



# NON-POISONOUS TIMBER PROTECTION

## Introduction

Timber is a common building material. It is convenient to use and is a renewable resource. It is strong, versatile and often offers the best economic option for the construction of a variety of buildings. The benefits of building with wood are greatly limited, however, if the timber is vulnerable.

As an organic material, unprotected wood is affected by climatic, biological, and human factors. These include:

### Climatic

- weathering (e.g. rain, blown sand or grit)
- moisture (e.g. condensation)
- heat (e.g. solar radiation)

### Biological

- insects (e.g. termites, beetles, wood wasps)
- fungi (e.g. moulds, stains, rots)

### Human

- fire

In recent years, many people have recommended chemical preservative treatments for timber protection. There is no doubt that these methods are effective, but a number of health hazards and environmental problems have been found to result.

In some cases (such as in situations with a high risk of fire or fungal and insect attack) chemical treatment may be unavoidable, but if other protective measures are employed as well, the preservatives used can be of low toxicity and therefore less harmful. In many instances (such as in situations with a low risk of fire or fungal and insect attack) non-poisonous timber protection practices can be employed to avoid any chemical treatment of wood.

This Technical Brief outlines:

- the disadvantages of treating timber chemically; and
- means of protecting timber, including examples of protecting timber by proper felling and seasoning; by good design and construction practices; and through the use of natural preservatives.



Figure 1: Building with timber

## Disadvantage of chemical treatment

The chemical treatment of wood is designed to prevent wood-destroying organisms such as insects and fungi from attacking and weakening the timber, or to prevent the further decay of timber that is already affected. Usually this is achieved by using highly toxic insecticides and fungicides, but

- Fungicides and insecticides have to be sufficiently toxic to be effective. They cannot differentiate between harmful and harmless organisms, which are both destroyed.
- The chemicals affect animals and humans by skin contact, inhalation, or through contaminated food, causing a variety of health problems ranging from headaches, nausea, dizziness, depressions and rashes to diseases of the lungs, heart, liver, kidneys and other organs, paralysis and even cancer.
- The production, application and disposal of chemical treatments all contribute to serious environmental pollution. Toxic chemicals can enter the food chain and accumulate in increasing concentrations in the bodies of all living organisms and most of all, in human beings. Factors such as solar radiation, high temperatures, humidity and atmospheric pollutants can transform certain preservatives into other even more dangerous substances.

## Means of protecting timber

Timber can be protected by:

- The reduction of moisture content to less than 20 per cent, below which timber is usually immune from fungal attack.
- The avoidance of distortion and splitting. This weakens the structure. Splitting also provides access for insects.
- The protection of vulnerable surfaces. This includes the end of beams, concealed surfaces, or those exposed to climatic elements.
- The exclusion or quick removal of water. This prevents deterioration due to excessive expansion and contraction as a result of frequent wetting and drying.
- The use of natural preservatives, minimising the development and spreading of fire, fungi and insects.
- These methods should be used together to protect timber effectively, although the relative importance of each will depend on local circumstances.

**Reduction of moisture content**

- Timber should be cut when its moisture content is the lowest (towards the end of the dry season). Allowing the felled tree to lie for some time with all its branches and leaves accelerates the drying process.
- Seasoning timber is the process of drying sawn timber under a roof for protection from the rain. The saturated air around the timber is removed by fresh air, which is circulated naturally, or forced through the gaps between the pieces of timber.

Seasoning should be done to a moisture content in equilibrium with the atmosphere in which the timber will be used, in order to avoid excessive moisture movement after construction. Kiln seasoning is faster than air seasoning, and provides timbers of uniform moisture contents by controlling the air circulation, humidity, and temperature within the kiln. Recently, solar seasoning kilns have been developed (Figure 2). The interruption of the drying process after sunset enables the moisture from the centre of the wood to come to the surface, thus preventing excessive tension between the surface and the interior, which can cause distortions and splitting.

The solar kiln works without fans on the principle of thermal air circulation. The solar collectors supply the kiln with heated fresh air and replaces the humid air which escapes through the chimney. This prototype was developed by the Central Building Research Institute in Roorkee, India.

