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NORMA EUROPEA

Prodotti prefabbricati di calcestruzzo
Lastre per solai

UNI EN 13747

GENNAIO 2009

Precast concrete products
Floor plates for floor systems

La norma specifica i requisiti, i criteri prestazionali di base e i metodi di valutazione della conformità delle lastre per solai realizzate con calcestruzzo armato o precompresso.
La norma fornisce inoltre i criteri per la marcatura CE dei prodotti.

TESTO INGLESE

La presente norma è la versione ufficiale in lingua inglese della norma europea EN 13747:2005+A1 (edizione ottobre 2008).

La presente norma sostituisce la UNI EN 13747:2005.

ICS 91.100.30

UNI
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PREMESSA NAZIONALE

La presente norma costituisce il recepimento, in lingua inglese, della norma europea EN 13747:2005+A1 (edizione ottobre 2008), che assume così lo status di norma nazionale italiana.

La presente norma è stata elaborata sotto la competenza della Commissione Tecnica UNI
Ingegneria strutturale

La presente norma è stata ratificata dal Presidente dell'UNI ed è entrata a far parte del corpo normativo nazionale il 28 gennaio 2009.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13747:2005+A1

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English Version

Precast concrete products - Floor plates for floor systems

Produits préfabriqués en béton - Prédalles pour systèmes de planchers

Betonfertigteile - Deckenplatten mit Ortbetonergänzung

This European Standard was approved by CEN on 17 February 2005 and includes Corrigendum 1 issued by CEN on 6 December 2006 and Amendment 1 approved by CEN 14 September 2008.

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Foreword

This document (EN 13747:2005+A1:2008) has been prepared by Technical Committee CEN/TC 229 "Precast concrete products", the secretariat of which is held by AFNOR, and was examined by and agreed with a joint working party appointed by the Liaison Group CEN/TC 229-CEN/TC 250, particularly for its compatibility with structural Eurocodes.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2009, and conflicting national standards shall be withdrawn at the latest by April 2009.

This document includes Amendment 1, approved by CEN on 2008-09-14 and Corrigendum 1 issued by CEN on 2006-12-06.

This document supersedes EN 13747:2005.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

The modifications of the related CEN Corrigendum have been implemented at the appropriate places in the text and are indicated by the tags AC AC.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 89/106/EEC.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This standard is one of a series of product standards for precast concrete products.

For common aspects reference is made to EN 13369: *Common rules for precast products*, from which also the relevant requirements of the EN 206-1: *Concrete — Part 1: Specification, performances, production and conformity* are taken.

The references to EN 13369 by CEN/TC 229 product standards are intended to make them homogeneous and to avoid repetitions of similar requirements.

Eurocodes are taken as a common reference for design aspects. The installation of some structural precast concrete products is dealt with by ENV 13670-1: *Execution of concrete structures — Part 1: Common rules*, which has at the moment the status of a European prestandard. In all countries it can be accompanied by alternatives for national application and it shall not be treated as a European standard.

The programme of standards for structural precast concrete products comprises the following standards, in some cases consisting on several parts:

— EN 1168, *Precast concrete products — Hollow core slabs*

— EN 12794, *Precast concrete products — Foundation piles*

— EN 12843, *Precast concrete products — Masts and poles*

— EN 13747, *Precast concrete products — Floor plates for floor systems*

- AC prEN 15037, *Precast concrete products — Beam-and-block floor systems* AC
- EN 13224, *Precast concrete products — Ribbed floor elements*
- EN 13225, *Precast concrete products — Linear structural elements*
- EN 14992, *Precast concrete products — Wall elements*
- EN 13693, *Precast concrete products — Special roof elements*
- EN 14844, *Precast concrete products — Box culverts*
- EN 13978, *Precast concrete products — Precast concrete garages*
- EN 14991, *Precast concrete products — Foundation elements*
- EN 15050, *Precast concrete products — Bridge elements*
- EN 14843, *Precast concrete products — Stairs*

This standard defines in Annex ZA the application methods of CE marking to products designed using the relevant EN Eurocodes (EN 1992-1-1:2004 and EN 1992-1-2:2004). Where, in default of applicability conditions of EN Eurocodes to the works of destination, design Provisions other than EN Eurocodes are used for mechanical strength and/or fire resistance, the conditions to affix CE marking to the product are described in ZA.3.4.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

The evaluation of conformity given in this standard refers to the completed precast elements which are supplied to the market and covers all the production operations carried out in the factory.

For design rules reference is made to EN 1992-1-1:2004. Additional complementary rules are provided where necessary.

In clauses 4.3.3 and 4.3.4, the present standard includes specific provisions resulting from the application of EN 1992-1-1:2004 and EN 1992-1-2:2004 rules made specific for the concerned product. The use of these provisions is consistent with a design of works made with EN 1992-1-1:2004 and EN 1992-1-2:2004.

1 Scope

This European standard deals with the requirements, the basic performance criteria and evaluation of conformity for precast floor plates made of reinforced or prestressed normal weight concrete according to EN 1992-1-1:2004, used in conjunction with cast-in-situ concrete (topping) for the construction of composite floor slabs. Annex B gives different types of composite slabs made with floor plates.

These floor plates, with or without void formers, can include lattice girders or stiffening ribs incorporated during the precasting.

They shall be manufactured in factories by casting, slip forming or extrusion.

The products covered by this standard are intended to be used as part of structural floors in applications such as:

— floors and roofs of buildings (including industrial and storage buildings, public buildings as schools, hospitals, etc.);

— parking/circulation areas;

— cover for culverts;

— etc.

The products may be used in seismic areas provided they fulfil the requirements specific to this use.

This standard does not cover:

— reinforced [A1⟩ and prestressed ⟨A1] floor plates with a nominal thickness less than 40 mm;

— prestressed floor plates with a nominal thickness less than 50 mm [A1⟩ without stiffening ribs or lattice girder ⟨A1];

— floor plates with a very smooth upper face, such as defined in 6.2.5 of EN 1992-1-1:2004.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13369:2004, *Common rules for precast concrete products*.

[AC⟩ EN 10080:2005 ⟨AC], *Steel for the reinforcement of concrete — Weldable reinforcing steel — General*.

EN 12390-4, *Testing hardened concrete — Part 4: Compressive strength — Specification for testing machines*.

EN 12390-6, *Testing hardened concrete — Part 6: Tensile splitting strength of test specimens.*

EN 1991-1-1:2002, *Eurocode 1: Actions on structures — Part 1-1: General actions — Densities, self-weight, imposed loads for buildings*.

EN 1992-1-1:2004, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*.

EN 1992-1-2:2004, *Eurocode 2: Design of concrete structures — Part 1-2: General rules — Structural fire design*.

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply. For general terms EN 13369:2004 shall apply.

3.1 Floor plates

3.1.1
floor plate
generally reinforced or prestressed concrete plates are used as permanent formwork for cast-in-situ concrete, which, when hardened, forms a structurally composite slab with the floor plate

NOTE Some floor plates may be used as formwork for cast-in-situ concrete, with no contribution to the strength of the finished floor.

3.1.2
reinforced floor plate
floor plate in which reinforcing steel constitutes the main reinforcement of the composite slab

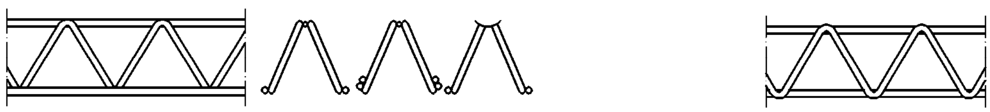
3.1.3
prestressed floor plate
floor plate in which the prestressing steel constitutes all or part of the main reinforcement of the composite slab

3.1.4
floor plate with lattice girders
floor plate in which continuous lattice girders are incorporated generally in the longitudinal direction (i.e. parallel to the span) to provide strength and rigidity for transient situations

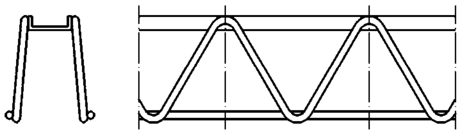
3.1.5
floor plate with ribs
floor plate in which continuous stiffening ribs are positioned generally in the longitudinal direction (i.e. parallel to the span) to provide strength and rigidity for transient situations

3.2
lattice girders
two dimensional or three dimensional metallic structure comprising an upper chord, one or more lower chords and continuous or discontinuous diagonals which are welded or mechanically connected to the chords

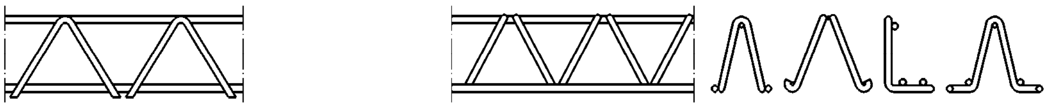
Figure 1 gives some examples of lattice girders.



a) continuous diagonals



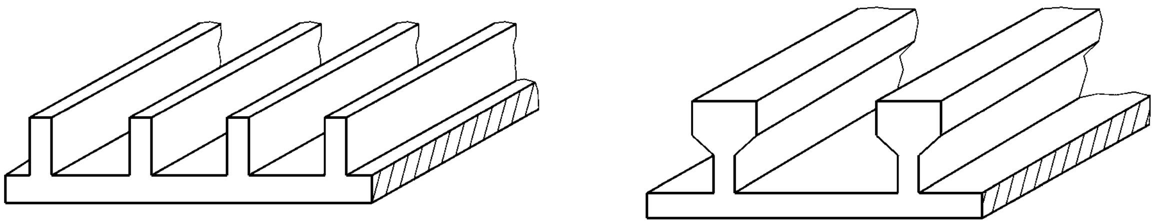
b) continuous diagonals with steel profile unfilled with concrete



c) discontinuous diagonals

Figure 1 — Examples of lattice girders

3.3
stiffening rib
continuous concrete profile formed on the upper surface of the floor plate during the precasting operation. It extends generally in the main direction of the floor plate. Figure 2 gives examples of different stiffening rib configurations



a) rectangular ribs b) T-section ribs

Figure 2 — Examples of stiffening ribs

3.4 Dimensions

3.4.1
length, L
dimension of the product in the main mechanical direction (i.e. supporting the most important bending moment)

3.4.2
width, b
dimension perpendicular to the length

3.4.3
thickness, h_p
nominal distance between the upper and the lower faces of the floor plate. Where the upper surface is uneven (see Figure 3) the distance should be measured to the mean plane of the surface

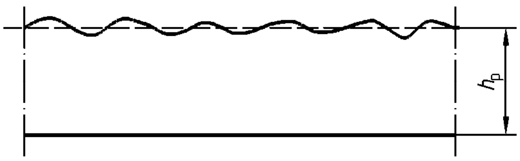


Figure 3 — Thickness h_p of a floor plate

3.4.4
edge
side of the floor plate. A distinction is made between:

— supported edge: edge intended for connection to the support elements of the structure;

— lateral edge: edge between contiguous floor plates;

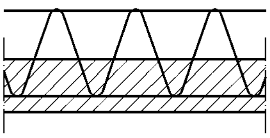
— free edge: edge left free after construction of the floor

3.4.5
upper face
face of the floor plate when in its final position of use. It forms the interface with cast-in-situ topping above the floor plate

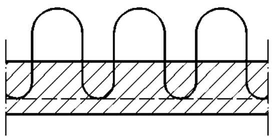
3.4.6
lower face
visible face of the precast element in opposition to the upper face

3.5 Reinforcements

3.5.1
connecting reinforcement
reinforcement anchored on both sides of the interface between the floor plate and the cast-in-situ concrete. It consists of the diagonals of the lattice girder, individual or continuous reinforcement in the form of loops, possibly with a longitudinal bar welded at the top and/or bottom (see Figure 4).



a) lattice girder



b) loops

Figure 4 — Examples of connecting reinforcement

3.5.2
shear reinforcement
reinforcement with angles, α and β, generally between 45° and 90° to the plane of the floor plate and the cast-in-situ concrete. In practice it consists of pieces of lattice girders, loops or stirrups (see Figure 5)

a) lattice girder b) loops

Figure 5 — Examples of shear reinforcements

3.6 Void formers

3.6.1
void former
element glued, connected or otherwise incorporated into the floor plate during or after precasting (see Figure 6), but before delivery. These elements are generally intended to decrease the weight of the floor

a) glued or connected b) incorporated

Figure 6 — Void formers

3.6.2
non-structural void former
void former that does not contribute to the mechanical strength of the composite slab

3.6.3
structural void former
void former that, together with the cast-in-situ concrete, contributes to the mechanical strength of the composite slab

3.7
cast in unit
unit incorporated into the floor plate during precasting, e.g. lifting inserts, junction or switch boxes, conduits, ducts, etc.

3.8
topping
in-situ concrete layer cast over the entire floor plate surface, so that it acts monolithically by bond, with or without connecting reinforcement

3.9
composite slab
slab comprising a floor plate and bonded topping, which together behave as a monolithic slab after the hardening of the topping

4 Requirements

4.1 Material requirements

4.1.1 General

Clause 4.1.1 of EN 13369:2004 shall apply.

4.1.2 Constituent materials of concrete

Clause 4.1.2 of EN 13369:2004 shall apply.

4.1.3 Reinforcing steel

4.1.3.1 Bars, coils and welded fabric

Clause 4.1.3 of EN 13369:2004 shall apply.

4.1.3.2 Lattice girders

Bars and coils used in production of lattice girder shall comply with EN 10080.

The weld strength or the mechanical strength of joints of lattice girder shall match the anchorage requirements in the concrete.

4.1.3.3 Connecting reinforcement

Connecting reinforcement, other than lattice girder, shall be ribbed, indented or smooth steel complying with their relevant standards. Where its suitability can be proven prestressing wires and strands may also be used.

When a welded longitudinal bar is present the steel of connecting reinforcement shall be weldable.

The weld strength or the mechanical strength of joints of connecting reinforcement shall match the anchorage requirements in the concrete.

4.1.4 Prestressing steel

Clause 4.1.4 of EN 13369:2004 shall apply.

For prestressing steel, the nominal diameter shall be less than or equal to 13 mm. Only indented wire or strands made of several smooth or indented wires shall be used.

4.1.5 Inserts and connectors

Clause 4.1.5 of EN 13369:2004 shall apply.

4.2 Production requirements

4.2.1 Concrete production

Clause 4.2.1 of EN 13369:2004 shall apply.

4.2.2 Hardened concrete

4.2.2.1 Strength classes

Clause 4.2.2.1 of EN 13369:2004 shall apply.

4.2.2.2 Compressive strength

Clause 4.2.2.2 of EN 13369:2004 shall apply. In addition, the minimum concrete compressive strength at delivery shall be specified.

The concrete class shall not be less than C25/30 for reinforced floor plates and C30/37 for prestressed floor plates.

The minimum concrete strength at delivery shall not be less than 15 MPa for reinforced floor plates and 20 MPa for prestressed floor plates.

4.2.2.3 Tensile strength

When a characteristic value or a minimum value for the concrete tensile strength is referred to, it shall be expressed as axial tensile strength. It should be determined by testing (for example by converting values obtained according to EN 12390-6 or deduced from the compressive strength at the same age by applying 3.1.2 of EN 1992-1-1:2004).

4.2.3 Structural reinforcement

4.2.3.1 Processing of reinforcing steel

Clause 4.2.3.1 of EN 13369:2004 shall apply.

4.2.3.2 Tensioning and prestressing

4.2.3.2.1 Initial tensioning stresses

Clause 4.2.3.2.1 of EN 13369:2004 shall apply.

4.2.3.2.2 Accuracy of tensioning

Clause 4.2.3.2.2 of EN 13369:2004 shall apply.

4.2.3.2.3 Minimum concrete strength at transfer

At the time of transfer of prestressing, the minimum compressive strength, $f_{cmin,p}$, measured on cylinder specimens shall be at least (5/3) σ_{cp} where σ_{cp} is the compressive stress developed in the bottom fibre of the floor plate under the final prestressing force, or 20 MPa, whichever is the greater.

Minimum concrete strength at transfer shall be verified in accordance with 5.1.

4.2.3.2.4 Slippage of tendons

For sawn products, Clause 4.2.3.2.4 of EN 13369:2004 shall apply.

For protruding tendons, 2 classes are given:

— class A: the maximum slippage values are evaluated according to 4.2.3.2.4 of EN 13369:2004;

— class B: the maximum slippage values are deduced from Table 1. If the initial prestressing force, σ_0, is lower than the maximum prestressing force, σ_{0max}, as defined in 4.2.3.2.1 of EN 13369:2004, the values of Table 1 shall be reduced by σ_0/σ_{0max} ratio.

Table 1 — Maximum slippage values for prestressing tendons, ΔL_o, in mm

Wires			Strands		
diameter	$f_{cmin,p}$ = 20 MPa	$f_{cmin,p}$ = 30 MPa	**diameter**	$f_{cmin,p}$ = 20 MPa	$f_{cmin,p}$ = 30 MPa
∅ 4	2,0	2,0	∅ 5,2	2,5	2,5
∅ 5	2,2	2,0	∅ 6,85	2,8	2,5
∅ 6	2,4	2,0	∅ 9,3	3,0	2,5
∅ 7	2,6	2,3	∅ 12,5	3,5	3,0

NOTE “Good” bond conditions may be assumed for extruded, slipformed and cast elements on conditions given in Figure 8.2 of EN 1992-1-1:2004.

Slippage of tendons shall be verified in accordance with 5.4.2.

4.2.3.2.5 Limit values for prestressing force

The value of the prestressing force shall be limited by the following two conditions:

a) Minimum prestress

The mean value of compressive stress, $\sigma_{p,m}$, in the concrete cross section of the floor plate as a result of the only action of the final prestressing force shall not be less than 1,5 MPa.

b) Maximum prestress

In the absence of reinforcement in upper part of the floor plate, the maximum tensile stress in the upper fibre of the floor plate shall be limited to $0,30 f_{cmin,p}^{2/3}$.

NOTE $f_{cmin,p}$ is the strength of the concrete at the time of prestressing.

The maximum compressive stress in the lower part of the floor plate shall not exceed $0,66 f_{cmin,p}$.

