17.3.2023 ICS: 93.040

ELOT TS 1501-03-05-01-00:2023

ΕΛΛΗΝΙΚΗ ΤΕΧΝΙΚΗ ΠΡΟΔΙΑΓΡΑΦΗ

HELLENIC TECHNICAL SPECIFICATION

Επικεραμώσεις στεγών

Roof coverings with roofing tiles

Pricing class: **10**

50, Kifisou Av., 121 33 PERISTERI

Preamble

This Hellenic Technical Specification revises and replaces ELOT TS 1501-03-05-01-00:2009.

This Hellenic Technical Specification was prepared by Experts and checked and evaluated in its field by a Supervisor/Specialist - Expert, who assisted the work of the Technical Committee ELOT/TE99 “Specifications of Technical Works”, the secretariat of which belongs to the Directorate for Standardisation of the Hellenic Organization for Standardization (ELOT).

The text of this Hellenic Technical Specification ELOT TS 1501-03-05-01-00 was adopted on 17.3.2023 by ELOT/TE 99 in accordance with the Regulation on the drafting and publication of Hellenic Standards and Specifications.

The European, international and national standards referred to in the standardisation references are available by ELOT.

HELLENIC ORGANIZATION FOR STANDARDIZATION
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Content

Introduction

This Hellenic Technical Specification (HTS) is part of the technical texts originally prepared by the Ministry for the Environment, Spatial Planning and Public Works and the Institute for Constructions Economy (IOK) and was subsequently edited by ELOT in order to be applied to the construction of national public technical works, with a view to produce works that are robust and capable of meeting and satisfying the needs which have dictated their construction, and be beneficial for the society as a whole.

Under a contract between NQIS/ELOT and the Ministry for Infrastructure and Transport (online publication number 6ΕΟΒ465ΧΘΞ-02Τ), ELOT was assigned the editing and update as 2nd Edition of three hundred fourteen (314) Hellenic Technical Specifications (HTS), in accordance with the applicable European Standards and Regulations and the procedures laid down in the Regulation on the drafting and publication of Hellenic Standards and Specifications and in the Regulation on the establishment and operation of Technical Standardization Instruments.

This Hellenic Technical Specification was prepared by the contractor of the restricted tender No 1/2020 for the award of the work “Revision of the 1st edition of 314 HTS” (online publication number ΩΕΕΑΟΞΜΓ-ΞΗΔ), checked and evaluated in its field by a Supervisor/Specialist - Expert and submitted for Public Consultation. It was approved by the Technical Committee ELOT/TE 99 “Specifications of Technical Works”, which was set up by the Decision of the Managing Director of the NQIS, Δν.Σ. 285-19/08-02-2019 (ΑΔΑ6ΩΛΡΟΞΜΓ-15Ξ).

This HTS covers the requirements arising from the EU law, the relevant New Approach Directives currently in force and the National Law, and refers to and is compatible with harmonised European standards.

Roof coverings with roofing tiles

1 Objective

The purpose of this Technical Specification is to define the requirements for carrying out roof coverings with roofing tiles consisting of wooden, metal or reinforced concrete carriers, using tiles of all roof covering types and/or systems, consisting of tiles together with the required special fittings (e.g. end fittings) and accessories thereof.

The execution of the work requires the drafting of detailed plans which are the subject of the Study or provided by the manufacturers of the roof-covering systems.

2 Standardization references

This Technical Specification incorporates –by way of references– provisions of other publications, whether dated or not. These references refer to the respective parts of the text and a list of these publications is presented thereafter. In case of references to dated publications, any subsequent amendments or revisions thereof shall apply to this document when incorporated in it by means of amendment or revision. With regard to references to undated publications, their latest version shall apply.

ELOT EN 490	*Concrete roofing tiles and fittings for roof covering and wall cladding - Product specifications -- Κεραμίδια και εξαρτήματά τους από σκυρόδεμα για επικαλύψεις στεγών και επενδύσεις τοίχων - Προδιαγραφές προϊόντος*
ELOT EN 492	*Fibre-cement slates and fittings - Product specification and test methods -- Πλακίδια και εξαρτήματα από ινοτσιμέντο - Προδιαγραφή προϊόντος και μέθοδοι δοκιμής*
ELOT EN 544	*Bitumen shingles with mineral and/or synthetic reinforcements - Product specification and test methods -- Ασφαλτικές πλάκες με ενίσχυση από ορυκτό ή/και συνθετικό υλικό - Προδιαγραφή προϊόντος και μέθοδοι δοκιμής*
ELOT EN 1304	*Clay roofing tiles and fittings - Product definitions and specifications -- Κεραμίδια από άργιλο και εξαρτήματα - Ορισμοί και προδιαγραφές προϊόντος*
ELOT EN 13501-1	*Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests -- Ταξινόμηση δομικών προϊόντων και στοιχείων σχετικά με την φωτιά - Μέρος 1: Ταξινόμηση με τη βοήθεια δεδομένων από δοκιμές αντίδρασης σε φωτιά*
ELOT EN 13859-1	*Flexible sheets for waterproofing - Definitions and characteristics of underlays - Part 1: Underlays for discontinuous roofing -- Εύκαμπτα φύλλα στεγάνωσης - Ορισμοί και χαρακτηριστικά υποστρωμάτων - Μέρος 1: Υποστρώματα για ασυνεχείς επικαλύψεις στεγών*
ELOT TS 1501-03-06-02-03	*Thermal insulation of clay roofing tiles -- Θερμομονώσεις κεραμοσκεπών στεγών.*

3 Terms and definitions

The following terms and definitions are used in this Technical Specification:

3.1 Categorisation of roofing tiles based on construction material

On the basis of their construction material, roofing tiles are distinguished into clay (ceramic), plastic, bitumen, concrete, metal and porcelain roofing tiles.

