

Expanded polystyrene (EPS) blocks for floor systems insulation formwork

Solai realizzati con casseri isolanti a rimanere di polistirene espanso (EPS)

This document defines the requirements and performance criteria for formworks made with expanded polystyrene (EPS) used in building projects to construct reinforced concrete slabs.

Published on 10 March 2017

ICS 91.100.30



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Further to the application of this UNI/PdR, anyone interested in providing suggestions for its improvement is requested to send their own contributions to UNI, Italian Organization for Standardization, which shall take them into account.

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INTRODUCTION

The document is a guideline for characterizing the constituent elements of formworks made of insulating EPS intended to remain after the construction of horizontal or sloped slabs, as employed in the construction industry.

The permanent slab formwork made with EPS is characterized by a weight less than that of traditional slabs and is easily managed on building sites during the construction phase of the building.

This component helps to obtain a building characterized by a high resistance to mechanical stress.

The presence of EPS creates a light slab that offers, at the same time, an adequate mechanical resistance created by an elevated structural rigidity.

The interaction between the horizontal elements so manufactured and vertical elements allow for the creation of a building that responds adequately to seismic stresses in accordance with existing national legislation.

This type of slab is also used in diffusely reinforced building systems, defined in Italy by the acronym "SAAD" (Sistemi Ad Armatura Diffusa).

It can be placed on a deck of provisional supports, perfectly matching the formworks in order to eliminate any thermal bridge in correspondence with the ribs, and integrated with the cast concrete to form beams and the slabs of specified width.

EPS is used as the material that constitutes the formwork, remaining in place around the cast concrete and its reinforcement and, at the same time, providing thermal insulation. EPS elements can be of different sizes and geometries and also incorporate elements of different materials.

The components of the formwork manufactured in EPS may include elements of longitudinal reinforcement that contribute to achieving the self-supporting capacity of the formwork. These stiffening elements are often inserted in the insulating material so that they also offer support in position for the finishing of the lower surface of the slab by providing for appropriate systems to achieve this finishing.

The slab includes the use of metal reinforcement and cast concrete to meet the needs of the structural size required by law and the finishing of extrados and intrados for the completion of the works.

1 SCOPE

This UNI/PdR defines the requirements and performance criteria for formworks made with expanded polystyrene (EPS) used in building projects to construct reinforced concrete slabs for mono-, bi-, and monolithic structures.

The formworks in EPS do not add to the structural strength of the finished slab system (formworks with no structural features).

The formworks of EPS are employed to make both the first and intermediate floors and also covering slabs. They contribute to a high and continuous thermal and acoustic insulation of the complete horizontal structure and, therefore, of the building system.

NOTE UNI EN 15037-4 is not applicable to the slabs that are the object of this UNI/PdR 30:2017 as these are not resting on joists of prefabricated concrete. That provision is, however, the most exhaustive normative reference for the purpose of structuring this UNI /PdR.

2 NORMATIVE REFERENCES

This UNI/PdR makes reference, by dated and undated references, to provisions contained in other publications. These normative references are cited at the appropriate points in the text and listed below. For dated references, subsequent amendments or revisions made to any of these publications apply only when cited in the present document as update or review. For undated references, the latest edition of the referenced publication applies.

UNI EN 826 Thermal insulating products for building applications - Determination of compression behaviour

UNI EN 1365-2 Testing of fire resistance for load-bearing elements - Part 2: Floors and roofs

UNI EN 1609 Thermal insulation products for building applications - Determination of short term water absorption by partial immersion

UNI EN 1994-1-1 Eurocode 4 - Design of composite steel and concrete structures - Part 1-1: General rules and rules for buildings

UNI EN ISO 10211 Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations

UNI EN ISO 11925-2 Reaction to fire tests - Ignitability of building products subjected to direct impingement of flame - Part 2: Single-flame source

UNI EN 12089 Thermal insulating products for building applications - Determination of bending behaviour

UNI EN 12390-4 Testing hardened concrete - Compressive strength - Specification for testing machines

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UNI EN 12667 Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance

UNI EN 13163 Thermal insulation products for building applications - Factory made expanded polystyrene (EPS) products – Specifications

UNI EN 13369 Common rules for precast concrete products

UNI EN 13501-1 Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests

UNI EN 13501-2 Fire Classification of Construction Products and Building Elements - Part 2: Classification Using Test Data from Fire Resistance Tests, Excluding Ventilation Systems

UNI EN 15037-4 Precast concrete products – Beam and block floor systems - Part 4: Expanded polystyrene blocks

UNI EN ISO 16000-1 Indoor air - Part 1: General aspects of sampling strategy

UNI EN ISO 16000-2 Indoor air - Part 2: Sampling strategy for formaldehyde

UNI EN ISO 16000-5 Indoor air - Part 5: Sampling strategy for volatile organic compounds (VOC)

UNI EN ISO 16000-9 Indoor air - Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method

UNI EN ISO 16000-10 Indoor air - Part 10: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test cell method

UNI EN ISO 16000-11 Indoor air - Part 11: Determination of the emission of volatile organic compounds from building products and furnishing – Sampling, storage of samples, and preparation of test samples

UNI EN ISO 16000-19 Indoor air - Part 19: Sampling strategy for moulds

UNI EN ISO 16000-26 Indoor air - Part 26: Sampling strategy for carbon dioxide (CO₂)

CEN/TS 16516 Construction products - Assessment of the release of dangerous substances – Determination of emissions into indoor air

3 TERMS AND DEFINITIONS

For the purposes of this document, the following terms and definitions apply:

3.1 toe/base beam: The element of the EPS formwork that allows it to limit the poured reinforced concrete. This element can be made in two parts that belong to two separate adjacent pieces of formwork, or it can be included in each individual formwork.

