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Barra Hall, Middlesex (Moderately Hydraulic Lime Fender & Emmerly Hydraulic Lime Fender)



Castle Conservation Range
Preserving Britain's Heritage

Health and Safety

When lime is mixed with water or body fluids it creates a strong alkaline solution which can cause serious burns to eyes or skin. The alkaline solution also acts as a local anaesthetic therefore serious burns can develop without pain being felt. Avoid eye and skin contact by wearing suitable eye protection, waterproof clothing, waterproof footwear and waterproof gloves. On contact with eyes or skin, rinse immediately with plenty of clean water. Seek medical advice after eye contact.

See the Castle Cement Health and Safety data sheets for more comprehensive information on the safe handling of lime which is available from the Technical Helpline on 0845 722 7853.

Photography on front cover, pages 3, 5 and 11 courtesy of Lime Technology Limited.

St Pancras Station, London (Natural Hydraulic Lime 3,5 & Ketton Freestone).



Castle Cement Conservation Range

Product overview



Ensuring you get the very best performance

Castle Conservation products can be delivered nationally, so that you can be sure of a consistently high standard of product no matter whether you are in Troon or Truro.

You can also be sure of the best advice, either through our Technical Helpline or team of field-based technical services managers. Castle is proud to have a group of people whose range of knowledge is unrivalled. These experts help develop industry standards and assist in education.

Castle uses only high quality ingredients, with strict quality control to ensure products maintain a high degree of consistency in performance and colour.

Castle Natural Hydraulic Lime NHL 2, 3,5 and 5

Castle's Natural Hydraulic Limes are suitable for a wide range of jobs, offering a variety of strength classifications and excellent workability. The high degree of whiteness offers high quality architectural finishes and can be pigmented to supplement sand colours. With the aid of Castle's technical know-how, support is available to give advice on estimating work.

Castle Hydraulic Lime Mortar Moderately and Eminently

When natural hydraulic lime is specified on a new build project, it is often viewed with caution by contractors as its gauging and mixing with sand to make a mortar requires care and experience to get consistent results. Castle Cement can offer a solution to this problem in the form of dry, pre-mixed hydraulic lime mortar, produced using factory precision batching techniques to tried and tested recipes.

Castle Lime Putty

Castle Lime Putty is a traditional, matured, slaked, lime putty recommended for producing mortars, renders and plasters for all conservation, restoration and new build applications. It can also be added, in small amounts, to hydraulic lime mortars and renders to improve their plasticity.

Castle Fine Lime Plaster

Contributes to a healthy internal environment and is an economic and practical alternative to plasters containing gypsum that has little or no vapour permeable qualities.

Castle Ketton Freestone

With its superb colour and texture, Ketton Freestone is highly regarded for its looks. But its beauty doesn't mean that it is not practical. It is also prized for its durability, ease of working and consistency, making it ideal for carving and masonry work.



Emmanuel College, Cambridge.



Castle Natural Hydraulic Lime NHL 2, 3,5 and 5

Castle Natural Hydraulic Limes offer a range of NHL 2 (feebly), NHL 3,5 (moderately) and NHL 5 (eminently) hydraulic lime produced to meet the requirements for mortar, render and plaster for conservation, restoration and new build construction.

They meet the requirements of BS EN 459-1 : 2001 type NHL Natural Hydraulic Lime strength classes 2, 3,5 and 5 and are suitable for use in lime: sand mortars for stone, tile, brick and block laying, external rendering and internal plastering. They provide options for the whole range of climatic conditions encountered in the UK. They are particularly useful in designing mortars and renders to complement the strength of natural stone and soft brick construction.

The high degree of whiteness facilitates production of quality architectural finishes and can be pigmented to supplement sand colours and provide matches for restoration work.

Applications

Natural Hydraulic Lime as a constituent of lime: sand mortars can be used for a wide range of applications for jointing mortars, bedding tiles, renders and plasters. Using suitable sharp sand the mortar will have excellent workability and good water retention when applied to most bricks, blocks and surfaces to be bedded, rendered or plastered.

Natural Hydraulic Lime mortars have excellent resistance to sulfates in either groundwater or in masonry. NHL 3,5 and NHL 5 mortars of lime: sand ratios of 1: 2 1/2 and 1: 2 have good resistance to freezing and thawing actions.

