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EXPERIMENTAL STUDY ON THE CONTRIBUTION OF GWB TO THE LATERAL PERFORMANCE OF WOOD SHEARWALLS

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ABSTRACT: It is well-known that gypsum wall board (GWB) affects the structural performance of light wood frame buildings (LWFBs) constructed with wood-based shear walls. However, the behaviour of the LWFBs including GWB under earthquake actions is still unknown. As the first step to investigate the seismic response of LWFBs with GWB, the structural behaviour of shear walls and the contribution of GWB are studied experimentally. Twelve (12) shear walls sheathed with oriented strand board (OSB) or GWB alone, or in combination are being tested under static monotonic or reversed cyclic lateral load. The structural performance of shear walls in terms of stiffness, load-carrying capacity, ductility, failure modes, failure mechanism, load distribution between OSB and GWB will be analysed. Based on the tests, the influence of the panel orientation, the taping and number of layers of GWB on the shear walls will be investigated. This test will provide essential information for the development of a supper macro model to simulate the behaviour of shear walls sheathed with OSB and GWB, and the simulation of the seismic behaviour of LWFBs considering the contribution of GWB as well.

KEYWORDS: Wood Structures, Shear walls, Gypsum wall boards, Structural performance, Test.

1 INTRODUCTION

In light wood frame buildings (LWFBs), shear walls which provide the lateral resistance are constructed with dimension lumbers and wood-based panels, such as oriented strand board (OSB), fastened together on one or two side(s) by nails which generally exhibit large ductility. For fire resistant and sound isolation reasons, gypsum wall boards (GWBs) which show stiffer and less ductility are sheathed on the interior side of the shear walls.

It is well-known that GWB contributes to the structural performance of the LWFBs [1-2]. However, the influence of GWB to ductility, failure mechanism and load-transferring path of the LWFBs are still unknown. A study was undertaken to investigate the influence of GWB to the seismic response of the LWFBs.

The effect of single-layer GWB on the structural performance, in terms of load-carrying capacity and stiffness, of shear walls has been studied by Wolfe [3], Ceccotti and Karacabeyli [4], and Sinha and Gupta [5]. It was commonly found that the lateral resistance of shear walls with OSB and GWB appeared to be equal to the sum of contributions of shear walls sheathed with OSB or GWB only. However, the influence of GWB to the ductility, which is used to determine an important seismic force modified factor, R_d, [6] of shear walls obtained by Ceccotti and Karacabeyli [4] is completely different from that derived by Sinha and Gupta [5].

Hence, as the first step towards investigating and understanding the seismic response of LWFBs with GWB, the structural behaviour of shear walls and the contribution of GWB were studied experimentally. The parameters, including the panel orientation, the taping and number of layers (single and double) of GWB, are being investigated.

2 TESTING PROGRAM

A total of 12 assemblies were designed to investigate the influence of GWB on the structural performance of shear walls. All shear walls had the same dimensions of 2440 × 2440 mm (8 × 8 ft) and different types of sheathing panels (OSB, GWB, and OSB + GWB), taping cases (with or without taping) and panel orientations (vertical and horizontal).

At the time of writing of this abstract, all shear wall assemblies are being manufactured with 38 × 89 mm (2 × 4 in.) spruce-pine-fir (SPF) dimension lumbers of stud

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grade, 12200 × 2440 ×12.5 mm OSB, 1220 × 2440 × 12.5 mm GWB, Simpson HD3B hold-down, 15.9 mm diameter A307 anchor bolts, 8d (Φ3.5 × 63.5 mm) and 16d (Φ4.1 × 89 mm) common wire nails, Φ3.25 × 50.8 mm and Φ 3.25 × 63.5 mm screws. Prior to testing, assemblies will be stored in the laboratory for two weeks to allow for wood relaxation around the nails.

The end studs of each shear wall are fastened to the foundation beam by mechanical hold-down devices, and the bottom plate is attached to the foundation beam by anchor bolts. Similarly, the top plates are connected to the load beam with bolts. The lateral load is applied to the specimens through a hydraulic actuator.

Two shear wall assemblies sheathed with OSB or GWB alone are tested under static monotonic load according to ASTM E564 [7] to derive the maximum loads and ultimate displacements which are used in the reversed cyclic loading test; while the other ten shear wall assemblies are tested under reversed cyclic load in accordance with ASTM E2126 [8] to investigate the influence of the panel orientation, the taping and number of layers of GWB on the structural performance of shear walls.

3 RESULTS AND DISCUSSIONS

The structural performance of shear walls sheathed with OSB or GWB alone, or in combination will be investigated under static monotonic or reversed cyclic load. Parameters such as stiffness, load-carrying capacity, ductility, failure modes, failure mechanism, and load distribution will be determined from test data. Since the testing is underway, results will be presented in the full length paper later.

4 CONCLUSIONS

In total 12 shear walls are being tested under static monotonic or reversed cyclic lateral load to investigate the structural behaviour of shear walls sheathed with OSB or GWB only, or in combination. Based on the test, the influence of the panel orientation, the taping and number of layers of GWB on the shear walls will be researched.

For further investigation, a supper macro model for simulating the behaviour of the shear wall sheathed with OSB and GWB will be developed, and some refined FE models with such super macro model can be used to investigate the contribution of the GWB to the LWFBs under earthquake actions.

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