

**LOAD TEST ON
ASSEMBLED SINGLE BAY TOWER SCAFFOLD**

FOR

WANCHENG CONSTRUCTION EQUIPMENT CO. LTD

MARCH 2016

BY

BUILDING CONSTRUCTION TEST LABORATORY

1. INTRODUCTION

At the request of Wancheng Construction Equipment Co. Ltd, we attended on 19 and 20 March 2016 a load test session on their single bay tower scaffold with a view to verify the samples vertical load carrying capacity, and the samples' stiffness when they are in freestanding status.

The tower scaffold is designed for use in general at construction site as a mobile heavy live duty scaffold for access.

The test was carried out at 6 Gatwood close Padstow, New South Wales. The test loads and methods are evolved from consideration of the newly issued Australian Standard Appendix A: "Load Test on Assembled Single Bay Tower Scaffold", and Appendix F: "Stiffness test on assembled freestanding scaffold" in AS1576.3: 2015, "Prefabricated and Tube-and-coupler scaffolding".

The following tests have been carried out:

- ✧ Working load capacity;
- ✧ Design load capacity,
- ✧ Minimum strength load capacity, and
- ✧ Stiffness test

2. Test Apparatus

The test was carried out using a test loading frame as a firm horizontal foundation. Chain block to provide tension force on the samples, through a load cells 0-15t and digital reading displayer, which has been calibrated by Precise Calibration Services Pty Ltd (PCS), a NATA accredited calibration company, valid to 01 July 2016.

Accessories include:

- Forklift trucks
- 5 t rating sling;
- Loading bars and couplers,
- Stopwatch;
- Rulers,
- Laser measures, and
- Levers
- Pulley, weight, and ropes

3. Specimen and Set up

The details of the test samples and test arrangement are set out below.

3.1. Specimen

We are advised by the supplier that the components of the one sample of the assembled scaffold are randomly selected.

The components for the assembly are listed below, in Table 3.1.

Components	quantity	Unit weight (kg)	Total weight (kg)
Frame 2000	2	6.5	13.0
Frame 1600	2	5.6	11.2
Frame 1200	2	4.4	8.8
Frame 1000	2	3.0	6.0
Plank	1	16.3	16.3
Ledger handrail (yellow)	6	2.2	13.2
Ledger (Green)	10	2.9	29.0
Ledger diagonal (black)	1	3.0	3.0
Sum			100.5
Cater Wheels	The weight is not applicable for this testing		
Kick board 1800			
Kick board 620			
Outriggers			
Stairs			

Table 3.1: Components of Test Assembly

There are permanent markings of "SCF 01/16" on all ledgers and frames. No markings on caster wheels and planks.

3.2. Set Up

The set up of the assembled single bay tower scaffold is shown in Photo A.

The vertical members of the frames are designed to be supported on adjustable caster wheels at the base with an extension of 300mm. The 5.25 meter deck high tower is constructed with four adjustable OD150mm caster wheels with extension of 300mm length and three levels of frames. The frames are one on top of the other. The two 2000mm high X 680mm wide frames topped with two 1600mm high X 680mm wide frames, then topped with two 1200mm high X 680mm wide frames. Each level of frames was connected by side braces in both sides at a horizontal distance of 1835mm.

The assembled tower scaffold sits on a foundation of firm horizontal test steel beam rig. The height from the foundation to the designed working platform at the upper frame is 5250mm, which is approximately the same of "three times

the least base dimension”, as specified in the requirement of AS/NZS 1576.3.

Laser distance measuring devices are installed at the top and mid height of the assembly to measure deflections in both longitudinal and transverse directions.

The loading beams are installed on top of the load bearing vertical members. There are spigots inserted into the tube of the frame to prevent lateral ensure test load centralized.

Test load generated from the tension by a 7 T capacity chain block, linked with the load cell, sling to the loading beams. When the load applies, the force can be read from digital displayer and the deflections of the vertical members can be measured with the laser distance measures.

For stiffness testing, the tower legs are fixed at base with tubes and couplers to prevent lifting of the scaffold during this test. The height of pull out nodes on the top of legs measured from the base under caster wheels is 5.25m. The adjustable caster wheels are extended to 300mm extension. They are turned towards the diagonally opposite corner and the breaks applied.

Two horizontal 260N force are applied outwardly, perpendicular to the outer face of the scaffold from the upper most nodes at the design height of the top working platform, one onto each of the two legs. Outriggers are installed as manufacturer instruction.

