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Wood Information Sheet

WIS 2/3-32
Subject: Protection
Revised: December 2011

Fungi and insect pests in timber

This Wood Information Sheet (WIS) outlines the more important types of fungi and insects which can affect timber. This is an overview of the subject with signposts to more detailed sources that are listed at the end.

With its relatively cold temperate climate, the UK is not seriously afflicted by insect pests. Termites, a major scourge of tropical and subtropical countries, are absent altogether (occasional accidental introductions have been swiftly eradicated). Another widely prevalent pest overseas, the house longhorn beetle, has a very restricted distribution in the UK.

Much unwarranted alarm can be caused by insects in buildings, although many do not attack timber. *WIS 4-17: Pests in houses* [1] describes the common types.

This WIS does not deal with attack by bacteria, soft rot fungi and marine borers. Refer instead to Eaton and Hales' *Wood: decay, pests and protection* [2].

Related WISs are:

- *WIS 2/3-16: Preservative treatment for timber – a guide to specification* [3]
- *WIS 2/3-33: Wood preservation - chemicals and processes* [4]
- *WIS 2/3-66: Specifying timber species in marine and freshwater construction* [5].

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Figure 1: Surface mould growing on timber
note that the wood immediately beneath the surface is still bright

Key points

- Chemical 'extractives' in wood confer resistance to bio-deterioration by fungi and insects.
- Sugars and starch can persist in the log or converted timber and can influence the susceptibility of timber to degrade by fungi and insects.
- BS EN 350-1 defines durability classes that rank the resistance of timber species to attack.
- BS EN 350-2 enables specifiers to identify species of appropriate durability.
- For resistance to fungi, BS 8417 contains guidance for specifying an appropriate durability class for a particular use class and desired service life.
- Fungi can cause staining, decay and weakening, while insects disfigure the timber or render it unserviceable by boring holes and/or consuming it.
- Fungi require a moisture content of at least 20% in timber in order to develop and cause damage.
- The variety and vigour of insect pests of timber are much lower in temperate regions than in tropical and sub-tropical regions.
- Termites are essentially a problem of tropical and sub-tropical regions.
- The lyctus (powder post) beetle is an important pest in tropical and sub-tropical regions and is also found in the UK.
- Ambrosia beetles infest freshly felled logs. Attack can be very rapid (within a few hours) unless protective treatment is carried out.
- Longhorn beetles are widely distributed in tropical and temperate regions. In the UK, the house longhorn is restricted mainly to Surrey where it is controlled by preservative treatment.

Timber

Timber is composed primarily of hollow fibres of cellulose, cemented together with lignin, a complex organic material constituting some 20% by weight of dry wood. The ratio of wood to air, the shape, variety and arrangement of the constituent fibres and the small proportion of loosely bound 'extractives' vary between species to give timbers that have quite different physical and mechanical properties (for example balsa and lignum vitae, both tropical hardwoods).

The chemical constitution varies little except for the 'extractives'. These confer the specific properties of colour, odour and, in relation to this WIS, resistance to bio-deterioration by fungi and insects. Sugars and starch form part of the vital system of the living tree; they can persist in the log or converted timber for several years under the right conditions and can influence the susceptibility of timber to degrade by fungi and insects.

Resistance to attack

Some timber species are resistant to fungal and/or insect attack, while others are susceptible. Typically, only the inner heartwood zone contains the extractives, whilst the outer sapwood in all species layer is extractive free and contains starch and sugars. Therefore, sapwood is essentially unprotected from fungi and insects, if the conditions for attack are satisfactory. This is important to bear in mind when the 'natural durability' of a timber species is quoted. This is assessed on the performance of test stakes in ground contact or on standard laboratory tests, and relates only to the heartwood. Consider the resistance of the sapwood of most species as the most susceptible class, that is 'not durable' or 'susceptible'.

BS EN 350-1 Guide to the principles of testing and classification of natural durability of wood [6] defines durability classes that rank the resistance to attack by:

- wood-destroying fungi
- insects (beetles and termites)
- marine organisms.

BS EN 350-2 Guide to natural durability and treatability of selected wood species of importance in Europe [7] enables specifiers to identify species of appropriate durability for a particular end use. If protection is needed to achieve an adequate resistance to attack, *BS EN 350-2* also classifies species according to their 'treatability' (the ease at which the timber can be treated with a preservative).

Fungi

Fungi can cause staining, decay and weakening, while insects disfigure the timber or render it unserviceable by boring holes and/or consuming it. Fungi require the timber to have a moisture content of at least 20%, if they are to develop and cause damage. Internal timbers, even in unheated buildings, should never reach this level unless there is a defect that results in a leak or water ingress. In many external situations out of contact with the ground, the moisture content of timber may be kept below 20% by correct design and detailing, which minimises wetting and promotes drainage of rainwater and adequate ventilation. Such measures do not, however, necessarily confer immunity to insect damage since some insects can attack wood with a moisture content of less than 20%.

