ROOFS
PART 2

YONA FRIEDMAN

HUMAN SETTLEMENTS
AND SOCIO-CULTURAL
ENVIRONMENT

UNESCO
COMMUNICATION CENTRE
OF SCIENTIFIC KNOWLEDGE FOR SELF-RELIANCE

UNDER THE AUSPICIES OF THE UNITED NATIONS UNIVERSITY
WITH THE PARTICIPATION OF THE INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

ROOFS MADE WITH MINERAL MATERIALS
In July 1991, "Roofs for People" by Yona Friedman and Eda Schaur, was awarded among 3068 entries, the Grand Prize/Prime Minister's Prize at the 5th International Design Competition, Osaka, promoted by the Japan Design Foundation.

The jury's comments are as follows:

"This work is a proposal for the construction of dwellings at low cost to house poor and illiterate people. Underlying the proposal is a most topical message involving criticism of the rationalistic mindset of modern people.

The proposal presents a method by which people could build houses for themselves at low cost using materials available in their own region; instruction manuals using "picture scripts" would be provided for those unable to decipher technical drawings. The proposal is an attempt to solve a highly important and pressing problem for hundreds of millions of people in the world who subsist on low incomes.

As well, the work seems to contain a valuable message: it prompts reflection on the fact that various problems related to modern cities have resulted from neglectful attitudes towards the earth."
FALSE DOMES
If your house can be built on a circular plan,

it is easy to cover it with a dome.

A dome is a vault on a ring-shaped wall.

But even easier to build

is a "false dome".

A "false vault" is built with bricks.

With each row of bricks protruding slightly

beyond the row below it.

This arrangement, repeated row by row,

creates a false vault.
When building a false vault

It is important to weight down the wall

(Which has to be pretty thick)

And each row of bricks should be kept by a temporary support,

Which can be taken away when the vault is ready.

Without that precaution the vault will fall in.

But a false dome on a circular plan

Is easier to build than a false vault.

This comes from the rows of bricks being circular.

Thus each brick keeping its neighbour from falling in.
Such a false dome can be up to 10 feet large and has to be at least as high as it is large.

Thus it will be much steeper than a regular dome.

Such a false dome can be eventually built over a square plan too.

First you have to start those protruding rows of bricks in the corners.

Till the protruding rows become like a circular belt.

Then, upon that belt, you can continue the false dome on circular plan.
Another way to build a false vault involves the use of scaffolding. A simple scaffolding prevents the vault from falling in before it is completed.

Once the vault is finished, the scaffolding can be removed:

The vault will remain in place without it.

Scaffolding for a false vault consists of a solid triangle shaped according to the desired shape of the false vault, made of bamboo or other similar material.

That triangle is made so that parts of it can be dismounted and the scaffolding removed from under the finished vault.
THE PROCEDURE IS SIMPLE:
AFTER SETTING UP
THE SCAFFOLDING,
A PORTION OF THE FALSE VAULT
CAN BE BUILT
WITH EACH BRICK LEANING
ONTO THE SCAFFOLDING.
ONCE THE LAST BRICKS
ARE PUT INTO THEIR PLACE
THE VAULT IS SOLID ENOUGH
AND THE SCAFFOLDING
CAN BE TAKEN
TO UNDER THE NEXT PORTION.

IT IS EASY TO BUILD
A FALSE VAULT
OR A FALSE DOME,
WITH OR WITHOUT A SCAFFOLDING.
MUCH EASIER
THAN TO BUILD A REAL VAULT
OR A REAL DOME,
BUT IT CAN COVER
ONLY A LIMITED AREA,
SMALLER THAN THAT OF A REAL VAULT
OR A REAL DOME.
CONIC DOMES
The simplest kind of domes are the conic domes.

They can be built easily with the same technique as false domes.

That means, that each row of stones or bricks should protrude slightly inward, over the row beneath.

To build such a dome the best shape is a circular shoulder-line.

Thus, for example, a round house.

But, a similar structure can be built over a square design too.
Once you have defined the shoulder-line, for example, a circular one,

you can continue to build row after row,

each circle being smaller,

than the circle beneath it.

The conic dome, like all vaults or domes,

exercises a strong side pressure.