Deformations are measured from the data recorded at stages of preload, under load, and removing load. The information of deformation then can be used to calculate the maximum permitted height.

One direction test for the worst face for the outward force is conducted as the calculated result shall be more conservative than the result from four directions.

4. Determination of Test Load

4.1 Test load

Vertical test loads for each of the three stage tests were determined. According to AS1576.3, and the information from the manufacturer, for one working deck application:

- ✧ Q, Live load: The live load is 7.7KN for heavy duty working deck.
- ✧ Gd, Weight of assembled scaffold at its maximum designed height 5.2m is 100kg, as shown in Table 1, or 9.8KN:

- ◇ G_t , Weight of the assembled scaffold tower as erected to the required height for the test. In this case, $G_t = G_d$.

Therefore, the test loads for vertical member of the frame tower are:

For Working load test,

$$P_w = (Q + (G_d - G_t)) / 4 = 7.7\text{KN} / 4 = 1.9\text{KN}.$$

The total test load for 4 legs is $1.9 \times 4 = 7.7\text{KN}$

Similarly, for Design load test, the total test load is

$$P_d = (1.5Q + (1.5G_d - G_t)) = (11.55\text{KN} + 4.9\text{KN}) = 16.5\text{KN}.$$

For Minimum strength load test, the total test load is

$$P_m = (2.25Q + (2.25G_d - G_t)) = (17.3\text{KN} + 12.3\text{KN}) = 29.6\text{KN}$$

For stiffness testing, the two horizontal loads are 250N, one on each of the legs at upmost nodes of the legs.

4.2. Acceptance Criteria

In A6 of AS/NZS 1576.3:2015, it is specified that following removal of the test load *“any measured permanent deformation of the loaded standards shall not exceed 0.1% of the height of nominal working platform of the test assembly to the foundation.”*

As the designed maximum height of working platform from foundation is 5250mm, the threshold of acceptance criteria for permanent deformation, in this case, is 5.3mm.

For stiffness testing, there is no acceptable criteria, but the maximum permitted height shall be determined by calculation based on the equation F5(1) and F5(2) of the Standard.

5. Test, Results and Observations

Tests based on the test procedure as specified in AS/NZS 1576.3, testing results and observations are set below.

5.1 Working load capacity

When applied test load P_w , the following deflection and deformation were observed.

Location of deflection measurement	Direction of deformation			
	Longitudinal		Transverse	
	Under load	Remove load	Under load	Remove load
Top of assembly	1	0	0	0
Mid of assembly	0	0	0	0

Table 5.1: Deformation measured for working load capacity, in mm

Inspection after removing of test load:

There is no failure or any permanent deformation observed.

The permanent deformation did not exceed acceptance criteria 5.3mm.

5.2 Design load capacity

When applied test load P_d , the following deflection and deformation were observed.

Location of deflection measurement	Direction of deformation			
	Longitudinal		Transverse	
	Under load	Remove load	Under load	Remove load
Top of assembly	1	0	0	0
Mid assembly	1	0	1	0

Table 5.2: Deformation measured for design load capacity, in mm

Inspection after removing of test load:

There is no failure observed. No cracks in material, or welding on assembly components. Caster wheels can be adjusted freely by hand.

The permanent deformation did not exceed acceptance criteria 5.3mm.

5.3 Minimum strength load capacity

When applied test load P_m , the following deflections and deformation were observed.

Location of deflection measurement	Direction of deflection/deformation			
	Longitudinal		Transverse	
	Under load	Remove load	Under load	Remove load
Top of assembly	2	1	2	1
Mid assembly	3	1	3	3

Table 5.3: Deformation measured for minimum strength load capacity, in mm

Inspection after removing of test load:

There is no failure observed. Maximum permanent deformation observed as 3mm. No cracks in material, or welding on assembly components. Caster wheels can be adjusted freely by hand. See Photo C.

The permanent deformation did not exceed acceptance criteria 5.3mm.

5.4 Stiffness Test

When applied test load for 300 seconds, the following deflections were observed.

Location of measurement	Deflection at Transverse Under load 250N	
	Node A	Node B
Top of assembly	29	35

Table 5.4: Deflection measured for stiffness, in mm

The maximum permitted height h shall be: $h \leq 100 \times H/S$

$$\text{As } S = (29+35)/2 = 32$$

$$100 \times H/S = 5.25/32 \times 100 = 16.4 \text{ m}$$

The calculated height is greater than the design height of 5.25m.

