Press-Lam: Research Finds A New Furniture Feedstock

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In recent years, competition for solid hardwood stock has forced furniture manufacturers to consider alternative materials of construction such as plywood, particleboard, medium density fiberboard, and plastics. Now, a cooperative research program involving the U.S. Forest Products Laboratory at Madison, Wis., Purdue University’s Furniture Research Center at Lafayette, Ind., and a major manufacturer of upholstered furniture, the Schnadig Corp., Chicago, Ill., is resulting in the development of a material termed Press-Lam, with aesthetic and mechanical properties sufficiently close to those of wood that it often can be substituted for solid wood on a one-to-one basis. The cost of sofa frames cut from frame-grade Press-Lam is less than or no more than the cost of comparable frames cut from number-two common lumber. Furthermore, the cost of exposed wood parts cut from clear Press-Lam is expected to be even less than comparable parts cut from clear solid wood.

Press-Lam itself consists of layers of thick-cut veneer that are bonded together with all of the plies running in the same direction. The veneer is rotary cut from hardwoods. Defects can be eliminated readily from the veneer so that high-grade Press-Lam can be produced from logs that would normally yield mostly low-grade sawn lumber. Furthermore, interior laminations may be fabricated from lower-grade or less desirable species so that woods that ordinarily cannot be used alone may be mixed with other species to produce an acceptable product.

When Press-Lam was first developed by the FPL, it was planned for use primarily as 2x4s and larger structural members in conventional building construction. It appeared to the authors, however, that hardwood Press-Lam should have properties that would make it well suited for furniture construction. A cooperative research project was set up, accordingly, between the FPL and Purdue’s FRC to investigate the use of Press-Lam as upholstered-furniture-frame stock. Simultaneously, an agreement was made with the management of the Schnadig Corp. to make a trial production run of Press-Lam frames, if the initial tests at FRC proved promising.

The Press-Lam used in the study was fabricated from ¼"-thick veneer which was rotary peeled from tie- or timber-quality red oak logs obtained in central Wisconsin. Part of the veneer was cut by the Weyerhaeuser Co. of Menford, Wis.; the remainder was cut at FPL. All of the Press-Lam was manufactured by the Press-Lam research team at FPL.

The Press-Lam used in these studies had not been designed or processed to meet the specific needs of furniture-frame stock. Rather, it was prepared using the same processing techniques used for producing softwood Press-Lam for use in large structural members. Furthermore, red oak was chosen as the parent material because it was anticipated that more problems would likely be encountered with the thick peeling of it than with most other species. The general rationale followed was that if promising results could be obtained with this material, improved performance could be anticipated through subsequent development of the Press-Lam process itself, along with engineering of the material to meet specific product needs.

The study was carried out in three overlapping phases. In the first phase, basic strength tests were carried out on Press-Lam at Purdue’s FRC. In the second phase, frame tests were carried out at FRC while additional basic strength tests, along with frame tests, were conducted by Schnadig’s research and development group in Montoursville, Pa. In the third phase, a production-line cutting was made of Press-Lam at Schnadig’s Cornelia, Ga., plant. Part of the resulting cuttings was shipped to R and D at Montoursville for further frame testing; the remainder was shipped to Schnadig’s Rushville, Ind., plant for frame assembly, upholstering evaluation, new product development tests, and, finally, for normal processing of the remaining Press-Lam material as production sofa frames.

The machining tests were carried out in Purdue’s Department of Industrial Education. Results of the machining tests indicated that Press-Lam did have some properties that were different from those of solid wood, but, in general, the same techniques could be used in machining Press-Lam that are used to process solid lumber.

The strength tests conducted at FRC indicated that the maximum bending strength of red oak Press-Lam was about

The frames were assembled under normal production line conditions.
70% as great as that of the parent red oak stock or about the same or slightly greater than that of yellow poplar, a wood that is regularly used as frame stock. Fastener and joint strength characteristics were also found to be about the same as those of yellow poplar.

In the full-scale frame tests, the Press-Lam frames performed as well as those constructed of mixed hardwoods. It was concluded that in most cases, Press-Lam could be substituted for mixed hardwoods on a one-to-one basis. If a frame were constructed entirely of a high-strength wood such as red oak, however, redesign of some critically stressed parts might be necessary.

The initial screening tests carried out at Schnadig's R and D facility in Montourville were designed to provide a basis for comparing the pertinent properties and performance characteristics of Press-Lam with those of the solid hardwoods the company was currently using. Tests were carried out, therefore, to determine the bending strength, modulus of elasticity, internal bond, screwholding power, and staple-holding strength of the Press-Lam. In addition, several frames were constructed of Press-Lam and tested. Some of these frames were tested in the laboratory; others were placed in the field for testing under everyday use conditions.

Results of these tests indicated that the Press-Lam had an average bending strength of about 10,000 psi., a modulus of elasticity of 1.3 million psi., and an internal bond strength of 850 psi. Furthermore, screw withdrawal from the face of Press-Lam averaged 66% of that from solid red oak; withdrawal from the edge of Press-Lam amounted to 55% of that from solid stock. Staple withdrawal strength amounted to 61% and 69% of that from the face and edge, respectively, of red oak.

