TEST REPORT
EVALUATION OF HORIZONTAL RACKING RESISTANCE FOR WALLS FITTED WITH WILMAPLEX TENSIONED 0.8MM SS HOOP IRON

CLIENT:

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JOB NUMBER: **WILMAPLEX/20/002**

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This Test Report refers to testing only one sample
This Test Report can only be reproduced in full

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1. Introduction

This report describes the evaluation of the horizontal racking resistance for one type of bracing configuration as shown in Figure 1. The wall frames comprised of MGP10 (JD5) radiata pine frames fitted with Wilmaplex Stainless Steel (SS) Hoop Iron metal straps, using both galvanized and SS fasteners, the specimens were fabricated and tested at the structures laboratory of Universal Testing Facility (UTF).

2. Executive summary of test results

Table 1 Recommended design racking load for strength

Type of bracing	Racking load (kN/m)
As shown in Figure 1	6.0

3. Test specimen details

Four replicates of braced wall frames specimen were fabricated at UTF using 90x45mm MGP10 radiata pine, braced with SS Hoop Iron, each wall frame comprised 6 studs at 450mm centres laterally supported with a single nogging, the walls were 2295mm wide and 2700 high. The hoop iron braces were fixed on the top and bottom plates with an angle of around 56° in compliance with AS1648.2, Table 8.18 (d), which specifies the inclination of the metal braces to the plates at 30 to 60°. The metal straps used were 0.8x30mm and were connected to the frame as detailed in Figure 1. The fasteners used were Wilmaplex Connector Nails Twist Shank, H D Galvanized, 35x3.15mm, and Connector Nails, ring Shank, 35x3.15mm Grade 316 Stainless Steel, this information was provided by Wilmaplex.

