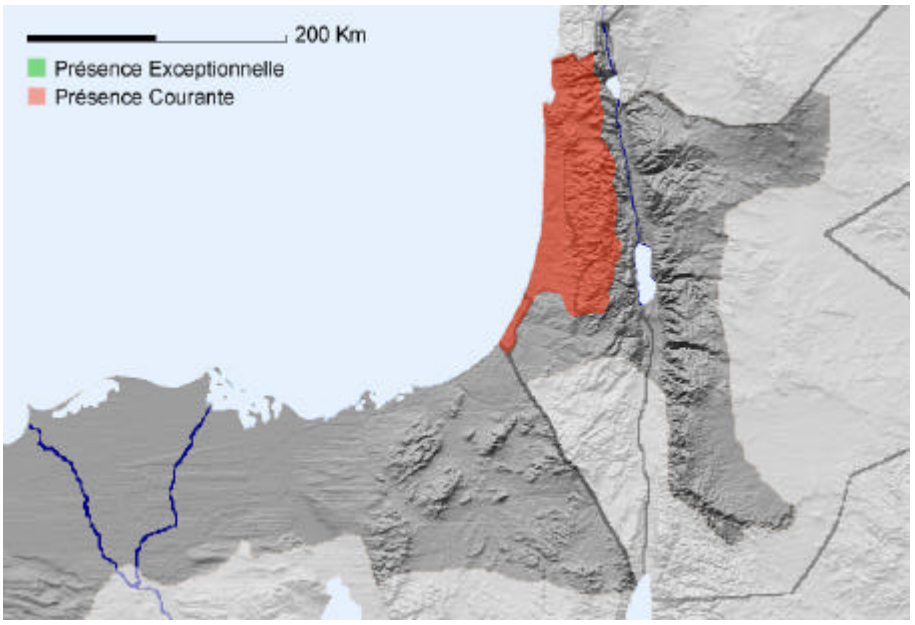
Building techniques :

D3 – Flat Roofing with stone, or terracotta, ceramic tile

Country : Palestine

PRÉSENTATION

Geographical Influence



Definition

Flat Roofing with stone, or terracotta, ceramic tile

- *Roof with very weak slope covered with a terracotta or stone covering plate, laid with lime mortar, resting on one or more layers of mortar, earth or sand.*
- *The roof rests either on a wooden floor, or on one or more barrel vaults.*
- *The covering plate is sometimes covered with a rendering of lime mortar to ensure waterproofing.*
- *This type of roofing requires regular maintenance, subject to deterioration of porous stone, the joints of the covering plate or the protection rendering.*
- *This technique, still used in Palestine, disappeared in Algeria, Egypt and Greece.*

Environment

In the MEDA area, flat roofings with stone or terracotta are often present in urban and rural environment, seaside and plain, and sometimes mountain.

In Palestine, this type of roofing is often present in urban environment and rural environment, in all geographical environments , including mountain .

Illustrations

General view:

Detail close-up:

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CONSTRUCTION PRINCIPLE

Materials

Nature and Availability (in what form)

The roofing consists of a calcareous covering plate of stoneor terracotta , sometimes rendering, resting on one or more layers of mortar, earth or sand.

In Palestine, the slabs are cut on the spot in blocks of calcareous stone. The covering plate is laid with a mortar of lime and broken tile. Sometimes, lime is prepared on the spot, from calcinated limestone.

Modules, Dimensions, Thickness, Dosages

The total thickness of the roofing varies 10 cm to 50 cm, the thickness of the slabs is a few centimeters.

In Palestine, the rectangular slabs of stone are irregular size; the total thickness of the roofing is approximately 15 cm.

Type of laying

Type of laying

The covering plate is laid with lime mortar on a layer of earth, sand or algae, or directly on the floor or the masonry of the support.

In Palestine, the covering plate of stone is directly laid in mortar on a floor or a vault masonry.

Associated framework

The roofing generally rests on a wooden floor, sometimes on one or more cross or barrel vaults.

In Palestine, the roofing rests on a floor, or a plane blocking masonry of cross or barrel vaults.

Drainage

Adapted slope (%)

The slope, extremely weak, ranges between 1% and 5%.

In Palestine, the slope ranges between 1 % and 2,5 %.

Water collecting and drainage

The slope is sufficient to allow water run-off, whose evacuation is ensured by gutters.

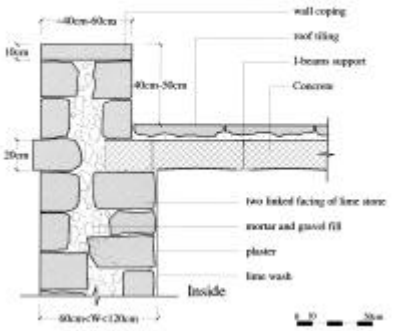
In Palestine, the water run-off is ensured by galvanized metal gutters.

Processing of specific points (bargeboards, runoff, neck gutters, ridge sheathing...)

The roofing is a homogeneous surface. Generally, the sides are girdled acroters in the masonry, sometimes with openings connected to the gutters.

In Palestine, an acroter in masonry, with openings connected to the gutters, is carried out on the circumference of the roof.

Illustrations



Construction principle: vertical section

CONSTRUCTION PRINCIPLE (CONTINUED)

Tools

Specific tools are sometimes used for the sizing of the stones, or the preparation of the mortar.
In Palestine, the stone cutter prepares the slabs using specific tools.

