Sustainable Urban Rehabilitation in Europe

Construction Applied to Heritage

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Sustainable Urban Rehabilitation in Europe

3rd Semester

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Construction Applied to Heritage

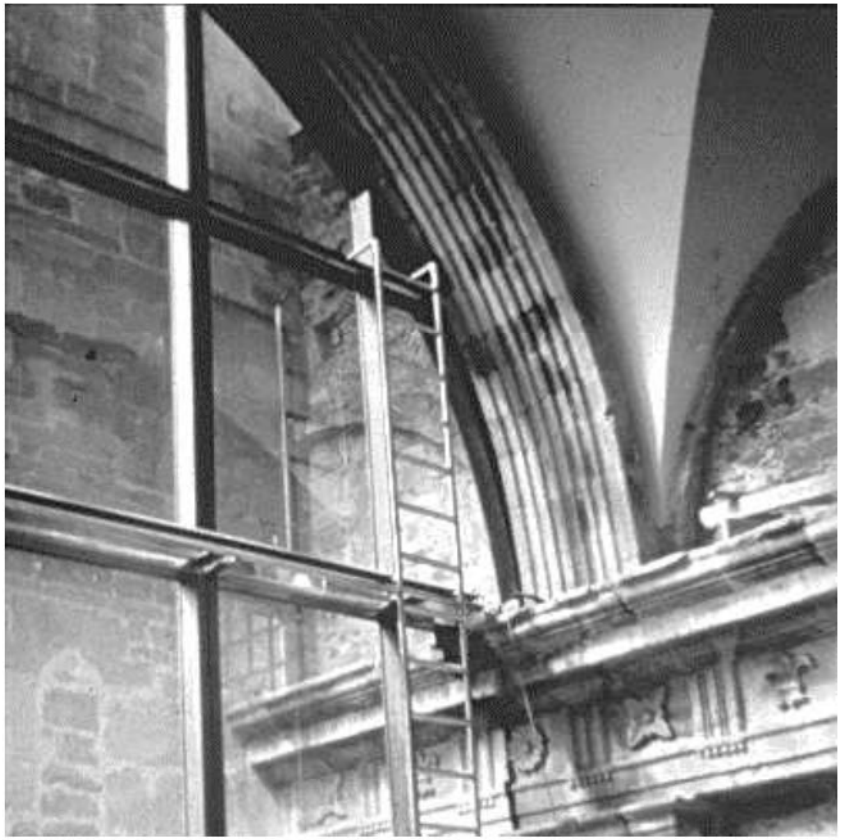
3 ECTS

SH

Sustainable Heritage

EC

Elective Courses



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SURE
SUSTAINABLE URBAN REHABILITATION IN EUROPE

UNIVERSIDAD POLITÉCNICA DE MADRID

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Elective Courses

1. Foundations.
2. Retaining Works.
3. Drainage and Sewerage Systems.
4. The Porous Loadbearing System.
5. The Porous Loadbearing System. Walls.
6. The Porous Loadbearing System. Grid Structures.
7. The Compact Loadbearing System.
8. The Porous and Mixed Horizontal Loadbearing System. Slabs.
9. The Porous and Mixed Horizontal Loadbearing System. Grid slabs.
10. Roofs.
11. Sloping Roofs.
12. **Flat Roofs.**
13. Façades. Porous System. Ventilated Façades.
14. Façades. The Compact System. Curtain Walls.
15. The Internal Partitioning Layout. Construction Process.

Sustainable Urban Rehabilitation in Europe

3rd Semester

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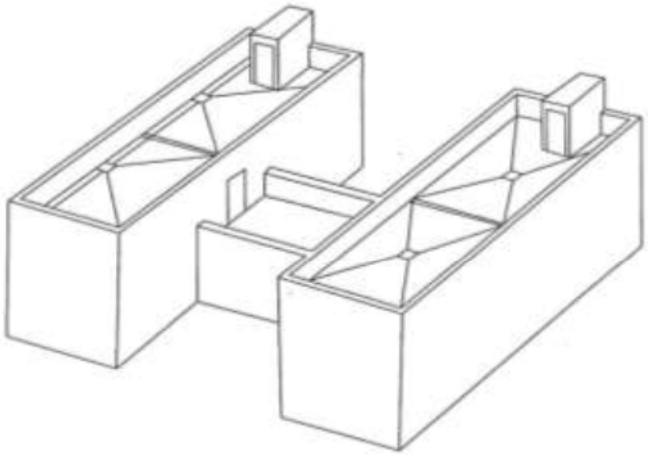
3 ECTS



12 FLAT ROOFS

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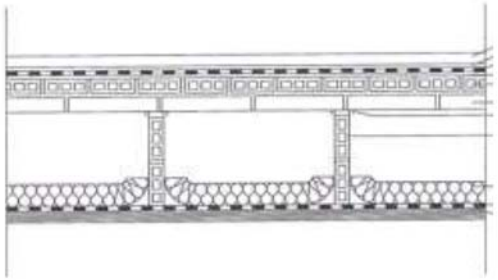
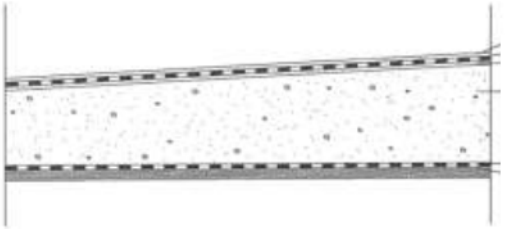
- Analysis by components of low slope roofs.
- Types of plans.
- Structural base.

SLOPE FORMATION
RESISTANT BASE, HORIZONTAL PLANE

SLOPES SYSTEM.
MINIPARTITIONS



SLOPES SYSTEM.
LIGHTWEIGHT CONCRETE



LOW SLOPE OR FLAT ROOFS

The flat roof is currently in a process of reviewing its function and, therefore, its design. It is not just a question of conceiving it as a plane whose only function is waterproofing.

Thanks to the new technologies existing in the market, the flat roof can fulfill new functions as:

- capture of solar energy.
- water storage
- green soil area
- paving.

It makes possible the proposal given by the modern movement architects about conceiving roofs as the fifth façade of the building.

LOW SLOPE ROOFS

GENERAL COMPOSITIVE CRITERIA

-General layout:
- -Floor plan analysis.
  - -Existing downpipes.
  - -Pipes influence divisions.
  - -Joints.

-Types according to use:
- -Non trafficable.
- -Trafficable.
- -Special type: garden roofs.

-Types according to organization:
- -Single layer.
- -Double layer.
- -Insulation placement: direct or inverted.
- -Water drainage:
- -Free falling.
- -Water collection:
  - -linear.
  - -punctual.

-Conditioning strategies:
- -Waterproofing.
- -Thermal insulation. Acoustic insulation.
- -Vapour barrier correct placemente.

-Elements on the roof plan:
- - Slope formation layer.
- - Insulation.
- - Waterproofing.
- - External finishing.

-Charactericsic features.

WATERPROOFING ELEMENTS AND INSULATORS

- Types according to materials:
  - -Sheets and foils (elastic and not elactic):
    - -De caucho butílico.
    - -Oxyasphalt.
      - -Not protected.
      - -Selfprotected.
      - -Coated.
      - -Reinforced.
      - -Sandwich type.

- Anchors / Stabilizations:
  - -Gravity.
  - -Weight.
  - -Mecanical.
  - -Adhesion.
  - -Hanged.

- Usual thermal insulation materials:
  - -Rigid.
  - -Flexible.
  - -Granular.
  - -Foam.

