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HAZARD CLASSES OF TIMBER IN USE *

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HAZARD CLASSES OF TIMBER IN USE

In this paper discussion is limited to biological hazards to timber construction. Temperature chemical and fire damage may be extremely important in some situations, but these are relatively rare and have little relevance to the formulation of a timber preservation standard.

Biological hazards to timber can range from zero as in the interior of an Egyptian tomb or in Antarctica to extreme, where timber may be completely decayed or termite-ridden in a matter of weeks. Between these extremes hazards merge more or less gradually into one or another with few well defined demarcation limits.

The definition of hazards is a necessary prologue to the setting of preservative treatments either of type or degree or both. But here also the degree of protection even with a particular specification and timber species may vary widely due to inevitable variations in the wood, between batches and between preservative chemicals which have been assigned the same nominal efficacy.

The various hazard classes and the various corresponding treatment specification distribution may be depicted as two series of frequency curves where the overlap between a hazard and its corresponding preservative is acceptably small. Thus, a single case e.g. anobium attack might be represented in Fig. 1 by curve H while the corresponding preservative specification is curve P. Protection is gained except in the shaded region where H $>$ P on the intensity axis. If a given percentage, say 1% of pieces is acceptable as being unprotected i.e. subject to attack then the area U remains constant and various possibilities may be explored. In Fig. 2 are shown a lower treatment level with more rigourous process control, with consequent savings in salt cost but more expensive control. Figure 3 shows the effect of wrong hazard definition for the process specified, e.g. mixing in carpenter bees with anobids or lycta. (Carpenter bees, which do not ingest wood are not deterred by biocides.)

The whole range of hazards and corresponding preservation systems might be as Fig. 4. It can be seen that while hazard definition is important, equally so is appropriate preservative specification and the two interact for satisfactory economy.

These concepts will be familiar to structural engineers conversant with reliability based design. Goodman (I) gives a summary of this concept and the associated statistical procedures which could be transferred to the problem of matching hazards and protection.

In preservation codes, hazard definitions follow a fairly regular pattern. Table I gives the detailed descriptions given in the Fijian standard and in the proposed standard currently under discussion for joint adoption by New Zealand and Australia. The required minimum retention levels for a widely used treatment salt are shown. Most other codes follow much the same format with additions for specialised products such as plywood or beehive timber. Comparisons between codes are very difficult. This is partly because similar wordings may describe quite different hazards, as for example, the risk of fungal attack in cool and tropical climates. This is effectively the lateral position of curve H in Fig. 1. The other difficulty is the probability of failure accepted, that is the shaded area in Fig. 1. This is rarely if ever stated, or even accurately described. A suitable prescription for a hazard/preservation combination would be: "This specification will provide 95% survival after 80 years" (the prescription for NZTPA specification C2B for house poles). Even where some attempt is made in this direction it is frequently incorrectly stated. Thus the wording of H5 Table 1 ends up ".... is a critical use requiring additional protection". What the specifier is really after is a lower probability of failure for a given lifetime or a longer life for a given probability of failure, or both. The result of this is more intensive treatment, but this may be achieved by more rigourous quality control rather than by higher retention levels. This point is well illustrated by comparison of the NZTPA specifications C5 for fencing materials and C6 for exterior joinery. The same retention levels are specified e.g. 5.4kg/m^3 for Tanalith NCA, but whereas all species are allowed in C5, only Radiata pine is permitted in C6. There are no penetration requirements in C5 but in C6 complete penetration is required, detailed sampling procedures are specified as are the core analyses of active elements and the allowable tolerance.

A detailed comparison has been made by Hedley (2) of the requirements of the codes of New Zealand, Queensland, New South Wales, Standards Assn. of Australia, Fiji, Japan, USA and UK. This runs to 12 pages of detail.

The differences between code requirements for the same hazard description are sometimes very large, e.g. up to 3 times the retention for anobid/lyctid treatment between New Zealand and Japan. Some of these differences may be due to desire for lower failure probabilities, some to conservatism, but some must also be due to different meanings attached to hazard descriptions.

