ROUGHTON

ARCHITECTS
ENGINEERS
SURVEYORS

RARDE NORTH SITE
WALTHAM ABBEY

BRIDGE ASSESSMENTS

JUNE 1993

PSA
Projects

RARDE NORTH SITE
WALTHAM ABBEY

BRIDGE ASSESSMENTS

JUNE 1993

JOB NO. ICC 657

Rev.A

DEFENCE LANDS SERVICES 3
CENTRAL DISPOSALS UNIT
MINISTRY OF DEFENCE
LEATHERHEAD ROAD
CHESSINGTON
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CONTENTS

WALTHAM ABBEY NORTH SITE BRIDGES

INTRODUCTION

Roughtons were instructed to carry out assessments of 20 bridges on the Waltham Abbey RARDE North Site.

Initially a search for record drawings was carried out at the Ministry of Defence Estate Surveyors office in Chessington. Record drawings of some of the structures were found, these drawings having been included in this report.

It should be noted that the bridges have been numbered in a logical sequence for this report. Their locations are shown on the enclosed site plans.

Site inspections were carried out of all the bridges to determine their condition. Where record drawings of the structure did not exist, a detailed survey of the bridge was undertaken including all dimensions, sizes of members and connection details.

The bridges were assessed either in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures" or in the case of Aquaducts they were assumed to be full of water with material properties being taken from the same design manual.

In the case of road bridges they were assessed to determine their ability to carry i) the current specified maximum axle load and ii) the original maximum axle load. These loads for the various road bridges are as follows:

New No.	Description	Original Max Axle Load	Current Max Axle Load	Old No.
1	Flagstaff Bridge	2.5	2.5	2
2	Bailey Bridge	8.5	5	3
4	Bailey Bridge	9	5	4
6	Concrete Bridge	9	5	10
8	Concrete/Steel Bridge	13	5	6
10	Brick Bridge	16	5	7
11	Bailey Bridge	8.5	5	8
12	Steel Trough	9	9	9

Where bridges appear to be of sufficient strength they have been checked to determine whether they can carry full HA live loads i.e. 40 Tonne lorries.

In places in this report assessment live load has been quoted instead of axle load. The Department of Transport Design Manual for Roads and Bridges Part 3 BD21/93 Table 5/4, an extract of which is shown below, gives the axle load values for various assessment live loads.

Assessment Live Load (Tonnes)	Nominal Single Axle Load (Tonnes)
40	20
38	18
25	18
17	18
7.5	10
3	5

For each bridge there is a written text including description, condition survey, assessment criteria, survey and assessment results, cost estimate and options. In addition there is a principal inspection report, sketches or drawings of the bridge and photographs.

The defects extent and severity has been taken from the Department of Transport Bridge Inspection Guide Clause 1.5 which uses the following scales:

Extent

A No significant defect

B Slight; not more than 5% affected (of area, length, etc)

C Moderate; 5% - 20% affected

D Extensive; over 20% affected

Severity

1 No significant defect

2 Minor defects of non urgent nature

3 Defects of an unacceptable nature which should be included for attention within the next 2 annual maintenance programmes.

4 Severe defects where action is needed (these should be reported immediately to the Engineer) within the next financial year

Item numbers used on the principal inspection report sheets refer to the following:

1	Foundations	19	Jack Arches
2	Invert	20	Bracing and/or Cross Ties
3	Apron	21	Deck Concrete/Timbers
4	Cutwaters	22	Expansion Joints
5	Fenders	23	Arch Springing
6	Piers	24	Arch Ring
7	Columns	25	Voussoirs/Arch Face
8	Abutments	26	Spandrel Walls
9	Wing Walls	27	Tie Rods
10	Embankments	28	Deck Plates
11	Training Walls	29	Waterproofing
12	Drainage - Sub Structure	30	Drainage - Superstructure
13	Main Beams - Edge	31	Masonry and/or Brickwork
14	Main Beams - Internal	32	Pointing
15	Bearings	33	Surfacing
16	Transverse Beams	34	Paintwork
17	Crossheads	35	Parapets
18	Troughing/Buckle Plates		

Where an item has not been included on the sheet in this report it does not exist on that particular bridge.

Generally bridge parapets throughout the site do not comply with the requirements of Technical Memorandum BE5. It is compulsory for existing Department of Transport Trunk Road and Motorway bridges to be upgraded to comply with this document. If the bridges are to remain in private ownership, Technical Memorandum BE5 is not mandatory. However the bridge owner must consider the implications of Owners liability towards any persons using the bridges and it is therefore recommended that the parapets of all bridges are upgraded.

Cost estimates have been provided for upgrading the bridge to comply with each of the criteria i (current specified maximum axle load) and ii (original maximum axle load). Where the cost of remedial works was high an estimated cost for renewing the bridge or replacing with a culvert has been included.

In order to estimate the cost of replacing any of the bridges with a box culvert the size of the latter has been based on the existing cross-sectional area available for water flow. Data has not been available regarding the catchment area for each watercourse hence it has not been possible to determine maximum flow rates; this must be assessed prior to replacing any bridge to ensure the culvert is of adequate size.

In compiling all the cost estimates it has been assumed that all the bridge works would be carried out under the same contract. This would keep preliminaries, overheads and establishment costs to a minimum. If any bridges were repaired on an individual basis the repair costs would be considerably greater than those given in this report.

All costs quoted in this report are approximate and will be subject to variation when prices are obtained from Contractors. The costs are to be used only as a guide to enable economic choices to be made.

