

# Installation manual

# Roofs

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## APPLICATIONS AREAS

The NTE-QTT standard provides a map to be able to create a table that facilitates the pitch choice. This map is divided into three zones according to rainfall, the action of wind, the atmospheric aggressiveness, the snow load, etc, which is reproduced below with the Spanish territory dividing it on three zones: 1, 2, 3.

It should take into account besides these 3 zones, the weather effects that may result from the local situation of each one of them. Three different places can be differed on each zone:

### Protected place

Area completely surrounded by elevations and protected of the wind in all directions.

### Normal place

Completely flat area with possible slight unevenness of terrain.

### Exposed place

Area exposed to strong winds, 5 km close to sea, cliff tops or slim peninsulas, or islands. It can be inland narrow valleys where the wind is strong as well as on the top of the hills.

## PITCH

This section will provide the necessary information to determine the minimum required pitch depending on the type of tile and the geographical situation of the building and its environment (application areas).

### Curved tile

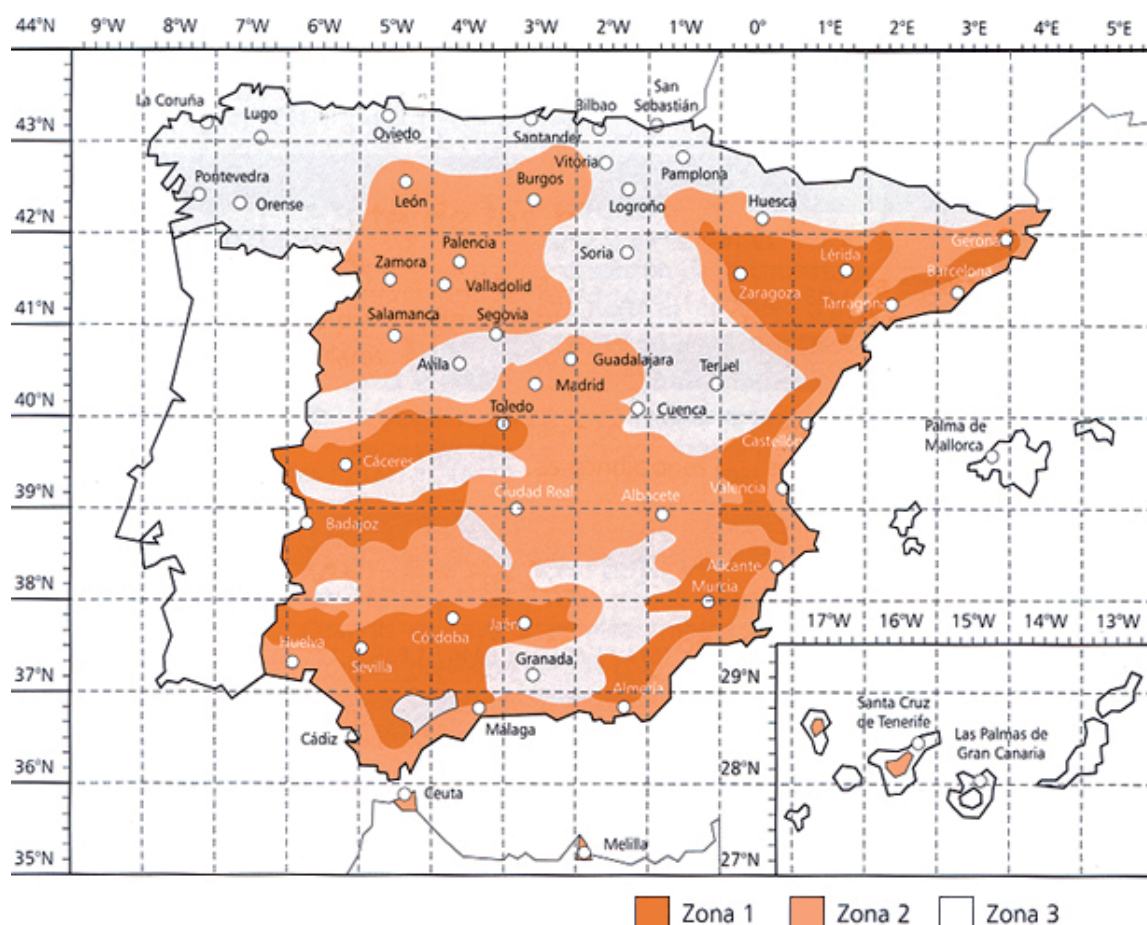
According to the standard NTE-QTT, the field of the roof which uses curved tiles must have a minimum pitch of 26%, although it is possible that the local conditions make this minimum increase according to its environment.

Zone 1											
Pitch (%)	26	28	30	32	34	36	38	40	42	44	>46
Pitch (°)	15	16	17	18	19	20	21	22	23	24	>25
Solape mm	150	140	135	130	125	120	115	110	100	100	70

Zone 2											
Pitch (%)	26	28	30	32	34	36	38	40	42	44	>46
Pitch (°)	15	16	17	18	19	20	21	22	23	24	>25
Solape mm	(*)	150	145	140	135	130	125	120	110	100	70

Zone 3											
Pitch (%)	26	28	30	32	34	36	38	40	42	44	>46
Pitch (°)	15	16	17	18	19	20	21	22	23	24	>25
Solape mm	(*)	(*)	(*)	150	145	140	135	130	120	100	70

It should do a study for the fields of the roof with more than 12 meters following the recommendations of our technical and commercial departments.



## Mixed and flat roof tiles

According to the nte-qtt standard, the fields of the roof which use mixed or flat roof tiles must have at least a pitch of 25%, but it is possible that this minimum may be increased according to the local conditions and environment (application areas).

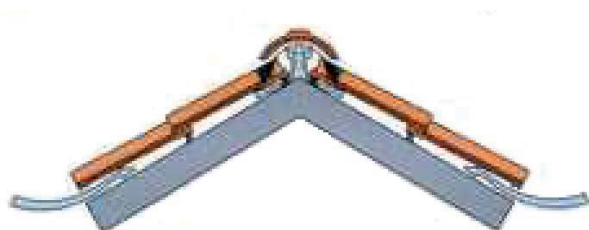
Another aspect, which must be taken into account, is the length of the field of the roof, distinguishing decks up to 6.5 meters, from 6.5 to 9.5 meters and from 9.5 meters to 12 meters.

