Good building practice when working with Limestone

The following guidelines have been produced to help you and your organisation understand the requirements when using Limestone in your construction project.

If built correctly limestone will last for a thousand years or more. This is evident by the miles and miles of dry stone walling which stretch through the Cotswolds, Rutland, Lincolnshire and other counties, as well as the many churches and cathedrals which have stood the test of time since medieval times. However, if not built correctly most limestone would be lucky to survive one or two extreme winters. Some beds of limestone are more resilient to frost than others and rely on experienced masons to identify the most suitable stone for the application.

Long gone are the days when masons and quarry owners could leave stone out to the elements to 'prove' over several winters. With today's building technology and a wide range of damp proof materials and membranes, in addition to a raft of metal products such as fixings, wall ties, etc, incidents or failure can be minimised by good building practice.

As a rule of thumb, most limestone is very happy with one or two faces to the weather, so long as there are no other forces at work such as rising damp or water soaking from the rear or above.

A common reason for the failure of some limestone is the hard landscaping of the adjacent ground surface which is allowed to butt up next to the natural stone. A drainage gap should be provided for rainwater to drain prior to soaking the limestone wall.

For applications such as in the external walls of a house where the roof keeps it dry from above, and the damp proof course prevents moisture from the ground, no issues should be encountered, providing the stone is allowed to breath with the adoption of a suitable mortar mix. Where natural limestone is required below DPC it is advisable to seek advice from us. See "Building with Limestone below DPC" on page 3.

Other matters that effect natural stone is quarry sap. This is a natural inclusion in most newly quarried stone and usually takes between 12 months and 3 years to dry out. When the quarry sap has dried out of the limestone, it's considered at its hardest, and most weather resilient. On rare occasions, slight spalling from the faces may occur following freezing conditions, this however usually stops after the first one or two years following construction.

Stone specification

When choosing the stone for your building, some building applications require the stone to have certain physical properties. If the stone is going to be exposed to harsh weather conditions or water saturation, such as copings, parapets, retaining garden walls or external floor tiles, please check that the stone you are sourcing has the physical properties to withstand the elements and is frost-resistant. Please ask our team for advice and recommendations on the right materials for your project.

Storage of limestone goods during winter periods

Stone is very susceptible to weather damage until it's laid. If your stone is being delivered during the colder months please ensure it is protected from the weather during storage. A minimum of two layers of insulating material covered by strong polythene or tarpaulin should be used. This will protect if from freezing weathers and frosts, and keep water out. The packaging provided upon delivery is not on its own considered suitable for winter protection.

Part built structures need protection too

Part built structures and walls are extremely vulnerable to frost damage during the winter periods, and should be covered with at least two layers of heavy sacking material and an outer layer of robust polythene or tarpaulin so that water doesn't get in.

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Patina

The patina is the act of the newly exposed stone reacting to air which starts to mature the coloration, for example from white to a honey color.

Mortar for natural stone

The habit with modern pointing is to mix too much Portland cement into the mortar. All stone absorbs a certain amount of moisture in wet weather, and in order to dry out again it must be able to breath freely through the mass in every direction. Unless this can happen some types of stone will fail, and can be adversely affected. Very hard non-porous joints impede this aeration and are therefore wrong.

The aesthetic effect of too much cement in the mixture is invariably bad. A good working mixture for most purposes is ten parts of clean sand to two or three parts lime, beaten up with water, with the addition of no more than one part ordinary Portland cement. The object of adding more cement is to help the mortar to harden, and no more should be added than is sufficient to make sure of that, nor should any be added until just before the mixture is going to be used. On exposed sites and with harder stones, a slightly harder proportion of cement is sometimes acceptable. For historic buildings on the other hand, Portland cement is never right and is no longer used by the department of the environment.

Source: 'English stone building' (Alec Clifton Taylor & A.S Ireson)

Hydraulic Lime
Many buildings were built before the use of cement. When re-pointing, alterations or repair of a historic building is required, it may be necessary to use hydraulic lime. One part hydraulic lime should be mixed with two parts sand.

