Environmental Monitoring
Holistic & Sustainable Solutions to Conservation

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Introduction

Deterioration of historical building materials such as in Churches, Abbeys, Castles, Monuments and buildings of historic and architectural interest are attributed to changes in the built environment. The main environmental parameters affecting the decay of materials are water, humidity, temperature and lack of ventilation.

The majority of environmental problems are associated with building defects leading to water ingress, condensation and dampness in the building fabric. Severe salt efflorescence, staining, blistering of finishes and timber decay in buildings are mainly the result of water penetration.

The causes of deterioration are influenced by the internal building environment, which has a varied microclimate depending upon the building structure and the envelope of the internal building fabric.

Environmental Monitoring

To determine the causes of the above, environmental monitoring and investigation is best carried out. This is done by employing a range of hand held instrumentation, physical sampling and sensor technology to monitor various parameters within the fabric of the building.

Environmental Monitoring, Methodology and Overview of Approach

The first step to investigation of a problem building is to carry out a thorough inspection of the building for defects. The second step is:

- to Establish moisture contents in affected materials, such as timber, plaster, masonry, insulation materials and textiles.
- to Establish the humidity, temperature and dew point in the environment. Both internally and externally.
- to Investigate in greater detail as necessary the moisture profiles in large dimension timbers and across masonry masses.

This information can be determined by:

- Moisture contents of timber can be taken directly by the use of resistance based moisture meters. Probes can also be used to measure moisture contents at depth in large section timbers and those built into masonry.
- Surface moisture readings in plaster and masonry can be taken using moisture meters. These will indicate if a wall is dry but can give false readings of dampness, see below.

- Were possible mortar samples should be taken of the areas affected to determine accurately the moisture and salt content of the masonry. This does however have the disadvantage of not being non-destructive.
- Data loggers can be used to measure the environmental parameters, temperature, Humidity and dew point both internally and externally.
- Specialist probes can be used to measure moisture across masonry walls.

The results of all or some of the above tests will establish the cause and enable a solution to the problem to be put forward.

Mortar sample analysis

Mortar sample analysis is one of the most important tools in establishing accurately the moisture levels in masonry and plasters. Samples can also give levels of salts present in the wall s, which can establish whether a problem is current or historic in nature. The type of salt can also be determined which can be useful when trying to establish whether there is a genuine problem with rising dampness. This method does have the disadvantage of causing some damage, which would not be suitable in some situations.

Timber Moisture Contents

Timber moisture contents above 20 percent indicate unacceptably high moisture levels in the building. If this is a general moisture level then this is likely to be associated with high humidity in the building. Localized high readings are more likely to be associated with a building defect. For instance, high readings in a built-in end of a timber would indicate that the wall was damp. This represents a risk of future timber decay. The options are to isolate the timber from the wall, provide an air gap around the timber to allow the timber to breathe or to monitor the timber as the wall dries out after repair or removal of the damp source. Which option is chosen will be determined by each situation.

Masonry moisture Monitoring profiles across walls.

Measurement of the moisture across the thickness of a wall is a specialised task as there are no instruments available off the shelf for carrying this out. Tailor made probes are used based on hygroscopic materials which are placed in the wall at varying depths in their own sealed atmosphere. These are left in the masonry for a period of time and readings taken. This will give an indication of moisture levels across the thickness of the wall and combined with temperature and humidity readings both internally and externally will give an indication of the moisture source, see below. They have the limitation however of being inaccurate at higher moisture levels.

Environmental Data Loggers

Data loggers measuring temperature and humidity are useful to determine whether there is for instance an abnormally high humidity or risk of condensation in a building.
If readings are taken on both the interiors and exteriors of the building dew points within materials such as masonry masses can be calculated.

Stabilising the Historic Environment

Once the above investigations have been carried out a strategy can be put forward to stabilise the building environment.

It is important to stabilise the historic building environment. For the holistic and sustainable conservation and preservation of the building, various building works will be required to prevent further water penetration and to maximise ventilation to damp affected materials.

Correction of these building defects, combined with measures to dry down the wet areas and to protect the decorative interior finishes by allowing ventilation of the wet areas, will prevent further deterioration.

Until the drying out of the building fabric and its associated timber elements is completed, any other actions to remedy the deterioration problems will be ineffective and a waste of time and resources. Continuous long-term monitoring and preventative maintenance of the building may be necessary and will provide the following information:

- on the state of moisture equilibrium and balance (moisture sources, reservoirs and sinks) in the building environment, building fabric and structural elements as the building dries out;

- will allow co-ordination and scheduling of work stages to prioritise the remedial work to achieve acceptable levels of moisture in the masonry and timber to prevent future deterioration problems;

- will allow a cost-effective, long-term holistic approach to environmental stabilisation of the historic environment.

Author's Biography

Dr Jagjit Singh, Director of Environmental Building Solutions Ltd, is an independent consultant specialising in building health problems, heritage conservation and environmental issues. His current research focuses on interrelationships of building structures and materials with their environments and occupants.

Further Reading

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