The writer is aware of only one attempt to numerically classify a decay hazard. This is Scheffer's Climate Decay Hazard Index for wood out of ground contact.

$$I = \frac{1}{30} \sum_{Jan}^{Dec} \left[(T - 35)(D - 3)\right]$$

where: T is mean monthly temperature ^{o}F

D is the mean number of days in the month with 0.01 inch or more of precipitation. The factor 1/30 arbitrarily brings the index into the range 0 - 100 for the USA.

$I < 35$ is low decay hazard
$I = 35 - 65$ is moderate decay hazard
$I > 65$ is high decay hazard

It has later been proposed that 70 is a more practical boundary than 65.

Use of the CDH Index is confined to only one of the six Hazard Classes described in Table 1 but its quotation in specifications for H3 could be a useful means of giving some assurance to the transfer of one country's specifications to another. Unfortunately no similar indices have been developed for ground contact specifications.

There is general agreement between preservation scientists that more uniform and objective preservation standards are required. Hedley in an internal report, described how both New Zealand and Queensland at a recent meeting both came up with similar proposals for standardising evaluation protocols for wood preservatives and subsequent approval for commercial use. But the quality control criteria also need to be standardised in the same way that wood strength statistical criteria are becoming internationally standardised. General agreement on the reliability indices to be used in considerations of hazard/protection diagrams such as Fig. 1 would also be highly desirable.

Proposals such as these are only starting to be discussed. In the meantime immediate action is required for the preparation of treatment standards in numerous widely differing developing countries. These countries differ in climate, in insect species, timber types and species and in construction practices. The cost-benefits of preservation will also vary widely from country to country.

In recommending a preservation code for use in developing countries, it is apparent that there is almost complete absence of objective criteria for guidance. The best we can hope for is that experience and judgement are wisely applied, and that regulations are so framed that as improvements and changes in specifications are warranted, that these applied in a rational manner.

TABLE I

Two Hazard Classifications

NZ - Australia	Fiji
Hazard Class H1. Where timber, including plywood is used out of contact with the ground and in situations which are adequately ventilated and continuously protected from the weather by roofs, external walls or a well maintained paint system. The primary risk to timbers is attack by wood boring beetles such as Anobium and Lyctus. NZTPA Tan NCA 3.2 Kg/m^3	Out of ground contact and continuously protected from the weather. Situations where timber is continuously protected from the weather, adequately ventilated, free of contact with the ground, damp masonry, etc. e. g. furniture timbers, internal panelling, interior framing and roofing timbers. etc. Main Hazards: Drywood termite and pwder post beetle Tan NCA 3.5 Kg/m^3
Hazard Class H 2. As for H 1 but giving protection against termites also. No NZ equivalent. AS1604 and Q'land Tan NCA 4.0 Kg/m^3	
Hazard Class H 3 Where timber including reconstituted wood products may be exposed to the weather but will not be in contact with the ground. NZTPA Tan NCA 5.4 Kg/m^3	2 Out of ground contact NOT continuously protected from the weather. Situations where timber is not in ground contact but is not continuously protected from the weather, or damp masonry in unventilated groundline floors, other damp situations, exposed verandah floors, garden furniture, barge boards etc. Main Hazards: Fungi, drywood termite and powder post beetle. Tan NCA 7 Kg/m^3

Hazard Class H4. Where timber is used in contact with the ground or in fresh water or in other situations favourable to decay. Very severe environments such as horticultural sites constitute a higher hazard (Class H5) which should be used for critical commodities

NZTPA Tan NCA 10.1 Kg/m^3

Hazard Class H5 Where timber is used in contact with ground that because of the climate., soil or other factors presents and extreme decay hazard or where the commodity is a critical use requiring additional protection.

NZTPA Tan NCA 13.5 Kg/m^3

Hazard Class H 6. Where timber is subjected to prolonged immersion in sea water.

NZTPA Tan NCA 24 Kg/m^3 rounds
28 Kg/m^3 sawn and part rounds

3. In ground contact. Situations where timber is in continuous contact with the ground. This end-use category is subdivided into two, based on the acceptable life of different commodities and their relative values.

3A Low risk, low val ue items e.g. fence posts, passion fruit poles etc.

3B High risk, high value items, e.g. house piles, poles for pole frame housing, transmission poles etc.

Main hazards: Fungi, subterranean and drywood termite and powder post beetle.

