L i s a E d d e n
Consulting Structural Engineer
Ballyknockan, Valleymount, Co.Wicklow
Tel/fax 045 867 484 e-mail lisaedden@eircom.net

View on deck looking north

Structural Engineering Report on the Metal Bridge, Lower Road, Strawberry Beds, Co. Dublin for Fingal County Council

View of bridge from south bank looking east

Appointment and Brief

Fingal County Council commissioned Lisa Edden, Consulting Structural Engineer to carry out the following to the Metal Bridge at Lower Road, Strawberry Beds, Co. Dublin:-

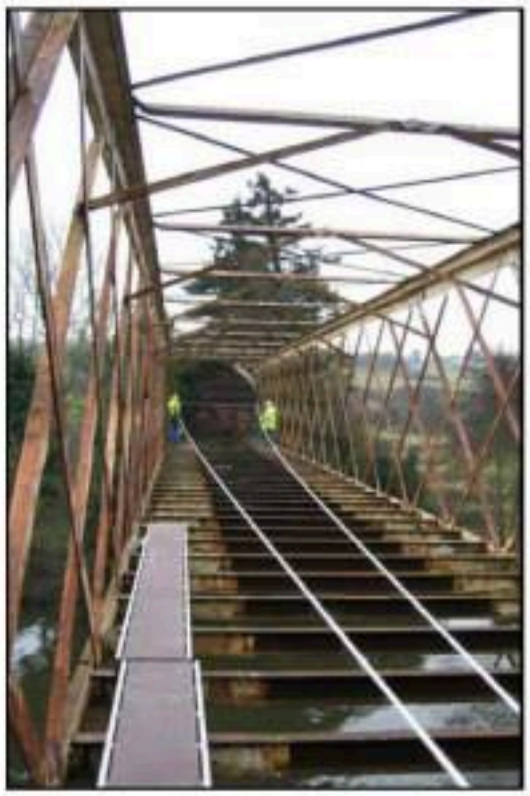
- *Inspection*
- *Report*
- *Recommendations for Repair & remedial works.*

Inspection

A brief visual inspection from the river road at Strawberry Beds was carried out 13th December 2005

The second fuller inspection was made 18th February 2006, a still clear day, with the assistance of John Rainey and Company Ltd, Steeple Jacks. The inspection was carried out from ladders and younger-mans boards spanning across the deck beams. All personnel wore harnesses clipped to the safety lines erected along the full length of the deck. This was all carried out in accordance with the method statements previously issued and approved.

The inspection consisted of both a general visual inspection, measurements of the general layout and specific measurements of many of the structural elements (but not all). A detailed visual inspection of some of the areas most vulnerable to deterioration was made. The abutments were also inspected but local areas such as the bridge bearings at both ends could not be inspected because of the build-up of debris. The south abutment was also much covered in ivy and the base of this abutment was in the river therefore out of the reach of this inspection.



Bridge deck looking south

Report

Location

The metal bridge at the Lower Road, Strawberry Beds is located at map reference O 089 358. The bridge spans clear across the river road and the River Liffey. It connects the southern river flood plain and the village of Palmerstown to the high banks on the north side of the river and the Guinness Estate. It is reported that *"the bridge was a footbridge built by the Guinness family to allow workers on it's estates on the North side of the river to get from their homes on the southside of the river around Palmerstown old village"*.

Layout and general description

The bridge is supported on two stone abutments. The south abutment projects into the river and forms the retaining wall to the river end of the embankment which brought the footpath from the low lying plain up to the level of the bridge. The north abutment is much more majestic and forms an end arch to the bridge visually offset by the steeply rising land behind it. The bridge is formed of two wrought iron lattice girders 4m high and 54 metres long.

The girders are set apart 4 metres and connected with bracing at their tops and deck beams at 950mm centres to the base. The decking to the bridge appears to have been of concrete in-fill between the floor beams but is only present in traces. The bridge was once painted white (and possibly even silver) but now is much discoloured by rust.

North abutment tower

Date of construction and materials

It would appear from the form of construction, materials used and the few contemporary drawings that the bridge was constructed in the late 1880's - ref. appendix 1. Interestingly the earliest of the drawings of the "Palmerstown Bridge" dated 1879 and the latest drawing, 1886, show details most closely resembling the bridge as constructed. The intermediate drawings from 1884 / 1885 may indicate other proposals that were not followed through. The seven drawings viewed together might indicate a construction date of 1886.

Similar lattice girder bridges built in Ireland and the UK were constructed generally in the period 1855 to 1887. A list of some of these can be found in the Bibliography at the end of this report.

The historical timeline of materials used in construction also dates the bridge to the last decades of the nineteenth century.

South Abutment, note ivy

The late nineteenth century and early twentieth century saw a rapid change in the use of different type of ferrous metals. The use of cast iron decreased as the use of large sections built up of wrought iron increased and the use of both then diminished in favour of steel.
The large built up top and bottom booms of the two truss girders are typical of wrought iron sections, as are the riveted connections. Indeed the angles and flat plates between the main booms and the bracing elements between the top of the two girders all display typical wrought iron detailing.