4. Conclusion

Using the test methods specified in AS/NZS 1576.3:2015, the test results for the sample single bay tower scaffold assembly suggested:

- The working load test passed the acceptance criteria;
- The design load test passed the acceptance criteria;
- The minimum strength load test passed the acceptance criteria;
- The design height satisfies requirement in terms of its stiffness, in comparison to the calculated maximum permissible height.

The test is supervised by

Lida Song

B.E., M.E. PhD (Civil Eng), C.P. Eng, NPER (659737), RPEQ (14348)

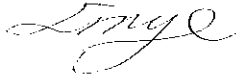
Signature:



Technician:

Linye Zhai (B. Scien)

Signature:



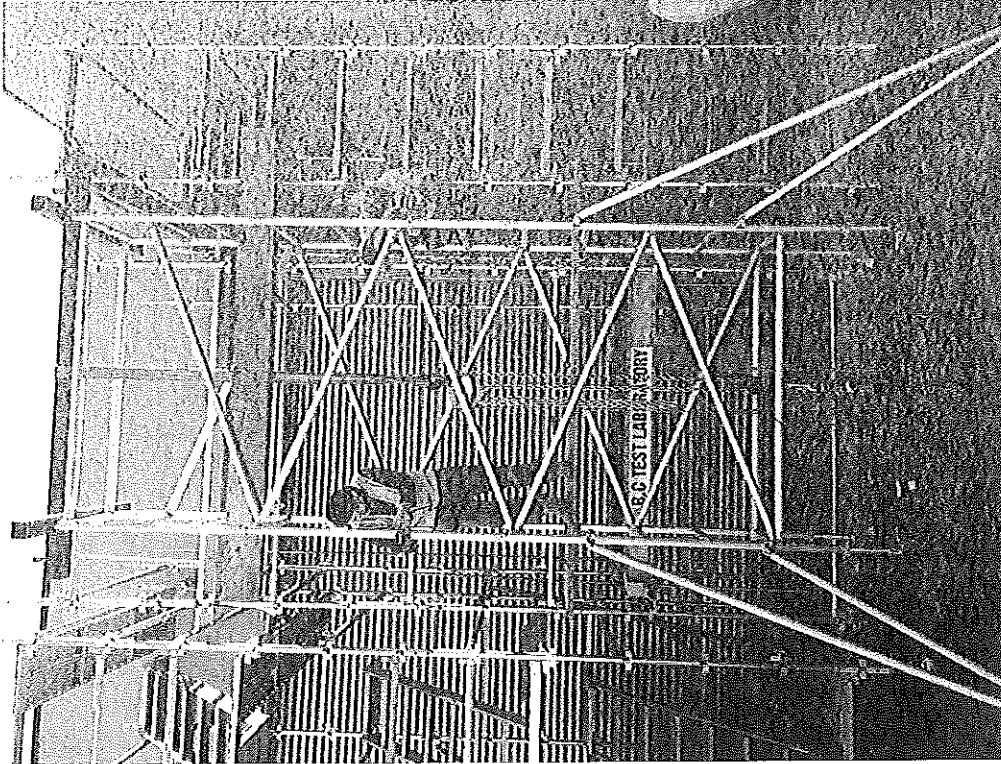


Photo A: Test Set up

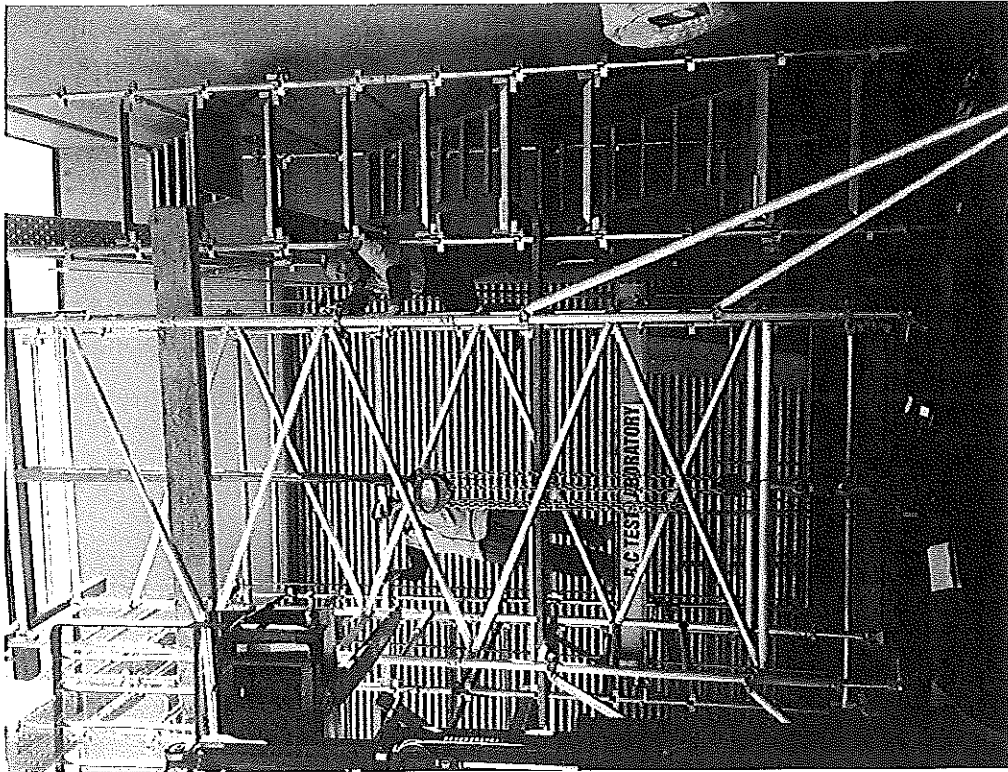


Photo B: Under vertical testing load



Photo C: Stiffness Test Set Ups

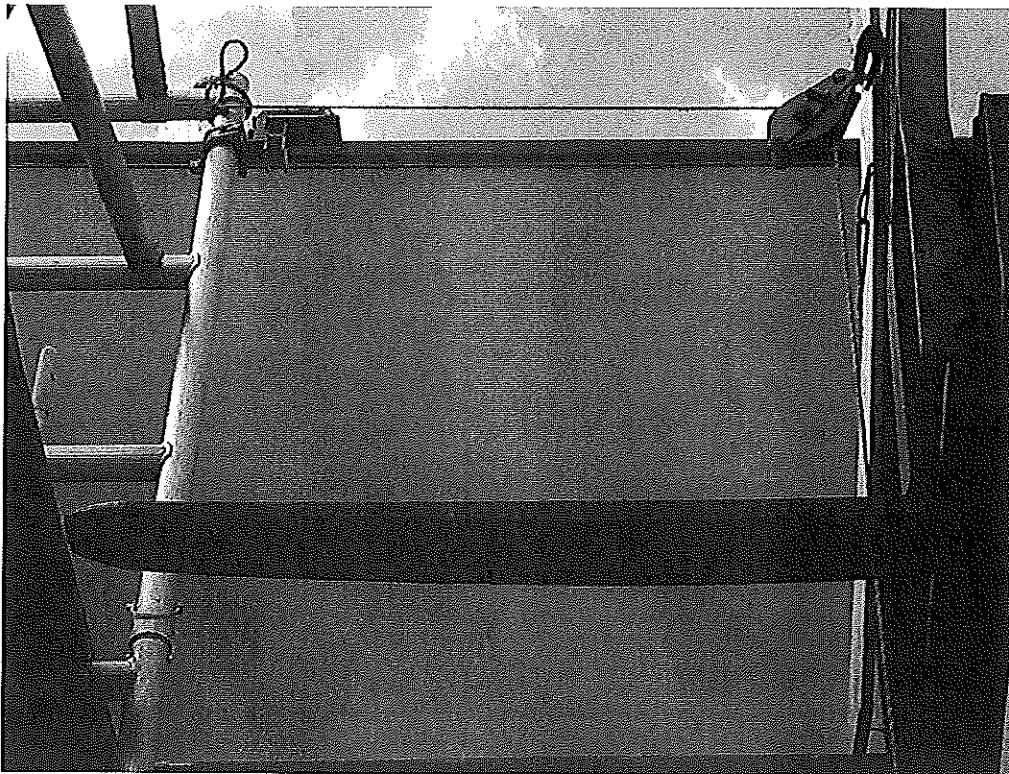


Photo D: Under Horizontal Force with Deflection Measuring