PD CEN/TR 16239:2011

BSI Standards Publication

Installation rules of fibrous (gypsum) plaster works

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National foreword

This Published Document is the UK implementation of CEN/TR 16239:2011.

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A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Installation rules of fibrous (gypsum) plaster works

Règles d'exécution des ouvrages en staff

Regeln für den Einbau von Formteilen aus faserverstärktem Gips

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (CEN/TR 16239:2011) has been prepared by Technical Committee CEN/TC 241 “Gypsum and gypsum based products”, the secretariat of which is held by AFNOR.

This Technical Report is one of a series of European Standards including:

— construction products standards, concerning gypsum and gypsum based products;

— works design standards, providing general principles for the design of works to realize with these products;

— technical reports, providing rules and recommendations for installation of works on site realized with these same products.

NOTE 1 The fibrous plaster products are the subject of the European Standard EN 13815 "Fibrous (gypsum) plaster casts - Definitions, requirements and test methods".

NOTE 2 The principles of design of fibrous plaster works are the subject of the European Standard EN 15319 "General principles of design of fibrous (gypsum) plaster works".

It has been assumed in the draft of this Technical Report that the application of its provisions is entrusted to appropriately qualified and experienced professionals, for whose guidance it has been prepared.

Introduction

This Technical Report applies to works carried out using fibrous (gypsum) plaster products-traditional and GRG - made by the moulding of thin reinforced gypsum.

The fibrous plaster work is installed by positioning and fastening of these products to the appropriate part of the building construction. Then they are sealed or screwed and jointed to form continuous surfaces without apparent joints.

NOTE The figures used to illustrate this document are intended to make the text easier to understand. Therefore, they shall be taken as indicative and non-restrictive examples of the works described in the text.

1 Scope

This Technical Report provides details on the rules and recommendations for the installation of works carried out using fibrous (gypsum) plaster casts as defined in European Standard EN 13815, with instructions and details about construction.

Fibrous (gypsum) plaster casts from the three categories of production below (see 4.1 of EN 13815:2006) should be involved in this Technical Report:

a) “cpp” allowing regulatory marking CE,

b) “cppv” allowing regulatory marking CE,

c) “ipp” either when CE marking is required or without CE marking (see Annex D, note 2 of EN 13815:2006).

There are three products:

— traditional fibrous (gypsum) plaster casts, and two specific products:

— GRG casts,

— PMGRG casts.

NOTE 1 Construction of traditional gypsum plaster works using screwed system, showing similar provisions with GRG works screwed construction, is not dealt in this Technical Report.

NOTE 2 PMGRG works are not dealt in this Technical Report.

There are three ranges of casts, defined by their principal functions shapes and configurations (see 4.2 of EN 13815:2006):

— casts for interior architecture,

— casts for technical functions and

— units.

The equipment, accessories and devices are defined in this document.

This Technical Report applies to both new construction and to the refurbishment, restructuring or conversion of existing buildings.

Fibrous plastering work should be capable of having the usual finishes applied directly to them (e.g. paint, wallpaper), subject to the normal preparatory work applicable for the finish.

This Technical Report should not apply to:

— works consisting of various boards, elements or casts when they are not fibrous (gypsum) plaster casts or fibrous plaster works which, by their nature, do not form an integral part of the structure by the use of permanent fixing (see the scope of EN 15319:2007).

— fibrous plaster works consisting of casts and embellishments, when they are to be applied directly to either new or existing wall or ceiling surfaces, for purely decorative applications (see Figures 3 and 4 of EN 15319:2007); works of these types should be carried out in accordance with standard practice.

This Technical Report does not contain the regulatory requirements with which fibrous plaster works (e.g. ceiling) must comply in certain buildings.

NOTE 3 In the field of safety, most regulations relate to certain types of building for example:

— public buildings (PB),

— high rise buildings (HRB),

— buildings for educational purposes,

— buildings for sanitary purposes.

This Technical Report does not deal with the ability of fibrous plastering works to comply with particular technical requirements (e.g. fire behaviour, protection against noise, energy economy, etc) needed for the works to comply with the requirements of the particular building contract.

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 335 (all parts), *Durability of wood and wood-based products — Definition of use classes*.

EN 350 (all parts), *Durability of wood and wood-based products — Natural durability of solid wood*.

EN 351 (all parts), *Durability of wood and wood-based products — Preservative-treated solid wood*.

EN 460, *Durability of wood and wood-based products — Natural durability of solid wood — Guide to the durability requirements for wood to the used in hazard classes*.

EN 573-3, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3 : Chemical composition and form of products*.

EN 599-2, *Durability of wood and wood-based products — Performance of preventive wood preservatives as determined by biological tests — Part 2 : Classification and labelling*.

EN 1396, *Aluminium and aluminium alloys — Coil coated sheet and strip for general applications — Specifications*.

EN 1611-1, *Sawn timber — Appearance grading of softwoods — Part 1: European spruces, firs, pines and Douglas firs*.

EN 1912, *Structural timber — Strength classes — Assignment of visual grades and species*.

EN 1993-1-1, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*.

EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*.

EN 10143, *Continuously hot-dip coated steel sheet and strip — Tolerances on dimensions and shape*.

EN 10152, *Electrolytically zinc coated cold rolled steel flat products for cold forming — Technical delivery conditions*.

EN 10169, *Continuously organic coated (coil coated) steel flat products - Technical delivery conditions*.

EN 10244-2, *Steel wire and wire products — Non-ferrous metallic coatings on steel wire — Part 2: Zinc or zinc alloy coatings*.

EN 10346, *Continuously hot-dip coated steel flat products - Technical delivery conditions*.

EN 13279-1, *Gypsum binders and gypsum plasters — Part 1: Definitions and requirements*.

EN 13815:2006, *Fibrous gypsum plaster casts — Definitions, requirements and test methods*.

EN 13963, *Jointing materials for gypsum plasterboard — Definitions, requirements and test methods*.

EN 14195:2005, *Metal framing components for gypsum plasterboard systems — Definitions, requirements and test methods*.

EN 14566, *Mechanical fasteners for gypsum plasterboard systems — Definitions, requirements and test methods*.

prEN 15303-1, *Design and application of plasterboard systems on frames — Part 1: General principles of design*

EN 15319:2007, *General principles of design of fibrous (gypsum) plaster works*.

EN ISO 12944-3, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 3: Design considerations (ISO 12944-3: 1998)*.

3 Terms, definitions, symbols and abbreviations

See Clause 3 and Figures 1 and 2 of EN 15319:2007.

4 Technical requirements

See Subclause 4.3 of EN 15319:2007.

5 Site installation

5.1 Conditions required prior to commencing the installation of fibrous plaster works

See Subclause 5.1 of EN 1531:2007.

5.2 Equipments to be used for fixing to the backgrounds

5.2.1 Safe loads

The equipment, accessories and devices described in this subclause are those commonly used. Other materials or procedures may be used, provided that they are suitable to maintain an equivalent level of reliability. The safe loads adopted for the hangers are determined by the test results of breaking loads of these, and application of a safety factor equal to 3.

5.2.2 Humidity and moisture conditions

Table 1 — Classes of exposure

Classes	Conditions
A	Building components generally exposed to varying relative humidity up to 70 % and varying temperature up to 25 °C but without corrosive pollutants.
B	Building components frequently exposed to varying relative humidity up to 90 % and varying temperature up to 30 °C but without corrosive pollutants
C	Building components exposed to an atmosphere with level of humidity higher than 90 % and accompanied by a risk of condensation
D	More severe than the above

The level of protection against corrosion of metal equipment and accessories as set out in Tables 2, 3 and 7, when exposed in the range of exposure conditions given in Table 1 below (see 4.3.1.1.1, 4.3.1.1.2, 4.3.1.1.4 and 4.3.1.2 of EN 15319:2007), are contained in Annex A.

The choice of gypsum casting plaster use for manufacture of traditional casts is given in 5.3.1.1.

Table 2 — Examples of accessories for fixing and anchoring to the background and for attachment (see 3.2.6, 3.2.7 and 3.2.8 of EN 15319:2007)

Designations	Constituents and treatments against the corrosion	Characteristics and sizes mm	Examples of uses
Mason's nails	Galvanised steel	70 x 1.7	Anchorings on wood, plaster, etc, made of two nails driven in diagonally, with securing wad (see Figure 1).
Slater's nails	Zinc electroplated steel		Lightweight fixings on wood, plaster.
Plasterboard nails	See EN 14566	35 x 2.3	Lightweight fixings on wood.
Flat trumpet screws	See EN 14566	35 x 3.5	Varied lightweight fixings.
Self-tapping flat trumpet screws (TMN, TSN, THN)	See EN 14566	Length : 25 to 140	— Fixings on metal and wood, — Attachments.
Rehabilitation screws eyes	Zinc electroplated steel	With screwed tip	Fixings on timber through existing plaster ceiling.
Expanding, self-drilling or chemical threaded bolts	— Zinc electroplated steel — Stainless steel — Brass	Thread ϕ : 6 to 12	Anchorings on concrete and masonry.
Nails and studs driven by cartridge hammer	Zinc electroplated steel		Anchorings on metal.
Fixings called "alligator clips"	Zinc electroplated (25 µm) tempered steel		Fixings to flanges of beams; Connectings
Wads	See 3.2.10 of EN 15319:2007 Use of sisal fibres should be recommended		— Fixings on masonry, plaster (see Figure 3) and to wood laths, metal sections, etc; — Fastenings of hangers or supporting lugs on the background (see Figure 2) ; — Attachments (see Figure 4)
Ties wire	Round steel wire		Connectings (see Figure 9)

The thickness of the zinc coating should be at least 5 µm.

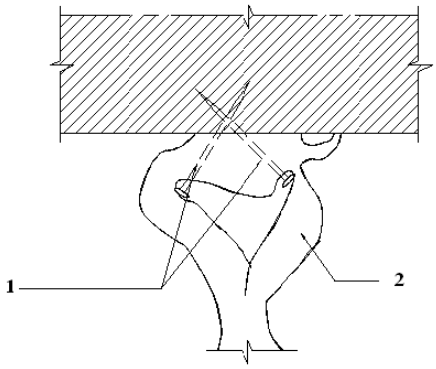
Equivalent processes of treatment against the corrosion should be allowed.

Installation of fixings and anchorings should be carried out in accordance with:

— either the planning documents (design documents), if required with reference to the relevant ETAG,

— or the manufacturer's technical instructions, with reference to the national building regulations.

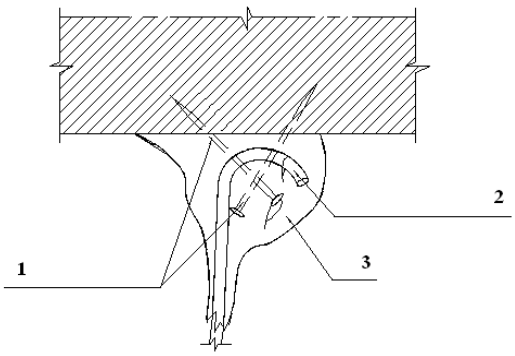
Where the fixing is into steel or timber the requirements of ENV 1993-1-1 and ENV 1995-1-1 respectively should apply.



Key

1 nails driven in diagonally
2 wad

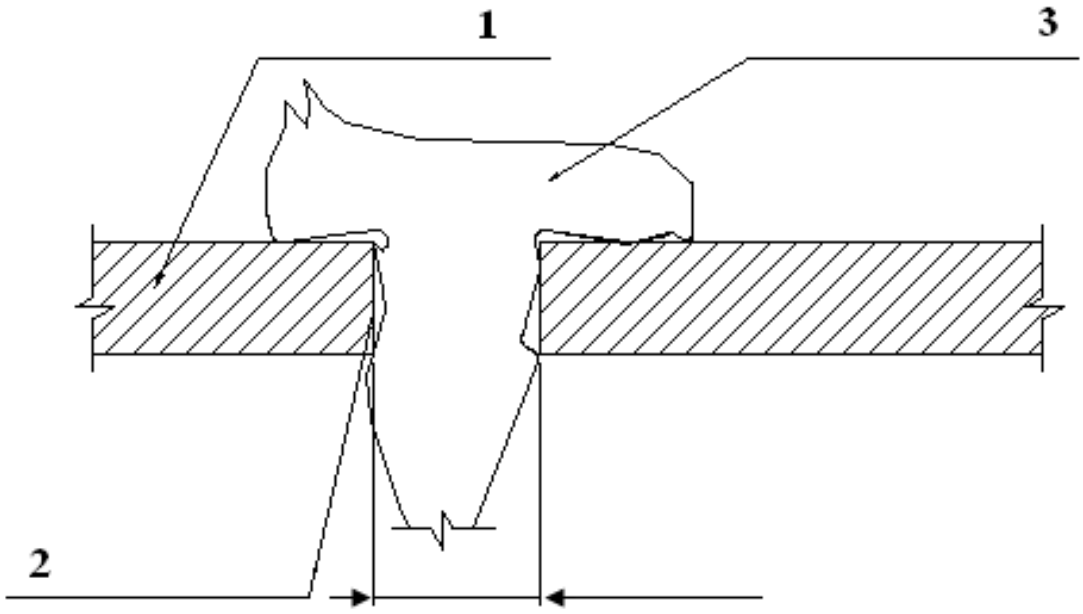
Figure 1 — Example of fixing using nails and wad



Key

1 nails driven in diagonally
2 round rod hanger
3 wad

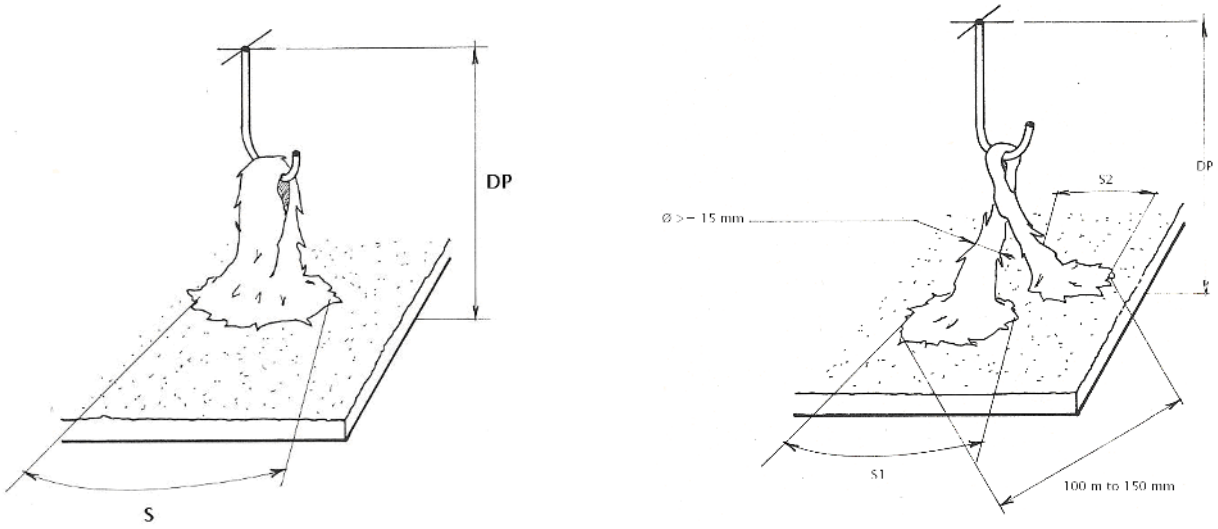
Figure 2 — Example of fixing using nails and wad securing of hanger



