CASE HISTORY

MAGDALEN BRIDGE, OXFORD, ENGLAND, U.K.

On May 1st of each year Magdalen Bridge becomes the focal point for Oxford 's May-day celebrations. Choristers traditionally sing from the Tower of Magdalen College located at the Oxford end of the bridge,attracting both students and tourists to listen and enjoy the atmosphere. For some, these festivities can even include jumping from the parapets into the river Cherwell below.

A test on the strength of the parapets had been originally undertaken in 1998. There were concerns about the pressures being imposed upon the parapets by the people standing on top of them and also by the large crowds that may push against them.

This test revealed that the 6m length of parapet was unable to withstand a load of 2.0kN/m. This result revealed considerably less strength than had been anticipated and therefore some form of remedial work was considered necessary.

In February 2002 another section of parapet was tested on the South West side over the first span heading towards Oxford. The section had been reinforced with Cintec anchors over a 5.66m length. It was conducted in compliance with the requirements of 'The Home Office Guide to Safety at Sports Grounds' Fourth Edition and used specially designed barrier load testing rigs (see figure 1). Deflections were monitored with dial gauges having a resolution of 10 microns.

A load level of 5kN/m was requested by the client. The parapet was initially loaded up to a bedding load of 4kN/m to remove any slack from the components of the parapet. It was then loaded to 5.0kN/m to observe the level of deflection. The parapet was found capable of accepting the load and the maximum deflection measured was 0.57mm at approximately midway between two die blocks located either side of the test length (see Test Certificate below). Because of the successful trials, the parapet walls for the entire lengths of Magdalen bridge will be strengthened with Cintec Anchors. Vertical M20 anchors of 2m are located within the die blocks and M25 anchors of 4.5m are installed through the pillasters. The horizontal anchors are M16 and between 7m and 10m in length.

Figure 2 shows the holes drilled horizontally through the parapet.
Figure 3 shows a horizontal cintec anchor prior to installation.

LOAD TESTING OF MAGDALEN ROAD BRIDGE PARAPET OXFORD ISIS ACCORD — JOB REFERENCE No: IA/503/03

BEDDING CYCLE

Pressure/psi	Load/Ram/kN	G1 (Deflections/mm)	G2	G3
0	0.00	44.48	41.86	48.54
280	0.80	44.38	41.57	48.33
535	1.59	44.14	41.13	47.93
790	2.39	43.71	40.42	47.30
1045	3.19	43.18	39.67	46.56
1300	3.98	42.42	38.38	45.50
0	0.00	44.13	41.37	48.17
Maximum deflection/mm		2.06	3.48	3.04
Maximum Permanent Deflection/mm (Max=2mm)		**0.35**	**0.49**	**0.37**
Recovery/% (Min=75%)		**83.0**	**85.9**	**87.8**

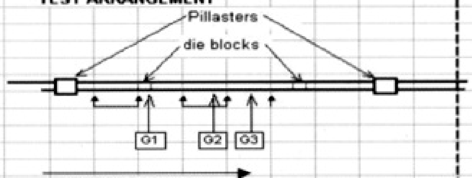
PROOF CYCLE

Pressure/psi	Load/KN	G1	G2	G3
344	1.00	43.86	40.79	47.61
663	1.99	43.40	40.01	46.93
981	2.99	42.83	39.17	46.19
1300	3.98	42.22	38.22	45.33
1619	4.98	40.88	36.47	43.84
LOAD MAINTAINED FOR FIVE MINUTES				
1689	4.98	40.49	36.18	43.61
0	0.00	43.63	40.80	47.67
Maximum deflection/mm		3.64	5.19	4.56
Maximum Permanent Deflection/mm		**0.50**	**0.57**	**0.50**
Recovery% (Min95%)		**86.3**	**89.0**	**89.0**

BARRIER DETAILS

Length	5.66 m	Factor(1.1/Height)	0.88
Height	1.25 m	No of rams	5
Spacing	n/a m	Total des. service load	19.92 kN
Gradient	n/a °	Max load/ram(bedding)	3.98 kN
Bedding load	4.00 kN/m	Total proof test load	24.90 kN
Design load	5.00 kN/m	Max load/ram(proof)	4.98 kN

TEST ARRANGEMENT



Date Tested: 22/02/02

OBSERVATIONS PRIOR TO TESTS

Test conducted on section strengthened with Cintec 'anchors', on South West side of bridge, on span nearest Headington end. Locations 1 - 3 tested in1998.
Missing coping stone and horizontal reinforcement bar, to right of test .
Test length shortened to 5.66m, away from missing coping stone.

