



HYDRAULIC LIME RENDERS AND PLASTERS

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IMPORTANT NOTICE

Singleton Birch cannot accept any liability for incorrect use or application of Hydraulic Lincolnshire Lime. Recommended 'best practice' should be followed at all times.

If in doubt, please call us on Tel: 01652 686000 for advice or assistance.

GRADES OF HYDRAULIC LIME & NON HYDRAULIC LIME FOR BUILDING WORKS

BSEN 459 PART 1, gives details and performance standards for the grades of building limes in use within the EU and can be summarised as follows:

1. CL90 – Non Hydraulic Lime
2. Natural Hydraulic Lime (NHL) 2
3. Natural Hydraulic Lime (NHL) 3-5
4. Natural Hydraulic Lime (NHL) 5
5. Hydraulic Lime (HL) – the regulations allow this grade to include cement
6. Natural Hydraulic Lime (Z) – this grade will have added pozzolan

The grading of the hydraulic limes refers to their strength therefore NHL 2 is the weakest and NHL 5 the strongest.

Strength and frost resistance can also be varied by altering the mix ratio, typically the ratios will range between 1 lime : 1.5 Sand to 1 lime : 3 Sand (by volume) Generally exterior hydraulic lime renders will be 1 lime : 2 Sand . Interior work, if hydraulic lime is specified, can be weakened to 1 lime : 3 sand.

Those requiring further information not contained in the remainder of this Best Practice Guide should:

- a) Contact Singleton Birch for technical advice and assistance
 - b) Refer to the following books
1. 'Building with lime' by Stafford Holmes and Michael Wingate ISBN 1 85339547/1 Revised 2001. Published by Intermediate Technology.

2. Hydraulic Lime for Mortar for Stone Brick and Block Masonry. Published by Donhead ISBN 1873394640.

In 1998 UK Government funded research into hydraulic limes began at the University of Bristol resulting in the publication of the second book listed above in 2003. To date this book remains the definitive reference to the performance of most hydraulic limes.

GENERAL PRINCIPLES FOR PREPARATION OF SUCCESSFUL HYDRAULIC LIME RENDERS

To obtain the best performance from lime mixes it is essential that the correct sand and lime to water ratios are used. This will include assessment of the masonry units. For local building works when the same sands, stone or bricks are repeatedly encountered this should only take a few minutes. The factors which affect the strength of a mix are:

1. The type of sand. Soft sands with fine circular grains make weak mixes. Sharp sands with angular particles including some 3 –4mm grit produce the strongest mixes.
2. The water content. Too much water will decrease the mixes strength by holding the grains apart thus leaving an open structure when dry .This effect can be dramatic.
3. The amount of binder. Generally the purpose of the binder is to hold the sand particles together and to fill the voids between the grains of sand.
4. The type of binder. The strongest binders are those using Portland cement. The weakest are those made from high calcium lime. In between are the hydraulic limes categorised into three groups: HL2: HL3.5: HL5 - prefixing the category with N (i.e. NHL2 or NHL3.5) indicates a natural hydraulic lime with no additives.

Storage of Lime & Aggregate

Our Hydraulic Lime is supplied in 25kg paper bags which must not be allowed to become wet. 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. For larger orders the individual bags will be supplied with 40 on a pallet.

Aggregate should also be covered since if left exposed fines can be washed out and the material as a whole can gradually separate. The result will be to make the aggregate less well graded and this may impair durability of the mortar. Covering the aggregate will also stabilise the water content and make mixing more consistent.

Aggregate

There are many poor quality sands on the market. In most cases for good quality lime work, these soft fine sands, frequently containing clay, are not acceptable. Clean sharp, well graded sand should be specified. A good supplier should be able to provide a sieve analysis against which the sample sieve analysis provided (see the Fact Sheet Sharp Sand download) can be compared.

Sand Void Percentage

If you find a good local sand which you may use repeatedly, establishing a void percentage is a very worthwhile exercise. Working with unknown materials is not a good idea. Knowing the voids in the sand tells the user 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 to find the void percentage is as follows:

1. Take a container of known volume (a one or 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:

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

say for example the answer is 30%

Then a 1 lime to 3 sand (by volume) will fill the voids

In general the type of sands suitable for lime work will have a void ratio in excess of 30% probably 35-40%. Therefore our general advice is to use a mix ratio of 1:2 or 1:2½ in order to ensure adequate frost resistance.

Water Content of Masonry Units

The more water remaining in the render the weaker will be the final result. However too little water will also prevent necessary chemical processes taking place and weaken the material. The water absorption of masonry units with which the render is being used has a considerable bearing upon the final strength by altering the amount of water left in mortar.

