Veneered Panels — A Horn of Plenty, but Who -Will Blow It?: Coping with Plywood's Cost-Price Squeeze

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Products are subject to life cycles; they are developed and refined, they grow, they capture markets, and they reach maturity. And, if competing new technologies are developed, they also decline. To avoid that fate, such products have to be reinvigorated to meet old needs better or redesigned to fill new needs. Veneered panels are undergoing such a period of reappraisal.

The plywood industry has successfully evolved with changing circumstances before. From its origins as a supplier of door skins, it spread into the construction sheathing markets when advances in gluing made that possible. The industry coped with the declining availability of large diameter old-growth Douglas-fir by adapting technology to peel smaller southern pine. Today, because oriented strandboard is less expensive to manufacture, the plywood industry is challenged to defend its sheathing market base or find replacement markets. Reducing manufacturing costs and diversifying the product mix are steps needed to accomplish those goals.

Wood Cost Reduction

There are many steps in plywood manufacturing with costs that exceed those of the competing technology, but none more important than the raw material itself. Wood is the costliest component because the plywood process is not very tolerant of small and defective logs. On the basis of volume, wood gets more expensive as its grade (and size) increases. So, as large logs became more scarce and costly, plywood mills increasingly turned to smaller diameter stems. This required equipment to increase processing speed because smaller block sixes are detrimental to plant economics by hurting lathe productivity. Some of the measures that have enabled mills to handle a larger share of small stems are (i) reducing inactive lathe time by accelerating block charging, (ii) decreasing wood waste by more accurate positioning of blocks, (ii) increasing recovery by reducing spindle size, and (iv) raising output by speeding up lathes. The downside of small log use, however, is that there is less clear veneer and more juvenile wood in the mix, both of which narrow product options. In the best of all possible worlds, peeler logs would be somewhat large and clear but not much more costly than pulpwood-sized logs. How realistic is such an ideal?

One course of action that farsighted veneer mill owners could design their long-term strategies around is agroforestry, based on fast growing species such as hybrid poplar. Lending impetus to this have been changes enacted in U.S. farming policy that are decoupling commodity program payments from farm production decisions. The forest products industry itself has begun to explore this option in a significant way with almost 120,000 acres (48,000 hectares) of plantings reported in 1996, mainly for pulpwood production. But experience elsewhere indicates that peeler and sawtimber sizes can also be achieved within spans of time as short as 13 to 17 years with various clones of poplar.

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The economics of agroforestry rest on minimizing the exponentially increasing opportunity cost of capital tied up in the crop. The relatively short time to harvest means that intensive management programs, such as cultivating, fertilizing, pruning, and irrigating, can be employed in the hope that the costs of these measures will be recovered before the accumulating burden of interest becomes prohibitive.

Poplars are ideally suited to this approach because they are by nature a pioneer species, genetically programmed to outcompete brush that comes in on a vacated site. By practicing intensive cultivation, this tendency can be enhanced, resulting in stems of large girth and height in periods of time that, by the standards of forestry, are exceptionally short

The ability of many poplar clones to reproduce vegetatively from cuttings means that they get a further headstart bypassing the initial near-stagnant years during which the plant establishes itself or recovers from transplant shock. This creates a strong base from which the principle of compounding can later build. pruning lower branches early in the rotation ensures that a large part of the log volume will be clear, straight-grained, and more cylindrical.

Plantation density affects the financial rotation (assuming greatest financial return occurs with harvest at culmination of mean annual increment) (Fig. 1). With decreasing stem density, the optimum rotation time lengthens. This is because the denser a stand is, the quicker its annual volume growth tops out. But, for a regime targeted to yield large stems, lower density spacings allow stems to widen before growth stagnation sets in, sacrificing some quantity for quality.