The spores of wood-decaying or staining fungi are so widespread that avoiding attack by sanitary measures is impossible. Long service life, in an environment suitable for fungal development (where the moisture content of the timber is over 20%), depends on high natural durability of the timber species used or effective wood preservation treatments with fungicidal chemicals. The degree of preservative protection required to prevent infection from spores is less than that needed to stop an existing fungal attack of wood, or to stop fungus in the soil growing into adjacent sound timber. See *WIS 2/3-16* for specifying preservative treatments.

Table 1 classifies the resistance of timber to attack by fungi, according to BS EN 350-1.

Table 1: Classes of natural durability of wood to fungal attack

Durability class	Resistance
1	very durable
2	durable
3	moderately durable
4	slightly durable
5	not durable

Table 3 of *BS 8417 Preservation of wood. Code of practice* [8] contains guidance for specifying an appropriate durability class for a particular use class and desired service life.

Sapstain fungi and moulds

Various fungi cause deep-seated (sapstain or blue stain fungi) or superficial (surface moulds, *Figure 2*) discolouration of damp timber and wood products. Both types feed on the cell contents and stored food reserves in the timber (i.e. starch and other sugars), and are therefore generally confined to sapwood. They

do not cause loss of strength but can reduce the value of timber, or even render it unsaleable by spoiling its appearance. Even if arrested in its early stages by reducing the timber moisture content, sap-stain or mould attack can revive, if moisture content increases, and can cause disruption of paint or varnish films in service.

Moisture content greater than 25% is required for active sapstain development, whereas surface mould growth can continue down to about 18%, if high relative humidity persists. Sapstain is of greatest consequence with softwoods and light-coloured tropical hardwoods, such as obeche, ramin, celtis, jelutong and koto – all species where even the heartwood does not contain sufficient extractives to provide protection. Debarked logs are most susceptible, but infection can enter via log ends, branch stubs, damaged bark or bark beetle holes. Converted timber is also susceptible.

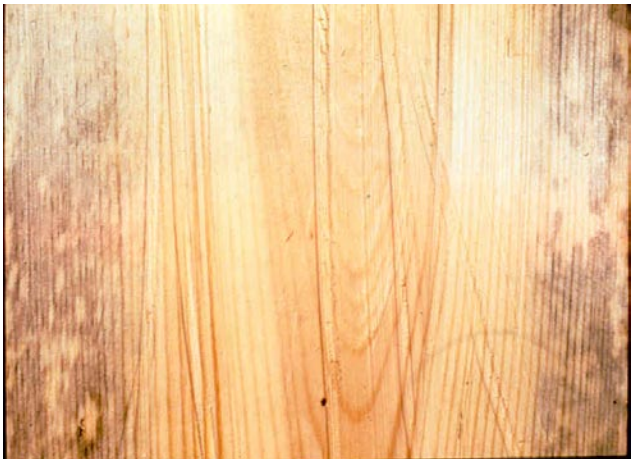

Figure 2: Sap stain in the sapwood of Scots pine

Wet-rot fungus

These fungi cause decay of timber with a moisture content over 20%, and are subdivided into white and brown rots *(Figure 3)*. White rots destroy both the cellulose and lignin components of the timber, while the brown rots attack the cellulose and leave the lignin as a brown residue. Numerous species of fungi are involved worldwide, varying in their vigour, timber preferences and susceptibility to control by wood preservatives.

The first line of control is to keep the timber moisture content below 20%. In certain external applications where the timber is permanently in ground contact, such as poles, posts and sleepers, this is impossible so it is necessary to rely on the inherent natural durability of the timber or wood preservatives. In other situations, such measures are a back-up defence or form of insurance against the failure of design and maintenance measures.
Wet rot fungi cause loss of strength and eventually complete disintegration of timber. Their rate of development depends on temperature, moisture content of the wood, oxygen availability and the durability of the timber.

Figure 3: Wet rot decay in window joinery due to poor detailing between the sill and brickwork

Dry-rot fungus

This title is a misnomer in that this species of brown rot fungus (serpula lacrymans) requires timber to have moisture content of at least 20% for attack to occur. The distinctive feature of this species is that it is able to 'translocate' moisture and form its own wet zone in timber, thereby facilitating conditions suitable for decay to occur. It typically thrives in damp, humid, unventilated spaces in buildings and, once established, is very persistent *(Figure 4)*.

