BASIC PRINCIPLES TO AVOID BEING WOOD'S WORST ENEMY: BY THE NUMBERS

Rod Stirling and Paul I. Morris
FPInnovations, 2665 East Mall, Vancouver, B.C. V6T 1Z4

Summary

The design, construction, and maintenance of wooden structures affects the risk of biodeterioration. The present paper outlines general principles to minimize decay, weathering, and insect attack. These include the 4Ds for decay resistance (Hazleden and Morris 1999), the 6Ss for protection against termites (Morris 2000) and now the 5Ps for protection against weathering, introduced in this paper.

1. Introduction

Human action (or inaction) can result in the premature failure of wood products due to decay, weathering, and insect attack. This is increasingly unacceptable as we strive for a more sustainable society. Premature biodeterioration may be due to many factors, including choosing materials that are not intended to perform under the conditions in which they are placed, increased deterioration hazards due to poor design, lack of maintenance or improper maintenance, and undue faith in our ability to thwart nature through clever design.

There are many examples of people using wood in ways that increase its risk of biodegradation (Morris 2009). Rather than further dwell on these failures, we would rather focus on solutions. It is difficult to ensure that wood will always be used wisely as new building materials, construction practices, wood uses, and maintenance protocols emerge. However, there are guiding principles that we can follow to protect wood from decay, weathering, and insects. These are the focus of this paper.

2. Protection against Decay (4Ds)

The 4Ds were introduced by Hazleden and Morris (1999) to provide users with basic principles to protect wood structures from decay.

Deflection refers to systems that prevent rain from contacting walls or other vertical structures. This includes roof overhangs, siding profiles, flashing, and post caps. Deflections systems are the first line of defense and should protect the structure from most rain.

Drainage refers to systems that remove liquid water from a structure. These include sloped roofs and decks, gutters, down spouts, and wall systems with cavities behind the cladding to drain any accumulated water. It is critical to avoid designs that lead to water traps, and to ensure that gutters and drains are maintained.

Drying is necessary to allow water vapour to escape from wood that has got wet and ensure wood moisture contents rapidly drop below the critical thresholds for decay. Designs should facilitate adequate ventilation.

Durable materials are the last line of defense. If wood remains wet for prolonged intervals it will be at risk of decay. In these situations the wood itself must be durable. Durable materials include preservative treated wood, and some naturally durable species.

3. Protection against Termites (6Ss)

Morris (2000) introduced the 6Ss to summarize the options for protecting wood structures from termites.

Suppression aims to reduce the termite population and prevent spread to other areas. Suppression techniques include burning or heat-treating infested wood, location and destruction of nests, and inspection of wood moving out of termite areas.

Site management focuses on elimating nests on a site and removing potential sources of food, such as stumps and woody debris.

Soil barrier includes chemical or physical barriers placed in the soil outside the building. Chemical barriers require periodic reapplication, which can be costly and may not be appropriate for all structures. Physical barriers include graded gravel and stainless steel mesh. Care must be taken to ensure these are not bridged or breached.

Slab/foundation details are designed to prevent undetectable access by eliminating certain access points and facilitating inspection for shelter tubes.

Structural durability ensures that wood components are themselves resistant to termites. This includes woods with natural termite resistance (e.g. yellow-cypress) and wood products treated to protect against termites. Several preservative systems are standardized for protection against termites, including Formosan subterranean termites in the southern USA.

Surveillance and remediation is necessary to monitor and fix any problems that arise with the other systems in place to protect wood structures from termites. Surveillence involves looking for evidence of termite activity and for problems with termite defences.

Remediation involves replacing any components damaged by termites and fixing termite defences.

4. Protection against Weathering (5Ps)

Sound wood outdoors above ground is frequently replaced due to weathered appearance rather than decay. The 5Ps are intended to guide users on how to best protect the appearance of wood from weathering when used in exterior applications.

Preparing the surface is the first step in protecting wood from weathering. This can include technologies such as profiling, which reduces the incidence of checking, plus coarse sanding, drying and pH adjustment to maximize coating adhesion (McFarling et al. 2009; Cool and Hernández 2011; Sönmez et al. 2009). Protection of wood surfaces from light, or removing the affected surface, before applying coatings is also necessary to maximize coating adhesion (Williams and Feist 1994).

Preserving against stain and decay involves making sure the durability matches the hazard. Coatings can reduce moisture uptake but they may also retard drying and they should not be considered a substitute for preservative treatment. Wood must be able to resist decay and insects, but also black stain fungi which frequently disfigure wood products used in exterior applications. Several preservatives are available to protect against decay and insects; however, there are few (if any) systems with demonstrated long-term performance against black-stain fungi (Stirling et al. 2011).

Protecting from light is critical to prevent wood surface photo-degradation due to UV and visible light. This is particularly challenging when wood's natural appearance is desired. Transparent and semi-transparent coatings often include chemicals that absorb UV light. However, visible light must be allowed to pass in order to see the wood itself. Technologies such as hindered amine light stabilizers can provide some protection against visible light, but have not been demonstrated to provide long-term performance (Stirling and Morris 2013). Technologies that stabilize the wood itself may yield more long-term solutions (Evans 2009).

Preventing moisture uptake is necessary to reduce the risk of decay, as well as checking, and leaching of extractives or preservatives. This can best be achieved following the principles outlined in the 4Ds. In addition, any coatings applied should be able to prevent liquid water uptake, while allowing water vapour to escape.

Proactively re-finishing is the final step required to maintain wood's appearance. All coatings fail at some point. If the failure is severe, UV/visible light-damaged surfaces can be sanded off, but it is extremely difficult to eradicate black-stain fungi. Refinishing before the wood surface is severely degraded means the coating has a chance of giving a service life similar to the first application.

5. Conclusions

The sustainability and competitiveness of wood in exterior applications is predicated on slow biodeterioration. Biodeterioration can be slowed by using wood wisely. General principles for reducing the risk of decay (4Ds), weathering (5Ps), and termites (6Ss) have been presented. By using these principles you can avoid becoming wood's worst enemy.

6. Literature

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