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Fastener Pullout Testing

Results of First Series of Fastener Tests on OSB & CDX Plywood by Richard Tippet, Applied Roofing Technology

(Editor's Note: Richard Tippet, founder of Applied Roofing Technology, of Watsonville, Calif., has worked in light and heavy construction for 25 years. Applied Roofing Technology is one of the most complete roof consulting firms on the West Coast. They provide complete laboratory testing facilities. Applied Roofing Technology was the first firm on the West Coast to provide nuclear roof surveys. Approximately one third of the firm's work is forensics for the legal defense of developers, roof workers and stucco contractors. Tippet is a member of the Western States Roofing Contractors Association, the American Institute of Plant Engineers, ASTM and ICBO.)

First a little background. In the late summer of 1988 we received a copy of test results (reportedly prepared by Weyerhaeuser) that were intended to show that 1/2" OSB board retains nails better than 1/2" CDX five-ply plywood.

While the Weyerhaeuser results did in fact show that the OSB board tested apparently had greater nail holding power than the five-ply CDX, they also showed something else.

The tests showed that, after being wetted and then dried, both boards lost most of their ability to hold a nail against direct withdrawal (pullout) forces. The OSB lost nearly 67% of its ability to hold a nail; the five-ply CDX lost nearly 83%. Withdrawal resistance from OSB was reported as only 14.6 lbs., while five-ply CDX, wetted and dried, provided less than 6 lbs. resistance; about enough to hold a handkerchief after a good sneeze.

Most BUR manufacturers appear to have based their plywood fastener spacing on a pull-out resistance of 40 lbs./fastener. Any indication that plywood or OSB roof decks provided less than this resistance after exposure to moisture could present a problem.

A telephone conversation with Weyerhaeuser confirmed that their work was a study done without regard to actual field conditions and was intended only as a reproducible product comparison. For testing, 10D nails had been driven into panels after their manufacture. Some fasteners had been pulled immediately; some fasteners had been pulled after the panels had been vacuum-wetted for 24 hours; some had been pulled after the panels had been oven-dried at 210°F - 215°F until the panels stopped losing weight; ie, after not only the water from wetting was gone, but also most if not all other moisture and evaporatives in the wood, glues (binders), or surface coating was also evaporated, causing the wood to shrink away from the 10D nail.

We decided to rerun Weyerhaeusers tests, this time using typical roof membrane fasteners and simulating real-world conditions. The first series of tests is now completed.

Purpose and Method of the Tests

The purpose of the first series was to study how well OSB retained fasteners in comparison with nominal 1/2" five-ply CDX, the industry "standard" for panelized roof deck construction.

Roofing fasteners of different types were driven into the wood and some were immediately pulled out to measure the boards ability to retain fasteners as they were received from the supplier.

Another group of fasteners was driven into the boards immediately after they had been wetted for five days, to simulate conditions where a contractor is directed to roof directly over wet plywood. At the same time a second series of the original fasteners was pulled to measure the effect of wetting the panels on fastener holding ability.

The panels were air-dried to equilibrium moisture level under winter conditions. At this time all remaining fasteners were pulled and the withdrawal force measured. Five types of fasteners were selected for the test: electro-galvanized shingle nails, Owens-Corning self-tapping screws, staple-and-tape system, ring shank square-head nails, and Carlisle simplex screws.

Test Results

The first round of tests showed that the OSB and CDX plywood boards do perform differently with regard to fastener retention. Retention of all types of fasteners (except for the Carlisle screws) was approximately equal for both the plywood and the OSB as received from the supplier.

The CDX plywood tested showed a greater ability to retain all types of fasteners (except staples) under nearly all test conditions than the OSB panel tested. The plywood also showed more instances of improved fastener retention after wetting and drying than did the OSB.

Both the plywood and the OSB board showed improved retention of square head nails after wetting and drying; retention increase was greater in the plywood than in the OSB. The plywood showed no improvement of staple retention after wetting and drying, while staple retention in the OSB board actually improved.

Observations

The first screw fasteners driven into the OSB board were loosened by vibrations caused by driving subsequent screws. The same effect was observed as square head nails were driven. This didn't seem to effect their withdrawal resistance.

In general, withdrawal forces for fasteners in the plywood were more consistent after wetting and drying than they were for the OSB. For plywood, differences in fastener withdrawal force ranged as high as 50% for shingle nails driven into wet plywood; for OSB the greatest range was that of withdrawal forces for Carlisle screws driven into wet OSB.

Both panels before wetting 15/32" in thickness. After wetting the plywood measured 1/2" in thickness; the OSB measured 17/32" in thickness. After drying, the plywood measured just over 15/32"; the OSB still measured over 1/2" in thickness. •••