4.2.3.2.6 Losses of prestress

The final prestressing force, $P_{m,\infty}$, is equal to the initial prestressing force, P_o, less the total losses ΔP after an infinite time.

For the determination of prestressing losses, in the absence of more accurate calculation, the values should be deduced from Table 2.

Table 2 — Final losses of prestress

Initial stress in the tendons (σ_{0max})	Final losses at infinite time in percentage of initial prestress force ($\Delta P/P_0$ %)
min ($0,85 f_{pk}$; $0,95 f_{p0,1k}$)	22 %
$0,80 f_{pk}$	21 %
$0,75 f_{pk}$	20 %
$0,70 f_{pk}$	19 %
$0,65 f_{pk}$	17 %

4.2.4 Positioning of reinforcement

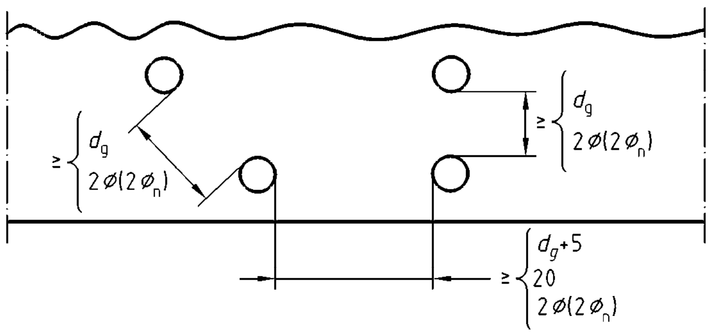
4.2.4.1 Common requirements for positioning of reinforcement

Reinforcement transverse to the main reinforcement is not required in floor plates with width equal to or less than 1,2 m when the transverse moment need not to be considered.

4.2.4.1.1 Correct concreting and compaction of the concrete

Unless it can be justified otherwise, the nominal clear distance between bars constituting the main reinforcement shall be at least equal to those as shown in Figure 7.

Dimensions in millimetres



Key

d_g = maximum aggregate size

Ø = diameter of the bar

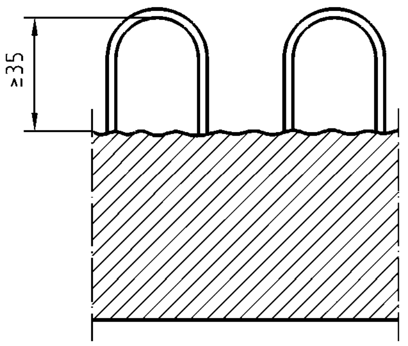
NOTE For definition of $\varnothing_n$ see 8.9.1 of EN 1992-1-1:2004.

Figure 7 — Minimum distances for good concreting and compaction

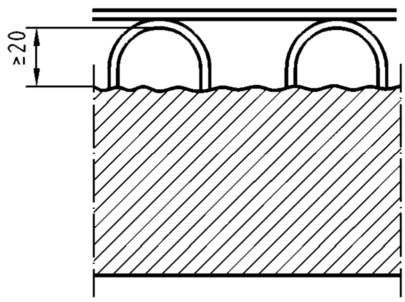
In order to ensure adequate compaction of the topping around connecting reinforcement, the free distance between the upper surface of the floor plate and the underside of loops or stirrups shall not be less than 35 mm. If there is a longitudinal bar welded to the top of the loops or stirrups, this distance may be reduced to 20 mm (see Figure 8).

Dimensions in millimetres

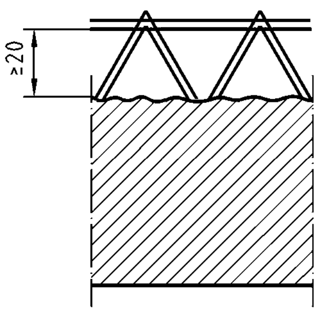
[AC>



a) loops without longitudinal bar



b) loops with longitudinal bar



c) lattice girder with welded longitudinal bar <AC]

Figure 8 — Protruding connecting reinforcement

4.2.4.1.2 Positioning of connecting reinforcement in the floor plate

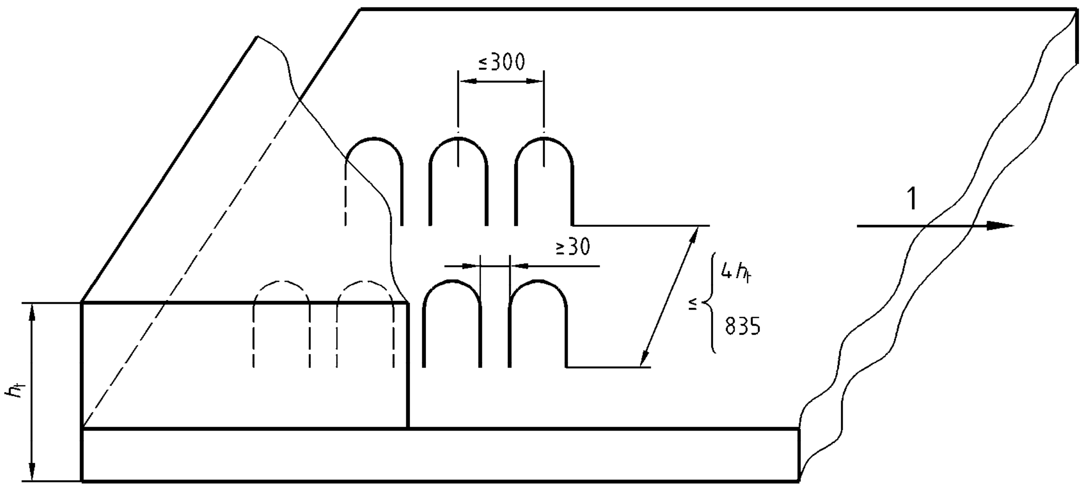
When the connecting reinforcement is made of continuous loops, the nominal distance between two adjacent reinforcement lines shall be no greater than 4 h_t or 835 mm whichever is the lesser (see Figure 9).

The distance between vertical legs of a same loop or of two adjacent loops shall be as follows:

— between the centre axes of two adjacent loops ≤ 300 mm;

— between the adjacent legs of two loops ≥ 30 mm.

Dimensions in millimetres



Key

1 shear force direction

Figure 9 — Spacing of connecting reinforcement

4.2.4.1.3 Connection with the supporting structure

Some typical construction details are indicated in Annex E.

4.2.4.1.4 Connection between adjacent floor plates

Connection details shall be given in project specifications.

Examples of reinforcement details between adjacent floor plates are shown in Annex F.

4.2.4.2 Particular requirements for positioning of lattice girders

The positioning of lattice girders shall comply with the following requirements:

4.2.4.2.1 Distance between lattice girders

The nominal distance between axis of lattice girders shall be such that (see Figure 10):

a ≤ [835 or (15 h_p + 125)] mm whichever is the lesser

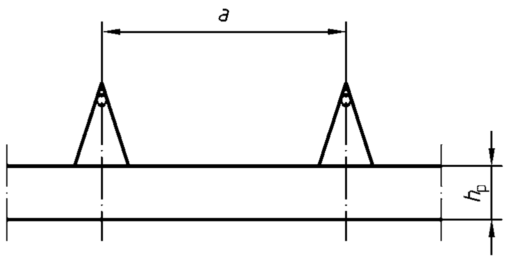


Figure 10 — Distance between axis of lattice girders

4.2.4.2.2 Distance between the outer lattice girder and the nearest edge of the floor plate

The nominal distance between the centreline of the edge lattice girder and the nearest edge of the floor plate shall be such that (see Figure 11):

$a_2 \leq 0{,}5$ [835 or ($15\ h_p + 125$)] mm whichever is the lesser

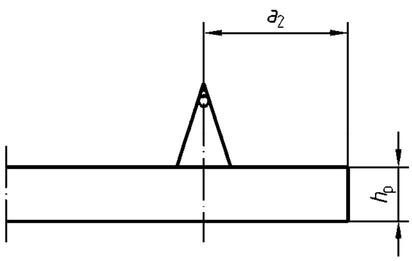


Figure 11 — Distance between the axis of the outer lattice girder and the nearest edge

4.2.4.2.3 Specific case of reinforced floor plate with a single lattice girder

The nominal width of a reinforced floor plate with a single lattice girder shall be such that (see Figure 12):

$b \leq 0{,}75\ (15\ h_p + 125)$ mm or $b \leq 630$ mm whichever is the lesser

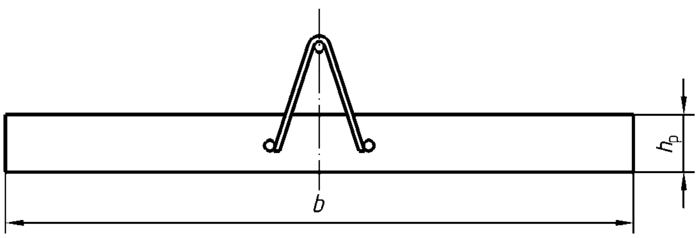


Figure 12 — Case of a floor plate with a single lattice girder

4.2.4.2.4 Minimum embedment of the lower chord into the floor plate

The minimum actual embedment of the lower chord of the lattice girder into the floor plate shall be not less than 10 mm (see Figure 13).

Dimensions in millimetres

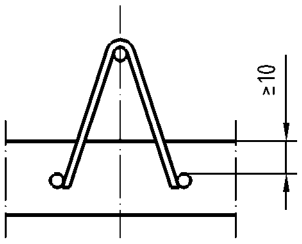


Figure 13 — Minimum embedment of lower chord of the lattice girder into the floor plate

4.2.4.2.5 Longitudinal positioning of lattice girder

The nominal distance, l_g, from the lower joint of the first diagonal to the nearest edge of the floor plate shall not be greater than 250 mm if this element should be a reinforced plate with lattice girder (see Figure 14).

NOTE Short lattice girders which do not fit this requirement should be added (e.g. as bond reinforcement).

Dimensions in millimetres

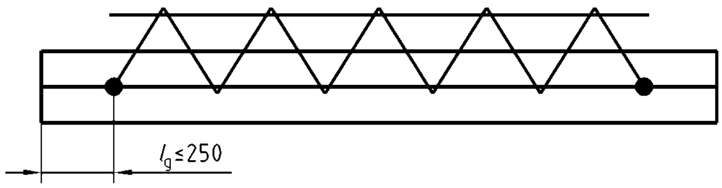


Figure 14 — Longitudinal positioning of lattice girders

4.2.4.3 Particular requirements for positioning of prestressing tendons

4.2.4.3.1 Positioning of prestressing tendons in the floor plates without ribs

The pretensioned tendons shall be located on one or more layers according to the thickness of the floor plate.

When the floor plate thickness is less than 60 mm the prestressing tendons should be located on one layer, situated close to the middle plane of the floor plate in order to avoid tensile stress in the concrete.

In the absence of specific calculation or tests, the following requirements shall be complied with:

a) the number of prestressing tendons shall be restricted to 30 tendons per layer and per meter;

b) the prestressing tendons shall be distributed evenly in each layer;

c) in every floor plate at least two prestressing tendons shall be provided;

d) the nominal clear spacing l_i, between individual prestressing tendons shall comply with the two following conditions (see Figure 15):

  — maximum clear spacing $l_{i, max}$ = 300 mm;

  — minimum clear spacing $l_{i, min}$ = 5∅ if ∅ ≤ 7,0 mm or 7∅ if ∅ > 7,0 mm;

— for groups of tendons, the nominal clear spacing between tendons shall be at least:

  — horizontally: (d_g + 5 mm), 20 mm or ∅, whichever is the largest;

  — vertically: d_g, 10 mm or ∅ whichever is the largest.

e) the nominal distance l_e, between the outer tendon edge and the nearest longitudinal edge of the floor plate shall be not lesser than 3 ∅ and not greater than 150 mm.

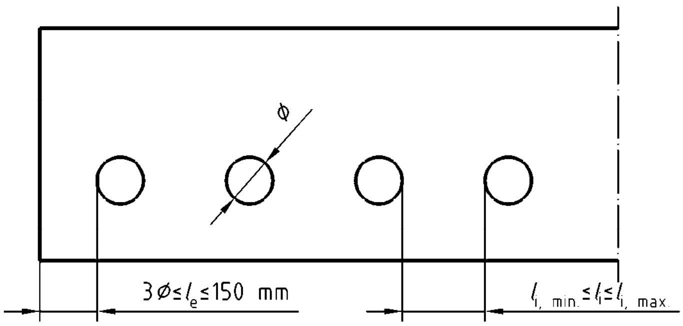


Figure 15 — Positioning of prestressing tendons in floor plate without ribs

4.2.4.3.2 Positioning of prestressing tendons in ribs

When prestressing tendons are located in ribs and in the absence of specific justifications, the nominal concrete cover, *c*, defined as the distance of the prestressing tendon to the nearest edge of the rib shall comply with (see Figure 16):

c ≥ (3 ∅ or 15 mm) whichever is the greater

where ∅ is the greatest nominal diameter of tendons.

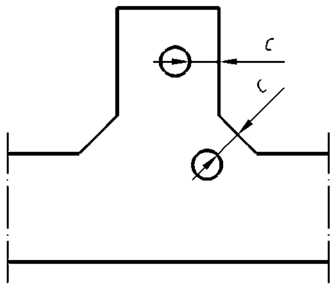


Figure 16 — Positioning of prestressing tendons in ribs

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.1.1 Production tolerances

4.3.1.1.1 Dimensional tolerances

The maximum deviations, measured in accordance with 5.2, on the specified nominal dimensions shall satisfy the following requirements:

a) ± 20 mm for the nominal length;

b) (+ 5, – 10) mm for the nominal width;

NOTE 1 These values should apply to floor plates of standard width. In the other cases, different tolerances may be defined.

c) (+ 10, – X) mm for the nominal average thickness with X =Min(h_p/10 ; 10 mm) ≥ 5 mm (greater tolerances as + 15, –10) mm may be accepted locally however);

d) ± (5 + L_e/1000) mm for straightness of edges of the floor plate where L_e is the nominal length of a edge of the floor plate;

e) 1 mm with the straightedge of 20 cm length and 3 mm with the straightedge of 1,0 meter length on the flatness of the moulded surface;

f) ± 30 mm for the position and the dimensions of cut outs and notches;

g) ± 50 mm in the longitudinal direction and ± b_w/10 in the transversal direction for the position of incorporated units and void formers, where b_w is the nominal width of a stiffening or a cast-in-situ rib between void formers (generally at the weakest level);

h) (+ 10, -X) mm for the eight h_r of the ribs with X= Min (h_r/10 ; 10 mm) ≥ 5 mm.

NOTE 2 Reduced tolerance values, in place of those given above, should be declared by the manufacturer.

4.3.1.1.2 Tolerances in the positioning of reinforcement

The tolerances on the positioning of reinforcement shall be specified on the basis of analysis of quality control results. The tolerances given by the manufacturer shall under no circumstances be higher than the values given below:

- ± 5 mm vertically on individual values for passive longitudinal reinforcement;
- ± 5 mm on the vertical position of each strand or wire;
- ± 3 mm on the centre of gravity of strands or wires, taken on one meter of width of floor plate;
- + 50 mm on the distance from the first diagonal/lower chord joint to the edge of the floor plate;
- ± 10 mm on the vertical positioning for connecting and shear reinforcements.

4.3.1.2 Minimum dimensions

Clause 4.3.1.2 of EN 13369:2004 shall apply.

For stiffening ribs and void formers, Annex C may be used.

4.3.2 Surface characteristics

4.3.2.1 Edges

The edges of the floor plate shall be free of any excess concrete that could be detrimental to the positioning of adjacent floor plates.

4.3.2.2 Upper surface

Requirements given in 6.2.5 of EN 1992-1-1:2004 shall apply.

The upper surface of the floor plates shall be clean and free of any soiling that could be detrimental to the bonding.

4.3.3 Mechanical resistance

Complementary to 4.3.3 of EN 13369:2004, 4.3.3.6 of this standard shall apply.

4.3.3.6 Transient situations

The transient situations covered by this sub-clause relates to storage, handling, transport and installation.

The strength and properties of the concrete floor plate to be considered in transient situations are those specified by the manufacturer at the time of delivery.

Main and secondary transverse reinforcements provided in the floor plate shall be capable to withstand the loadings expected for the transient situations.

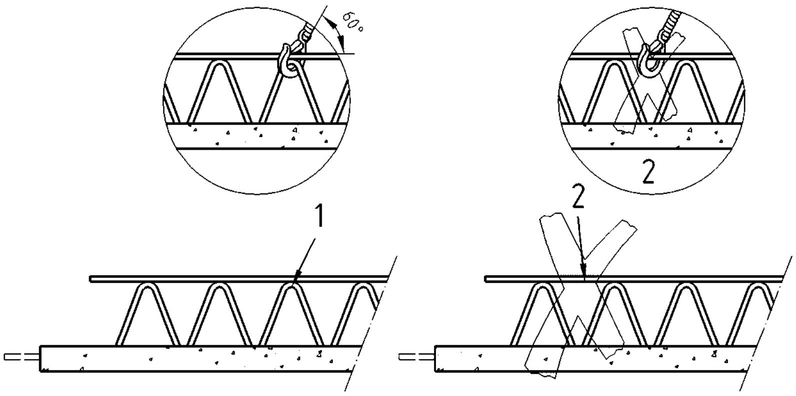
4.3.3.6.1 Storage and transportation

The methods of storage and transportation, and the position of bearing points shall be indicated on documentation provided.

4.3.3.6.2 Handling

When the floor plates are handled using lattice girders, as shown in Figure 17, the anchorage of lattice girders in the concrete shall be verified, taking into account the guarantee strength of the welds and the distribution of lattice girders on the floor plate.

AC›



‹AC

Key

1 minimum 3 nodes

2 prohibited

Figure 17 — Handling with lattice girders

4.3.3.6.3 Conditions for use

Floor plates shall be installed in accordance with technical specification.

Floor plates shall be erected with provisional supports (props) at intermediate and/or edge positions if required by technical specification.

