

## TECHNICAL NOTE No. 39

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# Stonework Repairs

### 1. Introduction

Much of the Province's built heritage is constructed of stone – castles, churches, cathedrals, stately homes, houses and cottages, all use this material in a vast variety of ways and styles. Considering the large stock of stone masonry buildings it is perhaps indicative of the good inherent properties of the stone that more failures are not observed.

Possibly one of stone's biggest assets is its major difficulty. Decay of stone is a process which either occurs naturally or is induced by man, that can take a comparatively lengthy period of time, consequently decisions on what and when to repair are often the most difficult.

### 2. Repair Guidelines

The first step of any repair scheme must be to evaluate the existing state of the stonework and the degree of intervention/repair necessary. From a position of knowledge the most appropriate decisions for a building can be taken. EHS advocates that those contemplating major work should research or commission a detailed analysis of their stonework. This should be clear about any previous interventions as well as the source of stone used and possible substitutes..

This evaluation also has implications on the type of repair techniques to be undertaken and their application, as they can often be matched on various stages of decay, as exhibited by different stones or elements of the building.

We refer to this as a “palette of techniques” when various methods of repair are matched to particular stone problems, possibly in the one building or even the one façade.

As with all repairs of an historic building the best approach is to be conservative in the extent of the works and retain the maximum amount of historic material. Decayed stonework can contribute significantly to the character and patina of age of an historic building and should not be removed as a matter of course. Where stones are hastening the overall decay of a building however or their condition constitutes a health and safety risk their repair will be necessary.

### 3. Repair Techniques

#### (a) Complete Stone Replacement.

This by its description is quite obviously complete replacement with new stone, which can be either newly quarried stone or salvaged stone.

This is usually only undertaken when failure of the original stone is such that none of the other techniques can be applied, and is often associated with large-scale failure

due to fracturing or large scale spalling where it has created large losses of stone.

The problems of replacement stone are also aggravated by finding suitable compatible alternatives. Not every type of stone is currently available or quarried and matching should be geological; the durability and qualities of the replacement stone should relate to its particular location; and the visual qualities, is, colour and texture, although these are often most paramount from a client/user viewpoint.

Complete stone replacement is not generally considered as good conservation practice in that all original stonework is replaced. Replaced stone in most cases should be matched to the original face of the stone and not to adjacent weathered surfaces. A rule of thumb is that if it is not causing a structural or a health and safety risk then leave it alone. Weathering issues can often be addressed by careful use of flashings.

### **(b) Indenting**

In essence a variation of the complete stone replacement system when individual stones are being considered for either total replacement or refacing.

Selection of a suitable new stone is again important, the geological match being critical.

The new 'face' is usually in excess of 75 mm in thickness and is dependent on the amount of decay on the 'mother' stone. Fixings must be non-ferrous with cramps or pins often set in resin, with a suitable mortar applied to the joints. It is important that any mortar to the rear of the indent is lime rich and does not create a barrier to moisture transfer

Good practice usually means that a complete face of the original stone is replaced. However, small localised repairs can also be undertaken using this technique to replace broken elements. Care needs to be taken to consider the overall aesthetic impact of such work on a building.

The main advantage of this refacing technique is that it is only a facial repair and less disruptive than having to remove the whole stone from the body of the wall. Some stone features like cornices are tied deep into an inner wall and the consequent structural considerations of replacement are avoided.

### **(c) Plastic Repairs**

The very description is almost a misnomer and possibly contributes to many of the failures observed with this technique. The 'plastic' refers to the fact that the material is mouldable and can be placed and allowed to 'set'. Architectural dentistry is perhaps a more helpful analogy, this technique should only be used for small localised repair.

The material is itself a mortar and there are a variety of mixes available in order to suit the repair, but the most important factor is the porosity of the mix with the natural ingredients being chosen to provide colour match, etc. Sand cement based mortars used in the past can be counter productive removing original stone as they fall off or hastening decay. They will not be permitted on listed buildings. Care should also be taken with resin based alternatives that they are not too strong for a particular stone. Lime based repairs are often a better alternative, these require skill but because of their porosity they form less of a barrier to moisture movement.

The other major item often ignored with this technique is the need for a mechanical method of fixing as opposed to chemical bonding agents. Correct cutting back and

preparation is required to find suitable sound stone. Non-ferrous cramps are required to form the mechanical key with successive layers of mortar build-up to form a composite repair.

Original joints and stone profiles should be retained and pointed as original stones, maintaining the jointing system. Tooling marks and other patterns of the original stone should be reproduced.

#### **(d) Chemical Treatments**

These should only be considered as a last resort and should be based upon detailed analysis. Experience has shown that the long term effects will be hard to quantify. In common with 'plastic' repairs this technique offers a method of repair that can be seen as 'economic', but long term problems if not used with care can exacerbate the costs of future maintenance. If such a technique is considered it is vital that detailed records of the application are kept for future reference. The main current area of use in Northern Ireland is with sandstones, particularly the poorer quality ones, eg, Scrabo stones which can exhibit large scale areas of decay and surface dusting/scaling.

There are two techniques of chemical treatment - consolidants and water repellants. They should not be confused.

#### **Consolidants**

These aim to restore the binding element in the stone matrix thus reclaiming the strength of the original stone. Whilst the application of the chemicals is comparatively simple and does not require traditional stone masonry skills, the technique must never be undertaken without a thorough laboratory test programme. This identifies the geology, and physical and chemical properties of the stone, in order to allow assessment of a suitable chemical choice and to determine the reaction and depth of penetration. This establishes a hardness profile which is consistent through the depth of the stone, yet does not restrict the porosity of the stone itself.

#### ***Water repellants***

These may be necessary for water protection, which again must be fully tested prior to application to control water related decay mechanisms. These systems must never be viewed as 'cure alls'. Their use must be well researched and evaluated.

All surface applied techniques are at the mercy of the operative applying them and they rarely penetrate more than 25mm. They may cause a chemical change between this outer layer and the rest of the stone hastening decay mechanisms at the interface. Water repellants are likely to need to be reapplied on a regular timespan. There is a real danger that once water gets behind this surface it will be trapped in the wall adding to damp and decay problems in the long term.

The associated chemistry and geology may be well beyond many professional architect's traditional fields of expertise. Laboratory and site testing with specialist personnel is strongly recommended.

#### **(e) Re-dressing**

When surface failure has occurred a technique sometimes considered is re-dressing of the stonework to its original profile. It is a skilled stone mason's task.

It is also possible to reface chemically consolidated stonework as discussed under item (d) particularly rockfaced walling that has deteriorated on the face.

Generally only 25-30 mm of the decay stone is removed to allow realignment to the original profile and is used for decayed stone that is particularly deeply bedded within the wall which has minimal decay, yet is disfigured. Doorcases and window cills are some particular examples. This technique should not just be considered as a cosmetic exercise. Care should be taken to recreate tooling and detail lost by the process. Disk marks are often the result of poor application of this technique. Hand held disc cutters rarely provide a satisfactory result.

### **Other techniques:**

#### **Stone cleaning**

This should only be carried out after careful consideration of the likely effects on the material. Cleaning has resulted in hastened decay in many instances and can be visually disruptive - particularly if a building forms part of a group or terrace. The appropriateness of this technique is often linked to the type of stone found on the building. See technical note 52.

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