Trades

Trade, Number of people necessary
Flat roofings are implemented by a mason, or a specialized roofer, such as a paver. The slabs of stone are prepared by a cutter workman. Three to six people at least are mobilized, according to the cases, for these works.
In Palestine, the roofing is carried out by a team made up of a stone cutter and a master mason (ema' lem) helped by two workmen. Four people at least are necessary.

Performances

Waterproofing, Protection against bad weather
The resistance of a flat roofing with stone or terracotta is generally rather good against rain, wind and strong sun.

In Palestine, flat roofings with stone are resistant to extreme climatic conditions, in particular against rain and wind.

Thermal insulation
Flat roofings with stone or terracotta generally offer rather good thermal performances, which depend mainly on the characteristics of the support.
In Palestine, flat roofings with stone offer good thermal performances in particular reflective capacity, due to their clear colour.

Ageing pathology

Linked to materials and climatic conditions :
The slabs of stone or earth terracotta, porous, are subject to a progressive deterioration due to bad weather.

In Palestine, the slabs of stone or earth terracotta, porous, disintegrate gradually with time, and can undergo water infiltration.

Linked to the technique :
Damages (water infiltration) can appear if the joints of the covering plate are defective, in the case of a badly shaped slope, or consecutively to a deformation of the support, or lack of maintenance (obstruction of the gutters...).
In Palestine, defective joints, or the obstruction of the gutters by waste, can generate parasitic vegetation causing water infiltration.

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CONSTRUCTION PRINCIPLE (CONTINUED)

REALIZATION DESCRIPTION

In Egypt:

Conditions of realization :

The realization of work must be done in dry weather, to avoid the rainwater infiltration; no particular protection is necessary.
In Palestine, the favourable period is the dry season, in spring or summer.

Preliminary works :

The slabs of stone are cut on the spot from blocks of limestone. The terracotta slabs, crafted, are supplied on the spot. Sometimes, lime is crafted on the spot, with calcinated limestone.
In Palestine, the roofing support is cleaned beforehand. Lime is sometimes prepared on the spot, starting from burnt limestone. A stone cutter prepares the slabs ; he makes approximately 6m2 to 8m2 of covering plate per day.

Realization :

In Palestine, the master mason (ema' lem) helped by two workmen, shapes the slope using water, marking the levels on the acroter, and connects various points using a string. A slab of stone is laid with lime mortar at each marked point; the string is used to mark the laying of the slabs between the various points. The slabs are then laid from top to bottom, parallel to the walls. When the roof is covered along the axis of the walls, the non-covered interstices are filled with small slabs cut to the right size. While the master mason lays the slabs, the workmen prepare the laying mortar, handing the slabs to the Master, and helping control the slope of the covering plate. This team can carry out approximately 10m2 to 12m2 of covering plate per day. A fatty lime mortar and broken tile is then applied by the master mason or a specialized craftsman, to fill the joints of the covering plate; approximately 20m2 of covering plate per day.

Significant details :

The slabs of stone must be cut in their natural bed direction.
In Palestine, a drying of the roofing of one or two days is necessary before going on with the roof. A difference of about 10cm can be found between two extreme joints of two lines of slabs.

Means of verification :

One can check the waterproofing of the roofing by sprinkling water, in order to detect possible water infiltration.

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USE, EVOLUTION AND TRANSFORMATION

Use

Types of buildings

Flat roofing with stone or terracotta is found on all types of buildings throughout the MEDA area.

In Palestine, flat roofings with stone are for dwelling houses, as well as for buildings of service.

Period when the technique first appeared / Period of use of the technique - contemporary or disappeared.

The appearance of flat roofings with stone or terracotta is generally very old: it goes up to Antiquity in Palestine, to the beginning of the Moslem period in Egypt, to the beginning of the Ottoman period (XVth century) in Algeria, and to Venetian times (XVth century) in Greece. If this technique disappeared in Algeria, Egypt and Greece (since the beginning of the XXth century), it is still used in Palestine.

Reasons of the disappearing or the modification of the technique

The emergence of new materials (cement, concrete, terrazzo...) more resistant and requiring less maintenance, is at the origin of the disappearing or the developments in the technology of roofing of slabs of stone or terracotta.

In Palestine, the technique of flat roofing with stone, relatively expensive, is still used in restoration.

Evolution / Transformation

The materials

The traditional slabs of stone or terracotta are replaced, according to cases, by a modern covering plate, or other roofing coatings (terrazzo, compacto, gravel chippings...).

In Palestine, slabs of regular mechanically sawn stone, replace the traditional slabs, which were variable in size.

The technical aspects

The technique of laying the covering plate evolved, in particular with the emergence of cement mortars and tight films (bituminous felts).

In Palestine, the slabs of stone are laid with cement mortar, to replace lime mortar . The wooden floors are sometimes replaced by floors of beams and concrete sewer blocks.

Evaluation of materials and replacement techniques

For the laying of the covering plate, replacing lime mortar with cement mortar presents various disadvantages: cement does not offer good thermal performance, and is not very compatible with traditional wooden floors. On the other hand, the industrial covering plates (terrazzo, compacto) laid on bituminous film, implemented in Algeria, offer a satisfactory alternative to the traditional covering plates in terracotta or stone, which require heavy maintenance.

In Palestine, the laying of regular size slabs with cement mortar, which is appropriate for new building, is not satisfactory for the restoration of old buildings.

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