South girder bottom boom at north abutment

The only structural elements that may be of another type of ferrous metal are the deck beams. These are possibly formed of mild steel. The beams certainly appear to be contemporary with the main elements as the connection details are identical to those of other elements of this bridge. However in the late nineteenth century smaller rolled mild steel sections were coming to the fore. The fact that these beams have corroded much more significantly than any other elements may indicate that they are formed of mild steel.

Detail of bottom boom and deck beam connection

The corrosion may also be as a result of the deck construction detail. Although little remains in place it is likely that the deck took the form of a "filler joist floor" over the central section, with some other material such as timber to the sides. There is an indication of loadings from "concrete" on a contemporary temporary works drawing and there are the remains of a clinker type concrete between the central section of some of the deck beam flanges.
A description of the specific elements can be obtained from the drawings Appendix 4 at the back of this report.

Detail of clinker concrete between deck beams

All of the original metalwork was at one time painted white. Under previous legislation there was a requirement to paint navigational hazards white. This white would have been a slightly mellow "lead white". The word "lead" should not be ignored.

There are some later ferrous elements that were added to the bridge in more recent years. These are the mild steel sheets to the last bays at the north end of the bridge, the gate to the north abutment and the screen to the south end of the bridge. All of these elements have been erected for security reasons and do not form part, nor are they necessary to the structural performance of the bridge

Later steel security sheeting welded to girders

Condition of bridge span

The condition of the bridge metalwork appears very alarming on first glance as the whole structure has been stained dark orange-brown by the corrosion of the ferrous metal. The remaining remnants of the paintwork are flaking and in many locations give the appearance of distorted metal. However all of the main structural elements retain most if not all of their section. There are local pockets only where the sections are pitted but there has not been any substantially loss of section to the main structural elements.

Bracing detail between top of girders

However the four bridge bearing points are suspected to be suffering from significant corrosion. The underside of the bottom girders at the supports and the bearing details in the same location can not be seen because of the build up of debris, however it should be assumed that there has been deterioration at these points because of both their location at the base of the structure and the build up of debris.

Bridge bearing detail at North Abutment

The bridge deck beams have also in places corroded to such an extent that holes have formed through the sections. The corrosion is particularly significant in the locations where the original clinker concrete stopped and thus where possibly water on the deck drained off around the beams.

Samples of paint were taken from a couple of locations and analysed. The results showed that the existing paint as expected contains a high proportion of lead - refer to Appendix 2

Deck beams, note corrosion of both flanges and web

Condition of Bridge Abutments

The bridge abutment to the north end of the bridge is in relatively good condition. The structure is substantial and is likely to be well founded. However there is serious deterioration of the roof and in time this will reflect on the rest of the building. There are substantial trees growing from the roof top concrete and the stonework to the underside is showing signs of dampness and the wall tops are showing signs of salt migration. There are many tall conifers within very close proximity of the tower. These trees put the tower at risk of damage should they fall.

North abutment – roof garden

The south abutment although less majestic has an onerous task standing in the waters of the Liffey. An assessment of the condition of this abutment was not undertaken as part of this initial investigation. However it should be assumed that there is likely to be root damage from the copious ivy encompassing the structure and also scour of the masonry joints, stones themselves and possibly the base of the structure below water level.

North abutment u/s roof, note rwdp in corner

Approach Structures

The north bridge abutment joins with a substantial retaining wall that runs approximately 50metres to the east to the access gate way. There are no immediate signs of distress to this wall but there is much ivy growing over the wall and substantial trees growing very close to the upper retaining part of the wall. The gate way is 3020mm wide between substantial dressed limestone piers.

Retaining wall to north abutment approach

Gateway to gate house

Immediately behind and slightly to the east of this gate way is the Gatehouse.
The gatehouse is of modest plan, single storey and constructed of yellow brick and limestone masonry. There are the remains of some timber windows and joinery. The roof was of timber pitched construction and finished in slate. This house is in a state of severe dereliction. It has many trees growing from within and out its walls. Access is extremely difficult at present thus proper investigation is not possible – however it can be assumed that at best the walls alone are salvageable

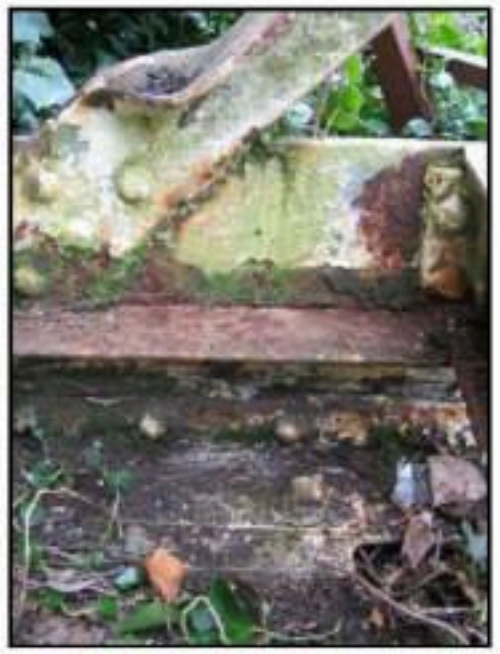
Gatehouse to east of north abutment

To the south end of the bridge the approach climbs a steep earthen embankment from the river flood plains. The bridge has security metal work welded to its southern metal arch that unfortunately is not successful from either an aesthetic point of view nor as security.

