



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

EUROPEAN STANDARD

PRECAST CONCRETE PRODUCTS

HOLLOW CORE SLABS

EN1168

Jan de Wit

Manager R & D Dycore Netherlands, secretary CEN 229, WG1, TG1





**TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER**

**EUROPEAN
STANDARD**

**PRECAST
CONCRETE
PRODUCTS**

**HOLLOW
CORE
SLABS**

EN 1168

TOPICS PRESENTATION

- **History and future**
- **Value**
- **No part of the standard**
- **Highlights of the standard**
- **Annexes**
- **CE marking**



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

History and future

- 1st meeting 1990
- 1st draft prestressed HC standard 1991
- splitting up prestressed and reinforced 1992
- prEN 1168 - 1 for inquiry August 1993
- 1st draft prEN 1168 – 2 August 1993
- prEN 1168 - 2 for inquiry August 1999
- reinforced - prestressed in one standard 2001
- prEN 1168 accepted by CEN 229 TG1 2003

HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – ANNEXES – CE MARKING



History and future

TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

- Formal vote December 2003
- Date of Availability July 2004
- National standard version of hEN announced in MS September 2004
- Publication of National standard version of hEN December 2004
- hEN reference published in OJEC March 2005
- Reference to National standard version of hEN published in MS
- Date of withdrawal of conflicting technical specifications March 2006

Default 9 monts
CE marking
Not available

Default 1 year
CE marking
optional



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Value

- general acceptance HC in member states
- minimum quality level
- minimum values for tolerances
- same basis for calculations
- free marketable between member states



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

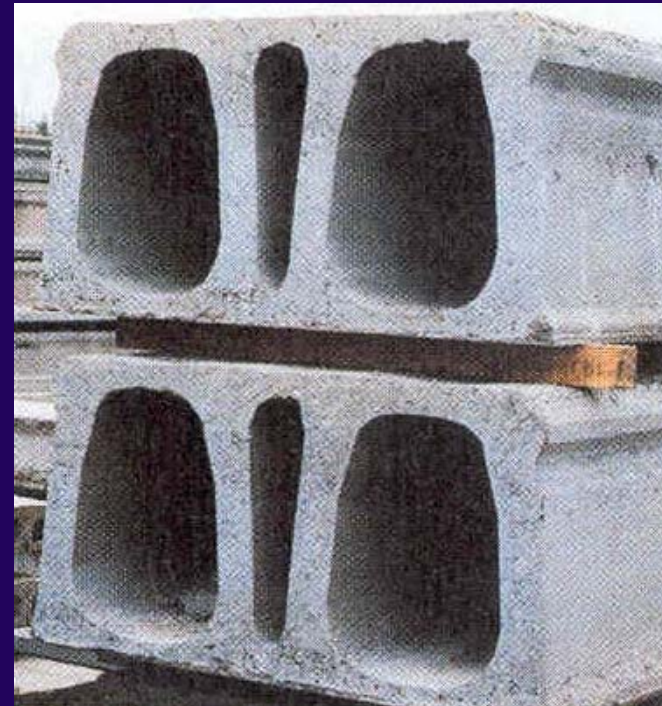
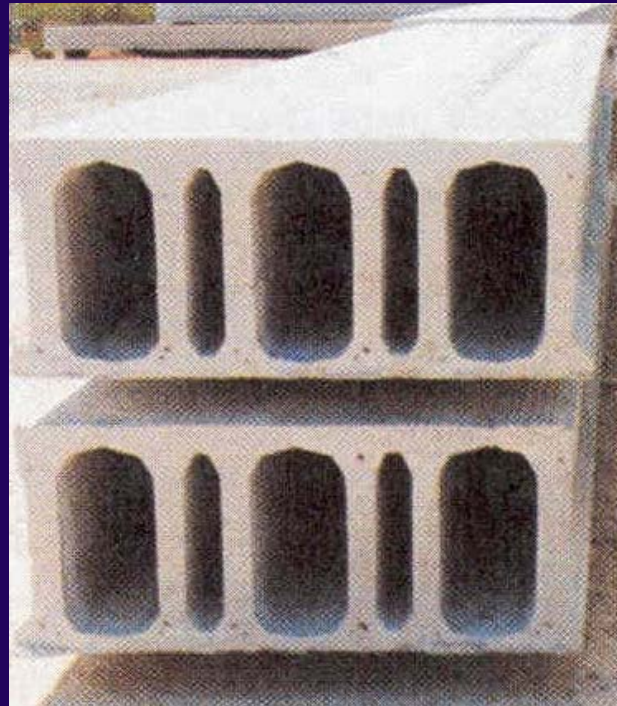
PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