This depends upon its "slenderness". That pressure can be compensated with making the walls very thick,

or making them lean slightly inward.
SIMPLE WAYS TO BUILD A VAULT

Yona Friedman
A vault resembles a curved wall.

Which can bear a load because its shape.

A vault can be built of bricks, over a scaffolding of semi-circular form.

The bricks should be posed on the scaffolding with their small end downwards.

So all bricks would point in a direction slightly different than that of their neighbours.

When you arrange bricks for building a vault.

You have to put plenty of mortar between any two bricks like when you build a wall.

When the mortar is hard and the vault is solid.

You can take the scaffolding away.
You can sometimes build a vault without scaffolding.

For this purpose, you use ceramic jars instead of bricks (they are lighter).

First you draw on the ground the line which will determine the profile of the vault.

And you do this on the spot where you want to build the vault.

Then you place one row of jars along this line (but only one row).

The jars should be placed with their small end towards the centre.

The jars have then to be fixed with plaster along the profile.

And left to dry.

Once the arch becomes rigid as the plaster hardens,

you carefully lift the arch in vertical position and prop it up with some sticks.

Then start immediately the next arch. When you finished the next arch, you lift it in position as near as you can to the preceding one.

Then you fix the new arch to its neighbour with some plaster.

So, from arch to arch you will build your vault, which will consist of a row of arches.

This vault will be evidently weaker than an arch made of bricks.
VAULTS
WITHOUT SCAFFOLDING
TO COVER YOUR HOUSE

YOU CAN BUILD A SIMPLE VAULT

WITH SUN-DRIED BRICKS.

YOU CAN DO SO WITHOUT ANY SPECIAL SCAFFOLDING EXCEPT A LADDER.

THIS IS PARTICULARLY IMPORTANT AS SCAFFOLDING IS EXPENSIVE.

AS IT USES A LOT OF WOOD

FIRST OF ALL YOU HAVE TO BUILD THE WALLS OF THE HOUSE.

YOU SHOULD BUILD A GABLE ON EACH OF TWO OPPOSITE WALLS.

THE PROFILE OF THOSE GABLES WILL DETERMINE THE SHAPE OF THE VAULT TO BUILD.

IT IS WISE TO DISPOSE THE GABLES IN SUCH A WAY THAT MAKES THE VAULT HAVE THE LESSER SPAN.
The best form for a vault is not the half of a circle, but a figure called "parabola".

You can draw that figure by copying a freely hanging rope or chain.

Turning that drawing upside down, you get the shape of the gable.

The technique for building a vault is by building a row of arches. As for an arch, it is solid because of the pattern according to which the bricks are located:

Between each couple of bricks there is a narrow triangular interstice filled in with mortar.
You should start to build the first arch.

(following the line of the gable)
so that it leans against the gable.

Thus, the first incomplete arch will lean against the gable, fixed to it with mortar.
The second (complete) arch will lean against the first one, fixed to it with mortar.
The third arch should lean against the second, the fourth against the third, and so on.

But the second will be complete.

And so will be all the others.
All these arches, each leaning on the other, will keep together, and the vault remain in place during the building period without any scaffolding.

The vault will be more solid if you weigh down its shoulder line by continuing to heighten the wall with a few rows of bricks.

This vault will be a good roof for your house, but first you have to make it water-tight.
SUSPENDED DOMES
You know how to build a dome over a circular layout, or over an octagonal one.

But, how to build such a dome over a rectangular house?

If you build that dome with materials of vegetable origin, like bamboo, reed or wood,

you can proceed as you would do over an octagonal layout.

Four sides of the dome resting on the walls.
Your dome will then cover the square room.

But, in each of the 4 corners, a triangular space will remain uncovered.

You should cover those 4 triangles with sloping rooflets (called "pendentives").

The upper edge of each rooflet should be covered by the lower edge of the dome.

If you build the dome with bricks, baked or unbaked,

You should proceed differently:

You have to start, in the corners, with the pendentives.

Using for this purpose the technique of vaults or that of false vaults.

Those pendentives will form an octagonal (or circular) shoulder-line.
Over that shoulder-line, you can build 'the dome'.

Masons and architects call such a dome a "suspended" one as it rests on a shoulder, which is built, partly, over a void.

A suspended dome makes the room seem larger than a room covered by an ordinary dome of the same size.

You can build a suspended dome supported by arches only, 4 arches replacing the 4 walls.