		Roof field up to 6,5m			Roof field 6,5m - 9,5m			Roof field 9,5m - 12m		
		Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3
Protected place	Pitch (%)	25	25	27	26	28	30	27	30	35
	Pitch (°)	14	14	15,5	15	16	17	15,5	17	19,5
Normal place	Pitch (%)	25	27	30	28	32	36	32	35	40
	Pitch (°)	14	15,5	17	16	18	20	18	19,5	22
Exposed place	Pitch (%)	33	37	40	35	39	43	42	45	50
	Pitch (°)	18,5	20,5	22	19,5	21,5	23,5	23	24,5	26,5

It should do a study for fields of the roof with more than 12 meters following the recommendations of our technical and commercial departments.

## VENTILATION

There must be an air flow between the support board and the tiles for a proper function of the roof. Due to it, the condensations are avoided, improving the hydrometric functions of the roof, the conservation of the materials and the tile fixing.



The air flow must enter by the lower part of the deck, through the ridge line or the ventilation tile, placing a minimum of two per field of the roof or one per 10 m<sup>2</sup>. It is not recommended to exceed 12 meters.

The air flow must go out through the ridgepole, using the ventilation tile or the chimney and placing a minimum of two per field of the roof or one every 10 m<sup>2</sup>. A bigger difference of heights between the entrance and the exit of the air will provide a better air flow.

## TILES FIXING

The different levels used for the correct tile fixing for the field of the roof are described below.

### Curved tile

- Minimum level. The curved concave roof tiles will be fixed to the support. All the roof tiles (concave and convex) will be fixed on the eaves, laterals, ridgepoles, hips, the joints with vertical parameters and any other singular point avoiding the support regardless of the support material.

- Level "A". When the roofs have a pitch between 26% and 70%, together with the minimum level indications, all the convex tiles will be fixed every 5 vertical lines.

- Level "B". When the roofs have a pitch higher than 70% or they are located in strong wind, exposed or high earthquake level >7 areas, all the tiles will be fixed with hooks or nails.

### Mixed and flat roof tiles

- Minimum level. All the tiles will be fixed to the support on the eaves, side finishings, ridgepoles, hips, the joints with vertical parameters and any other singular point avoiding the support regardless of the support material.

- Level "A". When the roofs have a pitch between 25% and 40%, the tiles will be simply leaned on the battens, avoiding the sliding with the interior side stoppers.

- Level "B". When the roof have a pitch between 40% and 100 %, all the tiles will be used with mortar, and if battens are used, one out of five are fixed to them with nails, screws or hooks.

- Level "C". When the roof has a pitch between 100% and 173%, one out of five tiles are fixed regularly with nails, screws or hooks.

- Level "D". When the roof has more than 173% pitch or it is located in strong wind, exposed or high earthquake level >7 areas, all the tiles will be fixed with hooks or nails.

## FIXING MATERIALS

### Mortar

It is considered the traditional fixing method of the tiles.  
The mortar M-2,5 (dose 1:7) will be used. More quantity of cement should not be allowed because it can produce cracks in the tiles.

### Nails and screws

They should have minimum 3 mm diameter and 50 mm length to allow the introduction on the pre-drilled holes of the tiles assuring their fixing.

The nails and screws will be treated against corrosion or will be stainless.

The fixation will be strong enough and will avoid the vibration of the tile caused by the wind, using flexible washers to avoid the breakage of the piece caused by excessive pressure that may be exerted.

### Glue and adhesives

The glue is an economic and efficient method to glue small accessories. The most used one is the "mastic" which is applied with a pistol over clean and dried surfaces. It must not be used under 5°C and the manufacturer indications always should be followed.

## PREVIOUS STUDY OF THE ROOF FIELD

Antes de comenzar el replanteo, se comprobará que el faldón reúne las condiciones necesarias en cuanto a estabilidad, resistencia, inclinación, dimensiones y planeidad.

Before starting the calculations, it will be checked that the field of the roof has the necessary conditions of stability, resistance, inclination, dimensions and flatness. The next step will be to know the real length of the roof field. The K coefficient will be used from the table below to have the exact dimension. This coefficient is the equivalent of the real distance of the percentage of inclination of one linear meter.

Once the length of roof field is known, it will be necessary to follow the indications of the distance calculation between battens for a correct calculation of tiles.

Pitch %	19	20	21	22	23	24	25	26	27	28	29	30
Inclination (°)	10°45	11°18	11°51	12°24	12°57	13°29	14°02	14°34	15°06	15°38	16°10	16°41
Coefficient "k"	1,0179	1,0198	1,0218	1,0239	1,0261	1,0284	1,0308	1,0332	1,0358	1,0384	1,0412	1,0440

Pitch %	31	32	33	34	35	36	37	38	39	40	41	42
Inclination (°)	17°13	17°44	18°15	18°46	19°17	19°47	20°18	20°48	21°18	21°48	22°17	22°46
Coefficient "k"	1,0469	1,0499	1,0530	1,0562	1,0595	1,0628	1,0662	1,0697	1,0733	1,0770	1,0808	1,0846

Pitch %	43	44	45	46	47	48	49	50	51	52	53	54
Inclination (°)	23°16	23°44	24°13	24°42	25°10	25°38	26°06	26°33	27°01	27°28	27°55	28°22
Coefficient "k"	1,0885	1,0925	1,0965	1,1007	1,1049	1,1092	1,1135	1,1180	1,1225	1,1271	1,1317	1,1365

Pitch %	55	56	57	58	59	60	61	62	63	64	65	70
Inclination (°)	28°48	29°14	29°40	30°06	30°32	30°57	31°22	31°47	32°12	32°37	33°01	34°59
Coefficient "k"	1,1413	1,1461	1,1510	1,1560	1,1610	1,1661	1,1713	1,1766	1,1819	1,1872	1,1927	1,2206

