TRADITIONAL BUILDING IN PERU

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Summary

The analysis of current building methods in Peru still reveals an extremely wide use of earth as basic material all around the country, even if it is diffused less and less every year due to the social bias that considers earth building poor and not modern enough, neither comfortable, if compared to brick or concrete building. In the past 15 years, the percentage of the country's population living in earth dwellings has gone down from 54% to 43% - with most of the concentration in urban and coastline areas.
This fact, in turn, produces a loss of technical capability in using traditional materials and consequently a real detriment in the quality of life of poor and middle class people.
Only a deep study of the potentiality of **adobe, tapial and quincha** earth traditional dwellings will allow for the maintenance and the enhancement of the existing ones and for a renewed possibility to put in practice, in an economical form, the national and ancient skill of building, using earth.
Earth can be found everywhere and simply used to build residential houses with good results, that is to say with safe and comfortable features from a thermal and acoustic point of view, cheap to build and affording true energy saving.
Some main defects (as the low resistance to water and the reduced ability to withstand seismic shocks) can be solved with simple technological stratagems, partially surviving in the present way of building and partially recoverable from the memories of the lost traditional art of building with poor materials.
The paper deals with the history of earth building in Peru since its origin and illustrates some traditional technological aspects of the building procedure itself, in particular a number of methods on how to "stabilize" the base material with respect to water and some infrequently used but well-working ways of seismic improvement.

A historical outline

Peru is a country that has chiefly experienced, and still is experiencing, the situation of buildings with plain earth, and possesses some of the most ancient and great monuments of the past, maintaining such a technique even in the current situation.
There is a long line of evidence of continuity which unmistakably links the past to the present, where the presence of **adobe** is a significant element of the urban scenario, but above all of the rural one.
In ancient Peru, the adobe technique was well known and widespread in relation to multiple forms, styles, techniques and work procedures.

Conic adobes are encountered on the archaeological site of Sech*ín*, in the Casma Valley (2000-1250 B.C.), as well as in the nearby temple-platform of Moxeke (IX cent. B.C., circa).
Near the splendid city of Trujillo, the Mochica civilization (100-800 A.D.) bequeated posterity with the grand remains of two main huge temples built with ***rectangular adobes*** called Huaca del Sol (342 m long, 159 m wide and 45 m high, today largely degraded) and Huaca de la Luna, evidence of a work method concerning various and independent groups of producers.
Between 1200 and 1440 A.D. sees the period when *Chanchán* (Trujillo), the biggest adobe city in the world and the capital of the ancient pre-Incaic empire of the Chimú, was built. The city reached an extension of about 28 Km^2 and its inhabitants, at the peak of the empire, were about 50,000.

In the course of the Incaic Period (as from the second half of the XV century) the building material which, above all in the sierras, was a main feature of the architecture of this civilization, is **stone** in the shape of *pirka* (an irregular stone with mud grout) or squared stone without the use of grout in line with the Incaic tradition – *(Machu Picchu*, *Sacsahuaman*) even if this does not totally exclude the use of earth. Besides stone, in fact, the building in big blocks of earth prepared on the spot with moulds **(tapial)** is typical of a widespread and extremely economical solution above all in rural areas. When the earth was predominantly clayey or "rich", the **adobe** technique was preferably availed of; in the case of a more sandy or "lean" earth, the **tapial** was used to a far greater extent.

The Spanish Conquest of the XVI cent. and the subsequent rule, which lasted until the XVIII cent., witnessed the passing of a number of the infinitely varied methods of building with plain earth, and a rationalization the procedure. At the same time precolonial traditions influenced the prevailing culture, in a sort of bijective mixture of experiences. In fact, if, on the one hand, the words **adobe, tapial** (or tapia) themselves are a clear expression of Spanish influence, several local procedures and technologies little varied in connection – such as the repeated use of *leather strips* instead of nails for the fixing of one beam to another. What ultimately occurred was a gradual adjustment to territory and to local custom, both features which afforded the tradition of plain earth long life.