A row of such domes covers a large space with no walls, only a few pillars.
YOU HAVE TO ENSURE THAT YOU MAKE THE PILLARS MASSIVE

OTHERWISE THE DOME AND THE PENDENTIVES EXERCISE A SIDE-PRESSURE MAKING THE PILLARS FALL.

YOU CAN CANCEL THAT SIDE-PRESSURE WITH IRON RODS (THE KIND USED IN CONCRETE BEAMS).

ANCHORED THE RIGHT WAY SUCH RODS KEEP THE STRUCTURE TOGETHER.

AN APPROPRIATE ANCHOR CAN BE MADE WITH A PIECE OF WOOD OR EVEN WITH SCRAP METAL.

PROVIDED IT HAS A SURFACE LARGE ENOUGH SO AS NOT TO TEAR A HOLE IN THE PILLAR OR IN THE WALL.

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HOW TO KEEP ALIGHT
THE ROOF
Walls made with mud,
either in sun-baked bricks
or in pisé
are sensitive to humidity.

Even little rain can be violent.
Such rain damages seriously mud walls.
And if the roof is borne by the mud walls alone
the whole house might collapse with a heavy rainfall.
There are solutions to prevent such damage.

The first one concerns roofs made with vegetal material. Such a roof, which is usually quite light, can be borne by posts and a tension frame.

These posts and tiers should be independent of the mud walls.

A roof supported by such an independent structure will keep in place even if the mud wall becomes soft or if it crumbles away.

It is much easier to repair a mud wall than to rebuild the whole roof.
A mud wall can be stabilized with an incorporated skeleton made in bamboo or in wood. Such a skeleton is particularly solid when triangulated but that is not absolutely necessary. The rods making up that skeleton should be visible from outside, so they will get enough air to avoid their rotting away from humidity, which would happen if they were inside the wall. The mud constituting such wall will be filled into the meshes of the skeleton.
WHERE KILN-BAKED BRICKS ARE AVAILABLE

BUT TOO EXPENSIVE FOR THE ENTIRE WALL TO BE BUILT WITH THEM,
A SKELETON MADE WITH KILN-BAKED BRICKS CAN BE BUILT.

THEN YOU DON'T NEED TOO MANY OF THESE EXPENSIVE BRICKS.
THE MESHES OR THAT SKELETON SHOULD BE FILLED WITH SUN-BAKED BRICKS.

SUCH A SKELETON NEEDS SOLID FOUNDATIONS
WHERE IT TOUCHES THE GROUND.
THE SKELETON ITSELF CAN CONSIST OF A PATTERN OF ARCHES OR OF FALSE ARCHES.

SUCH A SKELETON WILL SUPPORT EVEN A VAULT (WHICH MIGHT BE HEAVY),
WHICH WILL NOT GET DAMAGED WHEN THE MUD OF THE WALL IS WASHED AWAY BY THE RAIN.
TECHNIQUES TO LEARN
THE CHAIN-LINE
Before building a vault or a dome, you can determine which shape would be the most advantageous.

For that purpose, the technique of the chain-line is useful, easy, and efficient.

A good shape for a vault is one with the least side pressure.

Less side pressure requires thinner bearing walls, thinner, but not less safe.
A shape generating less side pressure can be found with the help of a hanging chain (or rope).

Such a chain takes, spontaneously, a particular form. You can draw this form onto a board.

Or you can bend a bamboo (or a reed) into the same shape, and fix it in that shape with ropes.

That line which you have copied from the hanging chain, is, like cows' horns, pointing upwards.

It is the inverted shape of an arch.

If you put that model upside down, you obtain the shape of the vault you were looking for.
If you make that shape higher
(by using a longer chain
for the model)

The side pressure of the vault
will be smaller.

But, a higher vault
needs more material

And might be
more difficult to build.

If you start that vault
(or that dome)
directly from the ground up
directly on the foundations
You have not to bother much
about side pressure,

And don't need more material
as in the case
of a vault on walls.

A vault according a chain-line
from the ground
to the ground

Is a solid... and inexpensive structure.
HOW STRONG CAN A BEAM BE?
You might sometimes want to span.

A distance between two walls or posts with a beam.

In order to support a roof

Or other loads.

In order to support loads.

A beam has to be strong.

How strong it is will depend upon the span (the distance between the supports).