3.2 insulated formwork: Formwork of variable geometry in EPS for forming reinforced concrete slabs in building projects and then performs as thermal insulation. It can provide for the presence of reinforcing elements and the support elements for finishing the intrados surface.

3.3 reinforcing elements: Presence of any elements positioned within the formwork in EPS to improve the load bearing capacity.

3.4 EPS: Rigid cellular plastic material, virgin and / or regenerated, manufactured by sintering beads / granules of expandable polystyrene or one of its copolymers, characterized by a structure with air-containing closed cells.

3.5 SAAD: Italian acronym for “diffusely reinforced building systems”.

3.6 slab system: System consisting of EPS formwork, reinforcing rods, cast concrete with the completed extrados and the finishing of the intrados.

4 PRINCIPLES

This UNI/PdR defines the requirements and performance criteria for the formwork made with expanded polystyrene (EPS) that is used for making reinforced concrete slabs in building construction.

In the document, requirements for the material are identified along with the requirements for the finished product and the test methods related to the defined requirements.

This document also defines the checks that shall be performed for verifying conformity with the declared performance in terms of identifying initial testing and factory production controls.

The annex completing the document relates to the fire behaviour of lightened slab systems.

5 REQUIREMENTS

5.1 EPS REQUIREMENTS

The EPS material used shall satisfy the pertinent requirements specified in UNI EN 13163.

If other materials are combined with EPS, their suitability shall be demonstrated.

Suitability may be demonstrated by a European standard that would specifically apply to the use of this material in building construction. In the absence of a European standard, suitability can also be demonstrated, with the same conditions, by an international ISO standard.

If this material is not covered by a European or international standard, or deviates from the requirements of these standards, suitability may be demonstrated from:

- relevant national standards or provisions valid where the product is used that relate specifically to the use of this material in products for building construction;
- or an approved European technical specification for the use of this material in building construction.

5.1.1 COMPRESSIVE STRENGTH

Formworks in EPS shall satisfy the following requirements.

The minimum class shall be CS(10)70 (compressive strength $\sigma_{10} \geq 70$ KPa for 10% deformation) in accordance with UNI EN 13163.

The compressive strength shall be measured as defined in clause 6.3.

5.1.2 FLEXURAL STRENGTH

The manufacturer shall declare a flexural strength measured in accordance with clause 6.4.

5.1.3 WATER ABSORPTION

Water absorption by the EPS that is used for insulating formworks shall have values $\leq 0,5$ Kg/m² determined in accordance with UNI EN 1609 (partial immersion for a period of 24 h) as described in clause 6.5.

5.1.4 PERMEABILITY TO WATER VAPOUR

To express the transpiration of water vapour by a material, two correlated quantities are normally used:

- δ [Kg/s m Pa], permeability of water vapour: expresses the actual quantity of vapour that actually crosses through a material, that is the quantity of vapour in Kg per second that crosses through a 1 meter thickness of the material under a pressure difference of 1 Pascal;
- μ [-], resistance factor to the diffusion of water vapour: this dimensionless parameter expresses the ratio between the thickness of air to the thickness of the material in question offering the same resistance to the passage of water vapour.

The manufacturer shall declare the resistance factor to water vapour, μ , in accordance with clause 6.6.

5.1.5 REACTION TO FIRE

The manufacturer shall declare a reaction to fire in conformity with UNI EN 13501-1 not inferior to Euroclass E.

5.1.6 THERMAL CONDUCTIVITY AND THERMAL RESISTANCE

The value of λD (thermal conductivity) and the calculation of the value of R (thermal resistance) shall be declared on the basis of the geometry of the block (weighted thermal resistance).

NOTE The thermal conductivity of EPS does not change with time.

5.1.7 DANGEROUS SUBSTANCES

In the absence of harmonized test methods at the European level, verification and declarations relating to the release / content of substances can be carried out taking into account national provisions in the place of use.

National regulations on hazardous substances may require the verification and declaration concerning the release of substances, and sometimes the content, when the construction products covered by this standard are placed on the market.

The assessment of the release of certain substances can be conducted in accordance with standards in UNI EN ISO 16000 and in accordance with CEN/TS 16516.

An online database of information relative to European and national provisions on dangerous substances is available at http://ec.europa.eu/growth/tools-databases/cp-ds/index_en.htm.

5.2 REQUIREMENTS OF EPS FORMWORKS

5.2.1 DIMENSIONS AND DIMENSIONAL TOLERANCES

Some non-exhaustive examples of different types of EPS formworks are shown below.

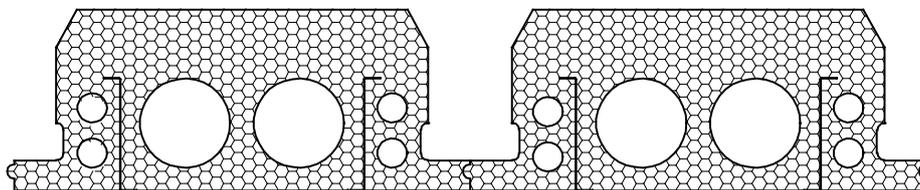


Figure 1 – Type of formwork in which the base is formed by two toes from two distinct side-by-side blocks