SITE PLANS

SURVEYED BY :
MILTON KEYNES SURVEYS
67a HIGH STREET, STONY STRATFORD.
MILTON KEYNES. MK11 1AY.
TEL. 0908 565561 FAX. 0908 560533

LAND SURVEY AT:

RARDE – WALTHAM ABBEY

FOR

PSA – SPECIALIST SERVICES

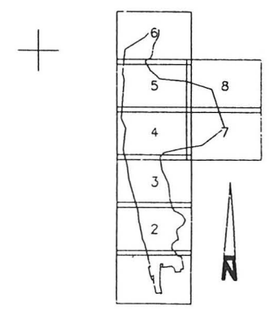
SCALE 1:500 – JOB No 3927 – DATE MARCH 1993

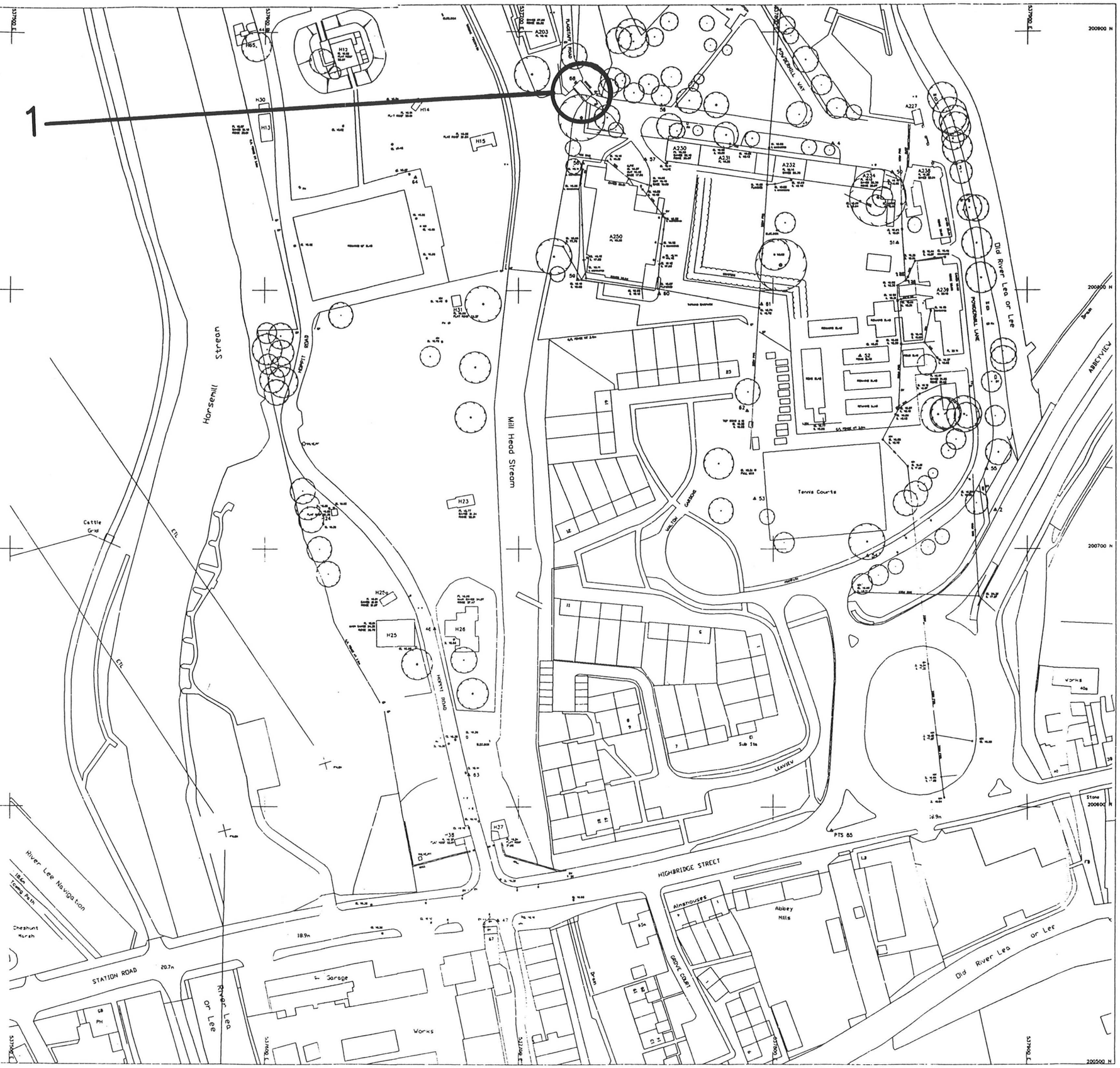
SHEET 1

NOTES :
1. GRID IS BASED ON O.S. DATUM.
TRIG PILLAR – TL 51/1 – 538563.382E 202427.410N
BRASS RIVET – PTS 85 – 537822.73E 200590.95N
L.S.F. 0.999983 USED ON ALL CONTROL STATIONS.

2. LEVELS BASED ON O.S. DATUM.
OSBM – BUILDING No L168 POWDERMILL WAY – 19.35m
OSBM – LOCK RIVER LEE NAVIGATION – 19.57m

3. MKS SURVEY DATA ADDED TO O.S. SURVEY DATA.





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LAND SURVEY AT:

RARDE – WALTHAM ABBEY

FOR

PSA – SPECIALIST SERVICES

SCALE 1:500 – JOB No 3927 – DATE MARCH 1993

SHEET 2

NOTES :
1. GRID IS BASED ON O.S. DATUM.
TRIG PILLAR – TL 51/1 – 538583.362E 202427.410N
BRASS RIVET – PTS 85 – 537822.73E 200590.95N
L.S.F. 0.99983 USED ON ALL CONTROL STATIONS.