The Republican Period saw the establishing of the bases for the development of the building industry. Several materials which are popular at present made their appearance then.
The *eucaliptus*, which started being planted in several parts of the country as from mid 19^{th} century, brought about a significant change in the building sector towards the end of the century, allowing for the realisation of covered structures and various room space, still and however linked to adobe building.
The beginning of the new century saw the latest materials come on the market: **bricks** and **cement** which, for the first time ever, represented a substantial alternative that would gradually establish itself, determining a basic transformation, not only concerning materials but also technology.

The process of slow modifications gradually took its course: the extreme thickness of the adobe walls faded away in time, a thickness which guaranteed greater stability and

optimum thermic and acoustic insulation of dwellings; knowledge of the original blend of the adobe itself died out with the use of *stabilizing solutions* and natural sealers such as animal dung, or the local plant decoctions; the workmanlike "adobe process" was forgotten about, and the very prestige of this type of building progressively lost ground.
In parallel with adobe and stone, the technique of the **quincha** has rather ancient traditions, in Peru, which date back many centuries before the coming of the Spaniards. The origin of the word *"quincha*" goes far back in time and derives from "*quinzha*", in ancient quechua language, which was an extremely rudimental enclosure made of posts or rush mats.
The technique so came into being during the pre-Hispanic period and reached perfection as time went by, above all during the colonial period, when it achieved its technological climax and utmost diffusion in the 18th century or thereabouts, so much that a difference is highlighted between a *quincha prehispanica***,** traditional along the country's coastline, and a ***quincha virreynal***, above all urban, which relies on basic Spanish technological elements.
At present this technology is to be found once again in the background and is of secondary importance, generally linked to the rural world.

The progressive scrapping of the adobe, tapial and quincha building techniques, in favour of the so called "modern ones" (bricks and reinforced concrete), was brought on as from the 1930s by a series of concurrent propitious conditions such as the installation, in 1929, of the first Peruvian factory of **cemento** (*Acotongo*, in the vicinity of *Lima*), the price reduction of **bricks**, produced on an industrial scale, and the production of **iron for building**, as from the 1950s, at the steel and iron plant in *Chimbote*.

Much more than any natural disaster or than any technological improvement, it looks as if **social bias** is the primary cause of the scrapping of these traditional technologies which have, for a great deal of time, met with the most varied needs of standards of living. The not so affluent classes, who still turn to the above mentioned technologies out of necessity and under scanty forms where an adequate technical culture is entangled, experience it as a symbol of backwardness which they would avert in favour of modern materials, perhaps far more expensive and equally (if not more) inadequate, but a symbol of an extremely improved standard of living.

The data of the census reports of the past forty years speak for themselves. In fact, as from **1961**, when *Adobe* e *Tapial* actually stood for more than half of the national building heritage **(54.30%),** with almost uniform levels shared by both urban and rural areas, the situation slowly transformed itself in favour of cement and bricks which, by **1981**, stood out as predominant material in urban areas. *Adobe* e *Tapial* still represent the types of building prevailing at a national level, standing for **43.32%** of the existing building sector and housing more than 9 million people – that make up 41.45% of the country's total population.
Even ***quincha***, which has always been another building material characteristic of the country, and which, until 1972 ranked third, **9.33%**, predominantly in the urban area of the coastline, in relation to the building heritage, had its widespread feature cut down all over the country (**4.69%** in 1993).

Hence, a situation undergoing a slow and gradual reduction, yet still significant in such a way that it stands for the main refuge for most of the Peruvian population (30% of the

population living in urban areas, and as much as 68% of the population living in rural areas).
The current year 2000 prices of a one storey **adobe** building of medium dimensions, including the foundations, external walls, plugging, and roof (excluding finishings) costs less than 9$ per square metre.
A one storey dwelling **in tapial** costs less than an adobe one inasmuch it concerns the walls but there is a higher incidence of the roof which, above all in the sierras, is realized with sloping features, with tiles and wooden (usually eucaliptus) beams – more toilsome and expensive with respect to the widespread and economical *caña de Guayaquil* on the coastline. The cost comes to a total of about 8$ per square metre, excluding the finishings.
Living in plain earth houses, however, still is in Peru today, as in times gone by, not only one of several possibilities, but something which cannot be done without.