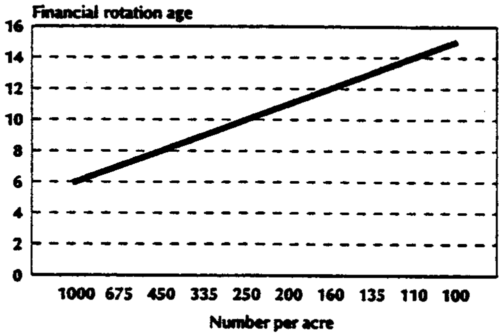

Fig. 1. Financial Rotation Age vs. Stems Per Acre
Source: FAO 1979

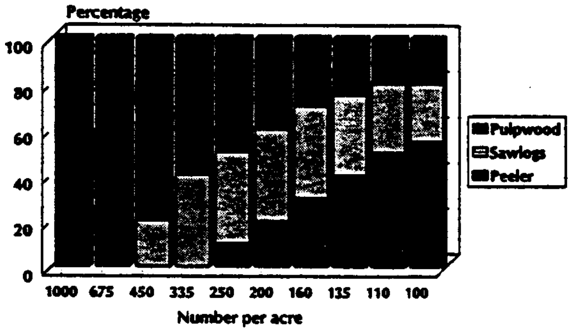

Fig. 2. Product Mix vs. Stems per Acre
Source: FAO, 1979

Typically, by the end of the 13th year of a 200 stem per acre plantation, average usable wood volume per stem ranges between 26 and 27 ft^3 (0.74 and 0.77 m^3). At an assumed 90 percent survival rate, this results in more than 360 ft^3 (102 m^3) per acre per year, or about six times the average net growth on all industrial forestlands in the United States (Powell et al. 1994) and more than twice as much as for intensively managed pine plantations (Ince et al. 1997). Diameters at breast height after 13 years can average between 12 and 14 in. (305 and 356 mm) (D. Riemenschneider, Forest Sciences Laboratory, Rhinelander, WI, personal communication). Grown under such a regime, the expected distribution of volume is 30 percent peelers, 40 percent sawlogs (chip-n-saw), and 30 percent pulpwood (Fig. 2) (FAO 1979).

To illustrate, in a historical context, the expected economics of such a planting, we simulated the costs of a managed poplar stand as if it had been established in 1985 and harvested in 1998, using cultivation cost and land rental values that were typical during the past decade. Estimated costs by year are biggest at the end of the rotation when harvest transportation, and severance tax costs are incurred. Each year, the interest cost, calculated at a rate of 7%, rises but remains moderate. By category (Fig. 3), the largest outlay is for harvest and transport, then interest, land rent, severance taxes, and finally various cultural practices. Final yield at harvest is projected at 367 ft^3 (10.4 m^3) or 4.2 tons (3.8 metric tons) per acre per year. This translates to an average cost of $1 per cubic foot ($35 per cubic meter). By comparison, across the South, a mix of delivered pine logs of the grades and proportions' stated ranged between $1.2 and $1.7 per cubic foot (842 and $60 per cubic meter) for the second quarter of 1998 (University of Georgia 1998).

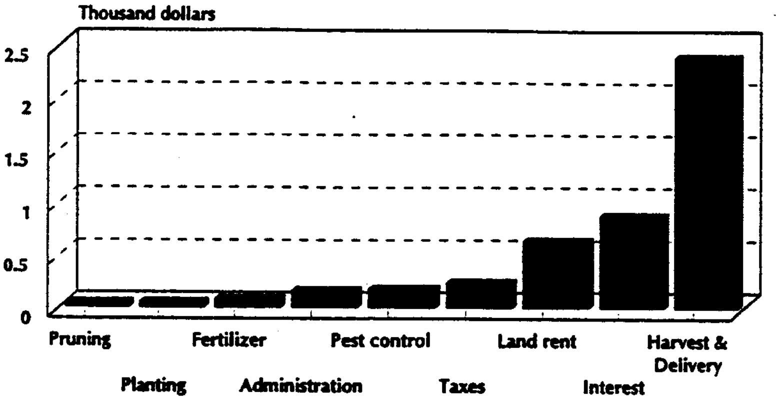

Fig. 3. Total Hybrid Poplar Costs by Category

One disadvantage of fast-grown poplar is that its physical properties are lower than the more traditional woods used for plywood. Poplar is less dense than either pine or fir. Moreover, a large part of the wood will have juvenile characteristics, but research comparing fast-grown poplar with plantation pine showed that "the degree of juvenility...is much more pronounced in loblolly pine than in cottonwood" (Bendtsen and Senft 1986). A recent examination of wood properties of 17-year-old hybrid poplar showed that they were "similar in properties and characteristics to current aspen and. cottonwood" (Kretschmann et al. 1998). Aspen and cottonwood are admittedly less strong and stiff than pine, but by pruning, a larger share of the wood would fall into the higher grades of straight-grained and knot-free wood than from unpruned pine. Data from the lumber in-grade testing program show that the gap in stiffness between aspen and pine is considerably narrowed when the highest grade of the former is compared with a knottier grade of the latter (Green and Evans 1988). In any event, the weaker characteristics of poplar can be compensated by making panels slightly thicker. Plywood made from aspen is currently marketed by a number of mills in the Midwest The product is characterized by a uniform, cream-colored appearance with faint grain lines and generally small knots. Because of the color uniformity, plugs blend in easily. Sheathing and underlayment grades as well as those used in cabinetry and other sanded applications are sold.