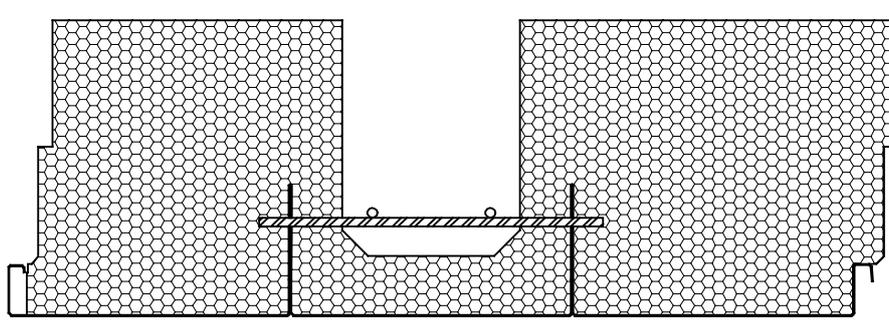


Figure 2 - Type of formwork in which the base is comprised in each individual block

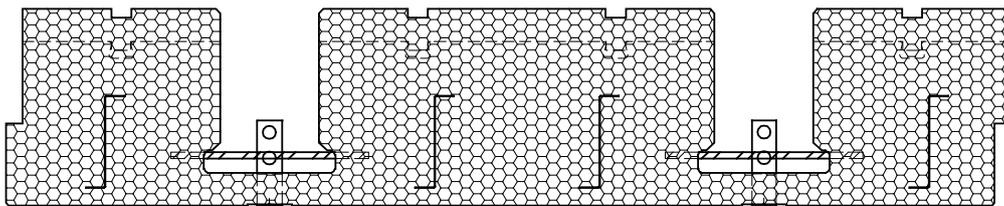


Figure 3 – Type of formwork that allows for the formation of two beams

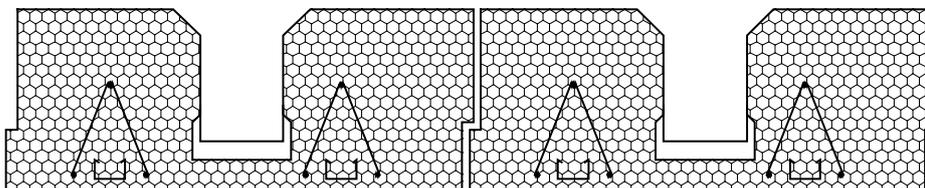


Figure 4 - Type of formwork in which the base is comprised in each individual block

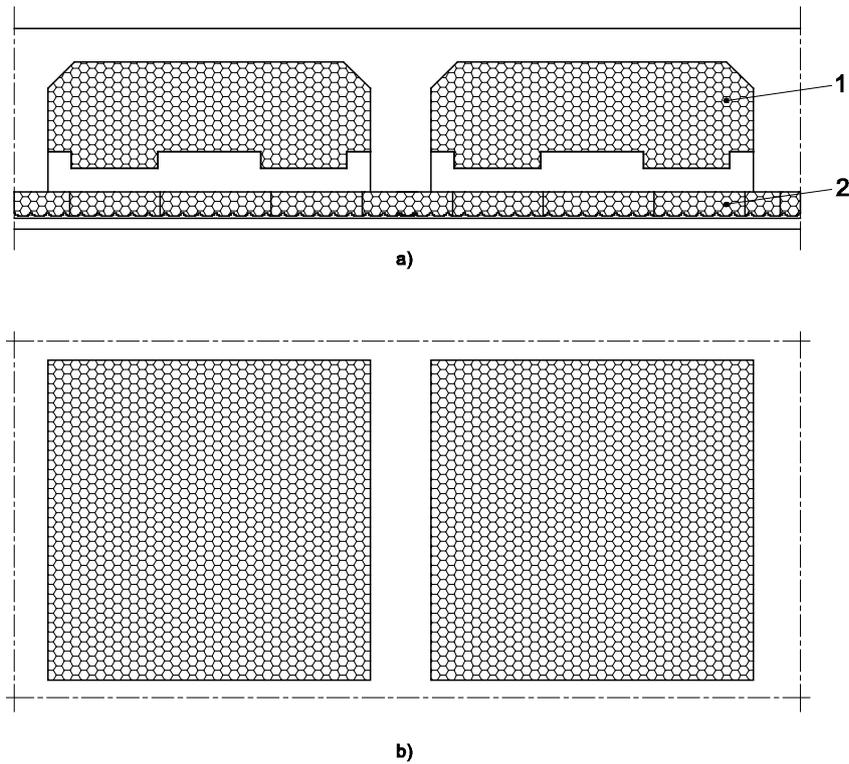
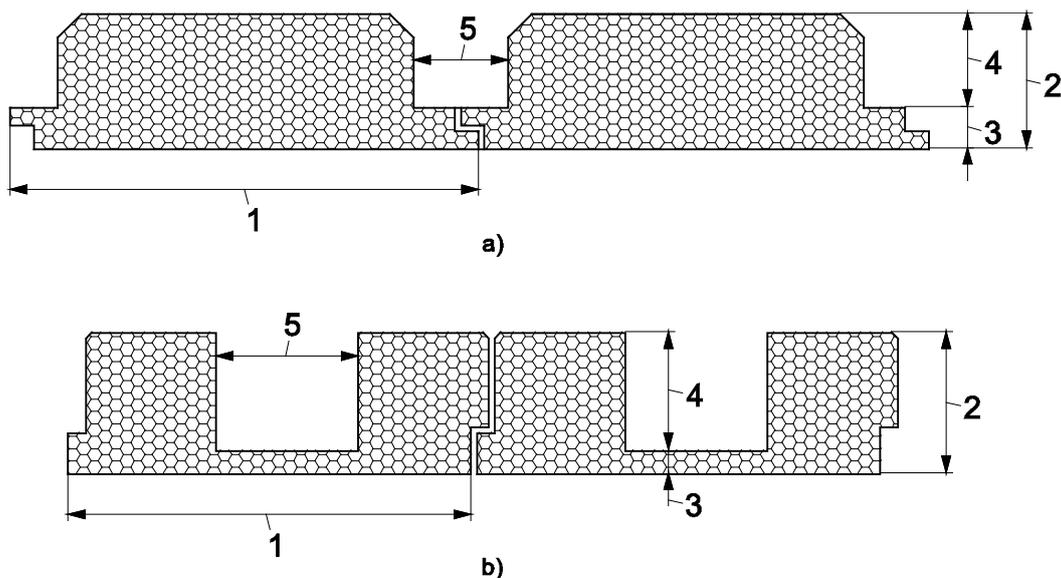