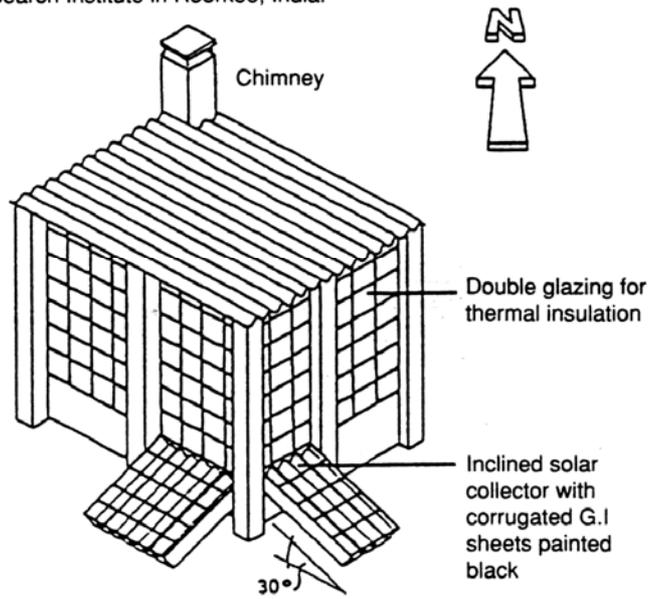


Figure 2: A solar Kiln

**Avoidance of distortion and splitting**

- Distortion and splitting are caused by wood shrinking. This varies according to the direction of the shrinkage. Longitudinal shrinkage is negligible - about 0.1 to 0.2 per cent. Radial shrinkage is about 8 per cent from the 'green' to the dry state. The corresponding tangential shrinkage is about 14 to 16 per cent (Figure 3).
- The stacking of sawn timber for seasoning and for storage afterwards requires careful horizontal placement on equally spaced battens to avoid sagging and differential stresses.

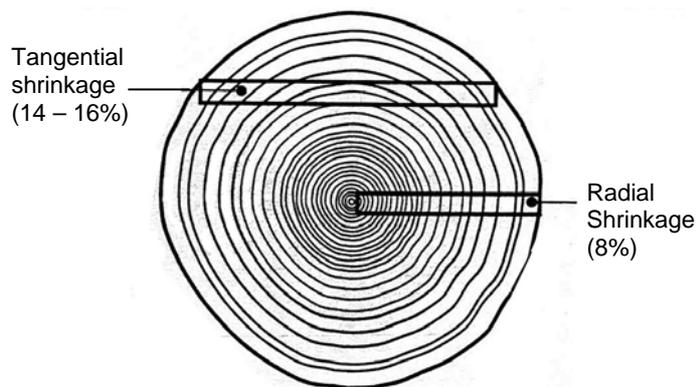


Figure 3: Timber shrinkage

technical brief

**Protection of vulnerable surfaces**

- Surfaces of timber beams and columns which are cut across the grain are extremely vulnerable to insect and moisture penetration. Problems are avoided by fixing protective wooden boards or metal plates at the end of beams (Figure 4).
- Wood surfaces in contact with the ground, or with other building materials that accumulate moisture (e.g. concrete), are in constant danger of moisture and insect penetration. Splashing rainwater and floods are additional hazards for wood components close to the ground.

Therefore:

- timber components should be installed at a minimum of 30cm above the ground;
- timber columns should be fixed on metal supports and never embedded in concrete or masonry footings;
- if necessary adequate resistance to insect penetration should be provided using metal plates projecting at least 5cm (Figure 5).

