OSB vs. Plywood

Evaluation of Moisture-Related Risk Factors

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The commonly available exterior plywood and oriented strandboard (OSB) sheathing panels can be considered structurally equivalent for all of our standard construction purposes. Both engineered wood products meet or exceed national voluntary performance standards for strength and stiffness, dimensional stability and bond durability. A partial list of these performance tests include racking, uniform load, concentrated static load, impact resistance, direct fastener withdrawal, lateral fastener strength and linear expansion.

There is, however, only limited published testing of the comparative moisture exchange performance of plywood and OSB. In other words, when the two panels are exposed to excess moisture, which resists moisture infiltration better? More importantly, if the two panels become wet, which tends to dry faster?

Industry groups such as APA – The Engineered Wood Association and the Structural Board Association simply state that, when properly installed in conformance with code requirements and industry standards, neither type of panel should ever be exposed to long-term excess moisture.

However, we believe that readers of this column who have had real world experience with exterior plywood and OSB sheathing panels that have become wet will agree that wet plywood panels generally tend to provide better performance (i.e., a slower rate of loss of structural integrity and a somewhat greater resistance to severe proliferation of mold or decay fungi) than comparably wet OSB panels.

Quantification of these performance tendencies are provided in a report published by Achilles Karagiozis of the Oak Ridge National Laboratory, titled *Building Enclosure Hygrothermal Performance Study – Phase 1*[1]. The report provides two-dimensional simulations of the long-term hygrothermal performance of stucco-clad wall systems in Seattle.

The computer modeling of potential real-world conditions of building leakage demonstrates that, during periods of moisture increase within the stucco wall assembly, the moisture content of plywood panel sheathing tends to increase initially at a somewhat faster rate than the OSB panels. However, during periods of moisture decrease, the plywood more rapidly releases its moisture. This results in some extended periods (greater than three months) during which the moisture content of the OSB remains significantly greater than the plywood.

Dr. Karagiozis' report demonstrates that for OSB panels, unlike plywood, the rates for wetting and drying differ greatly and both the wetting and drying rates improve exponentially for the orthogonal 'y-direction' (i.e., laterally within the panel) when compared with the 'x-direction' (i.e., through the panel). In other words, unlike plywood, it is far easier for excess moisture simply to move laterally within an OSB panel than to exit through the panel. This results in an increased potential for conditions favorable to structural deterioration and fungal growth.

High-density gradients between the outer and inner layers of wood strands produced during hot-pressed manufacture of the panels and the addition of wax during the OSB manufacturing process explain this performance characteristic. Such observations are general, of course. Both plywood and OSB panel performance may be affected by many environmental and product variables, including the natural resistance to decay of the differing wood species used to manufacture the engineered wood products.

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According to an August 1994 article by APA – The Engineered Wood Association, *Dimensional Stability*[2], "When exposed to direct wetting, the moisture content is influenced by wetting time and by panel variables such as veneer species of plywood and wax additives of OSB."

In addition, the modeling results reported by Dr. Karagiozis appear to be consistent with prior comparative research of moisture diffusivity of OSB and plywood carried out by Mostafa Nofal and Kumar Kumaran of the National Research Council of Canada, as reported in the April 2000 issue of *Professional Roofing* magazine and the October 2000 issue of The *Journal of Light Construction*. Dr. Nofal and Dr.

Kumaran demonstrated that an initial wetting-and-drying cycle significantly compromised OSB's ability to resist water infiltration during subsequent cycles:

"OSB's moisture-absorption capacity increased with each cycle, and the time required for reaching maximum moisture content was reduced drastically as cycles progressed."[3]

Increased Moisture Obstacles

A related performance difference between plywood and OSB panel sheathing is thickness swell resulting from increased moisture content. The testing reported by APA[4] reveals, in general terms, the potential for an approximately 30 percent maximum increase in thickness for water-saturated OSB compared to only an approximately 9 percent maximum increase for similarly saturated plywood.

It is reasonable to conclude that due solely to this thickness swell issue the use of OSB sheathing behind stucco cladding will lead to an increased risk for cracking of the attached hardcoat system. In response to this concern, the project architect may wish to provide increased provisions for control and expansion joints, or to call out plywood sheathing instead.

Evaluating the Risks

These observations should not be construed as a blanket condemnation of the use of standard OSB structural panels in roof, wall or floor assemblies, even in the wettest and most humid climates. OSB is a well-engineered product that provides significant economic and environmental benefits through the use of lower quality and more easily farmed trees. For many uses, OSB provides performance and/or service values that are superior to plywood; however, it is clear that on a project-specific basis, prudent designers, specifiers and contractors must evaluate known moisture-related risk factors to determine if OSB is a reasonable substitute for plywood.

Various risk factors (e.g., wintertime construction or high ambient humidity or a projected long lead time before the building is closed in) may lead the design team to: specify plywood instead of OSB; specify a different cladding or roof covering assembly over the OSB; or upgrade the specifications and details for installation of the weather-resistive barrier or felt underlayment and related flashing assemblies.

In addition, combining these risk factors might lead the builder to more closely supervise and coordinate the subcontractors' work or to upgrade the weather protection systems for the exposed construction.

In the event of subsequent building defects litigation, knowledgeable attorneys may require all parties involved in the design, specification and construction processes to defend their evaluation of this OSB vs. plywood issue. This discovery process may lead to claims that the extent and severity of the building's structural damage would have been lessened by proper consideration of known moisture-related risk factors. m

Designers, specifiers and contractors may want to evaluate on a project-specific basis whether moisture-related risks make it appropriate to use OSB or plywood.

[1] A.N. Karagiozis, *Building Enclosure Hygrothermal Performance Study – Phase 1*, Oak Ridge National Laboratory, ORNL/TM-2002-89. http://www.ornl.gov/~webworks/cppr/y2001/rpt/113799.pdf.

[2] *Dimensional Stability* (TT-028), APA – The Engineered Wood Association, Technical Services Division, August 1994. http://www.apawood.org/level_c.cfm?content=pub_tch_libmain.

[3] M. Nofal and K. Kumaran, "Moisture's effects on OSB," *Professional Roofing* magazine, April 2000.

[4] *Dimensional Stability* (TT-028), APA – The Engineered Wood Association, Technical Services Division, August 1994.