Clay roofing tiles are a traditional material in roof covering technology. They are characterised by impermeability to water, they have satisfactory thermal insulation properties, they offer breathability and they are non-combustible. Depending on their shape, they are divided into three categories and applied to a different substrate and in a different way.

Plastic roofing tiles are usually made of polypropylene, they are available in a wide range of shapes and sizes, single or multiple or in slabs, and they can ensure insulation and tightness.

Bitumen tiles are usually formed with a double layer of oxidised asphalt, glass fabric or pre-impregnated polyester as a reinforcement and dusting with quartz sand. A coloured basalt mineral chip, which protects the bituminous mixture from ultraviolet radiation (UV), is often used as outer top coating, and as a bottom coating fine-grained quartz sand is used as a separating layer of the bitumen roofing tiles when they are packaged. Bitumen tiles are light and flexible, easily adaptable to architectural requirements, are available in a variety of types, shapes and colours, and are watertight and impervious to water and frost.

Concrete roofing tiles are made of lightweight concrete, yet they are heavy; thus, care should be taken to ensure that they are not ‘fresh’ when laid, but that they have been stored well in advance due to a risk of breaking.

Porcelain roofing tiles stand out due to their very low water absorption, they are not susceptible to mildew and do not change colour under the influence of external conditions. They are used on a small scale due to difficulty in application, fragility and high cost.

Metal tiles are an alternative, given that they are lightweight, offer a speedy application and can be coated with chippings to improve appearance.

3.2 Categorisation of roofing tiles by shape

Based on their shape, roofing tiles are divided into the following categories: convex, flat, interlocking or slab-shaped and types resulting from a combination thereof. They are distinguished into Byzantine roofing tiles (convex), Roman and Dutch roofing tiles (interlocking and corrugated), which derived from the combination of convex and flat roofing tiles, and French roofing tiles resulting from the combination of flat and interlocking.

Table 1 – Categorisation of roofing tiles by shape

Interlocking and corrugated roofing tiles (French and Dutch)	This form of roofing tiles displays appropriately shaped edges, so that they interlock firmly with each other. After they are placed on the wooden or metal truss, they are fastened to the purlins with wire, which passes through a hole that exists in a special rib on the back side of the roofing tiles. For small slopes and in areas with light winds the fastening can only be done in a few rows. The roofing tiles of ridges and hips are fixed with a strong cement mortar. These are roofing tiles (French, Roman, Dutch type) that have simple or double grooves on their edge: on the large side (the one placed parallel to the slope) for water tightness and flow between them, and on the small side for the tightness between them. With these grooves it is possible to limit the overlaps of tiles to a small percentage of their surface. They are available in various dimensions from 23/33 cm to 24/42 cm or larger. They shall always be placed in wooden or metal purlins which are attached to top chords of wooden or metal roofs or to beams parallel to the slope of the roof mounted on a reinforced concrete plate.

French roofing tiles		They originated in Southern France at the beginning of the industrialisation of the ceramic industry, so it was possible to produce solid roofing tiles by mold pressing, with appropriate ribs and folds facilitating installation and functionality.
Dutch roofing tiles		With two deep and wide grooves, they have excellent rainwater drainage capacity, while thanks to the interconnectors between them, they protect the roof from the ingress of unwanted moisture, and have excellent application on installation.
Roman roofing tiles		This is an evolution of traditional, Byzantine type, roofing tiles, with a similar final visual effect and clear advantages in the installation method. They have excellent rainwater discharge capacity. Roman roofing tiles are available in a wide range of natural colouring
Byzantine roofing tiles		These are tiles whose use dates back to ancient times. They are placed alternately so that one piece acts as a water discharge channel (sleeper), and the other as a cover element leading the water to the channel (coverer).
The Byzantine roofing tiles (gutters – lids) are available in various lengths (30 – 50 cm) and widths (16 – 22 cm). They are used on slightly sloped roofs. They may be positioned in different ways (see Annex B hereto) Directly with mortar on an inclined carrying plate of reinforced concrete, on a wooden board substrate of various thicknesses or on sheets of wood derivatives, in wooden purlins as long as the bottom surfaces of the gutters have two local parallel tendons with holes for their mechanical attachment or between trapezoidal cross-section battens mounted vertically into purlins.		