Hydraulic Lime Mortars (HLM) are designated by their compressive strength @ 91 days range from 0,5 - 5,0 MPa (HLM 0,5 - 5,0) These mortar classes correspond to MC classes of EN998 – 2

General guide to mortar selection by building application

Building element	Hydraulic Lime Mortar Designation
Internal walls	HLM 0.5
External walls	HLM 0.5 – 2.5
Facing to solid construction	HLM 1.0 – 2.5
Walls close to/below ground	HLM 2.5 – 3.5
Parapets, sills, lintels and cornices	HLM 2.5 – 3.5
Copings and cappings	HLM 2.5 – 5.0
Chimneys	HLM 3.5 – 5.0
Earth retaining walls	HLM 3.5 – 5.0
Masonry below water level	HLM 5.0

Notes:

Selection of mortar should take into account any structural requirements and the properties of the masonry units. The mortar designation (see following table for individual mixes) is for average exposure conditions. Selection must take account of any special local environmental considerations such as prevailing wind, frequency of frosts, location (coastal, hill-side, protected), etc. Hydraulic Lime Mortars for: stone, brick and block masonry

General guide to selection by hydraulic lime mortar designation (HLM)

HLM designation	Castle NHL 2 (lime: sand) by volume	Castle NHL 3,5 (lime: sand) by volume	Castle NHL 5 (lime: sand) by volume	Mean compressive strength (MPa @ 91 days)
HLM 5.0	-	-	1: 2	5.0
HLM 3.5	-	-	1: 2 1/2	3.5
HLM 2.5	-	1: 2	1: 3	2.5
HLM 1.0	1: 2	1: 3	-	1.0
HLM 0.5	1: 3	-	-	0.5

Quality

Castle Natural Hydraulic Lime is produced from the natural argillaceous limestone deposits in quarries located in the South of France. The Quality Control at the works ensures a high degree of consistency in performance and colour.

Strength

The lower strength of natural hydraulic lime mortar compared with Portland cement based mortars allows mixes to be produced which complement the lower strengths of many natural stone and soft brick applications whilst improving plasticity and retaining a high level of cohesion with low shrinkage.

The use of natural hydraulic lime mortar imparts special properties to mortar of low shrinkage combined with elasticity and allows cracks to heal autogenously by continuing carbonation.



Mortar mix design

Natural hydraulic lime mortars gain strength by a combination of hydraulic action and carbonation. It is essential to consider the mix proportions of mortars with care. The following mix proportions provide a guide from which a mix can be selected to suit the construction and local environmental conditions. Other factors, such as the type of brick or stone, or the sand being used will affect the final mix selection.

Table of standard mixes for 25kg bag of natural hydraulic lime

Composition by volume (lime: sand)	Sand content (15 litre buckets/ bag of lime)	Water addition approx (litres)*	Yield (m ² /bag)	Castle NHL content (kg/m ²)
Castle NHL 2				
1: 2	6	18	0.10	260
1: 2 1/2	8	21	0.12	215
1: 3	10	23	0.14	180
Castle NHL 3,5				
1: 2	6	14	0.09	275
1: 2 1/2	7	18	0.10	245
1: 3	9	20	0.12	205
Castle NHL 5				
1: 2	5	14	0.08	310
1: 2 1/2	7	16	0.10	255
1: 3	9	20	0.12	215

* Water addition to mortar will depend on the moisture content of sand, quantities in table assume a moisture content of 7%.

Notes:

For the purpose of gauging sand a heavy-duty 15 litre bucket should be used. Sand should be clean, sharp and free of foreign or harmful materials. When mix proportions are by volume care should be taken, if the sand is either dry or excessively wet, to allow for bulking. Backgrounds should be damp before application of render and the work should be kept damp for at least 24 hours after application. Work should only be undertaken when the ambient temperature is above 5°C and below 30°C. During continuing cold weather, i.e. 5 – 10°C, consideration should be given to increasing the NHL strength class or mortar designation. New work should be protected from direct sunlight and strong wind. In cold weather cover new work to protect against frost, rain or snow. In hot or fast-drying weather cover new work and keep damp for at least 72 hours.

Renders

Choice of suitable mixes for renders follows a similar process to that for masonry mortars. In this case the properties of the substrate must be considered. The choice of sand will also be affected by the kind of finish required with finer sands being necessary for some smooth decorative renders and plasters. The overall mix durability in relation to exposure details will be similar to that for masonry mortar.

General guide to mortar for renders by substrate type

Substrate	Base coat	Finish coat	Castle NHL
Weak or porous e.g. soft brick	1: 2	1: 2 1/2	NHL 2 – NHL 3,5
Medium	1: 2 1/2	1: 2 1/2*	NHL 3,5 – NHL 5
Impervious e.g. dense brick	1: 2 1/2	1: 2 1/2*	NHL 3,5 – NHL 5
Plasterwork	1: 2	1: 3 finish on 1: 2 1/2 second coat	NHL 2 – NHL 3,5

* Each successive coat should be weaker and/or less thick moving away from the substrate. This can be achieved by mix proportions, NHL strength class and/or thickness of coat.

