CAROLYN BATES

Rating OSB Performance

by Ted Cushman

Since plywood became widespread after the Second World War, builders have come to take it for granted. Practical, strong, cheap, and durable — it's easy to see why nobody thinks twice about the stuff. Not so with plywood's younger cousin, oriented strand board, or OSB, which was introduced in the early eighties. Though OSB offers comparable strength to plywood at a lower price, some builders still don't trust it. And after Hurricane Andrew devastated huge numbers of homes in South Florida in 1992, OSB was an early scapegoat. South Dade County's zoning board outlawed its use as roof sheathing, saying it was a factor in many unnecessary roof failures, while the newspapers called it "particle board," lumping it in with everything from hardboard to cardboard. For Miamians it became a symbol of cheap, sloppy, make-a-buck-and-get-out development.

Hurricane Andrew aside, one sure thing is that OSB seems poised to dominate the structural panel market. No one is building new plywood plants these days, but six new OSB plants are currently in the works, at an estimated cost of $60 million to $100 million apiece. OSB costs less to make because the raw material is cheaper. It can be manufactured from fast-growing, 4-inch-diameter trees that used to go for pulp — aspen and poplar in the North, yellow pine and sweet gum in the South. The trees are shredded into long, thin strands (usually around 1/2 inch wide by 4 inches long) that are then glued together under high pressure and heat to form plies about 3/16 inch thick; the plies are then pressed into panels of the desired thickness (see Figure 1, next page).

Lab tests and field reports show that for most applications, oriented strand board can perform as well as plywood

Performance Standards

Perhaps one reason some people distrust OSB is that they confuse it with waferboard, an earlier non-plywood structural panel made from wood chips about 2 inches square. As is the case with plywood, manufacturers have stopped building waferboard plants, and have converted many existing plants to OSB, which is superior as a sheathing material. The reason for this superiority is

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Figure 1. *Top: A hopper full of strands that will be pressed into plies. Above: The edges of a completed OSB panel are trimmed as it rolls out of the press.*

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Figure 2. *To qualify for the APA stamp, a mill's samples must pass a battery of tests. Top: A wall sheathed with OSB is subjected to increasing racking pressure to measure deflection and ultimate failure. Above: OSB panel undergoes a three-day soak before structural testing.*

grain orientation. The wafers in waferboard are nondirectional, so the grain runs randomly in all directions. But OSB is fabricated like plywood in that its strands are arranged in directional plies, with the grain in each ply running at right angles to its neighbors. Like plywood, more of these strands run in the sheet's long direction, so OSB is strongest when laid perpendicular to framing members.

In fact, from a structural perspective, plywood and OSB aren't much different. Both products are held to the same industry-wide performance standards. The organization that sets these standards is the American Plywood Association (APA), which is the major industry association for structural panels in the U.S. As an industry association, the APA's operating costs are paid by its member companies. And though its functions include product research and development as well as marketing and public relations, its most important function is quality control for its member firms. The APA stamp (see "Reading the APA Stamp," page 37) on any structural panel means that the product has been through a tough program of technical testing, both before it's introduced to the market and on a daily basis at the mill.

The APA does not currently rate any waferboard panels. But all-veneer plywood, oriented strand board, and "composite" panels (which have veneer faces and an OSB core), are all subjected to the same APA rating process.

To qualify for the stamp, each mill has to submit samples of its product for intensive testing (Figure 2). The APA has established performance criteria for panels based on the end use, and they run the samples through a comprehensive battery of tests. For example, a test wall sheathed with $^{15}/_{32}$-inch OSB is slowly subjected to a racking force in a special jig. At a load of 600 pounds per foot, the wall should deflect no more than 0.02 inch and must not fail under a load less than 1,680 pounds per foot.

Another test measures floor deflection by using a vacuum device to slowly increase the force on a panel by 50 pounds per square foot per minute. At a hundred pounds per square foot, a panel with a 16-inch span rating must bend no more than 0.044 inches (between $^{1}/_{32}$ and $^{1}/_{16}$ inch). The panel must not fail under a load less than 330 pounds per square foot — about two or three times the typical design value for floors.

Once the mill gets the stamp, that's not the end of the story. If it wants to keep the stamp, product samples must continue to pass routine tests. Each mill must have an APA-trained "Certified Inspector" on its payroll. The inspector takes sample sheets from different parts of the mill and ships them promptly to a testing laboratory. (The mill can lose its stamp just for a delay in shipping the samples.) The inspector has to follow an APA-approved manual for quality control at the mill. Just to make sure, though, a "Quality Auditor" on the APA payroll drops by frequently to check the mill's quality control records and to pull a few test samples himself. If too many samples fall below standards in routine tests, the APA resumes its intensive testing. If the product doesn't perform better in the intensive test program, the mill loses the stamp.