Key

1 stability to be checked
2 hole formed with a drill between 25 and 30 mm ∅
3 wad forming a binder

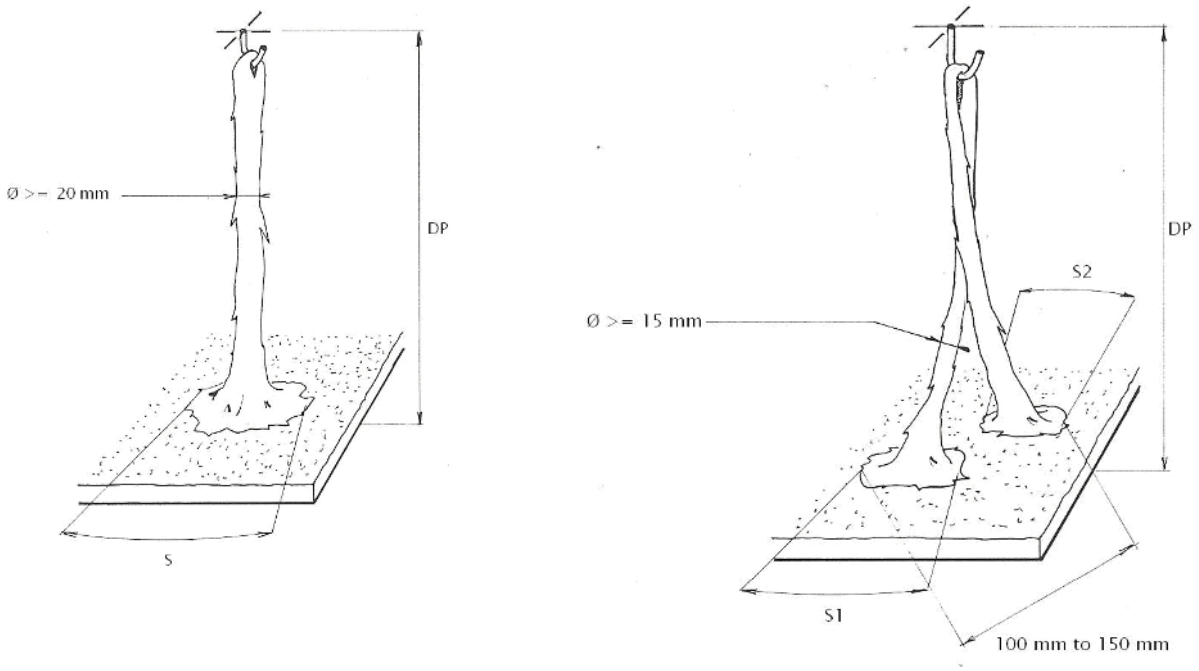
Figure 3 — Example of anchoring to an old reinforced plaster ceiling



Key

Dp depth of suspension
S contact surface of wad (see Table 3)

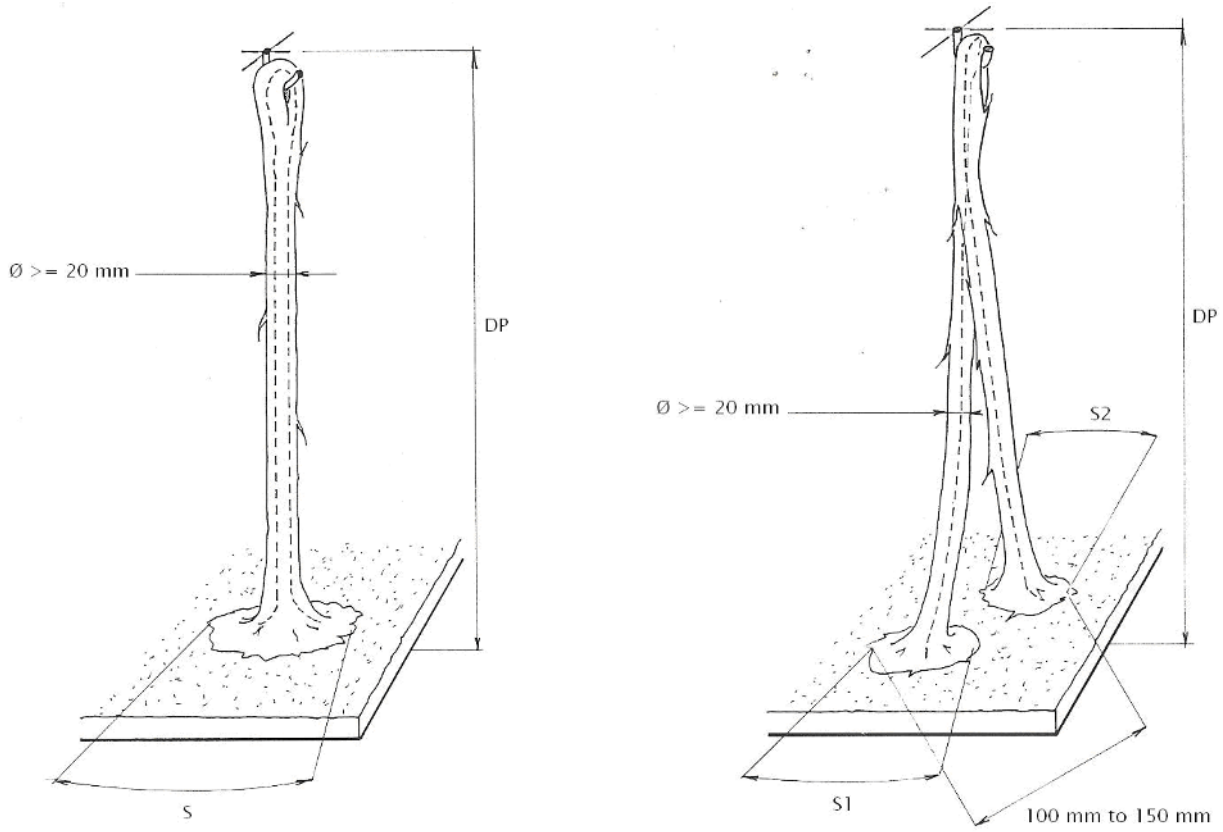
Figure 4 — Examples of attaching wads (single and double)



Key

Dp depth of suspension
S contact surface of wad (see Table 3)

Figure 5 — Examples of fibrous plastered hangers (single and double)



Key

Dp depth of suspension

S contact surface of wad (see Table 3)

Figure 6 — Examples of fibrous plastered wire hangers (single and double)

5.3 Installation of traditional fibrous gypsum plaster works using sealed system

5.3.1 Products and materials constituting this traditional fibrous plaster work itself

5.3.1.1 Traditional fibrous plaster casts (flat units or related and architectural casts)

The fibrous (gypsum) plaster casts used should comply with requirements of Clause 5 of EN 13815:2006, particularly:

— made from special gypsum casting plaster.

— unit surface mass:

  — common units ≥ 1kg/m^2 per mm thickness,

  — unit for fire resistance function ≥ 0.9 kg/m^2 per mm thickness.

This surface mass may apply to developed area of shaped or elaborated casts.

— cast surface hardness:

  — common casts ≥ 70 Shore C units,

— casts for fire resistance function ≥ 60 units Shore C units.

These traditional fibrous plaster casts should comprise possible complementary reinforcement by softwood lath or lightweight section.

When the intended use of traditional casts is for areas with exposure conditions such as classes B, C or D (see Table 1):

— use of gypsum casting plasters with alpha hemihydrate average content ≥ 25 % should be recommended for manufacture of casts.

— use of mineral reinforcement according to 5.6.3.2 of EN 13815:2006 should be recommended.

5.3.1.2 Plasters used for installation

Gypsum casting plasters – calcium sulphate hemihydrate – used for installation should be manufactured according to EN 13279-1 (class C1)

5.3.1.3 Water

The mixing water should be clean and free from contamination and impurities.

Normal tap water may be used.

5.3.1.4 Fibres and hessian used for installation

The fibres and hessian used for installation should comply with the specifications shown in 5.6.3.1 and 5.6.3.2 of EN 13815:2006.

5.3.1.5 Fibrous plaster ropes (see 3.2.11 of EN 15319:2007)

These should be used, among other purposes, to join two fibrous plaster casts together in the work (sealed system) and to fix the work at the edges.

The fully impregnation of fibres with plaster should be necessary.

5.3.2 Equipment to be used for fibrous plaster works with spaced fixing suitable for installation by sealed system

Recommendations as specified in 5.2 (1st paragraph) applies

Table 3 — Examples of accessories, devices and frames for spaced fixing installation (sealed system)

<table>
<tr><th>Designation</th><th>Sizes (mm) - Treatments against the corrosion - Timber quality</th><th>Recommendations and requirements</th></tr>
<tr><td>Wads
(see figure 4)</td><td>See 3.2.10 of EN 15319:2007
- diameter of ropes of double wads≥ 15 mm
- safe load : 30 daN</td><td rowspan="6">As far as possible :
- The contact surface S of wads, fibrous plastered hangers and other fibrous plastered devices on the rough back of fibrous plaster cast should be between 50 cm² and 100 cm² inclusive ;

- For the double wads, fibrous plastered hangers and other fibrous plastered devices, the contact surface is the addition of S1 and S2, and should be between 50 cm² and 100 cm², and the overall dimension of S1 and S2 overall width should be between 100 mm and 150 mm.

For wads, fibrous plastered hangers, fibrous plastered wire hangers and supporting lugs, the fully impregnated of fibres with plaster should be necessary.</td></tr>
<tr><td>Fibrous plastered hangers
(see figure 5)</td><td>See 3.2.11 of EN 15319:2007
- diameter of ropes:
single hangers ≥ 20 mm,
double hangers ≥ 15 mm.
- safe load: 60 daN</td></tr>
<tr><td>Fibrous plastered wire hangers
(see figure 6 and 9)</td><td>Round steel wire:
- minimum diameter = 1 mm,
- galvanised,
- diameter of rope ≥ 20 mm.</td></tr>
<tr><td>Fibrous plastered wire supporting lugs
(see 3.2.8.b) of EN 15319:2007)</td><td>Round steel wire:
- minimum diameter = 1 mm,
- galvanised,
- diameter of rope ≥ 20 mm.</td></tr>
<tr><td>Round wire hangers
(see figure 7)</td><td>Round steel wire:
- minimum diameter = 5 mm,
- galvanised.</td></tr>
<tr><td>Threaded rod hangers
(see figure 8)</td><td>Threaded rod:
- minimum diameter = 6 mm,
- zinc or cadmium electroplated.</td></tr>
<tr><td>Threaded rod supporting lugs
(see 3.2.8.b) of EN 15319:2007)</td><td>Threaded rod:
- minimum diameter = 10 mm,
- zinc or cadmium electroplated.</td></tr>
<tr><td>Intermediate timber lath frames</td><td>Spaced timber laths:
- minimum sizes = 50 mm x 15 mm;
- the timber used should conform at least to quality grade S10 (MS10) of EN 1912;
- the appearance grading of softwoods should conform at least to G2-4 (Table 1) or G4-4 (Table 2): unlimited knots as long as the integrity of the piece is maintained as specified in EN 1611-1;
- the use of oak is not allowed;
- the moisture content of the timber should not exceed 20% by mass;
- where protection against biological or other attack is necessary, the relevant provisions of EN 335, EN 350, EN 351, EN 460 and or EN 599-2 should apply;
- where wood preservatives are used, the corrosion protection method for the metal components that are connected to the timber components should be compatible with the wood preservative.</td><td>Those timber frames shall be used only for areas with exposure conditions such as class A (see Table 1)
For ceiling (see Figure 10) the maximum interval Pi between the primary laths and the maximum interval Hi between the stay hangers to primary laths should be in accordance with the sizes of laths.

Examples:

Sizes of laths mm | Pi and Hi values mm
50 x 15 | 600
70 x 18 | 1 000

For vertical positioned work, the same maximum interval for the same sizes as ceiling should be met (Hi indicates the interval of supporting lugs and Pi indicates the interval of primary laths. See Figure 1.d of EN 15319:2007)</td></tr>
</table>

Table 3 (*continued*)

<table>
<tr>
<td>Intermediate metal section frames</td>
<td>Spaced steel sections
- minimum sizes (recommended):
- U cold forming: 40 mm x 20 mm x 1.25 mm
- 0,8 mm folded sheet: 40 mm x 20 mm ;
- rigid tubular: 22,5 mm ∅
- where the metal section frame is formed in hot-galvanised strip or sheet of unalloyed steel, the minimum steel grade used should be DX 51D + Z according to EN 10346;
- if other steel types are used, they should conform to either EN 10152(ZE), EN 10169 or EN 10346 as appropriate.
- the thickness tolerance should be in accordance with EN 10143;
- where frame is made of aluminium alloy, the alloy should be in accordance with EN 573-3 and have 0,2 % yield strength of a least 160N/mm²;
- for corrosion protection of frameworks made of steel or aluminium, the minimum protection should be that given in Annex A.</td>
<td>For ceilings (see Figure 11) the maximum interval Pi between the primary sections and the maximum interval Hi between the stay hangers to primary sections, should be in accordance with the sizes of sections.

Examples:

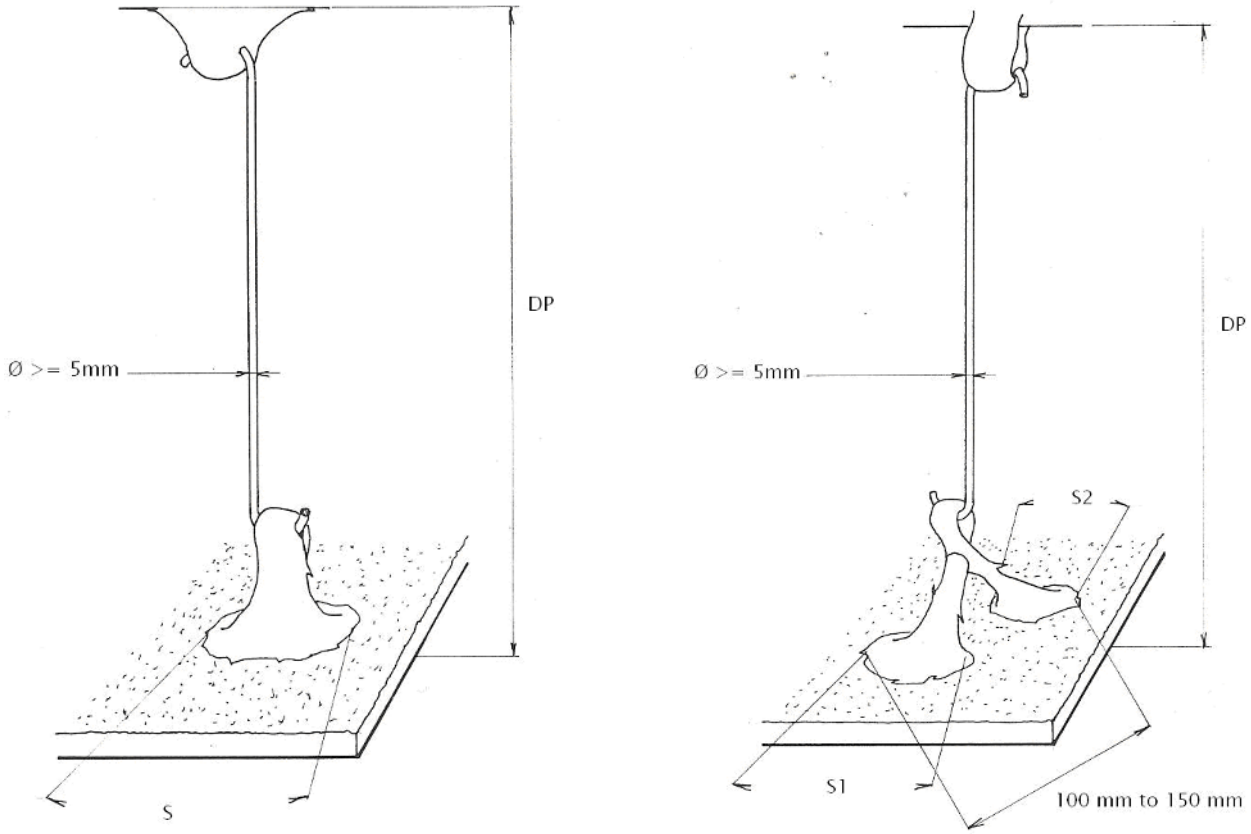
<table>
<tr><th>Sizes of sections
mm</th><th>Pi and Hi
mm</th></tr>
<tr><td>U cold forming:</td><td></td></tr>
<tr><td>40 x 20 x 1.25</td><td>1 000</td></tr>
<tr><td>40 x 20 x 1.5</td><td>1 200</td></tr>
<tr><td>40 x 20 x 2</td><td>1 350</td></tr>
<tr><td>I 0,8 mm folded sheet:</td><td></td></tr>
<tr><td>40 x 20</td><td>1 200</td></tr>
<tr><td>50 x 40</td><td>1 500</td></tr>
<tr><td>ϕ 22.5 mm tubular</td><td>1 200</td></tr>
</table>
For vertical positioned work, the same sizes should be met (Hi indicates the interval of supporting lugs and Pi indicates the interval of primary sections. See Figure1.d of EN 15319:2007).</td>
</tr>
<tr>
<td colspan="3">The recommendations relating to the areas of contact of wads, fibrous plastered hangers and fibrous plastered supporting lugs should particularly apply to flat areas of works (risk of small bucklings on finished surface due to over-sized accessories).