And on the proportions of the beam itself.
If a beam bears a load over a span

And that beam has a certain height

A beam twice as high bearing the same load

Can span a distance twice as wide,

Or it can bear over the original span

Four times as much load.

The strength of a beam

Depend thus

1. On the material it is made of:
   (A metal beam is stronger than a beam in hardwood, a hardwood beam is stronger than one made of soft wood, etc.).

2. On its height
   (A beam twice as high can bear 4 times more load, 3 times as high 9 times more load etc.).

3. And on its breadth
   (A beam twice as broad bears twice more load, 3 times broader 3 times more load etc.).
You can increase the strength of a beam if, instead of posing it simply on its supports (walls or posts), you fix it tightly to those supports (for example, with two boards disposed in diagonal). Then beam and support together will form one whole and will work together.

Such a construction we call a "frame." Frames are very strong.

They can bear somewhat more weight than bears a simple beam.

They give security in such cases where a beam posed on the supports would break or the supports collapse.

For example, in case of earthquake a frame can be quite safe.
Another way of increasing the strength of a beam is to "triangulate" the beam: by giving it the form of one triangle or more.

A triangulated beam can be made of thin wood and be strong at the same time.

A grid-like beam uses very little wood and stays very strong.

When you make a frame or a triangulated beam, test it before adopting it over the span you plan to bridge over.

Test it with a load superior to what it will bear once in use:

If the frame can bear the larger load, it will bear the definitive one without any risk.
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BENDING MAKES THE BEAM STRONGER
The strength of a beam can be increased when it is bent the right way.

Bending upwards makes the beam stronger.

Bending downwards can reduce its strength.

A bent beam can bear more weight, similar to an arc (a bow).

When it is bent, but one has to take care not to overbend it.

As a bent beam is made of a piece of thin wood (you cannot bend thick wood easily), and that thin piece of wood might crack if overbent.
Thin sticks are ideal for a bent beam.

You can bend them under your own weight.

But take care not to break them.

When the wood is properly bent

You should fasten its ends together with a string or a rope.

Such a bent beam will look similar to a bow.

If you want such bent beams to support your roof,

You should take care that the bent beams don't buckle (lean) to the side.

Once the load is charged on them,

A bent beam leaning to the side has no bearing strength at all.

Neither does a bent beam turning down.
In order to avoid bent beams leaning aside completely,

you can tie them together in pairs,
each of the two beams leaning slightly away from each other.

You should then tie their upper bars together with a rope.

And keep their lower ends apart by two small pieces of wood.

Such a composed beam can be quite strong.

You can fix together a row of bent beams as well.

with thin pieces of wood

or with long mats.

Only be careful that the main canes of the mat should lie crosswise to the beams.
BENT BEAMS ARE GOOD SUPPORT FOR ROOFS

BECAUSE THEIR FORM ASSURES "A GOOD SLOPE"

A SLOPE NECESSARY TO ALLOW WATER RUN-OFF.

ONLY THE UPPERMOST PART OF THE ROOF STAYS FLAT

(BECAUSE OF THE BOW SHAPE OF THE BEAM).

THERE YOU SHOULD USE A PARTICULARLY WATERTIGHT COVER MATERIAL.
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PRACTICAL THINGS ABOUT ROOFS
A roof should resist to water.
A roof protects you against the weather. But a roof has to be well made!

Otherwise, it could leak when it rains.

Or, it could let through much water.

If the rain is accompanied by wind, then the wind blows the water in.

The first thing you can do to make your roof waterproof is to choose an appropriate shape. Water always tends to run downwards, on a slope.

So a good roof shape has to have sufficient slope for the rainwater to run downwards, without accumulating in some spots forming small pools.

A roof on which water accumulates leaks almost in every case.
IF YOUR ROOF HAS STEEP SLOPES,

THE WATER WILL RUN OFF FASTER THAN ON GENTLE SLOPES.

IF THE WATER RUNS FAST, THE ROOF WILL NOT LEAK.

EVEN IF IT WAS MADE OF LESS WATERPROOF MATERIALS.

IF THE SLOPE IS SMALL, WATER TRICKLES DOWN SLOWLY.

AND IT MIGHT GET INTO CRACKS AND HOLES.
THEN THE ROOF WILL LEAK, IF MADE WITH LESS WATERPROOF MATERIALS.