Bricklayers and masons will normally add sufficient water to obtain adequate workability. However if the tradesmen are not used to mortars with sharp sands it is possible that too much water may be added.

IT IS STRONGLY RECOMMENDED that either:

Manufacturers absorption figures are obtained for the masonry or ~. The following test is carried out:

- a) the brick/stone is oven dried and weighed
- b) the brick/stone is then placed in bucket of water for 2 hours and then re-weighed

Water percentage in the masonry can then be established. Optimum strength is likely to be achieved with a final mortar water content of around 15% by mass after suction of water by the masonry using a typical sharp sand with 36% voids.

TECHNIQUES FOR EXTERNAL RENDER

Selection of Aggregate and Mix Ratio

The finer the aggregate particles the less porous will be the render. A balance' must be struck when selecting the aggregate between protection of the underlying masonry and providing for adequate evaporation of moisture. Annual weather conditions on site will have a bearing on the best aggregate and mixes. The standard mix for a render should be 1 lime to 2 sand by volume. It is important to follow the advice concerning mixing given in the above section.

Generally for render, a washed sharp well graded sand containing a proportion of 3-4mm grit will prove most satisfactory. If the level of fines is too high porosity of the render will be reduced and durability impaired. However shortage of fines will dramatically reduce workability and it may be necessary, if this happens, to add a little fine sand. Clay content in aggregate can cause shrinkage and will impair durability. Sands with over 1% or 2% clay should be avoided. In addition fine soft sands should also be avoided although the addition of a small proportion of fine sand for the final coat may improve the finish and workability. For an example sieve analysis of suitable sand see the Fact Sheet Sharp Sand download.

Assessing the Site

The location and layout of the site will have a bearing on several factors regarding the application of hydraulic lime. The main considerations are:

1. Exposure to drying winds
2. Height of the site above sea level -the higher it is the lower the temperatures likely to be encountered.
3. Some elevations will be more exposed to wind and sun and therefore prone to rapid drying. If possible leave south facing elevations for cloudy days.

Running water must be available to all parts of the site especially those elevations likely to need damping down. Adequate length of hoses and on site availability of covers will ensure work can be completed successfully and with the minimum of fuss.

Surface Preparation

Whether the render is onto new work or restoration, surface preparation is vital for a successful job.

The main points to ensure are:

1. A good keying surface for the render
2. Removal of loose material
3. A moist surface to prevent rapid suction of water from the render.

The first two should be tackled in the same way as any render but point 3. requires special attention. Some masonry, especially block work and porous bricks, can suck water from the render very rapidly; it is essential to prevent this by adequate damping down -without saturating the wall.

Mixing Technique

A conventional cement mixer can be used although for larger projects a roll pan or paddle mixer is preferable. These are becoming more readily available on the market with the renewed interest in lime products. Measuring of material must always be with a gauging box or bucket. A shovel is not acceptable since quantities are too inconsistent.

Lime mortars mixed in drum mixers can be prone to balling but use of particular mixing techniques can reduce this. It is therefore recommended that a small quantity of water is put into the mixer while not rotating and then the appropriate quantity of lime added. When the mixer is switched on the lime should be turned into a wet slurry. The sand is added to the slurry with more water and mixed for not less than 15-20 minutes. Do not overfill the mixer as this will prevent proper mixing.

The mix, to begin with, should appear rather dry but as mixing time increases the mortar will become much 'fattier'. At the end of 20 minutes the final water can be added to obtain the correct workability (if required). If too much water is added the risk of shrinkage will increase and the final strength will be reduced

Use of Air Entrainment Agent

Use of air entrainment agents is not recommended.

Addition of Hair or Fibreglass to Renders

Addition of natural hair or fibreglass will improve the strength and durability of the render. It can be added to our Hydraulic Lime based renders during mixing in accordance with accepted practice.

PREVENTION OF SHRINKAGE

Shrinkage 'cracking' is a risk with all renders. However on cement renders cracking will allow water behind the render with little ability for it to evaporate out. Lime renders are designed to breath and therefore small shrinkage cracks in the scratch coat will be filled in subsequent coats. Nevertheless excessive cracking should not be accepted since it may be an indication of early failure. The causes of shrinkage cracking are:

1. Too much water in the mix forces particles of sand and lime apart.
2. Excessive suction from substrate caused by lack of damping down prior to applying render.
3. Rapid drying caused by strong sun or drying winds.

If items 2 and 3 are assessed as the cause of shrinkage consideration should be given as to whether the setting process has been stopped due to lack of water. If only a few days have elapsed then spraying may encourage the set to continue.