For these wads and fibrous plastered devices, use of sisal fibres should be recommended.

The suggested intermediate frames and the maximum centres recommended relate to the flat works of a common nominal thickness equal to or less than 15 mm.

For some works consisting of other characteristics (superior thickness, very shaped configuration, very ornate style, use of other frame components, etc) the maximum centres required should then be adjusted to suit the bending strength of the laths or sections used.

In order to avoid corrosion due to contact between dissimilar materials (e.g. steel and aluminium), intermediate layers of suitable protecting materials should be applied according to EN ISO 12944-3.</td>
</tr>
</table>

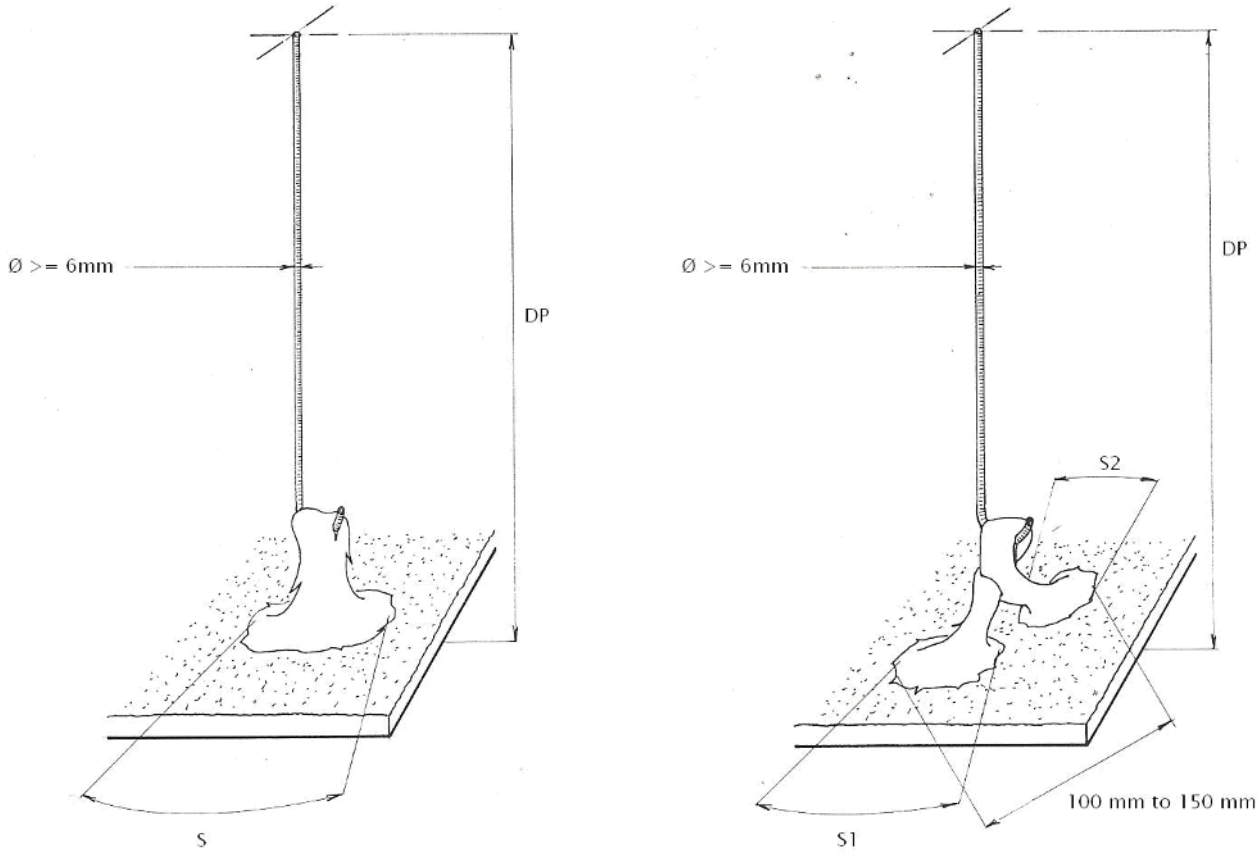


Key

Dp depth of suspension

S contact surface of wad (see Table 3)

Figure 7 — Examples of round wire hangers

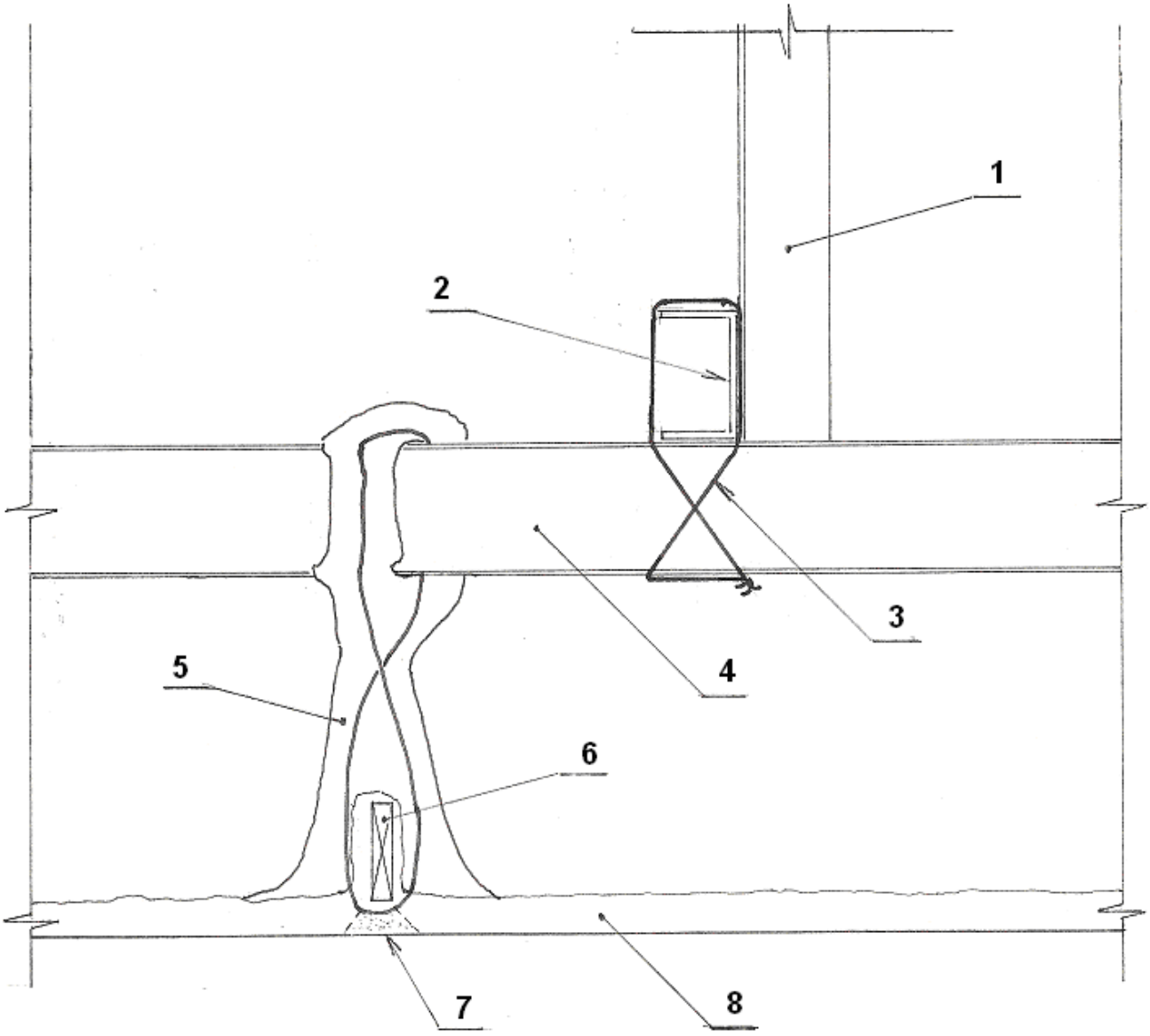


Key

Dp depth of suspension

S contact surface of wad (see Table 3)

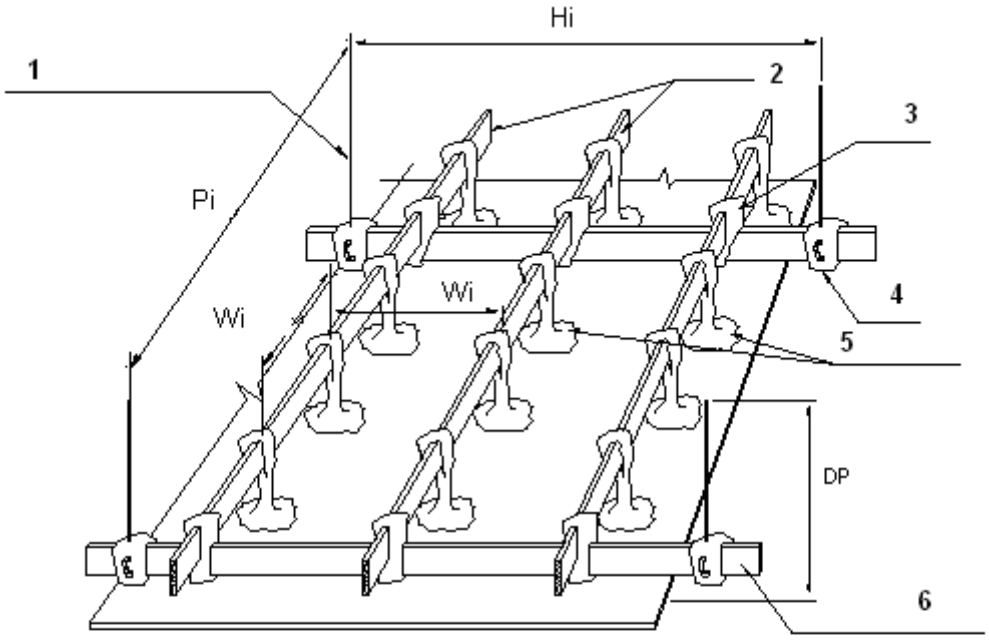
Figure 8 — Examples of threaded rod hangers



Key

1 hanging angle
2 primary metal section (channel)
3 tie wire
4 secondary metal section (channel)
5 fibrous plastered wire hanger
6 complementary reinforcement by softwood lath
7 filled joint and smoothing
8 traditional fibrous plaster ceiling

Figure 9 — Example of installation of traditional fibrous plaster suspended ceiling (sealed system) with intermediate metal section framework

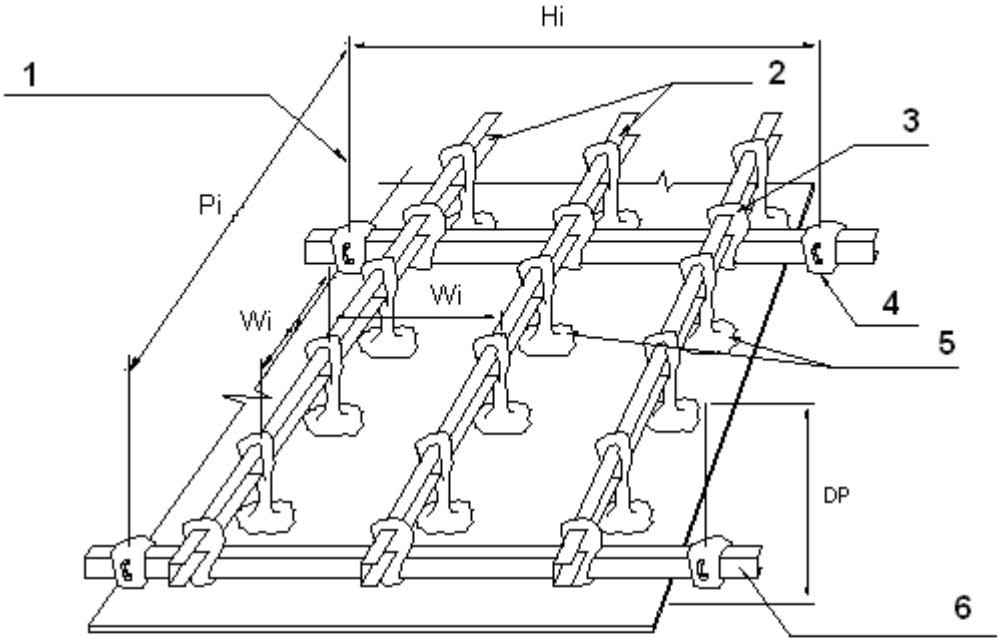


Key

1 stay hanger
2 secondary timber laths
3 collar with fibrous plaster rope
4 wad
5 wads or hangers
6 primary timber lath

Pi interval between primary laths
Hi interval between stay hangers to primary laths
Wi spacings between wads or hangers over ceiling (see Table 6)
Dp depth of suspension

Figure 10 — Example of intermediate timber lath framework for traditional fibrous plaster ceilings



Key

1 stay hanger
2 secondary metal sections
3 collar with fibrous plaster rope
4 wad
5 wads or hangers
6 primary metal section

Pi interval between primary laths
Hi interval between stay hangers to primary laths
Wi spacings between wads or hangers over ceiling (see Table 6)
Dp depth of suspension

Figure 11 — Example of intermediate metal section framework for traditional fibrous plaster ceilings

5.3.3 Construction of traditional gypsum fibrous plaster works using sealed system

5.3.3.1 Selection of spaced fixing equipment

The spaced fixing accessories, devices and frames defined in Table 3 should be selected depending on the depth Dp or on the spacing Sp, in accordance with Tables 4 and 5 below:

Table 4 — Traditional fibrous plaster ceiling works (e.g. suspended ceiling)

Spaced fixing accessories used (recommended)	Depth of suspension Dp (see Figures 1.a et 1.b of EN 15319:2007) mm			
	Very short: Dp ≤ 50	Short: 50 < Dp ≤ 400	Average: 400 < Dp ≤ 600	Large: 600 < Dp
Wads	+			
Fibrous plastered hangers		+		
Fibrous plastered wire hangers		+	+	
Round wire hangers		+	+	
Threaded rod hangers		+	+	
Intermediate timber lath frame				+
Intermediate metal section frame				+

Table 5 — Vertical positioned traditional fibrous plaster works (e.g. wall lining)

Spaced fixing accessories used (recommended)	Spacing from the background Sp (see Figure 1.d of EN 15319:2007) mm			
	Sp ≤ 50	50 < Sp ≤ 100	100 < Sp ≤ 150	150 < Sp
Wads	+			
Fibrous plastered wire supporting lugs		+	+	
Threaded rod supporting lugs		+		
Intermediate metal section framework			+	+

5.3.3.2 Setting out of spaced fixing accessories

The setting out of lines of spaced fixing accessories should be determined by the spacings recommended between the attaching points (wads, fibrous plaster hangers) on the fibrous plaster work.