Covering material:
- -Plants.
- -Wood.
- -Stone.
- -Ceramic.
- -Hydraulic.
- -Metal.
- -Plastic.
- -Glass.
- -Flexible continuous sheets

Anchors:
- -Wood.
- -Metal.
- -Mortars.
- -Nails and staples.
- -Adhesives.

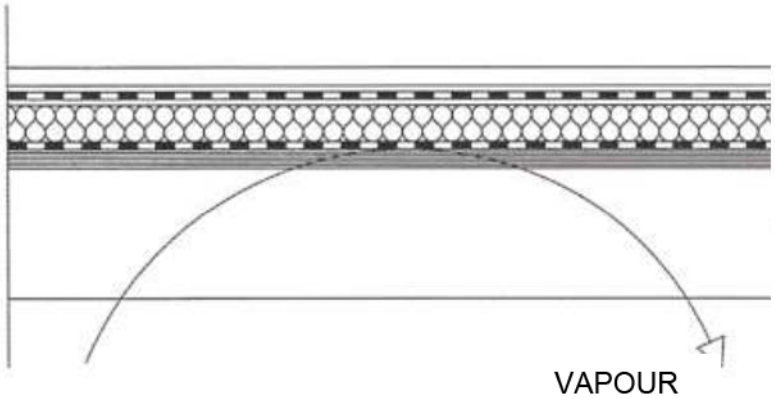
FLAT ROOFS CLASIFICATION

- ACCORDING TO THERMAL PERFORMANCE:
  - COMPACT ROOFS, SINGLE LAYER.
  - VENTILATED ROOFS, DOUBLE LAYER

- ACCORDING TO PLACEMENT ORDER FOR THEIR COMPONENTS:
  - DIRECT ROOFS
  - INVERTED ROOFS

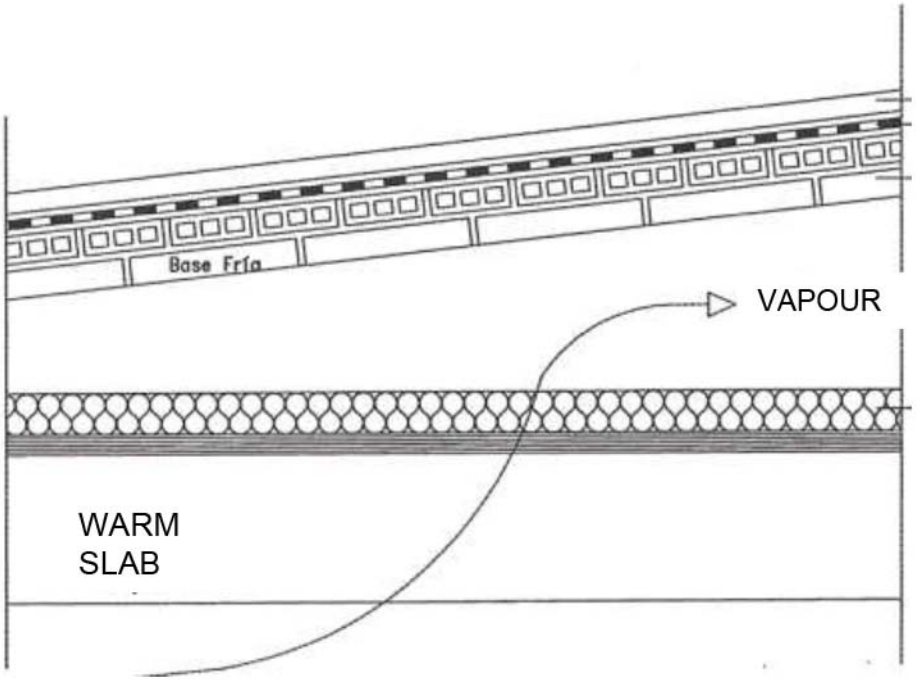
COMPACT FLAT ROOFS.

There is no air chamber and it is necessary to install a vapour barrier in order to avoid internal condensations.



VENTILATED ROOFS.

In order to avoid condensation air or any other material that constantly ventilates it is used as a means of evacuation.
The vapour barrier does not exist and it is replaced by an air cushion that is constantly renewed by openings on the roof pane.



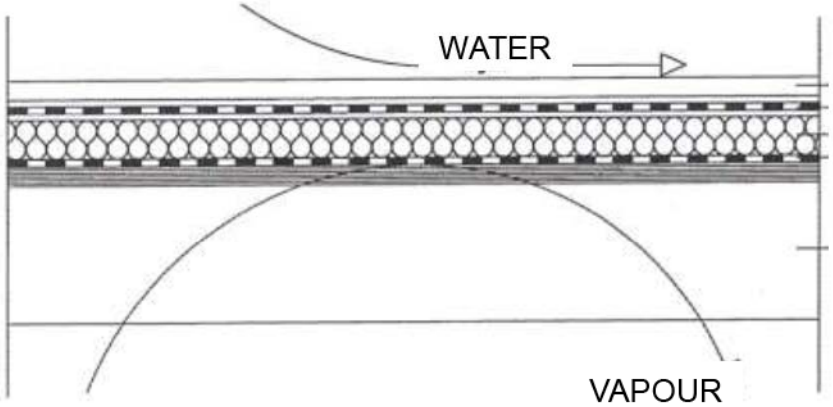
ORDER OF COMPONENTS. DIRECT

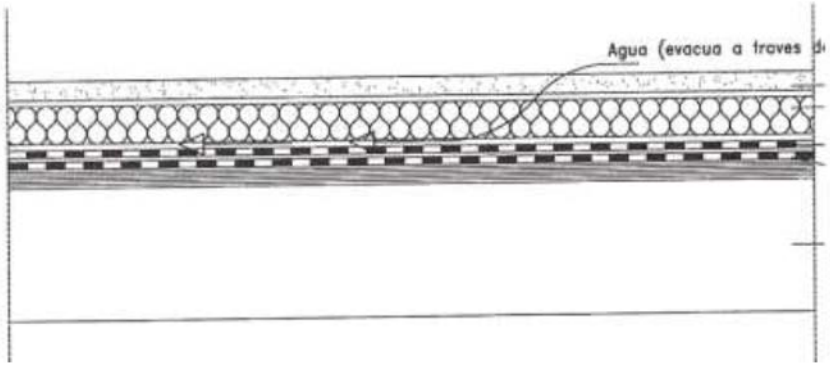
Traditional position of waterproofing elements and insulation.

ORDER OF COMPONENTS. INVERTED

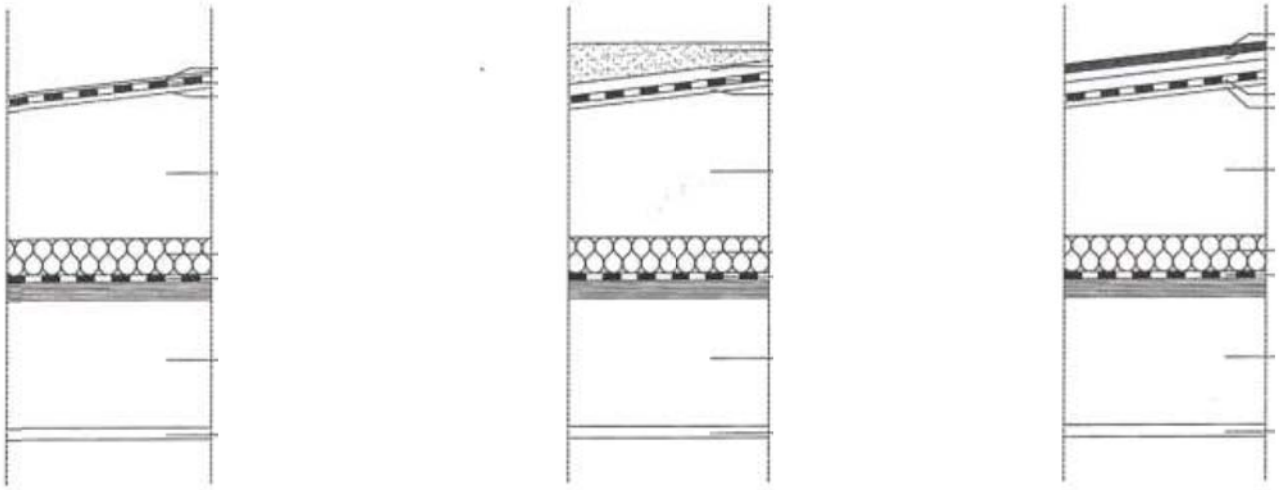
The position of the insulation is reversed and the insulation could be wetted.