The technology of the Adobe, Tapial and Quincha

The origin of these techniques dates far back in time; so does the origin of the names they carry.

The adobe, a term which is quite widespread at a universal level and what the English call ***mud brick*** o *sun dried brick*, stands for those blocks, or bricks, in plain earth, and of rather large dimensions, sun dried after they have been given shape, mostly by hand, by means of suitable moulds in which a plastic mixture of clay, sand and straw is compressed into, and then traditionally installed. An Egyptian hieroglyph proves the existence of the word "*ḏbt*" indicating "brick" since far-off times, a term which was picked up by Arabic as "*al- tūb".*

The tapial, as it is called in Latin America, even called *pisé* in Europe or *rammed earth* in the US, stands for a building technique in packed earth with rather thick walls (a minimum of 40 cm) realized by compressing earth into lateral shapes (mobile moulds) which are progressively shifted upwards, as work proceeds. In this way parts of walls take shape. These parts are about 2-3 metres long, about 80 cm high, and of a thickness which usually tapers off upwards. The characteristic operating method for complete horizontal "recurrence" determines a characteristic aspect featuring wide bands with, often, *diagonal joints*. This stratagem makes for an *effective attachment* system for the subsequent layer, thus improving the aspect as a whole.
The introduction of *stone rows* added to the base of every layer of earth in correspondence to all its length and thickness helps the wall to endure heavy rain and is capable of curbing the phenomenon of the capillary ascent of humidity from the ground. Furthermore, it cuts down the development of possible vertical cracks which may occur in the course of time because of settling or seismic loads, acting as a sort of bracing system.
The term *tapial* or ***tapia*** is another word derived from Arabic, "*tabiya*", which indicates a mould for the realization of a packed earth wall.

The Quincha is a technique in which the earth is utilized as a secondary filling element. The mixture, to which straw – or plaster – cement/lime are sometimes added to, is useful in covering up a structure, in another material, made up of wooden supporting elements and by a plugging feature in vertical or horizontal rushes fixed to such a structure and united to one another. The earth here fulfils the function of customary plaster, often featuring laying in several layers. Round or squared wood is utilized indistinctly, in order to create the supporting external frame which is then plugged with matting of rushes joined to one another by means of nails, iron wire, cord, vegetable fibre or slender strips of cow or sheep live skin called *huascas* which guarantee, on drying, a more secure grip.

Deterioration and possible remedies

The widespread bias on the durability and on the resistance of buildings in earth often underestimates the extraordinary capacities of potential use which this material enjoys, above all when appropriate stratagems allow for its being ***protected from water*** which, either directly or indirectly, may damage the structure.
The stratagems include: an adequate type of *foundations*, possibly uninterrupted, which effectively isolate the building from the ground, the presence of a perimetric *drainage system*, an effective *connecting* between the different parting walls and the supporting elements, a ***symmetric distribution*** of the vertical elements (in such a way that does not create torsional effects in case of earthquakes), an adequate positioning and scaling of the *clefts* (not too large or near the extremities of the walls), *protection against rainwater* guaranteed by an overhang of the roofing, ***structural compatibility*** of the wall elements (in particular of covering masonry and plaster whose different stiffness and transpirable features have a negative influence on its durability.)