"Security" sheeting to south end of bridge

Recommendations for Repair & remedial works

Immediate works – within the next year



- **Security -** The bridge is not secure to public access. The security metal work to the south end in particular is insecure and readily accessible to the children who use the park to the south. For health and safety reasons access to the bridge by the public needs to be halted.

- **Bearings -** The bearings of the two truss girders need to be exposed and assessed as part of the on going inspection and understanding of the bridge. These should be cleared of debris and the area washed down with a water hose or similar. Further inspection by an engineer should be arranged.

- **Plant growth -** The bridge abutments to both north and south side of river should be cleared of plant growth. Plants should be clipped back not pulled from the structure and further inspection arranged. A minimum of three trees nearest the north abutment should be felled to prevent risk of damage to the masonry tower. The prolific growth beneath the bridge between the river road and the river should be cleared as it is already growing up through the deck beams to the bridge. The gatehouse should also be carefully cleared of all plant growth to allow further inspection and understanding

Recommendations for Repair & remedial works

Mid term works – recommended within the next five years

- **Removal of paint and re-painting** – For the effective long term protection of the bridge metalwork the removal of the defective flaking paintwork and repainting is essential. A full scale grit blasting and re-painting of all the metalwork to the bridge should be commissioned. This is a large scale project requiring a carefully brief and project management.
  Appendix 3 discusses some of the hazards associated with lead paint removal. Removal of lead paintwork over a watercourse presents an additional range of problems as does the fact that the bridge is unlikely to be able to support a fully sheeted scaffold. A sheeted scaffold suspended from the bridge would be likely to impart lateral loads from the wind far in excess of that for which the open lattice work was designed. For these two reasons the containment of lead loaded grit from the paint removal process will need to be carefully thought out.
  Note the pipe that is suspended under the bridge is redundant and could be removed at the start of a painting contract

- **Roof to North Abutment –** The roof to the tower of the north abutment is leaking and will need replacement / addition to reduce the water damage that is occurring to the upper levels of stonework. A renewed roof covering will also tend to halt the number of plants and trees that are seeding themselves into the cracks and crevices in the current roof finishes.

- **Inspection of south abutment** – To fully inspect the south abutment not only does the plant growth need to be removed (see above) but also access to the river side of the abutment is required. Viewing of the below water level stonework is a further issue and would need to be coordinated with either a temporary reduction in river level and /or an inspection by a qualified diving team.

Splice detail top boom

Redundant pipe

South Abutment viewed from north bank

Long term works – five years and looking forward

- **Structural Analysis** - The longer term view of this historic structure should include it's re-use as a pedestrian link between Palmerstown and the park on the south bank with amenities on the north side of the river.
  With this in mind a detailed structural analysis of the bridge should be commissioned to assess its load carrying capabilities and its potential weak "links" along with recommendations for the possible upgrading / strengthening of elements to allow re-use.

View of bridge from south bank looking northeast

Lisa Edden.
B.Eng., C.Eng., M.I.Struct.E., M.I.E.I.
14th July 2006

Bibliography

http://www.archiseek.com/content/showthread.php?t=824
"This bridge was a footbridge built by the Guinness family to allow workers on it's estates on the North side of the river to get from their homes on the southside of the river around Palmerstown old village."

The Institution of Structural Engineers. 1996
Appraisal of existing Structures. Second Edition.

Construction Industry Research and Information Association. 1986.
Structural Renovation of Traditional Buildings *(CIRIA Report 111).*

The British Constructional Steelwork Association Limited. 1984
Historical Structural Steelwork Handbook. Compiled and written by W. Bates

Institution of Civil Engineers, and the Institution of Engineers of Ireland. 1998
Civil Engineering Heritage – Ireland. written by R C Cox and M H Gould
Note Metal bridge at Strawberry beds not referenced but two other lattice girder bridges mentioned:-
Obelisk Bridge across river Boyne constructed 1868
Ballyduff upper Bridge across River Blackwater constructed 1887

Similar Lattice Girder Bridges in Ireland and UK

Ireland

Boyne Viaduct	Railway bridge over R Boyne	1855
Obelisk Bridge, Nr Drogheda	Road bridge across River Boyne	1868
Ballyduff Upper Bridge	Road bridge across R Blackwater	1887

UK

Hungerford Bridge, London	Railway bridge over R Thames	1864
Kew Railway Bridge, London,	Railway bridge over R Thames	1869
Lee Dingle Bridge, Madeley	Tram bridge Blists Hill Ironworks	1872