Other process considerations include the higher moisture content of poplar (around 150 percent compared with 110 percent for the sapwood of southern pine) and its lower density. The first increases the veneer drying burden, the second reduces the block conditioning needs because the wood can be peeled at lower temperatures than denser wood (Lutz 1977).

Product Upgrading

Lowering plywood costs through agroforestry can be part of a long-term strategy, but in the meantime, plywood plants must deal with the pressure on the sheathing market from oriented strandboard. Most mills have attempted to diversify into other product lines. One strategy has been to upgrade veneers and manufacture more panels, such as sanded grades, for high-end and specialty markets. Some plants have switched to peeling hardwoods, abandoning traditional commodity markets altogether. **A** problem with this, however, is that as the supply of these panel types increases, markets can be oversupplied, dampening prices. In the summer of 1998, such shrinkage in premiums over sheathing occurred, caused partly by rising sheathing prices and partly by stagnant specialty prices.

As a second alternative, the engineered wood area offers the plywood industry a higher valued market for veneer. This development is based, ironically, on wood's traditional weakness, its inconsistency, or rather, the improved ability to lessen the variability within grades through more accurate sorting. Property variability exists in wood in all its forms. It tends to increase when round, tapered logs are cut into straight, rectangular products such as lumber and veneer. Traditionally, the veneer industry tackled this variability by sorting sheets according to visual criteria centered chiefly around the size, frequency, condition, and placement of knots. Within visual grades, however, there remains a large degree of residual variability.

Alternative methods of evaluation include tuning the propagation of sonic waves over a know distance on the surface of a veneer and/or inferring wood density through measurements of x-ray penetration through veneer. With these techniques, it is possible to further refine grading of visually sorted veneers and identify those with superior stiffness and strength. These sheets can then be diverted to make high-valued structural products, such as beams, girders, and joists, which were traditionally supplied from sawn lumber but which have tended to become costly as large-diameter trees have become less available.

For plywood personnel, these evaluation techniques requires a change in how wood is perceived Traditional thinking compartmentalized wood species into four groups with prescriptive codes dictating how panels assembled from each could be rated This ignored the variability within groups, which can place individual pieces into performance levels associated with another higher or lower group. But, if properties of each piece can be more accurately identified, then some portion of lower visual grades can be used for high-valued products. This enlarges the potential pool of usable wood to species that, on the basis of tests conducted on a few, small, clear specimens a long time ago, were deemed unsuitable for more exacting applications. Since the early 1970s, more than 180 stress wave veneer graders have been placed into use in North America, indicating that a great portion of the veneer supply is now being graded according to these nondestructive criteria.

Fully exploiting this opportunity poses complicating challenges to an operation geared for traditional plywood production. Besides visual classes, additional criteria multiply the number of sorts to be separated and tracked. Since the way a billet is laid up affects its final properties, this increased management effort extends to the lay-up operation. The location and amount of weak veneer permitted in a lay-up is a decision variable that depends on the load a product is designed for and on whether that load is applied in a flat or edgewise direction (Kretschmann et al. 1993). Figure 4 compares the edgewise stiffness of laminated veneer lumber (LVL) obtained from a batch of southern pine CD grade veneer regraded ultrasonically into three categories. To obtain similar stiffness values at the high end from visually graded veneer would require an assembly of all B grade veneers (Tang and Pu 1997). Figure 5 illustrates how changing the proportions of weak and strong veneers in an assembly affects its stiffness.

Existing plywood batch presses are also ill suited to making the thicker, longer billets required for structural members. But the efforts to accommodate these procedures are rewarding because the end product realizes a much higher return than can be obtained from the sheathing market. Mills should review and evaluate their raw material supply to determine whether the quality is there in sufficient volume to justify full engagement in the engineered wood market or merely that of satellite supplier to an engineered wood operation. Some small-diameter trees from suppressed stands that ordinarily would not be thought of as prime veneer material for visual purposes have been found to yield surprisingly large proportions of high strength veneer suitable for LVL manufacture (Willits et al. 1997) (Fig. 6).