2. LEVELS BASED ON O.S. DATUM.
OSBM – BUILDING No L168 POWDERMILL WAY – 19.35m
OSBM – LOCK RIVER LEE NAVIGATION – 19.57m

3. MKS SURVEY DATA ADDED TO O.S. SURVEY DATA.

Horsemill Stream

Old River Lea or Lee

Drain

Path (um)

HOPPIT ROAD

MIDDLE ROAD

LOOP ROAD

POWDERMILL WAY

THE STRAITS

FLAUNTWAY ROAD

5

4

3

2

17

1

LAND SURVEY AT:

RARDE – WALTHAM ABBEY

FOR

PSA – SPECIALIST SERVICES

SCALE 1:500 – JOB No 3927 – DATE MARCH 1993

SHEET 3

NOTES :

1. OPUS IS BASED ON O.S. DATUM.
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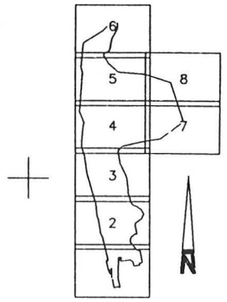
   BRASS RIVET – PTS 85 – 537822.73E 200590.95N
   L.S.F 0.99953 USED ON A.C. CONTROL STATIONS.
2. LEVELS BASED ON O.S. DATUM.
   058M – BUILDING No L166 POWDERMILL WAY – 19.35m
   058M – LOCK RIVER LEE NAVIGATION – 19.57m
3. MKS SURVEY DATA ADDED TO O.S. SURVEY DATA.



8

6

7

5

Horsemill Stream

Old River Lea or Lee

Drain

DISUSED LOCK

LONG WALK

LOOP ROAD

BRIDGE

FB

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13

19

14

10

18

16

9

LAND SURVEY AT:

RARDE – WALTHAM ABBEY

FOR

PSA – SPECIALIST SERVICES

SCALE 1:500 – JOB No 3927 – DATE MARCH 1993

SHEET 4

SURVEYED BY :
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LAND SURVEY AT:

RARDE – WALTHAM ABBEY

FOR

PSA – SPECIALIST SERVICES

SCALE 1:500 – JOB No 3927 – DATE MARCH 1993

SHEET 5

NOTES :
1. OPD IS BASED ON O.S. DATUM.
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BRASS RIVET – PTS 85 – 537822.73E 200580.95N
L.S.F 0.99983 USED ON ALL CONTROL STATIONS.

2. LEVELS BASED ON O.S. DATUM.
OSBM – BUILDING No L168 PONDERMILL WAY – 19.35m
OSBM – LOCK RIVER LEE NAVIGATION – 19.57m

3. NKS SURVEY DATA ADDED TO O.S. SURVEY DATA.

12

20

15

11

Cornmill Stream

Drain

Lea or Le

Old Riv

NEWTONS POOL

POND

LONG WALK

202300 N

202200 N

202100 N

202000 N

537500 E

537600 E

537700 E

TEXT
INSPECTION REPORT
DRAWING
PHOTOGRAPHS
FOR
BRIDGES 1 – 20

BRIDGE NO. 1

FLAGSTAFF BRIDGE - CAST IRON ARCH RIBS OVER MILL HEAD STREAM

(WEIGHT LIMIT 2.5 TONNE AXLE LOAD)

The previous inspection of this bridge was carried out on the 29th October 1991.

1.1 DESCRIPTION

The bridge comprises 6 cast iron arch ribs spanning 6.13m between brick abutments. There is a slight camber on the bridge. The bridge deck comprises 70mm concrete on gravel and sand fill on an 18mm cast iron plate. This plate is in turn bolted to the top flange of each of the cast iron arch ribs. There are cast iron restraint pieces bolted between the arch ribs. Each arch sits on a 500mm wide bearing shelf and is bolted back to a vertical masonry wall at the back of the shelf. The abutments on both sides of the bridge are brickwork.

There are 35mm diameter handrails along either side of the bridge at 425mm and 880mm above the road surface. The handrail stanchions are cast iron posts with a tapered section, the stanchions being at 1400mm centres.

1.2 CONDITION SURVEY

On the north side of the bridge the north west handrail stanchion is cracked at the base and the south east stanchion is missing. These should be repaired and replaced respectively. The concrete deck of the bridge has a transverse crack 1.6m from the north west abutment. The cast iron plate supporting the concrete is in good condition.

Between the two most south western cast iron arch ribs the restraint sections have been removed in order to install a steam main; it is believed this steam main is now redundant and can be removed. The external arch on the north east side has two sections of the bottom flange missing adjacent to the north west abutment. It is not possible

to swap this arch with any of the internal ones as they are different.

A hole was drilled in the concrete deck at the crown of the bridge 500mm from the south side. The concrete was found to be 70mm and the cast iron plate 18mm thick.

Some of the bolts fixing the arch ribs to the brickwork are severely corroded and there is a considerable quantity of loose material on the bearing shelf. A number of pieces of timber have been fixed into the bridge over each bearing and these should be removed and the paintwork behind made good. Generally the paintwork to the bridge is in good condition.

The abutment on the north west side is very damp due to the amount of water draining off the bearing shelf on the south west corner. Under the bridge the face of the brickwork has spalled away to a depth of 50mm to a height of 1.1m above the water level. On the south east abutment the brickwork has spalled away to a depth of 25mm within 1m of the water level. This has previously been patch repaired with mortar which is now coming away.

There is vegetation growing in the walls of abutments and adjacent embankments, root ingress having damaged the brickwork.

1.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

The permissible stresses in the cast iron have been taken in accordance with Figure 4/1 of BD21/93.

As the carriageway width was less than 5m it has been assumed to comprise one notional lane of 3.9m width.