3.3 Special roofing tile fittings

In order to be able to complete the roof covering, all previous categories of roofing tiles are required to be combined with special fittings such as:

(1) Ridge tiles and troughs (at the site of contact of two sloped roof fields).

(2) Side end fittings (left – right) with vertical edge.

(3) Side end fittings of main roof covering (half tiles left – right).

(4) Roofing tiles with side outlet and integrated screens for roof ventilation.

(5) Roofing tiles incorporating upward a cylindrical element of various diameters for the penetration of pipes–ducts or ventilation.

(6) Components for sealing the end fittings of ridge tiles.

(7) Components for adjusting the roof window frame, placed on the same level with the roof covering.

(8) Transparent glass or polycarbonate roofing tiles, similar to the envisaged clay roofing tiles or to other roofing tile types (necessary condition for proper assembly with other roofing tiles) for roof lighting.

3.4 Categorisation of tile roofs

(1) **Tile roofs with clay roofing tiles:** The customary choice regarding tile roofs. They stand out in terms of aesthetics and their resistance to external environment effects, but they are heavy structures.

(2) **Tile roofs with plastic roofing tiles:** They look like those made of clay roofing tiles, they are easily built and offer more advantages over the latter in terms of insulation and impermeability.

(3) **Tile roofs with concrete roofing tiles:** They are usually selected in areas with low temperatures. They are characterised by high resistance and durability, but are heavy.

(4) **Tile roofs with bitumen roofing tiles:** Bitumen roofing tiles are essentially bitumen felts processed to look like roofing tiles. Their functional life is more limited compared to other types, especially when exposed to high temperatures that cause faster ageing. Increased heat concentration due to their material is avoided through reflection by choosing more light-coloured types of bitumen roofing tiles. They stand out due to their high impermeability and low cost.

(5) **Tile roofs with roofing panels:** Roofing panels are shaped similarly to classic roofing tiles. They are available in various variations of quality, colour and shape. They stand out for their resistance to weather conditions and impacts.

4 Requirements

4.1 General

The application of roof covering, in addition to selecting the most appropriate type of roofing tiles on a case-by-case basis, requires careful design of the details of the edges and joints with the other construction components (troughs, ridge tiles, frames, gutters, penetrating components) to ensure adequate impermeability, ventilation and durability of construction.

All of the above are included in the subject of the Study, depending on the characteristics and performance requirements of the building.

It should be noted that roofing tiles together with the required special fittings (end fittings) usually form a system of products that can be adapted to the geometrical characteristics of each structure. The manufacturers of these systems usually have detailed plans and implementation instructions for the required fixings, seals, etc., which must in any case be complied with when carrying out works.

4.2 Requirements for roofing tiles

Roofing tiles shall satisfy the requirements of the following harmonised standards:

- ELOT EN 492 Fibre-cement slates and fittings

  Note: Standard version ELOT EN 492:2012 is harmonised with Regulation (EU) No 305/2011 [20]

- ELOT EN 544 Bitumen shingles with mineral and/or synthetic reinforcement

- ELOT EN 1304 Clay roofing tiles and fittings

  Note: Standard version ELOT EN 1304:2005 is harmonised with Regulation (EU) No 305/2011

- ELOT EN 490 Concrete roofing tiles and fittings

  Note: The version ELOT EN 490:2011 of the Standard is harmonised with Regulation (EU) No 305/2011

and are required to:

(a) bear a CE marking; and

(b) be accompanied by a declaration of performance under Commission Delegated Regulation (EU) No 574/2014 (OJ L 159/41, 28.5.2014).

According to harmonised standard ELOT EN 492, the essential characteristics of fibre-cement roofing tiles are tensile strength, reaction to fire (Euroclass), external response to fire, water permeability, geometrical changes, release of hazardous substances and durability.

According to harmonised standard ELOT EN 544, the essential characteristics of bitumen roofing tiles are tensile strength, reaction to fire (Euroclass), external response to fire, water permeability, geometrical changes and durability.

According to harmonised standards ELOT EN 1304 and ELOT EN 490, the essential characteristics of clay and concrete roofing tiles, respectively, are tensile strength, reaction to fire (Euroclass), external response to fire, watertightness, geometric changes, release of hazardous substances and durability.

The performance requirements of the essential characteristics must be specified in the Study based on the performance and on-site conditions of the Project.

As regards reaction to fire, concrete roofing tiles shall be classified in accordance with Decision 96/603/EC in Class A1 without testing if they have an organic content not exceeding 1 % by weight or volume and any coating with an organic content less than or equal to 1 % by weight or volume. Products that do not meet these requirements shall be checked and classified in accordance with ELOT EN 13501-1 and the requirements of paragraph 5.9.2.2.2 of ELOT EN 490.

Similarly, as regards reaction to fire, clay roofing tiles are classified in accordance with Decision 96/603/EC in Class A1 without testing, provided that the organic material content of glue is ≤ 1 % by weight or volume for tiles produced by gluing one or more clay components, and roofing tiles have an organic content of ≤ 1 % by weight or volume of homogeneously distributed organic material. Products that do not meet these requirements are checked and classified according to ELOT EN 13501-1.

