

**APOLLO CRADLES LTD
1.5M DEEP -BEAM
TEST REPORT AND LOAD EVALUATION**

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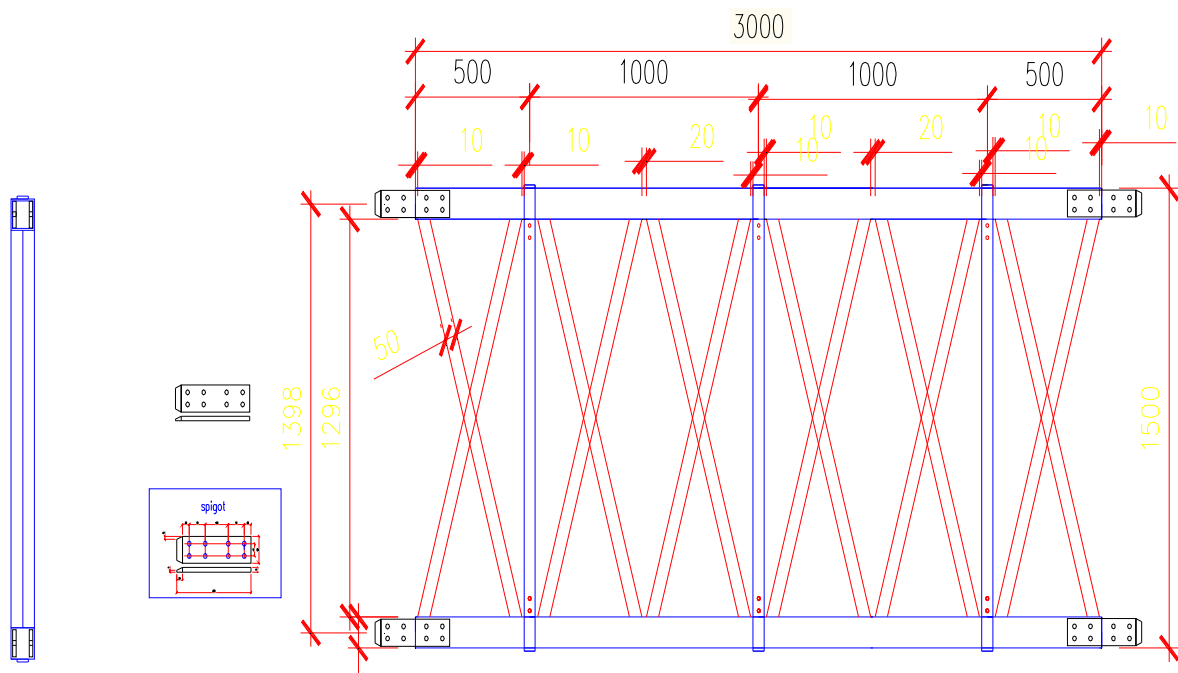
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Brief

This report describes the tests, as witnessed by Lloyds British Testing Ltd., carried out at Apollo Cradles Ltd. in Barnsley, on aluminium 1.5m deep beams, to confirm that they meet the acceptance criteria.

Geometry and Material

The geometry of the 1.5m beams is as shown below.



The beam is fabricated using aluminium alloy extruded sections in 6082T6.

Tests Criteria

The criteria were derived to test the beams response to 2kN/m^2 loading on a 30m span. The success of the test was measured against the following criteria:

1. The deflections at the working load are within the serviceability limits for the structure which is deemed to be $L/200$ or 150mm.
2. There should be no evidence of non-elastic deformation, instability or other sign of distress under the working load.
3. Under the proof load, there should not be excessive deflection or any sign of instability or imminent collapse.
4. The residual deflection measured 15minutes after the removal of the proof load should not exceed 5% of the measured deflection under the proof load.

Tests Description

Two proof load tests on the beams were made in October, at Apollo Cradles Ltd offices in Barnsley , UK

For the proof load test, two different load conditions were tested. Firstly a central point load was applied through a cross beam directly to a pair of Apollo 1.5m deep beams connected and braced at 1m intervals.

To proof test the shear on the beams, a load was applied at 1m from the end of the braced pair of beams.

