TRADITIONAL LIME TECHNIQUES AND PRACTICES

North India
1. Process starts immediately after calcination due to high reactivity of lime
2. Method Transportation and weather considerations
3. Storage in dry rooms in air tight bags
Lime slaking techniques

1. Tank slaking
2. Careful process
3. Exothermic reaction
4. Quick lime is mixed with batches
5. Lime is added to water
6. Mixing during slaking
7. Enough supply of water
8. Care and precautions are required—protection of eye and skin
Lime slaking techniques

1. Sieving after slaking- resultant milk is allowed to flow through 3.35 mm IS sieve into the lower tank
2. Removing under burnt and over burnt lime stone
3. Storing lime putty in tanks for months, as per requirement
4. Months old lime putty for finishing works
5. A layer of water over the lime
Lime slaking techniques in Rajasthan

1. Minimum of six months slaking period
2. Slaking with Jaggery in raw form
3. Adding salt during slaking
4. Change of water everyday
5. Adding Chach (butter milk) to the lime every alternate day
Lime slaking techniques
Lime slaking requirements

Quick lime storage area

Slaking tanks and lime putty storage tanks
   \textit{Size as per work requirement}

Mixing platforms
   \textit{Size as per work requirement}

Lime mortar storage tanks- \textit{direct protection from sun}

Shades- \textit{direct protection from sun}

Water supply
LIME MORTAR

Aggregates

1. Generally comprised of 65% of the volume
2. Several variations in ancient mortars
3. They act as filler
4. Reducing the amount of lime needed and thereby reducing drying shrinkage cracks
5. Gives a natural colour/texture to the mortar.
6. Most important for analysis for ancient mortars

- River sand is the most common aggregates
- Pure quartz for finishing works
- Marble powder for finishing layers
- Red stone powders for matching colors
LIME MORTAR

Aggregates

- Stone aggregates
- Brick aggregates (jeera)
LIME MORTAR

Aggregates

Requirements for Aggregates

Well graded

<table>
<thead>
<tr>
<th>Unsuitable for mortar</th>
<th>Suitable for mortar</th>
<th>Unsuitable for mortar</th>
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<tbody>
<tr>
<td>very well sorted</td>
<td>well sorted</td>
<td>moderately sorted</td>
</tr>
<tr>
<td>poorly sorted</td>
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The image shows a chart with categories of aggregates and their suitability for mortar, ranging from very well sorted to poorly sorted.
LIME MORTAR

Aggregates

Requirements for Aggregates

Sharp (angular)
LIME MORTAR

Pozzolana

Surkhi

1. Color is the representation of the quality of Surkhi

2. Dark red color – Burning temperature as required for conservation works

3. Yellow color- Represents poorly burnt bricks with less reactive silicates and aluminates

4. It should be free from organic additives such as grass, coal, ash etc.
LIME MORTAR

Organic additives

1. To improve the properties of mortars both in fresh as well as hardened state
2. Improving workability/plasticity
3. Providing initial and long term setting
4. Adding insecticide properties
5. Improving finishing in case of special works
6. Adding water proofing properties
7. Regional variations
Jute fibers and animal hairs

1. Reduce shrinkage in lime works
2. 25 mm to 100 mm long
3. Added just before its use while *knocking up* the lime mortar.
4. never added in advance as these are weakened by prolonged contact with water and un-slaked lime.

Jaggery

1. Used in dry form as well as wet form
2. Add to lime mortar to improve water proofing properties
3. It makes the colors of the mortar little darker
4. In Rajasthan, it is added during the lime slaking
Pulses

1. Urad Dal (Split Black gram) lentil which is used for the lime concreting finishing works to improve the workability of the lime mortar.
2. Urad dal is grinded to a powder and then soaked with water one night before its use.
3. The paste is then mixed with the lime mortar in specified proportions.

Milk and milk products

1. Used in several forms such as buttermilk, curd and skimmed milk.
2. Improve the binding and water proofing properties.
3. Used for decorative and polished works.
4. Casein protein which is the chief ingredient of the milk forms calcium
Egg white

1. Egg white is churned with water for some time and then removed.
2. The left over clean egg water is added with lime putty for the final layer plastering works.