Figure 5a (cross sectional view) e 5b (top view) – Type of formwork in which the toe is formed from two distinct side-by-side pieces. Each block in the formwork is devised in two parts: a hollow EPS block and an EPS base

Key

- 1 EPS Hollow Block
- 2 EPS Base

Figures 6a and 6b below are sections of types of EPS formworks identifying the relevant dimensions for the purpose of this document.



Figures 6 a) b) – Dimensions of EPS Formworks

Key

- 1 Width of formwork l
- 2 Height of formwork h
- 3 Thickness of base sf
- 4 Height of beam ht
- 5 Width of beam lt

The tolerances of the dimensions are shown in Table 1.

Table1 – Dimensional tolerances

Dimensions	Tolerances*
1 – Width of formwork l	+/- 5 mm
2 – Height of formwork h	+/- 5 mm
3 – Thickness of the base sf	+/- 4 mm
4 – Beam width ht	+/- 5 mm
5 – Beam height lt	+/- 5 mm

* The manufacturer may declare lower tolerances.

The length dimension of the formwork is a function of that of the slab to be manufactured.

The formwork is made with EPS and, possibly, reinforcements that have different characteristics relating to the tolerance of the finished product.

The maximum tolerance of the total length of the formwork is 40 mm with respect to the nominal length of the EPS. One can check if the reinforcement exceeds the formwork in EPS.

5.2.1.1 LONGITUDINAL RECTALINEARITY OF THE BLOCKS

Adjacent formworks shall not allow the formation of cracks that permit concrete to spill.

With reference to the shape of the formwork, the following nominal principal dimensions shall be declared:

- Width of the formwork l
- Height of the formwork h
- Thickness of the base s_f
- Height of the beam h_t
- Width of the beam l_t .

5.2.2 SURFACE APPEARANCE

The formworks shall not have defects that might be impair their mechanical and thermal performance.

For test methods, see clause 6.2.

5.2.3 FIRE RESISTANCE OF THE SLAB SYSTEM

The fire resistance class of the finished slab system is to be determined by the projected use of the building under constructed and its required performance.

Clause 6.7.2 provides useful information for the evaluation and declaration of fire resistance of the finished slab system.

5.2.4 MECHANICAL STRENGTH

Resistance to external loads:

- a) self-support (weight distributed – load concentrated);
- b) walkability;
- c) strength of base.

5.2.4.1 SELF-SUPPORT

Self-support is needed only in cases where slabs are not totally supported.

The self-supporting panels shall be able to withstand the loads at the initial construction stage, i.e., fresh concrete, reinforcing rods, and workers, as provided for by UNI EN 1994-1-1.

The test is carried out as described in clause 6.9.1 to verify the deformation deflection caused by agent loads defined according to the actual use and distance between supporting purlins.

5.2.4.2 WALKABILITY

Walkability is measured by the resistance to concentrated loads, P_{RK} .

The minimum resistance to P_{RK} concentrated loads shall be not less than 1.5 KN value (for the 5% fractile) and is evaluated according to the test described in clause 6.9.2 (test load focused on a single block).

5.2.4.3 STRENGTH OF THE TOE/BASE BEAM

The strength of the toe/base beam shall be evaluated by a load test in which an appropriate equivalent load simulates the load that shall supported by the work in progress (the poured concrete and iron reinforcement).

The test method is specified in clause 6.9.3. The test is passed if the breaking point of the toe/base is not reached with an appropriately-determined equivalent load.

5.2.5 THERMAL RESISTANCE OF THE SLAB

To calculate the thermal resistance of the slab (R value), the equivalent λ value shall be used. One method is shown in clause 6.8. Another method can be used, provided that the results are equivalent.

5.2.6 ACOUSTIC PROPERTIES

The acoustic properties depend on the finished slab (type of formwork, elements applied to the inferior and superior surfaces of the slab, etc.)

Where pertinent, clause 4.3.5 of UNI EN 13369:2004 should be applied.

NOTE For design purposes, and in the absence of measurement results, the method shown in Appendix L of UNI EN 15037-1:2008 shall be used (sound insulation from impacts and airborne noise).

5.2.7 DURABILITY

The durability of the formwork shall be consistent with the materials used for the construction of the slab.

6 TEST METHODS

6.1 DIMENSIONS OF EPS FORMWORKS

Dimensions shall meet the requirements and values declared by the manufacturer within the tolerances specified in clause 5.2.1.

The following are the principal nominal dimensions:

- formwork width l
- formwork height h
- thickness of the base s_f
- beam height h_t
- beam width l_t .

Dimensions shall be checked at least once for each order.

6.2 SURFACE APPEARANCE

The surface appearance of the blocks shall be visually inspected.

Defective products shall be discarded.

6.3 COMPRESSIVE STRENGTH

The compressive strength of the EPS shall be determined in accordance with UNI EN 826.