The effective support lengths, the distances between the bearing supports and between the props, the actions on the props together with the loads taken into account in determining them, shall be specified.

The erection spans shall be determined by calculation or by means of type tests, examples of which are given in Annex J. If not calculated according to 4.3.3 of EN 13369:2004 the design method shall initially be validated by tests.

NOTE 1 When the spans are determined by calculation, the assumptions of loading as well as the limitations of deformation may be taken from J.2.

When the spans between temporary supports are determined by calculation, the tensile stress in the concrete should not exceed 1,4 $f_{ctmin,j}$.

NOTE 2 The value of $f_{ctmin,j}$ should be taken equal to 0,30 $f_{cmin,j}^{2/3}$ where $f_{ctmin,j}$ and f_{cmin} are respectively the minimum tensile strength and the minimum compressive strength of concrete at the time of erection of the unit.

In the case of floor plates without lattice girders nor ribs, the nominal thickness of which is less than 80 mm, a defavourable deviation on the nominal thickness of the floor plate shall be taken into account by reducing the nominal thickness by:

$Max(e_r ; e_h)$ in the case of erection with props;

$\sqrt{e_r^2 + e_h^2}$, in the case of erection without props;

where

e_r is the tolerance on the centre of gravity of the main reinforcement position, in mm

e_h is the tolerance for the floor plate thickness, in mm

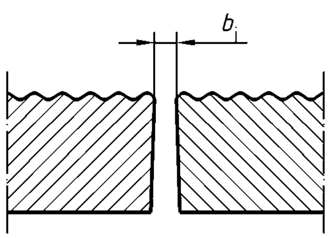
4.3.3.7 Permanent situations

Floor plates shall comply with the design of the floor system in which they are used. Recommended design procedures for composite slabs are given in Annex F.

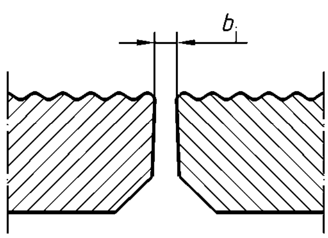
4.3.4 Resistance and reaction to fire

Complementary to 4.3.4 of EN 13369:2004, the following requirements shall apply:

— the fire resistance of a composite slab made of floor plates without void formers is the same as for a solid slab of identical characteristics. Calculation of the temperatures is carried out without taking into account the joint between floor plates as much as the width b_j is lower than 20 mm (see Figure 18);



a) corner edge



b) chamfer edge

Figure 18 — Examples of current joint profiles

— the fire resistance of a composite slab made of floor plates with void formers requires the details of the fire properties of the void forming materials and the determination of the temperatures profiles. Specific information are given in Annex H.

4.3.5 Acoustic properties

Clause 4.3.5 of EN 13369:2004 shall apply.

The sound insulation properties of a composite slab made of floor plates without void formers is the same as for a solid slab of identical characteristics, the influence of the joint between floor plates being negligible.

4.3.6 Thermal properties

Clause 4.3.6 of EN 13369:2004 shall apply.

The thermal properties of a composite slab made of floor plates without void formers is the same as for a solid slab of identical characteristics, the influence of the joint between floor plates being negligible.

4.3.7 Durability

Clause 4.3.7 of EN 13369:2004 shall apply.

NOTE Unless specified for other reasons, bathrooms in single family dwellings and ventilated crawl spaces of buildings should be designed for a class B ambient conditions according to EN 13369:2004. Void formers should not be used in structures susceptible to water penetration.

4.3.8 Other requirements

Clause 4.3.8 of EN 13369:2004 shall apply.

5 Test methods

5.1 Tests on concrete

Complementary to 5.1 of EN 13369:2004, Annex G of the present standard may apply.

5.2 Measuring of dimensions and surface characteristics

Complementary to 5.2 of EN 13369:2004, the following subclauses shall apply.

5.2.1 Position of reinforcement

5.2.1.1 Procedure

The measurements shall be taken either on the casting bed, when the product reaches the end of the manufacturing process, or in the stocks.

The following measurements shall be taken:

- the position of longitudinal reinforcement relative to concrete faces, including cover;
- the spacing of longitudinal reinforcing bars;
- the length of projection of protruding bars;
- the position of transverse reinforcement.

The measurements shall be recorded.

5.2.1.2 Interpretation of results

The results shall comply with the requirements of 4.2.4 and the tolerance values defined in 4.3.1.1.2.

5.2.2 Floor plate dimensions

5.2.2.1 Procedure

Measurements shall be taken either when the product reaches the end of the manufacturing process or in the stocks. The following measurements shall be taken:

- length;
- width;
- cross sectional dimensions;
- position and dimensions of cuts and notches;
- position of incorporated units and void formers.

The measurements shall be recorded.

5.2.2.2 Interpretation of results

The results shall comply with the requirements of 4.3.1.2 and the values specified by the manufacturer, within the tolerances given in 4.3.1.1.1.

5.2.3 Straightness of edges

This procedure applies to external edges.

5.2.3.1 Procedure

Place the string or the straightedge along the edge of the floor plate to be checked, from corner to corner. Measure the maximum deviation *t* between the string or the straightedge and the edge of the floor plate as indicated in Annex J of EN 13369:2004.

The measurements shall be recorded.

5.2.3.2 Interpretation of results

The results shall comply with the tolerance values given in 4.3.1.1.1 d).

5.2.4 Flatness of the moulded surface

Checking the flatness of the moulded surface of the floor plate is considered to be carried out by checking the flatness of the casting bed.

Annex J of EN 13369:2004 shall apply.

The results shall comply with the tolerance values given in 4.3.1.1.1 e).

5.2.5 Surface characteristics

The upper rough surface of floor plate shall be subject to appropriate controls:

- visual inspection of roughness in comparison with a reference sample;
- dimensional measurement of indented relief in the case of an indented surface.

The results shall comply with the requirements given in 4.3.2.2.

5.3 Weight of the products

Clause 5.3 of EN 13369:2004 shall apply.

5.4 Prestressing

5.4.1 Initial prestressing force

5.4.1.1 Procedure

The prestressing force is determined by measuring force and elongation.

5.4.1.2 Interpretation of results

The tensile force corresponding to measured force of the tendon shall be deduced from the "elongation-force" diagram provided by the tendon manufacturer.

The difference between the initial prestressing force obtained by direct measurement of the force and that deduced from measurement of elongation shall be less than 7 %.

The results shall be recorded.

5.4.2 Slippage of tendons

5.4.2.1 Procedure

Independent of the production method, tendon slippage shall be measured by means of an appropriate measuring instrument accurate to within 0,1 mm.

5.4.2.2 Interpretation of results

Slippage shall be limited to the values evaluated in 4.2.3.2.4.

For strands sawn at the ends of the floor plates, the individual slippage value of the strand is determined by taking the average for three wires (taken on a diagonal) of the strand.

Prestressed floor plates shall not present longitudinal cracking due to the spalling at the prestressing. In the case where such longitudinal cracking appears, the floor plate shall be rejected.

NOTE Where, for manufacturing reasons, the prestressing is in redundant, it is allowed to recalculate the floor plate without taking into account the tendon near the cracking.

6 Evaluation of conformity

6.1 General

Clause 6.1 of EN 13369:2004 shall apply.

6.2 Type testing

Clause 6.2 of EN 13369:2004 shall apply.

6.3 Factory production control

Clause 6.3 of EN 13369:2004, except 6.3.6.5, shall apply, with the complementary requirements of Annex A.

7 Marking

Clause 7 of EN 13369:2004 shall apply.

Delivered floor plate shall be uniquely identifiable and traceable until erection with regard to its production site and data. For this purpose the manufacturer shall mark the products or the delivery documents so the relation to the corresponding quality records required in this standard can be secured. The manufacturer shall keep these records for the required period of archiving and make them available when required.

8 Technical documentation

The detailing of the element, with respect to geometrical data and complementary properties of materials and inserts, shall be given in technical documentation, which includes the construction data, such as the dimensions, the tolerances, the layout of reinforcement, the concrete cover, the expected transient and final support conditions and lifting conditions.

The composition of technical documentation is given in Clause 8 of EN 13369:2004.

Annex A
(normative)

Inspection schemes

The relevant subjects of Annex D of EN 13369:2004 shall apply. Complementary to these subjects following schemes shall also apply.

A.1 Process inspection

NOTE Table A.1 is complementary to D.3.2 of Table D.3 of EN 13369:2004. It replaces 8 of D.3.1 of EN 13369:2004 and completes D.3.2 of Table D.3 of EN 13369:2004.

Table A.1 — Process inspection

	Subject	Method	Purpose *	Frequency *
Other process subjects				
1	Concrete compressive strength	Strength test on moulded concrete specimens or other methods (see 5.1)	Strength on delivery (see 4.2.2.2)	On each 500 m^3 of manufactured concrete and at least once by 5 production days, four tests (at least) shall be made for each concrete type : – two specimens are tested at the age corresponding to the minimum storage in the factory specified by the manufacturer (e.g. 2 days)
			Concrete strength at transfer of prestressing (see 4.2.3.2.3) For prestressed floor plates, it is not necessary to measure the strength at delivery when the same strength is measured at detensioning	Each production day, three specimens (at least) ** shall be made: – for each production unit and each concrete type if there is no heat treatment – for each casting bed and each concrete type if there is a heat treatment
2	Initial prestressing force	Direct measurement of jack force or elongation of tendons (see 5.4.1).	Verification of the stated value	Each production day, on one prestressing tendons per production unit

* The indicated tests and frequencies may be adapted or even deleted when equivalent information is obtained directly or indirectly from the product or process.

** If another method than the procedure described in Annex G is applied, one cube (at least) shall be made on each day of production.

A.2 Finished product inspection

NOTE Table A.2 is complementary to D.4.1 of Table D.4 of EN 13369:2004.

Table A.2 — Finished product inspection

	Subject	Method	Purpose*	Frequency*
Product testing				
1	Dimensions : – length – cross section – straightness of edges – flatness of the moulded face – protruding reinforcement	Measuring according to 5.2.1 to 5.2.4	Conformity with drawing and specified tolerances	Each 5 production days, one floor plate taken at random, every time a different type
2	Surface appearance : – roughness – general appearance	Visual inspection (see 5.2.5)	Roughness for monolithism	For each production run
3	Mechanical tests on finished products**	As described in Annex J	Conformity with the specified requirements of the product standard and with the specified or declared values	On each type of floor plates, after setting up the first production or if there is a major change in type of lattice girder, or method of manufacture. Then, for reinforced floor plates without lattice girders, at the age upon delivery, every 20 production days, on a floor plate of each depth, every time a floor plate with different types of reinforcement
4	Slippage of tendons	Measuring of slippage for none sawn elements (see 5.4.2)	Conformity with maximum value (see 4.2.3.2.4)	Each production day, three measurements per bed
		Visual inspection of sawn elements and measuring		Visual inspection of all elements and if there is no doubt measuring three tendons per production day. In case of doubt measuring of all concerning tendons

* The indicated tests and frequencies may be adapted or even deleted when equivalent information is obtained directly or indirectly from the product or process.

** Previous full scale tests performed before the date of this standard may be considered if they comply with the requirements of this standard. Test results may be those given by the producer of lattice girders. These tests are not required if erection spans are obtained by calculation following 4.3.3 of EN 13369:2004.

Annex B
(informative)

Types of composite slabs

B.1 Scope

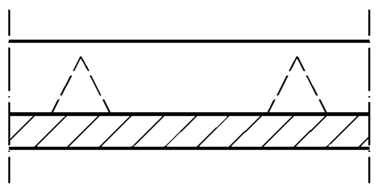
This Annex specifies different types of composite slabs made of floor plates, behaving monolithically after hardening of the cast-in-situ concrete. This monolithism is obtained through the bond between the precast element and topping with or without connecting reinforcement.

B.2 Different types of composite slabs

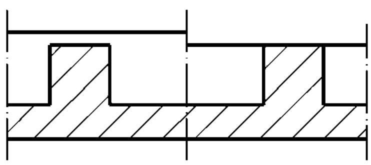
According to the presence or not of void formers it is distinguished:

B.2.1 Solid composite slabs

Composite slabs made of reinforced or prestressed floor plates, flat or with ribs, with or without lattice girders, but without void formers (see Figure B.1).



a) with or without lattice girders

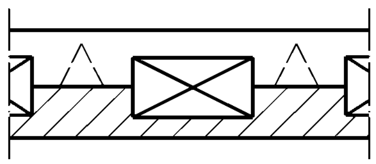


b) with ribs

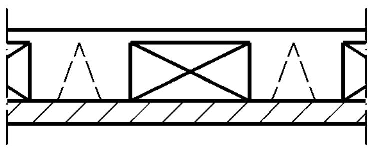
Figure B.1 — Examples of solid composite slabs

B.2.2 Hollow composite slabs

Composite slabs made of reinforced or prestressed floor plates flat, with ribs or with lattice girders and provided with void formers (see Figure B.2).



a) with embedded void formers



b) with glued void formers

Figure B.2 — Examples of hollow composite slabs

B.3 Topping

The class of the cast-in-situ concrete should be at least C20/25. The nominal thickness of the topping should be at least:

— 40 mm above flat floor plates in accordance with 6.2.5 of EN 1992-1-1:2004;

— 0 or 40 mm above the upper face of stiffening ribs of floor plates with ribs;

— 50 mm above the upper face of void formers.

Annex C
(informative)

Stiffening ribs and void formers

C.1 Stiffening ribs

Dimensions and positioning of stiffening ribs of reinforced and prestressed floor plates should comply with the following indications and should be checked according to 5.2.2.

The dimensional tolerances are defined in Clause 4.3.1.1.1.

C.1.1 Nominal width of ribs

The nominal width of ribs should be such as:

— $b_w \geq 55$ mm if the floor plate comprises several ribs;

— $b_w \geq 85$ mm if the floor plate comprises a single rib.

C.1.2 Nominal height of ribs

The nominal height of ribs should be such as:

— $h_r \geq 50$ mm.

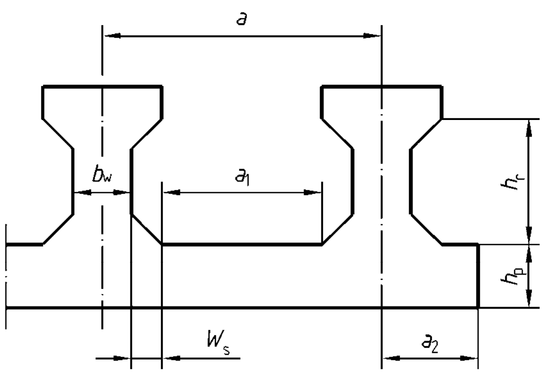
C.1.3 Nominal space between ribs

The nominal distance between the axis of ribs should be such as:

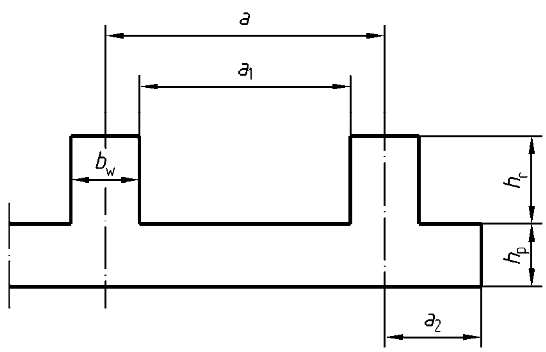
— $a \leq [835 \text{ or } (15\, h_p + b_w + 2w_s)]$ mm whichever is the lesser

The nominal clear spacing between ribs should be such as:

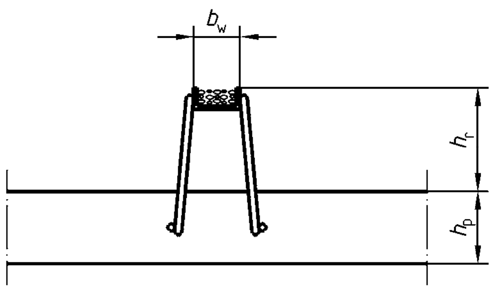
— $a_1 \geq (h_r \text{ or } 85)$ mm whichever is the greater



a) tapered rib with chamfer



b) straight rib without chamfer



c) lattice girder with concrete rib

Figure C.1 — Distance between contiguous edge ribs

C.1.4 Distance between the edge of the floor plate and the centre line of the nearest rib

This nominal distance should be such as:

— $a_2 \leq [600 \text{ or } 0{,}5\ (15\ h_p + b_w + 2w_s)]$ mm whichever is the lesser

C.1.5 Specific case of reinforced floor plate with a single rib

This nominal width should be such as:

— $b \leq [1\ 200 \text{ or } (15\ h_p + b_w + 2w_s)]$ mm whichever is the lesser

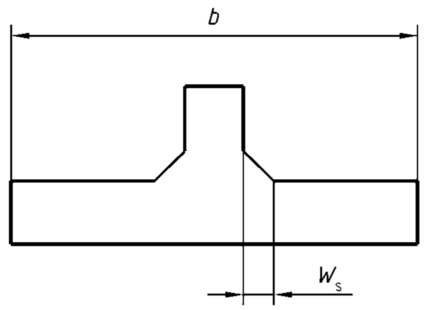


Figure C.2 — Width of floor plate with a single rib

C.2 Void formers

Void formers should be positioned such that the space between them forms a rib thickness sufficient to allow the transfer of shear force between the in-situ topping and the floor plate, which also providing sufficient concrete cover to connecting or any transverse reinforcement.