Mixing

It is essential that the lime is uniformly dispersed and that any fine agglomerations are broken down. The time of mixing will be controlled by the efficiency of the mixer used.

Admixtures

Admixtures may be used with natural hydraulic lime mortars, subject to any limitations imposed by the job specification. In particular the use of air-entraining admixture in mortars and renders exposed to severe frost can be particularly beneficial.

Additions

Addition of pozzolanic materials can improve the hydraulic activity and performance in some applications of natural hydraulic lime mortars. Materials such as traditionally used crushed brickdust, Castle BS EN 450 Fly Ash, ground granulated blastfurnace slag or metakaolin may be used to increase the mortar strength designation. Addition of Castle Hydrated Lime or Castle Lime Putty will improve the mix plastic properties but reduce the mortar strength designation.

Castle Hydraulic Lime Mortar

Moderately and Eminently



The gauging and mixing of Natural Hydraulic Lime with sand to make a mortar requires care and experience to get consistent results. The solution to the problem is a pre-mixed hydraulic lime mortar, produced using factory precision batching techniques to tried and tested recipes gained through years of experience.

Castle Hydraulic Lime Mortar is produced using dried sands and Castle Natural Hydraulic Lime. It is suitable for use in brick and block laying, stone masonry and as a backing or final coat render/plaster. Hydraulic Lime Mortar is available in 25kg bags, can be mixed in a conventional drum mixer and covers a range of applications both for conservation and new build.

Applications

Hydraulic Lime Mortar has excellent workability and good water retention when applied to most bricks, blocks and surfaces to be bedded, rendered or plastered.

The lower strength of Hydraulic Lime Mortar compared with Portland cement based mortars compliments the lower strengths of many natural stone and soft brick applications whilst improving plasticity and retaining a high level of cohesion with low shrinkage. Hydraulic Lime Mortar has high resistance to sulfates in either ground waters or in masonry and good resistance to freezing and thawing actions.

Quality

Castle Hydraulic Lime Mortar complies with the durability requirements of BS5628 : Part 3 : 2001. Hydraulic Lime Mortar is manufactured using factory batching techniques with the end product being subject to regular quality control procedures and testing. Raw materials are weighed and mixed under computer controlled conditions with rigorous quality control procedures. Although mortar is traditionally specified by volume, it is generally accepted that batching by weight produces mortar of a greater consistency.

Castle Lime Mortars are available in two grades Moderately Hydraulic Lime Mortar (HLM2,5) and Eminently Hydraulic Lime Mortar (HLM 5).

Castle Moderately Hydraulic Lime Mortar

For most normal applications i.e. cavity brickwork, blockwork and stonework, Moderately Hydraulic Lime Mortar will reach HLM 1 [class IV] at 28 days and HLM 2.5 [class III] at 91 days.

Mortar class	Lime: sand (vol/vol)	BS5628 mortar mix durability designation (equivalent)	Hydraulic lime mix designation	Typical compressive strength (N/mm ² @ 91 days)	Mortar durability class
Moderately hydraulic	1: 2 1/4	(iv) @ 28 days (iii) @ 91 days	HLM 2.5	2.5	5-6

Castle Eminently Hydraulic Lime Mortar

For use where a higher level of durability is required i.e. masonry exposed to severe weather, Eminently Hydraulic Lime Mortar will reach HLM 2.5 [class III] at 28 days and HLM 5 [class II] at 91 days.

Mortar class	Lime: sand (vol/vol)	BS5628 mortar mix durability designation (equivalent)	Hydraulic lime mix designation	Typical compressive strength (N/mm ² @ 91 days)	Mortar durability class
Eminently hydraulic	1: 2	(iii) @ 28 days (ii) @ 91 days	HLM 5.0	5.0	7-8

Castle Lime Mortars has been formulated to ensure consistent quality and a professional finish.

Castle Fine Lime Plaster



Castle Fine Lime Plaster is a traditional 1: 2 lime: sand wet mortar mix. It is produced using silver sand, soft sand and non-hydraulic (fat or pure) lime derived from high calcium quicklime (CaO) slaked and stored for a minimum of 30 days.