Research Data

Data from other sources support the APA's performance claims. Rollie Gertjejensen heads the Structural Composites lab at University of Minnesota's Forest Products Department in St. Paul. He says, "I have tested some OSB that is stronger than plywood and some that is not as strong." But, he adds, the strength of both materials is "way beyond" what's called for in a residential building. Similarly, in tests conducted by the US Department of Agriculture's Forest Products Laboratory in Madison, Wis., OSB proved to have equal or greater bending strength than plywood.

OSB and fasteners. Professor Poo Chow of the University of Illinois Forestry Department did a controlled study of fastener performance in OSB and plywood both before and after aging. He also compared the fastener performance of panels that had been aged for five years in an open field to those that had been subjected to four different types of accelerated laboratory aging. Using both nails and staples, students at Chow's laboratory carefully measured the force required to pull fasteners out of the panels, as well as the

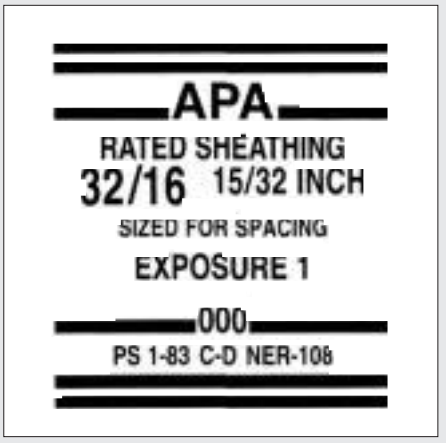
Reading the APA Stamp

All APA-rated sheathing panels carry a stamp like the one shown below. Under the words "rated sheathing" are the two sets of numbers that matter when you pick a panel. On the right is the nominal thickness of the panel — 15/32 inch in the example. To the left of this is the span rating, 32/16. This is not a fraction — it's two different numbers. The 32 means the panels can span a maximum of 32 inches between roof rafters. The 16 means the panel can span no more than 16 inches as subflooring.

It's unwise — and usually against code — to use a panel for a larger span than it's rated for. On the other hand, if you're the type who likes to overbuild, don't just choose a thicker panel. Instead, focus on the span rating and use a panel that's rated for a wider span. Whether it's OSB or plywood, a higher span rating means a stronger and stiffer roof, wall, or floor system.

One step up in span rating can make a bigger difference than you might think (see table, below). A panel with a span rating of 24/16, for instance, will meet code when applied over roof trusses 2 feet on-center. But moving up to a 32/16 rated panel, which is only 1/32 inch thicker, will raise the allowable live load for that roof by 75%, from 40 to 70 lb/sq ft.

Keep this in mind, too: when you install a panel that just meets code, you have very little leeway for installation errors. Some builders reported that when they switched to OSB, they began to notice sagging between trusses on roofs, an embarrassing visual defect. It's APA engineer Rick Tannis's job to check out these field reports; he said the problem is usually not "sagging," but buckling caused by the allowable linear expansion in the OSB panels. "The panels could buckle either up or down," he said, "but usually it's down." According to Tannis, buckling should not occur if carpenters maintained the recommended 1/8-inch gap between panels. Evidently many builders who have made the switch to OSB had been using 15/32-inch plywood with a 32/16 span rating. These heavier panels resisted buckling even when butted tightly together. The commodity-grade "half-inch" OSB they switched to was really a 7/16-inch panel rated only 24/16. With the lighter panel, the carpenters' habit of butting the panels tight together may have caused the buckling.



The best indication of a panel's strength is the APA stamp, printed on each panel, which includes a span rating. It's risky to use panels without the stamp — they might have come from a plant that has flunked inspection.

To avoid such installation-related problems and to create stronger buildings, APA encourages builders to exceed minimum code requirements for span ratings. Information on the "Code-Plus" program is available from the APA.

Another part of the APA stamp to pay attention to is the exposure rating. "Exterior" rated panels are siding panels; they are designed to withstand weather during their service life. "Exposure 1" rated panels are not meant to face the weather on a permanent basis, but they can hold up to weather exposure during the construction process. "Exposure 2" panels should not be exposed to rain, even during construction.

— *T.C.*

Recommended Roof Loads for APA Rated Sheathing* (Plywood or OSB)

Panel Span Rating	Minimum Panel Thickness (in.)	Maximum Span (in.)		Allowable Live Loads (psf)				
				Spacing of Supports Center-to-Center (in.)				
		With Edge Support	Without Edge Support	12	16	20	24	32
12/0	5/16	12	12	30				
16/0	5/16	16	16	70	30			
20/0	5/16	20	20	120	50	30		
24/0	3/8	24	20	190	100	60	30	
24/16	7/16	24	24	190	100	65	40	
32/16	15/32	32	28	325	180	120	70	30
40/20	19/32	40	32	–	305	205	130	60
48/24	23/32	48	36	–	–	280	175	95
60/32	7/8	60	48	–	–	–	305	165

SOURCE: AMERICAN PLYWOOD ASSOCIATION

Note: *Dramatic increases in strength result from one-step rises in span rating. You can achieve these gains either by using the next higher-rated panel or by placing supports closer together. This sample table applies to either OSB or plywood panels. The shaded area denotes roofs that would meet APA Code Plus recommendations. *Similar tables are available for wall and floor systems.*

force needed to pull the nails or staples through the panel's body.