6.4 FLEXURAL STRENGTH

The flexural strength of the EPS shall be determined in accordance with UNI EN 12089.

6.5 WATER ABSORPTION

The water absorption of the EPS shall be determined in accordance with UNI EN 1609 for absorption after partial immersion for a short period (24 h).

6.6 PERMEABILITY TO WATER VAPOUR

The factor of resistance to water vapour diffusion in EPS, μ , shall be determined according to UNI EN 12086 or found from tabulated values specifically reported in EN 13163, as follows:

Table 2 – Tabulated values of the transmission of water vapour in EPS

Compressive strength of the EPS at 10% deformation σ_{10} [KPa]	Resistance factor to the diffusion of water vapour μ [-]	Permeability to water vapour δ [mg/h m Pa]
70	from 20 to 40	from 0.015 to 0.030
80	from 20 to 40	from 0.015 to 0.030
90	from 30 to 70	from 0.009 to 0.020
100	from 30 to 70	from 0.009 to 0.020
120	from 30 to 70	from 0.009 to 0.020
150	from 30 to 70	from 0.009 to 0.020

6.7 REACTION TO FIRE

6.7.1 FIRE REACTION OF EPS AND THE SLAB SYSTEM

The reaction of EPS and the slab system to fire shall be classified in accordance with UNI EN 13501-1 and on the basis of the test methods in that standard.

6.7.2 FIRE RESISTANCE OF THE SLAB SYSTEM

The fire resistance of the slab system shall be assessed and declared in accordance with local regulations, as specified in the Italian Decree of 16 February 2007 "Classificazione di resistenza al fuoco di prodotti ed elementi costruttivi di opere da costruzione" and subsequent amendments.

Annex to this UNI/PdR 30:2017 specifies the types of slabs that use EPS formwork and clarifies their relative fire behaviors.

The fire resistance shall be classified on the basis of UNI EN 13501-2 and the results obtained from fire resistance tests described therein.

6.8 THERMAL PROPERTIES

6.8.1 THERMAL CONDUCTIVITY

Thermal conductivity shall be measured in conformity with clause 4.2.1 of UNI EN 13163 and UNI EN 12667.

6.8.2 THERMAL RESISTANCE OF THE SLAB

The thermal resistance of the slab is determined by calculations. The method used shall satisfy the requirements of EN ISO 10211.

6.9 MECHANICAL RESISTANCE

6.9.1 SELF-SUPPORT

The evaluation and testing of the self-supporting capacity of the EPS formwork under loads corresponding to the phase of pouring the concrete and the related actions of external agents is done according to the test methods indicated below.

The corresponding load test is used to in order to verify:

- the permanent deflection due to its own weight and corresponding to the phase of the concrete pour.
- the load-bearing capacity of the slab formwork against possible loads acting on the structure during the pour;
- the failure mechanism leading to collapse of the formwork.

The EPS formwork is placed on two supports that are placed at a distance that simulates the most unfavourable condition in which that element that will be found during construction.

Two centesimal gauges are positioned on the unloaded structure, one on the centerline (M1) and the other on the support to the right (M2).

The first step is performed with a uniformly distributed load over the entire span (Figure 7).

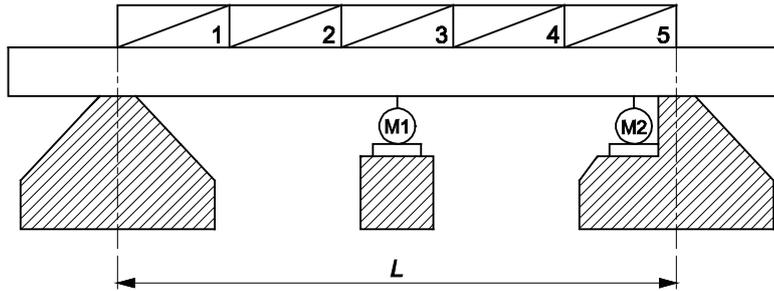


Figure 7 – Permanent load

The simulated load may be represented by bags of cement, whose total weight is determined on the basis of the concrete required to simulate the phase after which the concrete is poured and before its setting reaction is complete.

The average value of deflection measured in this step shall be less than the calculated theoretical deflection.

Useful information for verifying the behaviour of the formwork subjected to normal loads that occur during the pouring of the concrete is contained in UNI EN 1994-1-1. These loads may include concrete accumulations, increases in the height of the concrete due to stagnation effects as a result of deformations in the longitudinal reinforcements, and the weight of the workers involved in the pouring of the concrete.

UNI EN 1994-1-1 states: "The loads under construction represent the mass of the workers and machines for pouring the concrete and take into account any impact or vibration that may occur during construction. For each of 3 x 3 m area (or the length of the span, if less) the load characteristics of the construction and the surplus concrete mass is taken to be equal to a total of 1.5 kN/m² in addition to the mass of the concrete. For the remaining area, it is recommended that an extra load of 0.75 kN/m² be added to the mass of concrete. It is recommended that these loads are arranged so as to obtain the maximum moment of bending and / or shear ".

On the basis of the above, to determine the self-supporting capacity of the formwork in EPS, the test shall be carried out applying a distributed load of 1.5 kN/m² for a length of 1.00 m at the centre of the span between the supports (supports positioned at the maximum predicted distance between provisional purlins) and a load of 0.75 kN/m² on the two remaining parts at the ends of the formwork. At the end of this loading phase, the average deformation shall be detected only after the stabilization of the two gauges and the theoretical deflection shall be calculated.

The next step is to increase the load on the two ends of the span to match the load of 1.5 kN/m² present in the central area and, subsequently, incrementally increasing the load evenly along the whole formwork. The values of the corresponding deformations are measured continuing up to the collapse of the structure.