Tan NCA 18 Kg/m^3

4. Marine uses. Situations where timber is continually exposed to marine boring organisms e.g. boat and barge external sheathing, marine piles, bracing, ramps, slipways, groynes, sea walls etc.

Main hazard: Molluscan and crustacean marine borers

Tan NCA 48 Kg/m^3

TABLE 2

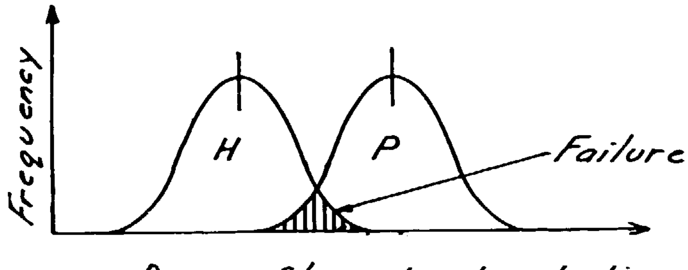
Retention requirements for CCA type 1 Exterior Use, not in contact with the ground.

Country and specification	Retention
New Zealand TPA C5, C6. C6B, C7, C11	5.0 - 5.4
Queensland TUMA H3	8.4
New South Wales TMA	6.0
Stds Assn of Australia AS1604/6	6.0
Fiji FDF2	7.0
Japan JIS A9108	6 - 10.0
USA AWPA C2	6.0
UK BWPA	Process Sec. 2% solution strength

REFERENCES

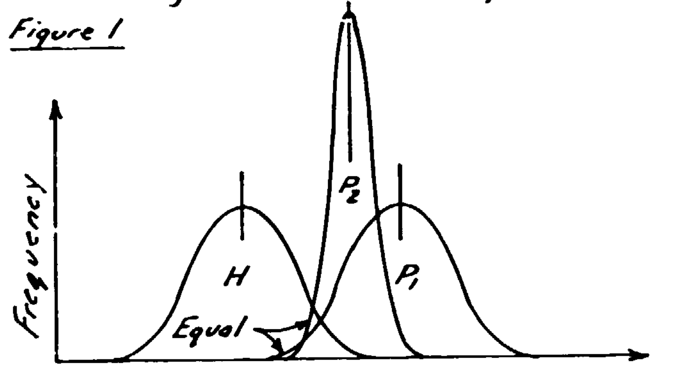
(1). Goodman J.R. 1984 "Reliability-Based Design for Wood Structures" Structural Wood Research ASCE, 345 East 47th St. New York

(2) Hedley M.E. 1984 Timber Preservation Standards in NZ, Australia, Fiji, Japan, USA and United Kingdom. Report to Forest Research Institute Wood Preservation Working Group.



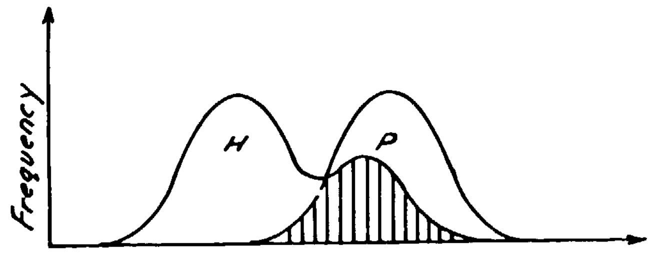
Degree of hazard and protection

Figure 1



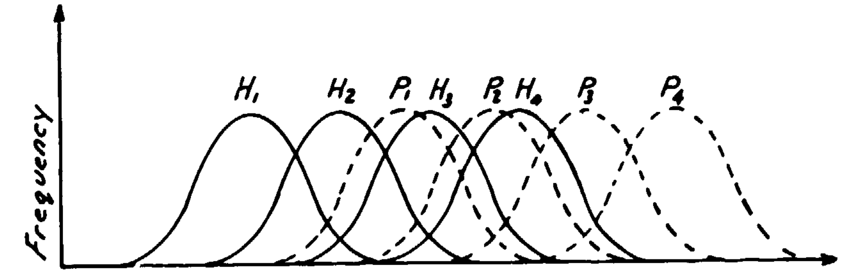
Effect of tight quality control

Figure 2



Poor hazard definition

Figure 3



Complete hazard and protection system

Figure 4