Wooden board

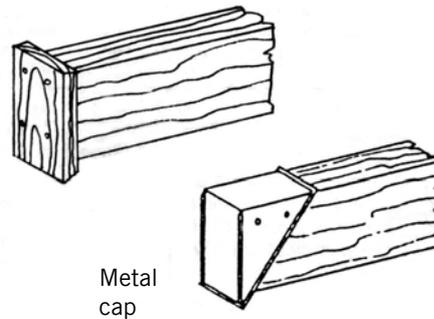


Figure 4: Simple ways of protecting end grain

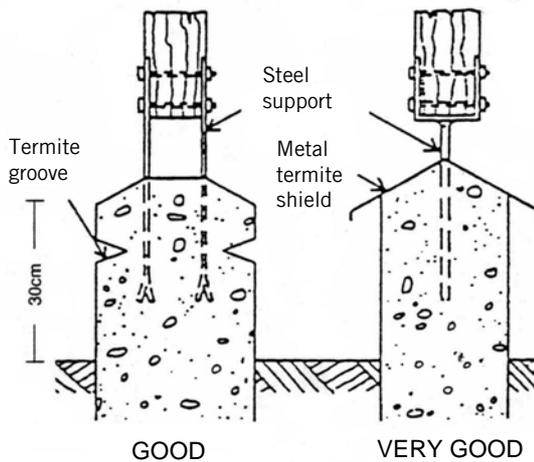


Figure 5: Timber posts on concrete footings

**Exclusion or quick removal of water**

- Wide overhanging roofs are essential where rain occurs frequently. Eaves gutters help to avoid the splashing of rainwater.
- Timber wall elements with the grain running vertically drain water fastest. The lower edges should be shaped so that dripping water is discharged outwards and not encouraged to find its way into joints and openings (Figure 6).
- To hasten the removal of any moisture (from rain or condensed water) that penetrates timber components, air must be allowed to circulate on all sides. Provision for ventilation gaps and cavities should therefore be made at the design stage of a timber construction.

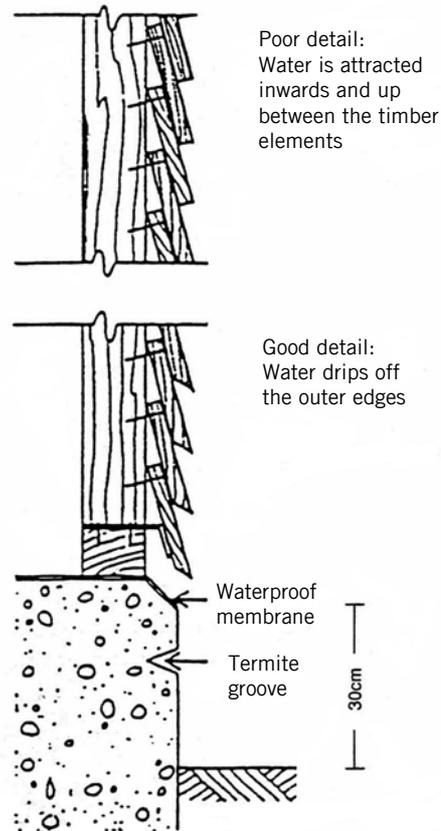


Figure 6: Timber wall cladding

**Low toxicity preservatives**

Chemical treatment may still be necessary in high-risk situations. If the protective measures described previously are employed, the preservatives used can be 'natural' or of low toxicity thus reducing, if not eliminating, health and environmental hazards.

- Borax is a fire retardant. It is also effective as an insecticide and a fungicide. Dissolved in water, it can be applied by brushing. Leaching is reduced by adding a binder such as a natural resin.
- Soda (sodium carbonate) is boiled in water and applied by brushing. Whilst drying, certain substances in wood which attract harmful organisms are decomposed.
- Potash is a traditional preservative for outdoor application, made by boiling wood ash in water and diluting the solution. It contains the same protective substances such as potassium carbonate and sodium which are present in the bark of trees.
- Linseed oil mixed with turpentine is applied by brushing and provides a tough, water-repellent surface.
- Beeswax is an ancient wood preservative for indoor use. Heated and applied thinly with a soft cloth it seals cracks and pores. Its resistance to water is low but this can be improved by adding a natural resin or oil.

**A note about paint**

The surface of wood can be protected by water-repellent paints. Paint can only be applied on fully seasoned timber. If paint is applied on wood that is not seasoned, then blistering, flaking, peeling, or mould growth will result. The complete sealing of well-seasoned timber can be advantageous, but requires regular renewal as damaged portions can be attacked by insects and moisture. Sharp edges should be sand-papered to ensure a uniform application of paint (Figure 7).