1.4 SURVEY AND ASSESSMENT RESULTS

The bridge is capable of carrying an axle load of 1.9 Tonnes when the cast iron arch ribs reach the allowable stresses. This is less than the minimum recommended load at which consideration should be given to closing the bridge. However if the speed and width of vehicles is restricted by using road humps and bollards then the bridge can remain in use for light vehicles until such time as an alternative route can be provided. In the meantime clear signing of the weight restriction is essential.

The cracks in the concrete deck need to be repaired by cutting a V notch in the location of the crack and filling it with a proprietary mortar to seal the surface of the bridge and make it watertight.

The north east external arch rib should have the bottom flange repaired where the two sections are missing adjacent the north west abutment. This can be done by bonding in a new section of cast or ductile iron using epoxy adhesives. Welding of cast iron is not possible.

Where the restraint sections between the cast iron arch ribs have been removed in the past new sections should be fabricated to match the existing and bolted to the arch ribs in the relevant places.

Where the bolts fixing the arch ribs to the brickwork abutment are severely corroded they should be removed and replaced with new ones. The brickwork behind should be made good including the location where the steam main penetrated the abutment wall and the bearing shelf cleaned of all loose material.

The paintwork on the cast iron sections is in reasonable condition, however it should be cleaned down and touched up where necessary.

The brickwork face on both abutment walls is spalling off including previous mortar patch repairs on the south east abutment. All loose material should be cleaned off, the surface sealed and subsequently a proprietary mortar render applied. Where the brickwork to the abutment and adjacent embankment walls has been damaged by root ingress the walls

should be repointed and any damaged bricks cut out and replaced.

If the bridge is to continue to carry vehicles the parapets do not comply with Technical Memorandum BE5 hence Trief Safety Kerbs would need to be installed on each side of the carriageway.

To upgrade the weight restriction on the bridge either the arch ribs would need to be strengthened or new steel beams placed between them to support the cast iron deck plate directly, there is no economic way to strengthen the cast iron arch ribs. To place new steel beams between the arch ribs would require the removal of the transverse restraints which would weaken the existing structure. To retain the existing visual appearance these beams would need to be limited to a maximum say of 250mm, slightly less than the depth of the arch ribs at mid span. Installing beams at this depth would not significantly upgrade the weight restriction on the bridge.

If a greater load capacity is required an alternative structure would be required. If English Heritage decide that this cast iron structure has to be retained then a new structure with a revised road layout would be required to the north of this bridge. The existing structure could then be retained for pedestrian traffic only.

1.5 COST ESTIMATES

a/ To repair crack in deck concrete.

£200

b/ To repair and replace north east handrail stanchions, repair north east external arch and reinstate transverse restraint sections between cast iron arch ribs.

£3500

c/ To remove corroded fixing bolts and replace.

£500

d/ Clean off bearing shelf and make good vertical brickwork behind.

£250

e/ Touch up paintwork where necessary.

£250

f/ To install Trief Safety Kerbs.

£900

g/ Clean down abutment walls removing all loose material, seal surface and subsequently repair with proprietary mortar render, repointing where necessary and removing all vegetation.

£1450

1.6 **OPTIONS**

The existing structure is capable of carrying a vehicle of 1.9 Tonnes. Irrespective of whether the bridge continues to carry vehicular or just pedestrian traffic a number of remedial works need to be carried out. The cost of these including installation of Trief Safety Kerbs would be approximately

£7050

If heavier vehicles need to cross this stream another structure should be constructed to the north of this bridge. This could comprise 2 No. 3m wide by 3m deep by 6.2 long box culverts, suitable for a carriageway of 3.65m, a footpath of 1.8m and verge of 0.75m. Including an additional 60m of 3.5m wide road the cost of this option would be

£32200

Alternatively there may be sufficient land between the canal and library basin to service this area by constructing a new road from Hoppit Road to the North. For a 3.5m wide road this option would cost

£17500

Date of This Examination: 19.4.93 Date of Last Examination: 29.10.91

Bridge Number: 1 Over: Mill Head Stream
Type of Construction: Cast Iron Arch Ribs Construction Date: 1832

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible
2	Invert				River Bed
8	Abutments	P	D	4	NW: water runs down wall from SW corner of bridge. Face of brickwork spalled away to 50mm depth within 1.1m of water level. SE: 25mm face of brickwork spalled away within 1m of water level. Patch render repair coming away, ivy growing up wall under bridge. Vertical face behind bearing shelf very damp, root ingress has dislodged bricks.
10	Embankments	F	D	3	Brick walls, some overgrown with ivy.
13	Main Beams I (Edge Beams)	P	B	4	6 No. cast iron arch ribs. NE Arch 2 sections of bottom flange missing adjacent NW abutment.
14	Main Beams II (Internal Beams)	G	A	1	
15	Bearings	P	D	4	Cast iron angle, arch ribs bolted to abutment behind bearing shelf, bolts very corroded.
16	Transverse Beams	P	C	4	Restraints between arch ribs removed between SW external arch and first internal.
21	Deck Concrete	F	B	3	Concrete on cast iron plate - one transverse crack 1.6m from NW abutment.
28	Deck Plates	G	A	1	Cast iron.
34	Paintwork	F	B	2	Clean down, locally touch up where necessary.
35	Handrails	F	C	4	NE side: NW post cracked at base. SE post missing.