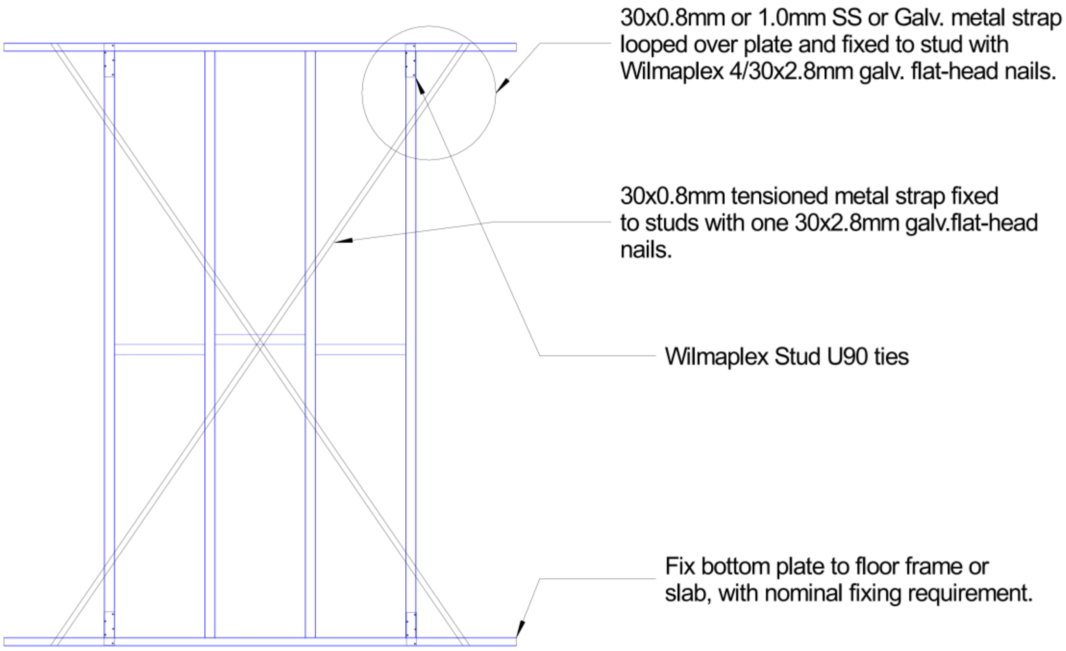

Figure 1 Wilmaplex SS Hoop Iron bracing configuration

4. Testing methodology

The test was undertaken in accordance with ASTM E72, Section 14. The test set up is shown in Figure 2, which was extracted from ASTM E72. The load was applied using a hydraulic cylinder fitted with a 50kN calibrated load cell. Four transducers were fitted onto the assembly; the first two ($D_{1a\&b}$) were located on the lower left of the wall to measure the rotation; the rotation was measured averaging the two readings. The third transducer (D_2) was located on the lower right end to measure the slippage and the forth transducer (D_3) located on the upper right end measured the total of the first three transducers plus the deformation of the panel, all load and displacement sensors were electronically recorded via an electronic data acquisition system. The net horizontal deflection of the panel at any given load, in accordance with ASTM E72, was the reading of D_3 less the sum of the readings of the average of $D_{1a\&b}$ and D_2. Test data from all transducers and load sensors were electronically recorded.

Net deflection=D_3-(D_1+D_2)

Note that $D_{1a\&b}$ represents the average of 2 transducers that were fitted to measure the rotation of the panel.

The loading sequence followed during the racking test was to:
• a preload of 0.2 kN was applied and maintained for 2 minutes; no deflections recorded;
• the preload was released; the frame was left for 5 minutes.
• load-deflection data commenced recording; load was continuously increased to 3.0kN, in around 2minutes.
• the load was held at this level for 5 minutes after which the was released;
• allow 5 minutes recovery time;
• start loading to failure.

After each loading cycle wall assemblies were closely examined for any signs of material or connector distress or buckling especially at the serviceability limit state levels.

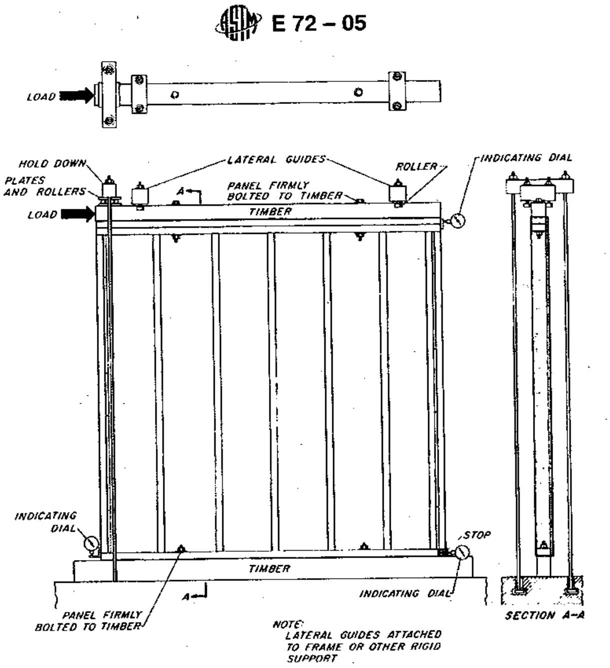

Figure 2 Racking load test setup taken from ASTM E72

5. Test results and analysis

The following criteria were set by the product manufacturers and during the process of preparing the framing code standard AS1468 in order to satisfy the limit state design criteria. The American practise imposes more stringent requirements.

Limit state design criteria requires that a serviceability limit (SLS) is met, this was undertaken via imposing a deflection limit of height/300, which is 8mm for the specimens tested, at this deflection level the specimen is not to show any significant signs of buckling or failure and shall be stable.
A strength limit state was established by determining the racking load capacity (ULS) at a deflection of height/100, which is 24mm for the specimens tested, at this load level the specimen continues to resist further load despite some material and fasteners might look under stress.