Pitch %	75	80	85	90	95	100	105	110	115	120	125	130
Inclination (°)	36°52	38°39	40°21	41°59	43°31	45°00	46°40	47°73	48°99	50°19	51°34	52°43
Coefficient "k"	1,2500	1,2806	1,3124	1,3453	1,3793	1,4142	1,4500	1,4866	1,5240	1,5620	1,6008	1,6401

Pitch %	135	140	145	150	155	160	165	170	175	180	185	190
Inclination (°)	53°47	54°46	55°41	56°31	57°17	57°99	58°78	59°53	60°26	60°95	61°61	62°24
Coefficient "k"	1,6800	1,7205	1,7614	1,8028	1,8446	1,8868	1,9294	1,9723	2,0156	2,0591	2,1030	2,1471

Pitch %	195	200	205	210	215	220	225	230	235	240	245	250
Inclination (°)	62°85	63°43	64°00	64°54	65°06	65°56	66°04	66°50	66°95	67°38	67°80	68°20
Coefficient "k"	2,1915	2,2361	2,2809	2,3259	2,3712	2,4166	2,4622	2,5080	2,5539	2,6000	2,6462	2,6926

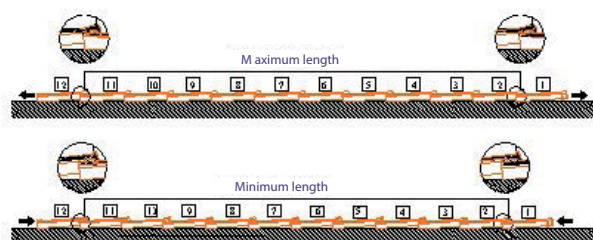
## CALCULATION OF THE DISTANCE BETWEEN BATTENS

In case we use wood or metallic battens, the distance between them will be calculated on the following way:

1 - 11 roof tiles are randomly taken from the sent pallets. They are placed as close as the fittings allow it and then as far as these fittings allow it.

2 - The measurements are taken between the extreme of the first tile and the eleventh tile.

3 - The distance "D" between the battens will be the sum of both measurement divided to 20 (tiles) according to the double measurements  $D=A+B/20$



### Calculation

After the previous study of the roof field, it is proceeded to carry out the calculations of the necessary materials, trying to use whole tiles.

It is necessary to determinate the line of the highest pitch of the roof field, which will indicate the water way from the ridgepole to the eave. A bubble level will be used to determine the ridgeline, being its perpendicular over the roof field the highest pitch line. This line will be marked, using a plummet or plumb line.

We need to take into account the singular joints, which may determine the calculations.

### Continuous support

Once the maximum pitch line is determined, the first horizontal line and the first vertical line are calculated. The guidelines of the roof field are calculated with the help of a carpenter's square, and they are marked lengthwise and width wise, using a plummet. It is used as reference to put the tiles perfectly aligned and embedded.

The lines must be formed by an exact number of tiles if possible, taking into the account the different singular points. Once they are studied and the solution is known, it is proceed as follows:



## Curved tiles

The first horizontal line of the tiles is placed perpendicular to the maximum pitch line, no matter if we start from the right or the left side.

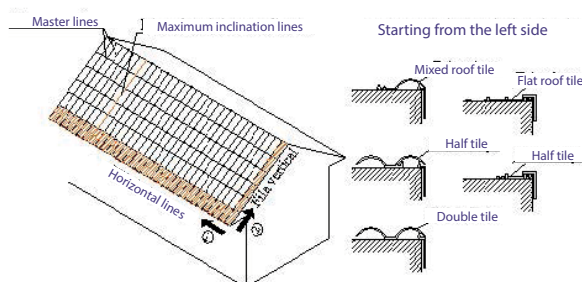
The distance between the longitudinal axels of the concave curved tiles will be the same along all the field of roof allowing us to put the convex curved tiles. It is necessary to leave a gap between 30 and 70 mm for the passage of water.

Then, the first vertical line parallel to the maximum pitch line is calculated, starting from the lowest part of the roof field to the ridgeline. The tiles will be overlapped as shown in the section "Pitch".

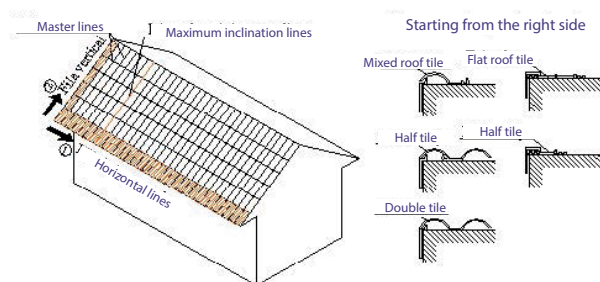
## Mixed and flat tiles

The first horizontal line of the tiles is placed perpendicular to the maximum inclination line according to the transversal mounting. It is started from the right side, leaving the tiles embedded. Then, the first vertical line is placed parallel to the maximum inclination line respecting the longitudinal line from the lowest part of the roof field to the ridgeline, embedding the tiles.

Flat tiles mounting  
Starting from the left side



Curved and mixed tile mounting  
Starting from the right side



## Discontinuous support

The discontinuous support is formed by battens of mortar, wood, metallic materials, etc. The first step is to determine the maximum inclination line over the field of the roof.

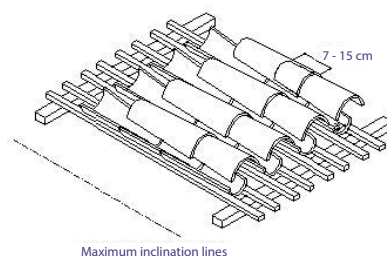
Once studied the singular points and known its solution, it is proceeded as follows:

### Battens parallel to the maximum inclination line:

#### Curved tiles

Each concave tile is leaned on 2 battens parallel to the longitudinal axis of the tile.

The separation between the set of battens will allow putting the convex tiles leaving a minimum separation for the passage of water between 30 and 70 mm. the battens are fixed to the support, proceeding afterwards to the placement of the tiles.