THE WATERPROOF COVER OF A ROOF CAN BE MADE
WITH TILES, WITH PLATES, Mats OR SIMILAR STUFF,

IN VARIOUS SHAPES AND SIZES.

(FOR EXAMPLE, TILES ARE SMALL SHEETS HAVING A SPECIAL FORM).

SUCH SHEETS MAM TO BE DISPOSED IN A CERTAIN WAY

ON THE SUPPORTING STRUCTURE.

IN ORDER TO PREVENT LEAKING IN WHERE TWO NEIGHBOURING SHEETS ARE JOINED TOGETHER.
The upper row of such sheets has to cover with its lower edge.

The upper edge of the following row:

The upper edge of each row has to be covered.

By the lower edge of the row immediately above it.

Thus, you have to start to work, when covering a roof, with the lowest row.

And continue it row by row upwards.

The sheets themselves should be cut (or tressed) in such a way as to have one or more "drip noses".

That is, points, or threads pointing down, or small canals, which will make the water take a particular path when running down the roof.
A steep roof covered with thatch, or with small dressed mats protects the interior of the house as well as expensive tiles do. The thickness of the waterproof cover plays an important role in the resistance to leakage.

A thick thatch roof, for example, is more waterproof than a thin one.
A Roof can be made waterproof simply with plastic foils, with a layer of asphalt or tar and similar materials, particularly on roofs which are nearly flat.

But plastic foil, asphalt or tar should be protected against wind and direct sunshine.

Rough weather can deteriorate a roof if they are not protected.
THE WATERPROOFING OF A ROOF 
HAS TO BE INSPECTED 
FROM TIME TO TIME.

IT SHOULD BE REPAIRED 
AT THE SLIGHTEST DAMAGE

AND PARTICULARLY 
BEFORE EVERY RAINY SEASON.

WATERPROOFING DETERIORATES 
WITH THE SEASONS,

AND, IF NEGLECTED, 
IT CAN BECOME MORE OF A NUISANCE

THAN A BENEFIT.
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KEEPING THE INSIDE TEMPERATE
In a warm climate the night is cooler than the day.

If you are able to make your house to retain the cool air at night without letting in the warm air during the day, your house will be an agreeable place to live in.

A house becomes hot inside.

1. Through the hot air coming in through windows or doors.

2. Through the heat passing through the roof exposed to the sun.

3. And through the heat passing through the walls.

Often, walls and roof store the day heat and don't permit the inside to cool down.

You should, first of all, protect roof and walls from heat.
To keep the roof cool, the first thing is to keep it in shade.

For example, you can build your house under a tree (if you have the opportunity). But often it is easier to build a sunshade over the roof, for example, by using mats.

(A sunshade does not necessarily have to be strong; it has to keep shadow on the roof).

You can use as well, in order to shadow the roof, any material which blocks sunshine, like twigs, thatch, straw, etc.

Another way is to use a shadow roof, made of mats, jute, or similar stuff.

The same techniques can be used for keeping the walls cool:

Sunshades out of mats all along the walls.

Or curtain-mats hanging a few inches in front of the walls.

Or sunshine-blocking material, like thatch, straw etc.

(Even empty cardboard boxes can serve for this purpose).

It is important that the air should circulate freely, between the protecting device and the wall.
A roof of thick thatch is a good insulation against heat.

But the use of sunshades might be easier and cheaper.

A thick wall, or a double wall with a void between the two planes,

Or also a wall made of straw or thatch and plastered with mud,

Are good for insulation.

You can use climbing plants too, like beans, vines etc.

Whose leaves shade the wall.

If walls and roofs are protected against heat,

You should protect the openings (windows and doors) too.

A simple or double mat curtain can stop the hot air from getting inside during the day.

And you can draw it aside at night when the air is cool.

With cheap materials, with mats, straw and thatch, you can make your house cooler.

And more pleasant to live in.
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PREVENTING FIRE
FIRE IN A NEIGHBOURHOOD

CAN BE A CATASTROPHE.

IT DOES NOT STOP AT ONE HOUSE WHICH BURNS DOWN COMPLETELY.

BUT IT RUNS FROM ONE HOUSE TO THE NEXT.

MANY PEOPLE AND MANY THINGS CAN BE LOST.

