

Stone Repair Mortar - Lithomex from Womersleys Ltd, www.womersleys.co.uk

Plastic repair materials for natural stone and masonry

The term plastic repair is generally held within the construction industry to be the application of a wet plastic repair mortar, usually cementitious in nature, to the eroded, damaged face or edges of natural stone masonry to return it to its former shape or plane with any former decorative detailing applied to the repair in such a way as to as closely as possible reproduce the host masonry. Most plastic repairs are coloured to match the recipient masonry.

Plastic repairs are usually carried out as a low cost means of repairing masonry facades or individual units of masonry. In practice they are often carried out by low skilled labour with little attention to the quality of the finish and little regard to the materials used, so long as the repair looks reasonable, rather than performing any specific function.

Plastic repairs can and should be more correctly called patch repairs and should be used to reinstate details, line, level and planes of masonry that left without repair will result in undue weathering of surrounding masonry, leading to accelerated decay of otherwise sound elements. In addition, they offer a significant advantage over wholesale masonry replacement.

Much of the masonry replaced in the last 30 years or so has resulted in partial or complete removal of predominantly structurally sound masonry that has suffered from little more than face weathering, often through neglect and lack of maintenance of basic building details such as gutters and down pipes.

The arbitrary use of replacement stone in these circumstances has left many buildings with thin skins of new stone, seldom matching the true characteristics of the original, and often leading to highly invasive intervention in what was an otherwise stable structure. Many of the thin skins are backed up in concrete, brick or any number of inappropriate mediums, or indeed with significant voids left behind the new veneers.

For surface repairs to be successful the materials employed need to have certain characteristics. They should:

Have characteristics similar to the host masonry.

Have adequate bond strength.

Have a good modulus of elasticity.

Be vapour permeable.

Be durable.

Be capable of being dressed with similar tools to the original masonry.

Remain workable long enough to allow details to be fashioned.

Match in colour and texture.

Absorb water sufficiently in wetting and drying periods to match adjacent masonry.

They must always be reversible.

They should never:

Become significantly stronger than surrounding masonry.

Have a significantly lower rate of Absorption or Adsorption than surrounding units.

Create a barrier to Diffusion.

For materials to meet these criteria, the materials themselves do not require to match every characteristic of the host masonry.

The main visual characteristic of masonry is colour, matching of colour can be subjective, different people see colour in different ways, many men for instance are red green colour blind to a greater or lesser degree, so one person may see a colour match differently from another, but it is generally controllable.

Lithomex can be accurately colour matched with proven light fast pigments.

The finish of a repair material is subject to some degree of licence from the applicator and is not directly attributable to the material, although if the material can be worked correctly with traditional tools after setting it will afford good physical matching.

Lithomex is capable of being dressed with standard masons tools or at time of placing by skilled operatives.

The physical properties of the masonry can and do vary from one area of the building to the next.

Absorption, is a process by which the materials take in a fluid to fill its voids. It can vary depending on a number of factors, not least the surface finishing. The finished repair mortar must have similar characteristics.

Lithomex can be seen by demonstration to Absorb water on to its set and hardened surface.

Adsorption is the process in which molecules adhere to the surface of the material, and should be similar in the repair material.

Surface Adsorption is noticeable in Lithomex repairs

Ageing is due to the changing of properties and appearance of materials with time (natural process) and is often a function of the previous two characteristics.

Lithomex does weather as a result of both of the above being sufficiently absorbent to take in pollutants over time, although not unduly.

Breathe-ability The extent to which a building material is able to allow moisture to move to the surface and evaporate harmlessly should be at least matched or exceeded by the repair material. The greater the degree of breathe-ability of the repair material the faster the release of moisture from the host masonry.

Lithomex has a very high degree of Breathe-ability by virtue of its Vapour Permeability.

