Decay of wood in structures

W. Wayne Wilcox

The value of services performed in California by the structural pest control industry in 1978 is expected to exceed $200 million.[1] A survey of four San Francisco Bay Area counties and two southern California counties revealed striking differences in the average cost of repairs between the north and the south. In the Bay Area the approximate average cost per notice of completion during a two-year period, prior to 1978, was lowest in San Mateo County ($603) and highest in San Francisco County ($852), with Marin County ($620) and Alameda County ($750) in between. Comparable figures in southern California were $273 for San Diego County and $346 for Los Angeles County. This difference in repair costs is, no doubt, affected by a similar difference in the types of problems encountered as indicated in Table 1.

While subterranean termites are active in both locations, drywood termite damage is primarily a problem in the south and decay and other fungus damage, along with the wet conditions that promote fungal growth, are primarily problems of the north. The tragedy in the figures for decay is not just that such repairs are expensive, but that most decay in structures can be easily and cheaply prevented with proper design, construction, and maintenance. Furthermore, replacement of wood destroyed by decay wastes timber because it diverts wood products from new construction and requires increased harvesting to supply the additional demand.

TABLE 1. Percentage of Total Inspection Reports in Each County Indicating Infestation in Various Categories

	County					
Type of Infestation	Marin	Alameda	San Francisco	San Mateo	Los Angeles	San Diego
	%	%	%	%	%	%
Subterranean termites	27	39	56	26	58	29
Drywood termites	2	5	1	11	75	73
Fungus or "dry rot"	78	77	75	79	29	29
Excessive moisture conditions	73	56	45	52	12	8

[1]*Data in this paragraph were provided by the Structural Pest Control Board, Sacramento.*

Forest products pathology research at the University of California's Forest Products Laboratory is aimed primarily at detection, diagnosis, evaluation, and prevention of fungal degradation (such as decay) of wood in structures.

Finding the source of a fungus that produces decay is rarely a problem. Decay fungi are nearly everywhere, either as airborne spores (which act like the seeds of higher plants) or as hyphae (the filamentous body of a fungus) growing actively on decaying organic material in the soil. (Decay fungi have four basic requirements for growth: food, air, proper temperature, and water. Their food is wood itself, and air and temperature are seldom limiting factors in conventional structures; water, therefore, is the sole factor controlling whether untreated wood in a structure will decay.)

The two biggest hazards to wood in service are soil contact and

This beam supporting a balcony is decaying because runoff water was trapped behind the building's facia.

water entrapment. Untreated wood should not be on or near ground, because soil is a source of water and actively growing decay fungi. Design and construction details should direct rain water or condensation away from the structure. If wood must serve in soil or water contact, it should be pressure-treated with a preservative. These simple precautions may spare the building owner considerable repair costs.

Wood decay in structures results in serious loss in strength. Research has shown that most wood strength is lost in stages of decay so early that they can only be detected in the microscope—and long before the decay is visible to the naked eye. Strength properties, which involve resistance to shock or suddenly applied loads, are particularly sensitive to decay, providing special problems for structures in areas subject to earthquakes. Ability to detect decay in its early stages is therefore important, but more important is avoiding those situations that provide moisture needed for growth of decay fungi.

Research has shown that microscopical examination can be relied upon to estimate, roughly, the degree of decay present in a particular sample based on the number, size and occurrence of fungal hyphae, bore holes, cracks within cell walls or separations between cells, the thickness of cell walls, or the size of cells. Such data, however, are not available specifically for California species and current research is directed at providing this information in sufficient detail so that the stage of decay may be estimated with considerable accuracy.

Speculating that electrochemical reactions might explain unexpectedly large amounts of wear on wood-cutting tools, Forest Products Laboratory researcher Barney Klamecki (not shown) reduced wear 20 percent by insulating the cutter from the lathe in wood-turning experiments. Subsequent studies, in which electrical potentials were applied to cutters and the cutting forces were measured, showed essentially no change in force with applied voltage. Klamecki believes the difference in wear caused by electrical interaction is the result of changed corrosion behavior rather than abrasion.

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Nonconventional bonding

Fred E. Dickinson

In California and in the United States as a whole, the single, largest use of forest products, excluding pulp and paper products, is for constructing single family dwellings. Solid wood and reconstituted forest products, with few exceptions, are the only products from a renewable resource economically suitable for building. In addition to this advantage, wood is produced with much less energy than are other competitive materials, such as aluminum, steel, or concrete. Ever-increasing costs for energy, capital, and labor to obtain nonrenewable materials from distant and inaccessible regions in the world also encourage substituting renewable wood for nonrenewable materials.

Complicating wood's advantages are the increasing demands to use our forests for such purposes as recreation and a trend towards using younger-growth timber for manufacturing. The latter leads to production of smaller-sized timber of decreased quality and consequent manufacturing losses. Reconstituted wood products, however, allow a more effective use of our raw material. Utilized are such processing residues as log and board ends, the slabs left in converting round logs to squares, sawdust, and other small, damaged, or otherwise unusable pieces. There is also a tremendous potential for the vast quantities of residues left in our forests after logging.

Particleboard is an excellent example of a reconstituted product that has shown remarkable growth over the last two decades; its compounded annual rate of growth between 1963 and 1973 was 22 percent. Most increased production has been in exterior grade particleboard for use in housing. This product can retain strength and dimensional stability at an acceptable level after extensive exposure to wetting and weathering.

In recognition of the tremendous potential for improved waste and residue utilization and its importance to housing, the University of California Forest Products Laboratory has undertaken major research, largely concentrating on developing a bonding method known as "nonconventional bonding." This method differs significantly from existing methods in that it does not utilize conventional petrochemically-based synthetic resins, such as phenolformaldehyde, thereby reducing our present dependency on them.

Objectives

Although the bonding system is widely applicable to any form of glued wood product, research has been concentrated on its adaptation to particleboard. Objectives are:

1. To develop an exterior grade, medium-density particleboard with dry properties equal to—and wet mechanical and physical properties superior to—those presently obtained in commercially manufactured phenolformaldehyde boards.
2. To assess carefully, to the extent practical, the total impact of the system on the environment.
3. To explore the fundamental chemical and physicochemical transformations that take place in this process, with the philosophy that such knowledge should lead to development of particleboard with vastly superior properties applicable to many other glued wood products.

To expedite this program a University of California interdisciplinary research team has been formed, managed by Donald G. Arganbright, wood technologist, with David L. Brink and