Giving stability to earth

Earth, as it is, is a material which does not resist compressing much and which considerably cannot stand the effects of water. Several methods apt to improve the properties of earth have been suggested; these methods make earth capable of amazing performances in terms of resistance, waterproofing and durability.
The following are some observations on *stabilization methods* utilized in Peru:

FIBRE BRANDERING

Straw fibres *(ichu*), preferably about 4/6 cm long, mixed with earth, have a basic role in *contrasting shrinkage* during the drying process and the consequent fissuring of the earth especially if this is produced in blocks and is particularly clayey. In the same way the fibres put a limit to *excessive swelling* in case of humidity, bringing about an increase of *tensile strength.*
As from quantities of 4% in volume, a satisfactory outcome is achieved up to proportions of about 20-30 kg/m^3 which are quite frequent. Once this optimum percentage is exceeded, strength decreases. A disorderly arrangement of the fibres inside the mixture creates a *tridimensional mesh* which turns out to be nothing else but brandering.
Their presence speeds up the drying process of the mass, right to its inner part, thanks to a humidity drainage outwards favoured by the ducts of the fibres (but, in the same way, they also favour absorption of water in case humidity is present). Furthermore, they carry out a useful lightening function and increase insulation characteristics (thermic and acoustic). Their application offers a special benefit in regard to performance in the case of seismic phenomena; the blocks become capable of absorbing major strain with a performance of

plastic cracking, not fragile. The fibre-free blocks normally "crumble", whereas those featuring fibre brandering tend to maintain a certain unit under the weight of dynamic loads.
Inconvenient aspects of vegetable fibres are: the risk of rotting because of long-term presence in humid surroundings, and their assailable feature on behalf of harmful. The addition of *bitumen* may do away with most of the said problematical situations, thus guaranteeing effective waterproofing.

CHEMICAL STABILIZATION
Chemical stabilization is resorted to in order to deal with the problems of the durability of the material, that is to say curb its tendency to absorb water or humidity.
A general rule recommends the utilizing of *bitumen* for sandy earth, *cement* for medium or low plasticity muddy earth, *lime* for high cohesion clayey earth.

Practically all earth, and particularly the one with predominant sandy features, may be potentially stabilized with **cement**, on the condition that it does not contain an excessive quantity of organic substance or salts.
Generally, the optimum percentages vary between 7 and 8% of the volume, within which practically there is always an increase in strength with respect to initial conditions.

Bitumen is a product, utilized since ancient times as a stabilizer, made up of at least 40% of heavy hydrocarbon and of fillers – which turns out to be particularly effective in the treatment of sandy or sandy/gravelly land, or in the case of earth which is not very cohesive (and which need an increase in plasticity) or when waterproofing is to be achieved.
Bitumen very little affects the colour of the original material and no characteristic odours persist after the drying process.
The typical proportion normally ranges between 2% and 8% according to the granulometry of the earth. The addition of bitumen may bring about a certain increase in the mechanical strength of the mixture up to a specific threshold beyond which a precipitous drop occurs, inasmuch excess bitumen ends up by actually acting as a lubricant.

Lime has practically no effects at all on earth which is extremely rich in organic substances. On the contrary, it is advisable for clayey/sandy, or highly sandy, earth, whose plasticity it reduces. Lime affects earth by way of different mechanisms: because of absorption of water or cationic exchange; because of flocculation and agglomeration; because of carbonation or pozzuolanic reaction.
The percentages vary from 1-3% in weight, only for reducing plasticity (with a remarkable reduction of both shrinkage and swelling), at values of 3-10% in weight, for obtaining real stabilization. The percentages refer to industrial lime, containing 90-99% of live lime; with regard to craftsmanlike lime (60%), the proportions are to be increased.

Use of natural products in stabilization
These are products of mineral, vegetable or animal origin, whose use has been handed down in time, linked, as it is, to learning and traditional methods.
However, most of them can guarantee a certain improvement with respect to water strength, thus slowing down their course of decay.

Products of mineral origin are fundamentally used to rectify the granulometry of earth. Sandy fractions are added to modify excessively clayey mixtures, or viceversa. Special effects may be obtained by selecting specific earth such as *bentonite* – a clay with degreasing features – which expands if water is present, forming a waterproof barrier; or else certain earth, above all of *volcanic* origin, which has pozzuolanic properties.