Hydrated Lime
Hydrated lime or 'air lime' is the type of lime most widely used as a component in mortars and renders. This is because it does not react with the water in the mix to form a 'set'. Instead, it reacts with carbon dioxide from the air in order to harden (carbonation). This is a gradual process and mixtures made with air lime products as the only binder may take days or even weeks to harden. We recommend using a mix of hydrated lime, sand and white cement. A popular mix among our clients is one part hydrated lime, six parts sand and one part white cement, however it will depend on the build.

White Cement
The use of white cement can be more aesthetically pleasing than grey cement. White cement, however, is around 33% stronger than grey which should be allowed for within the mortar mix.

For further information on lime mortar please see The Lime Mortar Guide from Conserv.

Building with limestone 'cavity walls'

When building with natural limestone, it is essential that air flow is able to circulate behind the stonework. The provision of weep holes at ground level and above all lintels is usually sufficient ventilation.

Where insulation batts are adopted, an air gap of 25mm minimum should be maintained for the stone to breath.

Where this is difficult to maintain, a product such as Surecav is designed for this purpose. The cavity should, in no circumstances, be fully filled with paper based products, polystyrene pellets or any other type of injected insulation. See section "Cavity wall ties" on page 3.

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Building with limestone below DPC

If building with limestone below DPC, water saturation is likely. Guidance Eurocode 6 Design of Masonry Structures BS EN 1996-1-2 1995 states that the masonry above the first 150mm and below 150mm of ground level are most at risk from frost damage. The builder should be aware to keep the cavity open to 150mm below ground level in order for the stone to breath.

The options available are:

1. Incorporate engineering bricks below the damp proof course.
2. Request highly frost resistant limestone such as a weather bed quality stone from our sales team.
3. Provide underground drainage so that ground water can discharge before rising into the stonework. Remember that the mortar mix should be compatible. All limestone exposed to freeze thaw requires air flow to the rear of the stone. The cavity should therefore be clear of groundwater, mortar, debris and insulation.

Cavity wall ties

There are hundreds of different wall ties on the market, made in different materials and different strengths. Some are rigid, others flexible. The specification of cavity wall ties is extremely specialist. The prevailing standard is now Eurocode 6 for Design and Masonry Structures. When choosing a tie the following should be taken into consideration:

- Location of the project within the country and height above sea level
- The likely wind speeds that the ties will have to cope with on a regular basis
- The thickness of the inner and outer leaves
- The compatibility of stiffness between the two leaves
- The width of the cavity and materials being used in the outer and inner walls
- The type of insulation proposed, if any
- Any backing products, such as Surecav
- The proposed mortar mix
- The number and position of the proposed ties
- The type and number of wall ties are extremely important to the integrity of a project.

It would be a good idea to furnish a structural engineer with the answers to the above for further advice.

Expansion joints

Guidance in the Eurocode 6 Part 2 BS EN 1996-1-2 2005 gives the following information:

The maximum horizontal distance between vertical movement joints is recommended as below:

- Aggregate concrete blocks and manufactured stone masonry 9m
- Autoclaved aerated concrete masonry 9m
- Natural stone 20m.

The above applies to where the build ratio length versus height is 3 to 1 or less. The distances should be reduced where the building design lies outside of this ratio. The use of movement tolerant ties are recommended.

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Structural steel

Sometimes structural steel is required in a stone building. Steel may be required to maintain the structural integrity of stonework. Our staff will not seek the services of a structural engineer unless requested prior to the production of stone products by the client. Costs associated with structural calculations will be passed to the customer. Any request for calculations should be in writing or email.

Air flow around the stone

It is essential that all limestone exposed to freeze/thaw conditions has sufficient air flow to the rear of the stone. The cavity should be clear of groundwater, mortar, debris and insulation. Weep holes sited at ground level and above all lintels will often provide sufficient ventilation. Where insulation batts are used, a minimum air gap of 25mm should be maintained.

Water saturation

Most limestone stays structurally sound with one or two faces to the weather, so long as there are no other forces at work, such as rising damp or water soaking from the rear or above. The main reason for the failure of some limestone is water saturation due to poor building practice which, in turn, causes frost damage. A common cause is the hard landscaping of the adjacent ground surface. A drainage gap should be provided for rainwater to drain. Where this is not possible, for example where you have steps, a 'fall away' from the stone face is essential.

Stone failure due to water saturation can also be caused by an insufficient coping stone. Copings require a sufficient overhang (minimum 50mm), and drip grooves, to help stop rainwater penetrating the stone.

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