The minimum space between the faces of void formers should be such as (see Figure C.3):

— $b_v \geq 85$ mm;

— $b_v \geq [85 \text{ or } (b_o + 2c)]$ mm whichever is the greater, where lattice girder is present.

where

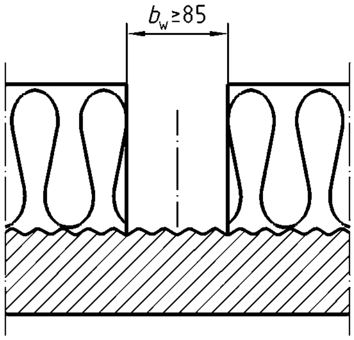
b_o is the width of the lattice girder at the upper face of the floor plate, in mm

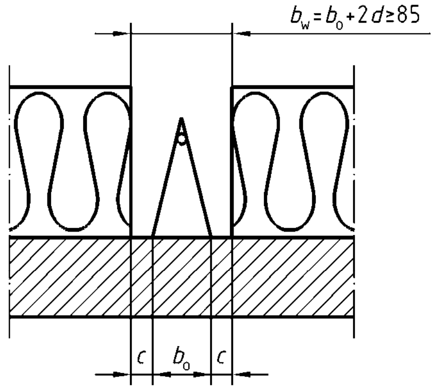
c is the concrete cover corresponding to class A in Table A.2 of EN 13369:2004, in mm

The position of void formers should be checked in accordance with 5.2.2.

Dimensions in millimetres

AC

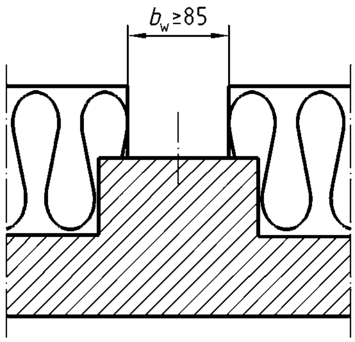




AC

a) without rib or lattice girder

b) with lattice girder



c) with rib

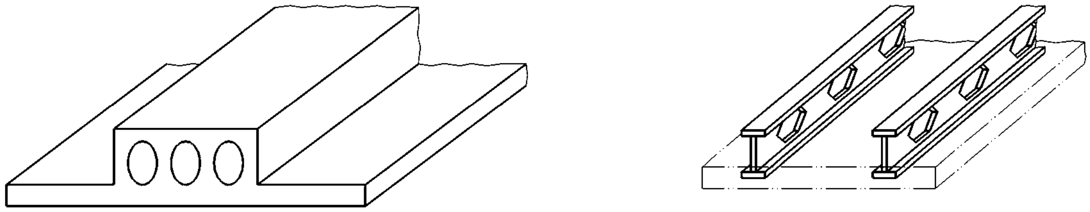
Figure C.3 — Minimum space between void formers

C.3 Additional examples of stiffening ribs and ball void formers

Elements, as defined in C.1 (stiffening rib) and C.2 (void former), typically comply with the description given in the next paragraphs.

C.3.1 General

The definitions given in 3.1.3 and 3.1.6 apply. Examples of specific stiffening profiles and void former elements are given respectively in Figure C.4 and Figure C.5.



a) concrete profile (shape and amount of holes are variable)

b) steel beam

Figure C.4 — Possible forms of stiffening profiles

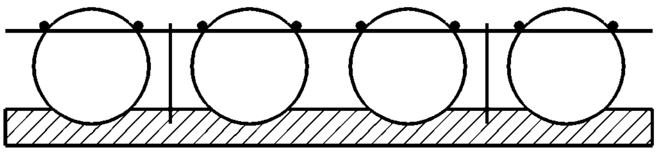


Figure C.5 — Ball void formers connected by reinforcement

C.3.2 Dimensions

C.3.2.1 Dimensions and positioning of stiffening profiles

Dimensions and positioning of stiffening profiles of reinforced and prestressed floor plates should comply with the rules given hereafter and should be checked according to 5.2.2.

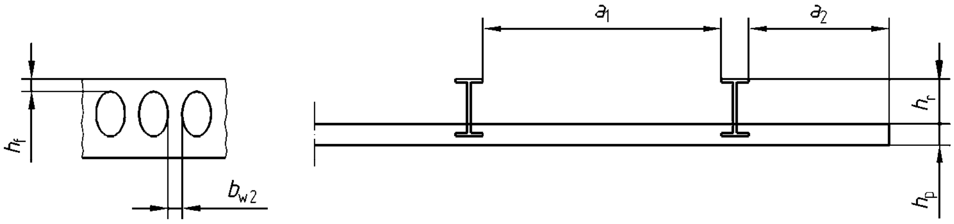


Figure C.6 — Dimensions and positioning of specific stiffening profiles

— nominal width of the webs $b_{w2} \geq 30$ mm;

— nominal height of the profiles $h_r \geq 50$ mm;

— nominal height of the flange $h_f \geq 30$ mm;

— nominal clear spacing between the profiles:

$50 \text{ mm} \leq a_1 \leq (800 \text{ mm and } 15\, h_p)$;

— nominal clear spacing between edge profile and edge of the floor plate:

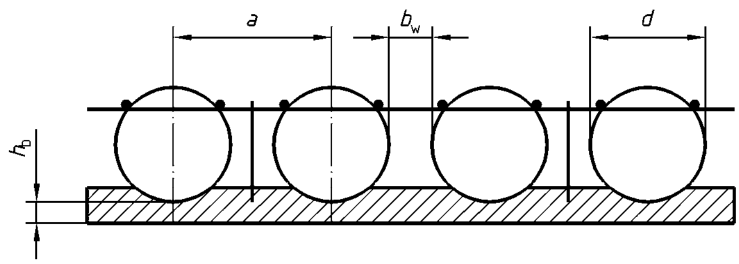
$a_2 \leq (560 \text{ mm and } 7{,}5\, h_p)$.

The dimensional tolerances are defined in 4.3.1.1.1.

C.3.2.2 Dimensions and positioning of ball void formers

The void formers should be positioned so that the space between adjacent units is sufficient for correct concreting of the cast-in-place mortar and to fulfil the static actions in the hardened situation. Inherent to this:

AC⟩



⟨AC

Figure C.7 — Dimensions and positioning of ball void formers

— minimum space between the side of ball void formers is such as:

$b_w \geq 20$ mm and $(0{,}1.a)$;

— the minimum concrete thickness at the bottom of the ball is such as:

$h_b \geq 20$ mm and $(0{,}1.a)$;

$a \geq [85 \text{ and } (b_w + d)]$;

— the minimum thickness of the in situ concrete cover over the ball void formers is greater than 0,1 a.

Annex D
(informative)

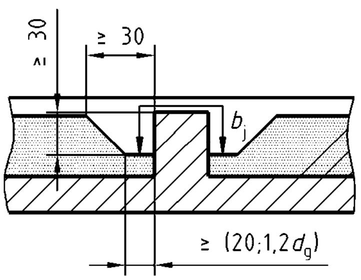
Monolithism of composite slabs

D.1 General

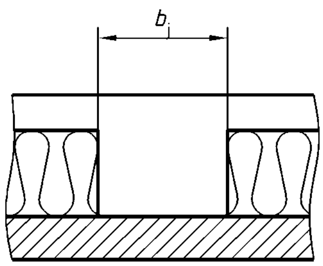
The design shear stress at the interface should satisfy 6.2.5 of EN 1992-1-1:2004.

For floor plates with void formers, the efficient width of the interface, b_j, is given on Figure D.1. Dimensions are in mm; those concerning Figure a) are lower limits of sizes.

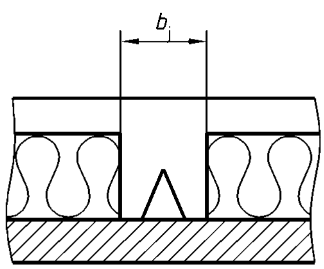
Dimensions in millimetres



a) with ribs and voids formers



b) without ribs and with voids formers



c) without ribs and with voids formers and lattice girder

NOTE The roughness is assumed constant at the interface.

Figure D.1 — Examples of efficient width of interfaces

NOTE The design shear strength of the composite slab may take into account the roughness that may be different between the elements of the floor plate.

D.2 Strength of connecting reinforcement

The design strength of the connecting reinforcement, for two diagonal legs at angles α and α' to the interface (see Figure D.2) is equal to:

$$F_{Rwd} = A_{sw} f_{ywd} (\mu \sin \alpha + \mu \sin \alpha' + \cos \alpha) \quad \text{(D.1)}$$

where

A_{sw} is the cross sectional area of the leg considered, in mm^2 ;

f_{ywd} is the design strength of the steel of which the leg is made, in MPa;

μ is the friction coefficient according to 6.2.5 of EN 1992-1-1:2004;

α and α' are the angles of the legs considered in radians, with $\pi/4 \leq \alpha \leq \pi/2$ and $\cos \alpha \geq 0$;
$\pi/2 \leq \alpha' \leq 3\ \pi/4$.

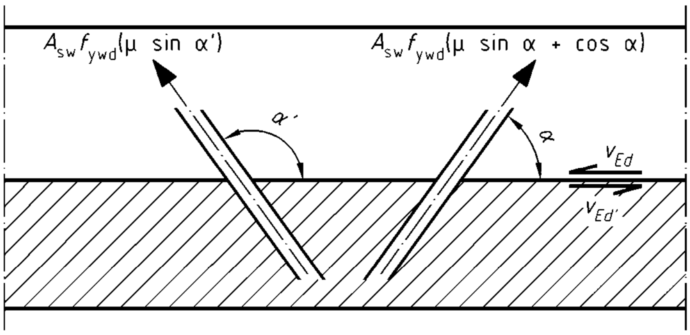


Figure D.2 — Definition of F_{Rwd}

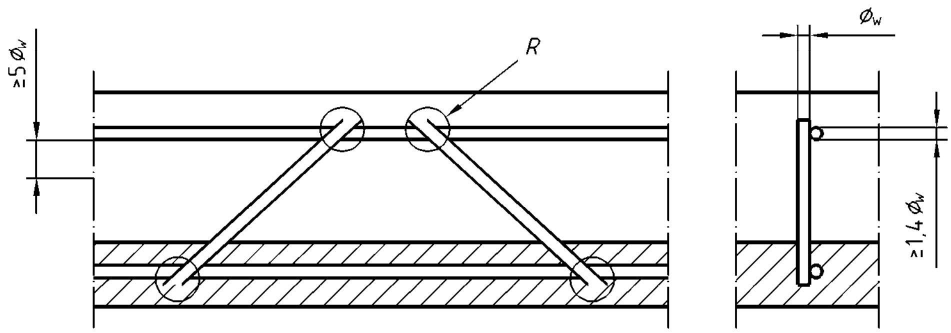
D.3 Anchorage of connecting reinforcement

The anchorage of connecting reinforcement in the concrete of the floor plate and in the topping should be designed at ultimate limit state by calculation according to 8.4 and 8.5 of EN 1992-1-1:2004 or by tests. This anchorage is provided by:

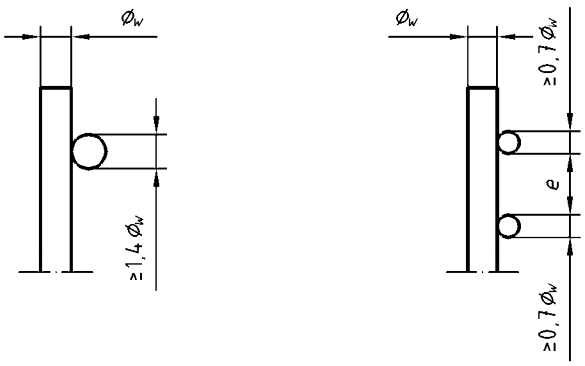
— welded junction or by mechanical junction in the case of discontinuous diagonals (see Figure D.3).

  In the case of a welded or mechanic junction, the anchorage is considered to be satisfactory, if the rules for shear reinforcement (see 8.5 of EN 1992-1-1:2004) are complied with (see Figure D.3) and if the strength of the welding complies with 7.2.4.2 of [AC) EN 10080:2005 (AC].

  For lattice girders, a reduction of 50 % should be applied to the values given in EN 1992-1-1:2004.



a) longitudinal and cross section views



with (20 mm and 2 $\varnothing_w$) ≤ e ≤ 50 mm

b) detail of junction

Figure D.3 — Welded junction

— loop in the case of connecting reinforcement with loops without welded longitudinal bar. The anchorage capacity should be determined by test or in accordance with 8.4 of EN 1992-1-1:2004. The values given in Annex K may be used as simplification;

— combination of loop and welded junction when a welded longitudinal bar in present at the top of loops or in the case of a lattice girder with continuous diagonals (see Figure D.4). In this case the anchorage is considered to be satisfied if the rules of the Figure D.4 are complied with and if the strength of the welding complies with 7.2.4.2 of [AC⟩ EN 10080:2005 ⟨AC].

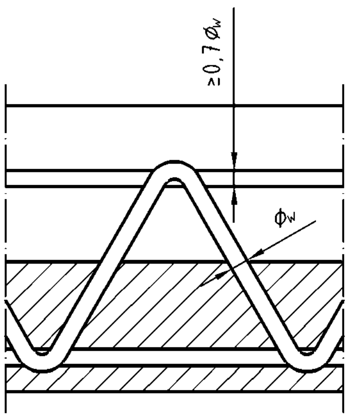


Figure D.4 — Loop and welded junctions

Annex E
(informative)

Detailing of support joints and anchorage of reinforcement of composite slabs

E.1 Scope

This annex specifies different detailing in order to ensure the anchorage of bottom reinforcement of composite slab.

E.2 General

E.2.1 Effective support length

To determine the nominal support length, the minimum value of the support length should be increased by taking into account the values for tolerances and the effect of spalling.

In the absence of specific justification, the minimum values for actual effective support lengths of the floor plates at their bearings should be:

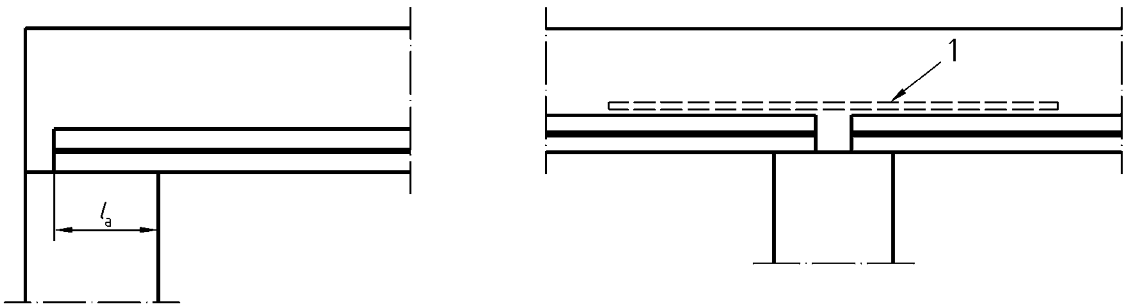
- if the floor plates are erected without intermediate props or if the main reinforcement is not protruding:
  - 50 mm bearing on masonry;
  - 30 mm bearing on steel or concrete.
- if the floor plates are erected with intermediate props and if the main reinforcement is protruding:
  - 40 mm bearing on masonry;
  - 20 mm bearing on steel or concrete.

If these conditions are not complied with, an edge prop should be provided.

E.2.2 Types of connections

Three different types of connections can be specified:

a) the support length of the floor plate on the bearing is sufficient to achieve the anchorage of the lower reinforcement of the composite slab in the floor plate on its support length, with a minimum of 60 mm (see Figure E.1);



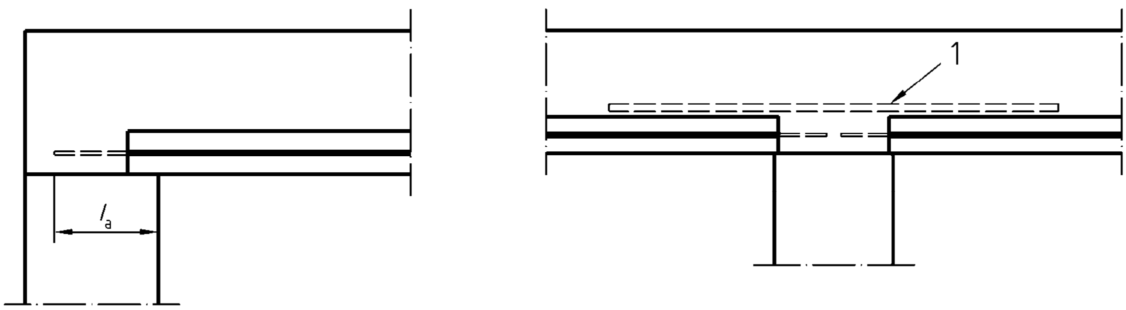
a) on edge support b) on intermediate support

Key

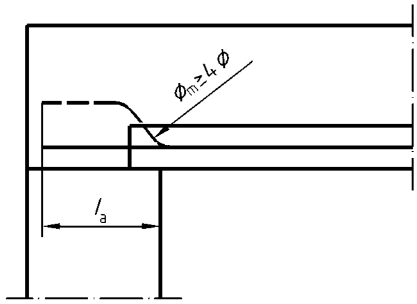
1 eventual additional reinforcement

Figure E.1 — Anchorage in the floor plate on its support length

b) the support length of the floor plate on the bearing is not sufficient to achieve the anchorage of the main lower reinforcement of the composite slab in the floor plate on its support length. In this case the anchorage is achieved by means of protruding reinforcement (main reinforcement of the floor plate or additional reinforcement) (see Figure E.2). Except in the case of special calculations or tests, the anchorage length on the support la should be greater than 100 mm.



a) on edge support b) on intermediate support



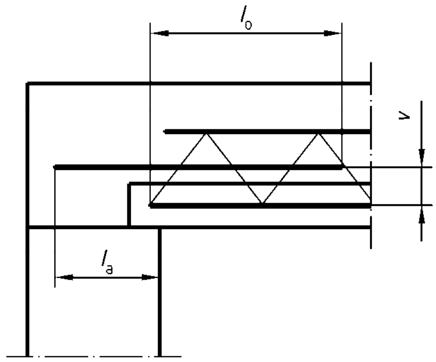
c) by bent up reinforcement

Key

1 eventual additional reinforcement

Figure E.2 — Examples of anchorage by protruding reinforcement

c) the support length of the precast floor plate on the bearing is not sufficient to achieve the anchorage of the main lower reinforcement of the composite slab within support length. The anchorage is achieved by means of additional reinforcement in the topping on the floor plate (see Figure E.3).