Products of animal origin are usually devoted to the stabilizing of plaster and sheating. Some of the traditional ones are:

3 Solid animal dung which has little effect, if any, with respect to waterproofing, and whose activity is entrusted to the presence of fibres (finely cut straw), phosphoric acid and potassium. At the same time, *animal urine*, utilized instead of water in the mixture, effectively does away with fissuring and increases the earth's erosion strength, above all if used together with lime;

3 *fibres or animal hair*, mainly for the stabilizing of plaster;

3 *animal glue* is obtained from horns, sections of bone, hooves, hide, ...

3 *oils and fats* which may act as waterproofing agents.

The products of vegetable origin are:

- *Vegetable oils and fats* (coconut, cotton, flax, …) which, in order to be effective, are to manifest hardening in contact with air and not be water soluble;
- *wood ashes* and wet or polyphenol acids, derived from lignin, which form hard and stable compounds;
- *sap and latices*, such as banana leaf decoctions, which, precipitated with lime, improve erosion strength and slow down water absorption. Latices mix well with acid earth (when coagulation takes place), but, better still, with basic earth;
- in the 1980s what was widely experimented and extensively used in Peru was "***goma o mucilago de tuna***", a prickly pear (Opuntia ficus indica) based stabilizing agent – traditionally used in earth building and utilized for the restoration of the grand ruins of Chan Chan (the Tschudi complex) in the 1960s – sulphuric acid extracts (complex polysaccharide) contained in the plant's leaf texture, not water soluble but capable of absorbing and retaining the water and which, coming into contact with the latter, form a viscous/colloidal solution. This gel manifests conglomerating properties (if it is blended into the mixture) and protective ones (if used on the surface); furthermore, it manifests an inhibiting action concerning various bacteria, preventing their proliferation.

  A report, which was presented at the 1990 6th International Congress that concerned plain earth building and the Chan Chan restoration works, advises: 350 gr of leaf pulp left to soak in 0.5 l of water for 24 hours; the obtained substance is to be diluted in water, 5-10%; utilization is to take place within the subsequent 48 hours as from the initial preparation; when this space of time elapses, the cells begin undergoing a rapid decomposition process which reduces viscosity to 85%.

Earthquake-resistant earth-building technologies

Economy and the ease of self-manufacturing of the *adobe* (apart from the other several benefits which have already been taken into consideration) add on to the extremely widespread situation of this material, especially in connection to the not so affluent classes in Peru today.
However, one of the main shortcomings which the material carries is the *scarse capability of resisting to earthquakes*, because of its low tensile strength.
In the past years this has seen the development of a great deal of research which has brought up the suggestion of a *new earthquake-proof building technology* (which is inspired by the excellent performance of *quincha* historical building and which suggests the inner brandering of walls in *adobe* with rush matting).
Besides the quality of the material used, a basic role in the seismic strength of building lies with the undertaken building stratagems capable of guaranteeing the *total connecting* of all building parts and, hence, the capability of achieving an aggregate solution of the concerned structure. The following are a number of points which consider the best way to **"make adobe"** in a country prone to earthquakes.

PREPARATION:
- ✰ First, *which earth?* Dark and agricultural earth is to be avoided since it contains an excessive amount of organic substances; in the same way, the mixture is not to contain stones, sullage, or vegetable residues;
- ✰ an *adequate mixture* for producing **adobe** is made up of: clay, sand and straw (or horsehair, rush fragments, dung, etc.) which is normally added with the proportion 1:3 or 1:5 in volume with respect to the basic mixture, and broken down into 5 – 10 cm long fibres. These components are amalgamated with the addition of an adequate amount of water which guarantees the right malleability without causing any shrinkage problems in the course of the drying process.
  As far as ***adobe*** is concerned**,** the most adequate mixture carries the followinf percentages: Sand – 55-75%, Silt – 0-28%, Clay – 15-18%.
  The earth is then to be sifted through a grid (with a 10 mm mesh) and then mixed with water (the proportions: 1/3 water, 2/3 earth).
  In preparing **tapial** the advisable amounts come under the following proportions: Gravel – 0-15%, Sand – 40-50%, Silt – 0-35%, Clay – 15-25%;
- ✰ the mixture is then left to stand for at least a day or two;
- ✰ the mould is soaked in water before being used and subsequently sprinkled with sand to stop earth from clinging to its sides;
- ✰ once the block is ready, it is to be left to dry away from sunlight (in order to avoid an excessively rapid drying process which favours fissuring).