The racking load capacity evaluation was based on the prototype testing described in Section D5 of AS1720. Where the critical design action Q^* is given by equation D2 of AS1720.1, based on the equivalent test load Q_E obtained from testing, this equation was rearranged as follows

$$Q^* = \frac{Q_E k_1}{k_2 k_{26} k_{27} k_{28}}$$

Because it is understood that these tests were undertaken for comparison purposes, the sampling factor k_{28} =1.46 was based on 3 replicates and an assumed coefficient of variation of 10% tested.

The recommended racking load capacity was the most critical value of the following:

- The critical design action Q^* as determined using the above equation.
- The strength limit design load (ULS) shall be greater or equal to the serviceability limit state (SLS) load multiplied by a factor 1.5 to ensure stability.
- The strength limit design load shall be less or equal to 0.8 of the ultimate load (ULT), this serves as what is defined as a capacity factor for limit state design in AS1720.1.

Table 2 gives all the calculated test data.

Table 2 Summary of test data analysis and evaluation

Wall type	Q^*	1.5xSLS	ULS	0.8xULT
1	3.6	1.6	1.6	3.4
2	3.1	1.4	1.5	2.9
3	3.2	1.2	1.5	3.0
4	3.2	1.3	3.0	3.0

The coloured cells are the recommended racking capacities.

The design value adopted was 2.7 for 1.8m bracing as described and shown in Section 3 and Figure 1.