Fenugreek Seeds

1. Improve the workability of the lime mortars for the decorative works
2. Seeds are grounded to make a powder and soak in water overnight
3. Mashed and sieved to remove fibers and other particles. The sieved water is mixed with lime mortar to add stickiness required for the profile plaster works.

Fruit pulp

1. The pulp of *belgiri* fruit
2. The fruit is dried in sunlight
3. Soaked in water over night and then properly meshed to separate the pulp of the fruit
A buffalo pulls the stone wheel around the trench of a *gharat* in the centre, the masons' names are included (top right), Dundlod (1888)
LIME MORTAR

Mixing techniques

Lime chakki

Stone grinding lime mortar
LIME MORTAR

Mixing techniques- historical references

One of the labour is weighing the mortar and lime for checking the proportion of mix.

Source: Akbar- the Aesthete
Painting illustrated in Akbarnama depicts the construction of fort at Agra
LIME MORTAR
Mixing techniques - historical references

Source: Akbar- the Aesthete
Painting illustrated in Akbarnama depicts the construction of Fatehpur Sikri
LIME MORTAR
Mixing techniques- current practices

Lime chakki
LIME MORTAR
Traditional mixing techniques

1. Lime chakki is the most suitable way of preparing lime mortar

2. Thoroughly compressed or beaten

3. Action mobilizes the lime putty and spread over the surface of each grain

4. Storing lime mortar for long time under a layer of water
The techniques of preparing lime mortar are developed based on following three requirements:

1. Filling the voids in between the sand grains with lime would develop the dense lime mortar fabric
2. Covering the sand particles surfaces with lime putty which developed well interlinked lime mortar profile
3. Reducing the particle size of lime putty by compressing over each which improves the plasticity and workability of the lime mortar
LIME MORTAR
Traditional mixing techniques

1. Quantity of water
2. Consistency of lime putty
3. Gradual mixing
4. Workability with thorough mixing

5. Hand mixing is suitable when brick aggregates are used in lime mortar
LIME MORTAR

Traditional mixing techniques

1. Lime mortar is taken out before use
2. Ramming, beating, chopping, and cutting
3. Water is not added
4. Mixing organic additives just before use
5. Mixing surkhi before its use if required
1. Lime plastering is a porous layer of lime based mortars
2. Due to porosity of the lime mortar fabric, this layer acts as a sacrificial layer which provides a surface for accumulation of the salt components of the moisture which is trapped within the historic masonry.
3. Salt contents get deposited over the plaster surface during the evaporation process and therefore protect the chief building fabric
LIME PLASTERING

Number of Layers
Single coat
Double coats
Three coats

Type of masonry

Type of finishing

Type of form in case of stucco works

Work in layers allow each particle to carbonate
PLASTERING LAYERS AND TEXTURES
PLASTERING LAYERS AND TEXTURES
Surface preparations

Coarse base
to provide keys in between different layers

Brushing
Cleaning
Algae, loose particles, dust etc

Curing
The surface should be wet before applying the plaster layer. In case of dry surface, porous materials may absorb the water from the lime mortar leading to early drying of fresh lime mortar and in result affecting the initial carbonation and hydraulic setting
LIME PLASTERING

First layer- coarse aggregates- Rough
Allowed to carbonate
Second layer with finer aggregates
Soft ramming for shrinkage cracks
Final layer
Hydraulic mortars for base coats
LIME PLASTER FINISHING LAYERS

Matured lime putty, burnt clay, find sand and organic additives grinded together on stone grinder
LIME PLASTERING

Wooden tools finishing
No use of steel tools for finishing
Spray curing
Tools for different types and sizes for different kinds of works
LIME CONCRETING

Terracing
Flooring
Coping
Forms
Base
works
LIME CONCRETING

1. Lime mortar- Lime putty and sand
2. Brick aggregates of different sizes (1/8 inch to ½ inches)
3. Aggregates
4. Jute fibers
5. Urad Dal powder
LIIME CONCRETING

1. Laying
2. Ramming/ compaction ( around 1 week)
3. Beating ( approximately 3 weeks)
4. Finishing with belgiri and Jaggery
5. Sound check
Lime
Araish