CHOOSING THE SITE:
- ✰ A correct building position is basic, neither too close to rivers, the sea or marshes, nor on too sloping land or immediately next to the latter, and not even in lowlands – easily floodable;
- ✰ in the same way backfilling or age-old dumping land is to be avoided;

- ✰ an optimum location is on dry and solid land, slightly at a higher level with respect to its surroundings.

BUILDING DETAILS:

- ✰ The foundations are to rest on solid land; it is thus necessary to carry out excavations until a stable land is reached and, anyhow, to a depth of at least 40 cm;
- ✰ the thickness of the excavations are to be at least 1½ times as much as the thickness of the wall;
- ✰ the foundations are to preferably be in plain concrete with considerably large stones and, with this purpose in mind, the following is to be utilized: 1 part of cement, 4 of sand, 6 of pebbles/cobblestones and 10 of large stones, plus water. As an alternative, lime may be used instead of cement, or, as a last resource, large stones blended in with the earth itself, it being understood that the thickness of the foundations is at least double the thickness of the wall and that the depth is not less than 60 cm;
- ✰ in order to protect the base of the building structure against the erosive characteristics of rainwater (direct or bounced back), superfoundations, of the same type of the foundations, but with medium-sized stones, are to be carried out – with a minimum height of 25 cm. In the case of "tapial", in order to optimize the anchorage between two successive cast blocks, with a shovel or a similar tool what can be created is a "*slight hollow*" over the sloping surface of the already realized block onto which the new one will lean in such a way that the latter may act as a "joint".
- ✰ Still regarding tapial, but also adobe building, it is appropriate to **incorporate rush matting,** lain vertically and horizontally, in the walls. The base of the vertical rushes, which is to be submerged in the foundations, features nails jutting out in every direction, (or iron wire knotted to the open tips) which carry out the function of *anchoring elements* to allow for setting in the cast (an alternative is the fixing of the base of the said vertical rushes to a horizontal rush, in turn fixed to the lower mould, which is submerged in the cast). It is appropriate not to congest the walls with these reinforcing elements which might constitute weak points in the structure and which, hence, it is appropriate to space out (at about every 40 cm for the vertical rushes and every 4 courses of adobe for the horizontal ones). Several experiments showed greater strength (about 40% more) and greater ductility (collapse strain 3 times as much) of *tapial* building with respect to *adobe*. In the case of reinforced *tapial* (with 1' horizontal and 1.5' vertical rush brandering, every 40 cm) experiments carried out at PCUPof Lima have shown a shearing strength of about a maximum of 16 tons, in comparison with the 12 tons of *adobe*, and a side collapse displacements of 60 mm, in comparison with the 34 mm of adobe
- ✰ once the superfoundations have been realized, the upper surface of the dried up cast is *scratched* with a nail in order to roughen the surface and, hence, to improve its grip with the upper layer of mortar;
- ✰ the mortar is to be of the same mixture utilized for the making up of *adobe*, and is likewise to stand for 1 or 2 days;
- ✰ in order to avoid a rapid drying process of the mortar, it is advisable to wet adobe before laying – joints are to be of 2 cm;
- ✰ the subsequent linking of the blocks and the masonry apparatus follow the customary rules of the structural work with a displacement of the vertical joints, controlling of the lining up of the wall, an arrangement of adequate lintels over the clefts – the only

advice here is to erect a maximum of 1 metre of wall per day, in order to avoid buckling of the newly realized masonry under its own weight;