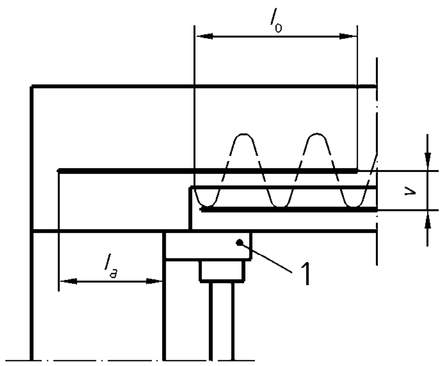


l_0 : design lap length according to 8.7.3 of EN 1992-1-1

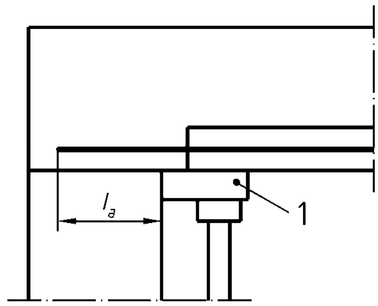
Figure E.3 — Examples of anchorage by additional reinforcement in the topping (case with lattice girder)

When before installation it is noticed that the support length is insufficient or of no value, an edge prop should be located and the gap between the precast floor plate and the bearing should be closed by means of a shuttering (see Figures E.4 and E.5). Hangers reinforcement should be required. The use of a foam to close the gap is prohibited.

NOTE When l_a is greater than the support length, reinforcement should be bent.



a) without protruding reinforcement from floor plate

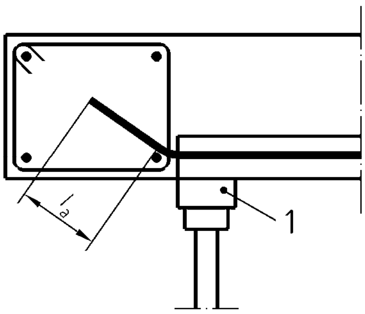


b) with protruding reinforcement from floor plate

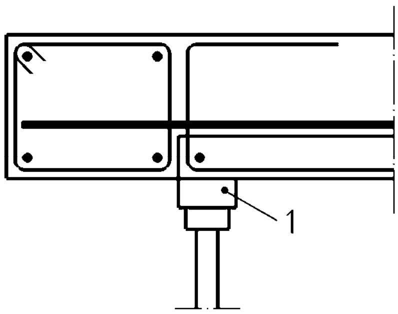
Key

1 Shuttering

Figure E.4 — Case when the floor plate does not reach the support



a) with protruding reinforcement



b) with reinforcement on the floor plate

Key

1 Shuttering

Figure E.5 — Case with embedded beam

E.3 Anchorage of lower reinforcements of the composite slab

E.3.1 Anchorage on the end support

E.3.1.1 General

The anchorage of lower reinforcement of the composite slab is achieved:

— inside the floor plate (type 1);

— by protruding reinforcement from edges of the floor plate (type 2);

— by means of additional reinforcement in the topping above the precast floor plate (type 3).

The anchorage design should be made by considering for anchorage length, the distance, l_a, between the edges of the reinforcements and the internal face of the bearing.

E.3.1.2 Connection type 1 (see Figure E.1)

In the case of a connection as type 1 the anchorage is achieved inside the floor plate.

E.3.1.3 Connection type 2 (see Figure E.2)

In the case of a connection as type 2 the anchorage is achieved by means of protruding reinforcements from edges of the floor plate.

These reinforcements can be additional reinforcement located in the floor plate, overlapping the reinforcements of the floor plate with a sufficient length.

In the case where these reinforcements are bent up reinforcement, these can be bent up in the floor plate, as shown by Figure E.2.c), directly in front of the support with a mandrel of which the curve radius is at least equal to four times the diameter of the bar.

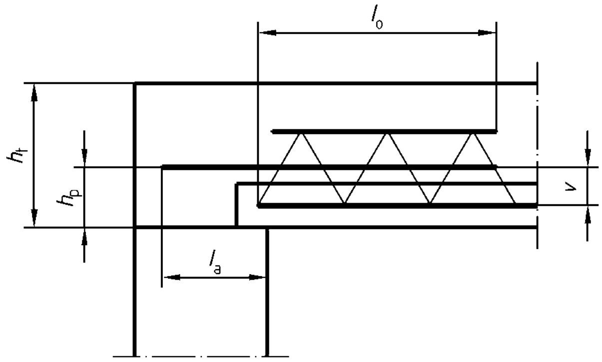
The verification is made by considering a reinforced-concrete anchorage over distance l_a, taking into account the transverse pressure according to 8.4.4 of EN 1992-1-1:2004.

E.3.1.4 Connection type 3 (see Figure E.3)

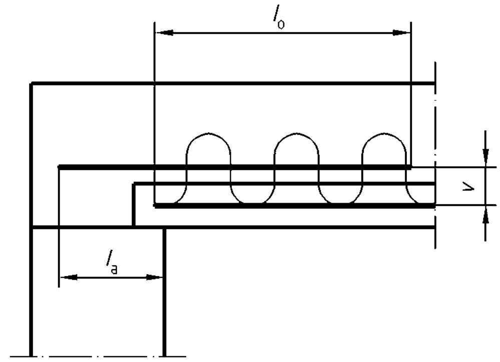
In the case of connection as type 3, the anchorage is achieved by additional reinforcement located above the floor plate in the topping. The following conditions should be complied with:

a) the nominal thickness of the floor plate, h_p, should not exceed one half of the thickness of the composite slab ($h_p \leq h_t / 2$) ;

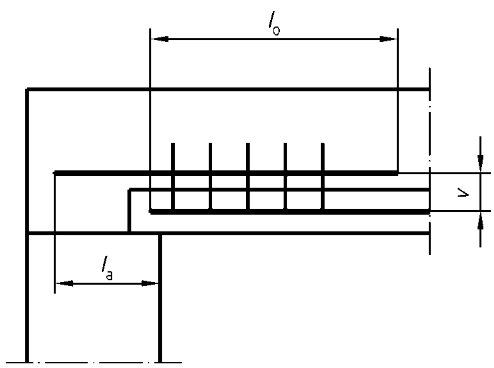
b) the transfer of the anchorage-force is ensured by overlapping on a length equal to the anchorage length $l_{b,net}$ plus, except in the type case shown in Figure E.6 d), the distance v between the main reinforcements of the floor plate and the additional reinforcements located above the floor plate in the topping. In these zones the linkage between these two reinforcements is achieved by connecting reinforcement as shown (see Figure E.6).



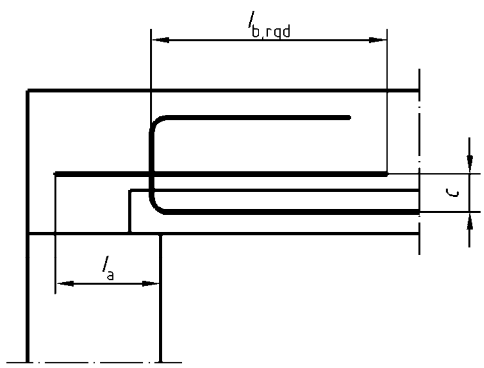
a) by lattice girder



b) by connecting reinforcement



c) by stirrups



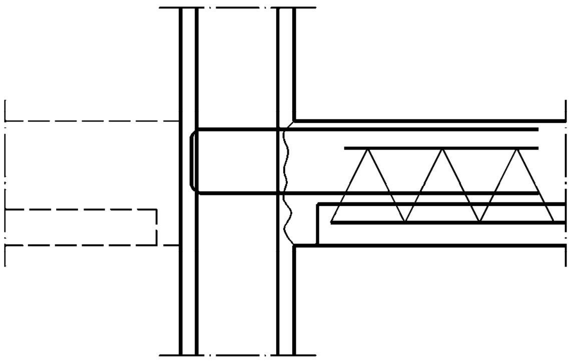
d) by bent up reinforcement

Figure E.6 — Linkage between additional reinforcement and the floor plate reinforcement

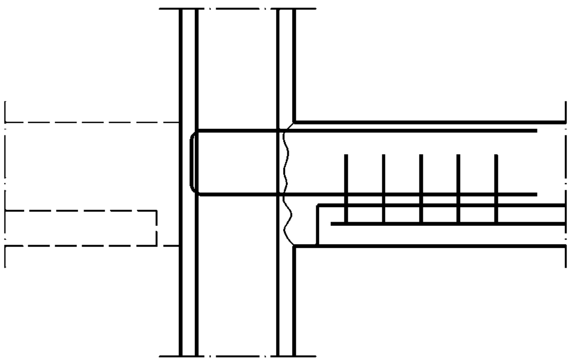
It is recommended that a mechanically continuous extension of the lower reinforcement be anchored in order to be able to resist accidental positive moments (settlement of the support, explosion, etc.).

E.3.2 Anchorage in special cases

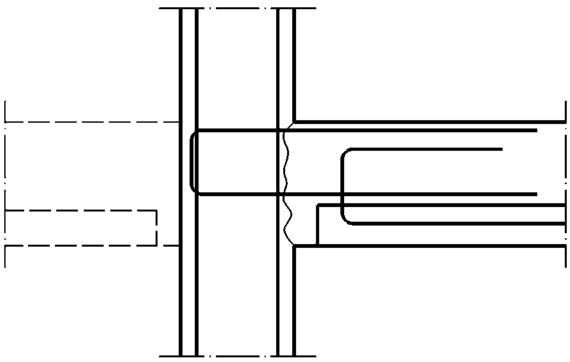
When the composite slab is constructed after the continuous support is placed (slipforming wall for example) or when the composite slab is hung up on the bearing (wall or beam) the connection between the support and the composite slab should be ensured by hanging reinforcement as shown in Figures E.7 and E.8.



a) with lattice girders

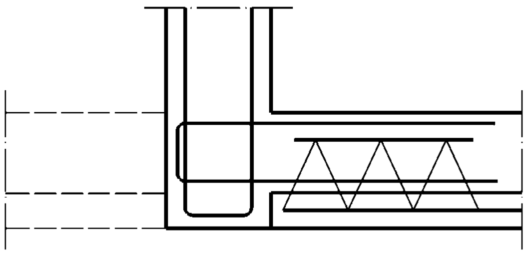


b) with stirrups

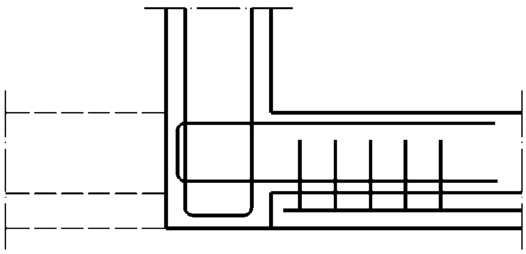


c) with bent up bars

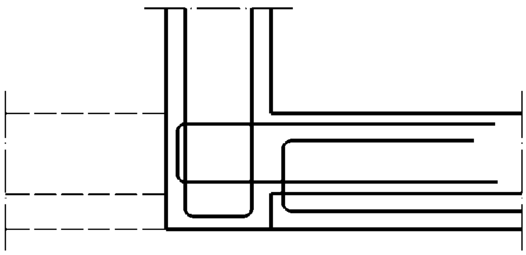
Figure E.7 — Examples of connections on a continuous support



a) with lattice girders



b) with stirrups

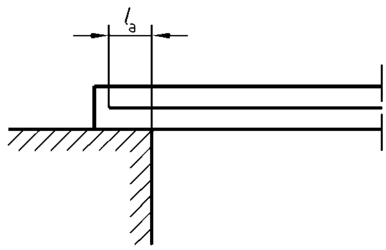


c) with bent up bars

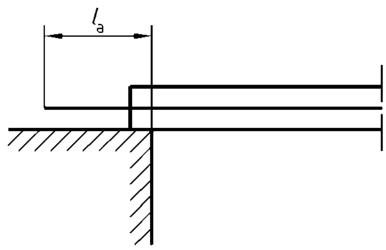
Figure E.8 — Examples of connections of hung up composite slabs

NOTE The limit values of the dimensions (minimal or maximal) are not represented on Figures E.7 and E.8. The respect of these values is a necessary condition to ensure a good behaviour of the connections.

The anchorage length, l_a, shown in Figure E.9, should be sufficient to satisfy the anchorage requirements of the main reinforcement of the composite slab.



a) connecting reinforcement within the floor plate



b) connecting reinforcement protruding

Figure E.9 — Connecting reinforcement cast integral with the floor plate

Annex F
(informative)

Design of composite slab

F.1 General

The floor plate concrete strength and characteristics to be taken into account in permanent situations are those stated by the manufacturer at 28 days.

The floor plate should contain all or part of the main reinforcement required in the composite slab.

The resistance and stability of composite slabs made of floor plates result from their association with in situ concrete and possibly voids formers.

Providing shear forces can be transferred through the interface of the floor plate with the in situ concrete (see Annex C), the design of composite slabs is identical to the design of monolithic slab offering the same configuration.

This design should be carried out by reference to EN 1992-1-1:2004 by taking into account the following considerations.

When the applied load, Q_p, is greater than 10 kN/m^2, the effective span taken into account for the calculation should be in accordance with 5.3.2.2 of EN 1992-1-1:2004. Otherwise, if $Q_p \leq 10$ kN/m^2, the effective span are given in Table F.1 depending on the type of bearing support.

NOTE The reduction of the effective span for applied loads lesser than 10 kN/m^2 is justified by the narrow width of the strut on the support.

Table F.1 — Effective span for different support conditions ($Q_p \leq 10$ kN/m^2)

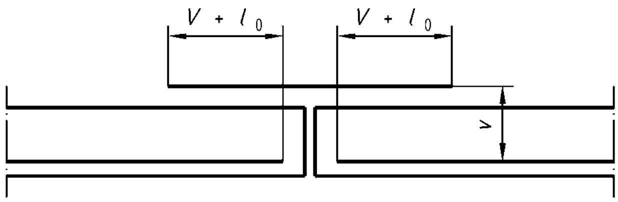
Type of supports	Edge and intermediate supports without continuity	Intermediate supports with continuity
Concrete beams Columns Concrete walls	clear distance between the faces of the supports	
Steel floor joist	distance between the edge of the flanges (span side)	distance between the axis of the bearings
Masonries with small elements	clear distance between the faces of the supports + 5 cm	
Bearings	distance between the axis of the bearings	
Embedded beams	distance between the axis of the beams	

NOTE For the calculation of frame stability, the effective span should be taken as the distance between the bearings axis.

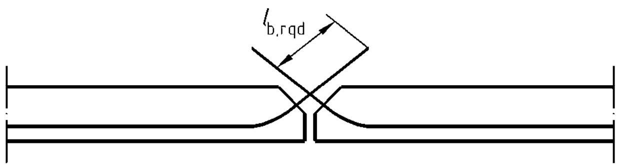
F.2 Connections between adjacent floor plates

The connection details may be given in project specifications.

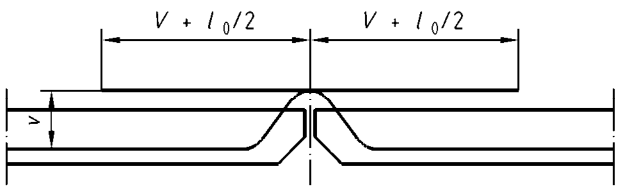
Examples of reinforcement details between adjacent floor plates are shown in Figure F.1. Where partial or total mechanical continuity across the connection is to be relied upon, the relevant details from the design criteria may be adopted and detailed.



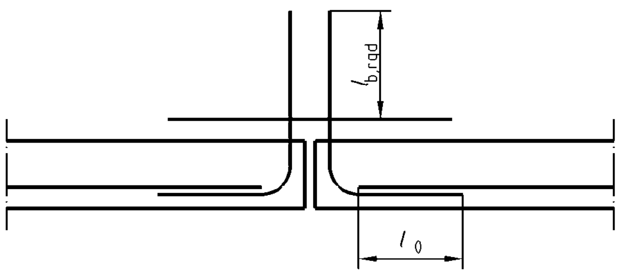
a) with additional bars placed in cast-in-situ concrete



b) with protruding floor- -plate reinforcement



c) with protruding bent floor plate reinforcement



d) by additional reinforcement anchored in the floor plate

Figure F.1 — Examples of reinforcement detailing between adjacent floor plates (cross section to span direction)

NOTE For the last case (Figure F.1 d)), a protection of the protruding additional reinforcement should be provided.

F.3 Bending ultimate limit state

The bending ultimate limit state design should be made by applying EN 1992-1-1:2004 with following rules.

Reinforcement for transversal bending moment should comply with EN 1992-1-1:2004.

The upper member of resisting void formers can take into account in the compressive resisting member of the composite slab.

In the case where the compressive member of the composite slab is constituted by different materials (rib of floor plates, cast-in-situ concrete, resisting void formers) the strength of these different materials should be considered.

When non prestressed reinforcement are used in prestressed floor plate and when these are not located at the same depth as the prestressed reinforcements, the tensile force in the non prestressed reinforcement should be deduced from their stress-strain diagram.

NOTE The minimum area of non prestressed reinforcement should not be taken as less as 1,2 times the area required in ultimate limit state verification, but not greater than $A_{s,min}$ = 0,18 (f_{ctm}/f_{yk}) $b_t\,d$ where b_t is the mean width of the tension zone.

F.4 Serviceability limit state

F.4.1 General

Two cases should be considered:

- case of "thin" floor plates;
- case of "thick" floor plates.

F.4.1.1 Case of "thin" floor plates

A floor plate is considered to be "thin" when its thickness, h_p, complies with:

$h_p \leq (h_t/2$ or 80) mm whichever is the lesser

where h_t is the nominal thickness of the composite slab, in mm.

In the case of thin floor plates, the following considerations a) and b) should be made:

a) the design of the composite slab can be made by not considering the different stages of the construction;

b) the transverse bending moment should be not considered when otherwise the following conditions are complied with:

- the composite slab is supported on two opposite sides;
- the applied load is mainly static;
- the imposed load is limited to categories A and B according to EN 1991-1-1:2004 (premises for residential use, hospitals, offices);
- the traffic load is restricted to traffic category F according to EN 1991-1-1:2004 (traffic and parking areas for light vehicles).