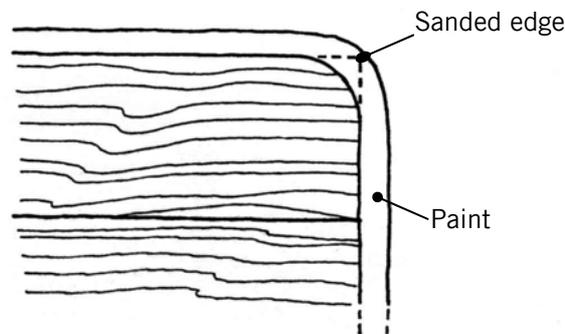


Figure 7: Paint on a timber surface

**Disaster mitigation**

Most of the chemical preservatives used today contain highly toxic pesticides, which not only destroy harmful organisms, but also a number of useful ones. Several pesticides are now known to cause serious health problems amongst larger animals and human beings, and are suspected of causing cancer and birth defects. However the most serious problem is their persistence which makes their safe disposal impossible.

As in the case of DDT, which is well documented, the chemical gradually enter the food chain via the soil, groundwater and water bodies, where they are absorbed by microscopic organisms and plants. As these are eaten by larger creatures, which serve as food for still larger animals, the dosage of poison is increased 10 to 100 times at each stage. By this process of bio-amplification, DDT and several other pesticides are now found in nearly every living organism.

On account of this, many pesticides have been prohibited in the industrialized countries, but they are still being produced for and widely used in most developing countries. This chemical time-bomb is the real disaster that needs to be mitigated. As one important step is to reduce greatly or, wherever possible, completely stop the used of toxic chemicals for timber preservation.

## References and further reading

- *Woodworking* Practical Action Technical Brief
- *A Woodworking Bench* Practical Action Technical Brief
- *How to Make a Jack Plane* Practical Action Technical Brief

This Technical Brief was originally published in the *Appropriate Technology* journal Volume 18/Number 4 March 1992.

This Technical Brief is based on the ESCAP Building Technology Series No 9: Non-poisonous timber protection, prepared by Kiran Mukerji on behalf of ESCAP/UNCHS Joint Unit on Human Settlement, Bangkok, Thailand, 1987 and adapted by Rod Shaw, WEDC for *Appropriate Technology* and printed with the permission of ESCAP.

The Water, Engineering and Development Centre (WEDC) is a self-funding unit within Loughborough University of Technology in England devoted to training, research, consultancy and other activities related to the provision, operation and maintenance of physical infrastructure in developing countries.

WEDC  
Water Engineering & Development Centre  
Loughborough University  
Leicestershire  
LE11 3TU  
United Kingdom  
Tel: +44 (0)1509 222390  
Fax: +44 (0)1509 211079  
E-mail: [WEDC@lobo.ac.uk](mailto:WEDC@lobo.ac.uk)  
Website: <http://wedc.ac.uk>

For more information about *Appropriate Technology* contact:  
Research Information Ltd.  
222 Maylands Avenue  
Hemel Hempstead, Herts.  
HP2 7TD  
United Kingdom  
Tel: +44 (0)20 8328 2470  
Fax: +44 (0)1442 259395  
E-mail: [info@researchinformation.co.uk](mailto:info@researchinformation.co.uk)  
Website: <http://www.researchinformation.co.uk>  
Website: <http://www.appropriatechnology.com>

Practical Action  
The Schumacher Centre for Technology and Development  
Bourton-on-Dunsmore  
Rugby, Warwickshire, CV23 9QZ  
United Kingdom  
Tel: +44 (0)1926 634400  
Fax: +44 (0)1926 634401  
E-mail: [inforsew@practicalaction.org.uk](mailto:inforsew@practicalaction.org.uk)  
Website: <http://practicalaction.org/practicalanswers/>

Practical Action is a development charity with a difference. We know the simplest ideas can have the most profound, life-changing effect on poor people across the world. For over 40 years, we have been working closely with some of the world's poorest people - using simple technology to fight poverty and transform their lives for the better. We currently work in 15 countries in Africa, South Asia and Latin America.

# technical brief