These two proof load cases simulate a practical application of bending and an extreme shear case.



The layout as constructed comprised a pair of 1.5m deep beams spanning 30m with cross bracing at 1m intervals. The load was applied at the designated load points using chain pulls. The load amount was determined using electronic load cells and the deflections recorded throughout the testing.

The test followed the procedures set out in AWD Document N0190-001 Test Procedures.

A further test to destruction was carried out in December 2009 at Apollo Cradles offices.

For this test the beam was cantilevered by 15m from a tower and held down at the rear. The load was applied at 14m from the support and the load applied in the same manner..

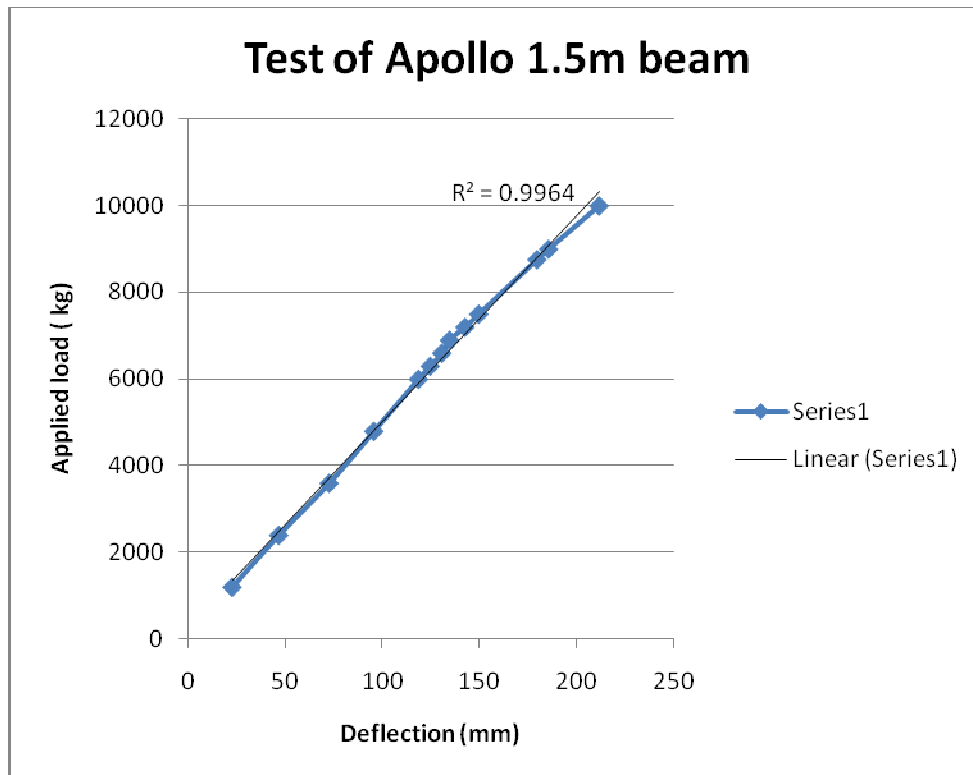
Proof Load Tests Results

Central point proof load



This load test produces full effects only in the central region of the beam with the maximum occurring at the centre. Twin X-Beams were used to brace the main beams at 2m centres and a single X-beam with plan diagonal braces was provided between them to give bracing at one metre centres on the beam.

The graph of the test results is shown below.



The graph shows the linear regression trendline of the data from which it is apparent that there is very little deviation from the line as signified by the coefficient of determination of the regression R^2 which is very close to 1.0, the perfect fit. So the test has been conducted purely in the elastic region of the beams response.

The test was conducted in three phases. Firstly a settling down load was applied which takes up any slack in the joints of the beams. This produced a permanent set of 1mm deflection at the mid-point.

The second phase was to take the beam to its working load of 60kN in 5 increments of 12kN, hold it at this load and then reduce back to zero load. This did not produce any residual deflection. At the full load the centre point deflection was 119mm which is equivalent to $L/252$.

The third part of the test was to incrementally take the load to the “proof load” level of 75kN and then unload it. Again this did not produce any residual deflection.