NOTE 1 When the above conditions are complied with or when the width of the floor plates is lower than 1,20 m, transverse reinforcements are not required in the floor plate other than that required for transient situations (storage, handling and installation) and reinforcement above the joint is only a consideration and not a rule.

NOTE 2 In other cases, a minimum quantity of reinforcement should be placed in the floor slab in order to limit cracking due to shrinkage. It may be placed in either the floor plate or the topping and should represent at least ($20/f_{yk}$) % of the cross section of the slab (f_{yk} is the yield strength of the reinforcement concerned, in MPa).

F.4.1.2 Case of "thick" floor plates

When h_p > ($h_t/2$ and 80) mm, each stage of the construction should be considered and the transverse distribution of loads should be investigated.

The checks of normal stresses should take into account the different construction phases.

Transverse bending should be verified in accordance with F.4.1.1 b) above. If these conditions are not complied with, the effect of joint between floor plates should be considered for the calculation.

F.4.2 Serviceability limit state design of composite slab made of reinforced floor plate

F.4.2.1 Stress limitation and crack control

The serviceability limit states relating to stress limitation and crack control may be deduced from 7.2 and 7.3 of EN 1992-1-1:2004.

F.4.2.2 Deflection control

The verification of the deformation limit state of composite slab involves limiting the active deflection in order to prevent disorders in the works supported by the floor.

Active deflection is due to:

- the part of the permanent load applied to the finished floor system before construction of supported works, for which the verification is carried out, as a result of long time creep deformation, considered as a long-term action;
- the permanent load applied after construction of the supported works, for which the verification is carried out, considered as a long-term action;
- the variable loads applied after construction of the supported works, for which the verification is carried out, considered as a short-term action;
- the part of differential shrinkage between the floor plate concrete and the cast in-situ concrete that takes place after construction of the supported works, considered as a long-term action.

The limit value for active deflection depends on the type of works supported by the floor (fragility of partitions and floor finishing, etc.). The active deflection is limited to:

- for masonry partitions (e.g. gypsum plaster tiles) and/or brittle floor finishing: $L/500$;
- for other partitions and/or non brittle floor finishing: $L/350$;
- for roof element: $L/250$.

where L is the span of the floor, in metres.

The simplified method given hereafter should be used for uniformly distributed loads. We can distinguished the following applied loads:

G_v are the permanent loads (with self weight) applied on the floor before the erection of the brittle floor finishing (dead loads before), in kN/m^2;

G_a is the self weight of the brittle floor finishing (brittle loads), in kN/m^2;

G_p are the permanent loads applied on the floor after the erection of the brittle floor finishing (dead loads after), in kN/m^2;

Q are the variable loads (live loads), in kN/m^2.

The corresponding isostatic bending moments are:

M_{Gv}

M_{Ga} and $M_{Gv+Ga} = M_{Gv} + M_{Ga}$

M_{Gp} and $M_{Gv+Ga+Gp} = M_{Gv} + M_{Ga} + M_{Gp}$

M_Q and $M_{Gv+Ga+Gp+Q} = M_{Gv} + M_{Ga} + M_{Gp} + M_Q$

E_{cm} is the tangent modulus of elasticity of the cast in-situ concrete according to Table 3.1 of EN 1992-1-1:2004, in MPa and E_{cmv} the corresponding long-term modulus of elasticity according to 7.4.3 of EN 1992-1-1/2004.

Except for more accurate calculation:

— $E_{cmv} = E_{cm}/(1 + \varphi)$ with $\varphi = 2$;

— the steel-concrete effective modular ratio is taken as 15;

— the precast-cast in-situ concrete effective modular ratio is taken as 1 for the calculation on the basis of uncracked section.

The cracking moment M_{cr} corresponds to a concrete tensile stress f_{ctm} in the homogenized section.

The total deflection is equal to:

$$w_t = \xi_t\, w_{t,fc} + w_{t,uc}\,(1 - \xi_t)$$

[AC›

$$w_{t,fc} = (M_{Gv+Ga+Gp} / (E_{cmv} \cdot I_{fc}) + M_Q / (E_{cm} \cdot I_{fc}))\, L^2 / 10$$

$$w_{t,uc} = (M_{Gv+Ga+Gp} / (E_{cmv} \cdot I_{uc}) + M_Q / (E_{cm} \cdot I_{uc}))\, L^2 / 10$$

‹AC]

where

$\xi_t = 0$ if $M_{Gv+Ga+Gp+Q} \leq M_{cr}$ and $\xi_t = 1 - (M_{cr} / M_{Gv+Ga+Gp+Q})^{0,5}$ if $M_{Gv+Ga+Gp+Q} > M_{cr}$;

I_{uc} is the uniform inertia of the uncracked section, in mm^4;

I_{fc} is the uniform inertia of the fully cracked section, in mm^4.

The deflection to deduce is the one that occurred before the erection of the brittle floor finishing.

— If this erection occurs just after the unpropping:

$$w_1 = w_{fc1}\, \xi_1 + w_{uc1}(1 - \xi_1)$$

$$w_{fc1} = (M_{Gv+Ga} / E_{cm}.I_{fc})\, L^2 / 10 \text{ and } w_{uc1} = (M_{Gv+Ga} / E_{cmv}.I_{uc})\, L^2 / 10$$

$$\xi_1 = 0 \text{ if } M_{Gv+Ga} \leq M_{cr} \text{ and } \xi_1 = 1 - (M_{cr} / M_{Gv+Ga})^{0,5} \text{ if } M_{Gv+Ga} > M_{cr}.$$

— If this erection occurs a very long time after the unpropping:

$$w_2 = w_{fc2}\, \xi_2 + w_{uc2}(1 - \xi_2)\ ;$$

$$w_{fc2} = (M_{Gv} / E_{cmv}.I_{fc} + M_{Ga} / E_{cm}.I_{fc})\, L^2 / 10 \text{ and } w_{uc2} = (M_{Gv} / E_{cmv}.I_{uc} + M_{Ga} / E_{cm}.I_{uc})\, L^2 / 10\ ;$$

$$\xi_2 = 0 \text{ if } M_{Gv+Ga} \leq M_{cr} \text{ and } \xi_2 = 1 - (M_{cr} / M_{Gv+Ga})^{0,5} \text{ if } M_{Gv+Ga} > M_{cr}.$$

— According to the passed time between the unpropping and the erection of the brittle floor finishing:

$$w_a = w_1 + \psi\, (w_2 - w_1)$$

where ψ is a coefficient of interpolation comprised between 0 and 0,5. Except for more accurate calculation, ψ may be taken as:

$\psi = 0,5\ t/90$ for $t \leq 90$ days (with t in days);

$\psi = 0,5$ for $t > 90$ days.

The deflection to consider is equal to $w_t - w_a$, and should be lower than the limits given above.

NOTE The continuity may be taken into account changing the isostatic moment with the moment of the considered span and keeping the floor span between supports for the calculation of w.

For floor plates with lattice girders, this deflection may be reduced by a coefficient (no lower than 0,85) which should be demonstrated by testing. Two identical floor plates (concrete type, dimensions, etc.), with for only difference the absence of diagonal reinforcement, should be tested. The deflection of the floor plates is compared in order to demonstrate the positive influence of the lattice girder.

F.4.3 Serviceability limit states design of composite slabs made of prestressed floor plates

F.4.3.1 Stress limitation and crack control

F.4.3.1.1 Case of "thin" floor plate

In the absence of more accurate calculation, the entire cross section of the floor plate can may be assumed to be submitted to an average prestressing stress, σ_{pm} with $\sigma_{pm} = F_{pm}/A_c$ where A_c is the sectional area of the floor plate and F_{pm} is the final prestress force.

NOTE The calculation of the state of stresses in the floor plate is not very satisfactory taking into account relative uncertainties on the position of tendons, on the levelling of props or on the unrecoverable deformations taken during storage. However, if the stresses at the bottom and at the top of the floor plate are difficult to evaluate, we can determine with a good accuracy the average prestress which is not modified during the erection phases.

In order to ensure durability of the reinforcement towards the corrosion, the longitudinal bending moment under applied loads should be restricted to:

$$M_{cr} = W\,[\sigma_{p,m} + 0{,}7\,f_{ctm}]$$

where

$\sigma_{p,m}$ is the average prestress, in MPa;

f_{ctm} is the mean value of axial tensile strength of the floor plate concrete, in MPa;

M_{cr} is the limit value of the bending moment at the serviceability limit state, in Nmm;

W is the lower inertia modulus of the composite slab, in mm^3.

F.4.3.1.2 Case of "thick" floor plate

A full analysis may be performed taking into account the different construction stages, the statically indeterminate prestressing moments above supports and the moment distribution due to long time effect of prestress force, shrinkage and creep of the concretes.

F.4.3.2 Deflection control

F.4.2.2 applies taking in addition in consideration the deferred differential effects of the prestressing action:

— a part of the prestressing force acting only on the floor plate;

— the other part acting on the composite slab.

In the case of thin floor plates, the section is considered to be uncracked if the rules given in F.4.3.1.1 are complied with.

F.5 Transverse bending design of composite slab

Reinforcement for transversal laps that will support transversal bending moment should comply with 8.7 of EN 1992-1-1:2004.

When the transverse moment should be considered, transverse reinforcement should be required in order to counter this transverse moment.

These transverse reinforcements should be located:

- in the cast-in-situ concrete;
- only above the joints between floor plates, providing the mechanical continuity be overlapping of transverse reinforcements of the floor plate (see Figure F.2).

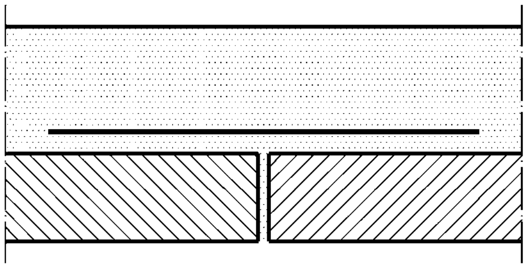


Figure F.2 — Transverse reinforcement above the joint

I In the case of particularly heavy or dynamical loads, it should be necessary to hang the shear force in the cast-in-situ concrete by means of hangers (see Figure F.3), or to provide adequate joints on floors plate edges (see Figure F.4). In the latter case, the shear force is hung, according to the intensity of the force, either by the roughness of the lateral face of the joint of which the shape should provide a correct grouting, or by a longitudinal groove.

Dimensions in millimetres

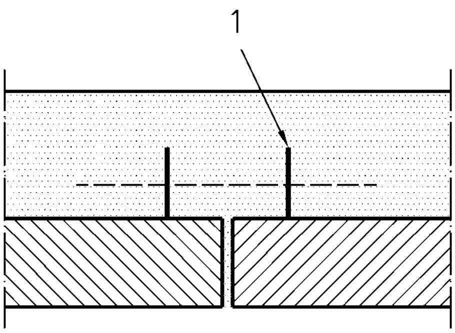


Figure F.3 — Hangers

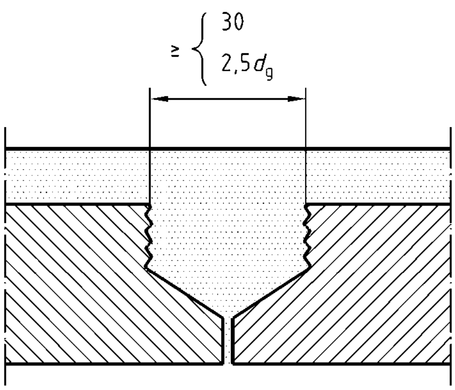


Figure F.4 — Rough joint

Key

1 hangers

NOTE When the floor plates are floor plates with ribs, particular arrangements should be provided in order to ensure the mechanical continuity between contiguous floor plates.

Annex G
(informative)

Concrete strength at time of prestressing

G.1 General

G.1.1 Procedure

The minimum compressive strength that the concrete has to reach before prestressing (release) should be determined by crushing cube or cylinder specimens. If the tested specimens are different than the standardised cylinder (150 × 300) mm, coefficients of correlation should be applied.

The specimens should be sampled during manufacture, should undergo the same heat treatment as the floor plates, and should be stored in the same environment until the time of compressive strength testing.

NOTE The concrete strength at the time of transfer of prestressing may be determined by other methods (rebound hammer, sound velocity, maturity measurement) after correlation by means of laboratory tests.

G.1.2 Interpretation of results

After the time considered necessary for the concrete to have hardened sufficiently for prestressing to go ahead, the procedure described in Figure G.1 may be applied.

Other appropriate methods may also be applied provided the required minimum compressive strength, $f_{\text{cmin,p}}$, at release is as given in 4.2.3.2.5.

The results should be recorded.

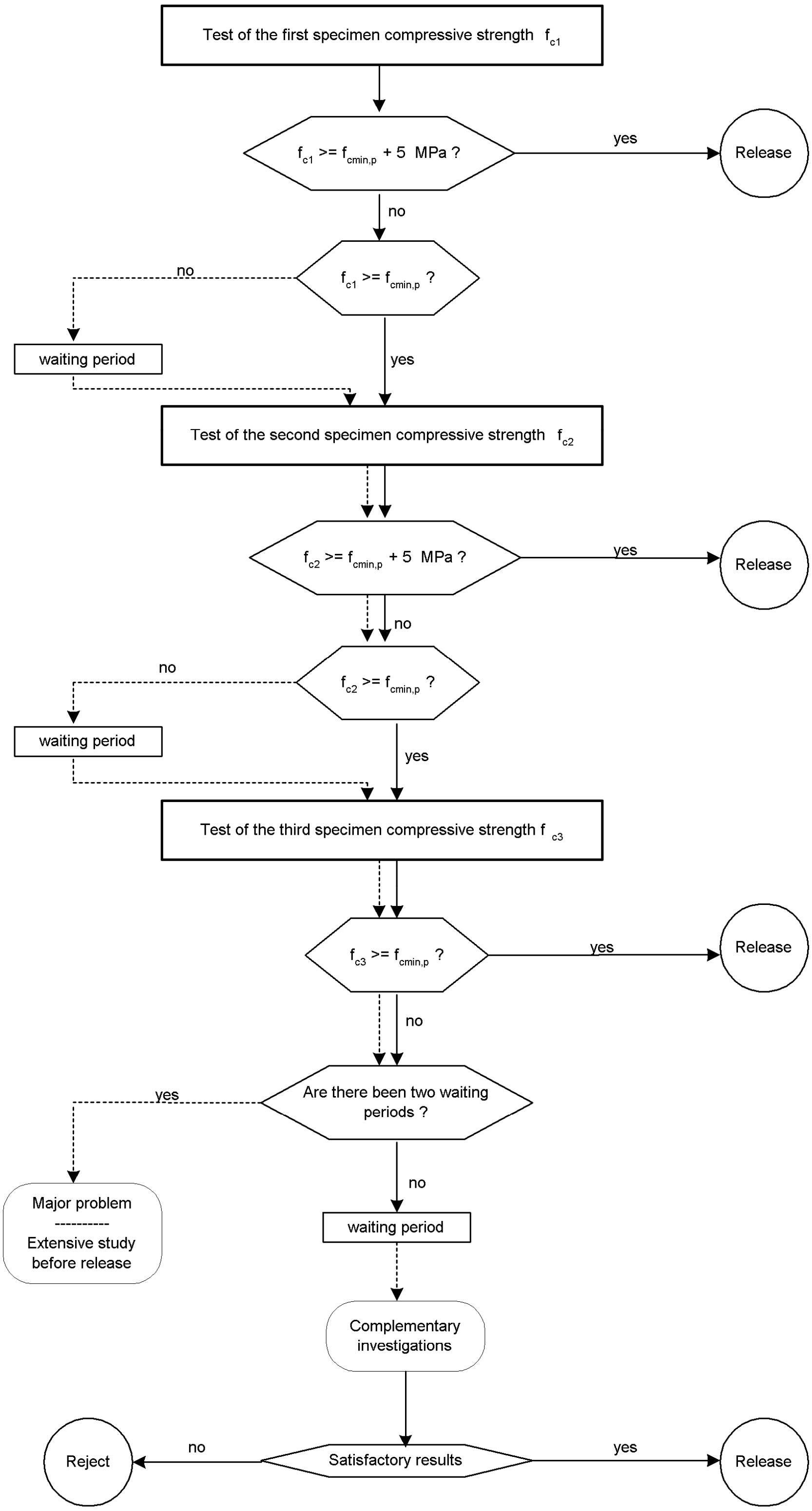


Figure G.1 — Testing procedure before release

Annex H
(informative)

Composite slabs with void formers

H.1 General

This Annex gives some properties of void formers only for fire situation (not yet given in a European Standard).

If toxic gases are produced by inflammable void formers while burning they should be submitted to appropriate standards, as regards the measure of their acceptability, because this topic is not covered by a European Standard. The evaluation of the fire resistance, definitions and calculation rules should be taken from EN 1992-1-2:2004.

H.2 Material properties

In the following clauses, material properties are reported coupled to some specific temperature values meaning that, unless otherwise stated, other values may be interpolated among them.

H.2.1 Polystyrene/Air voids

Polystyrene is an insulating material up to approximately 100 °C. At higher temperatures it vaporises, leaving an air void. Properties for polystyrene should be used up to 100 °C, and properties for an air void thereafter. A large temperature difference across the air void is liable to occur in fire situations, giving rise to significant convection within the air void, and radiation across the void increases as the temperature rises.

To make theoretical calculations with computer programs, "apparent" or "equivalent" values for the "moving" air are considered.

The couples of values of Table H.1 may be taken.

Table H.1 — Polystyrene properties coupled to temperature values

T [°C]	0	100	500	1 500
λ [W/mK]	0,04	0,1	33	33
c [J/kgK]	1 210	1 210	1 000	1 000
ρ [kg/m^3]	15	15	1	1

where T is the temperature, λ the thermal conductivity, c the specific heat capacity and ρ the density.

H.2.2 Clay

This material is, of course, rather stable of its own but the presence of voids, although very small, makes convective air motions still rather effective, yielding "apparent" parameters specific to the geometry of the void formers used.

