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HEALTH AND SAFETY

Dry Rot in Buildings - its Biology & Control

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Timber is a major component of most historic buildings and continues to be a useful structural building material with pleasing aesthetic properties as well as being an energy-efficient and renewable resource. However, timber when used in buildings can provide specialised ecological niches for organisms such as fungi and insects. The most common and destructive to timber are *Serpula lacrymans* (dry rot), *Coniophora puteana* (wet rot), *Anobium punctatum* (common urniture beetle), and *Xestobium rufovillosum* (death watch beetle).

The ravages of dry rot are familiar, as is the destruction caused by some eradication methods. *Serpula lacrymans* (dry rot) is a fungus belonging to the same class of fungi as most of the common mushrooms and toadstools. Sexual reproduction is by rust-coloured spores, which are produced in enormous numbers by a fleshy, pancake-shaped fruit body, a sporophore, which can sometimes measure more than a metre in width. A sporophore less than one metre square can produce more than fifty million spores per minute for several days. The appearance of the fruiting body, together with a distinctive 'mushroom' odour may be the first indication of an outbreak of dry rot.

Spore germination requies a precisely favourable microclimate at the wood surface - a timber moisture content of 20% to 30%. Fine filaments known as hyphae appear, these form a white mass called the mycelium, which can colonise timber with a moisture content of 20%, growing at an optimum rate when it is between 30% and 40%. The fungal strands or rhizomorphs (aggregates of specialised hyphae) produced by the mycelium have the ability to spread through plaster, brickwork and masonry because of their relatively impervious, alkaline-tolerant, outer layer, and can extend a distance of several metres from the nutrients and water source to attack sound timber. Strands may grow up to 6mm in diameter and are relatively brittle when dry, and flexible when moist. The mycelia produce water by metabolic breakdown of wood and can translocate it from one region to another via these thick strands. It has been suggested that dry rot fungus can live on this metabolic water alone, but in practice the water is reduced by evaporation and dispersed within the dry timber by capillary action. At moisture contents of less than 20% the fungus becomes dormant and eventually dies within nine months to a year.

There are many fungal species causing decay of timber in buildings, the most common species being *Coniophora puteana, C. marmorata, Antodia sp, Phellinus continguus, Pleurotus ostreatus, Asterostroma sp* and *Donkioporia expansa*.

The Built Environment

The indoor environment results from complex interactions between the external environment, the building materials, the design, the contents, the activities in the building and the occupants. To try to manipulate any one of these factors without consideration for the effects on the others can be at worst ineffective and at best inefficient and costly. Building decay organisms cannot be eradicated from the building environment even by the most Draconian pesticide treatments. However, these organisms will only flourish in buildings if the environmental conditions are conducive to their growth.

Lack of repair and poor maintenance and management can often lead to the implementation of radical solutions (open heart surgery) to remedy building decay. Remedial treatment in the form of ubiquitous application of a cheap, general-purpose pesticide mixtures has often been used to compensate for deficiencies in the quality of materials, workmanship or maintenance employed in buildings. The problems with this approach soon became clear in that remedial treatment of the timber decay infestations with insecticidal fungicidal chemicals is not only expensive, inconvenient, unnecessary, and hazardous to the operatives and occupants but is also environmentally unacceptable. Orthodox measures could entail the loss of irreplaceable decorative finishes, floors and ceilings. Eradication of dry rot spores or insect pests in an historic building and its contents is in practice, impossible. The volumes of chemicals necessary and the toxicity required would be damaging both for the buildings and all its occupants.

Current Standard Practice

Remedial treatment of dry rot

Establish the size and significance of the attack. In particular if structural timbers are affected, carry out or arrange for a full structural survey to determine whether structural repairs are necessary and, if they are, take appropriate steps to secure structural integrity.

Locate and eliminate sources of moisture.

Promote rapid drying of the structure.

Remove all rotted wood cutting away approximately 300-450mm beyond the last indications of the fungus.

Prevent further spread of the fungus within brickwork and plaster by using preservatives.

Use preservative-treated replacement timbers.

Treat remaining sound timbers which are at risk with preservative (minimum two full brush coats).

Introduce support measures (such as ventilation pathways between sound timber and wet brickwork, or, where ventilation is not possible, providing a barrier such as a damp proof membrane or joisthangers between timber and wet brickwork).

Do not retain dry rot infected timber without seeking expert advice. There is always some risk in retaining infected wood which can be minimised by preservative treatment and subsequent reinspection.

Inspection

Diagnosis of Dry Rot in Buildings

The following techniques are used to diagnose the decay:

Physiochemical and morphological characteristics of decay;
Cultural characteristic of decay;
Genetic finger printing and protein profiles;
Trained animals.

Ecological Factors affecting Timber Decay

The environmental factors favouring the decay of timber are temperature, water, humidity and lack of ventilation.