These spacings should depend on the characteristics of the work and of the fibrous plaster casts from which it is formed, such as:

— configuration: flat or including shapes (see 5.3.3.8);

— category of reinforcement: elementary reinforcement or elementary reinforcement with complementary reinforcement;

— nominal thickness.

For flat fibrous plaster surfaces (e.g. ceilings, wall linings, etc.) in fibrous plaster units, the maximum spacing of the rows of fixing points in both directions should comply with the values shown in Table 6 below:

Table 6 — Spacings of sealings on traditional fibrous plaster works (see Figures 10 and 11)

Reinforcement classes	Usual nominal thicknesses of casts mm	Maximum spacings Wi recommended between the rows of sealings (e.g. wads) mm
Casts with only elementary reinforcement e.g. f1, f2	10	400
	12	475
	15	550
	20	According to configuration of the work (e.g. 600)
Casts with elementary and complementary reinforcement e.g. f3w, f4m	5	600
	12	600

5.3.3.3 Fixing of traditional fibrous plaster works applied directly to wall or ceiling surface

Installation of works consisting of casts and embellishments for purely decorative applications, intended to be applied directly on existing surfaces, is not processed in this Technical Report (see scope).

NOTE Equipment and accessories of Table 2 and adhesives should be normally used for fixing of these casts.

5.3.3.4 Fixing of traditional fibrous plaster works with a spacing from their backgrounds

For those works of a common nominal thickness equal to or less than 15 mm, the mechanical stresses as given in 4.3.2.3 of EN 15319:2007 should be absorbed within the method stated, provided that techniques and requirements recalled below are observed:

— use of spaced fixing accessories as defined in Table 3, complying with the maximum spacings Wi recommended in Table 6;

— in case of use of intermediate frames in timber or in metal:

— accordance with maximum intervals Pi and Hi as recommended in Table 3 (see Figures 10 and 11);

— use of the securing devices or anchors for the spaced fixing accessories to the backgrounds such as given in Table 2;

— use of accessories for attaching such as given in Table 2.

NOTE Because of the high density of the devices required to comply with the characteristics of the completed works (flatness), the suspension systems described in this Technical Report greatly secure the permitted loads listed in 4.3.2.3. of EN 15319:2007.

Any non-planned contact, between the fibrous plaster work or its spaced fixing accessories on the one hand and the services equipment or their fixing devices passing through plenums or voids in the work on the other, is not allowed.

5.3.3.5 Jointing of traditional fibrous plaster works

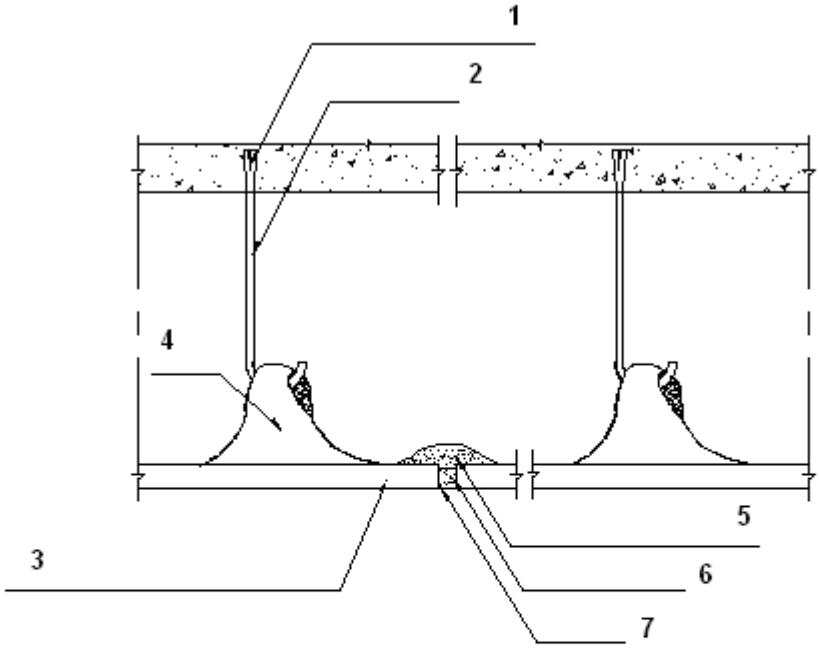
Casts having square or bevelled edges (see Figures 1 and 2 of EN 13815:2006)

The casts should be positioned edge to edge at least 5 mm apart and should be fixed and sealed together with a wide fibrous plaster rope pushed through the joint (see Figure 12).

NOTE The gap between the casts shall depend on their thickness.

In order to obtain the required characteristics in the completed work (see 6.2) any difference in level between two adjacent units should be less than 0.5 mm.

The joints should be filled with gypsum casting plaster and then smoothed using the same type of plaster.



Key

1 anchoring bolt
2 threaded rode
3 fibrous plaster unit comply with EN 13815
4 wad
5 fibrous plaster rope
6 filled joint
7 smoothing

Figure 12 — Example of installation of a suspended ceiling with short or average depth of under reinforced concrete flooring, for casts having square edges (sealed system)

5.3.3.6 Edges of works

Perimeter edges to walls should be normally fixed and sealed by fibrous plaster ropes, then filled with gypsum casting plaster and smoothed.

Particular situations (see 5.3.3.7)

5.3.3.7 Expansion joints, separation around penetrations and insertions, separation at edges of work, sub-division of work

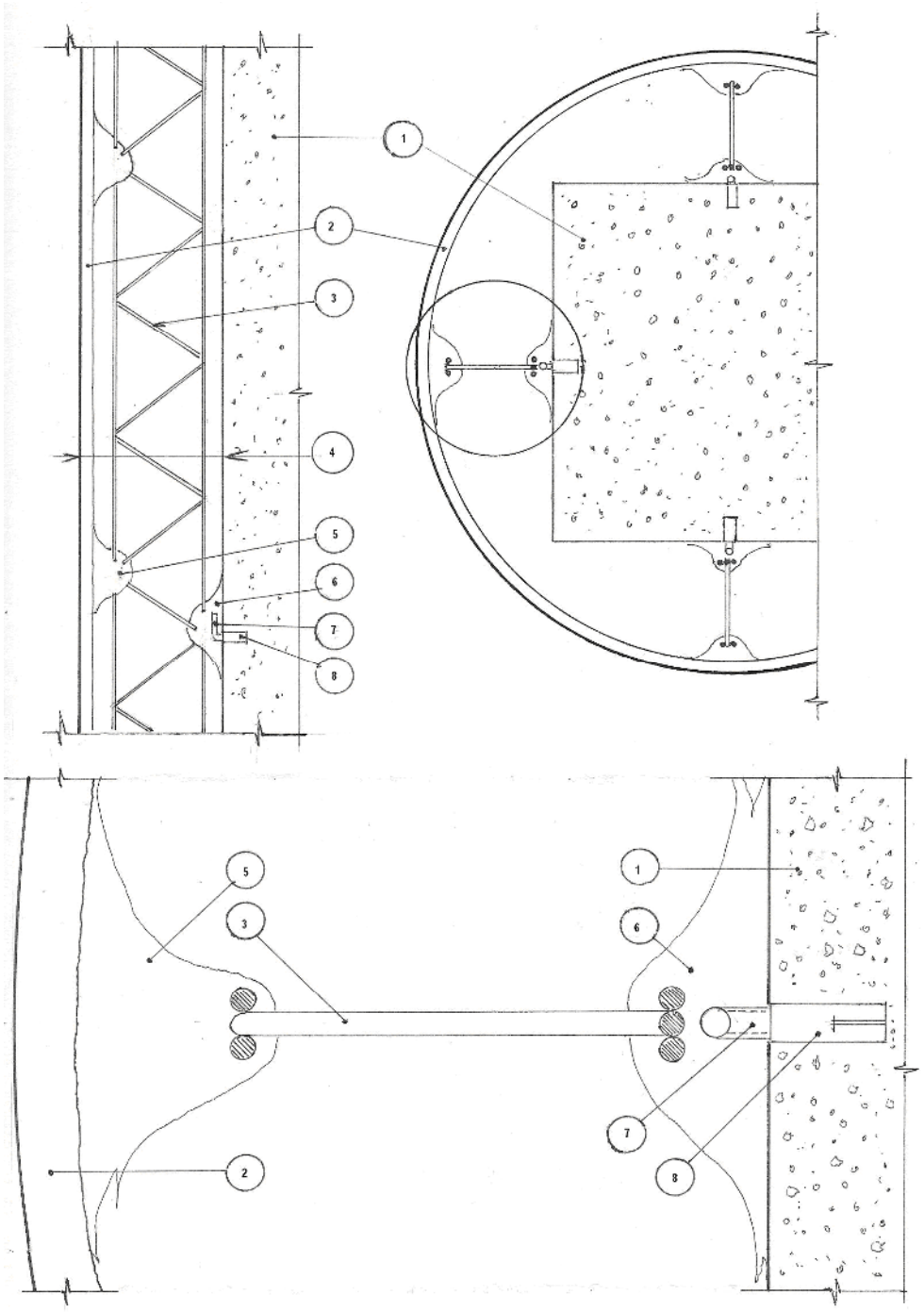
In some situations, joints defined to 4.3.2.4 of EN 15319:2007 may need to be designed and constructed.

5.3.3.8 Case of architectural works including shapes and/or elaborated ensembles

5.3.3 applies to flat or related (e.g. small reliefs, simple contours) works

For architectural works including shapes (e.g. vaults, domes, coffered ceilings, volumes for acoustic improvement in auditorium) or elaborate ensembles (e.g. restoration of ancient décor), selection and setting out of the spaced fixing accessories, should be determined according to provisions of 5.2 and relevant adaptations of recommendations of 5.3.3 (see Figures 1.b and 1.d of EN 15319:2007).

5.3.3.9 Example of installation of traditional fibrous plaster column (sealed system).



Key

1 reinforced concrete pillar

2 traditional fibrous plaster column 800 mm ∅ (15 mm thickness)

3 galvanised wire stud poutrafil type 4,5 mm ∅ 100 mm width

4 Sp 170 mm spacing.

5 wad for fixing fibrous plaster to stud (installed around at 450 mm centres)

6 wad for fixing stud to pillar (installed around at 1050 mm centres)

7 ∅ 6 mm fastening

8 anchoring bolt

Figure 13 — Example of installation of traditional fibrous plaster column (sealed system)

5.4 Installation of GRG works using screwed system

5.4.1 Products and materials constituting this GRG work itself

5.4.1.1 GRG casts (flat units or related and architectural casts)

The GRG casts should comply with definition of 3.2.17 and with requirements of Clause 5 of EN 13815:2006, in particular:

— made from alpha based gypsum plaster;

— the surface mass of flat casts shall be at least 1.4 kg/m^2 per mm of thickness; this surface mass may apply to developed area of shaped or elaborated casts;

— the recommended average surface hardness value of GRG casts should be equal to or greater than 80 shore D units.

These GRG casts should comprise:

— reinforced rim edges with rebates or tapered fields and /or shoulders, which may include built-in softwood laths or plywood strips should comply with 5.6.3.1.3 of EN 13815:2006 for screwing (see Figures 17,18,19 and 20);

— possible gauged reinforced ribs on back for screwing suitable to frames;

— possible flanges on back;

— possible complementary reinforcement by softwood lath or lightweight steel sections;

Through lack of apha based plaster, only specially modified beta based plaster on the market is permissible. Resin is not allowed.

5.4.1.2 Screws

Screws used – self-tapping flat trumpet – should comply with EN 14566.

5.4.1.3 Jointing materials

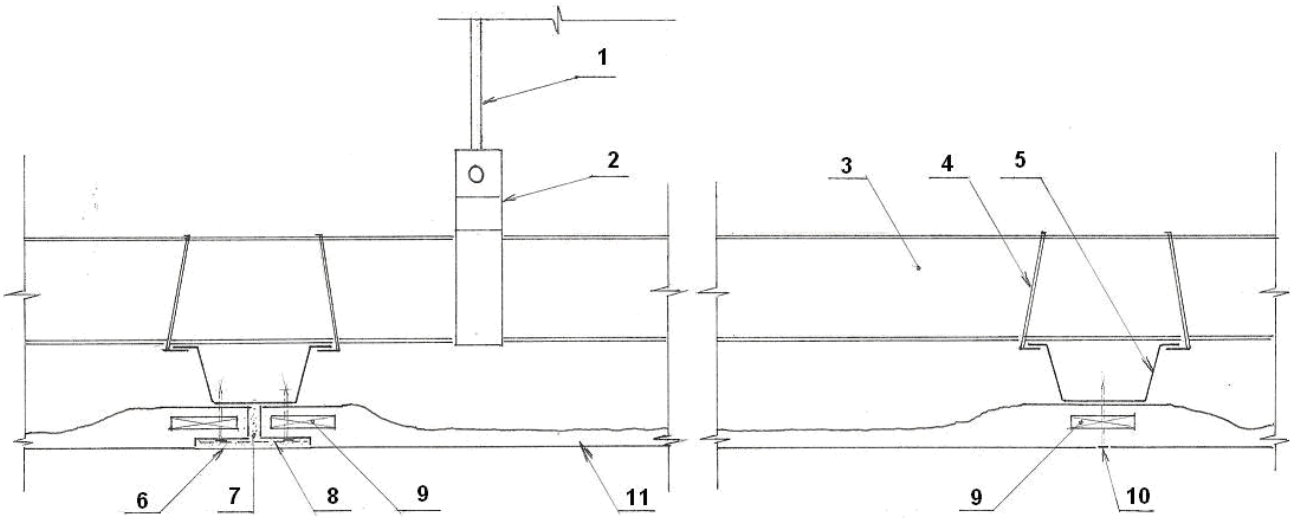
Gypsum based dual-purpose compound used for jointing and recessed screw heads sealing should comply with EN 13963.