No part of the standard

- prestressed elements with a depth > 450 mm
- reinforced elements with a depth > 300 mm



HISTORY – VALUE – **NONE STANDARD** – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

No part of the standard

- prestressed elements with a depth > 450 mm
- reinforced elements with a depth > 300 mm
- elements wider than 1200 mm and reinforced elements with transverse reinforcement wider than 2400 mm
- light weight concrete
- special use in walls and other applications
- high traffic and fatigue load
- add. provisions for seismic zones in EN 1998-1

HISTORY – VALUE – **NONE STANDARD** – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

- EN 1168 gives requirements, basic performance criteria and minimum values
- for common aspects reference is made to EN 13369 *Common rules for precast products*
- for design rules reference is made to EN 1992-1-1 special design rules for HC are in the standard and the (informative) annexes

HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 4 Requirements
- 5 Test methods
- 6 Evaluation of conformity
- 7 Marking
- 8 Technical documentation
- Annexes

HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 4 Requirements

HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4 Requirements

4.1 Material requirements

4.2 Production requirements

4.3 Finished product requirements



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4 Requirements

4.1 Material requirements

HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.1 Material requirements

4.1.4.1 Maximum diameter of prestressing steel

Max. diameter for wires = \varnothing 11 mm

Max. diameter for strands = \varnothing 16 mm

Prestressing of bars is not allowed





TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4 Requirements

4.1 Material requirements

4.2 Production requirements

4.3 Finished product requirements



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.2 Production requirements

4.2.1 Concrete production

4.2.2 Hardened concrete

4.2.2.1 Strength classes

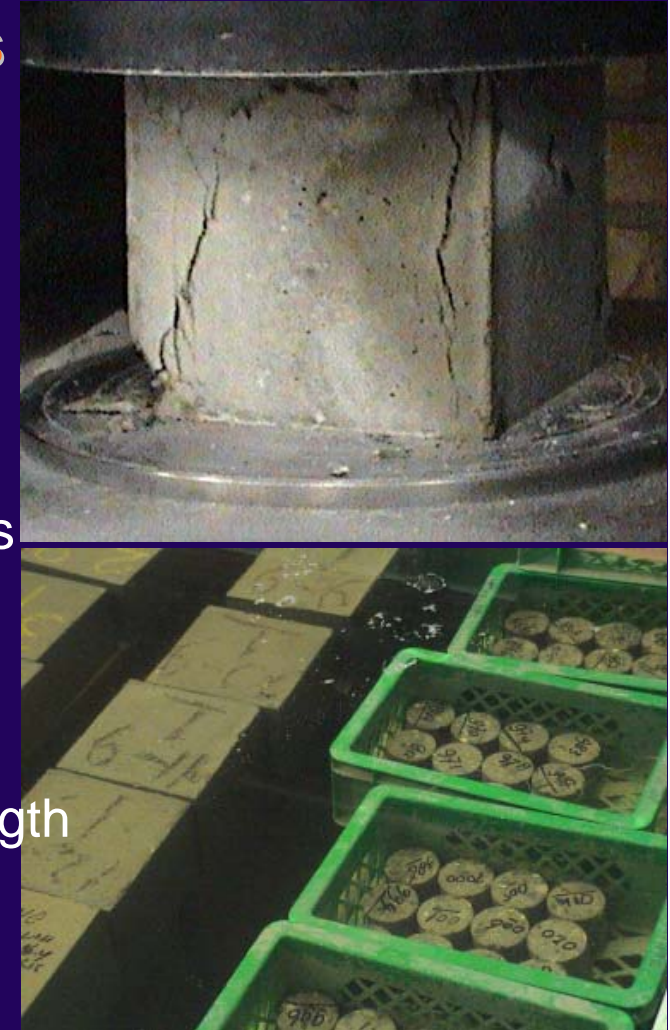
Min. C20/25 for reinforced products

Min. C30/37 for prestressed products

4.2.2.2 Compressive strength

Potential strength

Direct and/or indirect structural strength





TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.2 Production requirements

4.2.3 Structural reinforcement

Distribution of reinforcement

reinforced	prestressed
uniformly distributed	uniformly distributed
max 300 mm distance	min. 4 tendons
min. 1 bar in outermost web	not required in outermost web
nominal clear spacing	
hor. = $(\max.(d_g + 5 \text{ mm}), 20 \text{ mm and } \emptyset) + \text{tolerance}$	
vertical = $\max.(d_g, 10 \text{ mm and } \emptyset) + \text{tolerance}$	