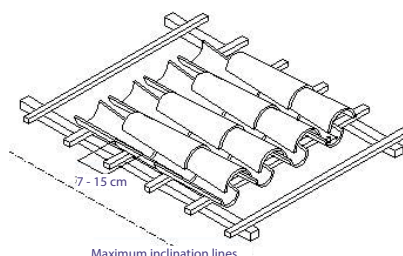


### Battens perpendicular to the maximum inclination line:

#### Curved tiles

In this case, each concave tile is leaned on a batten. The separation between them must allow the accumulation of the necessary minimum overlap, fixing it later. Then, it will be proceeded to place the first horizontal line so that the distance between the longitudinal axis of the concave tiles allows the placement of the convex tiles, leaving a separation between 30 and 70 mm for the passage of water.

Then, it will proceed to the first horizontal row having in mind that the distance between the longitudinal axis of the upper tiles must allow to put the under tile keeping a separation for the continuous water circulation, between 30 and 70 mm.



### Mixed and flat tiles

The distance between the batten of the eave and the next one is different from the rest of the roof field because at this point the tile of the eave must overlap at least 5 cm.

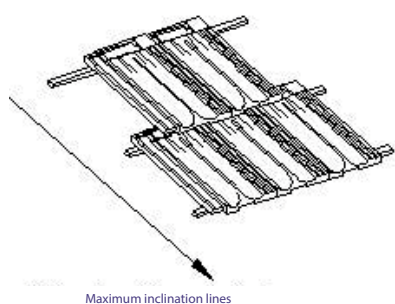
The special pieces can also be used to solve the eave which determine the distance of the first batten and the rest of them (see batten section). The battens are fixed perpendicular to the maximum inclination line and with a distance between them determined by the longitudinal mounting.

Once the battens are fixed, it is proceeded to place the first line of tiles according to the transversal mounting. When the battens are fixed, the guideline of the roof field is made parallel to the maximum inclination line with the help of a carpenter's square. Then, they are marked using a plumb line. It is taken as reference to put the rest of the tiles perfectly lined and fitted.

Mixed Tile



Flat Tile



## MOUNTING

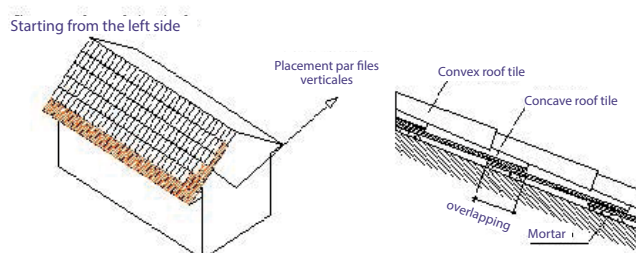
Once the calculations and the supports were made with the guideline traced and with the battens fixed, it will be proceeded to the mounting of tiles as follows:

### Curved tile

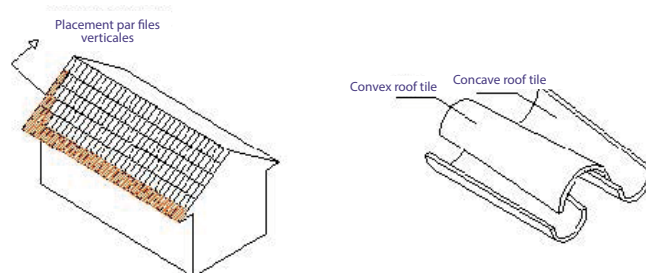
Starting with the first horizontal line of the eave, the concave tiles are placed, being orientated with the widest part towards the ridgeline. They are fixed individually on the superior extreme part.

Then the convex tiles are placed over the two adjoining concave tiles orientated with the widest part towards the eave. All the vertical lines of the eave will be made in that way and successively, taking into the account previously the section of fixing.

Starting from the left side



Starting from the right side



## Mixed tile

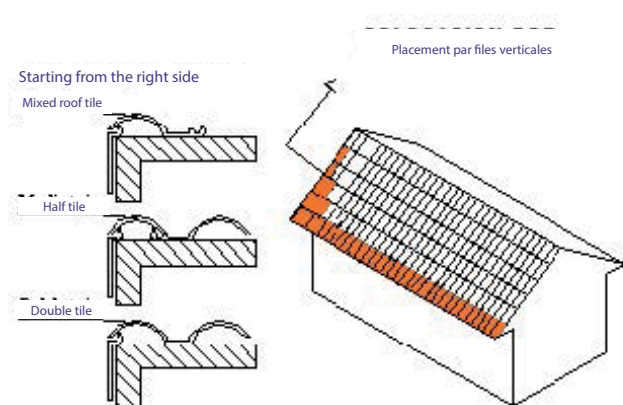
First, the side finishing pieces are placed from the eave to the ridgeline along the entire edge.

Then the tiles that form the eave are placed from the right to the left. They are kept overlapped laterally and fitted each other due to the longitudinal lace.

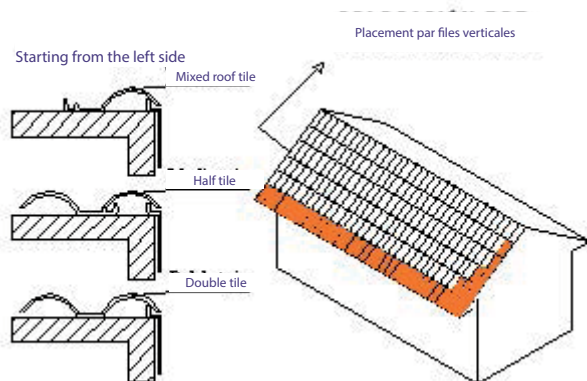
Then the tiles of the first vertical line are placed from the eave to the ridgeline, fitted together due to the lace system that they have.

The rest of the roof field is completed by successive vertical lines of tiles, parallel to the maximum inclination line from the eaves to the ridge line, following the guidelines obtained in the calculation and the recommendation of the tile fixing.