Capillarity - the ability of a material that is in contact with water, to raise water through capillary canals (capillaries). This is not a desirable quality of any construction or repair material. Capillary pores occur mainly in dense cement materials and hold water, reducing

evaporation, many naturally occurring sandstones do have a degree of capillarity, but it is seldom continuous.

Porosity - defines the amount of holes (pores) in the unit of the material volume and can have a bearing on the durability and breathe-ability of the masonry and the repair material. The porosity of the masonry and the repair material is a function of the Pore size
Pore dimensions cover a very wide range. Pores are classified according to three main groups depending on the access size

- Micropores: less than 2 microns diameter
- Mesopores: between 2 and 50 microns diameter
- Macropores: larger than 50 microns diameter

Matching the porosity is not therefore essential, what is essential is to maintain good Breathe-ability, this is a function of the extent and nature of interlinked pores. There are two main and important typologies of pores: closed and open pores. Closed pores are completely isolated from the external surface, not allowing the access of external fluids in neither liquid nor gaseous phase. Closed pores influence parameters like density, mechanical and thermal properties. Open pores are connected to the external surface and are therefore accessible to fluids, depending on the pore nature/size and the nature of fluid. Open pores can be further divided in dead-end or interconnected pores.

Suitable repair materials should have interconnected pores-Micropores structure with tiny microscopic holes or pores approximately 5 microns in diameter interlinking the general pore structure. Water droplets are typically 500-5000 microns in diameter 'drizzle' droplets can be as small as 200 microns in diameter. Attraction between the water molecules forces molecules to group together in a droplet. Water droplets are too large to penetrate the Micropores without substantial pressure. It is difficult for water droplets to pass through, and therefore the material is reasonably waterproof. Water vapour molecules are much smaller (typically less than 0.0003 microns) and pass easily through the holes, carrying moisture away.

Lithomex does have some Porosity, but this is not linked to Capillarity

Materials that are suitable for masonry repairs should have a measurable and high vapour permeability range.

As a comparison, the following charts show the vapour permeability range of cement lime sand mixes against different lime mortar mixes.

Portland cement mixes.	1:1:6	1:2:9
Permeability (Vapour exch.Gr of air x m ² x hour x mmHg)	0.23	0.25

Lime Mortar Mixes	1:3	2:5>
Permeability (Vapour exch.Gr of air x m ² x hour x mmHg)	0.63	0.71

Hydraulic Lime Mortar Mixes (NHL 5 / NHL2)	1:3	1:3
Permeability (Vapour exch.Gr of air x m ² x hour x mmHg)	0.52	0.71

Lithomex has a vapour permeability figure of 0.75

	Tensile Strength N/mm ²	Compressive Strength N/mm ²	Elasticity Moduli MPa
7 Days	2.20	6.20	
28 Days	2.38	7.25	7,690

Tests on hardened mortar (water addition at 18.7%)			
Capillarity	2.06 gr.cm ² . √2 min	LOW	Tested at 28 days
Water permeability	0.25 ml.m.day	LOW	Tested at 28 days
Vapour permeability	0.75 gr.m ² .hour.mmHg	VERYHIGH	Tested at 28 days

The Modulus of elasticity is a key component in the ability of the material to flex with the stress imposed during curing and later through thermal, physical movement etc. the lower the number the greater the degree of flexibility. A cement lime sand mix of 1:1:6 ratio has a modulus of elasticity at 28 days of 16,200 compared with Lithomex at 7690 and lime putty in a 1:3 ratio with sand of approximately 9,000.

The compressive strength of Lithomex 7.25 N/mm² sufficiently high enough for the material to be robust enough for general conditions is considerably lower than most masonry units including soft-fired hand made bricks that usually have a compressive strength around 8-14 N/mm². Sandstones fall in the range 20-100N/mm². Lithomex is not suitable for step or tread repairs. For step and tread repairs Litholiant is a powder to which aggregates similar to the original stone is added. This will make a material suitably robust for aggressive wear conditions.