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.2 Production requirements

4.2.3.2.4 Slippage of tendons

Individual tendons $1,3 \cdot L_0$

Mean value per element L_0

$$L_0 = 0,4 \cdot l_{bpd} = \sigma_{pmo} / E_p$$

For $\sigma_{pmo} = 1000 \text{ N/mm}^2$ and $f_{ctm}(t) = 30 \text{ N/mm}^2$

The slippage of an individual tendon $\varnothing 12,5 \text{ mm}$ must be $< 1,3 \text{ mm}$ and for the mean value per element $< 1,0 \text{ mm}$

Following the Dutch code the slippage must be $< 3,1 \text{ mm}$ for an individual tendon and $< 2,5 \text{ mm}$ for the mean value per element



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4 Requirements

4.1 Material requirements

4.2 Production requirements

4.3 Finished product requirements



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

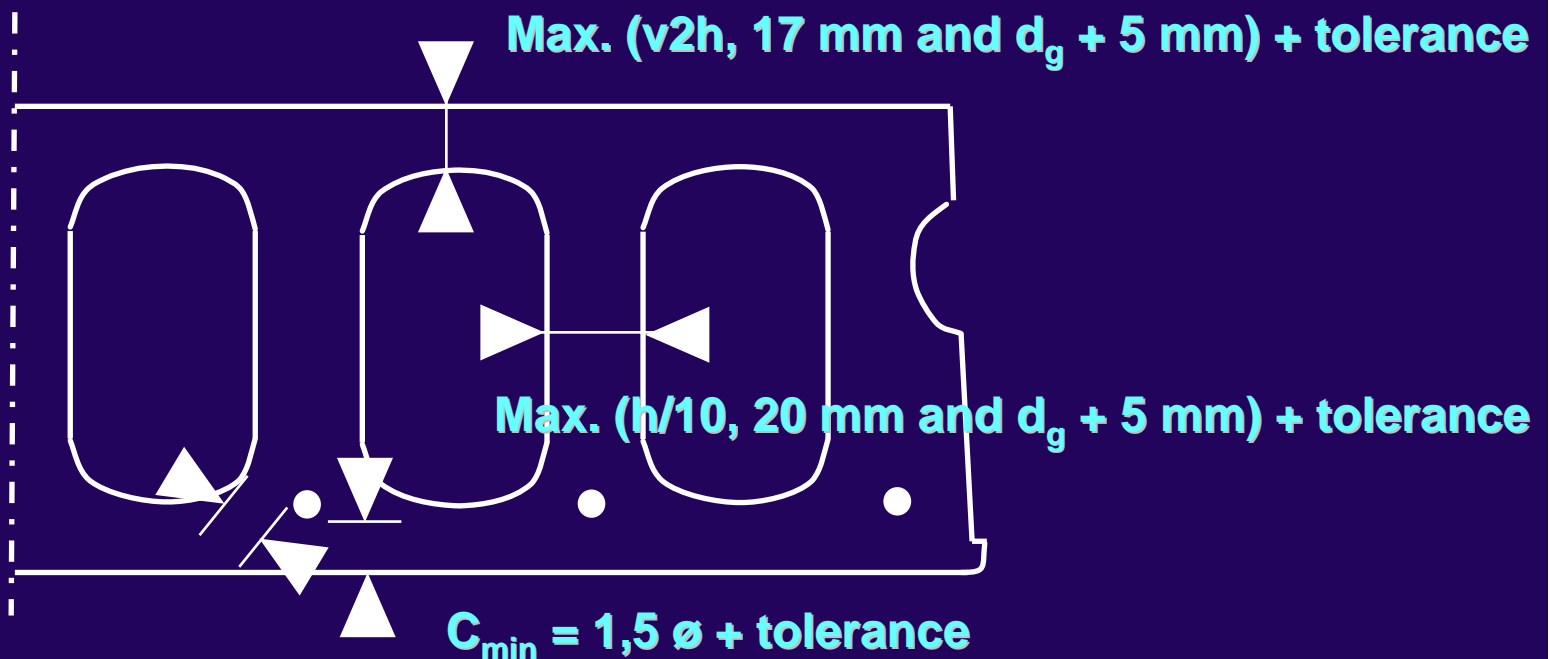
Highlights of the standard

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.1.1 Production tolerances

4.3.1.2 Minimum dimensions = Nominal values + tolerance





TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.2 Surface characteristics

4.3.3 Mechanical resistance



HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.2 Surface characteristics

4.3.3 Mechanical resistance



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3.3 Mechanical resistance

4.3.3.1 General

Note: Actions and safety factors are subject to national regulations or other rules valid in the place of use

Annex L (.... Of EN 13369) gives lower values of partial safety factors for materials by more quality control and stricter tolerances or by using reduced or measured geometrical parameters in the design or by assessment of concrete strength in finished structures or by control of the self weight