In the Passive Fire Protection Study of the building, the relevant requirements according to the Building Fire Protection Regulation (Bibliography [18]) are indicated.

4.3 Procedures for checking – receiving roofing tiles

The roofing tiles submitted to the project must be accompanied by the manufacturer's declaration of performance in order to verify that their essential characteristics meet the requirements of the Study.

In addition, it is recommended to carry out a sample check to establish whether or not there are broken roofing tiles and roofing tiles with defects on their surface or in their mass, which would be invisible after their placement.

From each batch received in the project, it is recommended to take 50 pieces at random and mark them so that the packaging (pallet) from which they have been taken can be traced, and examine the following defects:

Note: Any folding of the material other than grooves created during the pressing phase, stratifications in the mass of the piece and variations in the colour of the material shall not be considered defects

4.3.1 Craters

Craters result from the bloating of quicklime or silicon granules in clay mass.

It is not acceptable for roofing tiles to have on their outer (upward-facing surface) craters (conical-shaped holes) larger than 15 mm in diameter. In addition, they shall not have more than one crater with average diameter of between 7 and 15 mm per 0.1 m^2 of surface of the roofing tile projected at the level of the coating.

4.3.2 Circumferential material spills from the joints of the roofing tile mould

This defect is not acceptable because it prevents the proper attachment of the tiles to each other.

4.3.3 Superficial fine protrusions ofmaterial

They are not accepted when present in the area of roofing tile joints (in the clip areas).

4.3.4 Blisters

This is a local elevation of the material during the formatting phase.

In the area of joints they shall not have an average diameter greater than 15 mm.

On the remaining upper surface of the roofing tiles, they shall not be greater than 40 mm in diameter. In addition, there shall be no more than one blister between 15 and 40 mm in diameter per 0.1 m^2 projected surface of the tile at the level of the coating.

4.3.5 Peeling

It is a detachable section of the material mass. When it is in the joint ribs it is considered linear and angular at the angles.

In the joint areas between tiles, no peeling of an average diameter greater than 15 mm shall be permitted.

On the rest of the upward-facing surface of the tiles, the same restrictions apply as for blisters.

4.3.6 Irregular tearing throughout the thickness of the material

Such visible defects and their existence as revealed by a dull sound produced by the impact of a dry tile with a metallic object shall not be permitted.

4.3.7 Flatness

An edge deviation from the plane defined by the other three shall not exceed 8 mm.

4.3.8 Deviation from the alignment of edges and ribs

No arrows greater than 6 mm shall be measured at a rod placed on the edges and ribs.

4.3.9 Ribs of tile overlap areas

They shall not be smaller than 5 mm.

The recommended criteria for accepting or rejecting a lot of roofing tiles based on the above-mentioned checks, unless otherwise specified in the Study, are the following:

(a) For broken roofing tiles

If A is the number of broken roofing tiles and it is:

- less than or equal to 3, the lot is accepted.

- more than or equal to 7, the lot shall be rejected.
- between 4 and 6, a second sampling is carried out in a sample of 50 pieces.

So if B is the number of broken roofing tiles of the second sampling and:

- A + B is less than or equal to 8, the lot shall be accepted.
- A + B is greater than or equal to 9, the lot shall be rejected.

(b) For other surface and mass defects

As long as the result of the previous check is satisfactory, the check for whether or not the roofing tiles are to be accepted in terms of surface or mass defects shall continue. To this end:

If the results of the previous check are satisfactory, the other healthy pieces, taken at random as previously, are replaced in the batch of 50 pieces.

The check shall be carried out on the 50 pieces containing non-broken and replaced pieces, following the same procedure as in the previous paragraph and with the same acceptance/rejection limits.

4.4 Requirements for other roofing materials

4.4.1 General

The variety of roofing tiles and the specific application requirements of each type has led to the development and marketing of various clips, mortars, adhesives, sealing sheets made of metal and synthetic materials, impregnating products, etc.

These materials and products usually form part of the roofing system and their technical and quality characteristics are determined by the roofing tile manufacturer in order to ensure a long lifetime of the overall construction.

These products are covered by an extensive list of Standards (including harmonised ones), the reference to which is beyond the purpose of this Specification.

Thermal insulation materials, if provided for, are not included in the scope of this Technical Specification (see ELOT TS 1501-03-06-02-03).

4.4.2 Attachment fittings for roof covering

To attach roofing tiles on the roof the following are usually used:

(1) Metal stainless steel combs for sealing the holes of Byzantine tiles and tiles with grooves, other than the French ones, at the lower edges of the roof.

(2) Metal screens made of stainless steel wire to cover holes and prevent insect passage (also placed behind the combs of the previous paragraph and in each ventilation device at the bottom end of the roof coverings).