As an exercise the beam was taken to 100kN without distress, as shown in the graph.

Shear proof load

A load at 1m from the end of the structure gives a better indication of an acceptable shear value for the beam. The double beam was loaded incrementally to a value of 7840kg without distress.

Proof load acceptance criteria

From BS8118 the acceptance criteria for the proof load test were set out in the test procedures document. The criteria were derived to test the beams response to 2kN/m^2 loading on a 30m span. They are listed and the results identified as follows.

- 5. The deflections at the working load are within the serviceability limits for the structure which is deemed to be $L/200$ or 150mm .*

The deflection was 119mm which is equivalent to $L/252$ which is satisfactory.

- 6. There should be no evidence of non-elastic deformation, instability or other sign of distress under the working load.*

There was no sign of distress or elastic deformation under the working load.

- 7. Under the proof load, there should not be excessive deflection or any sign of instability or imminent collapse.*

There was no sign of excessive deflection or any sign of instability or imminent collapse under the proof load.

- 8. The residual deflection measured 15minutes after the removal of the proof load should not exceed 5% of the measured deflection under the proof load.*

There was no residual deflection after the removal of the proof load.

Proof load test conclusion

The tests proved conclusively that the Apollo 1.5m deep beams conformed to the criteria set for acceptance, which were derived to simulate the working load and proof load for a 2kN/m^2 load on a 30m span.

Lloyds British Testing Ltd have issued report certificates 181959/001 to 005 to confirm that the tests were witnessed and that the beams complied with the acceptance criteria.

Test to destruction

The test to destruction was carried out in a similar manner to the method described before except the layout was changed to use a cantilever beam to create greater moments for similar loads.



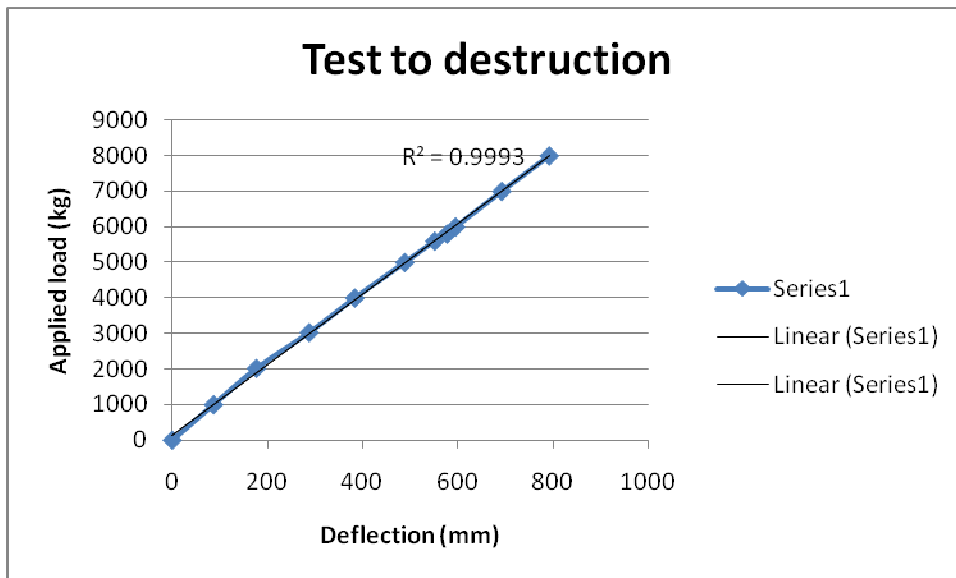
The test was carried out using double reeving of the load up to 6000 kg as shown in the picture below and then the load removed and the winch triple reeved to allow for additional loading to be applied.



The deflection of the beam was measured as before at intervals of 1000kg loading until the beam failed by buckling of the compression boom at the point of highest moment.

Test to destruction results

The results of the test are as shown in the graph below:



The graph shows the linear regression trendline of the data from which it is apparent that there is very little deviation from the line as signified by the coefficient of determination of the regression R^2 which is very close to 1.0, the perfect fit. This confirms that the failure was a sudden buckling of the compression boom.