These tests indicated that Press-Lam had sufficient strength and stiffness to be substituted for solid wood in frames on a one-to-one basis. The withdrawal strength of the staples was not as high as desired, however. Staples are used to attach the spring clips to the tops of the front and back rails. These clips are heavily loaded by the sinusoidal type springs used by Schnadig; hence there was concern whether the staples would have sufficient strength to hold the clips in place. To alleviate potential problems, spring clips were used in which one end of the clip extends out over the edge of the rail and is bent downward to provide support.

A standard model frame was then constructed of Press-Lam. It was sprung up, a section of Insul Dek was applied across the spring deck, and, finally, three cushions were placed on the spring deck. The frame was then fatigue tested for 50,000 cycles under a load of 250 lbs. per cushion. No problems resulted during testing.

Subsequently, nine additional furniture frames were constructed of Press-Lam. These frames included three sofas, three sofa beds, and three chairs. These frames, including the frame which had just been tested, were upholstered and placed in the field for in-service evaluation. Type of use ranged from what might be considered ordinary domestic service to institutional use. Periodic checks were made on all pieces. After nine months, no problems had developed with the frames.

On the basis of these results, it was concluded by Schnadig's R and D that Press-Lam would at most require few design changes to be used as a substitute for the hardwoods then used, largely on a one-to-one substitution basis. Plans were made, accordingly, to proceed with a trial production run of Press-Lam frames.

Sufficient Press-Lam was delivered to the Cornellia plant to permit the cutting of parts for about 70 frames. Since the material was 1" thick, it was first planed—both sides to 7/8" to correspond to the thickness of the material normally used. (Ordinarily, this operation would not be performed since the Press-Lam would be produced to give the desired final thickness.) One edge of each board was also trimmed to allow for an accurate measure of the footage used. No other preprocessing was carried out. A cutting was made for a standard frame. During processing, the material was treated and handled as though it were solid hardwood stock.

While the Press-Lam was being processed into sofa frame parts, observations were made as to the workers'
A few problems: Some Press-Lam parts split (left) when dowels or staples were driven into them, and the edges of the stock did not machine as smoothly as old solid woods.

Press-Lam expressed satisfaction with its performance. Furthermore, an economic analysis of the trial cutting indicated that frames cut from Press-Lam averaged slightly less in cost than duplicate frames cut from mixed hardwoods.

Following the cutting at Cornelia, 10 of the frames were assembled and upholstered by the R and D group at Montoursville. R and D personnel followed these frames from assembly through upholstering. Several assemblers and upholsterers were questioned about any problems they might have encountered. None were reported, and the R and D group concluded that the Press-Lam frames could be processed along with those constructed of solid stock.

The remaining cutting of 60 Press-Lam frames was shipped to Schnadig's plant at Rushville for new product evaluation by manufacturing and product engineering personnel. Initially, frames were assembled under production line conditions. Two minor problems were reported. First, the workers did complain that the material had a greater tendency to splinter than solid wood. It was not thought that this problem would be serious enough to affect normal production, however. Secondly, it was reported that small parts such as glue blocks that were cut from the Press-Lam had a tendency to split when staples were driven into them. This tendency to split was also noted, but to a lesser extent, when dowels and staples were driven into the ends of narrow members such as side slats and seat stretchers.

Although this would be a troublesome problem in production, a simple change in the manner in which the adhesive is spread during production of the Press-Lam will probably solve it.

No problems were encountered in upholstering the frames. In general, the upholsterers treated these frames the same as they did any others. It was feared that the fabrics might tend to snag on the Press-Lam since its surface was somewhat rougher than that of solid wood, but this did not occur. Furthermore, the upholsterers did not complain about splinters as had the assemblers.

One of the two frames upholstered at this time was subjected to a cyclic fatigue load test at the Rushville plant. In this test, a load of 100 lbs. was allowed to fall freely from a height of 6" onto the seat of the sofa. Normally, the test is carried out for 50,000 cycles. The Press-Lam frame was tested until 100,000 cycles had been completed. At the conclusion of the test, the frame was undamaged.

As a result of the frame evaluation at the Rushville plant, it was decided that solid-wood glue blocks should be used in place of those cut from Press-Lam. With this change, the remainder of the frames were then scheduled to be used for normal production.

The results of this cooperative test program clearly indicate that hardwood Press-Lam is well suited for applications such as upholstered furniture frame stock, where defects are hidden from view. Press-Lam is not limited to use as frame stock in the furniture industry, however. Defects can be eliminated completely from the material or limited to interior plies so that Press-Lam can also be used for show wood. Presently, Press-Lam is under consideration for such diverse construction as shelving, bed rails, kitchen cabinet framing stock and panels, case stock, and drawer sides. It is also being considered for high-strength applications in which it would be fabricated with clear thin veneer to produce high-strength laminated lumber that would be more uniform in strength than solid-sawn stock.

With Press-Lam, the opportunity exists to produce a structural material that has been designed to meet the specific strength and economic needs of the furniture industry. What is perhaps of even greater importance is that a material is now available so close in appearance and performance to solid wood that in many cases it can be substituted for solid wood without detracting from the appearance or the quality of the furniture. With the introduction of Press-Lam, therefore, we may see a return to the use of solid-wood construction in areas that have presently been lost to substitute materials.