The couples of values of Table H.2 may be taken.

Table H.2 — Clay properties coupled to temperature values

T [°C]	0	100	500	1 500
λ [W/mK]	0,2	6,7	6,7	6,7
c [J/kgK]	1 100	1 100	1 000	1 000
ρ [kg/m^3]	800	800	770	770

H.3 Temperature profiles

To evaluate these profiles the heat flux algorithm and the general and surface parameters given in EN 1992-1-2:2004 should be used with the specifications given in a) to c).

a) Radiative heat flux:

— (view or) configuration factor for exposed surface = 1;

— (view or) configuration factor for not exposed surface = 0;

— emissivity coefficient of the fire compartment E_f = 0,8;

— emissivity coefficient of the member E_m = 0,7.

b) Convective heat flux:

— coefficient of heat transfer for exposed surface = 25 W/m^2 °C;

— coefficient of heat transfer for not exposed surface = 9 W/m^2 °C.

c) External temperature, above the composite slab, has been considered to be constant and equal to : T_e = 20 °C.

H.4 Other items to be considered

Very high temperatures may lead to thermal cracking within the precast floor plate. Although the overall stability of the slab is not adversely affected immediately, thermal cracking of the bottom floor plate may be minimised by transverse bars suitably anchored to the rib reinforcement and/or by other equivalent means.

Being the concrete cover the most important factor in fire resistance of floor plates, above the average precautions must be taken in the factory control of the steel bars positioning.

An adequate increase to the anchorage of the reinforcement should be evaluated proportional to the fire resistance required.

Annex J
(normative)

Testing to determine erection spans (type testing)

J.1 General

The aim of these tests is to determine the erection spans regarding to the following criteria:

— flexural ultimate resistance;

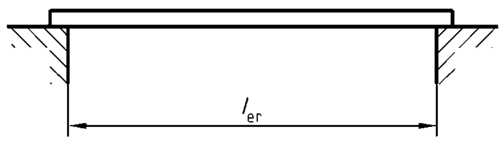
— flexural ultimate resistance at the supports (under negative bending moment);

— flexural stiffness (or deformability);

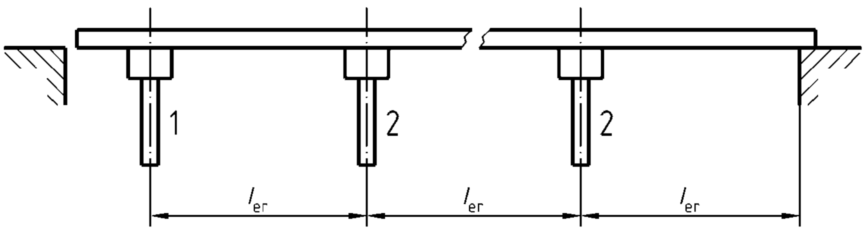
— shear ultimate resistance.

J.2 Determination of erection span

The distance between props or erection span temporary bearings, l_{er}, is defined in Figure J.1.



a) without props



b) with props

Key

1 edge prop

2 intermediate prop

Figure J.1 — Definition of erection span

In the case where an edge prop is used, the distance from the centre line of the edge prop to the face of the floor plate bearing shall not exceed 250 mm, or the value determined by calculation or by test (stability of the cantilevered part of the floor plate shall be checked).

The properties of the floor plate materials shall be taken as those specified by the manufacturer on the delivery.

The erection spans, l_{er}, shall satisfy both failure (condition a) and deflection (condition b) criteria in considering the static systems of Figure J.2, which gives the maximum values for stress in the spans and at the supports.

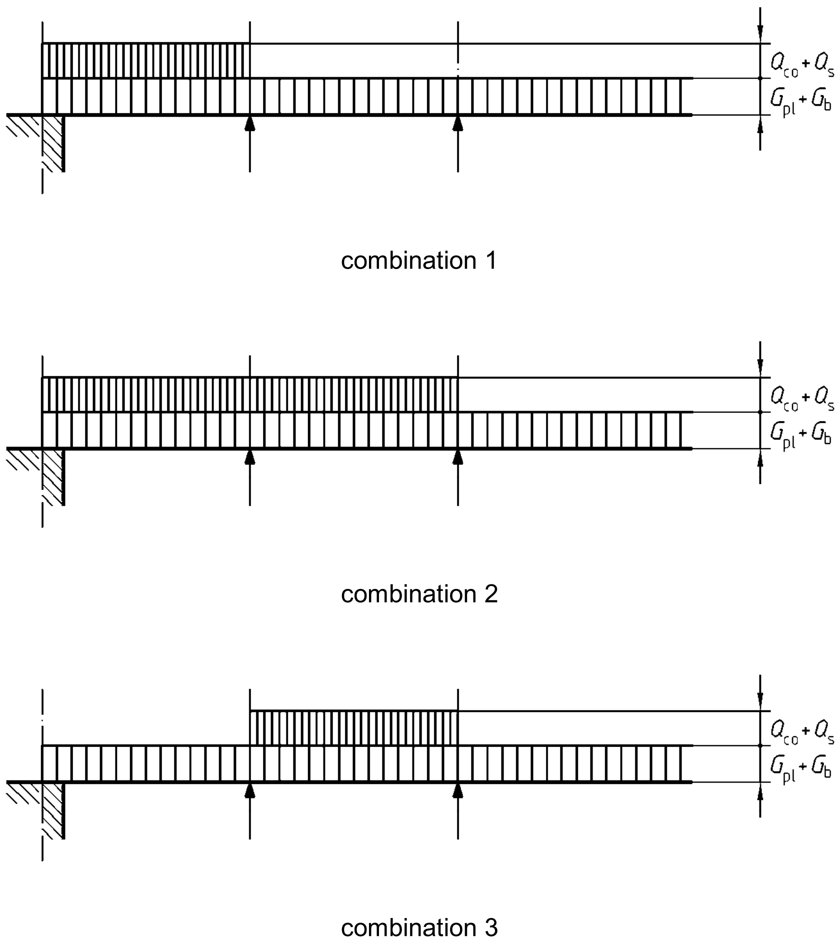


Figure J.2 — Static systems to be considered

J.2.1 Failure design (condition a)

The design load corresponding to the ultimate limit state for bending and shear force shall be at least equal to that due to the combination of actions:

$$\gamma_{Gpl} (G_{pl} + G_b) + \gamma_{Qco} Q_{co} + \gamma_{Qs} Q_s$$

where

G_b self-weight of the floor plate void formers;

G_{pl} floor plate self-weight;

Q_{co} weight of the cast-in-situ concrete;

Q_s temporary loads during floor construction.

NOTE Until such time as European regulations set the value of Q_s, it should be that given by site safety regulations valid in the country where the floor plates are used. A value of 1 kN/m^2 should be used.

J.2.2 Checking of the deflection (condition b)

For the combination of actions ($G_{pl} + G_b + Q_{co}$), the mid-span deflection between props or between temporary supports shall not be greater than the following values:

— 10 mm if $l_{er} \leq 4{,}00$ m;

— (l_{er}/400) mm if $l_{er} > 4{,}00$ m.

NOTE Different values should be specified for particular projects.

J.3 Equipment

The testing machine shall be a class 3 machine according to EN 12390-4. The loading device should be articulated. The dial gauges used to measure deflection shall be capable of measuring 0,50 mm to within 0,01 mm.

J.4 Preparation of test piece

The test shall be performed between 0 °C and 40 °C. The temperature shall be recorded.

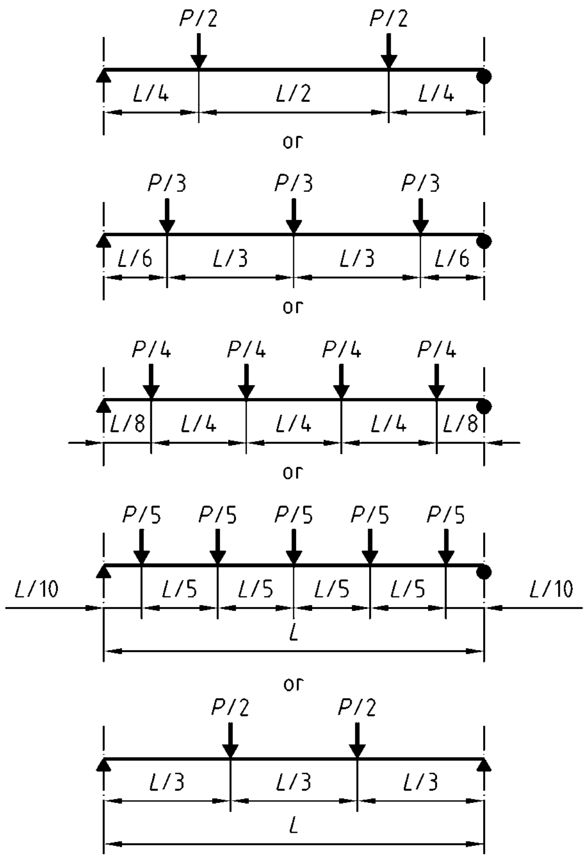
The test piece shall be a length of floor plate of, L or $2L$ in span, where L is the span approximately to l_{er} between the props or temporary supports.

NOTE It is possible to reduce the width of the floor plate to x times the distance between the centre axis of the lattice girders or the stiffening ribs and to interpolate or extrapolate the obtained results to the total width of the floor plate.

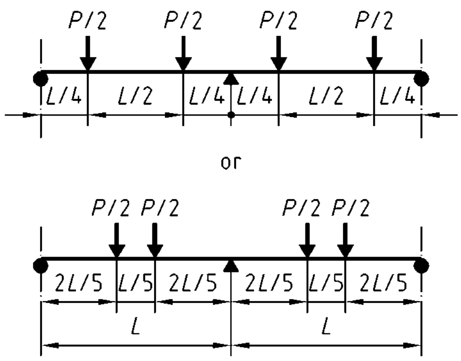
The test piece shall be supported on rollers (at least one of which shall be free to rotate) with 50 mm ± 5 mm wide and 10 mm ± 3 mm thick repartition pads if the lower face of the test piece is irregular.

The axis of the edge rollers shall be located at 50 mm ± 5 mm from the edges of the floor plate.

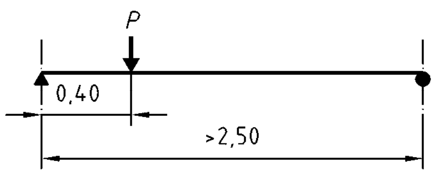
The load (P) shall be applied at positions shown in Figure J.3, by means of two 10 mm ± 3 mm thick distribution pads capable of absorbing any surface irregularities.



a) positive bending moment at mid-span and limit-deflection determination



b) negative moment at support



c) shear force

Figure J.3 — Possible dispositions for the test loading

NOTE For the negative moment, testing can be carried out with the arrangement of Figure a) placing the floor plate in an overturned position.

J.5 Loading

An initial loading, up to 10 % of the maximum expected load, followed by a return to zero shall be applied then withdrawn, to seat the floor plate (seating load).

Loading shall then be applied as follows:

1) progressively and incrementally. After each load increment, the mid-span deflection of the test piece shall be measured and corrected for bearing settlements which shall be measured at the same time the mid-span deflection;

2) when the mid-span deflection corrected for bearing settlement has reached the limit value, the load applied at that time shall be recorded (P_{flim}). The corresponding mid-span deflection and bearing settlement should be recorded;

3) the load shall be removed and the residual deformation measured;

4) after 5 min to 10 min without load (where applicable) the floor plate shall be loaded to failure using the same rate of loading as previously. The failure load, P_R, is the maximum load the floor plate can withstand.

NOTE During these loading phases, the increase in load should be stopped if an event requiring analysis occurs.

J.6 Interpretation of results

Two tests shall be carried out for each type of floor plate.

If the difference between the two results is greater than 15 % of the mean value, a third test is necessary and the mean value is calculated on the basis of three tests.

The erection span, l_{er}, shall be such that following four criteria are met:

— the mid-span bending moment calculated with span, l_{er}, and the combination of actions $(\gamma_{Gpl} (G_{pl} + G_b) + \gamma_{Qco} Q_{co} + \gamma_{Qs} Q_s)$ applied in the relevant static system shall not be greater than $M_{ms} (P_R) / \gamma_E$;

— the mid-span bending moment calculated with span, l_{er}, and the combination of actions $(G_{pl} + G_b + Q_{co})$ applied in the relevant static system shall be not greater than the moment corresponding to, P_{flim}, as determined under test conditions;

— the support bending moment calculated with span, l_{er}, and the combination of actions $(\gamma_{Gpl} (G_{pl} + G_b) + \gamma_{Qco} Q_{co} + \gamma_{Qs} Q_s)$ applied in the relevant static system shall not be greater than $M_S (P_R) / \gamma_E$;

— the shear force calculated with span, l_{er}, and the combination of actions $(\gamma_{Gpl} (G_{pl} + G_b) + \gamma_{Qco} Q_{co} + \gamma_{Qs} Q_s)$ applied in the relevant static system shall not greater than V_R / γ_E.

where

l_{er} is the erection span, in m;

M_{ms} (P_R) is the mean mid-span failure moment obtained from the tests (2 or 3), in kNm;

P_{flim} is the value of the load applied in test procedures corresponding with the limit value of the at mid-span deflection, in kN;

M_s (P_R) is the mean support moment at failure obtained from the tests (2 or 3), in kNm;

V_R is the mean shear force at failure obtained from the tests (2 or 3), in kN;

γ_E is the test coefficient taking into account the variation-coefficient of the model, relating to the geometry of the floor plate and the strength of the materials.

NOTE The relevant static system is the static system given in J.2, which led to the maximum stress level in the verification under consideration. Taking account of test results obtained on similar elements, the value of γ_E should be taken as 1,20 in the absence of more accurate information.

J.7 Test report

The test report shall mention:

- the identification of the test piece;
- span of the floor plate or the test specimen;
- the date of manufacture or some other code;
- the date and place of testing;
- the laboratory and the person in charge of testing;
- all the characteristics of materials required for testing;
- the test method;
- the measuring equipment used;
- the seating load and the residual deflection;
- the value of P_{flim} ;
- any observations regarding the test and any disorders noted (cracks, etc.);
- the failure load value, P_R ;
- the type of failure;
- a declaration that the tests were carried out in compliance with this standard, plus details of any amendments made.

Annex K
(informative)

Anchorage capacity of loops

The values for the anchorage capacity of loops given in Table K.1, for a C20/25 concrete class, should be used to check the monolithism of composite slabs (see Annex D).

Table K.1 — Characteristics of loops in the floor plate (in kN)

Diameter ∅ of the loop reinforcement (mm)	4	5	5	6	6	6	7	8
Anchorage length l_a of the loops on both sides of the interface (mm)	50	50	60	60	70	80	80	80
Spacing *s* between the tops of the loops (mm)	80	80	80	80	90	100	120	120
Section of the loop reinforcement for 1 meter length (mm^2)	310	490	490	710	630	570	640	840
Ultimate limit force per loop								
– smooth bars (f_{yk} = 235 MPa)	5,1	8,0	8,0	11,6	11,6	11,6	15,7	20,4
– ribbed bars (f_{yk} = 500 MPa or waste of tendons)	8,0	8,0	11,6	11,6	15,7	19,7	20,4	20,4
Ultimate limit shear strength per row of loops with regards to the lever arm *z* (mm)								
– smooth bars (f_{yk} = 235 MPa)	0,064*z*	0,10*z*	0,10*z*	0,15*z*	0,13*z*	0,12*z*	0,13*z*	0,17*z*
– ribbed bars (f_{yk} = 500 MPa of waste of tendons)	0,10*z*	0,10*z*	0,15*z*	0,15*z*	0,18*z*	0,20*z*	0,17*z*	0,17*z*

When the thickness of cast in-situ concrete over the floor plate is not sufficient for the minimal anchorage length of the loop, loop reinforcements may be used with a welded continuous bar at the bottom of the loops (with the same steel grade and diameter). In this case, the minimum anchorage length of the loops over the floor plate may be reduced applying a factor equal to 0,6, ultimate limit force values being the same.

If lower loops in the floor plate are at the level of the lowest longitudinal bars, the anchorage lengths given in the table are not required anymore.

Spacing between the tops of the loops given in the table may be different, but:

— no lower than 80 mm;

— and to take for the ultimate limit force of this loop the same as for the loop with the same diameter and anchorage length and with the lower spacing given in the table.

If the strength class of the cast in-situ concrete is greater than C20/25, it may be possible to:

— increase the ultimate limit forces per loop by the ratio f_{ctk}/1,5 without exceeding the force corresponding to the reach of the design yield strength of reinforcement (f_{ctk} is the characteristic axial tensile strength of the cast in-situ concrete);

— decrease the anchorage length of the loop in the floor plate by the ratio $\sqrt{1{,}5/f_{\mathrm{ctk}}}$.

Ultimate shear resistance is equal to the ultimate limit force per loop multiplied by the lever arm z spacing between the tops of the loops ratio.

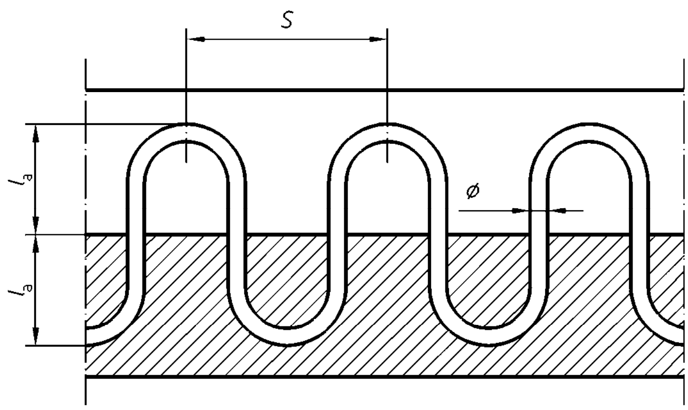


Figure K.1 — Connecting reinforcement with loops

A1 *deleted text* A1

Annex ZA
(informative)

A1 Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under the mandate M/100 "Precast Concrete Products"1) given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirements of the mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the floor plate for floor systems covered by this annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING — Other requirements and other EU Directives, not affecting the fitness for intended uses, may be applicable to the floor plates for floor systems falling within the scope of this standard.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this standard, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA, accessed through http://ec.europa.eu/enterprise/construction/internal/dangsub/dangmain_en.htm .