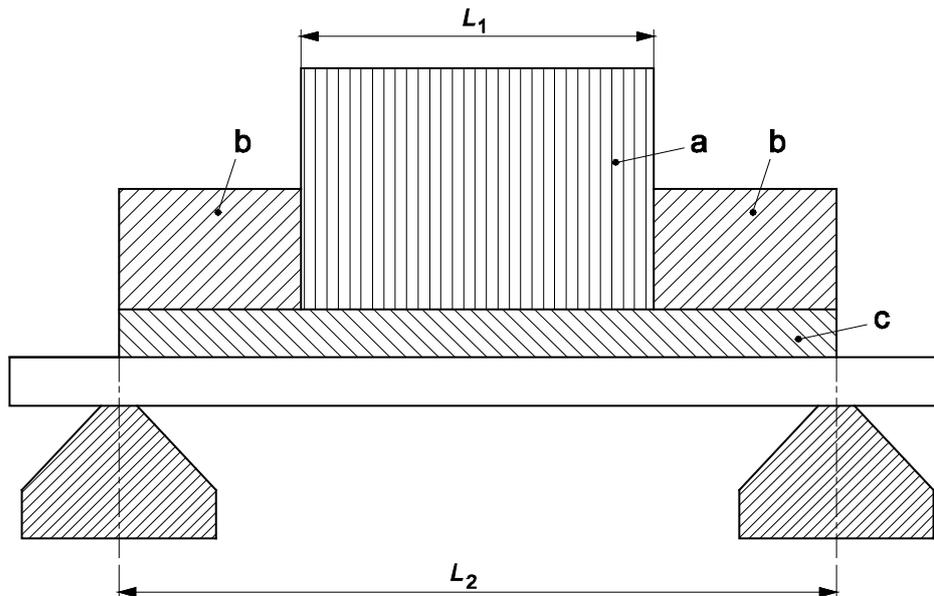


Figure 8 – Live load phase

Key

- (a) Concentrated Load under Construction of 1.5 kN/m^2
- (b) Distributed Load under Construction of 0.75 kN/m^2
- (c) Fixed Load

The average deformation is detected after the stabilization of the two gauges, calculating the theoretical deflection in each case.

The test continues with successive additional loads, registering the value of the deformation corresponding to each additional load until the structure collapses.

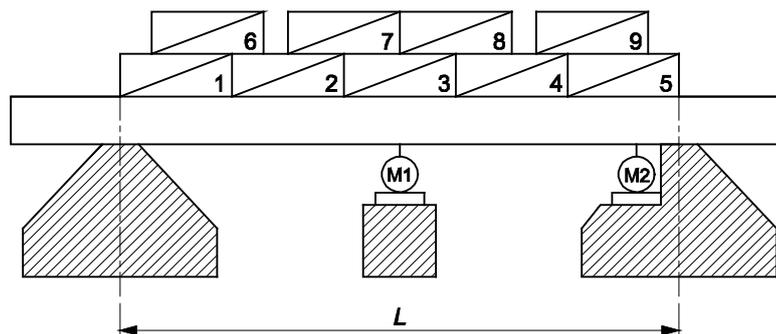


Figure 9 – Collapse phase

The collapse of the structure allows the verification of the failure mechanism of any reinforcing elements that shall be documented with a suitable structural analysis.

Each individual step of the loading process up to the breaking point shall also be documented with a visual examination.

6.9.2 WALKABILITY

6.9.2.1 TEST APPARATUS

- Test apparatus of at least class 3 for the application for forces specified in UNI EN 12390-4:2000;
- Framework sufficiently rigid to withstand the forces applied while loading the test object;
- Supports: the two supports represent the beams. One support shall be fixed and the other adjustable. If continuous support (formwork) is required by local regulations, that can also be used.

NOTE The two supports can be covered with abrasive cloth (40 grit) or a system that has an equivalent roughness. The abrasive cloth covers the actual length of and adheres to the supports. It can be cleaned and replaced regularly, at the discretion of the manufacturer.

Device for applying loads. The device for applying loads shall consist of a lifter (electric or hydraulic), a rigid plate for applying the loads (e.g., of wood or steel) with dimensions of 100 mm x 300 mm x 25 mm (Figure 10), a ball joint and a loading cell.

The use of a load application device comprising a ball plate (Figure 10) to reduce the effect of the horizontal resistance is specified in paragraph 6.2.2 of EN 15037-4.

