STONEWARE STUDIOS

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Sand Selection and Mortar Mixing

Selecting a Sand

Sand and larger sized aggregate makes up the larger proportion of most mortars. Colour, texture and overall strength are all strongly affected by the choice of aggregate. The aggregates most commonly used with hydraulic lime are sand and grit, although for the purpose of matching historic mortars various impurities may also be added. A good sand should be a washed and sharp (with angular grains to ensure good bonding qualities). Soft building sands should be avoided as their rounded grain shape can result in excessive shrinkage. Sands used should be well graded with a range of grain sizes, which for most plaster, render and mortar work will range from 5mm down to 75 micron. Larger sized aggregates may be used in some mortar or pointing work. As a rule of thumb for pointing, the maximum size of aggregate should be no bigger than one third of the joint width.

Sands that contain clay or silt content of 4% or more should be avoided, as these will inhibit the contact between lime binder and aggregate. Poor workability of some sharp sands can be avoided by blending 2 or more sands together to give a better distribution of varying sized grains.

Sands which have a high fines content also be avoided as the larger surface area of these will require more water to be used in the mixing. This higher water content will induce shrinkage and can affect flexural and compressive strengths. Monogranular sands should be avoided as they will possess poor workability qualities and will inhibit good vapour exchange i.e. the ability to breath.

Typical sand Grading

General mortar work % retained on sieve		Plastering backing coats % retained on sieve		Smooth plaster finishes % retained on sieve	
5.00mm	5%	5.00mm	0%	5.00mm	0%
2.36mm	8%	2.36mm	6%	2.36mm	0%
1.18mm	16%	1.18mm	22%	1.18mm	8%
600 micron	25%	600 micron	33%	600 micron	10%
300micron	31%	300micron	31%	300micron	32%
150micron	12%	150micron	20%	150micron	32%
<150micron	3%	<150micron	11%	<150micron	18%

Sand Void Percentage

Once you have identified a good local sand, it is worthwhile to establish its void percentage. Knowing the voids in the sand tells how much binder is required in order to fill the voids. Insufficient binder to fill the voids will weaken the material and make it vulnerable to frost damage.

The procedure is simple:

1. Take a container of known volume (a two litre jug or jar is ideal) and fill it level to the top with the selected sand.

2. Remove the sand and dry it completely in an oven on a tray.

3. Replace it in the container to a level top.

4. Take a measured jug of water and gradually add the water until bubbles stop rising and the water has saturated the sand.

5. The void ratio is then:

$$\frac{\text{volume of water added}}{\text{volume of sand}} \times 100$$

Say for example the answer is 30%.

Then a mix ratio of 1 part lime to 3 parts sand (by volume) will fill the voids.

Mixing your Mortar

A conventional cement mixer can be used, although for larger projects a roller-pan or paddle-mixer is preferable. Lime mortars mixed in drum mixers are prone to balling. However, the following mixing procedure can reduce this problem. It is vital to ensure that when measuring materials this is done by

volume. A gauging box or bucket will be necessary for this task. Measuring by shovel is not acceptable since quantities will be inconsistent:

Start with an empty mixer.
Add 1 part sand
Followed by 1 part lime
Followed by 2 parts sand
Mix dry for at least 5 minutes
After 5 minutes slowly add water until the desired consistency is reached, it is very important not to drown the mix by adding too much water.
Once the desired consistency is reached mix for a further 20 minutes

(The above example is based on a mix ratio of 1:3).

The mix, to begin with, will appear dry but as mixing time increases the mortar will become much 'fattier'. If too much water is added the risk of shrinkage will increase and the final strength reduced. Do not use any plasticisers.

Water Content

The addition of water should be considered carefully, as it will directly affect the ultimate strength and durability of a mortar. The more water introduced into the mortar mix, the weaker will be the final result. However too little water will prevent the chemical processes taking place and weaken the material. Generally, water should be added sparingly, until a useable consistency is achieved.

The masonry background may also affect mortar strength. Dry backgrounds can quickly 'suck' moisture from newly applied mortar. This should be controlled by dampening down the background prior to mortar application.

Storage of Lime & Aggregate

Roundtower Natural Hydraulic Limes are supplied in water-resistant paper bags. If the bags are allowed to get wet they may be irreversibly damaged. Also, once opened the exposure to air will start to weaken the hydraulic set. As a result any opened part bags left at the end of the day should be carefully folded over at the top and put into a dry store. In this state the lime will remain useable for a further 2 or 3 days. Thereafter it should be discarded.

Aggregate should also be covered since if left exposed fines can be washed out and the material as a whole can gradually separate.