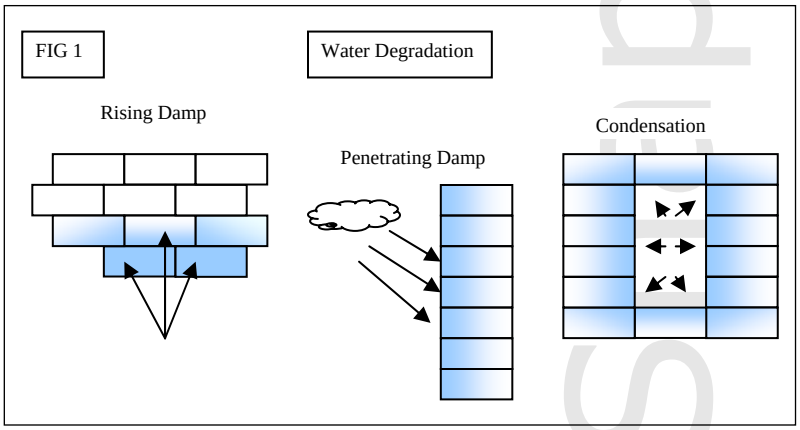
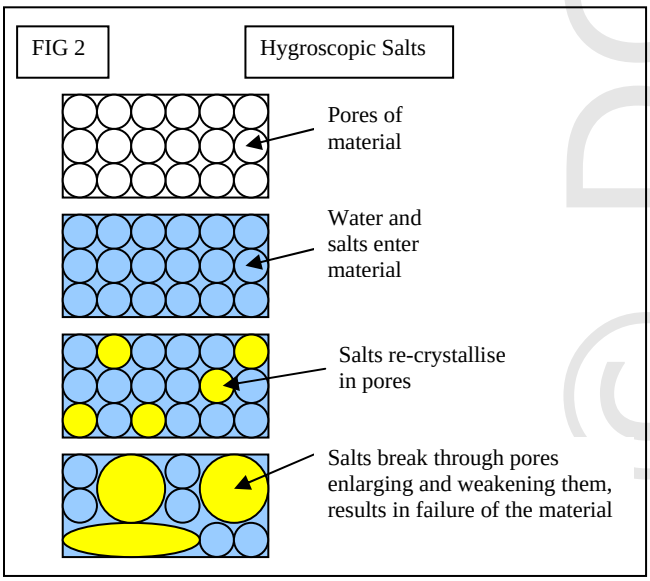
The effect of outdoor environments on historic buildings

Part 1 – degradation of buildings

Buildings of all ages, and all materials are subject to degradation due to external environmental factors. Materials will react differently and need varying methods of conservation to limit this unavoidable process, but knowing what is causing the degradation can help greatly in the overall battle against the elements.

Degradation can come from many sources, one of the most commonly seen is the effect of water. Rising damp occurs largely in older buildings without the protection of a damp course and is where water moves through capillary action in the stone, brick or woodwork (fig1). Other water problems are through direct precipitation, or penetrating damp (fig1). This is especially a problem in buildings where gaps in the masonry, pointing or windows occur, as this provides a route for the water to enter (Ashurst 1995). Major problems can also be caused by condensation within the building. (Weaver, 1997) Water within the air will condense out, often onto cool external walls or windows, if protective coverings are applied this water can be trapped within the walls. The water can cause extensive damage to both internal and external components of a building, cracking of stonework and brickwork is common when freeze/thaw action (Weaver, 1997) causes an expansion of water within the pores of a material. But not only does the building material get affected but the mortars as well, allowing more water to enter the building, then the process can occur again and again. Staining can also occur, on a small area this is no more than a nuisance but when a whole building is affected cleaning can be difficult. This problem though could be avoided by simple maintenance of the brickwork and the keeping clear of guttering and drains. The biggest problem though is through hygroscopic salts, these salts are present in the water and when they enter a building re-crystallisation can take place. This can cause a variety of responses dependant on the type of salts, some attract mould and bacterial growth, others absorb water, and some will just magnify the problems of freeze/thaw action (fig 2) as well as the occurrence of a powdered material on the buildings surface. The process of water or salts expanding doesn't just occur in extremes of temperature, daily and seasonal changes can be just as damaging. This though is unavoidable, if water enters a building this process is inevitable. Little can be done but to stop more water entering. If salts are present, there are methods of removal (Ashurst, 1995). Firstly absorbent clay could be added to the surface of the building; this sucks the salts into it and then can be safely removed. The second method is more extreme and requires the removal of large areas of pointing and replacement with a special salt