WITH HYDROPHILE INSULATION

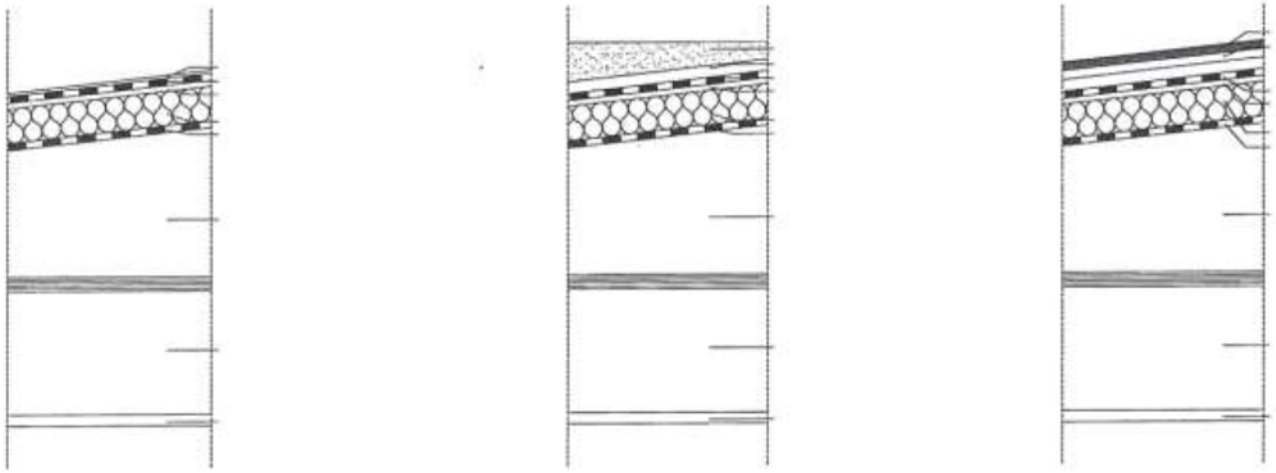




DIRECT ROOF (dry insulation).

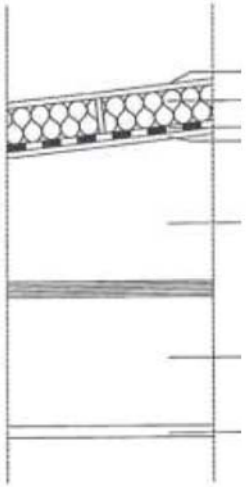


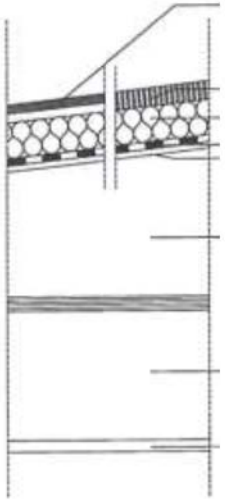
SINGLE LAYER ROOF (insulation under slope plane)

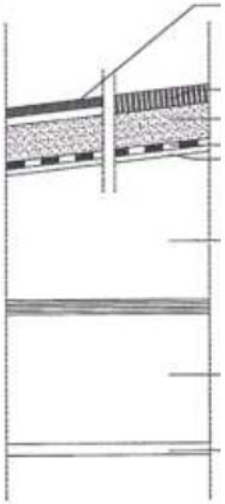


SINGLE LAYER ROOF (insulation on slope plane)

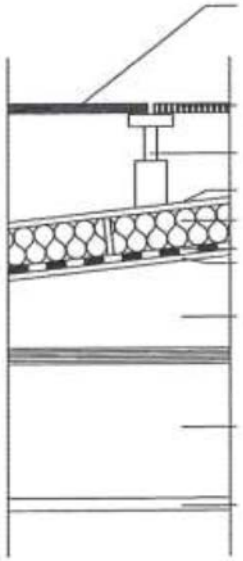
INVERTED ROOF (hydrophile insulation).