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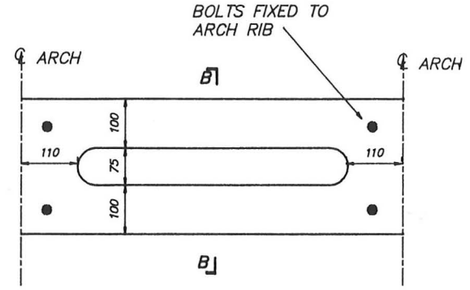
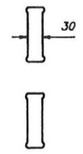
JOB No. ICC657	DRAWING No. 01	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 1*



TRANSVERSE RESTRAINT



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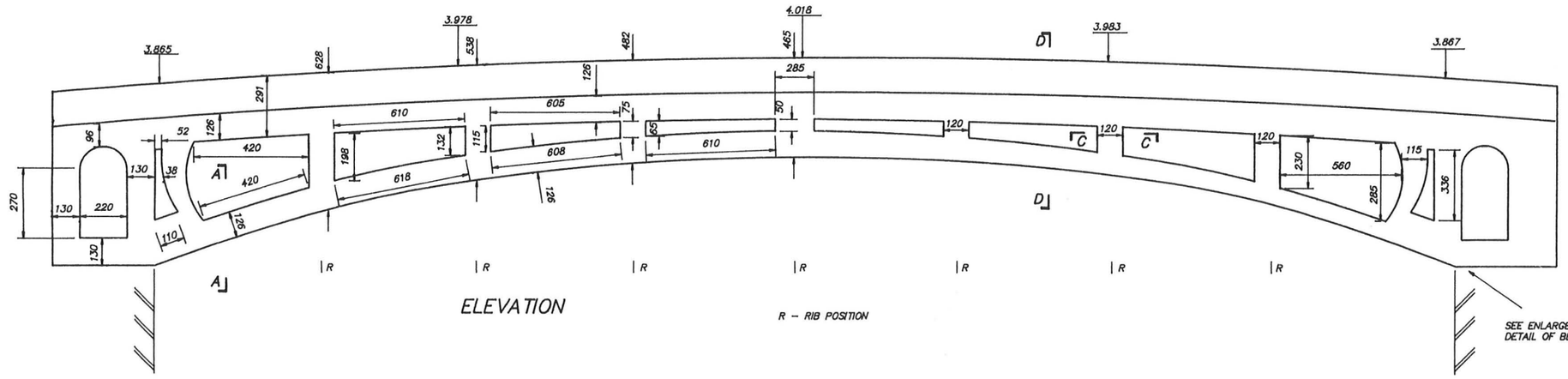
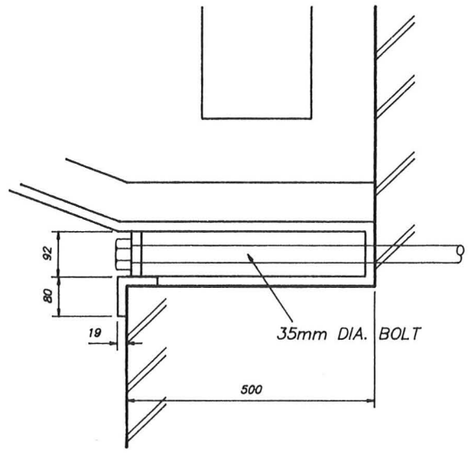
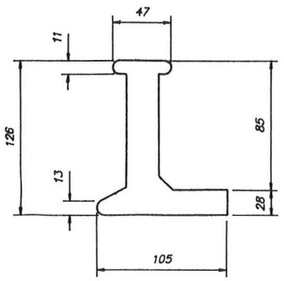


ELEVATION

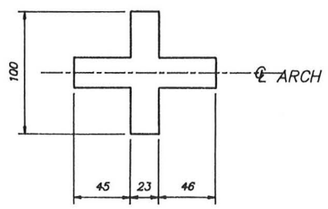


DETAIL OF BEARING

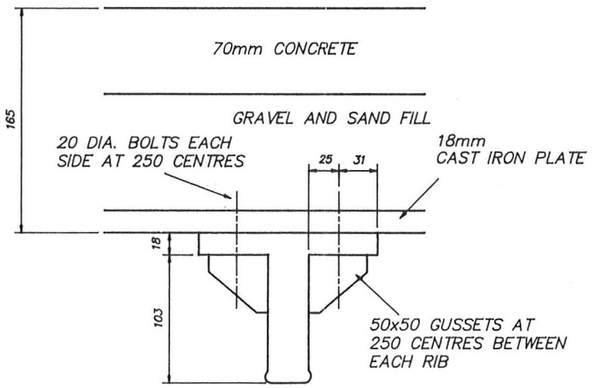


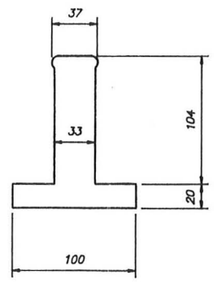
OUTER ARCH

SECTION A–A



SECTION C–C
(INTERNAL ARCH)





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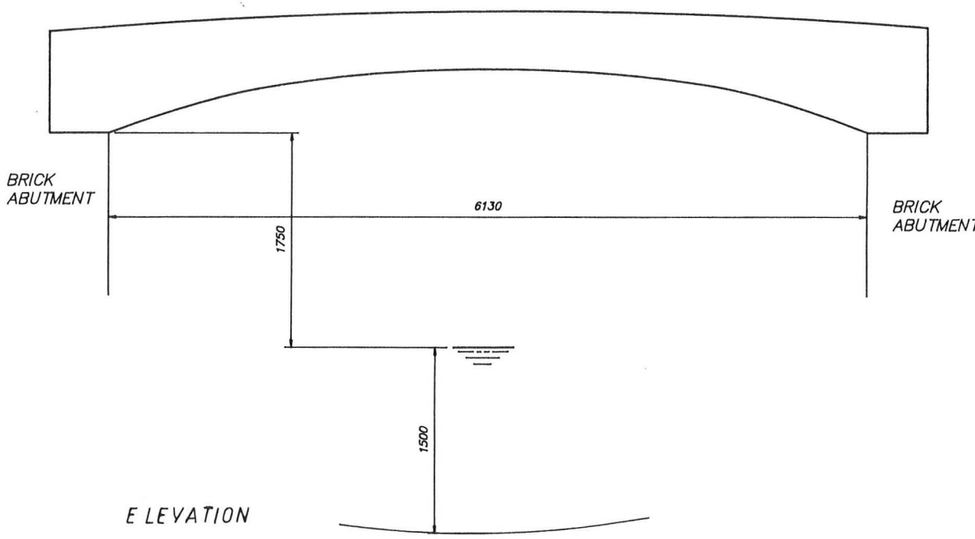
(INTERNAL ARCH)



ELEVATION

South Elevation.

