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ACANTHUS HOLDEN

HAFOD ESTATE CHAIN BRIDGE
Proof load tests

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EXECUTIVE SUMMARY

A series of static proof load tests has been conducted on six cast iron anchor posts on the Hafod Estate Chain Bridge. The objective of the tests was to demonstrate that each anchor post was capable of sustaining a proof load of 11 kN. Based on the test results, and considering that no sign of damage was apparent on completion of the tests, all of the anchor posts achieved the required proof load.

It is recommended that the existing anchor and guide posts are suitable for re-use in the construction of a new footbridge. The proposed imposed live loading is limited to 1 kN/m^2, for a mid-span sag of approximately 0.6m.

CONTENT

1. INTRODUCTION

1.1 CONTRACTUAL MATTERS

Cardiff University has been appointed as Consultants to Acanthus Holden Architects. This report has been issued by Cardiff University, Division of Structural Engineering for Acanthus Holden.

1.2 BACKGROUND

Cardiff University has been appointed to conduct static proof load tests on the existing anchor posts of the Hafod Estate Chain Bridge, to determine safe working live load limits in conjunction with an acceptable degree of mid-span sag. A maximum proof load of 11 kN has been deemed appropriate for a proposed live load of 1 kN/m^2, acting in conjunction with a mid-span sag of approximately 0.6m.

1.3 QUALITY ASSURANCE

The validation of all equipment and software used for testing and the acquisition and processing of data is in accordance with the procedures outlined in the Cardiff School of Engineering Quality Manual and the normal practice of the Division of Structural Engineering.

The Division of Structural Engineering has a range of universal testing machine and equipment for the application of load, which are regularly maintained and calibrated by an approved outside organisation. When load cells are used to measure load, they shall be calibrated in-house in a testing machine holding a current calibration certificate.

2. STATIC PROOF LOAD TESTS

2.1 TEST DETAILS

2.1.1 Specimen details

Six anchor posts were subjected to static proof load tests. All of the posts were fabricated from cast iron (Garfi 1998). Details of the anchor posts and associated guide-posts are presented in Figures 1 to 3 respectively.

2.1.2 Material properties

The posts were fabricated from cast iron; No tests were conducted to determine material properties. Material properties presented by BCSA (1991) give the average ultimate stresses for cast iron as follows: ultimate tensile stress of 92.7 N/mm^2, ultimate compressive stress of 494.2 N/mm^2 and an ultimate shear stress of 123.6 N/mm^2. Allowable design stresses are determined using a recommended factor of safety of 5.

2.1.3 Support and loading conditions

The static proof load tests were carried out on site using a general purpose test rig, with load being applied via a 32 kN hand operated Tirfor 532D, as shown in Figure 1. Opposing anchor posts were used as a self-straining rig, the steel rope being threaded through the existing post eyes and connected to the anchor posts via a threaded steel back plate. Existing anchorage rods were removed by grinding, to allow access of the steel rope and associated steel back plates through the eyes of the posts, as shown in Figures 2 and 3.

2.1.4 Instrumentation

An electronic load cell placed between the Tirfor and the test specimen measured the load applied to the anchor posts. An 8-channel digital micro-Disp Acoustic Emission (AE) system was used to monitor damage in the cast iron posts during testing.

AE sensors having a bandwidth of 70-300kHz (R15I) were attached to the side face of the anchor posts using tape. The surface of the posts was smoothed by light abrasion to remove loose material, prior to installation of the sensors. Silicon grease was used as an acoustic couplant between the sensor and the post. Following installation, the mounted sensitivity of each sensor was checked using an Hsu-Nielsen source, and recorded.

2.1.5 Test procedure

Three tests were conducted in total; two opposing anchor posts being loaded in each test. At the start of each test, a small pre-load of 0.5 kN was applied and removed, to seat the Tirfor, back plates and load point. Load was applied during the test by manually operating the Tirfor. Load was applied at small increments up to the required 11 kN proof load, and maintained at this level for 2 minutes. On completion of the proof load tests, load was removed slowly to zero.

2.2 TEST RESULTS

2.2.1 Proof loads

All of the anchor posts achieved a static proof load of 11 kN for a period of 2 minutes. None of the posts showed any signs of distress on removal of the test load.

2.2.2 Acoustic emission

During the tests, low energy/amplitude acoustic emissions were recorded, which were attributed to noise resulting from the loading process. No AE signals were recorded at the required proof load.

3. DISCUSSION AND CONCLUSIONS

Proof load tests have been conducted on six anchor posts. All of the anchor posts achieved the required proof load of 11 kN. None of the posts showed any signs of distress on removal of the test load. AE results indicate that no additional damage was introduced to the anchor posts as a result of the proof load tests.