- ✰ every 4 horizontal rows, *horizontal brandering* is arranged, utilizing rushes as from half of their thickness;
- ✰ the rushes are to be tightly fixed one to the other and to the *vertical brandering* rushes;
- ✰ at almost the top of the walls, it is basic to have every element come into play and to be sure of a perfect terminal connection of all the walls, placing an *upper connecting element* which may be a wooden beam, concrete casting, an electrowelded mesh, to which, in turn, all the vertical terminations of the rushes of the masonry brandering are fixed;
- ✰ laying is carried on with a number of further rows of adobe which may also help to set the possible gradient of the roofing;
- ✰ the realization of the roof may be carried out with different technologies; in the case of a roof still based on the fundamental materials used, rushes and earth, connecting transversal beams are arranged between two facing walls at a distance of about 60 cm, and jutting out beyond the masonry line at another 60 cm (in order to guarantee a good protection of the latter). What is next placed, in a perpendicular direction, are the rushes, side by side and linked to one another by wooden strips, arranged above, which are nailed at an interval of so many rushes. Next comes a laying of 3 cm thick earth which is to be superimposed by a protecting element (roof tiles, corrugated sheet iron, terracotta tiles, etc. …);
- ✰ next to be carried out is the plastering of the wall which may be realized with a mixture, still of earth or of other substances, with greater waterproofing features. The mixture adheres better to the wall if a *nailed iron wire framework* – which acts as an anchoring element – is arranged beforehand. The plastering is to take place in two subsequent layers.

GENERAL ADVICES

- ✰ The *symmetry* and the simple system of the building structure make up an excellent solution to guarantee a uniform performance of the structure itself, with no risk of bringing about dangerous torsional stress in case of earthquakes;
- ✰ the extension of a clear wall, in between two transversal walls, is not to be greater than 10 times its thickness. If greater lengths are needed, the wall is to be reinforced by means of an intermediate vertical buttress;
- ✰ the maximum height of the wall is not to be greater than 8 times its thickness;
- ✰ the breadth of a cleft is not to be greater than 1.20 m; the same measurement is to be made sure of as the distance between the cleft itself and the end of the wall; in such a way, the total of the cleft widths in the same wall is not to be greater than the proportion of 1/3 of the extension of the masonry itself;
- ✰ the supporting base of an isolated lintel is to be at least 50 cm;
- ✰ a fundamental aspect is the ultimate arranging of an upper connecting element (a *crowning beam*, or ‘correa’), and a minimum of 2 more rows of *adobe* to follow;
- ✰ in order to uniformly mete out the roof load, or the load of a floor, it is advisable to position a *distributing element* (a stone or a piece of wood) below the bearing point of a main lintel;
- ✰ the roof pitching is to be appropriately jutting out to shelter the walls from severe weather conditions.

Concluding remarks

Earth has always been an effective and widespread building material made available by nature at all times. Man has been capable of wisely using it to his advantage, by way of ingenious shapes and enchanting architectural structures. Earth has won the interest of various cultures that have learnt to make good use of its appeal and versatility to create newer and more amazing structures.

Earth, as a material, has inexhaustible resources and pursues an inevitable and *alternating process of denial and repossession* on behalf of man who constanly forgets all about it only to discover its worth once again with a different attitude and with renewed interest.

The real solution of this seesaw behaviour lies, as always, in the very middle – without going to extremes: one is not to make a clean sweep of traditions for love of modernism, pursued at all costs, and not even to ossify oneself by adopting an uninspired and dogmatic recovery of the said traditions. In order to survive and be immortalized in times afar reasonably and effectively, one is to carry out the task of careful reappraisal of this architectural world – *particularly of the technological details it is characterized by* – in order to have it, by means of profound reinterpretation and modifications, adapt itself to the needs of present day society, sunk, as it is, in its unavoidable modernity.

What lies ahead of us is a process split into phases. This process is sometimes against the general trend, yet, it is definitely unpredictable and somewhat challenging.

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