Mortars used in ancient buildings

- Clay mortar
  - Essential clays
  - Secondary clays
- Gypsum mortar
- Lime mortar

Clay mortar

This is the most common type of mortar used in the ancient periods, it is formed from different kind of clay minerals and used for building purpose at all periods, and composed from

- silicon dioxide $Si\ O_2$
- Aluminum oxide $Al_2\ O_3$

With some of accessory components as Iron, Alkali metals, Alkali earth metals and varying quantities of water.

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All of these materials come in the form of very small crystalline particles, less than 2 - 4 micron

This mortar essentially based on the same mix as the brick, but in its "*muddy*" state, after drying, it can be difficult to distinguish between mortar bed, brick and

some adobe aesthetics exploit this 'seamless' appearance to create a monolithic effect.

Preparing and using ***Mud*** as a mortar

Lime mortar

This mortar used for lime renderings and consists of calcium hydroxide which produces $CaCo_3$ when carbonated, in general terms building lime are defined as binders which main constituents are:

- Calcium oxide $Ca\ O$ and Calcium hydroxide, $Ca(OH)_2$.
- Magnesium oxide $Mg\ O$ and Magnesium hydroxide, $Mg\ (OH)2$
- Silica $Si\ O_2$
- Iron oxide $Fe_2\ O_3$
- Alumina $Al_2\ O_3$

Also, we can see that the building limes can be classified into 2 groups

- **Air Lime** → fundamentally by calcium oxide (unslaked lime) and /or hydroxide (slaked lime)
- **Hydraulic Lime** → this type consists predominantly of Calcium silicates, Calcium aluminates and Calcium hydroxide

Here, we can decide that the main difference between 2 types resides that the first case the addition of water has only objective of facilitating the mixture of

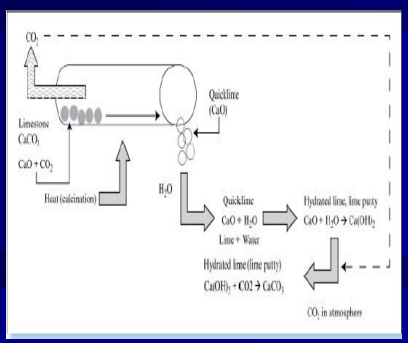
the components and placing the mortar , but it dos not intervene in any chemical reaction.

Also, we can see that the process of hardening of the mortar carried out with air lime tacks place for the reaction $Ca(OH)_2$ with the atmospheric CO_2 producing $CaCO_3$, this product provides to the lime mortar its physical and mechanical.

$$Ca\,CO_3 \xrightarrow[\text{heat}]{\text{“820-1200 C°”}} Ca\,O + CO_2$$

Calcite → *Calcium oxide* + *Carbon dioxide*

Limestone is dissociated under the action of heat releasing carbon dioxide and producing quicklime according to ed on the next equation.



Preparing and using ***Calcite*** as a mortar

Gypsum mortar

It is widely used in many places as a along eras in particular dried area as Egypt and Middle East either as a simple mortar, plaster or for rendering.

From scientific point of view we can decide that it is composed of $CaSo_4 .2H_2O$ and used in certain anhydrous or hydrated forms, and it is act as a simple mortar without adding any other inert substances.

Gypsum mortar

There are 2 main naturally occurring forms of Gypsum:

- Selenite → composed of Calcium dehydrate (Ca So4. 2H2O)
- Anhydrite → composed of Calcium dehydrate (Ca So4)

Artificially prepare modification of *Gypsum*

By heating ***Gypsum*** minerals on, different forms can be obtained according to the temperature and duration of heating and reducing or eliminating the water of crystallization, after finishing the manufacture steps we can produce different types of plaster by calcination of gypsum (CaSO4 2H2O), which partially dehydrates to produce a hemi-hydrate (CaSO4 ½H2O).

Several processes are available to calcinate gypsum into plaster of Paris as fallow:

$$\underset{\text{Gypsum}}{Ca\,SO_4\,2H_2O} + \xrightarrow[\text{heat}]{\text{“135-175 C°”}} \underset{\text{Plaster of Paris}}{Ca\,SO_4\,½H_2O} + ½H_2O$$

1st Calcination under atmospheric pressure ⟶ Beta plaster

2nd Calcination under elevated pressure ⟶ Alpha plaster

Preparing and using ***Gypsum*** as a mortar