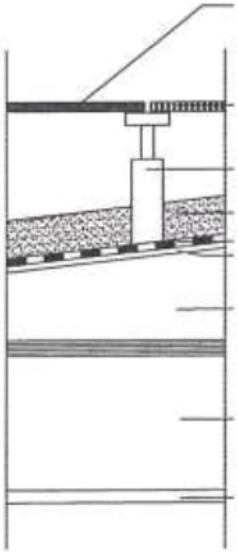




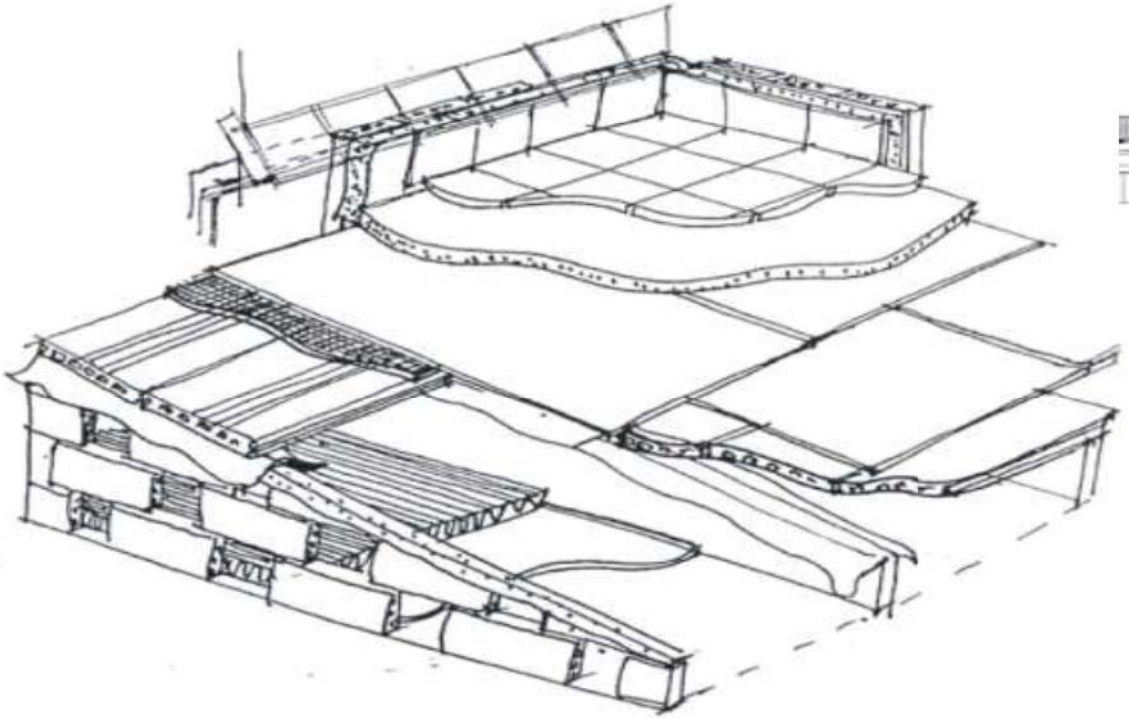


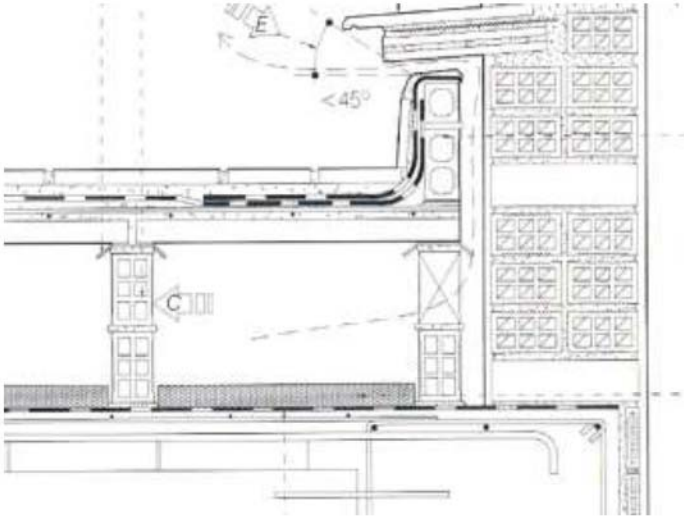
SINGLE LAYER ROOF





TWO-LAYER ROOF

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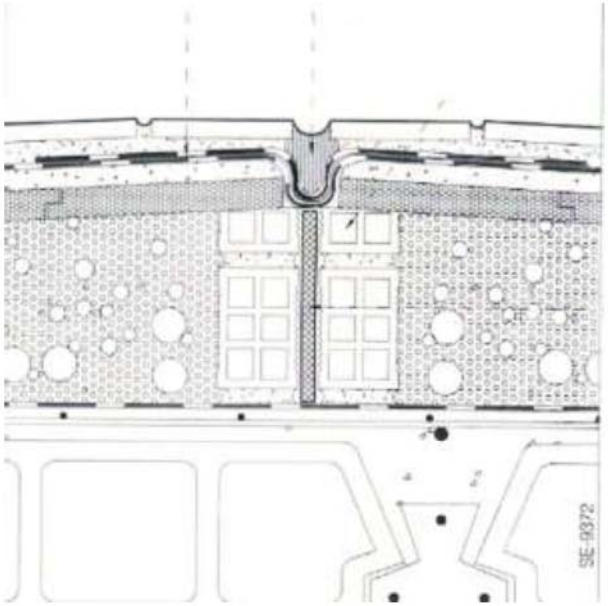
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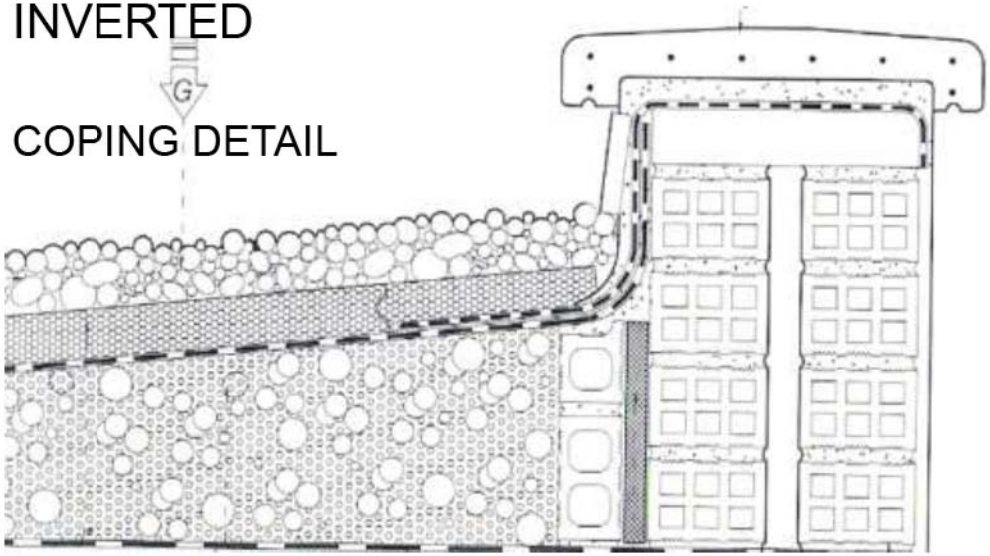
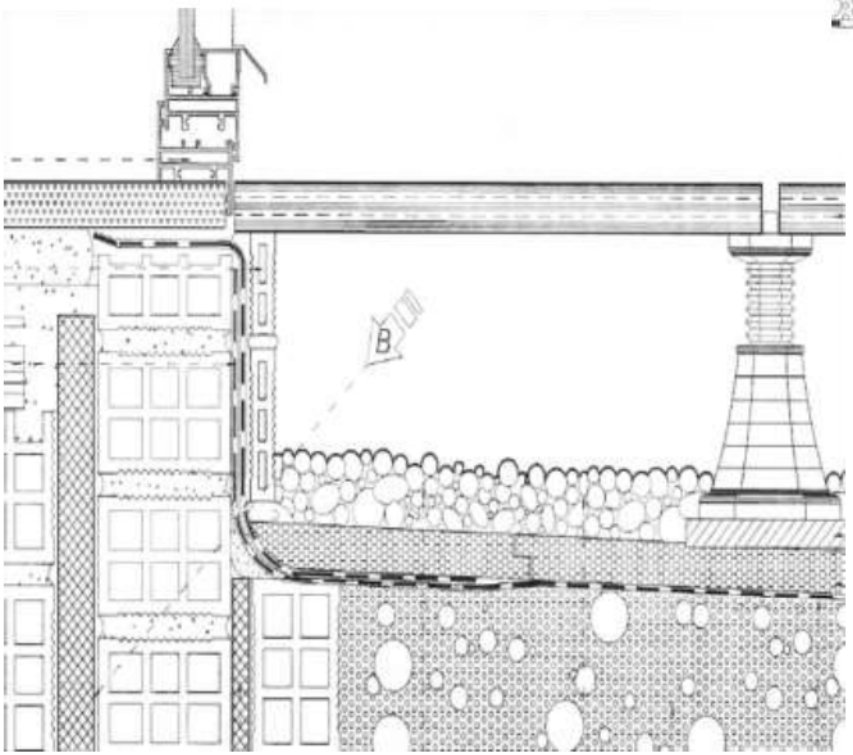
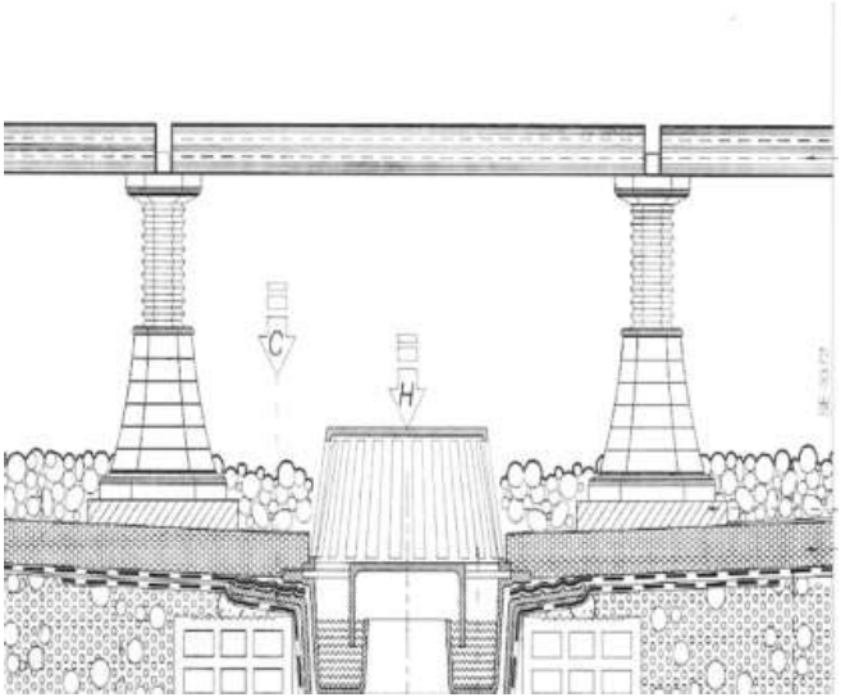
INVERTED