This annex establishes the conditions for CE marking of floor plates made of reinforced or prestressed concrete, used for the construction of the structures of buildings and other civil engineering works and shows the relevant clauses applicable.

This annex has the same scope as Clause 1 of this standard and is defined by Table ZA.1.

1) As amended.

Table ZA.1 — Relevant clauses for floor plates

Essential characteristics		Requirement clauses in this standard	Levels and/or class(es)	Notes and unit
Compressive strength (of concrete)	All methods	4.2 Production requirements	None	N/mm²
Ultimate tensile and tensile yield strength (of steel)	All methods	4.1.3 Reinforcing steel 4.1.4 Prestressing steel of EN 13369:2004	None	N/mm²
Mechanical resistance	Method 1	Information listed in ZA.3.2	None	Geometry and materials
	Method 2	4.3.3 Mechanical resistance	None	kNm, kN, kN/m
	Method 3	4.3.3 Mechanical resistance	None	Design specification
Resistance to fire (for load bearing capacity)	Method 1	Information listed in ZA.3.2	R	Geometry and materials
	Method 2	4.3.4 Resistance to fire	R	Min
	Method 3	4.3.4 Resistance to fire	R	Design specification
Airborne sound insulation index and impact noise transmission index	All methods	4.3.5 Acoustic properties	None	dB
Detailing	All methods	4.3.1 Geometrical properties 8 Technical documentation	None	mm /
Durability	All methods	4.3.7 Durability	None	Ambient conditions

The manufacturer or his authorized representative in the EEA shall select for CE marking the declaration method(s) he applies among the following:

— Method 1 = declaration of geometrical data and material properties (see ZA.3.2);

— Method 2 = declaration of geometry, material properties and product properties determined following this standard and EN Eurocodes (see ZA.3.3);

— Method 3 = declaration of product compliance with a given design specification distinguishing:

  — Method 3a = declaration of product compliance with a given design specification provided by the client (ZA.3.4);

  — Method 3b = declaration of product compliance with a given design specification provided by the manufacturer according to the client's order (ZA.3.5).

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements for that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor to declare the performance of their products with regard to this characteristic and the option "No performance determined" (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedure for attestation of conformity of floor plates for floor systems

ZA.2.1 System of attestation of conformity

The system of attestation of conformity of floor plate for floor systems, for the essential characteristics indicated in Table ZA.1, in accordance with the decision of the Commission 1999/94/EC of 25 January 1999 as given in Annex III of the Mandate M/100 "Precast concrete products", is shown in Table ZA.2, for the indicated intended use and relevant levels or classes:

Table ZA.2 — System of attestation of conformity

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Floor plates for floor systems	Structural	—	2+
System 2+ : See Directive 89/106 (CPD) Annex III-2 (ii) First possibility, including certification of the factory production control by an approved body on the basis of initial inspection of factory and of factory production control as well as of continuous surveillance, assessment and approval of factory production control.			

The attestation of conformity of floor plate for floor systems, for the essential characteristics indicated in Table ZA.1, shall be based on the evaluation of conformity procedure indicated in Table ZA.3, resulting from the application of the clauses of this or other European Standards indicated therein.

Table ZA.3 — Assignment of evaluation of conformity tasks for floor plates for floor systems under system 2+

Tasks			Content of the tasks	Evaluation of conformity clauses to apply
Tasks under the responsibility of the manufacturer		Initial type testing [a]	All characteristics of Table ZA.1 (1)	6.2
		Factory production control	Parameters related to all characteristics of Table ZA.1	6.3
		Further testing of samples taken at the factory	All characteristics of Table ZA.1	6.3
Tasks under the responsibility of the notified body	Certification of factory production control on the basis of:	Initial inspection of factory and of factory production control [b]	— Compressive strength (of concrete); — Ultimate tensile and tensile yield strength; — Mechanical resistance [c]; — Detailing; — Durability; — Resistance to fire R (in case of verification by testing).	6.3
		Continuous surveillance, assessments and approval of factory production control	— Compressive strength (of concrete); — Ultimate tensile and tensile yield strength; — Mechanical resistance [c]; — Detailing; — Durability; — Resistance to fire R (in case of verification by testing).	6.3

[a] Initial Type testing (ITT) includes calculation and/or testing. ITT by calculation is not required when only methods 1 and 3a are used.

[b] Includes assessment that the factory production control system contains documented procedures related to ITT (calculation and/or testing) and that these procedures are followed. Reference to ITT of mechanical resistance and resistance to fire (when assessed by calculation) can be omitted when only methods 1 and 3a) are used.

[c] Only for methods 2 and 3b.

ZA.2.2 EC Certificate and Declaration of conformity

When compliance with the conditions of this annex is achieved, and once the notified body has drawn up the certificate mentioned below, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity, which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and the place of production;

NOTE 1 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use etc.), and a copy of the information accompanying the CE marking;

NOTE 2 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

- provisions to which the product conforms (e.g. Annex ZA of this EN);
- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions etc.);
- the number of the accompanying factory production control certificate;
- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

The declaration shall be accompanied by a factory production control certificate, drawn up by the notified body, which shall contain, in addition to the information above, the following:

- name and address of the notified body;
- name and address of the manufacturer;
- the number of the factory production control certificate;
- conditions and period of validity of the certificate, where applicable;
- name of, and position held by, the person empowered to sign the certificate;
- generic identification of the products covered by the Factory Production Control Certificate and for each product, identification of:
  - the method(s) of CE marking applied by the manufacturer;
  - whether the product is reinforced or prestressed;
  - other distinguished product families as identified in this standard or by the manufacturer himself and affect the content and/or procedures of the factory production control including the procedure of type testing.

The above mentioned declaration and the certificate shall be presented in the official language or languages of the Member State in which the product is to be used.

ZA.3 CE marking and labelling

ZA.3.1 General

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EC and shall be shown on the product (or when not possible it may be on the accompanying label, the packaging or the accompanying commercial documents e.g. a delivery note).

The following information shall be added to the CE marking symbol:

- identification number of the certification body;
- name or identifying mark and registered address of the manufacturer;
- the last two digits of the year in which the marking is affixed;

- number of the factory production control certificate;
- reference to this European Standard;
- description of the product: generic name and intended use;
- information on those relevant essential characteristics taken from Table ZA.1 which are listed in the relevant subclause ZA.3.2, ZA.3.3, ZA.3.4 or ZA.3.5;
- "No performance determined" for characteristics where this is relevant.

The "No performance determined" (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

In the following subclauses the conditions are given for the application of CE marking. Figure ZA.1 gives the simplified label to affix to the product, containing the minimum set of information and the link to the accompanying document where the other required information is given. For what concerns the information on essential characteristics, some of them may be given by an unambiguous reference to:

- technical information (product catalogue) (see ZA.3.2);
- technical documentation (ZA.3.3);
- design specification (ZA.3.4 and ZA.3.5).

The minimum set of information to be put directly in the affixed label or in the companying document is given in Figures ZA.1, ZA.2, ZA.3, ZA.4 and ZA.5.

ZA.3.1.1 Simplified label

In the case of simplified label the following information shall be added to the CE marking symbol:

- name or identifying mark and registered address of the manufacturer;
- identification number of the unit (to ensure traceability);
- the last two digits of the year in which the marking is affixed;
- number of the CE factory production control certificate;
- reference to this European Standard.

All other information defined by the relevant method of CE marking in one of the relevant subclauses ZA.3.2, ZA.3.3, ZA.3.4 and ZA3.5 shall be provided in the accompanying documents.

The same identification number shall mark, in the accompanying documents, the information related to the unit.

Figure ZA.1 gives an example for the simplified label for CE marking.

CE	CE conformity marking consisting of the CE symbol given in Directive 93/68/EEC
AnyCo Ltd, PO Bx 21, B-1050	Name or identifying mark and registered address of the producer
45PJ76	Identification number of the unit
08	Last two digits of the year in which the marking was affixed
0123-CPD-0456	Number of the FPC certificate
EN 13747	Number of this European Standard

Figure ZA.1 — Example of simplified label

For small elements or for product stamping reasons, the size can be reduced by removing reference to EN.

ZA.3.2 Declaration of geometrical data and material properties (method 1)

Referring to Table ZA.1 and to the information quoted in the list of ZA.3.1, the following properties shall be declared:

- compressive strength of concrete;
- ultimate tensile strength of reinforcing steel;
- tensile yield strength of reinforcing steel;
- ultimate tensile strength of prestressing steel;
- tensile 0,1 proof stress of prestressing steel;
- geometrical data (only critical dimensions);
- conditions for durability;
- detailing.

This information may be given by reference to the manufacturer's Technical Information (product catalogue) for detailing, durability and geometrical data, including surface conditions and connecting reinforcement.

Figure ZA.2 gives, for a type of floor plate for floor systems, an example of CE marking inclusive of the information needed to determine, according to design regulation valid in the place of use, the properties related to mechanical resistance and stability and resistance to fire, including aspects of durability and serviceability.

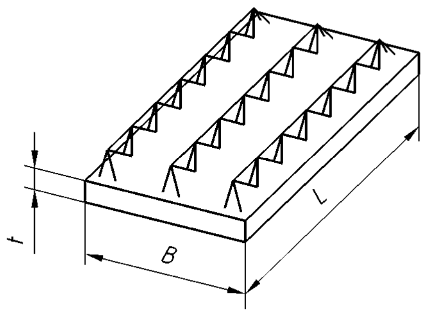
CE	CE conformity marking consisting of the CE symbol given in Directive 93/68/EEC
0123	Identification of the notified body
AnyCo Ltd, PO Bx 21, B-1050	Name or identifying mark and registered address of the producer
08	Last two digits of the year in which the marking was affixed
0123-CPD-0456	Number of the FPC certificate
EN 13747 Floor plates for floor systems	Number and title of European Standard concerned
REINFORCED FLOOR PLATES	Generic name and intended use
Concrete: Compressive strength......................f_{ck} = 45 N/mm^2 Reinforcing steel:	
Ultimate tensile strength ....f_{tk} = 580 N/mm^2	Information on product geometry and material characteristics including detailing
Tensile yield strength.......................f_{yk} = 500 N/mm^2	(to be adapted to the specific product by the manufacturer)
	NOTE 1 Numerical values are only as example.
L = 6 000 mm ± 20 mm *B* = 2 500 mm -5/+10 mm *t* = 50 ± 5 mm	
6 lattice girders 165 mm height (2+1 ∅8 long. + 2∅ diag. For detailing and durability see Technical Information Technical Information: Product Catalogue ABC : 2002- clause ii	NOTE 2 The sketch may be omitted if equivalent information is available in clearly identified technical information (product catalogue) referred to.

Figure ZA.2 — Example of CE marking with Method 1

ZA.3.3 Declaration of product properties (method 2)

For all design data, including models and parameters used in calculation, reference may be made to the technical (design) documentation.

Referring to Table ZA.1 and to the information quoted in the list of ZA.3.1, the following properties shall be declared (when relevant):

- compressive strength of concrete;
- ultimate tensile strength of reinforcing steel;
- tensile yield strength of reinforcing steel;
- ultimate tensile strength of prestressing steel;
- tensile 0,1 proof stress of prestressing steel;
- mechanical ultimate strength of the element (design values for non-seismic situations) with axial compression capacity for some eccentricities or with bending moment capacity and shear capacity of critical sections;
- resistance to fire R class;
- safety factors for concrete and steel used in calculation;
- other Nationally Determined Parameters NDPs used in calculation;
- acoustic insulation parameters (Airborne sound insulation and impact noise transmission);
- conditions for durability (exposure class(es));
- geometrical data;
- detailing.

This information may be given by reference to the manufacturer’s Technical Documentation for geometrical data, detailing, durability, other NDPs and acoustic insulation parameters.

These properties refer to the floor plate under the transient conditions (see 4.3.3.6).

Figure ZA.3 gives, for prestressed or reinforced floor plates, an example of CE marking in the case in which the properties related to mechanical resistance and stability and resistance to fire including aspects of durability and serviceability are determined by means of EN Eurocodes.

The design values of the mechanical ultimate strength of the element and the resistance to fire class shall be computed using, for the Nationally Determined Parameters, either the values recommended in EN 1992-1-1:2004 and EN 1992-1-2:2004 or the values given in the National Annex applicable to the works.

CE	CE conformity marking consisting of the CE symbol given in Directive 93/68/EEC
0123	Identification of the notified body
AnyCo Ltd, PO Bx 21, B-1050	Name or identifying mark and registered address of the manufacturer
08	Last two digits of the year in which the marking was affixed
0123-CPD-0456	Number of the FPC certificate
EN 13747	Number and title of European Standard concerned
Floor plates for floor systems REINFORCED FLOOR PLATES	Generic name and intended use
Concrete: Compressive strength.....................f_{ck} = x N/mm^2 Reinforcing steel: Ultimate tensile strength ....f_{tk} = yyy N/mm^2 Tensile yield strength......................f_{yk} = zz N/mm^2 Mechanical ultimate strength (design values): Bending moment capacity (in critical sections) ....mmm kNm Shear capacity (in critical sections) ....vvv kN	Information on product mandated characteristics including detailing (to be adapted to the specific product by the manufacturer)
Material safety factors applied in strength calculation: For concrete....................................γ_c = z,zz For steel ....γ_s = x,xx	NOTE 1 Mechanical resistance parameters refer to the precast element without any additional cast-in-situ part.
Resistance to fire R ....RXX for η_{fi} = 0,xx ....RYY for η_{fi} = 0,yy	NOTE 2 The values of resistance to fire may be replaced by a reference to the pertinent part of the technical documentation.
For geometrical data, detailing, durability, acoustic insulation parameters, possible complementary information on fire resistance and other NDPs see the Technical documentation Technical Documentation: Position Number xxxxxx	

Figure ZA.3 — Example of CE marking with Method 2

ZA.3.4 Declaration of compliance with a given design specification provided by the client (method 3a)

Referring to Table ZA.1 and to the information quoted in the list of ZA.3.1, the following properties shall be declared:

— compressive strength of concrete;

— ultimate tensile strength of reinforcing steel;

— tensile yield strength of reinforcing steel;

— ultimate tensile strength of prestressing steel;

— tensile 0,1 proof stress of prestressing steel;

— Reference to the design documents provided by the client.

This method applies also in case of a design made with means other than EN Eurocodes.

Figure ZA.4 gives, for prestressed or reinforced floor plates for floor systems, the model CE marking in the case the product is produced according to a design specification prepared by the client (designer of the works).

CE 0123	CE conformity marking consisting of the CE symbol given in Directive 93/68/EEC Identification of the notified body
AnyCo Ltd, PO Bx 21, B-1050 08 **0123-CPD-0456**	Name or identifying mark and registered address of the manufacturer Last two digits of the year in which the marking was affixed Number of the FPC certificate
EN 13747 Floor plates for floor systems PRESTRESSED FLOOR PLATES	Number and title of European Standard concerned Generic name and intended use
Concrete: Compressive strength..................f_{ck} = xx N/mm^2 Reinforcing steel: Ultimate tensile strength ....f_{tk} = yyy N/mm^2 Tensile yield strength...................f_{yk} = zzz N/mm^2 Prestressing steel: Ultimate tensile strength ....f_{pk} = uuu N/mm^2 Tensile 0,1 % proof-stress...........$f_{p0,1k}$ = www N/mm^2 For geometrical data, detailing, mechanical strength, fire resistance, acoustic insulation parameters and durability see the design specifications Design Specification provided by the client: Reference .... (file number)	Information on product mandated characteristics including detailing (to be adapted to the specific product by the manufacturer)

Figure ZA.4 — Example of CE marking with Method 3a

ZA.3.5 Declaration of compliance with a given design specification provided by the manufacturer according to the client's order (method 3b)

Referring to Table ZA.1 and to the information quoted in the list of ZA.3.1, the following properties shall be declared:

— compressive strength of concrete;

— ultimate tensile strength of reinforcing steel;

— tensile yield strength of reinforcing steel;

— ultimate tensile strength of prestressing steel;

— tensile 0,1 proof stress of prestressing steel;

— resistance to fire class;

— reference to the design specifications according to the client's order and dealing with geometrical data, detailing, mechanical strength, fire resistance, acoustic insulation parameters and durability.

This method applies also in case of a design made with means other than EN Eurocodes.

Figure ZA.5 gives, for prestressed or reinforced floor plates for floor systems, the model CE marking in the case the product is produced according to a design specification applied by the manufacturer according to the purchaser's order.

CE	CE conformity marking consisting of the CE symbol given in Directive 93/68/EEC
0123	Identification of the notified body
AnyCo Ltd, PO Bx 21, B-1050	Name or identifying mark and registered address of the manufacturer
08	Last two digits of the year in which the marking was affixed
0123-CPD-0456	Number of the FPC certificate
EN 13747	Number and title of European Standard concerned
Floor plates for floor systems PRESTRESSED FLOOR PLATES	Generic name and intended use
Concrete: Compressive strength ....f_{ck} = xx N/mm^2 Reinforcing steel: Ultimate tensile strength ....f_{tk} = yyy N/mm^2 Tensile yield strength ....f_{yk} = zzz N/mm^2 Prestressing steel: Ultimate tensile strength ....f_{pk} = uuu N/mm^2 Tensile 0,1 % proof-stress ....$f_{p0,1k}$ = www N/mm^2 For geometrical data, detailing, mechanical strength, fire resistance, acoustic insulation parameters and durability see the design specifications Design specification: ....(client's order)	Information on product mandated characteristics including detailing (to be adapted to the specific product by the manufacturer)

Figure ZA.5 — Example of CE marking with Method 3b

In addition to any specific information relating to dangerous substances, the product should be also accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

European legislation without national derogations need not be mentioned.

NOTE Affixing the CE marking symbol means, if a product is subject to more than one directive, that it complies with all applicable directives.

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