angular tolerances then the corresponding permissible deviations should be the lesser of:

- the values given in Table 3.1, see also Figure 3.1;
- the values in accordance with locally accepted practice.


< 20 mm
Storey height
Building height
Storey height
< 20 mm
< 50 mm
a) Verticality
< 20 mm
Intermediate floor
b) Vertical alignment

Execution of masonry

- Adhesion
- Laying masonry units
- Pointing and jointing
- Movement joints
- Incorporation of damp proof course membranes
- Incorporation of thermal insulation materials
- Cleaning facing masonry

Curing and protective procedures

- Protection against rain
- Protection against freeze/thaw cycling
- Protection against effects of low humidity
- Protection against mechanical damage
- Construction height of masonry

With the correct selection of materials, well designed and executed masonry can last for many years.

It can even be re-used as in this example from the old gas works of Vienna.

Thank you for your attention.