BY ONE BIG FIRE.

IN ORDER TO PREVENT FIRE THE FIRST THING TO DO IS TO TAKE PRECAUTIONS

WHILE COOKING.

WHILE LIGHTING A LAMP.

WHILE SMOKING.
When a fire breaks out

The first thing is to save people.

It is important, for this purpose, that people from the burning house should be able to flee to a larger open place, for example, or to a place where the fire cannot reach.

Such a space can be a square or a wider street, broad enough to stop the propagation of the flames.

People should be able to reach this space easily: it should be near all the houses, and it should be connected to other similar spots, for people might need to continue their flight.
FIRE NEEDS AIR TO BURN.

To put out a fire you should cut away the air.

For example, by throwing a wet blanket on the fire,
or water,
or even sand.

If petrol is burning, the water might be useless,

But a wet blanket or sand can extinguish the fire.

A Handy water reserve is important.

When fighting a fire:

A barrel full of water in front of each house can do it.

A water ditch along the street can be useful too.

The water for putting out fire does not need to be clean or drinkable:

It simply has to be close at hand.
One should keep those barrels covered.

In order to keep out mosquito larvae.

Or to keep small children safe from falling into the water.

And for prevent people using the barrel as a garbage dump.

There are safety precautions which can be built into the house:

For example, fire walls.

These are walls separating two houses and stopping the fire from spreading.

Such a wall has to be substantially higher than the roofs.

And it has to be made of fireproof materials such as stone, bricks or sun-dried mud.
If you have some space separating two adjoining houses, it can be sometimes useful. But only if you don't use it for storing inflammable materials like firewood, paper, clothes, etc.

But it is not dangerous to keep small domestic animals in this space like hens, ducks etc.

Inside the house security can be increased too, by protecting the roof from flames which might reach it. You can make, for example a metal hood above the cooking space or above lamps and above any open flame. Such a hood can be made from scrap metal like tins or barrels.

It will keep away heat from the wooden roof.
Protecting oneself from fire begins with precautions at home. It can be improved with fire prevention devices like fire walls or alleys between houses. Easy ways to flee into safety are very important, and above all, a handy water butt.
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IT IS IMPORTANT TO IMPROVE YOUR ROOF
A roof made of corrugated iron sheets (or out of similar materials) becomes very hot in summer and can be cold in winter.

A roof made of thin sheets lets in heat and cold.

How to protect the room under it from heat and from cold?

If you could keep your roof (made in thin sheets) in the shade, the room under such a roof will be less hot in summer.

If your roof, for example, is protected by the shadow of a tree, or by a climbing plant which covers the roof, your house will be more temperate.
ONE COULD REALLY HAVE AN "Umbrella roof" OVER ONE'S ROOF.

IT COULD BE MADE OUT OF MATS SUSPENDED ON A FEW POSTS, AS ROOFED AROUND THE ROOF.

AND BE FIXED WITH SOME ROPE.

AGAINST THE WINDS.

THE "Umbrella roof" PROTECTS THE REAL ROOF AGAINST RAIN TOO.

EVEN IF IT IS NOT WATERPROOF ITSELF.

USUALLY HEAVY RAIN HAS A FORCE, AND WHEN BEATING THE ROOF IT COULD ENTER INTO THE ROOM THROUGH THE JOINTS.

THE "Umbrella roof" WHEN LEATING THROUGH THE RAINWATER (AS MATS DO) INCREASES WITH ITS FORCE.

AND YOUR REAL ROOF WILL LEAK LESS.
One can protect a roof in corrugated iron sheets against heat and cold by dispersing a protective layer of earth or of sand and pebbles on it.

For this you have to protect the sheet against corrosion by having a thin plastic foil under the layer.

Isolating the layer from the roof.

If the roof is sloping as it should be for water run-off, you should ensure that the layer stays in place.

If you make folds in the plastic, folds filled with pebbles, for example,

Then the rain water will not wash away the protective layer.

But you should repair it after heavy rainfall.
If your roof has to support the weight of such a layer, (earth or reeds are heavy), you have to make the beams stronger.

You can do this by fixing pieces of wood linking beams to the posts.

The best way is that the reinforcing pieces should form a triangle with beams and posts.

A strong roof which is well protected by an "umbrella roof" or by a layer of earth, can make your house a better place in summer and winter.