Starting from the right side



Starting from the left side



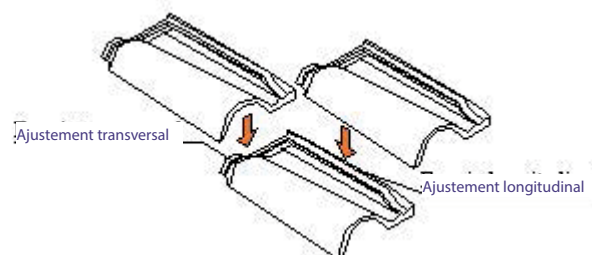
## "Staggered" Flat Tile

First of all, the tiles, which form the eave are placed, fitting laterally and overlapping each other due to the longitudinal anchor.

Placement of tiles will start on the left and it will be used tiles or half tiles.

Then, the successive horizontal lines from the eave to the ridgeline are placed. Half tiles or whole tiles are alternated in each line ends.

The side finishing will be placed overlapped above the flat tile. Its placement will be from the eave to the ridgeline, following the recommendations of the paragraph for fixing the tiles.



## EXECUTING SINGULAR POINTS

### Eave

Place a string or straightedge parallel to the eave, which serves as a reference to determine the height and the overlap of the tiles in their firstline. The minimum overlap of the tile is 10 cm. The tiles are raised through the highest batten to ensure the same pitch than the rest of the tiles.

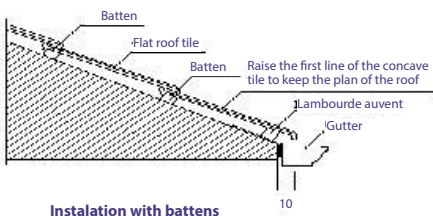
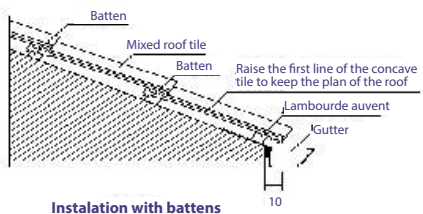
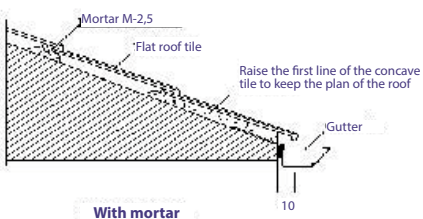
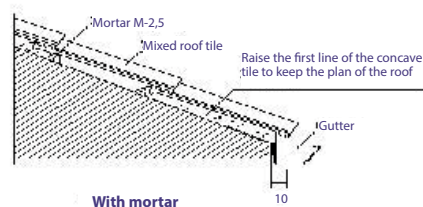
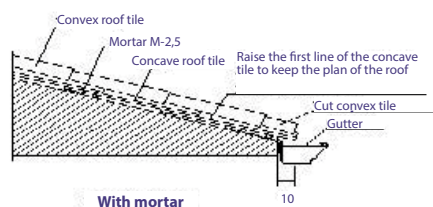
It is recommended for the mixed tiles to install special pieces on the eave. They will extend the eave, avoiding moisture and stain on the façade. Moreover, they will give the eave a finishing similar to a traditional curved tile. If it is anticipated the possibility of snow or ice accumulation that impedes the natural water drainage along the eave, a waterproof band will be installed beneath the first rows of tiles.

### Eave with Exterior Gutter

The clamp of the eave will be fixed with a maximum distance of 5 meters and a subsection under tile of 15 cm for a properly installation.

The slope of the gutter will be above 1%

Please check NTE-QTT for the measurement of the gutter.



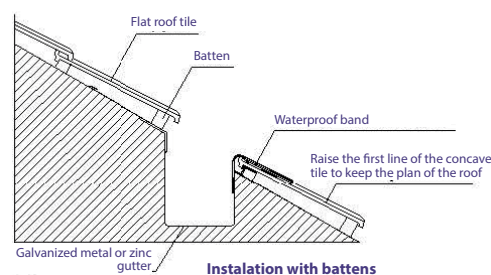
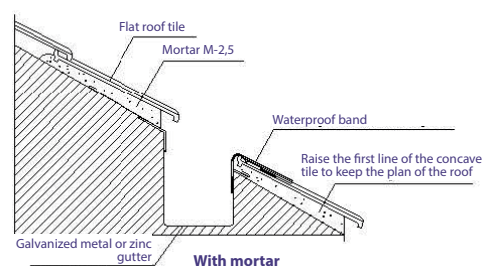
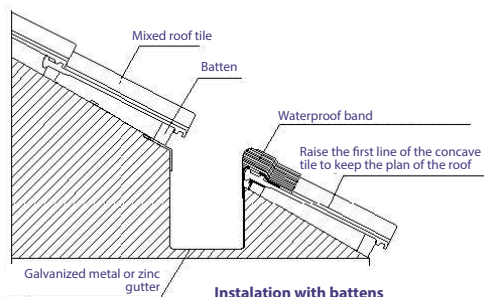
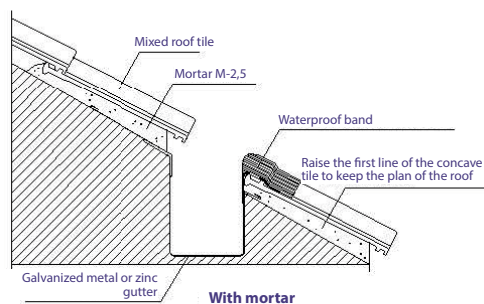
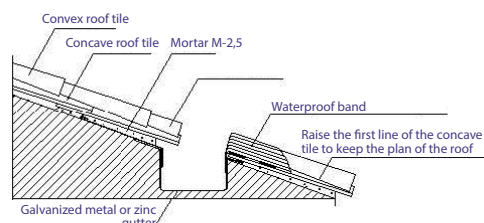
### Eave with Interior Gutter

Solution indicated for roof fields bigger than 12 m

The dimensions of the gutter meet the NTE-QTT and they will be easy to clean.

The slope of the gutter will be 1% and will exceed the distance between downspouts of no more than 20 meters.

It should be protected with a waterproof band that overlaps the roof tiles and the gutter to prevent leaks in the gutter.