5.4.1.4 Jointing tapes

When a jointing tape is required, strip of reinforced fibre should be used.

Common tapes are around 50 mm wide.

Small recessed or tapered fields should be designed for tape and filler on both sides of joints (see Figures 17, 18 and 20).



Key

1 threaded rod hanger
2 stirrup
3 primary profile (channel)
4 metal clip
5 secondary profile (furring channel)
6 smoothing
7 compound
8 jointing tape
9 built-in softwood lath
10 recessed screw head
11 GRG ceiling

Figure 14 — Example of installation of GRG suspended ceiling (screwed system) for casts having reinforced rim edges with rebates (see Figures 15 and 17). Normally, transversal edges should be square or bevelled (see Figures 21 and 22)

5.4.2 Equipment to be used for GRG works with spaced fixing suitable for installation by screwed system

Recommendations for reliability and protection as given in 5.2 (1st paragraph and Table 1) applies

5.4.2.1 Standard equipment for flat or related (small reliefs, simple mode natures) works

Table 7 – Examples of accessories, devices and frames for spaced fixing installation (screwed system)

Designation (see Table C.1 of EN 14195:2005)	Constituents (See Figure 13)	Sizes mm	Uses
Hangers, suspensions	- see Table 3 boxes b, c, e, f - straps hangers, - adjustable rod - special hangers	Length 95 to 450	Suspended ceilings (see prEN 15303-1 secondary support system)
Primary profiles	0,6 mm cold rolled sections according to EN 14195	U/15/45/15 U/27/47/25	
Secondary profiles (furring channels)		W/10/25/50/25/10 Width of supporting face should be at least 35	
Connecting elements	- metal clips - screws		
Supporting lugs	- see Table 3 (boxes d, g) - anchor clips		Wall linings (sheet cladding non-load bearing)
Stud sections	0,6 mm cold rolled sections according to EN 14195	U/35/50/33 U/35/68.8/35	

NOTE That standard equipment should be installed according to manufacturer recommendations. Other standard accessories designed for installation of plasterboards on frames may be used too (see EN 14195)

For suspended ceilings, the maximum interval Pi between the primary profiles and the maximum interval Hi between the stay hangers to primary profiles (see Figure 15) should be dependent on the sizes of primary profiles and their load-carrying capacity.

EXAMPLES

GRG flat ceiling suspended to standard frame as above, comprising primary profiles U/15/45/15/0.6 and secondary W/10/25/50/25/10/0.6:

GRG thickness *t* mm	Pi mm	Hi mm	Maximum loading (kg/m^2)
$t \leq 6$	1 200	1 200	20
$6 < t \leq 9$	900	1 200	20

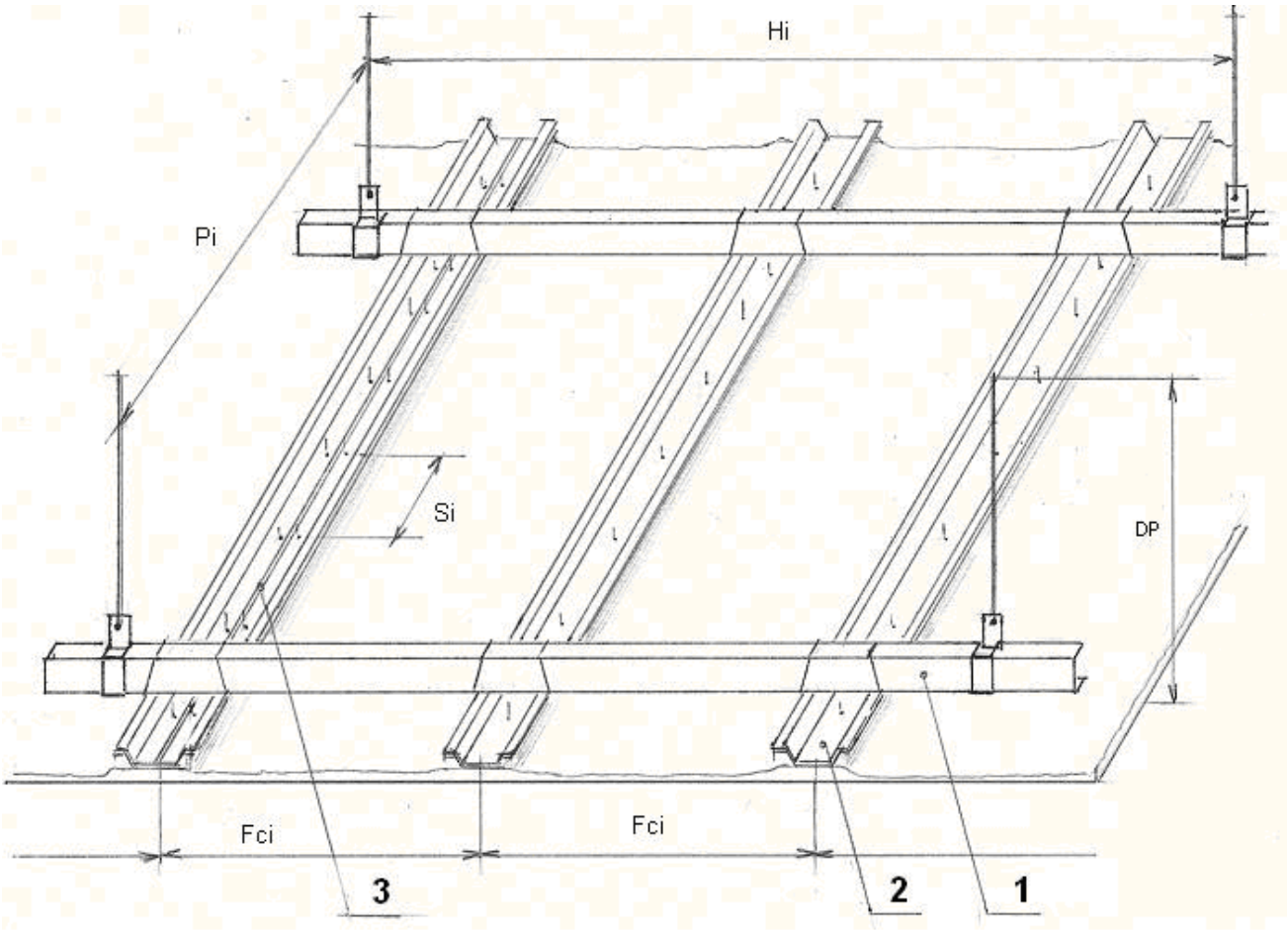
The maximum spacings Si between the rows of screws to secondary profiles should be at 200 mm centres.

Distance of screws from the edges of casts should be equal to or more than 10 mm. Piercing from screws to metal section should be equal to or more than 10 mm deep.

Recessed screw heads should be sealed with gypsum based dual-purpose compound.

For wall linings, the stud sections should be installed around at 600 mm centres; those vertical sections should be fixed to background at 1 500 mm centres with suitable anchor clips.

Special furring channels may be used for small spacing from background.



Key

1 primary profile (channel)
2 secondary profile (furring channel)
3 joint (reinforced rim edges with rebates see Figure 17)

Hi interval between the stay hangers to primary profiles
Pi interval between the primary profiles
Si spacing between the screws (normally at 200 mm centres)
Fci interval between secondary profile (normally: at 600 mm centres)
Dp depth of suspension

Figure 15 — Example of installation of suspended ceiling (screwed system) for GRG casts having reinforced rim edges with rebates

5.4.2.2 Individual equipment for shaped or elaborated works

Ironwork individually designed, made, assembled and secured on site, is normally used for spaced fixing installation by screwed system.

Those metal frameworks and/or structural back up are required for installation of GRG architectural works including shapes or elaborate ensembles as given in 5.3.3.8.

The spacings between the screws should be dependent on the both shapes and configurations of GRG works, and the thickness of casts. They are approximately at 200 mm to 300 mm centres to frame or structural back up.

Distance of screws from the edges of casts should be equal to or more than 10 mm.

Recessed screw heads should be sealed with a gypsum based dual-purpose compound.

NOTE That ironwork equipment itself should be installed with the GRG contractor recommendations.

5.4.3 Construction of GRG works using screwed system

5.4.3.1 Fixing of GRG works applied directly to wall or ceiling surface

Comments as given in 5.3.3.3.

5.4.3.2 Fixing of GRG works with a spacing from their background

For those works of a common nominal thickness equal to or less than 9 mm, the mechanical stresses as given in 4.3.2.3 of EN 15319:2007, should be absorbed within the method stated, provided that techniques and requirements recalled below are observed:

— use of screws as defined in 5.4.1.2, complying with the maximum spacing Si = 200 mm recommended in Table 7 and approximately at 200 mm to 300 mm centres as recommended in 5.4.2.2.

— in case of use of intermediate standard frame:

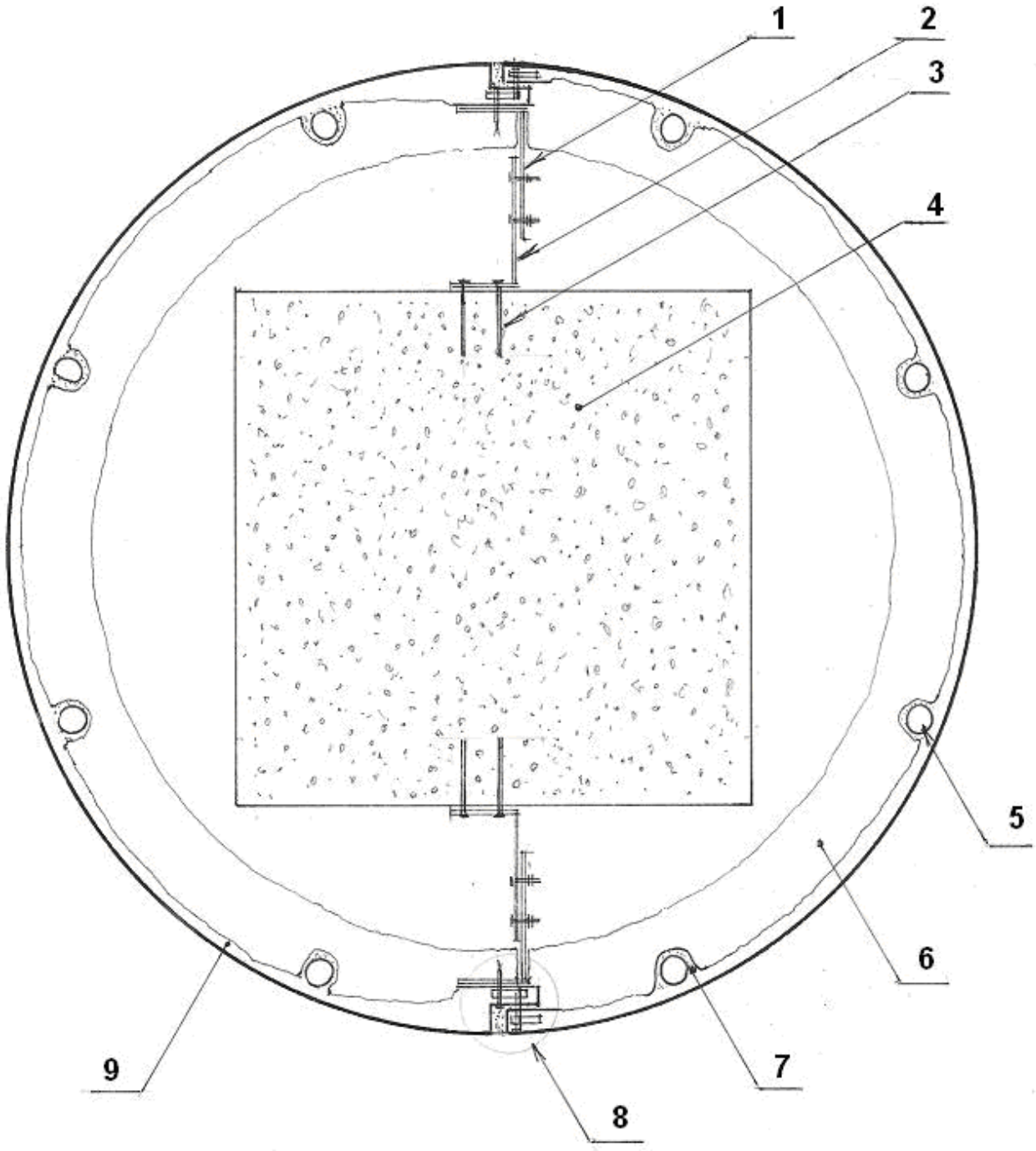
  accordance with maximum intervals Pi and Hi as recommended in Table 7 (see Figure 15);

— use of securing devices or anchors for spaced fixing accessories to be backgrounds such as given in Table 2;

— use of accessories for attachment and connection such as given in Tables 2 and 7.

Any non-planned contact, between the fibrous plaster work or its spaced fixing accessories on the one hand, and the services equipment or their fixing devices passing through plenums or voids in the work on the other is not allowed.

5.4.3.3 Example of installation of GRG work using screwed system



Key

1 steel fastening installed at 1 000 mm centres
2 steel angle overall height
3 anchoring bolt
4 reinforced concrete pillar
5 ∅ 20 mm steel tubular complementary reinforcement
6 GRG flanged stiffener if necessary
7 wad for fixing tubular to GRG, sealed during cast making with same plaster and glass fibres
8 jointing type iii (see Figure 19)
9 GRG column 900 mm ∅ (9 mm and 6 mm thickness)

Figure 16 — Example of installation of GRG column (screwed system)

5.4.3.4 Jointing of GRG works

GRG casts may show several types of edges for jointing.

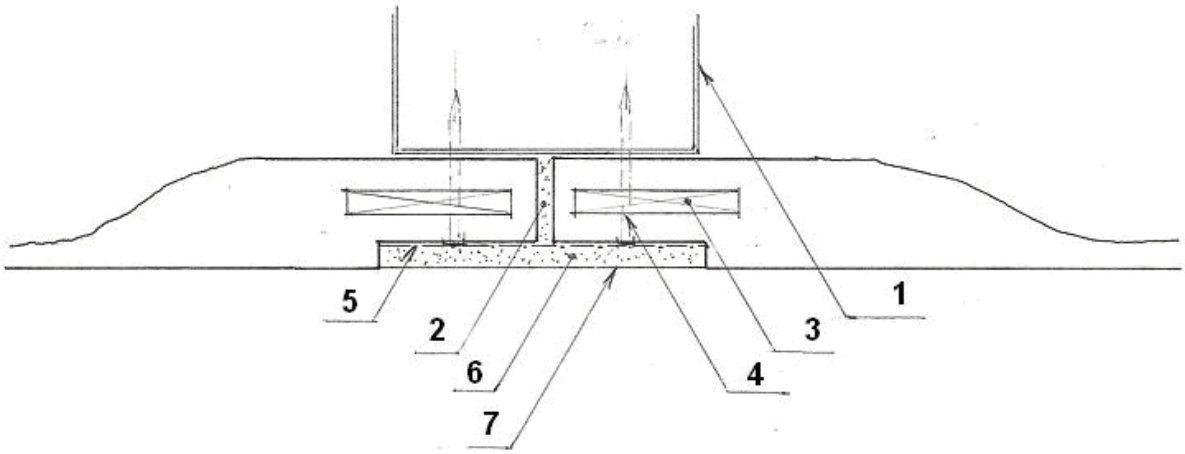
EXAMPLES:

i) Reinforced rim edges with rebates (see Figure 17) to joint and secure to metal frame.