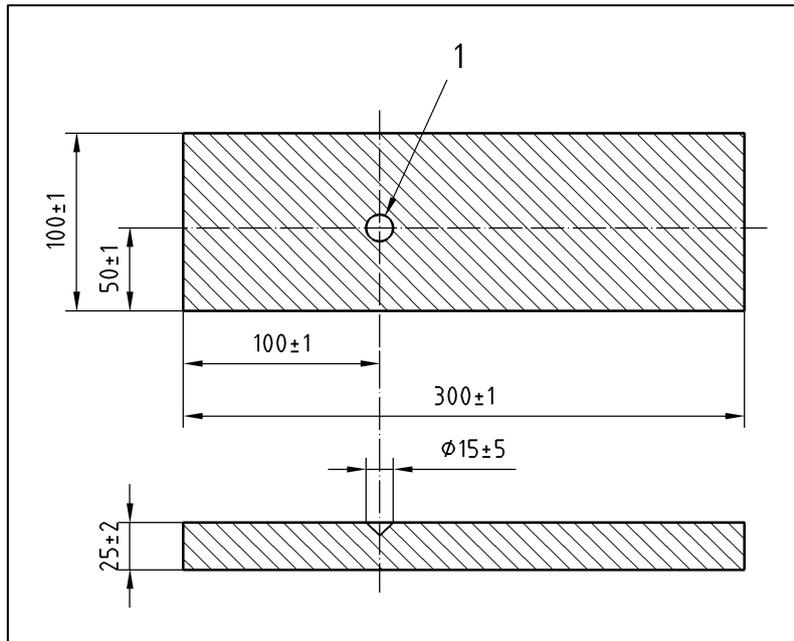


Figure 10 – Rigid plate for applying loads like that in UNI EN15037-4

Key

1 Position of the ball joint

Dimensions in millimetres

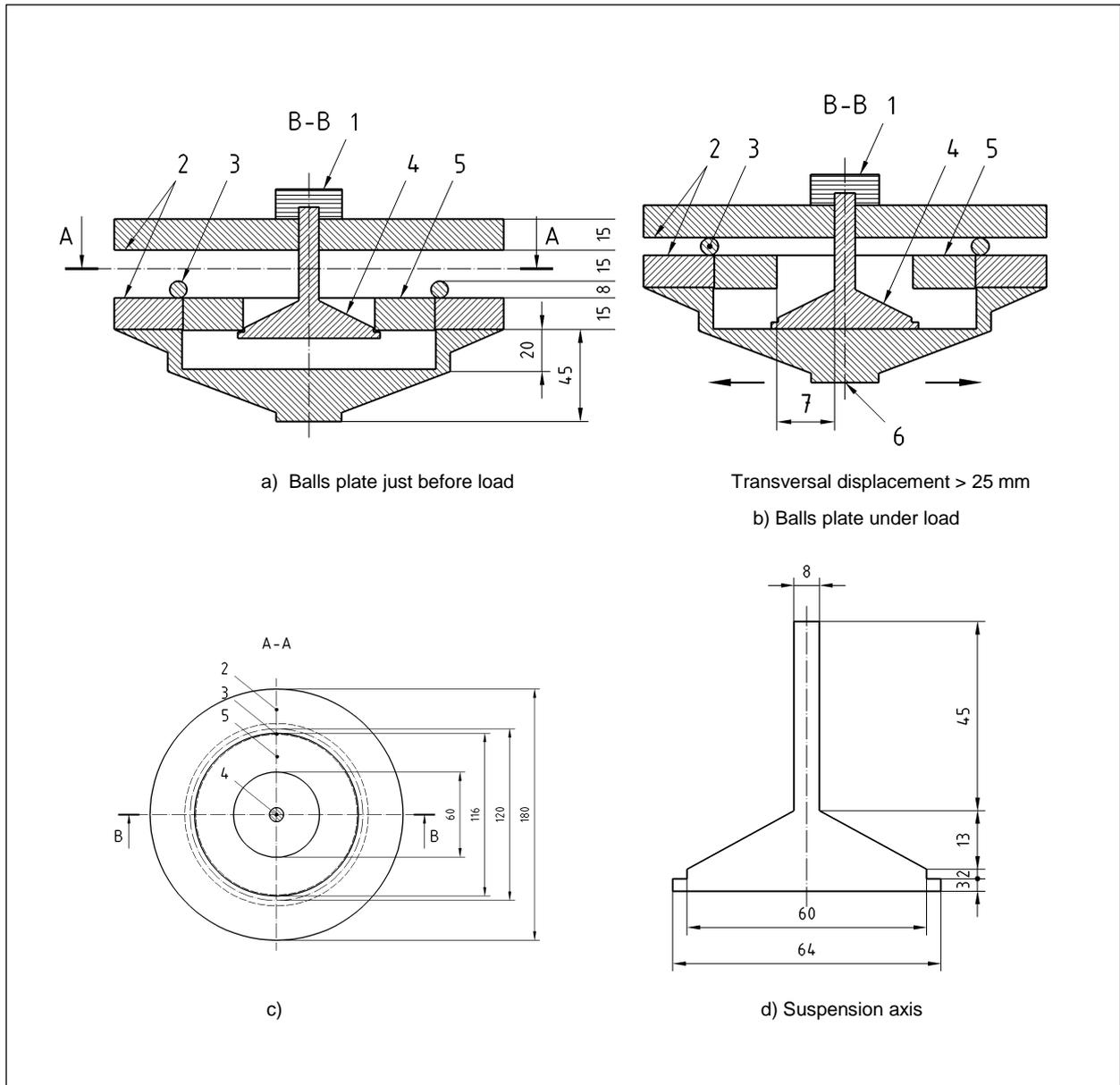


Figure 11 – Example of a plate with ball bearings like that in UNI EN15037-4

Key

- | | |
|--|---|
| 1 Connection to the load cell | 4 Suspension axis |
| 2 Hardened surface of the plates | 5 Washer interdependent with the lower plate |
| 3 Ball Ø 8 mm and cage thrust assembly | 6 Connection of the ball joint to the rigid loading plate |

Dimensions in millimetres

The ball bearing assembly shall have a diameter of at least 80 mm.

Immediately before the application of the load, the axis of the load cell shall be aligned with that of the ball join.

During the application of the load, the ball plate shall allow transverse displacement of the rigid load application plate of at least 25 mm in all directions.

Calibration: The resistance results obtained from the test apparatus described in section 6.2.1 of UNI EN 15037-4 (with or without a ball plate) shall be multiplied by a default calibration factor C1 as follows:

- 0.95 when the tests are carried out with a ball plate in conformity with clause 5.2.1;
- 0.85 when the tests are carried out without a ball plate.