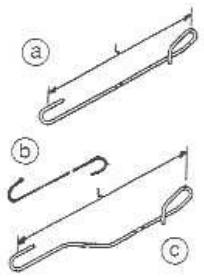
(3) Hard steel wire hooks for fixing Byzantine roofing tiles when not installed with mortar

(4) Stainless steel plate hooks for fixing ridge tiles

(5) Galvanised steel nails, flat-headed for fixing the breather membrane placed under the roof covering or for fixing the roofing tiles

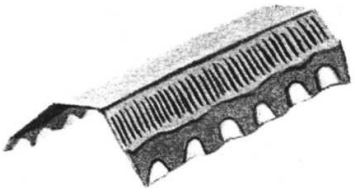
(6) Self-drilling screws for fixing the tiles in metal purlins.

Indicative forms of tile fixing accessories are shown in the following Figure 1. It should be noted that for the various types of roofing tiles, specialised support components are available on the market.



Byzantine tile clips

Ridge tile clip



Metallic stainless steel comb

Figure 1 – Examples of tile fixing accessories

4.4.3 Metal or synthetic sheets to ensure impermeability in the created gutters

They are placed on the created edges between roof levels or at the lower ends of the edges, according to the detailed plans of the Study.

(1) Sheets of galvanised sheet metal (it is noted that galvanising cannot withstand time).

(2) Sheets of electrostatically painted aluminium (must be at least 1 mm thick).

(3) Copper or zinc sheets

(4) Self-adhesive bitumen membranes coated with copper or stainless steel sheets in strips of various widths

(5) Flexible waterproofing sheets according to ELOT EN 13859-1 Standard.

These products are used to adapt and waterproof the roof covering with the various construction components (e.g. built flue), with which it comes into contact, and, due to their flexible nature, they fully adjust to all the folds of the roofing tiles.

4.4.4 Roofing tile fixing mortars

They are mainly used for Byzantine roofing tiles when they are not mechanically fixed and it is not necessary to form a breathing zone under their surface. Mortar is also used for sealing their holes at the bottom edges of the roof when no metal combs are placed, as well as on the ridge tiles when these are not fixed mechanically.

In all the above cases, a 150 kg lime and cement mortar with 175 to 225 kg of lime per cubic metre of dry sand must be used. The exclusive use of cement mortar results in significant rigidity in all roofing tile fixings and risks of cracking.

In order to improve the watertightness, adhesiveness and non cracking of the mortar, in particular in the ridge tiles and the various troughs, which are necessarily created in a roof where it comes to contact with various construction components, it is recommended to also use admixture emulsions of acrylic resin (without organic solvents) used in an insoluble form for pre-spreading the surface in lime cement mortars.

4.4.5 Roofing tile sealing materials

Transparent silicone waterproofing materials for impregnation without organic solvents may be used. These products should not affect the colouring of the tiles, turn yellow or peel over time.

5 Methodology for the execution of works

5.1 General

Roof covering work shall be carried out by a crew with established experience under the guidance of a foreman who has performed similar works.

During the execution of works, crews are obliged to:

a) comply with safety and hygiene rules, hold and use personal protective equipment (PPE).

b) have all the equipment and tools required for the work, such as self-supporting scaffolding and stairs; mortar engraving, mixing, preparation and screeding equipment; material transport equipment; manual hand tools; and power tools in excellent operational condition.

c) keep the above equipment clean and in good condition and correct any deficiencies thereof without delay.

e) construct a work sample for approval by the competent authority with a surface area of at least 1.50 m^2 in a location indicated by that authority. The sample must remain until the end of the project as a reference guide and all related works must be compared to it.

5.2 Structures that precede or are concurrent to the roof covering

(1) Fixed or opening glazing units at roof levels.

(2) Solar panels mounted on the roof level.

(3) Exit hatches to the roof, or automatic smoke vents.

(4) Metal structures consisting of a horizontal beam with its supports, mounted on top and parallel to the ridge tiles, so that a ladder can be mounted to visit and repair a roof.

(5) Television antennas of all forms, drainage network ventilation pipes, electrical networks, water supply networks, etc.

5.3 Start time of works

The commencement of roof covering works requires that the following, which are required for tiles of the mentioned forms, have been completed, where appropriate:

5.3.1 For Byzantine roofing tiles

(1) The wooden board lining with joints or sheet lining of wood derivatives has been completed.

(2) The purlins have been placed on the top chords, as long as the roofing tiles bear on the lower surface the brackets for fastening to the purlins (placement of tiles without wooden lining).

(3) The installation of a flexible or rigid bulkhead has been completed under the purlins or under the wooden lining and the bulkhead terminations on the upper and lower surfaces of the roof have been formed, so that the ventilation zones and the drainage of water that may leak from the roofing tiles can function.

(4) Any intended thermal insulation has been installed.

(5) Additional structures or their supports have been fitted.

(6) The hole sealing comb has been placed at the end edges of the roofing tiles.

(7) Metal sinks (gutters) have been fitted when no special ceramic gutters are provided for in the joints of the various roofing levels

(8) Construction of smoke ducts crossing the roof has been completed.

(9) All types of piping that crosses the roof have been completed in such places that special tiles can be installed.

(10) The devices for limiting thermal bridges between roofing end components and vertical components of the building envelope have been completed (see also ELOT Technical Specification 1501-03-06-02-03).

5.3.2 For roofing tiles with grooves (French – Roman – Dutch)

(1) The purlins have been placed on the top chords on which the roofing tiles are nailed or attached.