Figure 4: Dry rot attack in building

Insects

World-wide, the most economically serious insect pests of wood products are termites *(Figures 5 and 6*). The wide range of beetle species, whose larvae tunnel in wood for food and protection, come a close second.

Termites

Table 2 classifies the resistance to attack by termites of timber species, according to *BS EN 350-1*.

Table 2: Classes of natural durability of wood to termite attack

Durability class	Resistance
D	durable
M	moderately durable
S	susceptible

Termites are essentially a problem of tropical and sub-tropical regions, but they are also found, as a limited hazard to wood in service, in some temperate countries such as France, Japan, Korea and Germany. Low temperature, due to geographical location and/or altitude, limits their distribution. There are two main types that attack timber in service – 'drywood' and 'subterranean' termites. Of the approximately 2,800 species so far recognised, some 70 to 80 have been recorded as causing damage in buildings, and 53 species are serious pests in this regard, 10 of these being drywood types.

Drywood termites live entirely inside the timber on which they are feeding, often hollowing out large timbers but leaving a thin outer shell for protection. Attack, once begun, takes place largely within the timber and may be well advanced before being recognised. Prevention must take the form of using resistant or chemically treated timber, since building design features are ineffective against these flying insects. Fumigation is the normal means of eradication but only the application of insecticides confers long-term protection.

Subterranean termites live in nests, mounds or cavities in the ground. They leave little evidence of frass (droppings), in contrast to dry-wood termites, and possess a different form of colony organisation. The nest sites may be hundreds of metres from the attack but movement is always within protective tunnels, or runways, constructed by the foraging workers from earth and chewed wood. Preservative treatment and/or design features that prevent entry from below ground can control subterranean termite damage. Species differ considerably in their distribution and voracity.

Figure 5: Termite damage in tropical hardwood poles

Figure 6: Termite attack in building timbers

Beetles

BS EN 350-1 offers two descriptions of resistance to attack by larvae of wood-destroying beetles – 'susceptible' and 'durable'.

Lyctus beetle

The most important beetle pests of wood and wood-based products, particularly in tropical and sub-tropical regions, belong to the Lyctidae family. The lyctus beetle is also found in the UK. Susceptibility depends on two main factors. Firstly, the pores of the timber species must be large enough in diameter to allow the adult beetles to lay eggs.. This critical size varies with the species of beetle; for example for *Lyctus brunneus*, a European species, this is about 0.8mm. Secondly, the timber must have high starch content for, unlike most wood-boring beetles, these insects feed on the starch stored in the sapwood, which can be completely disintegrated if conditions are favourable.

The sapwood of large-pored tropical hardwood timbers (such as obeche and ramin) and European hardwood timbers (such as oak and ash) are most susceptible. Softwoods, small-pored hardwoods and the heartwood of all species are not attacked. When lyctus

beetles cause damage to susceptible hardwoods in the UK, the infestation is usually confined to local epidemics attributable to poor timber yard hygiene. This group is also responsible for the only significant insect attack of panel products (plywood) in the UK.

Lyctus beetles are often known colloquially as 'powder post beetles', a name they share with the mainly tropical Bostrychid beetles, which similarly produce powdery frass. Adult Bostrychid beetles bore short tunnels in which to lay eggs and so are not dependent on large-pored timber species. Early signs of attack are more readily detected and protective measures can be put in hand. Logs and dried timber can be infested in the tropics. Both the adult beetles and larvae feed on the starch contained in the sapwood of hardwoods. Imported timber infested with Bostrychid larvae is occasionally found in the UK; however the attack cannot survive the UK climate, so it quickly dies out and cannot spread. Adult beetles have been found to emerge from timber in buildings, however the UK climate prevents re-infestation and the beetles quickly die.

Ambrosia beetles

Ambrosia beetles *(Figure 7)* are small and infest freshly felled logs (or standing trees, if sickly or moribund). Both softwoods and hardwoods are vulnerable to attack by different species both in temperate and tropical regions. There are more than 1,000 named species. The damage, caused by the tunnelling of the adult beetles, is variously known as pinhole borer, pinworm or shothole borer, and is characterised by small circular holes with a dark lining. This dark colouration is caused by moulds, which grow on the insides of the tunnels, on which the larvae and adult beetles feed.

High moisture content (over 35%) is required for this fungal 'ambrosia' to grow. Infestation dies out when the timber is dried. Attack of freshly felled logs, however, can be very rapid (within a few hours) unless protective treatment is carried out.

Ambrosia beetle attack can penetrate to the centre of a tree and is not restricted to the sapwood. Somewhat unusually, it is the adult beetles that do the boring, creating circular holes 0.5mm–3mm in diameter, depending on the species of beetle, with the tunnels being across the grain of the wood. The attack does not persist in dried timber and there is no danger of spread to or re-infestation of converted timber.