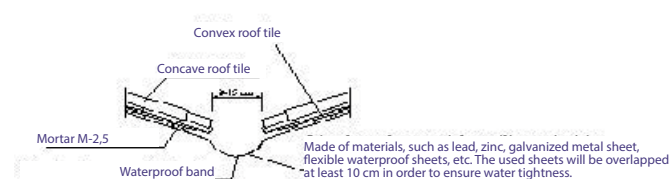
## Eavesgutter

The eavesgutter is one of the most critical points of the roof together with the eave because it is the line that receives water from the two fields of the roof. It is considered an inclined gutter towards the eave.

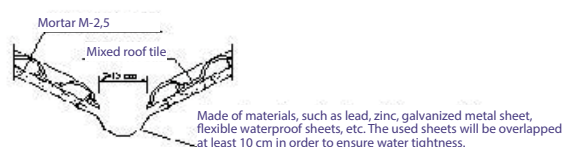
It is made of materials, such as lead, zinc, galvanized metal sheet, flexible waterproof sheets, etc. The used sheets will be overlapped at least 10 cm in order to ensure water tightness.

In case one of the roof fields has a greater length or inclination and the inclination is the minimum advisable, a wider eavesgutter will be made or an additional impermeable layer will be applied.

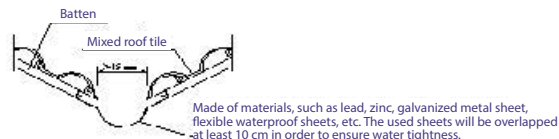
The minimum separation of tiles in every roof tile field, which flows water into an eaves-gutter will be 15 cm and an overlap over it at least 10 cm.



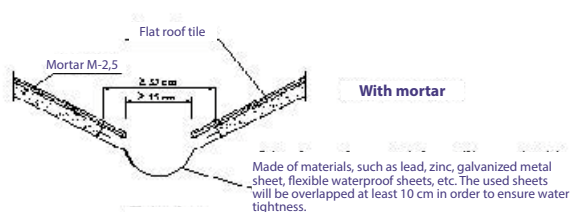
With mortar



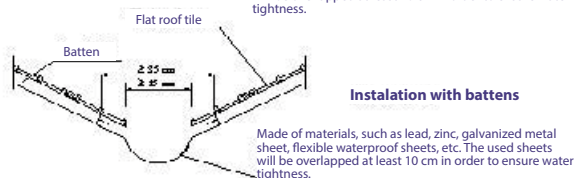
With mortar



Installation with battens



With mortar



Installation with battens

## Rigdepole

The horizontal line at its maximum eave height, which can be point between the roof field and another roof field (Gable roof) or between a roof field and a vertical plane (shed roof)

### Gable roof

If the placement is done with battens, the roof tiles will be placed at the head with the batten of the ridgepole. However if they are not used, the roof tiles will be placed at the head between them.

For the mixed roof tiles, the special piece called chock will be placed on the flat side of each tile of the last line.

Then it is proceeded to place the special piece ridge, which ends the ridgepole overlapping at least 5 cm to the roof tiles and chocks of both tile fields.

The placement of the ridges will begin by one of the ends placing the end ridge piece and it continues with the rest of the ridges, which are joined together due to the anchoring system. Their placement will be opposite to the prevailing winds.

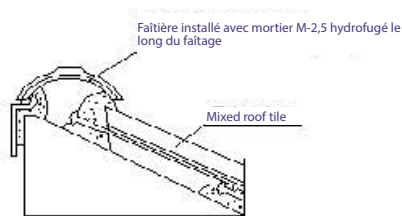
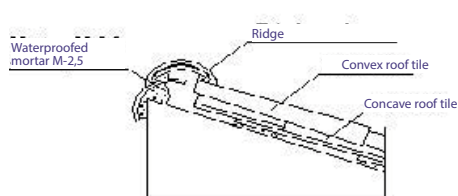
The meeting of the ridge with the gable end is solved using the lateral ridge cap that will be fixed by nails or screws.

If reversals are needed, the double ridge will be placed.

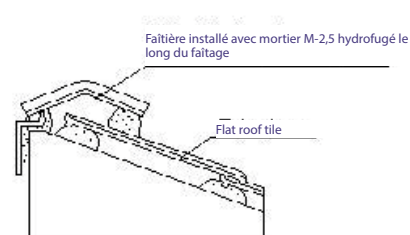
## Shed roof

If the placement is done with battens, the roof tiles will be placed at the head with the battens of the ridgepole. However, if they are not used, the roof tiles will be placed apart from the edge of 5-10 cm. For the mixed roof tiles, the special piece called chock will be placed on the flat side of each tile of the last line. Then it proceeds to place on the edge of the roof field a line of side finishings fixed on a wooden batten, as opposed to the prevailing winds.

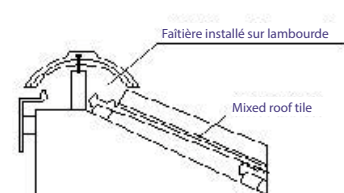
Then the special piece, end ridge is placed just as in the gable roof overlapping at least 5 cm to the roof tiles and the side finishing pieces that end the ridgepole.



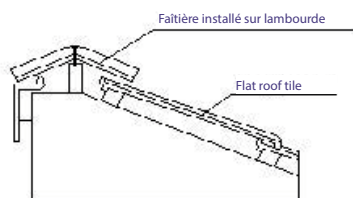
With mortar



With mortar



Installation with battens



Installation with battens

## Hip lines

The steps for executing a hip line are described below, being essential the use of ridges. The roof tiles in its meeting point with the hip line will be cut following the hip line.

If the placement is done with battens, the roof tiles will be placed at the head with the battens of the hip line, but if they are not used, it will be done at the head between them.

In case of mixed tiles, once the tiles of the roof field are cut and placed, a special piece called chock will be fixed on the flat part of every tile of the last horizontal line.

Then a line of ridges is placed overlapping 5 cm to the cut tiles of both roof fields.