(2) All the work referred to in the previous paragraph 5.3.1 has been completed.

5.4 Installation of non-clay roofing tiles

Roof covering systems consisting of synthetic tiles, concrete tiles, bitumen tiles and tile panels must be installed in accordance with the instructions of their manufacturers.

5.5 Roof areas requiring special attention

(a) Horizontal ridges

For horizontal ridge tiles, it is used the same type of tiles as on the rest of the roof, or tiles of larger size, but always with an overlap of $\geq$10 cm.

Prior to the application of the mortar it is recommended to place nails every 10 to 15 cm on top chords and these to be joined together by wire that acts as a reinforcement of the mortar joining the ridge tiles with the last upward row of roofing tiles

Mechanical fixing may also be applied, in combination with mortar or entirely mechanical fixing. In these cases, a special configuration of the ridge with an additional wooden beam or the use of special pieces of tiles is required, in accordance with the detailed plan of the Study.

(b) Ridges with pitch (convergence of two roof levels)

The provisions referred to in the previous paragraph apply, but roofing tiles must be cut slantwise by cutting wheel.

(c) Lower end edges of roof covering

In traditional dwellings, roofing tiles are laid on an overhang by sequential placing of concave and convex tiles with mortar. This installation does not allow to create a breather zone under the roof covering (see Figure 1). Mounting can also be applied in conjunction with a front, usually wooden made of marine plywood to form natural ventilation openings. This mounting requires a metal water dripper and a horizontal gutter that overhangs from the front or is internal.

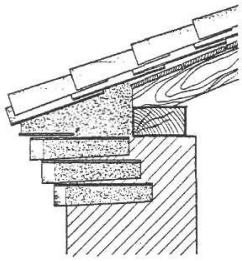


Figure 1

Free end of Byzantine roofing tiles in a traditional building

(d) Pitched gutters (from a cross-section of two roof levels)

At the formed dihedral angle, as long as the tiles are placed on a wooden substrate, it is recommended to apply a metallic coating made of zinc, copper or stainless steel (not galvanised sheet metal).

Where there are different pitches in the roof planes, the length of the overlap shall be such that in the case of water retention (due to run-off inability) there is no risk of leakage to the interior of the roof.

When the tiles are placed on purlins, the local metallic lining of the dihedral angle is recommended.

(e) End edges of roof covering on walls that continue vertically

Whether the roofing tiles are placed on purlins or on a wooden substrate, measures are required to ensure watertightness (see Figure 2).

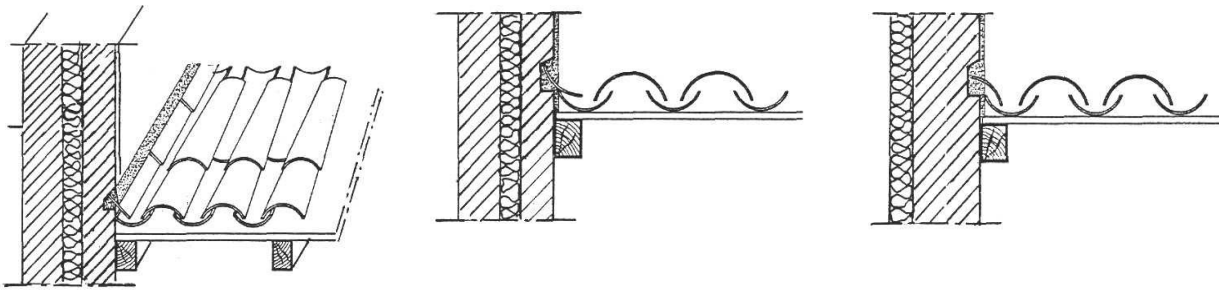


Figure 2 – Terminations of roof covering with walls continuing vertically

The waterproofing of tiling that ends laterally on a wall can be ensured either by mortar thickening of a tile cut lengthwise in a notch of the wall, or by installing bent metal sheets.

(f) Adapting roof covering with flue

Flue ducts crossing a wooden roof must be configured with double walls with an intermediate layer of rock wool, so that the wooden components of the roof cannot be affected by a possible fire leakage. These double walls must necessarily continue inside the areas.

Ensuring watertightness is carried out with bent sheets (made of steel, zinc, copper) of such width that they are covered by the last roofing tiles.

5.6 Surface sealing of roof covering

When using roofing tiles with increased water permeability (increased porosity) there is the possibility of sealing with transparent silicone waterproofing impregnating material. A prerequisite for this is that there is a relevant provision in the Study or that approval is granted by the Competent Authority.

6 Acceptance criteria of completed work

6.1 On site quality control

When carrying out the work, it must be checked by the Competent Authority that the materials and operations meet the requirements of this Technical Specification and the constructed overlappings ensure tightness, do not retain rainwater in any place and do not present any risk of wind ripping.

6.2 Tolerances

At no stage and type of construction is it allowed to create opposite inclinations and pockets for the retention of rainwater and concentrates.

7 Method of measurement of works

The measurement of the works is done in square meters of tiling, per type and applied technique, in accordance with the Contract Documents of the Project.

