WOOD-BASED STRUCTURAL-USE PANEL DIAPHRAGMS AND SHEAR WALLS: PROBLEMS DUE TO MOISTURE EXPOSURE AND RECOMMENDED REPAIRS

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ABSTRACT In North America diaphragms and shear walls, constructed with oriented strand board (OSB) and plywood provide the primary lateral load resisting system in residential construction and are very popular in low-rise light-commercial buildings. The ability of these assemblies to resist and transfer shear loads is greatly dependent on the strength and behaviour of sheathing-to-framing connections. A case study describing an investigation technique and testing of shear wall and plywood floor diaphragm problems associated with prolonged exposure to rain is provided. The repair technique, including recommended steps taken for correcting problems related to fastener nailhead embedment and improving glue bond durability problems for plywood panels, is presented.

KEYWORDS: OSB, plywood, diaphragms, shear-walls, delamination, embedded nail-heads

1 INTRODUCTION

In the United States, wood structural panels must be manufactured in conformance with U.S. Department of Commerce Voluntary Product Standard, PS 1, Construction and Industrial Plywood [6], or PS 2, “Performance Standard for Wood-Based Structural-Use Panels” [7]. In Canada, plywood structural panels are manufactured in accordance with Canadian Standards Association Standards CSA O121-M1978 Douglas Fir Plywood, CSA O151-04 Canadian Softwood Plywood or CSA O153-M1980 Poplar Plywood, and CSA Standard O325 “Construction Sheathing.

These standards establish minimum performance criteria based on the intended end-use application for the product and have worked well for ensuring satisfactory performance of panels used in typical sheathing applications. As with any building product, however, performance problems can and do occur. Performance problems with wood-based structural-use panels, as with any building materials, can occur during construction of the building or after the building has been completed and occupied. The most common problems associated with wood-based structural-use panels are related to dimensional changes of the installed panels after they have been exposed to moisture. A summary of a case study involving structural plywood performance problems related to nailhead embedment and face veneer delamination due to prolonged exposure to the rain is provided, including the recommended steps taken to correct the problems.

2 CASE STUDY

The observed structure was a two-story addition to a school building located in Southern California. The building under construction utilized light-framed wood construction. The L-shaped footprint of the structure is 43 meter in the north/south direction and 16.5 meter and 8.5 meter, respectively in the east/west direction.

2.1 EXAMINATION METHODS AND PROTOCOL

The floor and roof structure were visually examined for outward signs of moisture exposure, installation issues and possible glue-bond problems. Two samples of the floor plywood sheathing were also removed from selected areas to investigate the panel glue bond and sheathing fastener connection. Observation of the removed samples and the results of the testing are presented in testing section of this paper. Selected areas of the floor panels were tested for moisture content using digital moisture meter.

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2.2 TESTING OF STRUCTURAL PLYWOOD DIAPHRAGM PANELS

Since the building was located in a high seismic region of Southern California, plywood floor diaphragms and shear walls of this structure provide the primary lateral load resisting system. The capacity of these assemblies to resist and transfer shear loads is appreciably dependent on the strength and behaviour of sheathing-to-fastener connections. In order to predict the potential for reduction in shear capacity of sheathing connections, a nail lateral resistance testing according to section 7 of PS 2-09 [6] was conducted on two (2) sets of test specimens removed from the floor assembly.

Figure 1: Nail lateral load test in accordance with PS 2-09(top) and CASHEW program output; load-displacement response from monotonic pushover analysis (MIDDLE) and cyclic load analysis (bottom)

3 CONCLUSIONS

Wood-based structural-use panels are the primary structural sheathing components used in many types of light-frame low-rise wood structures built in North America. In comparison with other sheathing products, wood structural panels offer many advantages and have a well-established record of reliability. Most performance problems associated with wood structural panels are related to moisture exposure. In addition, fastener heads can become embedded in the panel due to thickness swell of the panels caused from prolonged exposure to the wet weather. A summary of a case study describing an investigation method for a plywood floor diaphragm and shear wall problems associated with prolonged exposure to rain is provided. A step by step field repair procedure for damaged plywood panels due to embedment of fastener nailheads and problems associated with plywood glue bond durability was provided.

REFERENCES