COPING DETAIL





TWO-LAYER INVERTED. TRAFFICABLE

ELECTION CRITERIA. TYPES.

- TRADITIONAL.

  A.- Not trafficable with heavy protection.

  B.- Trafficable.

  C.- Not trafficable with selfprotected membrane.

- INVERTED.
  D.- Not trafficable with heavy protection.

  E.- Trafficable.

- GREEN ROOF.
  F.- Garden roofs.

  G.- Eco-friendly. Water storage systems.

- METAL PLATE BASE.

  H.- Deck. - Not trafficable.
  - Gravel ballast.
  - Heavy protection.

- SPECIAL USE.

  I.- Deck system for road traffic.

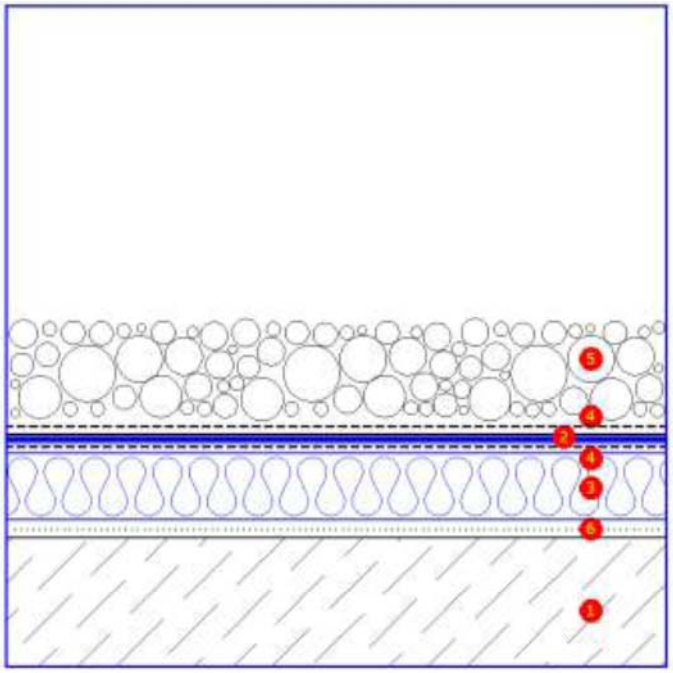
TRADITIONAL LOW SLOPE ROOF

On the roof deck, a slope formation layer with a minimum slope of 2% and a minimum thickness of 3 cm is disposed. A vapour barrier compatible with the material of the waterproof membrane sheet is placed on top of it.

Above these, thermal insulation panels are placed and an auxiliary geotextile layer is placed on top of them to guarantee that the waterproof sheet does not adhere to the thermal insulation material.

The waterproofing sheet is placed on top, over the rest of the system components and on top of it, an anti-puncture and non-stick geotextile sheet that improves the puncture resistance of the whole, and prevents the transmission of stresses from the pavement to the rest of the system.

The roof finishing is made with a heavy protection, which prevents the waterproofing sheet from being lifted up by the actions of the wind.



⑥ VAPOUR BARRIER
⑤ COBBLED STONES
④ SEPARATING LAYER
③ THERMAL INSULATION
② WATERPROOFING MEMBRANE
① RESISTANT BASE AND SLOPES FORMATION

TRADITIONAL LOW SLOPE ROOF WITH HEAVY PROTECTION

Characteristics:
This type of thermally insulated roof is the most widespread solution of the group of warm or non-ventilated, flat roofs.

It is useful in cold climates, with moderate summer temperatures.

It can therefore be used as long as there are no significant thermal gradients.

It is solved as compactly as possible.

In case of adapting the floating solution between the different elements of the system, possible harmful interactions between elements for the stability of the whole can be avoided.

TRADITIONAL LOW SLOPE ROOF WITH HEAVY PROTECTION

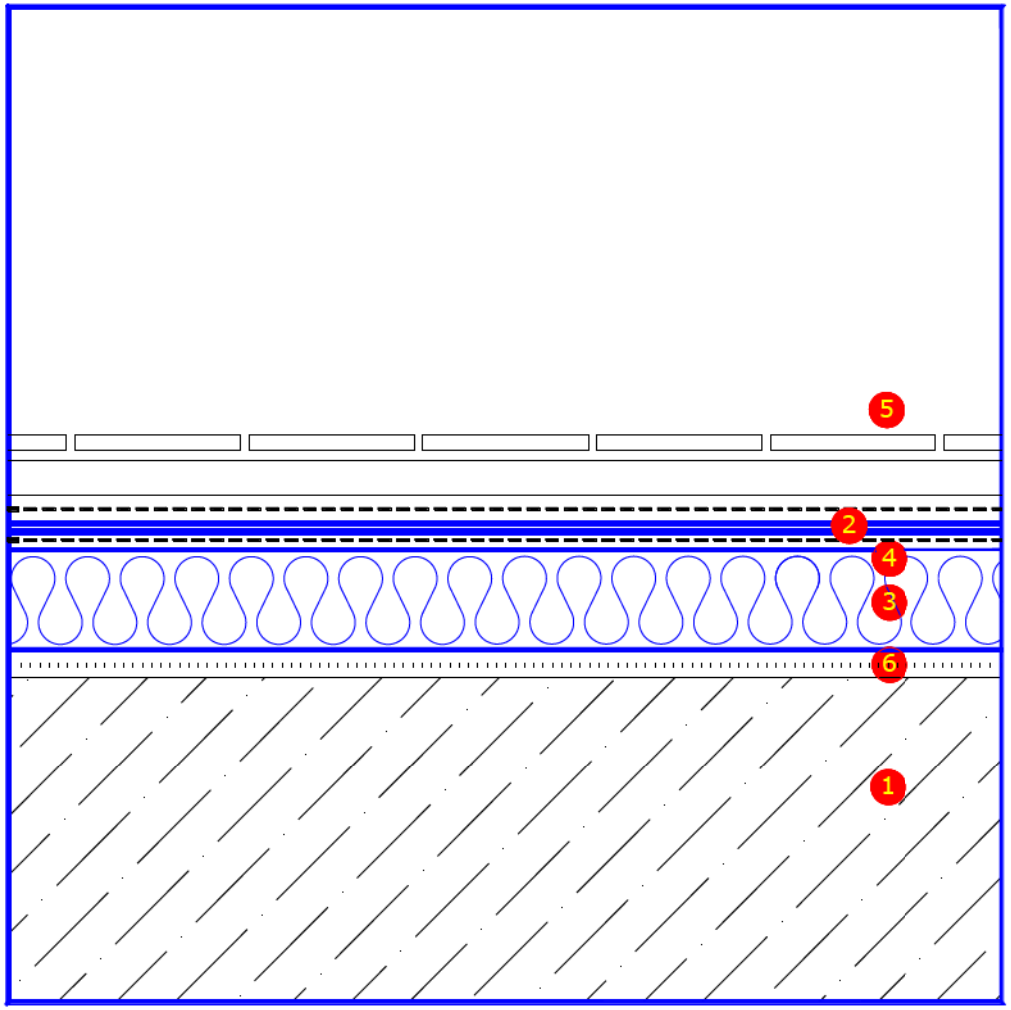
Execution process:

The roof finishing is a heavy protection, which prevents the waterproofing sheet from being lifted up by the actions of the wind. The minimum thickness of gravel in ballasted systems is 5 cm.