6. Racking load versus net deflections charts

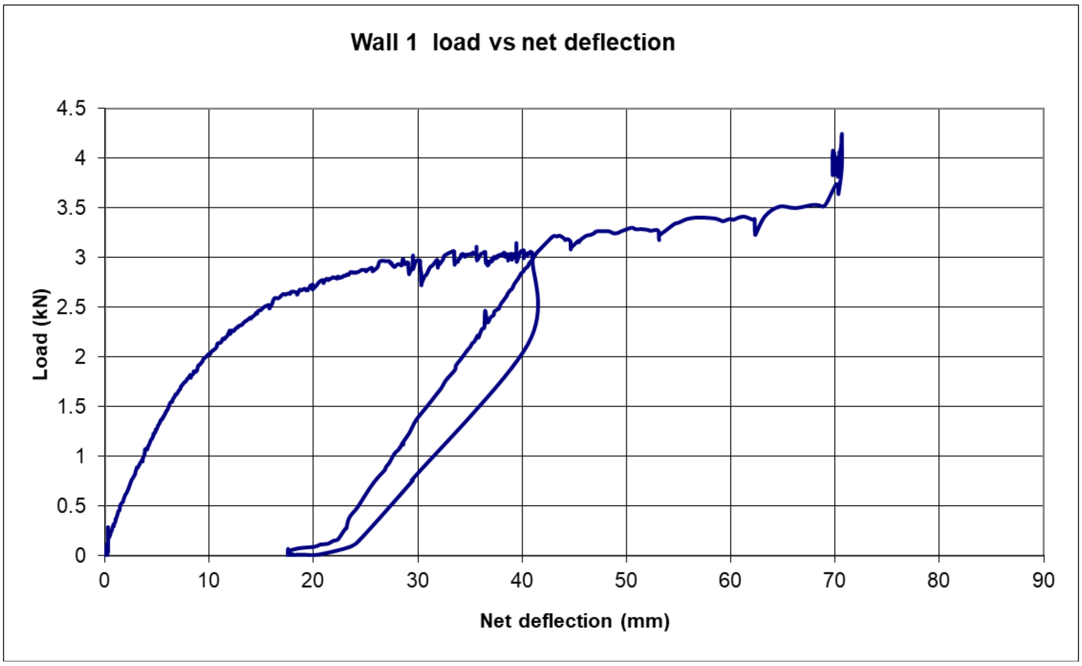

Figure 3 Racking load versus net deflection D3 for Wall 1

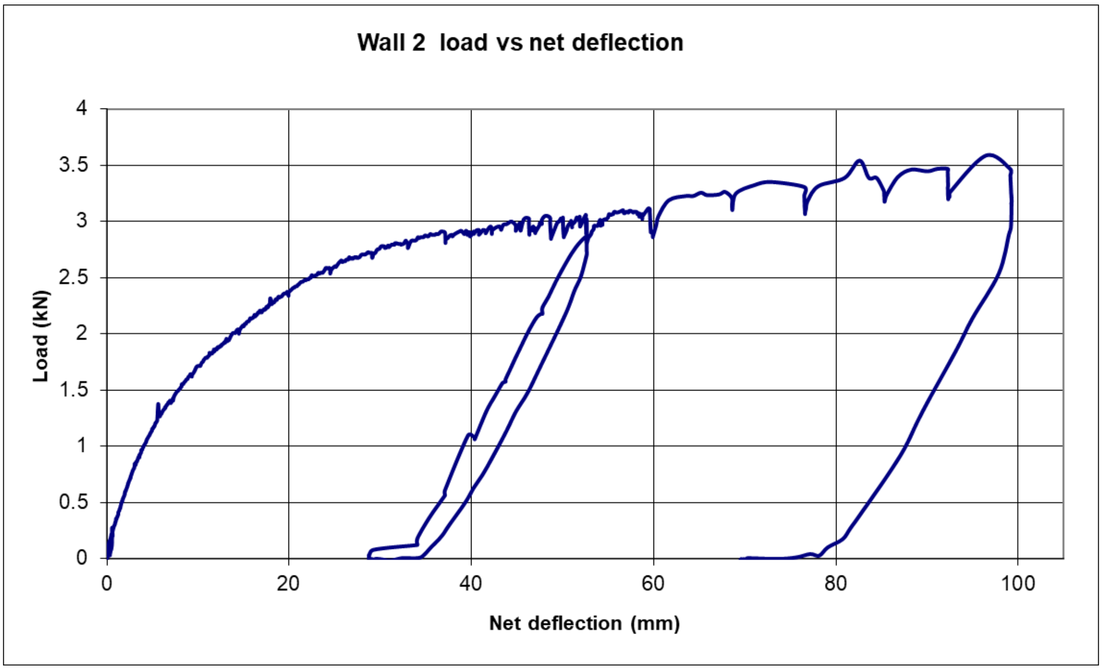

Figure 4 Racking load versus net deflection D3 for Wall 2

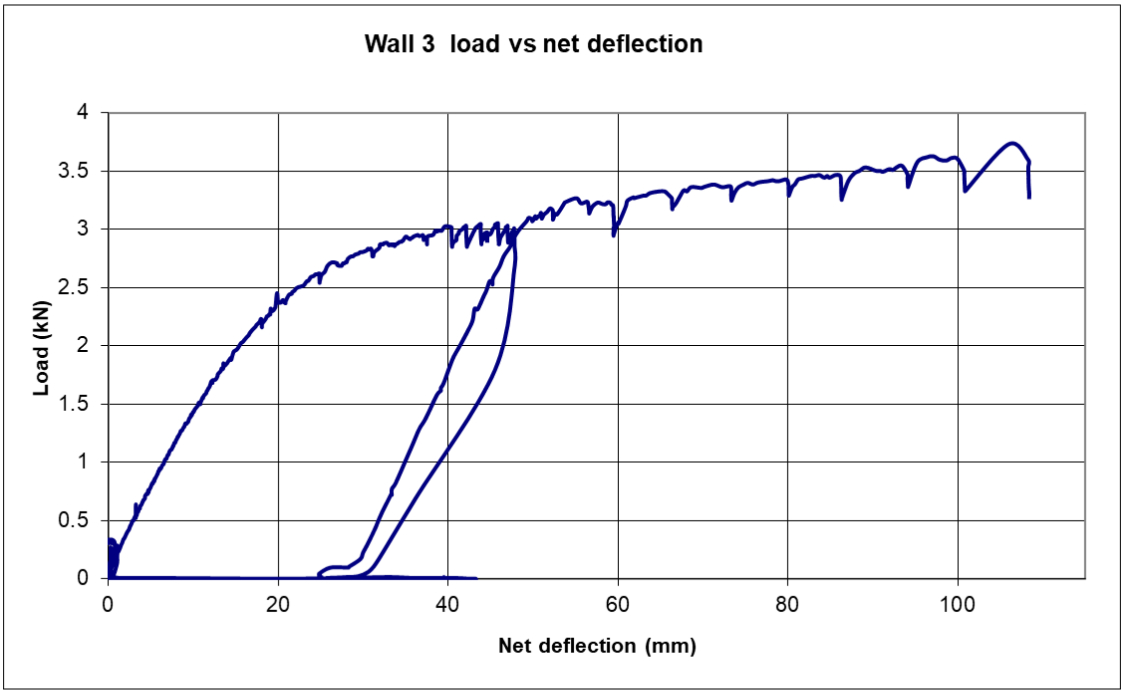