The adjacent casts should be fixed to their rebated edges next to each other at least 2 mm apart.

Screws through rebates approximately at 200 mm to 300 mm centres.

A jointing tape should be inserted into the bottom of the rebates, then the rebates should be filled with gypsum based dual-purpose compound and smoothed.



Key

1	structural back-up	3	built-in softwood	6	compound
2	at least 2 mm apart	4	screw	7	smoothing
		5	jointing tape		

Figure 17

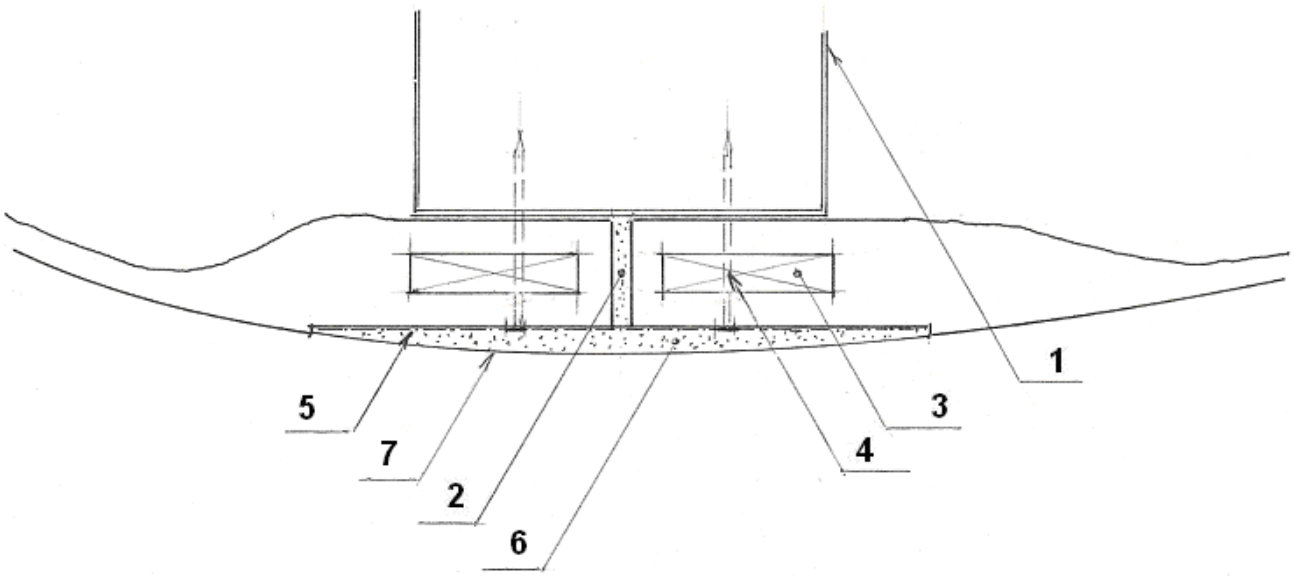
ii) Reinforced rim edges with tapered fields (see Figure 18) to joint and secure to metal frame.

The adjacent casts should be fixed to their tapered fields next to each other at least 2 mm apart.

Screws through tapered field approximately at 200 mm to 300 mm centres.

A jointing tape should be put over tapered fields.

Then the tapered fields should be filled with gypsum based dual-purpose compound and smoothed.



Key

1	structural back-up	3	built-in softwood	6	compound
2	at least 2 mm apart	4	screw	7	smoothing
		5	jointing tape		

Figure 18

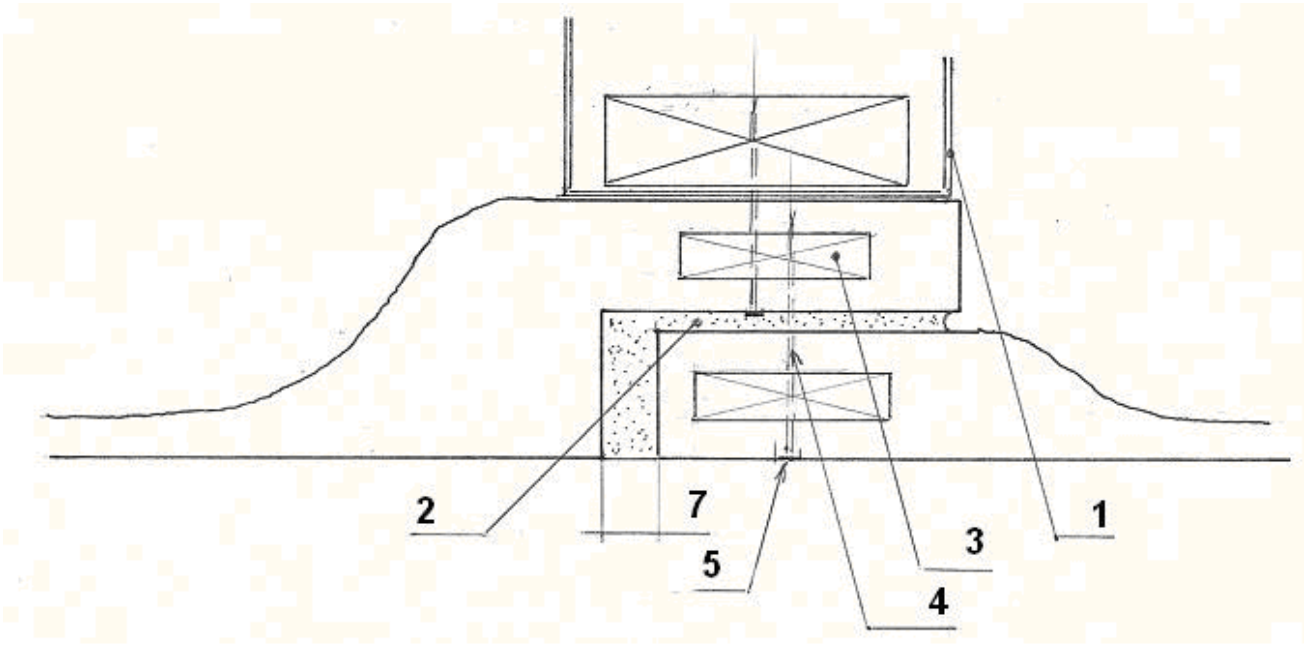
iii) Reinforced rim edges with shoulder (see Figure 19) to joint and secure to metal frame (e.g. column).

The adjacent casts should be positioned edge-to-edge no less than 5 mm and no more than 10 mm apart.

Screws through square edges and shoulders approximately at 200 mm to 300 mm centres. Both screws should be staggered.

Then the joint should be treated with a gypsum based dual-purpose compound and smoothed.

Recessed screw heads should be sealed.



Key

1 structural back-up
2 compound
3 built-in softwood
4 screw
5 recessed screw head
7 5 mm ≤ spacing ≤ 10 mm

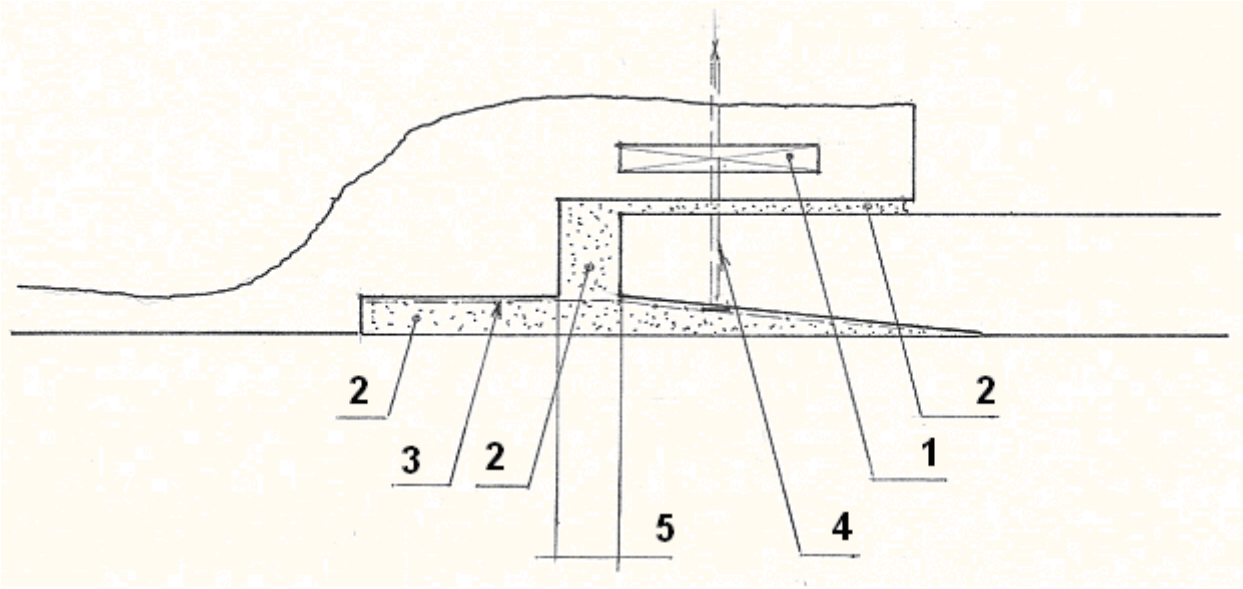
Figure 19

iv) Reinforced rim edges with rebate and tapered field, and shoulder (see Figure 20) only to joint.

The adjacent casts should be positioned edge to edge no less than 5 mm and no more than 10 mm apart.

Then the joint should be treated with a gypsum based dual-purpose compound.

A jointing tape should be put inside rebate-tapered field, which should be filled with gypsum based dual-purpose compound and smoothed.



Key

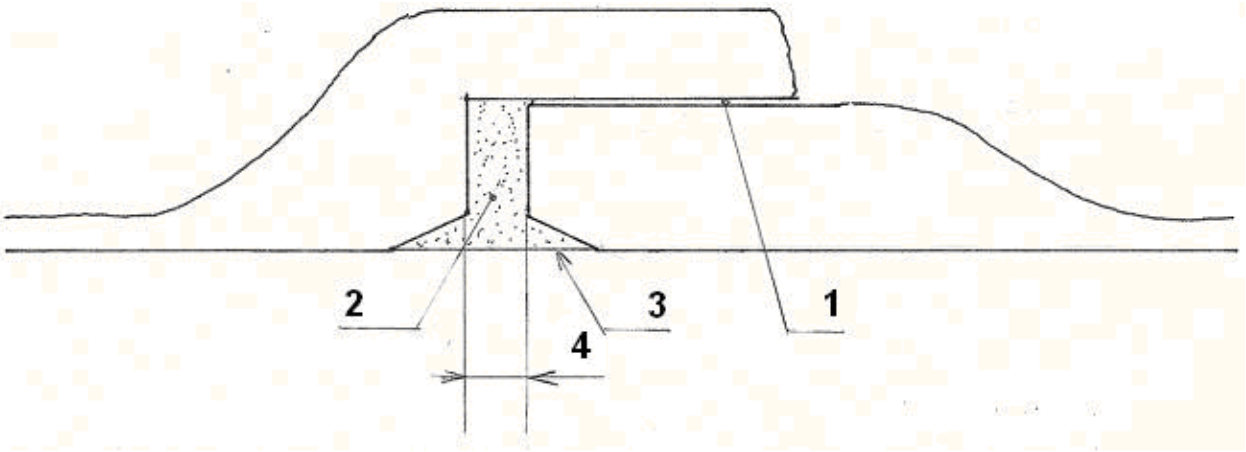
1	built-in soft-wood	2	compound	4	screw
		3	jointing tape	5	5 mm ≤ spacing ≤ 10 mm

Figure 20

v) Reinforced rim edges with shoulder and bevelled edges (see Figure 21) only to joint

The adjacent casts should be positioned edge to edge no less than 5 mm and no more 10 mm apart.

Then the joint should be treated with a gypsum based dual-purpose compound and smoothed.

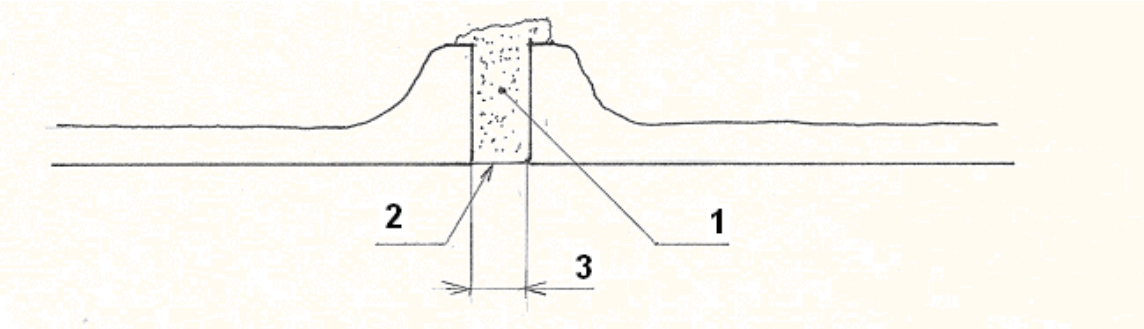


Key

1 dry joint
2 compound
3 smoothing
4 5 mm ≤ spacing ≤ 10 mm

Figure 21

vi) Reinforced square rim edges (see figure 22) only to joint.



Key

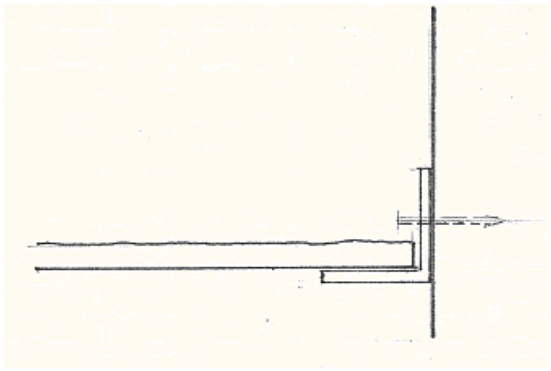
1 compound
2 smoothing
3 5 mm ≤ spacing ≤ 10 mm

Figure 22

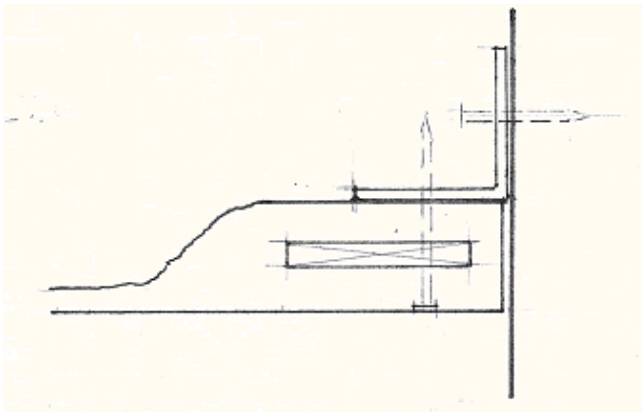
5.4.3.5 Edges of works

Perimeter edges to walls may show several types.