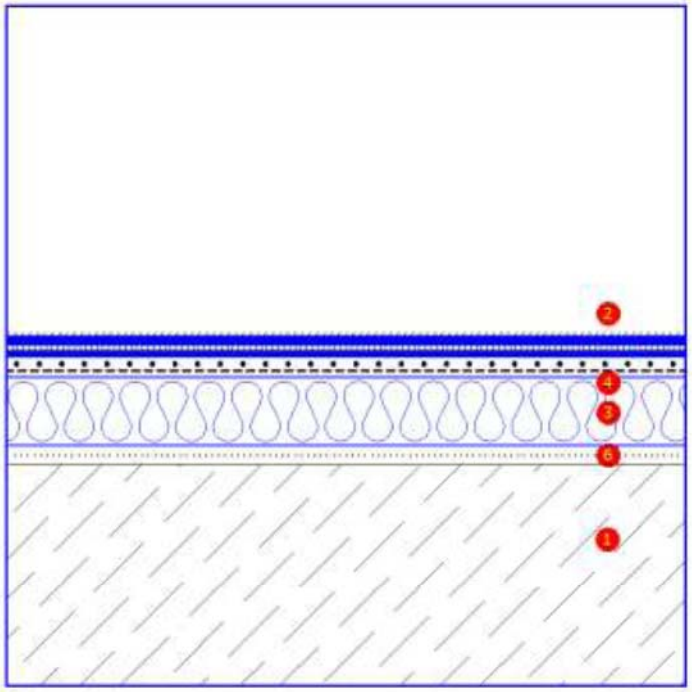
In this solution, the geotextile sheet placed on top of the waterproofing sheet must have a greater thickness, since it must be able to protect the waterproofing membrane from the punching action that the gravel may exert on it due to the eventual use of the roof for maintenance work.

Special care must be taken in the solving of the drains, so that smaller aggregates cannot cross them, falling down the drain pipes and breaking the pipes connections.

TRADITIONAL LOW SLOPE ROOF
TRAFFICABLE WITH CERAMIC TILES PROTECTION



⑥ VAPOUR BARRIER
⑤ CERAMIC TILES FINISHING
④ SEPARATING LAYER
③ THERMAL INSULATION
② WATERPROOFING MEMBRANE
① RESISTANT BASE AND SLOPES FORMATION



⑥ VAPOUR BARRIER
④ SEPARATING LAYER
③ THERMAL INSULATION
② WATERPROOFING MEMBRANE
① RESISTANT BASE AND SLOPES FORMATION

TRADITIONAL LOW SLOPE ROOF
NOT TRAFFICABLE
WITH MINERAL SELFPROTECTION

In this solution, the advantage is lost, from the point of view of the mechanical behavior of the waterproofing sheet, of the lack of adhesion when the union of the waterproofing sheet with the rest of the system is required, so that it compensates for the suction effect of the wind.

The laying of the cement mortar layer on the insulation panels is a constructive solution in which, due to the situation of the insulation, there is overheating or overcooling of the mortar layer which accentuates the thermal movements and the consequent possibility of the mortar breaking.

The waterproofing sheets must be protected from the action of meteorological phenomena, fundamentally from the action of the sun (ultraviolet radiation and temperature). This protection must be extended to all types of waterproofing membranes, regardless of the material used (bituminous, plastic, rubber, etc.).

LOW SLOPING INVERTED ROOF

It is a type of thermally insulated roof.

It is suitable for climates with high thermal gradients.

If it is used for trafficable roofs. The thermal insulation material must have mechanical resistance that allows it to absorb the loads received.

The thermal insulation material is subjected to the action of water. If the waterproofing material has a high accessible porosity from the outside, it will be wetted and the insulation properties will disappear.

As it is thermally protected, the waterproofing sheet is subjected to less dilatation-retraction stresses and, therefore, its durability will be increased.

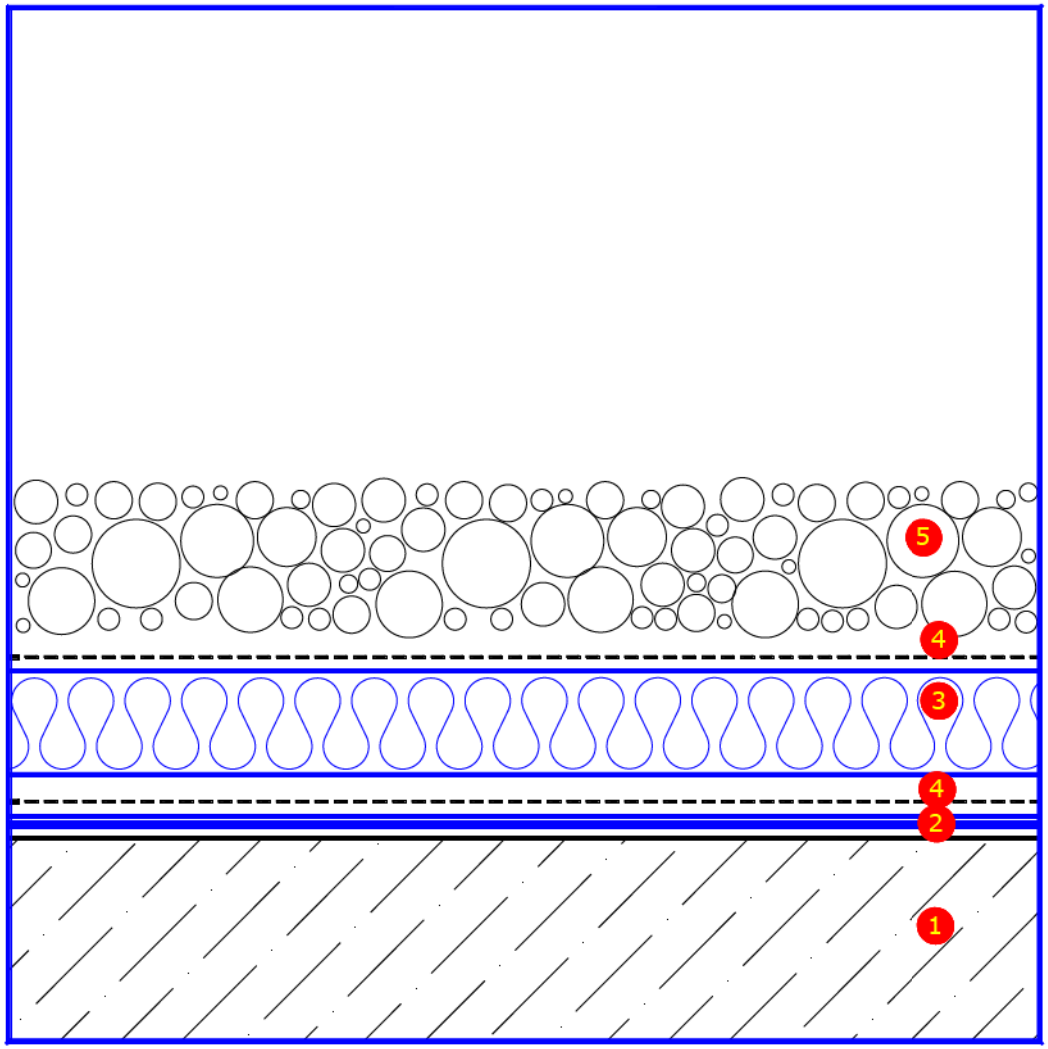
Due to their low density, the buoyancy of the insulation panels makes dangerous any water retention on the deck if they are not properly ballasted. The auxiliary layer that is placed on top of the panels contributes to their stability.