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3.3 Mechanical resistance

4.3.3.2 Verification by calculation

4.3.3.2.1 **Splitting** of hollow core slabs

4.3.3.2.2 Shear and torsion capacity



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3.3.2.2 Shear and torsion capacity

4.3.3.2.2.1 General

No control up to $0,5h$ from the edge of the support

By non ridged supports reducing transversal shear stresses has to be taken in account

4.3.3.2.2.2 Shear capacity – Torsion capacity

$$V_{Rdn} = V_{Rd,c} - V_{ETd}$$

4.3.3.2.2.3 Shear capacity of the longitudinal joints

4.3.3.2.2.4 Punching shear capacity

4.3.3.2.2.5 Capacity for concentrated loads

4.3.3.2.2.6 Load capacity of elements supported on 3 edges



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3.3 Mechanical resistance

4.3.3.1 General

4.3.3.2 Verification by calculation

4.3.3.3 Verification by calculation aided by physical testing

4.3.3.4 Verification by testing

4.3.3.5 Safety factors

4.3.3.6 Transient situations





TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.2 Surface characteristics

4.3.3 Mechanical resistance

4.3.4 Resistance and reaction to fire



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.2 Surface characteristics

4.3.3 Mechanical resistance

4.3.4 Resistance and reaction to fire



Highlights of the standard

TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

4.3.4 Resistance and reaction to fire



HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – ANNEXES – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3.4 Resistance and reaction to fire

4.3.4.1 Resistance to fire

Declared in classes to standard or alternatively to parametric fire

4.3.4.2 Classification for standard fire resistance

- By testing
- By tabulated data
- By calculation

4.3.4.3 Verification of resistance to parametric fire

See EN 1991-1-2

4.3.4.4 Reaction to fire

Concrete products without organic materials = Class A



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.2 Surface characteristics

4.3.3 Mechanical resistance

4.3.4 Resistance and reaction to fire

4.3.5 Acoustic properties

4.3.6 Thermal properties

4.3.7 Durability

4.3.8 Other requirements





TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 4 Requirements
- **5 Test methods**



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

5 Test methods

5.1 Tests on concrete

5.1.1 Compressive strength



HISTORY - VALUE - NONE STANDARD - HIGHLIGHTS - ANNEXES - CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

5 Test methods

5.1 Tests on concrete

5.1.1 Compressive strength

5.1.2 Water absorption

In most cases not relevant

5.2 Measuring of dimensions and surface characteristics

5.2.1 Element dimensions

5.2.1.1 Procedure

5.3 Weight of the products



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Highlights of the standard

6 Evaluation of conformity

6.1 General

6.1.1 Demonstration of compliance

6.1.2 Assessment of compliance

6.1.3 Acceptance testing

6.2 Type testing

6.3 Factory production control

The factory production control is okay if it is on basis of a quality systems according EN ISO 9001 and the requirements of EN 1168





TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Annexes

- **A(N)** Inspection schemes
- **B(I)** Typical shapes of joints
- **C(I)** Transverse load distribution
- **D(I)** Diaphragm action
- **E(I)** Unintended restraining effects and neg. moments
- **F(I)** Shear capacity of composite members
- **G(I)** Resistance to fire
- **H(I)** Design of connections
- **J(N)** Full scale test
- **K(I)** Prestressing losses
- **L(I)** Reliability considerations

HISTORY – VALUE – NONE STANDARD – HIGHLIGHTS – **ANNEXES** – CE MARKING



TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

Annexes

- **M(I)** Tables of thermal conductivity of concrete
- **N(I)** Measurement dimensions
- **O(I)** Resistance to fire: recommendations for EN 1992-1-2
- **P(I)** Assessment of compliance by a third party
- **R(I)** Technical documentation
- **ZA(I)** Addressing essential requirements of EU Directives
- **Y(I)** Choice of CE marking method



CE
TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER

EUROPEAN
STANDARD

PRECAST
CONCRETE
PRODUCTS

HOLLOW
CORE
SLABS

EN 1168

CE Marking

The manufacturer is responsible for affixing the
CE marking



HISTORY - VALUE - NONE STANDARD - HIGHLIGHTS - ANNEXES - CE MARKING



End of the presentation

**TECHNICAL
SEMINAR
LEUVEN
25 & 26
SEPTEMBER**

**EUROPEAN
STANDARD**

**PRECAST
CONCRETE
PRODUCTS**

**HOLLOW
CORE
SLABS**



EN 1168

HISTORY - VALUE - NONE STANDARD - HIGHLIGHTS - ANNEXES - CE MARKING - ?