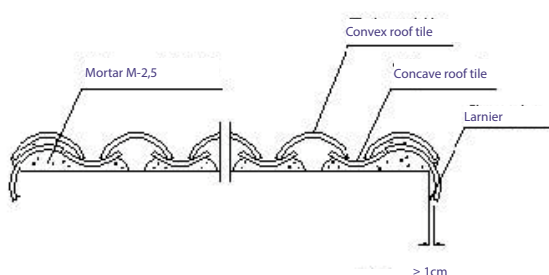
The placement will be from bottom to top.

The piece End Ridge will be used in the meeting point of the hip line with the eave. A three way ridge is used for the meeting points of the hip line with the ridge pole.

## Lateral edge

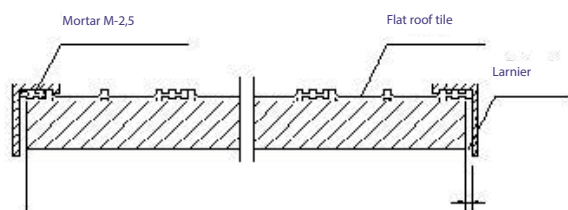
### Curved Tile

The tiles will be placed in vertical lines, reaching the edge with the concave tiles separated 10 cm. Then, a tile line will be placed on the lateral edge in convex position with a minimum overlapping of 10 cm in ascending order from the eave to the ridgepole, which will act as roof field. Then it is placed overlapping 5 cm to the concave tile line and in the half of the convex tile line, a curved tile line in convex position with a minimum overlap between them of 10 cm.



### Flat Tile

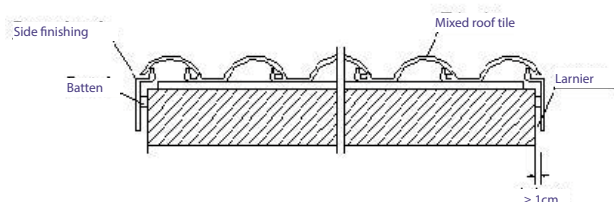
In this case, the side finishing will be placed on the tile overlapping them at least 10 cm with the same specifications of the assembly specifications as in the mixed tile.



### Mixed Tile

Side finishing pieces are fixed along the entire edge from the eave to the ridgepole lightly overhung towards the ridgepole. All the pieces will be fixed, nailed or screwed on a ribbon located on the side of the roof field. The nail hole should be sealed as a watertight guarantee.

The side finishing will always be overlapped by the curved part of the tile. It is recommended to use a Half Tile or Double Cushioned Tile to facilitate this work.

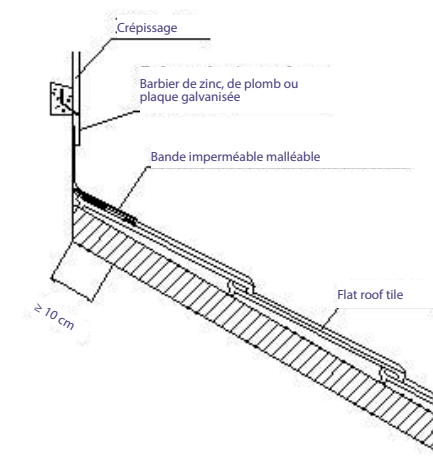
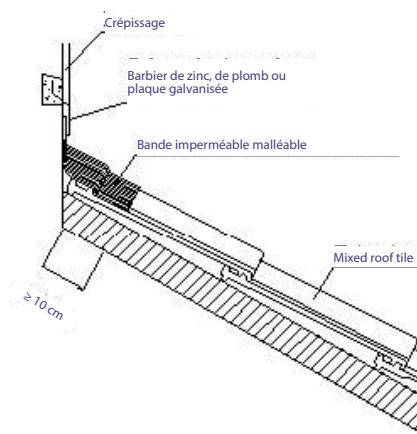
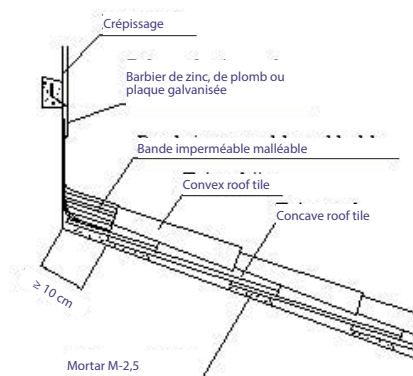


## Facing abutment

### Upper Vertical

It will endeavour to reach the top part of the roof field with entire roof tiles, which will be placed at head with the vertical facing and overlapping at least 10 cm.

In the last horizontal lines of tiles, a waterproof membrane is placed. It will be fixed to the vertical facing until reaching a height of at least 25 cm. The membrane fixing to the vertical facing will be made with metallic or sealed profile or introduced into a groove.



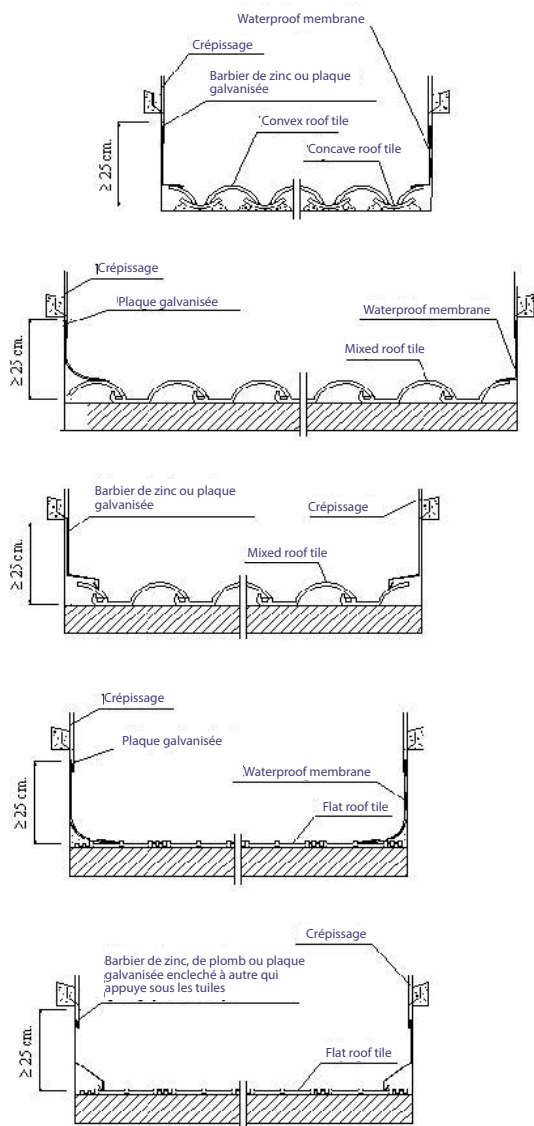
## Lateral vertical

It will endeavour to reach to the lateral side of the roof field with full tiles.

