



INTRODUCTORY NOTES

There are many uses for stone in the construction and maintenance of the built environment.

These uses range from:

- memorials and sculpture
- internal flooring, work surfaces and finishes
- paving
- roofing
- modern cladding
- drystone (mortarless) construction, and
- mortared load bearing masonry

In this traditional form of masonry construction, mortar (and this normally means lime mortar) is the other half of the picture.

The expression 'stone and lime' was once commonplace, but now, at the start of the 21st century, the industry and professions are struggling to rediscover the knowledge and relearn the skills associated with lime mortars, skills and knowledge which are essential for effective use of Scotland's resources of natural stone.

Historical summary

Lime mortars have successfully been used in construction for over four thousand years. Roman concrete, used in the still surviving major engineering structures of the period, was hydraulic lime concrete. In Scotland lime mortars were used in Roman times and again from the early medieval period. Lime mortars were used in the construction of the great medieval cathedrals and in many fortified buildings.

Production of lime was a major industry during the 18th and 19th centuries, and the material was essential to the rapid growth of agriculture, industry and building.

Lime was used for construction of lighthouses, harbours and canals. The foundations of the tenement blocks in Edinburgh, in Glasgow and in other cities such as Dundee and Inverness were, and still are, of hydraulic lime concrete.

The function of mortar

Mortar, in a traditional load bearing stone structure, serves to fill the spaces between the stones in order to stabilise individual stones and exclude the weather. Very rarely is it required to act directly in a load bearing capacity.

There are generally 4 groups of properties required of a mortar - those related to:

- Performance and behaviour
- Appearance
- Cost
- Environmental issues

Characteristics of an ideal mortar

Cement mortar

Lime mortar

• **Performance / behaviour**

| | | |
|--|------|------|
| Non-damaging to stone | * | **** |
| must have low salt content | * | **** |
| must be more permeable than stone | * | **** |
| Adequate weather exclusion | ** | *** |
| must be able to manage liquid water effectively | * | **** |
| Vapour permeability (breathability) | | |
| must allow the structure to breath, even when the building stone itself is relatively impermeable | ** | **** |
| 'Flexibility' | | |
| must enable the construction to cope with minor movement | * | **** |
| Workable and 'user friendly' | | |
| readily available | **** | ** |
| simple to produce | **** | *** |
| good handling/laying qualities | ** | **** |
| minimum of aftercare | *** | ** |
| Durability | | |
| should develop early frost resistance | *** | ** |
| should provide long term durability | *** | *** |

• **Appearance**

| | | |
|--|---|------|
| Sympathetic to the masonry as a whole | * | **** |
| Appropriate to the historic context | * | **** |
| Allow the appropriate character of the masonry to be achieved or maintained (regional variation, local distinctiveness) | * | **** |

• **Cost**

| | | |
|--------------------------------|------|-----|
| Job costs | | |
| low initial cost for materials | **** | ** |
| low labour time / cost | **** | ** |
| Costs in use | | |
| low long term costs in use | ** | *** |

• **Environmental issues**

| | | |
|---|------|------|
| Reduced atmospheric pollution, including o/all CO2 emissions | ** | *** |
| Low embodied energy | * | *** |
| Effective conservation (and, thus, availability for reuse) of buildings | * | **** |
| Recycling of building materials, including masonry components | * | **** |
| Non toxic | **** | **** |

Availability of lime

Range of types and properties

- strong, relatively hard materials (eminently hydraulic limes) – NHL5
- moderately hydraulic limes – NHL3.5
- feebly hydraulic limes – NHL 2
- industrially fired non-hydraulic limes (very pure, not historically typical) – CL90
- traditionally fired limes (currently not commercially available)

Producers / suppliers

At least 12 different hydraulic limes, from 6 different producers, are currently available in Scotland. Unfortunately none of these are produced from indigenous Scottish limestones, and none are produced in the UK - they are all imported from continental Europe.

Non-hydraulic lime is widely available in the form of slaked lime putty and, more appropriately, in the form of pre-mixed lime mortars (coarse stuff and fine stuff).

Lime mortars

Generally speaking, mortar comprises a binder and a filler. Lime mortars are no exception.

The binder is either non-hydraulic lime or, more usually, some form of hydraulic lime, in paste form, and the filler is sand or some variety of crushed rock.

Just as choice of an appropriate type of lime is important, so too is selection of the right sand or aggregate. Equally important is the availability of appropriate skills.