BRIDGE NO. 1

Underside of bridge showing cast iron arch ribs and west abutment.

BRIDGE NO. 2

ROAD BRIDGE OVER MILL HEAD STREAM (WEIGHT LIMIT 5 TONNE AXLE LOAD)

The previous inspection of this bridge was carried out on 29th October 1991.

2.1 DESCRIPTION

The bridge is a bailey bridge comprising single height, single width panels either side. On each side of the bridge there are four panels which in turn support transoms at alternate 1450mm and 1600mm centres. These transoms support steel joists at an average of 250mm centres which in turn support the timber deck of 220mm wide by 50mm thick timbers. 8mm steel durbar plate panels have been laid on the timbers for each wheel track. At each end of the bridge the side panels sit on bearings in turn supported on proprietary bailey bridge steel plates which in turn sit on concrete.

There is a 980mm wide footbridge fixed to the eastern side of the bridge. The footway is supported on angles bolted to the end of the transoms; 230mm wide by 45mm deep deck timbers span between these angles. On the outside of the footway there are tubular steel handrails supported on angle posts in turn fixed to the angles supporting the deck.

Both abutments comprise 75mm thick precast concrete piles.

2.2 CONDITION SURVEY

The steel plate wearing surface of the bridge is in good condition and comprises 1270mm wide by 2500mm long panels screwed down to the timbers. The timber deck supporting these plates needs cleaning down and thoroughly coating with preservative. 30% of the timbers are split longitudinally and will require replacement. There is diagonal cross bracing below the transomes comprising 30mm diameter tie bars with turn buckles. Some of these are loose and need tightening.

The paintwork on the side panels is in fair condition although in places needs attention at the joints. The transoms are in poor condition. There is considerable rust on the top flange and on the top of the lower flange, although generally the web is in good condition. The joists are in very poor condition.

The paintwork to the handrails of the footway on the east side of the bridge is in poor condition. The deck timbers are reasonable although need cleaning down thoroughly and coating with preservative. A number of the kicker boards require replacement. The top flange of the angles supporting the footway is very corroded.

Where steel sections are to be kept and need painting this must be done by cleaning off, subsequently blast cleaning and then painting with a suitable paint specification.

The bearings at all four corners of the bridge are severely corroded. The plate and bearing at the south west corner of the bridge have probably settled by as much as 100mm depending upon the levels to which the bridge was originally installed. The second transom at the north end of the bridge is resting on a concrete block on the east side. This will be upsetting the structural integrity of the bridge and hence this concrete block should be cut away. At the south end of the bridge the road has a very steep ramp which has led to vehicles grounding and damaging the road surface.

The concrete piles of the north abutment are generally in good condition. In three places there is rust staining on the face of the piles due to the reinforcement being too close to the surface. The top whaling has decayed and should be replaced.

The reinforcement in the south abutment concrete piles is too close to the surface, is exposed in a number of locations and is hence corroding. This will shortly lead to spalling of the concrete and loss of the integrity of the piles. At the west side of the bridge a 1.3m length of pile wall is missing and a further 3 piles are residing at an angle of 45 Deg into the river. The ground behind this area has been washed away and a section of concrete slab has dropped. This in turn is affecting the

south west bearing which is immediately behind this section of abutment wall.

2.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures"

Extensive reference has been made to the Bailey Uniflot Handbook and the Super Bailey Manual published by Mabey Bridge Company Ltd.

As the carriageway width is less than 3.65m it has been assumed to comprise one notional lane of 2.5m width.

2.4 SURVEY AND ASSESSMENT RESULTS

The side panels are capable of carrying a 17 Tonne assessment live load. However the transoms and stringers can only carry a 3 Tonne vehicle which equates to a 5 Tonne axle load. This complies with the current weight restriction on the bridge.

In order to upgrade the bridge to carry a 10 Tonne axle load the transoms and stringers would need to be replaced; an operation which would involve removing the deck timbers and replacing with a steel deck.

In order to accept a greater load, more suited for construction traffic the bridge would need to be replaced with either another steel panel bridge or concrete box culverts.

If the existing bridge is to be retained with a 5 Tonne axle load restriction the side panels, transoms and stringers would need to be thoroughly cleaned down and repainted. The timber deck would also need to be cleaned down and thoroughly coated with preservative and approximately 30% of the timbers replaced.

The angles supporting the footway need to be replaced which in turn would involve replacing the handrail stanchions and probably the handrail itself. Consideration should be given to removing the footway completely.

All the bearings should be replaced, with the concrete block adjacent to the north end of the bridge cut away such that it no longer supports the transom.

Irrespective of whether the bridge is retained or a new bridge installed on the existing abutments, the south approach to the bridge should be reconstructed so that the ramp up to the bridge is not so steep. Where reinforcement is exposed on the face of the concrete piles the concrete should be cut away locally and a waterproof epoxy mortar applied to protect the reinforcement.

The abutment at the south west corner of the bridge requries remedial works. The concrete piles leaning at an angle into the river need to be removed and approximately 2m of abutment and embankment wall replaced with either concrete or sheet steel piles. The area behind should be backfilled with either concrete or well compacted material. If the existing bridge is to be retained the level of the bearing should be raised such that the deck of the bridge is in the same plane rather than being twisted as it is at present.