Longhorn beetle

Longhorn beetles are widely distributed in tropical and temperate regions. They attack green (wet, freshly felled) and partially dried

Figure 7: Typical dark rimmed bore holes of ambrosia beetle damage in sapwood

timber. Their name comes from the long antennae on the heads of the adult beetles. Adults of some tropical species are 75mm in length. Thus the oval tunnels, which the larvae create, can be large and result in extensive but generally localised damage to the timber. Timber infested with this insect is rarely seen in the UK. Prompt removal of bark from the felled logs can prevent attack by forest longhorns, but this process encourages ambrosia beetle attack.

The house longhorn, *Hylotrupes bajulus*, differs in its life-cycle from the forest longhorns, in that it infests, and can re-infest, dry timbers in service. It is a widely distributed species, found in North and South America, South Africa and Europe, where it attacks the sapwood of softwood species. Damage is caused by the larvae, which burrow into the timber from an egg laid on the surface *(Figure 8)*. The larval stage can last up to 11 years and, since a fully-grown larva can be 30mm long, destruction of the timber can be extensive. Exit holes are oval and about 6mm-10mm at their largest dimension. The tunnels formed by the larvae burrowing through the wood are oval and 6mm-10mm at their largest dimension. The network of tunnels created by the larvae can result in the almost complete disintegration of the sapwood apart from a thin surface layer. In large infestations, larval feeding may be audible on warm days in the form of a scraping sound. In the UK, climate factors restrict the house longhorn to an area to the south and west of London (mainly Surrey), where it is controlled by special provisions in the Building Regulations for preservative treatment of roof timbers.

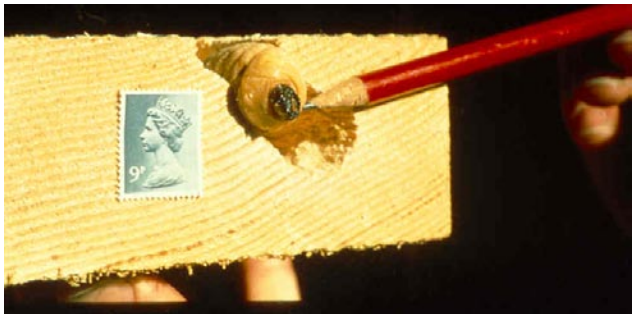

Figure 8: House longhorn larva

Other beetles

Various members of the beetle family, *Anobiidae, Anobium punctatum* ('woodworm' or Common furniture beetle, *Figure 9*), *Xestobium rufovillosum* (Death watch beetle, *Figure 10*) and *Ernobius mollis* (Bark borer beetle), are significant pests of dried timber in service. The larvae use the timber as a food source and, in some cases, cyclic re-infestation can eventually lead to structural failure of building components and furniture. The various species have different preferences for timbers, but they are able to infest a wide variety of timber species. In many situations, preservative treatment with a contact insecticide is the only practical preventative measure.

Figure 9: Common furniture beetle attack, showing a number of flight holes

Figure 10: Death watch beetle attack in 15th Century church timbers

Wood wasps

Wood wasps are pests of sickly standing trees or freshly felled logs of coniferous trees. Eggs are laid through the bark and into the wood, where the larvae, which hatch from them, tunnel into sapwood and heartwood alike, pupate and eventually emerge as adults through circular flight holes. The fear of a wood-wasp epidemic is a major factor behind the strict quarantine regulations imposed by Australia on imported wood products. Although three species of wood wasp exist in the UK, and adults occasionally emerge from converted timber within a building, they are not a problem in practice as they cannot reinfest dry timber.

In tropical and sub-tropical countries many other insects infest timber in its various stages of utilisation, causing structural weakening or marred appearance. Many are of local or sporadic occurrence; this WIS mentions only the most widespread and economically significant types. Fortunately for the UK, the variety and vigour of insect pests of timber are much lower in temperate regions than in warmer parts of the world.

References

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About TRADA

The Timber Research and Development Association (TRADA) is an internationally recognised centre of excellence on the specification and use of timber and wood products.

TRADA is a company limited by guarantee and not-for-profit membership-based organisation. TRADA's origins go back over 75 years and its name is synonymous with independence and authority. Its position in the industry is unique with a diverse membership encompassing companies and individuals from around the world and across the entire wood supply chain, from producers, merchants and manufacturers, to architects, engineers and end users.

Our aim

To provide members with the highest quality information on timber and wood products to enable them to maximise the benefits that timber can provide.

What we do

We seek to achieve this aim through active and on-going programmes of information and research. Information is provided through our website, an extensive collection of printed materials and our training courses.

Research is largely driven by the desire to update and improve our information so that it continues to meet our members' needs in the future.

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