Applications

Fine Lime Plaster is particularly relevant for the repair of historic buildings. This includes as a fine finishing coat for plasterwork and the laying and re-pointing of fine joint or gauged brickwork.

Fine Lime Plaster is also highly compatible with soft building materials such as earth (cobb, shuttered earth, clay block, pisé, witchert), wood, straw bale, coppiced wood and soft brick.

Characteristics

- It is suitable for use in for brick, block and stone masonry
- More flexible than Portland cement based mortars
- More flexible than gypsum based plaster and has excellent vapour permeability qualities which enables the building to breathe
- Consistent mix proportions
- Consistent quality of mortar
- Correct choice of sands
- Is pre-mixed so there is little or no need to re-mix or add water
- Can be re-worked up to the point of set
- Ideal for the repair of historic buildings
- Ideal as a finishing/ top coat plaster and for fine joint or gauged brickwork

Quality

Castle Fine Lime Plaster is manufactured using factory batching techniques with the end product being subject to regular quality control procedures and testing. It is a traditional 1: 2 lime: sand mix batched by volume.

The materials used conform to the following standards:

Building Lime BS EN 459-1 : 2001

Sand BS EN 13139 : 2002

The sand used is a blend of silver and soft sands that produces a finely textured mortar.

Strength

High strength is not normally required or desired for a building mortar or plaster. An unnecessarily strong mortar will concentrate the effects of any differential movement between the mortar and the masonry which could lead to cracking, reducing durability and increasing the risk of rain penetration. A weaker mortar will accommodate some differential movement between the mortar and the masonry and if cracking does occur it will generally be distributed as fine hairline cracks, thus preserving the integrity of the building.

Fine Lime Plaster has no hydraulic properties and stiffens initially by the loss of moisture from the mix by evaporation and absorption. The hardening of mortar is due to the lime reacting with the carbon dioxide in the atmosphere that converts the lime to calcium carbonate. This hardening process is slow and it is important that consideration is given to providing adequate protection for the work in wet or cold weather.

Castle Lime Putty



Castle Lime Putty is a stiff paste composed of a finely divided colloidal dispersion of slaked lime in water.

Lime putty hardens by absorbing carbon dioxide from the atmosphere, which converts the lime to calcium carbonate. The hardening process is slow and allows some movement in a structure to be accommodated before the final set is obtained.

Applications

Lime Putty is recommended for mixing with clean, well graded sands in the production of mortars, renders and plasters that are ideal for conservation, restoration and new build applications.

Lime Putty is a fat (pure) lime which will carry up to three times its volume of clean, well graded sand below a size of 5mm. Pozzolanic and other agents may be added to increase the speed of set.

Lime Putty may be added, in small amounts, to hydraulic lime mortars and renders to improve their plasticity.

Lime Putty may be thinned down using water, with or without the addition of pigments for making brushable lime washes.

Quality

Castle Lime Putty is classified as BS EN 459-1 : 2001 CL 90 Lime Putty.

Typical properties

High reactivity quicklime (CaO) is reacted with pure water in such a way that ultra fine slaked hydrated lime particles are uniformly dispersed through a thick viscous suspension.

After the reaction, the suspension is allowed to stand so that the fine particles can develop their colloidal affinity for water and form a fully matured putty.

Strength

High strength is not normally required or desired of building mortar, renders or plasters. An unnecessarily strong mortar will concentrate the effects of any differential movement between the mortar and the masonry which could lead to cracking, reducing durability and increasing the risk of rain penetration.

A weaker mortar will accommodate some differential movement between the mortar and the masonry and if cracking does occur it will generally be distributed as fine hairline cracks, and the self-healing characteristics will help to preserve the integrity of the building.

Lime Putty has no hydraulic properties and stiffens initially by the loss of moisture from the mix by evaporation and absorption. The hardening of lime putty mortars is due to the lime reacting with the carbon dioxide in the atmosphere that converts the lime to calcium carbonate.

This hardening process is slow and it is important that consideration is given to providing adequate protection for the work in wet or cold weather.

Mortar mix design

Lime Putty is usually proportioned with 2½ – 3 parts by volume of clean well graded sand, the lime putty filling the spaces between the total sand particles without adding to the overall volume, so the total volume is equal to the volume of the sand used. No additional water is usually needed as the required workability can normally be achieved by adequate mixing of the mortar.

Additions

Additions of pozzolanic materials such as crushed brick dust, Castle BS EN 450 Fly Ash, ground granulated blastfurnace slag or metakaolin can improve the rate of setting of lime putty mortars.

Radley College Sports Pavilion (Moderately Hydraulic Lime mortar).