They will be placed at head with the vertical facing, overlapping at least 10 cm. A waterproof membrane is placed to the last vertical tile row, which will be fixed to the vertical facing until reaching a height of at least 25 cm.

In case of the curved tiles, it should arrive at the facing with concave tiles.

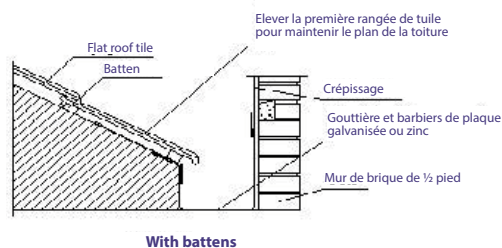
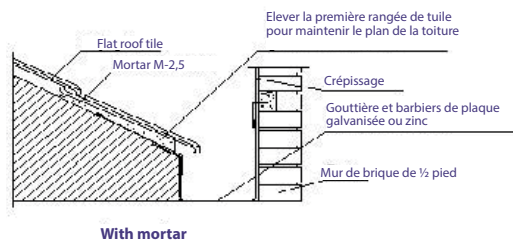
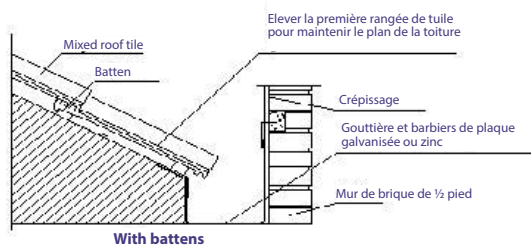
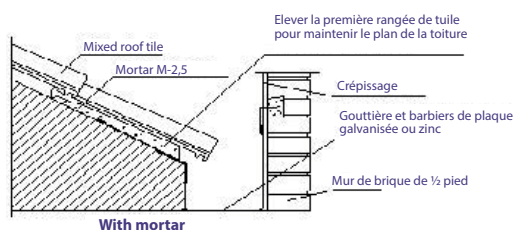
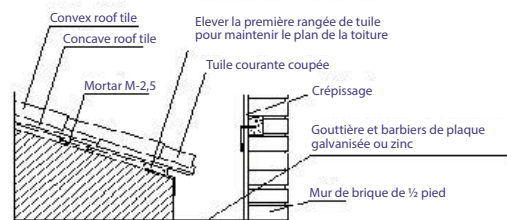
The fixation of the membrane to the vertical face is made with metal and sealed bar, introduced into a groove.



## Lower Vertical Face Encounter

The solution is similar to that used for an inside gutter with the difference that the waterproof material is fixed to the vertical face up to reaching a height of at least 25 cm.

The fixation of the membrane to the vertical face is made with metal and sealed bar, introduced into a groove.





## Pitch Change

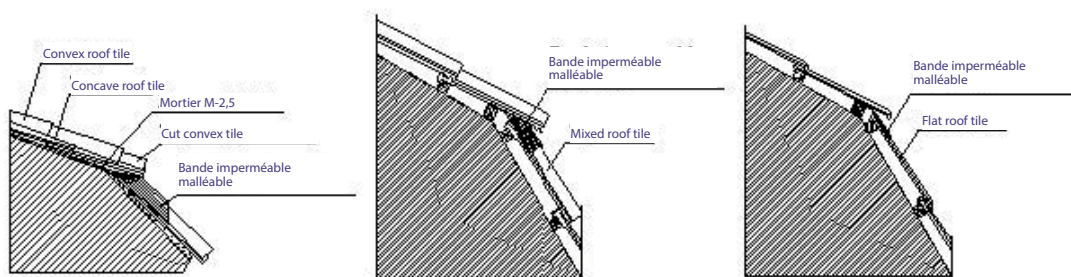
For the implementation of the pitch changes, it is necessary to begin by placing the tiles of the lower roof field.

The last row is made if possible with whole tiles. Then a waterproof membrane is placed overlapping the last roof line and attached to the upper roof field or the first of the battens if necessary.

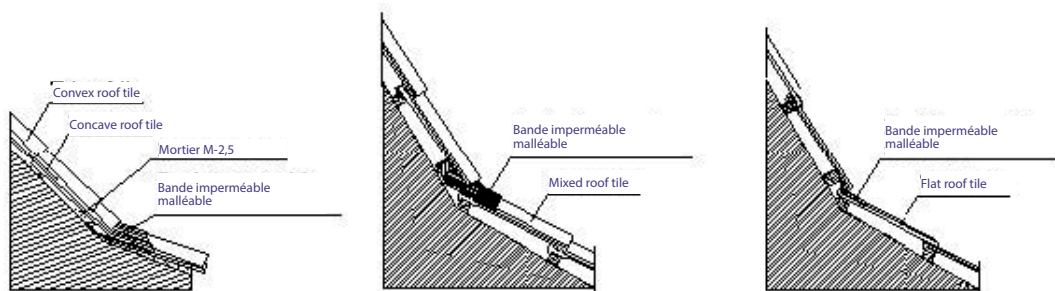
Subsequently, the roof tiles of the upper roof field are placed on the waterproof band, matching the tiles alignments in both roof fields.

When the pitch change is greater, the upper roof field will be treated as an eave.

Convex pitch change



Concave pitch change





**mazarrón**  
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