Vehicles are prevented from hitting the sides of the bridge by the steel kerbing, therefore the side panels do not have to comply with the requirements of Technical Memorandum BE5.

2.5 COST ESTIMATES

a/ To remove the deck timbers, replace existing transoms and joists and lay new steel deck.

£7600

b/ To clean down and repaint transoms and joists, clean and coat deck timbers with preservative allowing 30% replacement.

£3150

c/ To replace the entire footway including support angles, deck timbers and parapet.

£3500

d/ To locally treat side panels where corroding at the joints.

£950

e/ To replace all four bridge bearings.

£750

f/ To regrade the road on the south approach to the bridge.

£1350

g/ To cut away the concrete block upon which the second transom from the north end is resting.

£100

h/ To repair the concrete piles where the reinforcement is exposed and replace the top whaling to both abutments.

£400

i/ To remove damaged concrete piles and replace 2m length of river wall, backfilling with concrete and raising the level of the bridge bearing at the south west corner.

£1000

2.6 OPTIONS

The bridge is currently adequate to carry a vehicle of 5 Tonne axle load. However there are a number of remedial works that are necessary. The cost of these including all works to abutments and replacement of the footway would be

£11200

A 5 Tonne axle load is not deemed sufficient for construction traffic. Therefore the bridge is likely to need upgrading. There are three options. Either:

1/ Replace the transoms and joists to upgrade the bridge to a 10 Tonne axle load. Including all works to abutments and replacing the footway, this option would cost

£15650

or

2/ To replace the bridge with a new steel panel bridge, to carry 40 Tonne vehicles (without footway). Replacement of the deck plus any necessary works to the abutments would cost

£18000

or

3/ To replace the entire deck with 3 No. 2.9m x 2.5m side by side 6.15m long box culverts to carry 40 Tonne vehicles at a cost of

£30500

Date of This Examination: 19.4.93 Date of Last Examination: 29.10.91

Bridge Number: 2 Over: Mill Head Stream
Type of Construction: Bailey Bridge Construction Date: Late 60's or Early 70's

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	North G South P	B C	2 4	South: exposed reinforcement, 3 No. concrete piles collapsing into river. 1.3m length of piles missing.
10	Embankments	P	D	4	South: concrete piles. NE: timber piles. NW: river bank. All overgrown with root ingress.
13	Main Beams	P	D	3	Side panels: rusted in places. Paintwork fair.
15	Bearings	VP	D	4	All severely corroded.
16	Transverse Beams	P	D	4	Top flanges rusted 12.3mm thick at mid flange. Footpath supports severely rusted particularly at transom connection, expanded thickness of top flange up to 20mm.
17	Crossheads (Joists)	VP	D	4	Severely rusted. 1.5mm of flange thickness rusted away.
20	Bracing and/or Cross Ties	F			Grease
21	Deck Timbers	F	D	3	Need cleaning and preservative, 30% split longitudinally and require replacement. Footpath deck needs cleaning and preservative.
28	Deck Plates	G	A	1	Steel plates.
34	Paintwork	VP	D	3	Very poor.
35	Parapets - Footpath	P	D	3	

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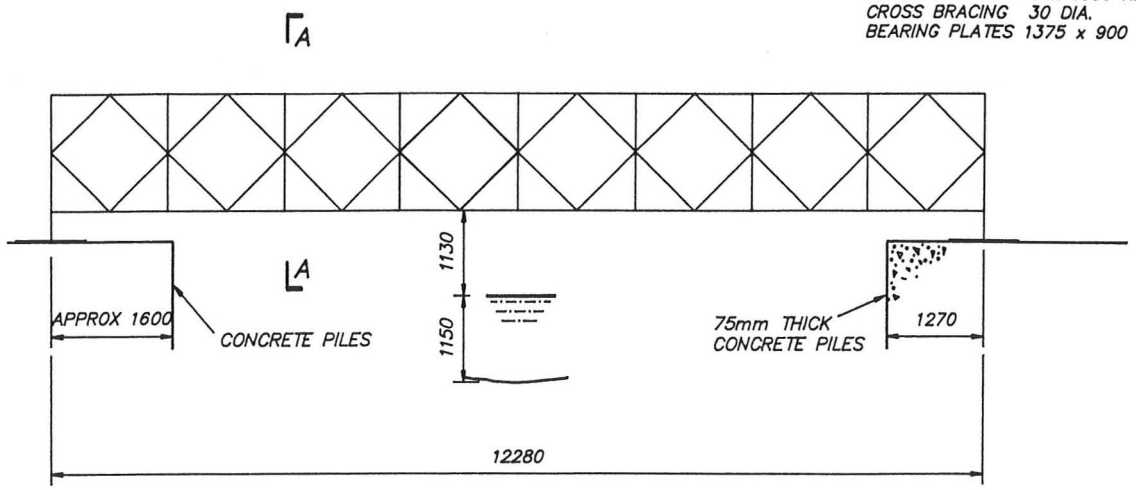
JOB No. ICC657	DRAWING No. 02	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