As with all flat roofs, a more careful solution of the singular points is required.

The minimum thickness of gravel in this kind of ballasted systems is 5 cm.

The thermal insulation must have a water absorption under 0.5% by volume so that, its insulating conditions are not altered as a result of the moisture absorbed. Even so, in this type of roof, the calculation conductivity must be increased by 10% to compensate not only the 0.3% possible absorption but also any losses due to joints or singular points.

INVERTED LIFHT SLOPE FLAT ROOF
NOT ACCESIBLE. WITH HEAVY PROTECTION.



⑤ COBBLED STONE
④ SEPARATING LAYER
③ THERMAL INSULATION
② WATERPROOFING MEMBRANE
① RESISTANT BASE AND SLOPES FORMATION

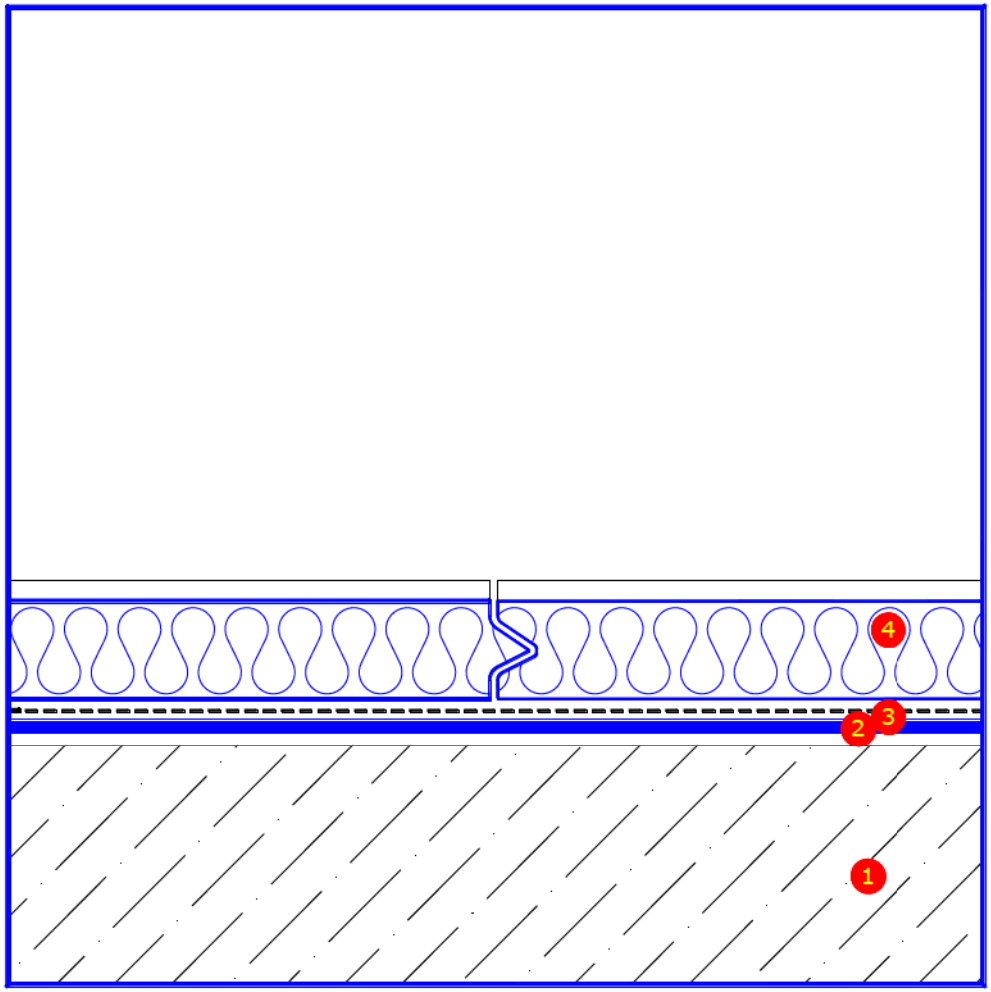
LOW SLOPING INVERTED ROOF
NOT TRAFFICABLE. WITH HEAVY PROTECTION.

As the roof is not trafficable, the thermal insulation does not necessary needs special mechanical requirements.

If the thermal insulation is protected with gravel, there must be a separating layer that distributes the punctual tensions that the gravel may produce during maintenance work.

If the thermal insulation material is not protected, there is a danger of wind suction due to the light weight of these materials.

INVERTED LIGHT SLOPE FLAT ROOF
NOT TRAFFICABLE. WITH SELFPROTECTED INSULATION.



④ SELFPROTECTED THERMAL INSULATION

③ SEPARATING LAYER

② WATERPROOFING MEMBRANE

① RESISTANT BASE AND SLOPES FORMATION

LOW SLOPING INVERTED ROOF TRAFFICABLE.

The gravel is replaced by a trafficable pavement.

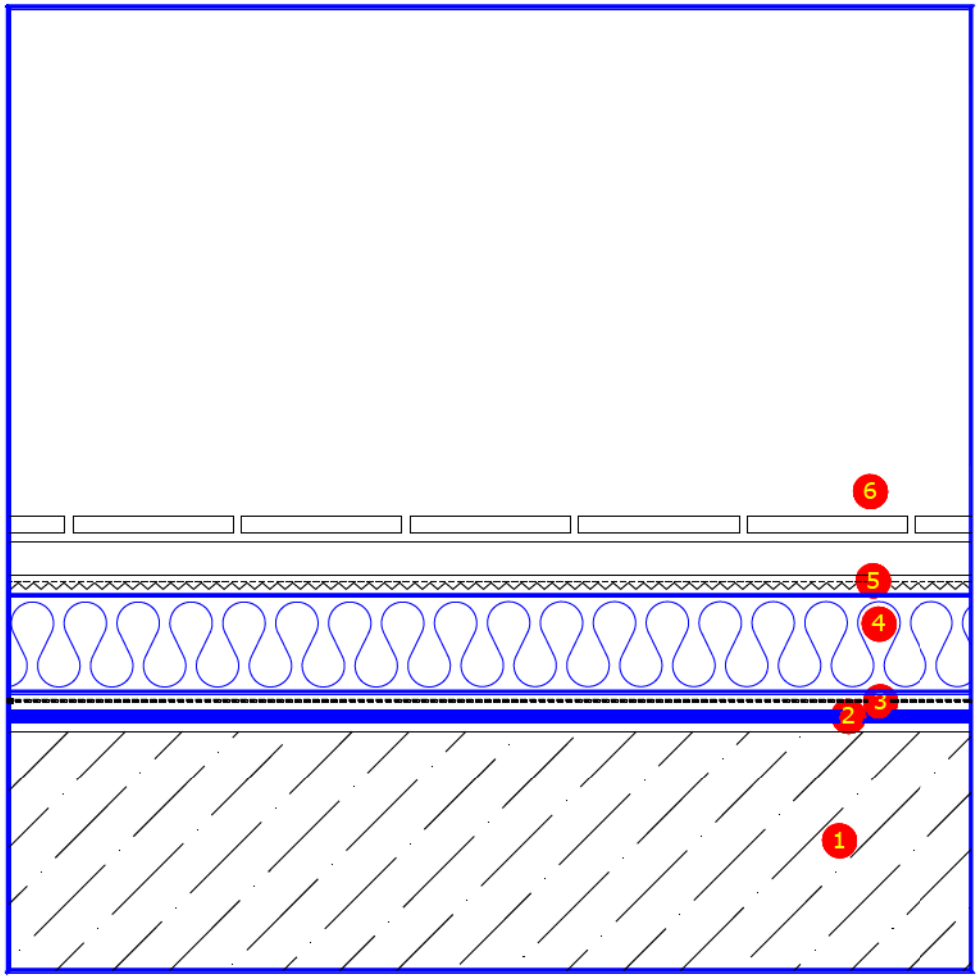
The difficulty of evaporation of the water that filters between the joints of the pavement, and that can be stored in the existing layers above the waterproofing sheet, makes it advisable to use some complementary drainage system.