The guaranteed value for PRK may be greater than the resistance to concentrated loads for the relevant class and test (see Figure 12).

UNI EN15037-4 Table 3 — Conformity criteria for determining the characteristic resistance to concentrated loads of EPS blocks			
Production	Number of blocks n	Criterion 1 \bar{P}_n (kN)	Criterion 2 P_i (kN)
At start	5	$\geq 1,2 P_{Rk}$	$\geq 0,8 P_{Rk}$
During production	≥ 15	$\geq P_{Rk} + 1,48 \sigma$	$\geq 0,8 P_{Rk}$
Key			
n number of individual results;			
\bar{P}_n average strength of the n individual results obtained:			
<ul style="list-style-type: none"> – with the specimens constituting the sample for the test (at start); or – with the specimens tested over the moving period considered (during production); 			
P_i individual strength of each block;			
P_{Rk} characteristic resistance to concentrated loads in accordance with 4.3.3;			
σ standard deviation determined from at least 35 test results over a period of at least three months immediately preceding the period in which conformity is to be substantiated.			

Figure 12 - Compliance criteria for determining the resistance characteristics of concentrated loads on EPS blocks from Table 3 of UNI EN15037-4

6.9.3 STRENGTH OF THE TOE/BASE BEAM

The equivalent test load that is placed on the toe to evaluate its strength shall simulate the actual load it shall support during construction (cast concrete and iron reinforcement).

7 VERIFICATION OF CONFORMITY TO DECLARED PERFORMANCE

The verification of conformity with the declared performance allows the evaluation of the quality of EPS formwork and is tested by means of:

- Initial characterization tests carried out by a qualified external laboratory (which remain valid until there are modifications of various natures that might influence the declared performance), in accordance with Table 3;
- production controls in the factory in accordance with Table 4.

The performance to be declared by means of initial characterization tests is shown below in Table 3.

Table 3 – Declared performance by initial characterization tests

Characteristics	
- Compressive Strength	Declaration conforming to the quality control and management plan in UNI EN 13163
- Flexural Strength	Declaration conforming to the quality control and management plan in UNI EN 13163
- Water Absorption	Declaration conforming to the quality control and management plan in UNI EN 13163
- Permeability to Water Vapour	Declaration conforming to the quality control and management plan in UNI EN 13163
- Reaction to Fire	Declaration conforming to the quality control and management plan in UNI EN 13163
- Thermal Conductivity	Declaration conforming to the quality control and management plan in UNI EN 13163
- Self Support	Qualified external laboratory
- Walkability	Qualified external laboratory
- Strength of the toe/base beam	Qualified external laboratory

The production control system in the factory calls for a plan for sampling and test frequency. The sampling and the test results shall be recorded.

Characteristics to be tested during production are listed in table 4 below.

Table 4 – Characteristics tested during production in the factory

Characteristics	
- Principle Dimensions	Quality control and management plan
- Reaction to fire of EPS used to produce the insulating formwork	Quality control and management plan conforming to UNI EN 13163
- Compressive Strength	Quality control and management plan conforming to UNI EN 13163
- Flexural Strength	Quality control and management plan conforming to UNI EN 13163
- Suitability of any reinforcements in the formwork	Quality control and management plan

The tests are to be performed on finished products (EPS formwork) or on samples appropriately obtained from the formwork according to what is specified in the rule for determining performance.

Table 5 - Summary of tests for the verification of conformity with declared performance

	Initial Characterization Test (Qualified External Laboratories)	Production Control in the Factory	Test Method	Sample on which Test is Performed	Minimum Frequency of Production Test Control
Principal Dimensions		x	UNI EN 15037-4 paragraph 5.1	Finished product/EPS formwork	For each order
Compressive Strength	x*	x	UNI EN 826	A Sample	According to management protocol for production quality
Flexural Strength	x*	x	UNI EN 12089	A Sample	According to management protocol for production quality
Water Absorption	x*		UNI EN 1609	A Sample	Not relevant
Permeability to Water Vapour	x*		UNI EN 12086 or tabulated value	A Sample	Not relevant
Fire Reaction	x*	x	UNI EN 13501-1	A Sample	According to management protocol for production quality
Fire Resistance	See clause 6.7.2				
Thermal Conductivity	x*		UNI EN 12667	A Sample	Not relevant
Self Support	x		Clause 6.9.1	Finished product/EPS formwork	According to management protocol for production quality
Walkability	x		Clause 6.9.2	Finished product/EPS formwork	According to management protocol for production quality
Strength of the Toe/Base	x		Clause 6.9.3	Finished product/EPS formwork	According to management protocol for production quality
Suitability of Any Reinforcement Elements		x	Manufacturer	Reinforcing Element	According to management protocol for production quality

* Compliance with UNI EN 13163, which includes the feature in question, meets the requirement.

ANNEX – REACTION TO FIRE OF LIGHTWEIGHT SLAB SYSTEMS

The types of slabs that are present in the market made with EPS formworks can be divided into two major groups:

- slabs with a lower finish of reinforced concrete;
- slabs without a lower finish of reinforced concrete.

The systems that are the subject of this UNI/PdR belong to the second group.

NOTE Any pressure relief vents are provided for only in the case the slab is made with a lower finish of reinforced concrete of 4-5 cm thickness.

In cases in which the slab does not have such a finish, pressure relief vents are not necessary.

Slabs made with SAAD systems covered by this UNI/PdR 30:2017 do not have lower finishes of reinforced concrete and, for that reason, do not require such a design feature, as stated in the note from the Italian Ministry of the Interior (Prot. N ° P599 / 4122 sott.55) of 26 July 2006.





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