The above measured works include:

(1) Provision and employment of the personnel, equipment and means required to carry out the works in accordance with the terms hereof.

(2) Supply of the necessary consumables or non-consumable materials, their transport and their temporary storage in the project.

(3) Wear and deterioration of materials and depreciation and stoppage of equipment

(4) Collection of all kinds of waste resulting from the execution of the works and their transport for final disposal.

(5) Carrying out all required tests and checks in accordance with this Specification, as well as taking corrective measures (work and materials) if non-conformities are found.

Annex A
(informative**)**

Health, Safety and Environmental Protection Conditions

A.1 General

During the execution of the works, the applicable provisions on Occupational Health and Safety Measures shall be met and employees shall be equipped with the necessary Personal Protective Equipment (PPE), as appropriate, which must comply with the provisions of Regulation (EU) 2016/425.

The requirements laid down in the approved Safety and Health Plan / Safety and Health File (ΣΑΥ/ΦΑΥ) of the Project must also be strictly observed, in accordance with Ministerial Decisions ΓΓΔΕ/ΔΙΠΑΔ/οικ/889 (Government Gazette, Series II, No 16/14-01-2003) and the ΓΓΔΕ/ΔΙΠΑΔ/οικ/177 (Government Gazette, Series II, No 266/14-01-2001).

A.2 Hazard sources in the execution of works

Usual hazards arising in construction works, with particular reference to the fact that they are works performed at a height which are not normally carried out using scaffolding.

A.3 Health and safety measures

Compliance with Directive 92/57/EU on the implementation of minimum safety and health requirements at temporary or mobile constructions sites (as transposed into Greek legislation by Presidential Decree 305/96), and with the Greek legislation on health and safety (Presidential Decree 17/96, Presidential Decree 159/99, etc.) is mandatory.

The mechanical equipment required for carrying out the works must be adequately maintained in accordance with the instructions of the manufacturing plants and inspected by technicians of the Contractor in order to verify that the systems directly related to safety are functioning satisfactorily.

Please note the mandatory use of the following personal protective equipment (PPE):

i. Safety helmets

ii. Construction site gloves made of cloth or leather

iii. Safety footwear

iv. Safety belts and lanyards

When chemicals are used, the use of protective measures is required, as appropriate, by the personnel performing the works, as specified in the Material Safety Data Sheet (MSDS) of the respective material producer.

Workers must in all cases be equipped with the required personal protective equipment (PPE), depending on the object and location of the work to be carried out and the type of equipment used. The PPE must be in good condition, free of damage, bear a CE marking and a declaration of conformity in accordance with the provisions of Regulation (EU) 2016/425 and fall under the following Standards:

Table A.1 — Requirements for PPE

Type of PPE	Relevant Standard
Personal protective equipment for work positioning and prevention of falls from a height — Belts for work positioning and restraint and work positioning lanyards	ELOT EN 358
Personal protective equipment against falls from height – Full-body harnesses	ELOT EN 361
Protective gloves against mechanical risks	ELOT EN 388
Industrial safety helmets	ELOT EN 397
Protective clothing – General requirements	ELOT EN ISO 13688
Eye and face protection for use at work – Part 1: General requirements	ELOT EN ISO 16321-1
Eye and face protection at work – Part 3: Additional requirements for mesh type protectors	ELOT EN ISO 16321-3
Personal protective equipment – Safety footwear	ELOT EN ISO 20345

A.4 Measures of environmental protection

The materials to be disposed of must be collected and transported to the site’s specifically designated locations for final disposal.

The Environmental Conditions of the Project shall always apply.

Annex B
(informative)

Installation methods for Byzantine roofing tiles

B.1 Installation of Byzantine roofing tiles directly on a surface of a bearing reinforced concrete slab

The fixing of the roofing tiles with mortar, even a partial fixing, significantly reduces the possibilities for ventilation of the lower surface of the tiling, especially when a metal comb is not used, in which case the holes at the ends of the roofing tiles are necessarily closed with mortar.

In order to accept this method, no frost events should occur in the project area.

B.2. Installation of Byzantine roofing tiles on wooden substrate

The wooden substrate consists of wooden beams fixed either on the bearing plate parallel to its inclination or consists of top chords of the wooden truss. The wooden substrate can also be combined with thermal insulation (when required).

The placement of the Byzantine roofing tiles on the substrate can be done with mortar or between battens placed parallel to the pitch of the roof on the wooden substrate.

The gutters are formed on the trays created by the battens which achieve lateral securing against transversal movements.

Fixing is achieved locally with mortar for the gutters or with a full mortar for the lids, as well as with special hooks or directly on the boarding (without mortar and without battens).

The following Figures B-1 to B-10 show the ways of mounting and fixing the roofing tiles that are usually applied in practice.

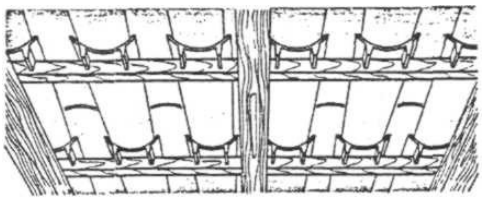


Figure B-1
Bottom view of the roof with Byzantine roofing tiles that have special brackets for their fastening to the top chords.