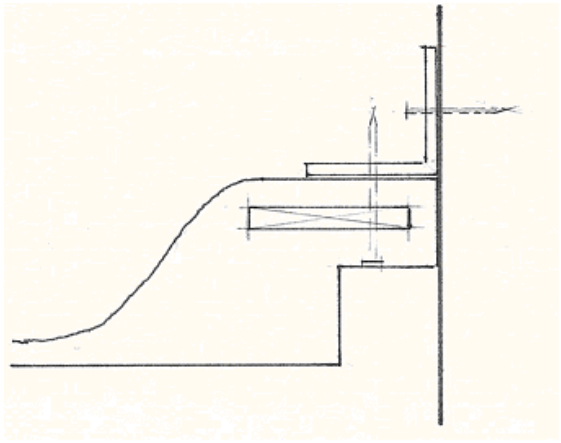
EXAMPLES



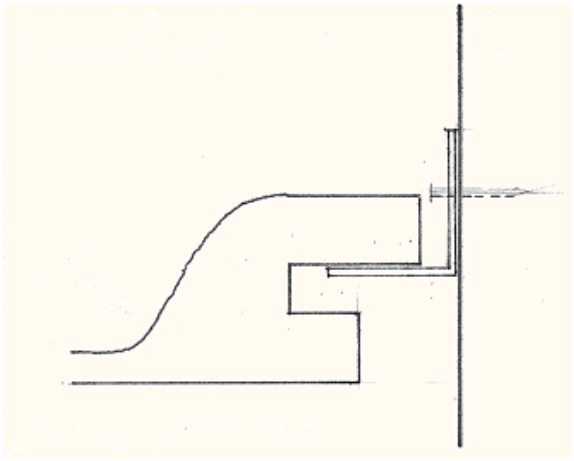
i) squared on angle



ii) squared screwed to angle



iii) rebated screwed to angle



iv) grooved

Figure 23 — Examples of perimeter edges of works to walls

5.4.3.6 Expansion joints, separation around penetrations and insertions, separation at edges of the works, subdivision of the works

In some situations, joints defined to 4.3.2.4 of EN 15319:2007 may need to be designed and constructed.

5.5 Installation of GRG works using sealed system

5.5.1 Products and materials constituting GRG works itself

5.5.1.1 GRG casts (architectural casts)

The GRG casts should comply with definition of 3.2.17 and with requirements of Clause 5 of EN 13815:2006, in particular:

— made from alpha based gypsum plaster;

— the surface mass of flat casts shall be at least 1.4 kg/m^2 per mm of thickness; this surface mass may apply to developed area of shaped or elaborated casts, after deduction of complementary reinforcement by steel section (see b) below);

— the recommended average surface hardness value of GRG casts should be equal to or greater than 80 shore D units.

These GRG casts should comprise:

— reinforced rim edges with rebates or tapered fields and/or shoulders, which may include built-in softwood laths or plywood strips should comply with 5.6.3.1.3 of EN 13815:2006 for screwing (see Figures 17, 18, 19 and 20);

— possible complementary reinforcement by softwood lath or light weight section.

These GRG casts intended to installation by sealed system may include two ways of construction:

way a) either built-up fixing metal devices (e.g. fastenings, hooks, corner plates) suitably arranges on back of casts for fixing to intermediate frame or stay hangers (see Figure 24)

way b) or built-up intermediate frame by steel sections (U, I, tubular) suitably arranged on back of casts for fixing to stay hangers (see Figures 25, 26 and 27)

These fixing metal devices and steel sections above shall be placed inserted and sealed during casts making with the same gypsum casting plaster, the one given in 3.2.17 of EN 13815:2006 and reinforcement by glass fibres

Fixing by sealing later is not allowed.

For these casts of a common nominal thickness equal to or less than 9 mm, the spacings between fixing metal devices, between steel sections or between sealings (wads) to steel sections, should be dependent on the shapes and configurations of casts; they are approximately at 600 mm centres.

5.5.1.2 Plasters used for installation

Gypsum plasters – calcium sulphate hemihydrate – used for installation should be:

— the same as GRG moulding, for use on GRG casts themselves;

— the one given in 5.3.1.2 for use on frame.

5.5.1.3 Water

The mixing water should be clean and free from contamination and impurities.

Normal tape water may be used.

5.5.1.4 Fibres and hessian used for installation

The fibres and hessian used for installation should comply with the specifications given in 5.6.3.1 and 5.6.3.2 of EN 13815:2006.

5.5.1.5 Screws

Screws used for installation should comply with the specifications given in EN 14566.

5.5.1.6 Jointing materials

Gypsum based dual-purpose compound used for jointing and recessed screw heads sealing should comply with EN 13963.

5.5.1.7 Jointing tapes

When a jointing tape is required, strip of reinforced fibre should be used.

Common tapes are around 50 mm wide.

Rebates and tapered fields should be designed for jointing tape and filler over casts on both sides of joints (see Figures 17, 18 and 20)

5.5.1.8 Fixing metal devices and steel sections (way a) and b) of 5.5.1.1)

Recommendations for reliability and protection given in 5.2 (1st paragraph and Table 1) applies.

5.5.2 Equipment to be used for GRG works with spaced fixing suitable for installation by sealed system

Recommendations for reliability and protection as given in 5.2 (1st paragraph and Table 1) applies.

The accessories, devices and frames defined in Table 3 (connectings, hangers, lugs and intermediate frames) should be used in ways a) and b).

5.5.3 Construction of GRG works using sealed system

5.5.3.1 Selection of spaced fixing equipment

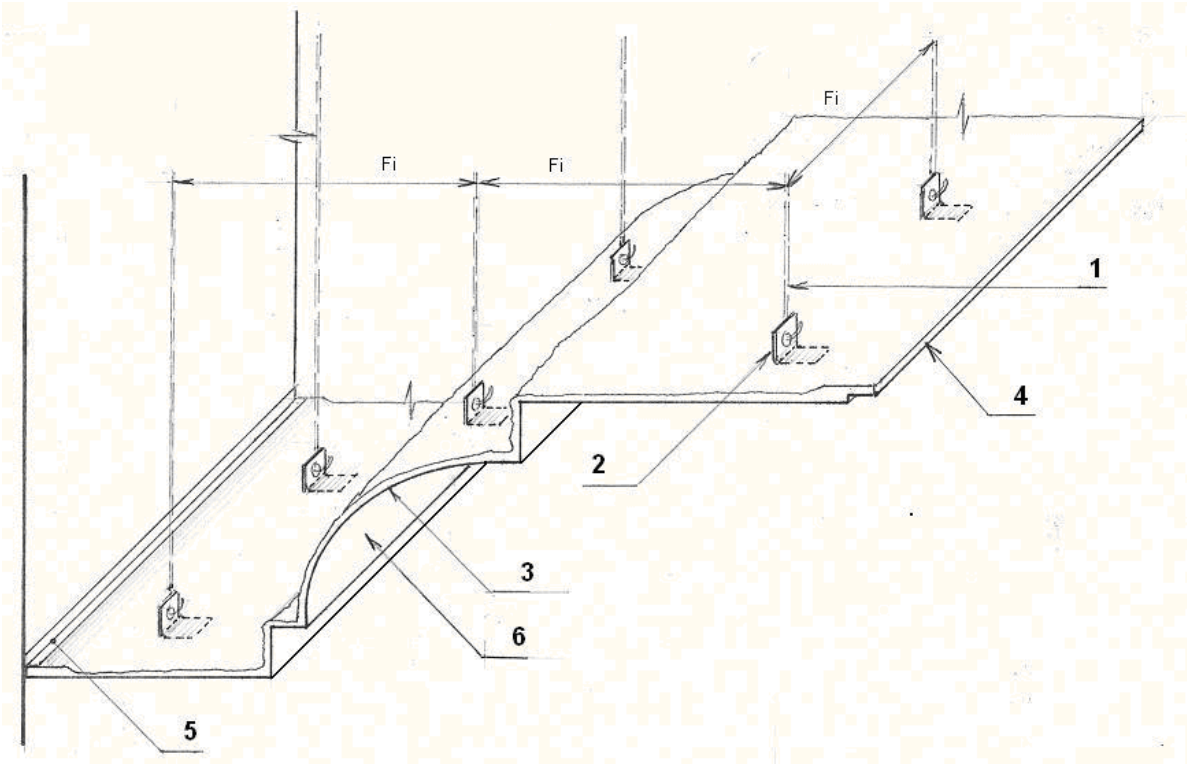
The nature and conditions of the background or supporting structures (e.g. sizes of depth), the technical requirements, the need to allow for passage of services equipments and particularly the configuration of the casts and/or the works may determine the choice of ways of construction using sealed system:

— the way a) of 5.5.1.1 may determine the choice of ways be able to concern casts configuration with many medium-sized shapes and reliefs or elaborate ensembles;

— the way b) may be able to concern casts configuration with large shaped surfaces.

5.5.3.2 Examples of installation of GRG works

5.5.3.2.1 GRG soffit (sealed system-way a) see 5.5.1)

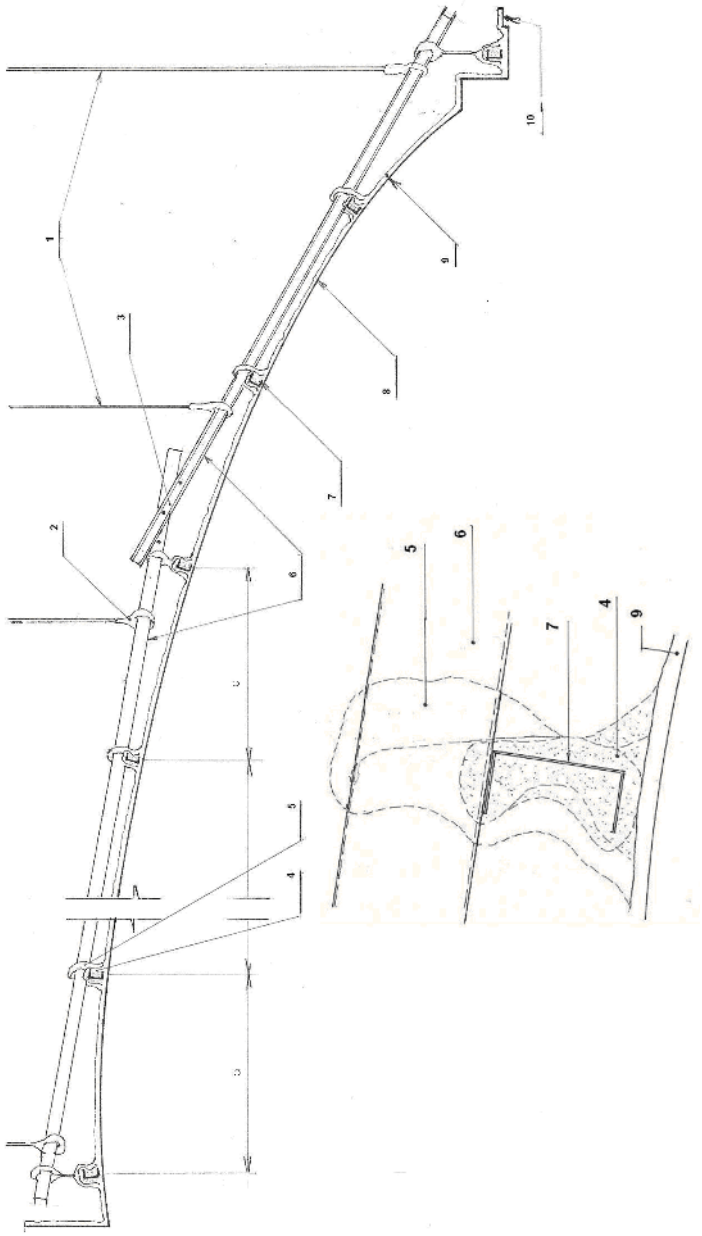


Key

1 round wire hanger with wad to fastening
2 built-up steel fastening sealed during cast making
3 jointing type vi (see Figure 22)
4 jointing type v (see Figure 21)
5 squared screwed edge to angle type ii (see Figure 23)
6 GRG cast
Fi spacing between fastenings (normally: at 600 mm centres)

Figure 24 — Example of installation GRG soffit (sealed system-way a) see 5.5.1.1)

5.5.3.2.2 GRG vault (sealed system-way b) see 5.5.1)



Key

1 threaded rod hanger ∅ 8 mm

2 clamping to U with securing wad

3 fishplate

4 wad for fixing U to GRG vault, sealed during cast making with same plaster and glass fibres

5 fibrous plastered rope for fixing U to U, sealed during cast making with same plaster and glass fibres

6 U cold forming 40 x 20 x 1,5 for frame (spacing around at 1 200 mm centres)

7 U cold forming 40 x 20 x 1,25 for complementary reinforcement

8 jointing type v (see Figure 21)

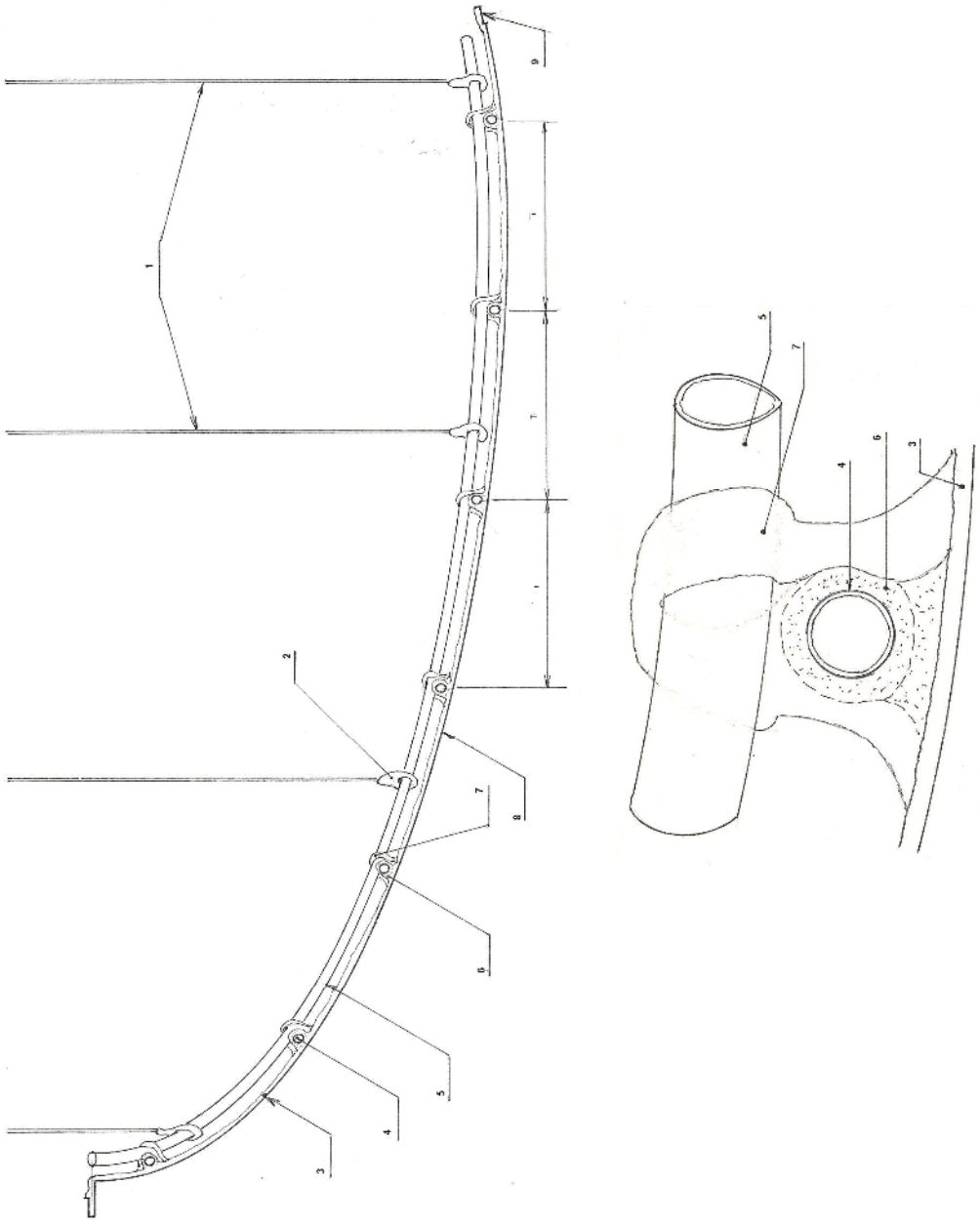
9 GRG vault cast (approximate developed area: 7 m^2)