absorbent render. This render will decay at an accelerated rate but will also remove the salts, treatment with both methods may take an extremely long time and replacement of the treatment may be needed. Corrosion of metals, rotting of wood are all caused by water, this though can also contain chemicals, when polluted water such as acid rain (water containing sulphur dioxide) hits buildings it can actually dissolve the buildings structure, little can be done about this except the application of protective coatings. The ratio of cost to benefit should be investigated before any work is carried out.

The wind itself can also cause degradation to buildings, this occurs due to a process called abrasion. When particulate matter such as dust, sand or vegetative debris are caught, some is blown by the wind. This can slowly hit buildings gradually removing the outside coatings (e.g. firing skin on bricks) and fracturing exposed edges, this can allow water to enter and creates an unappealing appearance. The effect of light on buildings can not be underestimated; the fading of materials is not the only problem. The ultraviolet radiation emitted can energise particles within the building materials and over extended periods cause degradation of certain minerals within the structure, this in turn can affect the stability of a material (Microsoft, 2002).

As well as general affects of weather, natural disasters can have a huge impact on buildings both old and new (fig 3). This damage can rarely be avoided and if extreme can totally demolish a building. The most dangerous thing though is the number of possible disasters: earthquakes, floods, landslides, avalanches, volcanoes, tornadoes, fires… the list is endless, and all can affect buildings in different ways.

Loma Prieta Earthquake FIG 3

Biological and botanical decay is often extreme, and can be as damaging if not more damaging than the chemical problems. Animals, birds, insects, fungi, bacteria, and vegetative matter can attack almost every type of material in some way. Ivy on buildings is a well known problem although it is actually widely used to protect the surfaces from the effects of weathering. Unfortunately though Ivy has aerial roots, it is these which attach themselves to the mortar spaces between the stone or brick, this degrades the mortar and can cause pieces to fall out. Lichens and fungi can also be a problem, often attracted to the surface due to excess water they can secrete acids and chemicals which ‘eat’ at the building. Tree roots, animal burrows, birds, and animal urine also cause problems and as with most degradation problems the only solution is removal and prevention, this though is often difficult and expensive to do correctly so short-cuts are taken. These shortcuts are among many of the man-made degradation problems buildings have to suffer, inappropriate rendering such as with Portland cement (Ashurst, 1995) can cause cracking and movement within the stone which allows other water based problems to occur. Vandalism is also a newer but just as important factor, windows can be smashed, walls covered in graffiti, railings broken and historic pillars climbed on. The only protection which really works in this situation is to catch and in some way punish those responsible, often a legally impossible aim.

Degradation can come in many forms and affect buildings in a huge variety of ways, the key to limiting the problems caused is through regular inspection and maintenance of a building. By doing this potential causes of degradation can be spotted before they become dangerous problems.