Moisture in Buildings

The following factors contribut moisture in buildings:

- Penetrating damp/rising damp
- Condensation

- Building disaster
- Construction moisture
- Building defects

Fungi differ in their optimum temperature requirements, but for most the range is from about 20°C to 30°C. The optimum temperature for dry rot growth in buildings is about 23°C, maximum temperatures are about 25°C and the fungus is rapidly killed above 40°C. Timber moisture contents in buildings in the 20 to 30% range is ideal for dry rot attack and other infestations.

Environmental and non-environmental factors

The following environmental parameters affect susceptibility to building decay:

- Relative humidity
- Light
- Air temperature
- Dust
- Pollution
- Pests
- Handling
- Visitors
- Fire and water
- Air movement
- UV
- Cultural/organisational/management

The Greener Approach

Environmental control and preventative maintenance are preferred to Draconian chemical treatments, as they provide a long-term solution to the health of the building and its occupants. A correct scientific analysis of decay organisms combined with independent inspection can provide an alternative, less destructive solution. Controlling the environment of susceptible materials is the most acceptable method of preventing biological decay. Correct identification of the fungi and insect material is important as not all decay organisms are equally destructive; some rots are present in timber when it is cut or are acquired in storage. Fungal materials may also be dead or dormant, representing conditions now past.

Environmental control relies on controlling the cause of the problem by controlling the environment.

- Locate and eliminate sources of moisture
- Promote rapid drying
- Determine the full extent of the outbreal
- Remove the rotten wood
- Determine structural strength of timber and fabric construction
- Institute good building practice
  - ventilation
  - DPC
  - Isolation

Environmental control is complex and requires a multidisciplinary team of scientists, engineers, surveyors and computing skills.

The Environmental Approach Standards

In cases of actual or suspected problems of woodrot in buildings the following standards should be met by any remedial works:

a. Investigation should be by an independent specialist consultant, architect or surveyor to establish the cause and extent of damp and timber decay, and any potential risk to the health of occupants before specification of remedial work. This investigation should include:
   i. The inspection of all accessible timbers to determine whether they are subject to, or at risk from, fungal decay or insect attack.
   ii. The determination as to whether any wood rotting fungi found are active and whether their activity is significant in each particular case.

b. Specification of remedial work should be by an independent consultant as in a(i) and (ii). Such specification should provide for:
   i. The maximum conservation of materials
   ii. The future health of the building and its occupants
   iii. The minimal use of new materials

iv. The avoidance of chemical presticide use where possible

v. The use of materials and techniques with minimum adverse environmental impact.

vi. The minimum cost of the whole project including the costs of the proposed works, the disturbance of occupancy, future maintenance costs, and the costs of safe disposal of all waste materials.

c. Remedial building works should be carried out as specified above to control the timber decay, to prevent further decay and to correct any significant building defects resulting in conditions of high moisture content or poor ventilation of timber. These should provide for:

i. The reduction of the sub-surface moisture content of all timber to below 16 to 18 per cent.

ii. The isolation of timber from contact with damp masonry by an air space or a damp proof membrane.

iii. The provision of free air movement around timber in walls, roofs and suspended floors.

iv. The prevention of humidities in voids exceeding an average relative humidity of 65%.

v. The removal active fungal material and any timber affected to the extent that its function is compromised or adjacent structures put at risk. Measures to avoid contamination should be implemented in the case of insect infestation.

vi. The prevention of, or protection of timber from, sources of water likely to cause wetting, such as overflowing gutters, leaking plumbing, condensation and rising or penetrating damp.

vii. The removal of timber damaged by insect attack to the extent that its function is compromised.

viii. The removal of all builders rubbish from voids and cavities and vacuum cleaning to remove dust.

d. The use of chemical pesticides should be avoided wherever possible. Where their use is essential the following requirements should be observed:

i. The minimum use of fungicides consistent with the probability of reinfestation in the light of c(i) to (viii).

ii. The limitation of insectividal treatment to the locations of significant active insect attack in the light of c(i) to (viii).

iii. specific agents to be used on specific organisms only. 'Combined', 'general' or 'precautionary' treatments should not be used.

iv. Fungicides and insecticides must be currently fully approved under the Control of Pesticides Regulations 1994. Pesticides with special dispensation or licence as of right are not to be used. As a guide products with serial numbers greater than 3000 have gone through the full HSE approval procedure.

v. Pesticides should be applied in accordance with the manufacturer's instructions and within any regulations, codes of practice guidelines or recommendations currently recommended by the BWPA, HSE, NCC or other competent authority.

vi. The contractor applying the pesticide must certify that the treatment will not damage the health of the occupants, the structure or wildlife in and around it.

vii. The contractor must certify that the disposal of surplus pesticide, pesticide containers and treated waste materials is safe, non-polluting, and in accordance with all current central or local government regulations and guidelines.