Application

If there are large voids in the wall these should be filled first to within not less than 10mm of the wall surface. This is called "dubbing out".

After damping the surface (on very porous walls several applications of water in the hour or two before render is applied may be required) render can be laid on using the normal technique. The first coat (scratch coat) will normally require two skins of around 6mm each in rapid succession. The first coat should be left to stiffen up and then a float used to compress the render over the whole area. Beginning the second pass too early (i.e. before the material has stiffened) can weaken the render by squeezing fines of sand and lime to the surface. The result may be voids deep in the render which make the render vulnerable to frost damage. Finally within an hour or two the surface is then scratched over using a suitable comb.

Once the first coat has hardened enough a similar technique is used for the second. The time interval between the two will vary depending upon the temperature as little as 24 hours in warm conditions but several days if cool. A fine spray of water should be applied beforehand. If a third coat is required proceed as above. If a fine surface is required for the last coat a finer sharp sand may be used and 'floated up' as the surface stiffens, in a similar way to the previous coats.

The company does not recommend rendering in hydraulic lime at temperatures below 5°C due to the risk of frost damage. Render must be used within two hours.

After Care

The render must be kept moist for several days after application of the final coat. Water will tend to drain down from the top of the work and therefore particular attention must be given to spraying the upper sections. Remember water is essential for the hydraulic set. It is important while maintaining the moisture to prevent rapid drying from wind and bright sunlight. Covering the work with damp Hessian is the best procedure.

If there is a risk of frost Hessian covers or bubble wrap should be used. However a circulation of air must be maintained between the cover and the render. Do not use anti-freeze additives. During daylight hours if warming winter sun is available, covers should be lifted to allow heat to be absorbed and then replaced during late afternoon. Even under these conditions a circulation of air is advisable between covers and masonry.

ADDITIONAL TECHNIQUES FOR INTERIOR PLASTERING

Techniques for interior plastering using Hydraulic Limes are the same as for exterior work with the following exceptions:

1. For base coats a sharp sand is still recommended. Finer sands can be used depending upon final finish required. Use of finer aggregates will reduce the permeability of the plaster and therefore if dampness in the masonry is a problem careful consideration should be given to choice of sand. Interior plastering is the only occasion when a fine sand needs to be used in order to obtain a smooth surface. This is achieved by allowing the final coat to stiffen up and then polished up with a wood float frequently wetted in a bucket of water.
2. The upper sections of plaster will dry very much quicker than the bottom metre. It is important that these upper sections should be kept damp in the first few days so that there is no apparent difference in colour, due to drying. In normal ambient temperatures over 12°C this practice should be maintained for three days on each fresh coat.
3. The plaster will generally carbonate, after the initial hydraulic set, at the rate of approximately 3mm per month. During this period it is not advisable to decorate the surface especially with paints that do not breathe. A good air flow in the room will help to speed this carbonation process. Heating rooms will not speed up the process, indeed it may damage the final result by causing too rapid drying. This may stop the setting process and possibly increase the risk of plaster shrinkage cracking.

PAINTING OF RENDERS AND PLASTERS

With lime renders and plasters it is recommended that lime washes are applied. The use of synthetic paints is not recommended since they will prevent subsequent carbonation.

Curing of render takes many months and if such paints are used, they should not be applied until carbonation is complete. Normally allow one month carbonation time for every 3mm of render thickness.

To summarise it is essential to ensure that:

1. The render is very well mixed - balling must be avoided. Use a gauging box or bucket to measure - not a shovel.
2. Do not put too much in the mixer at anyone time as this will reduce the quality of the mix.
3. The wall is well wetted before rendering commences.
4. Render must be used within two hours and then left to stiffen. A second pass must be made to compress the render but only when it has stiffened.
5. Do not apply if the temperature is too low i.e. 5°C or below. Be prepared to protect from frost, excessive sunlight and drying wind for up to 7 days. Protection may include Hessian sheets, bubble wrap or sheets of polythene. In very warm weather wetting of Hessian will help to reduce rapid drying. In the winter do not add antifreeze agents designed for use with Portland cement.
6. Keep render moist for 7 days. The chemical set can only complete in the presence of water. The need to keep render damp is best achieved by the availability of a hose with a fine spray. Not only will this ensure even coverage but the time taken will only be a few minutes each day (if indeed conditions require damping down).

Bear in mind the render will continue hardening for many weeks and final strength will not be achieved in less than one year.

HEALTH & SAFETY INFORMATION

Detailed Health & Safety Data Sheets are available to download from the "Technical Stuff" section of the website under Safety Data.