<u>Part 2 –Elvaston Castle</u>

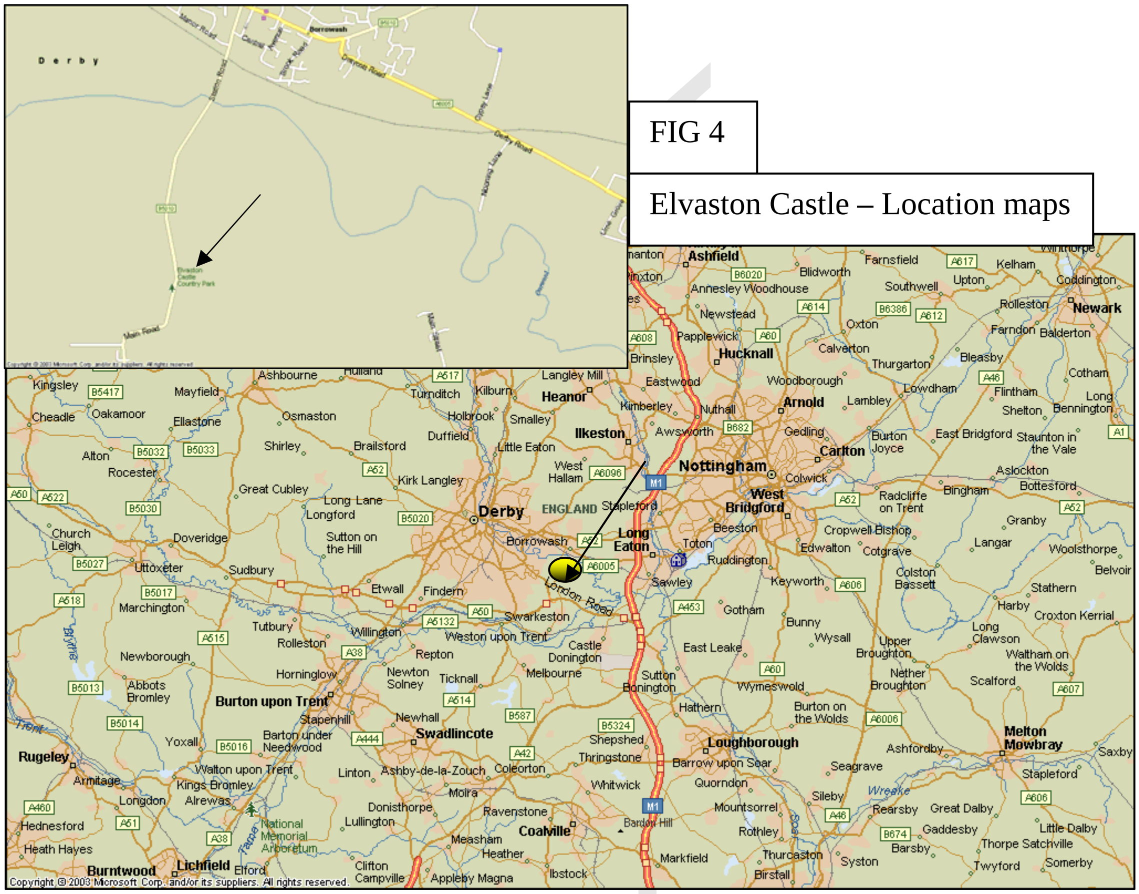


FIG 4

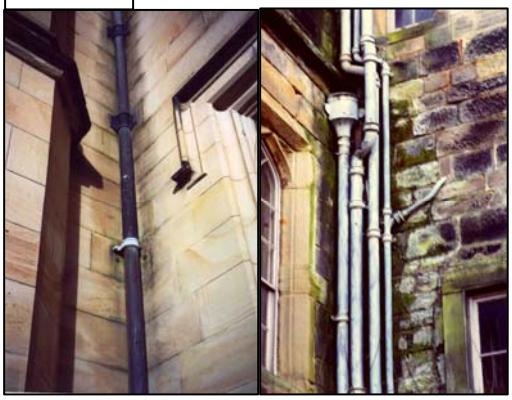
Elvaston Castle – Location maps

Elvaston Castle (fig 4) is originally a ninth century estate owned by the Stanhope family, the Earls of Harrington. Extensively adapted the house now seen is a nineteenth century design completed by the 3rd Earl during the gothic revival, only a small part of the original building now remains (Fig 5 - far right of picture). The building now is falling into the first stages of degradation after years of neglect in the hands of many owners and the local council, it now stands as a largely empty shell far from the splendour it once was (Milton and Sisson). The main structure is made of a cream/white building stone set with small joints. Some of the original brick and stonework is still visible with wider jointing and a much darker red/brown colouration. In places I believe this brickwork has been covered in a plaster-like finish to blend with the newer stone. Sandstone surrounds have been used on the quarry tile windows and some original leading on the drainpipes can still be seen. This leading is also seen on the lower roofs as well as old thick slate tiling.

FIG 5

After examining the building, evidence showed me that maintenance must over the last few years have been limited, water damage I believe is the chief cause of the degradation. Figure 6 shows how water is affecting the building, in this example most of the damage appears to be cosmetic (e.g. staining) but the build up of lichens and moss in the right hand picture could in the future have wider complications.