10 jointing type iv or v (see Figures 20 or 21)

Ci spacing between U (normally at 600 mm centres)

Figure 25 — Example of installation GRG vault (sealed system-way b) see 5.5.1.1) and detail of fixing U to U

5.5.3.2.3 GRG curved soffit (sealed system – way b) see 5.5.1)



Key

1 threaded rod hanger ∅ 8 mm

2 clamping to ∅ 25 mm steel tubular with securing wad

3 GRG curved soffit (approximate developed area: 6 m²)

4 ∅ 20 mm steel tubular for complementary reinforcement

5 curved ∅ 25 mm steel tubular for frame (spacing around at 1 200 mm centes)

6 wad for fixing ∅ 20 mm tubular to GRG soffit, sealed during cast making with same plaster and glass fibres

7 fibrous plastered rope for fixing ∅ 25 mm tubular to ∅ 20 mm tubular during cast making with same plaster and glass fibres

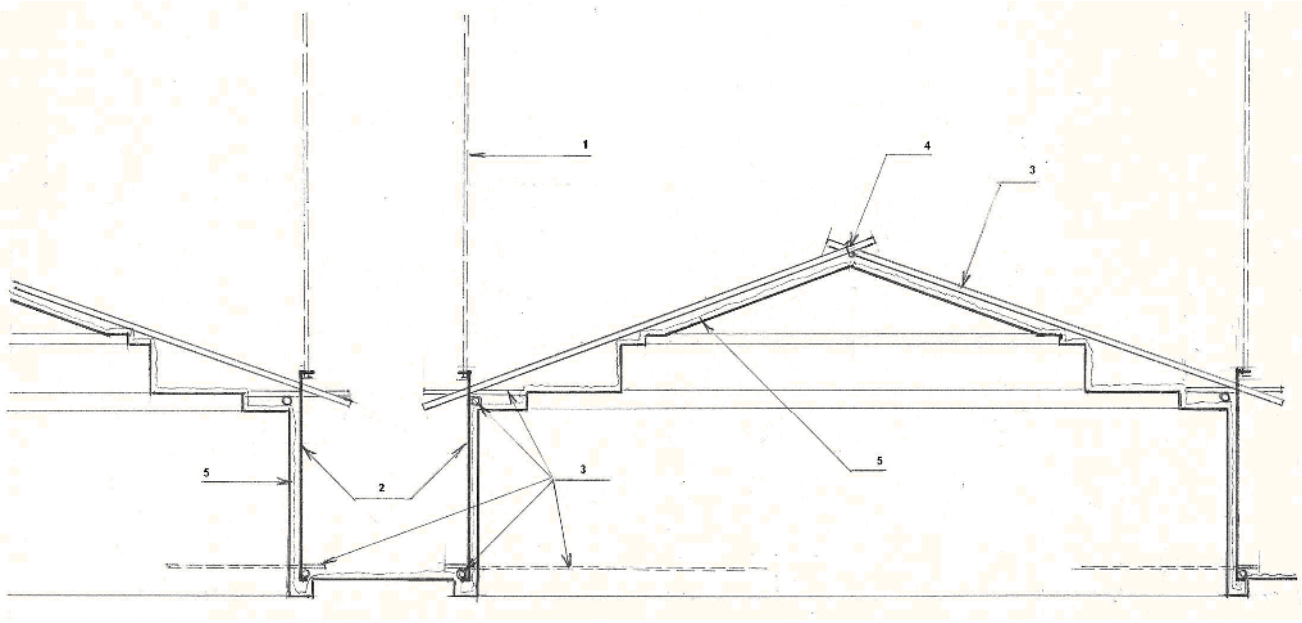
8 jointing type v (see Figure 20)

9 jointing type iv or v (see Figures 19 and 20)

Ti spacing between ∅ 20 mm tubular (normally at 1 200 mm centres)

Figure 26 — Example of installation of GRG curved soffit (sealed system-way b) see 5.5.1.1) and detail of ∅ 20 mm tubular to ∅ 25 mm tubular

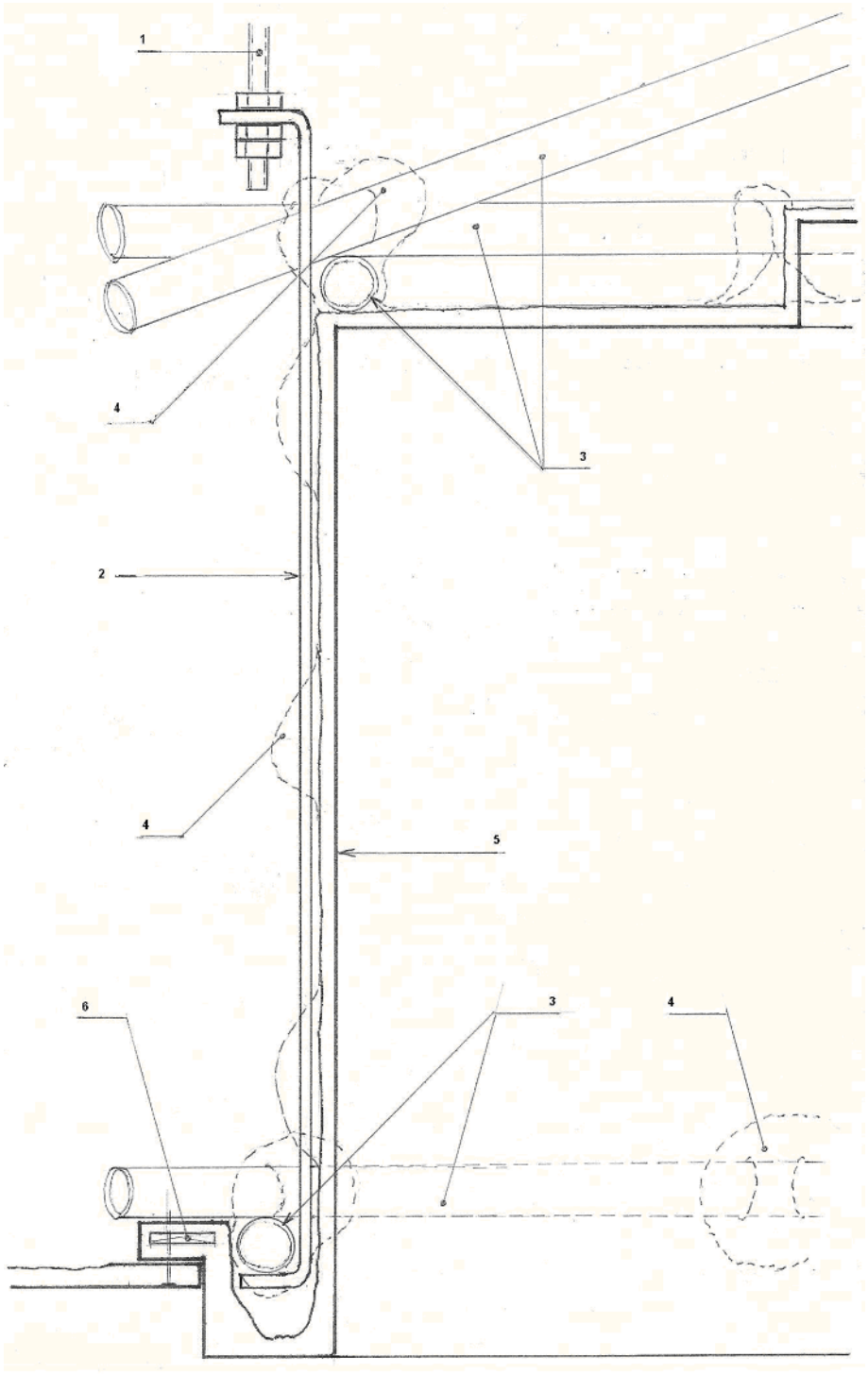
5.5.3.2.4 GRG coffered ceiling (sealed system – way b) see 5.5.1)



Key

1 threaded rod hanger ∅ 8 mm
2 steel fastening
3 ∅ 20 mm steel tubular complementary reinforcement
4 wad and fibrous plastered rope for fixing
5 GRG cast

Figure 27 — Example of installation of GRG coffered ceiling 1 600 mm x 1 600 mm (sealed system – way b) see 5.5.1.1)



Key

1 threaded rod hanger ∅ 8 mm
2 steel fastening 40 mm x 4 mm
3 ∅ 20 mm steel tubular complementary reinforcement
4 wad and fibrous plastered rope for fixing sealed during cast making
5 GRG cast
6 built-in softwood

Figure 28 — Detail of installation of GRG coffered ceiling (sealed system-way b) see 5.5.1.1)

5.5.3.3 Jointing of GRG works

Recommendations as given in 5.4.3.3.

5.5.3.4 Edges of works

Several types as given in 5.4.3.4.

5.5.3.5 Expansion joints, separation around penetrations and insertions, separation at edges of the works, subdivision of the works

In some situations, joints defined to 4.3.2.4 of EN 15319:2007 may need to be designed and constructed.

6 Characteristics of the completed works

6.1 Surface appearance of the works

The condition of the exposed face of the work must allow the application of the usual finishes without any other preparatory work than that which is normal for the type of finish being considered (see Annex C of EN 15319:2007).

The exposed finished surface of the fibrous plaster work should be substantially free from:

— oil or lubricants stains;

— efflorescence;

— inscriptions by coloured pencil or felt-tip;

— streaks;

— mould bubbles (small balls of plaster);

— spalls and chips on sharp edges;

— cavities or lacks of plaster on details;

— possible fissure or crack which should not be allowed.

The exposed face should be checked with lighting conditions defined in 5.1.3 of EN 15319:2007.

6.2 Flatness of work surfaces

6.2.1 Local flatness

This shall be checked with a metallic studded rule 200 mm long L comprising three studs, shown on Figure 29 (the isolated stud is positioned in the middle of the rule).

The stud height h being:

— 1 mm for common flatness,

— 0,6 mm for superior flatness.

The stud width l being 5 mm.

It should be possible for the two end studs of the rule to come into contact with the surface of the work at the same time and it should be possible to see the rule rocking when the central stud is in contact with the work.

For lack of studded rule, use of metal rule with feeler gauges should be allowed.

6.2.2 General flatness

Same procedure as above, with a rule metallic studded 2 000 mm long L.

The stud height h being:

— 5 mm for common flatness,

— 3 mm for superior flatness.

The stud width l being 25 mm.

For lack of studded rule, use of metal rule with feeler gauges should be allowed.

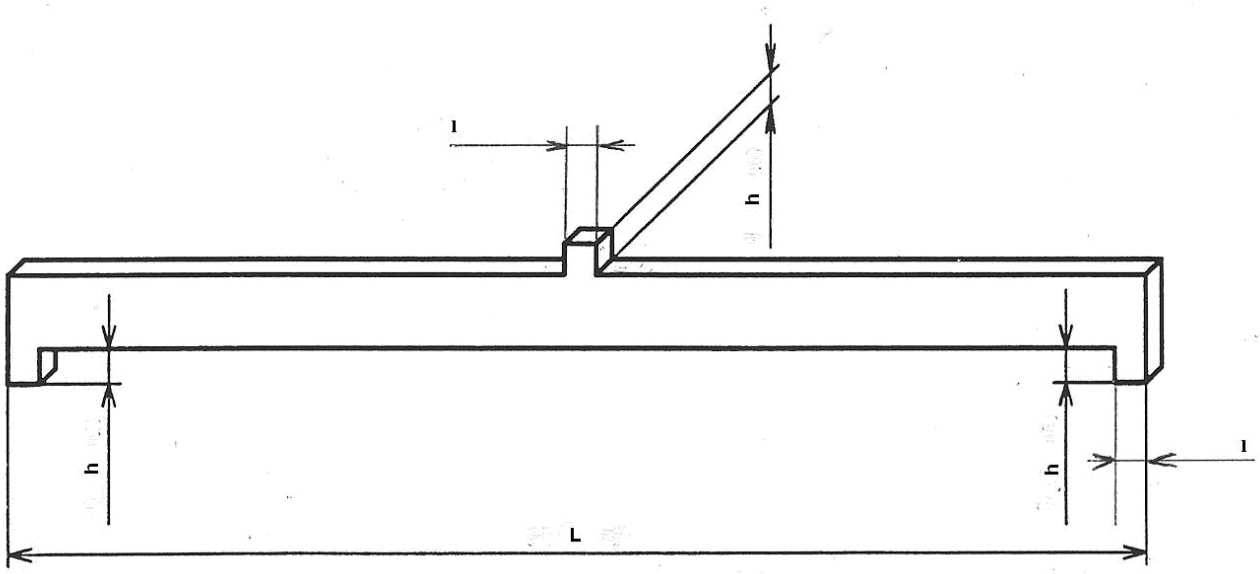


Figure 29 — Studded rule

6.3 Verticality of flat work surfaces

A tolerance of 1 mm in the verticality shall be acceptable for each section or part section of 500 mm height (e.g. for a height of 3 600 mm, the tolerance shall be 8 mm).

Annex A
(informative)

Classes of corrosion protection of metal framework components

Class according to Table 1	Profiles, suspensions[a], connecting elements[a]	
	Components made of steel	**Components made from aluminium**
A	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to EN 10346[b]. Products with electroplated zinc coating flat ZE25/25 according to EN 10152[b].	No additional corrosion protection required
B	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to pr EN 10346[b] . Products with electroplated zinc coating flat according to EN 10152 with or without an additional organic coating[c] as follows[c]: ZE100/100 without OC.	No additional corrosion protection required or coil coating according to EN 1396: corrosion index 2a
C	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to pr EN 10346[b] with an additional organic coating[c] of 20 µm per face Products with electroplated zinc coating flat according to EN 10152 with an additional organic coating[c] as follows[c]: ZE100/100 + 40 µm per face.	Anodising[c] (15µm < s < 25µm) or coil coating according to EN 1396: corrosion index 2a
D	Special measures depending on use and corrosion action. Minimum corrosion protection according to Class C. Additional measures as required	Anodising[c] (s > 25µm) or coil coating according to EN 1396: corrosion index 2b

[a] Round steel wires used as suspensions or part of a suspension shall meet the requirements of EN 10244-2 (Zinc or Zinc alloy coating on steel wire).

[b] Any equivalent corrosion protection leading to a similar level of protection is permitted.

[c] Coating of exposed parts with zinc compatible organic coating according to EN ISO 12944-3 applied by a post-painting process or equivalent coil coating according to EN 10169.

Bibliography

[1] EN 13964, *Suspended ceilings — Requirements and test methods.*

[2] ETAG.001, *ETAG Metal and anchors for use in concrete: Part 1 to 6.*

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