OBSERVATIONS DURING & AFTER TESTS

Cracks appeared in mortar joints under tension during loading, i.e. at rear face of coping mid-span, at front face of coping near end of span, and joint between ballusters and ballustrade plinth.
Cracks visible under load closed on release of load.
One cycle of bedding load and one cycle of full load applied as instructed by engineers on site.

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CINTEC

CASE HISTORY

GEOFFREY HARRIS HOUSE, CROYDON, ENGLAND, U.K.

The Geoffrey Harris House is a grade II listed building purchased by Croydon Health Authority for use as a day centre by the Mental Handicap Unit.

The Estate Department commissioned the Alan Marshall Partnership as structural engineers for the conversion project.

The building's external walls have a curious structure comprising two elements built over a century apart. The original random rubble wall was constructed in the middle of the 18th century. To this has been added a second brickwork skin.

The walls suffered from settlement of foundations and severe overstressing caused by the spreading of the roof construction and the removal of parts of the walls, resulting in instability and lack of verticality.

The displacement and general condition of the walls required careful attention. The walling at the east end of the main building was found to be in extremely poor condition. In some places the brickwork lacked vertical support as a result of the removal and non-replacement of piers and walling in the past. It was found that the internal faces of the external walls were crumbling and it was decided that these needed strengthening, if not rebuilding, in places.

The west end of the building incorporates two bay window walls. One was built integrally with the main building the other, forms part of the front of the building andis Victorian. This bay has no foundation and the walls were built without bounding at the junctions with the main walls.

It was evident from the severe deterioration and cracking that this bay was becoming detached from the main building and in general needed to be rebuilt or at least strengthened and connected to other walls.

The front elevation of the building itself presented great problems. The facing wall comprised a thin 100 mm skin built without foundations. Of late Victorian age, it was out of plane, cracked and severely out of plumb. Originally built in a straight line, the cavity between the facing wall and the main wall varied from 10 - 75 mm. There are no ties or connection, except for odd pieces of timber.

Soldier arches were provided over the window openings and seen to be displaced or cracked. A survey of the facing wall revealed out of plumb dimensions of 100 to 150 mm. These variations occurred haphazardly over the whole area of the front elevation.

It was decided that the wall would have to be rebuilt. Concern at the instability of this wall was such that it was decided that, until the rebuilding could be carried out, heavy and well braced shores needed to be erected to avoid collapse. The main wall to which the facing wall was added, varied in thickness from 300 to 600 mm as piers, with infilling of solid brickwork, in general 300 mm thick.

This wall was also well out of plane, both vertically and horizontally, and was in urgent need of strengthening in parts. The parapet wall, particularly the pediment, was found to be unstable. Previous efforts made to remedy this had proved ineffective.

English Heritage were consulted as to the remedial works. It was stated, in light of the historical importance of the building, that the Croydon Health Authority would not be allowed to demolish or alter the facade.

English Heritage had seen the Cintec fixing system used to save other buildings and suggested that Alan Marshall Partnership, project consulting engineer, investigate the possibility of using the system for this project.

Cintec International Ltd were contacted and consulting engineers, Ove Arup & Partners, visited the site on the Company's behalf and, in conjunction with the installers, WT Specialist Contracts, designed a solution using the Cintec System.

It involved using stitching anchors to fix the facing skin to the main wall. The wall was then tied back to a solid internal wall.

For stitching, 15 mm x 15 mm RWT anchors were used. To avoid disturbing the exterior of the building, the 30mm diameter holes into which the anchors were inserted, were drilled from the interior.

The fixings used to anchor back the external wall were 30 mm x 30 mm WSA fixings. The repair solution involved inserting anchors into the external and internal walls at approximately 450 mm centres.

Tie rods T16 were provided between the floor joists suitably connected and anchored to the internal walls. Turn buckles allowed for tightening. The holes in the internal walls were drilled 'by dry process', drilled from the inside of the building, giving a penetration of about 80 mm into the external skin.

Small holes were drilled in the brickwork from the outside in the mortar joints to locate the anchors. These pilot holes were filled and rendered almost invisible. Vertical tie anchors were drilled through the brickwork to give support to the anchors but, in many cases, the condition and out of plumbness of the walls prevented this being possible. Tie rods were provided to anchor the west bay into the main walls at frequent intervals vertically at the junctions and also at floor level.

Architects for this project were Andrews Sherlock & Partners; the Quantity Surveyors, David Langdon & Everest; and the Consultancy Civil/Structural Engineers, Alan Marshall Partnership.

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