In the case of using floating pavements, the possibility of storing water is minimised, as the water that penetrates can easily evaporate.

This system allows the use of any type of paving material.

The thermal insulation material must have mechanical resistance properties that are directly related to the type of use envisaged.

INVERTED LIGHT SLOPE FLAT ROOF
TRAFFICABLE. WITH CERAMIC PROTECTION.



⑥ CERAMIC TILES FINISHING
⑤ SEPARATING LAYER VAPOUR DIFFUSOR
④ THERMAL INSULATION
③ SEPARATING LAYER
② WATERPROOFING MEMBRANE
① RESISTANT BASE AND SLOPES FORMATION

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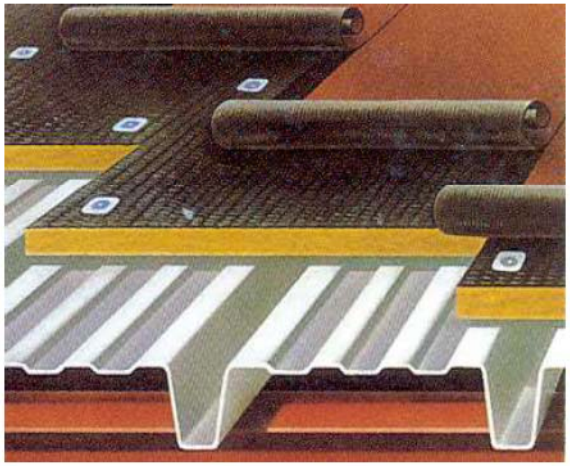
LOW SLOPE DECK ROOF

Industrial roof with lightweight ballasted solution.

Non-trafficable roof made of profiled metal sheet (with a slope of 1 to 5%) that incorporates thermal and acoustic insulation, by means of rigid panels, a vapour barrier on the warm face being incorporated into the metal sheet, waterproofing sheet and self-protected waterproofing sheet or gravel layer.



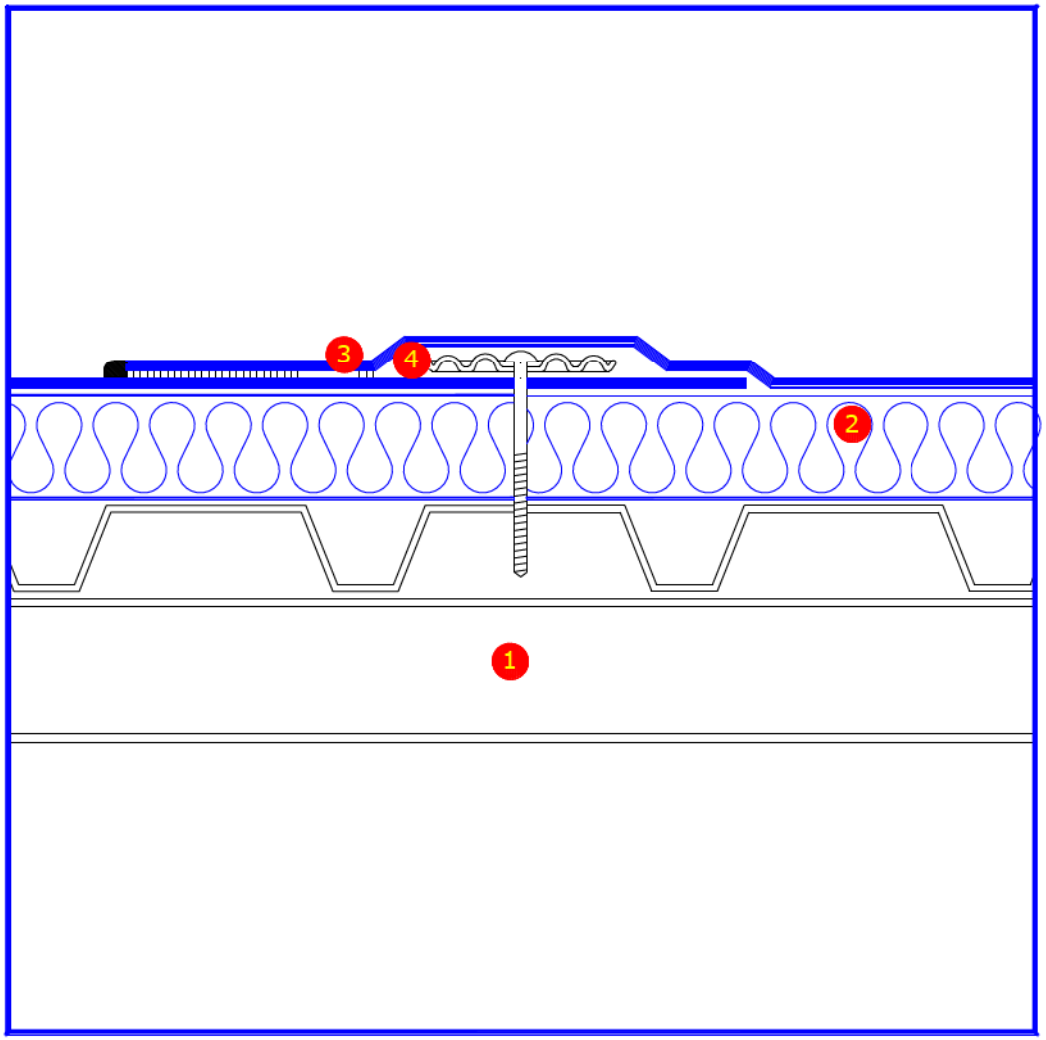
This type of roof has a limitation that must be taken into account in relation to the transmission of noise, airborne or impact, since it depends fundamentally on the thermal insulation panels.

CHARACTERISTICS

•Very fast execution, normally on great surfaces with few singular points.
•Low inertia which allows to quickly reach the conditions of well-being.
•Marked industrial aspect.
•The possibility of obtaining large membranes, both synthetic (PVC, etc.) and rubber (EPDM, Butyl, etc.) by joining traditional sheets off-site, to be used on large roofs with few singular points, makes these materials the most frequently used for this type of roof.

DECK ROOF
EXECUTION PROCESS
POSITIONING OF COMPONENTS

LOW SLOPE DECK ROOF
WITH SYNTHETIC SHEET



④ MECHANICAL ANCHOR
③ WATERPROOFING MEMBRANE
② THERMAL INSULATION
① RESISTANT BASE

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