Chow's study found that OSB held a nail or staple better than plywood, even after weathering. Chow credits this to the fact that OSB is denser than plywood. (To get a good glue bond between the strands in the mat, OSB has to be compressed at very high pressures and temperatures.) Chow warned, however, that his test values resulted from very careful stapling. "We drove the staples just flush with the surface," he said. "We used 50 pounds of pressure and adjusted the staple gun for each panel we tested."

In fact, the consensus among experts who inspected the storm damage is that a lack of attention to nailing or stapling was a big factor in Andrew-related roof failures in South Florida. Ed Laatch, an architect with the NAHB's Research Center in Upper Marlboro, Md., who toured the damaged areas, concurs: "I have pictures of plywood with staples sticking out of it, OSB with staples sticking out of it, and both plywood and OSB with the fasteners pulled through." Neither product seemed more prone to failure. Laatch blamed inadequate quality control on the job site for the high number of roof system failures. He believes that inexperienced or careless carpenters did not fasten the sheathing properly — nails and staples either were spaced too far apart or missed the underlying framing altogether.

Based on laboratory testing after the storm, in January, 1993, the APA published a new recommendation for nailing roof sheathing, calling for nails spaced 6 inches apart at panel edges and ends, and all intermediate supports. When nailed this way, both OSB and plywood panels preformed comparably, whether wet or dry, withstanding test pressures far beyond those of a Category 5 hurricane like Andrew.

The APA has no position on whether to nail by hand, or to use power-driven nails or staples, although studies are underway. APA engineer Tom Flint said, "We just make sure that our product meets all the national and local building code requirements. If someone comes along with a new fastening system, it's up to them to prove that it works." Experience indicates, though, that you have to be careful when using power fasteners. Be sure that you use enough of them, that you don't miss the framing members, and that you don't overdrive the fasteners.

Overdriving fasteners is more of a problem than many carpenters assume. Chow's tests showed that overdriving the staples weakens the fastener's holding power. If the head is driven 1/8 inch into the surface of a panel, you lose more than that 1/8 inch of thickness. The staple damages the material, said Chow, and if the panel gets wet and swells up, the damage can get worse. "That whole section of panel under the staple can detach from the rest of the panel completely," he said, negating the staple's effectiveness.

One factor that may have more bearing on OSB's appropriateness for hurricane-prone areas is impact strength. Lab tests confirm what most framers know from experience: it's easier to punch a hole through OSB than through plywood. This is usually not important after the panels are installed — impact resistance does not affect the building's strength under loads or racking forces. But it may have some bearing on a building's ability to withstand impact damage from flying objects in hurricanes and tornadoes.

Moisture-Related Issues

Another thing builders have to watch out for when using OSB is water vapor. When subjected to a sustained load in conditions of high or cyclic humidity, OSB can suffer a phenomenon known as "creep." When a force is applied to wood and wood-based composites, they bend; when that force is removed they spring back to their original shape. Creep is the tendency of a wood or composite member to stay bent rather than spring back.

In studies done at the Forest Products Laboratory, OSB showed significantly more "creep" when overloaded in a humid environment than did plywood. This is not cause for alarm; it only happens if the OSB is permanently loaded to more than half of its design load under conditions of high humidity. You will probably never need to worry about creep in a residential building. Even a snow load would not cause creep, for example, because it is a temporary load. If you are building a structure that will carry a high permanent load under conditions of high humidity, you can still use OSB, but you'll have to make design modifications. Your manufacturer can provide you with design specifications.

Liquid water causes more problems. The highly compressed strands in OSB absorb a lot of water when the panels get wet. A 1/2-inch-thick sheet of OSB will quickly grow to 5/8 inch thick when left out in the rain. There are no standards for this kind of thickness swelling, but APA experts say that swelling of 15% to 20% is not uncommon. Luckily, thickness swelling doesn't affect OSB'S structural qualities; all structural panels have to pass most of the structural tests for qualification after having been soaked for several days.

But if you think it might affect your finishes, you'll have to be careful. OSB works fine, for example, as a carpet underlayment, but potential swelling problems have led tile and hardwood floor manufacturers to void their warranties if their product is installed over OSB. The APA recommends only sanded veneer-faced panels for use under tile, linoleum, or vinyl unless an added layer of underlayment is applied. If you're replacing carpet with tile or wood, and you're looking at an OSB subfloor, ask the flooring supplier what kind of underlayment they recommend.

With the exception of certain flooring applications, there's now an OSB panel or part-OSB "composite" panel that will do the job of plywood in just about any building application. To get the best results, install OSB carefully and keep it dry; and for an extra margin of quality, use a panel with a higher span rating.

Further Reading

For detailed information about how to specify and use OSB and plywood panels, consult APA's design/construction guide *Residential & Commercial* and product guide *Grades and Specifications*. Both publications are available from the American Plywood Association, P.O. Box 11700, Tacoma, WA 98411-0700; 206/565-6600. ■

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