Preliminary Report into condition and decay of exterior stonework,

Robin Hood’s Bay Men’s Institute

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Robin Hood’s Bay Men’s Institute was formed shortly after WWI, providing alcohol–free recreation and support for men returned from the battlefield (pers comm. Patrick Holdsworth). It occupies an 18th century building set back a little from the sea, at a right–angle to the shore.

The building is of squared deltaic Jurassic sandstone, sourced locally from the North York Moors, with herring–bone tooling, a typical pattern in the area. The masonry is in a generally sound condition for a building of this age in this relatively exposed location. Significant areas of masonry, however, have suffered significant and exponential erosion and decay which is currently on–going.

The areas of decay present severe powdering and loss of matrix. Disaggregated sand grains are evident along the base of the building and upon cills. The most obvious cause of this denaturing of the stonework is salt. Salt passes into porous masonry in solution and as the masonry dries, the salt will crystallise and expand. Depending upon the pore structure, this process will cause more or less damage to the face of the stone. A tight pore structure will lead to more rapid decay than will a more open one – the expansion of salt crystals will break apart the matrix of a sandstone, robbing the grains of sand of ‘glue’. They will powder and fall away progressively.
The most common sources of salts in masonry are from the ground, carried by ground moisture wicking into the fabric of a traditionally constructed wall, or from air–borne pollution, which will combine with calcium carbonate present in the stone, and with that in the mortar to generate the formation of calcium sulphate (gypsum), which is itself a salt and which will expand upon crystallisation. In urban environments, road salt subsequently splashed onto walls by traffic will also deliver damaging salts into adjacent masonry. North York Moors sandstone contains a certain amount of calcium carbonate and is vulnerable to degradation by gypsum salts formed in a polluted environment or in close proximity to high concentrations of vehicle exhaust emissions as well as to the effects of road salts.

The environment in Robin Hood’s bay is little polluted.

The lowest courses of stone of the Institute building are generally sound, and Robin Hood’s Bay is generally frost and ice–free, so that road–salts are unlikely to be a factor in this pattern of decay. Similarly, salts carried into a wall by rising moisture will tend to cause damage in a fairly defined horizontal area at the drying zone, typically some three or four foot up the wall, the point at which capillary action is no longer strong enough to carry the water upwards. Without the water, the salts will crystallise and may cause significant decay and degradation in this location.

This is not the pattern of decay on the Institute building. The areas of decay are much broader and almost random. Salts are the almost certain cause, however.

It is tempting to assert that salt driven in from the sea might represent a contributory factor. However, one might expect more extensive areas of decay and none so localised were this to be so – as well as similar decay to surrounding, or even more exposed buildings in the town. This is not the case.
Adjacent and neighbouring buildings do not reflect this pattern of decay, even where they have been repointed with hard cement mortars, which might be expected to maximise the potential for such decay.
Wind may well be a factor in the levels of decay and their location. The lower section of the Men’s Institute building are shielded from direct exposure to salt-laden winds by the building below. The upper levels of the building are not. These upper levels are in a sound condition. However, the wind may whip around the building below and strike the lower levels of the Institute with accelerated force – contributing to the exponential rate of decay of already salt-laden masonry.

Salts are hygroscopic, attracting moisture to themselves from the atmosphere. Moist sandstone is more vulnerable to decay by wind – especially of this wind is even slightly laden with sand particles.

This may, therefore, be a factor.

The process of accelerated decay began whilst the building retained ordinary Portland cement mortar, a C20 repointing of the originally lime mortar bonded elevation. This hard and impermeable mortar may have accelerated and exacerbated the potential for decay; it will have trapped salts and redirected salts into the stonework but the source of these salts remains a conundrum. Had some salt-laden industrial activity taken place in the basement of the building? Has the basement been used for fish-salting in the past, leading to a concentration of salt in the walls which the presence of opc mortar allowed to become damaging?
The Men’s Institute building has been recently repointed with ‘lime mortar’ in an attempt to arrest the decay. This has not been achieved – the stonework has continued to erode. Much of the repointing itself has failed and has fallen or been washed out.

Unfortunately, the putty lime mortar specified by the National Parks Authority at the time was not used by the builders employed to repoint the building – not, at least, in a form that might be recognised as such by a conservation mason.