FIG 6



These mosses are already accumulating in the gaps between the bricks and stone. This could indicate areas of water logging, possibly caused by leaking drainage pipes. The build-up of salts as this areas cause can be ruled out as the problem is severely confined; only the brickwork within perhaps 60cm of the drainpipes has been affected, if salts were the cause a much wider area of damage would be seen. To solve this problem I would recommend the cleaning of the stone work. This could be done simply with clean water and a soft brush. After this all the drainpipes need to be checked for leaks and blockages on a weekly basis to stop excess water 'sitting' on the building. Potential problems can be seen at ground level, fig 7 shows the honey combing effect caused by freeze/thaw action on the lower brickwork. Due to the presence of a moss layer higher up I believe this is caused by either rising damp or regular water logging. In another area a possible reason for this dampness shows the difficult nature of the maintenance in an area with many trees (fig 8). These leaves not only block up drains and gutters but also hold water against the building. Without room to 'breath' this then rots and attracts bacterial growth as well as secreting acidic chemicals which can 'eat' at the stonework. The worst visible damage can be seen in fig 9. This could be due to inappropriate rendering, but my belief is that a combination of water and a cold prevailing wind has caused freeze/thaw action at an accelerated rate pealing off the thin layers, and in some places caused large cracks to appear in the brickwork. This problem is clearly in the extreme and major re-surfacing is needed, this will have to be in the correct original style (possibly lime based) and regular inspection must be carried out. If any more damage is seen a different mixture or new protective covering may need to be considered.

FIG 7

FIG 8

FIG 9

Vegetative growth so far can be seen to cause little damage and some areas have already been cleared of Ivy (fig 10) but other locations around the building have been identified where in the future problems may occur (fig 11)

My recommendation would be the total removal of all vegetative matter on or near to the building, all stone and brickwork around these areas would need careful cleaning and re-pointing using an appropriate mixture.

The effect of atmospheric pollution can also be seen on many of the photographs, fig 10 shows the contrast between the natural stone (left) and the darkened colouring (right) of the polluted stone. This though is unavoidable and little can be done except for cleaning, a possible deterrent is that of a lime wash but this is by no means a guaranteed solution.

FIG 10

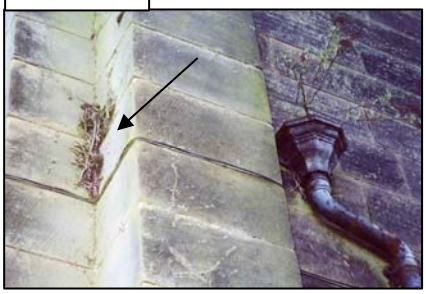
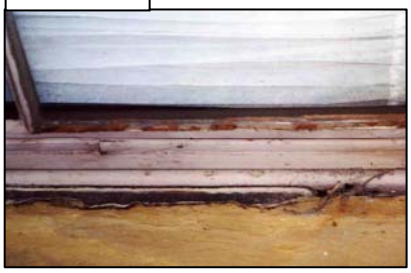


FIG 11

The tiling on most of the building is inaccessible, but one area demonstrated the possible condition of the main roof (fig 12). If the rest of the roof is in this condition replacement of many of the broken tiles may be needed to stop water penetrating into the building itself. This itself would be a complex job and due to the cost of solid slate tiles probably very expensive. If not completed the internal roof joists may become subject to wet rot, if this did occur extensive removal of the roof timbers could be needed. Evidence of rot is in most of the newer wooden window frames (fig 13) these can be replaced fairly easily and when done a protective coating such as paint should be added to stop future damage. This rotting wood has simply been caused by water, as most of the damage is on one side I believe it is in particular penetrating damp due to the prevailing winds.

FIG 12

FIG 13



The final piece of degradation seen is saddening; fig 14 shows the extensive damage caused by vandalism. After speaking with security guards (personal communication) I am informed that the holes in the window were caused by stones being thrown at it. Apparently the damage has been such that many of the less historic windows are being replaced with laminated glass to stop them smashing and avoid replacing them. In terms of historic value this is devastating, and a poor attempt at renovation, but if the vandalism continues a balance between cost and realism must be achieved.

FIG 14

The Castle and its surrounding grounds are a popular place for many people, they provide entertainment and a sense of cultural or historic pride. The degradation of this building though is becoming extensive and will not get better until regular maintenance work, inspections and better control of the external environment is achieved. This though is unlikely to happen whilst the castle is under county council control. My overall recommendation then to the estate is to simply limit the one main degradation factor, water. With no cost and little effort this problem could be reduced by simply keeping gutters and walls clear of debris and vegetation. If done the quality of the building may not improve but many of the future problems may not occur and allow time for more investment from external sources to correctly restore the building to its former glory.

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