Figure 5 Racking load versus net deflection D3 for Wall 3

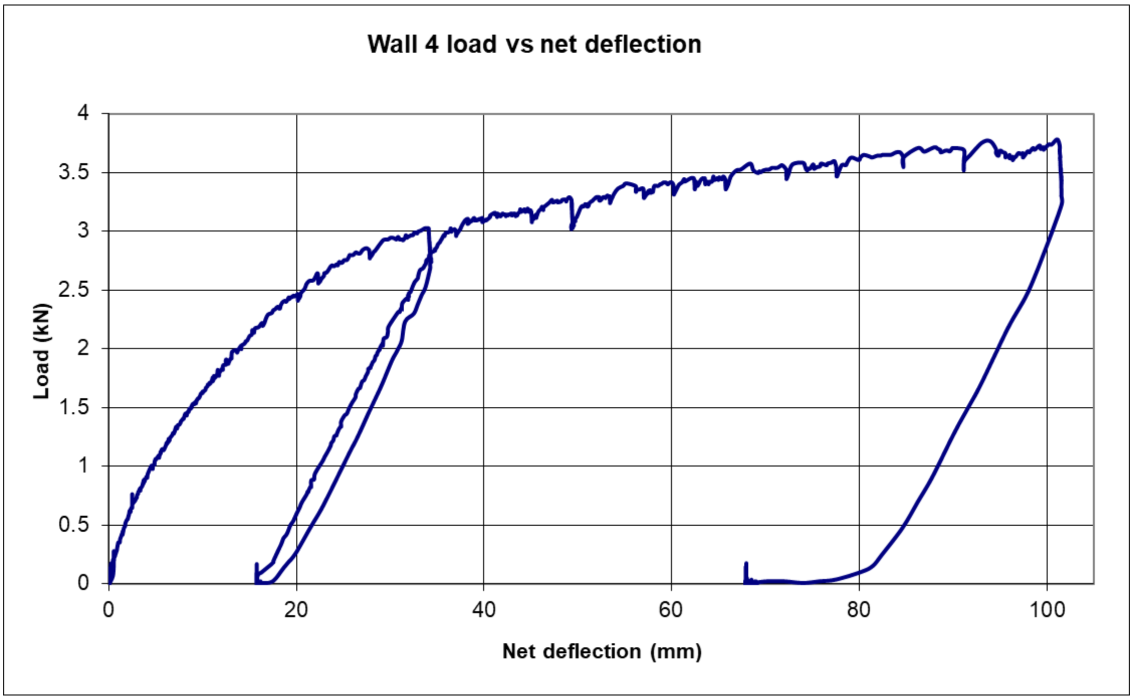

Figure 6 Racking load versus net deflection D3 for Wall 4

Mode of failure:

All specimens failed due to excessive horizontal net deflection which exceeded 100mm.