Putty lime was clearly added to the mortar – but it was not thoroughly mixed into the aggregate: lumps of it are clearly visible within the mortar that remains. Such significant inclusions of putty lime unmixed with aggregate will seriously weaken the structural integrity of the mortar as a whole, the strength of which will be variable even within one joint. The lumps of putty lime will wash out, leaving voids in the mortar joint. Driven rain will penetrate parts of the joint more extensively than others and will sit behind the harder parts. Indeed, the harder, denser parts are very much harder than the randomly dispersed dollops of unmixed putty lime – far harder certainly than might be expected of a poorly mixed putty lime mortar. Quite clearly, therefore, ordinary Portland cement was added to the mortar by the contractor, contrary to the specification.

Beyond this, the Secretary of the Institute does not recall any water running from the scaffold during repointing work; nor that there were any hoses present on the site during the works. This indicates that the contractor had no awareness of the need to well-wet the masonry and the joints of a building when working with lime mortar; nor of the need to control the set of the mortar by keeping it moist for a reasonable period to facilitate the curing and proper carbonation of the mortar.

Lime mortar placed into dry joints and dry masonry will not bond to the substrate and will dry too quickly for effective carbonation to occur. The mortar will rapidly fail, and this rapid failure is evident across the whole of the elevation of the Men’s Institute.

The good intentions of the specifier and of the custodians of this building were sabotaged, therefore, by the inexperience of the contractor and his incompetence to work with traditional lime mortars.

It is impossible to say, therefore, if the lime pointing of this building would arrest the decay of the stonework of its lower sections. The building has yet to be pointed with lime mortar.
Recommendations.

The uncertainty surrounding the source of the salts that are causing the decay forces caution upon the quest for a solution.

Further research may throw up an answer as to where these salts have come from. If this source is no longer active, then the application of a poultice to draw out some of the salts would be advisable before any repointing takes place. This might be achieved by the temporary application of a clay-based render to the most seriously affected areas. Salts will be drawn into this and will crystallise upon the face of the clay render. These salts may then be brushed or hoovered away. They should not be rinsed off with water.

Repointing should then be carried out using an appropriate and thoroughgoing lime mortar applied in keeping with proper procedure when using lime mortars and according to best practice by skilled craftsmen experienced in their use.

It is my opinion that a putty lime mortar deployed without pozzalanic additives would not endure in this relatively exposed location. Putty lime mortars without pozzalanic
additives (such as Metastar or brick dust) should primarily be used for internal plastering.

The addition of pozzalans makes the mortar behave as if a hydraulic lime, an initial set being followed by more gradual carbonation, begging the question, why not use natural hydraulic lime, for all that there will be a slight loss of plasticity?

Natural hydraulic limes were produced regionally in the historic period and NHL of similar properties – especially in lesser strength than imported French NHLs – to locally manufactured limes are readily available once more, produced in Lincolnshire.

It would be my recommendation, therefore, that repointing of this building should be carried out using a mortar composed of relatively fine but well-graded sharp sand, a small quantity of limestone dust and Singleton Birch NHL 3.5.

Importantly, however, this should not be rushed into. It is proposed that test panels will be executed in September this year and that the performance of these will be examined in the spring with a view to full repointing of the building being carried out during the summer of 2009.

Mortars will be:

1) 4 parts sharp sand: one part limestone dust: 2 parts putty lime + metastar
2) 4 parts sharp sand: one part limestone dust: 2 parts NHL 2.0
3) 4 parts sharp sand: one part limestone dust: 2 parts NHL 3.5

NHL will be Singleton Birch. Sharp sand will be Jewsons ‘concreting sand’ passed through a garden sieve to remove the coarsest aggregate; limestone dust will be Guiting stonedust from the Cotswolds. The addition of stonedust imparts greater porosity as well as improved plasticity. This will produce a mortar of a warm, beige hue, similar to that of the original mortar and tonally in keeping with the stone.

nigel copsey august 2007
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We place a strong emphasis upon the promotion of open, honest and unhierarchical dialogue between all those involved in a project, as well as engaging with the craft, history and cultural significance of the building or monument itself.

We believe that there are no circumstances in which the use of ordinary portland cement mortars may be either necessary or justified in the context of a structure not originally constructed using these materials.

We use lime mortars and traditional materials whose performance has been tested over centuries of use in all climates and conditions.

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