4. RECOMMENDATIONS

The cast iron anchor posts all achieved the required proof load of 11 kN. It is recommended that the existing anchor and guide posts are suitable for re-use in the construction of a new footbridge. The proposed imposed live loading on the new bridge is limited to 1 kN/m^2, for a mid-span sag of approximately 0.6m.

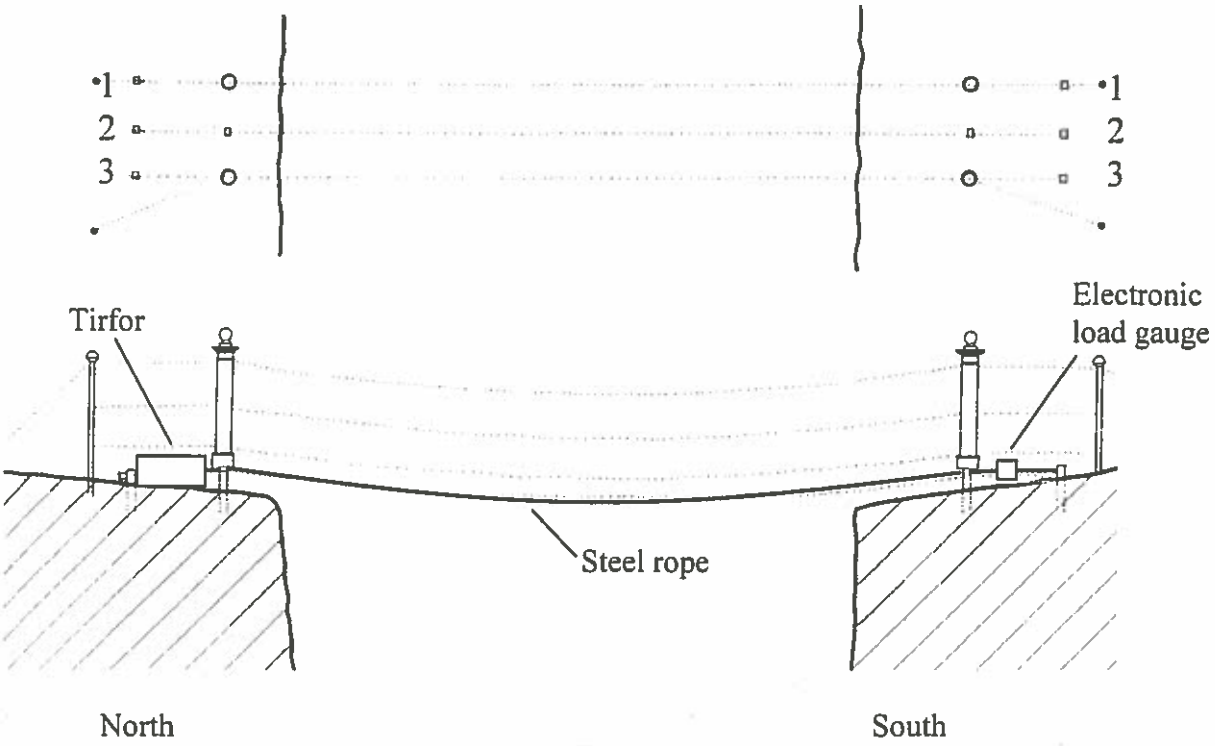
Protection of the existing cast iron components requires careful consideration. It is suggested that extensive rusting on the existing posts be smoothed away by light abrasion and oil used to protect the exposed surfaces.

REFERENCES

BCSA (1991) – Historical Structural Steelwork Handbook: Properties of UK and European Cast Iron, Wrought Iron and Steel Sections including Design, Load and Stress Data since the Mid 19th Century. The British Constructional Steelwork Association Limited, 4 Whitehall Court, Westminster, London, SW1A 2ES. ISBN 0-85073-015-5.

GARFI S (1998) – Hafod Chain Bridge Excavation: An archaeological investigation. Report for Peter Holden Architects, on behalf of The Hafod Trust.

FIGURES



a) General Arrangement.

b) Support and Static Loading Conditions – North side.

Figure 1 Details of Hafod Estate Chain Bridge Proof Load Tests.

FIGURES

a) Before removal of anchorage rods.

b) After removal of anchorage rods.

Figure 2 Details of South side posts.

FIGURES

a) Before removal of anchorage rods.

b) After removal of anchorage rods.

Figure 3 Details of North side posts.