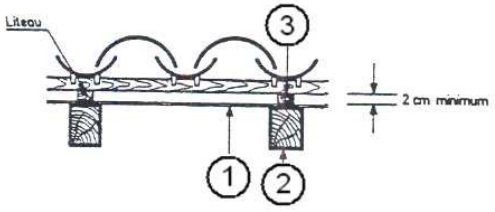


Figure B-2
Example of the installation on purlins of Byzantine roofing tiles with brackets, over a ventilation zone created by the application of a flexible bulkhead on the top chords: (1) flexible membrane, (2) top chord, (3) board

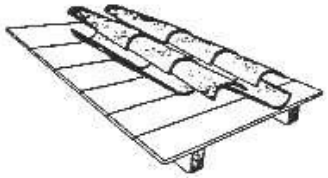


Figure B-3
Byzantine roofing tiles on wooden substrate

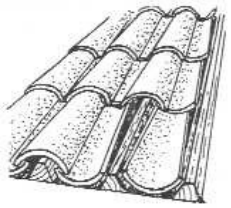


Figure B-4
Byzantine roofing tiles placed between battens

Figure B-5
Gutters of Byzantine roofing tiles of rectangular cross-section

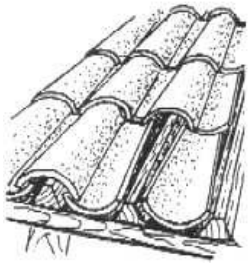


Figure B-6

The gutter of Byzantine roofing tiles is placed between trapezoidal cross-section battens, which have been fixed to the wooden substrate.

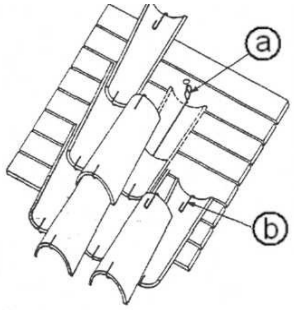


Figure B-7

Device with hooks mounting of Byzantine roofing tiles to each other and fastening to the wooden substrate of the tile-gutter.

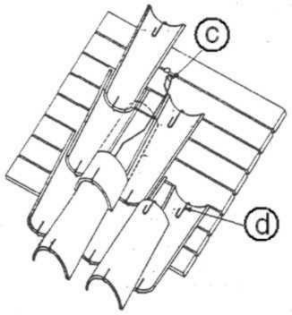


Figure B-8

Fixing of Byzantine roofing tiles with hooks on wooden substrate

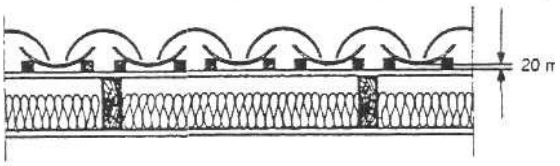


Figure B-9

Installation of roofing tiles between battens, with a height such as to allow for a gap of 2 cm between the convex surface and the wooden substrate.

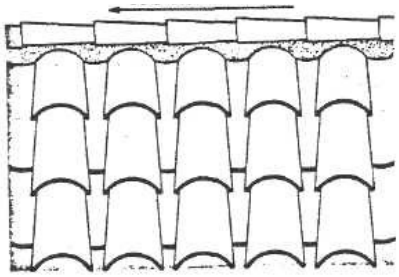


Figure B-10

Fixing of Byzantine roofing tiles on ridges with mortar

In the case of a particle board or blockboard substrate, the tiles must be placed between battens parallel to the pitch of the roof and fixed with metal clips.

B.3 Fixing of Byzantine roofing tiles

The density and distribution of the fixings depends on the slope of the roof, its exposure to wind pressure, the position of the roofing tiles on the roof and whether they are placed on a wooden substrate or in purlins.

Depending on the slope of the roof to avoid slipping of the roofing tiles, the following shall be observed:

a) Generally, for roof slope ≤ 30 % all tiles are fixed to the lower and lateral ends and to the gutters. On the rest of the roof area they are fixed one out of five.

b) For roof slope greater than 30 % and less than or equal to 60 % all tiles are fixed throughout the roof surface.

Fixing can be done by fastening to galvanised wire with a nail connection mounted on the lower side of the purlin with protruding bracket on the lower surface of the tile.

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[11] Presidential Decree 396/94 *"Minimum health and safety requirements for the use by workers of personal protective equipment at the workplace, in compliance with Directive 89/656/EEC" (Α΄ 220)*

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[14] Presidential Decree 305/96 *"Minimum safety and health requirements at temporary or mobile constructions sites, in compliance with Directive 92/57/EEC", in conjunction with Circular No 130159/7.5.97 of the Ministry for Labour and Circular No 11 (Protocol No. Δ16α/165/10/258/ΑΦ/ 19.5.97) of the Ministry for the Environment, Spatial Planning and Public Works regarding the above Presidential Decrees (Α΄ 212)*

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