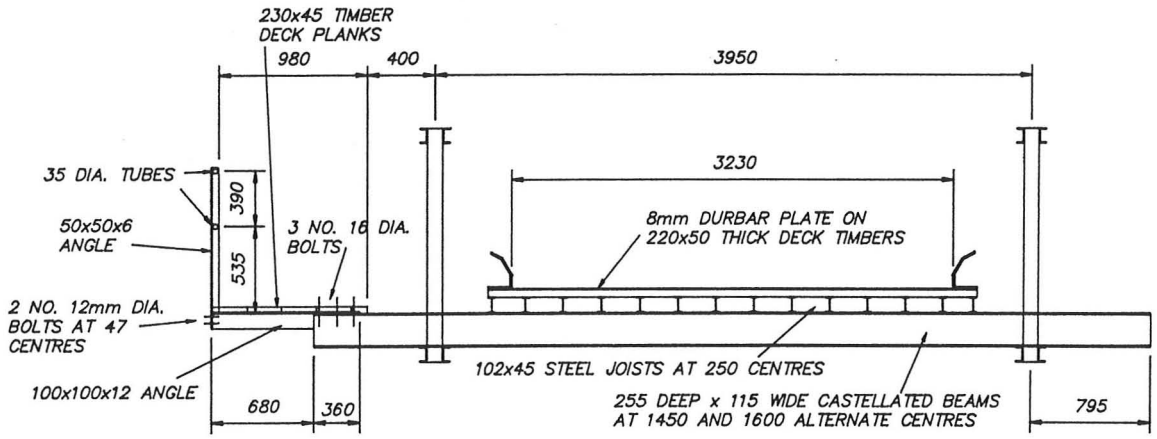
PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 2*

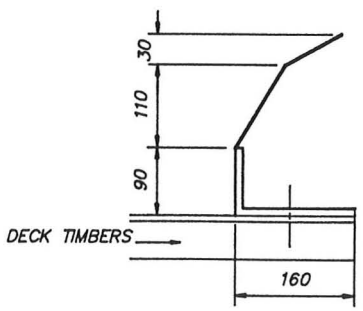
PANELS 3070 LONG x 1550 HIGH 180 WIDE
CROSS BRACING 30 DIA.
BEARING PLATES 1375 x 900



WEST ELEVATION



SECTION A–A



ENLARGED EDGE DETAIL

Viewed from the North.

South abutment showing damaged piles and missing embankment wall.

BRIDGE NO. 2

BRIDGE NO. 3

FOOTBRIDGE OVER MILL HEAD STREAM

We have no records of any previous inspections having been carried out on this bridge.

3.1 DESCRIPTION

The bridge comprises 18mm asphalted ply on 50mm thick deck timbers. These timbers are supported on 100mm deep by 130mm wide longitudinal timbers supported on transverse angles. The angles are fixed to a 300mm deep by 185mm overall width back to back channels which are in turn supported on concrete bearing shelves, the abutment walls being brickwork.

On each side of the bridge there are 50mm diameter handrails supported on posts of similar section.

3.2 CONDITION SURVEY

The plywood and deck timbers are in very poor condition. Wherever they are visible from the top side they are completely rotten, whilst on the underside they are very soft for a depth of at least 10mm.

The timber bearers supporting the deck are in fair condition. One fixing cleat between the timber bearer and the transverse angle supporting them needs replacing.

The transverse angles and back to back channels are in fair condition although all connections are beginning to rust. They have been painted although in places this is now peeling off.

Two metres from the south west abutment the inside bottom flange of the south east beam has been bent upwards by 10mm; this must have been impact damage. Adjacent to the north east abutment a 9mm laminate of rust was removed from the underside of the flange and at mid span a 2mm

laminate of rust was removed from the top flange of the beam. Generally however the beams are in fair condition.

Both abutments are brickwork. The south west abutment was very damp where water runs down from the bearing shelf. The brickwork above water level was in fair condition although at and below water level the pointing was missing to a depth of at least 100mm and bricks have fallen out of the wall.

On the north east abutment, one course below the bearing shelf, there is a 7mm horizontal crack, the wall and bearing shelf above this crack having moved backwards 20mm. Above the water line the depth to the pointing was a maximum of 11mm whilst below the water line it was between 15mm and 20mm from the face of the bricks.

The handrails on either side of the bridge were 50m diameter tubular steel with stanchions of a similar section. These were in fair condition although need to be cleaned off and painted.

3.3 ASSESSMENT CRITERIA

The calculations have been carried out in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

The material strengths have been taken as follows:

Timbers softwood of strength class SC3
Structural steel grade 43 (yield stress 250N/mm^2)

In accordance with BD21/93 the imposed load has been taken as 5KN/m^2 and the horizontal loading on the parapet as 1.4KN per metre run of handrail.

3.4 SURVEY AND ASSESSMENT RESULTS

The deck timbers are adequate in bending bearing and shear. However both the deck timbers and the plywood surfacing are in very poor condition and will need to be removed and completely replaced.

The timber bearers supporting the deck although adequate to resist the applied forces will need to be cleaned down and thoroughly coated with preservative.

The transverse angles and back to back longitudinal channels are adequate to support the required loads despite the loss of section due to corrosion. All the steel members need to be thoroughly cleaned down and painted.

The parapet handrail is satisfactory to resist the required horizontal forces but the stanchions fail in bending. Although generally in good condition the parapet does not comply with the requirements of Technical Memorandum BE5. The frame has not been infilled and no plinth or kicker has been provided.

The abutments are adequate to support the footbridge provided remedial works are carried out. The brickwork needs repointing and any missing bricks should be replaced. The cause of the horizontal crack below the north east bearing shelf is unknown. The joint should be infilled and checked on an annual basis to ensure that the damage is not progressive.

3.5 COST ESTIMATES

a/ To replace timber decking.

£500

b/ To clean down bearers and coat with preservative

£150

c/ To clean down back to back channels by grit blasting and apply two coats of paint.

£650

d/ To repoint brick abutments replacing bricks where necessary.

£1050

e/ To replace handrails with parapets that will comply with BE5.

£2100

3.6 **OPTIONS**

In order to maintain the integrity of the bridge a substantial amount of remedial works need to be carried out for the bridge to have a reasonable life span. Including replacement of parapets the cost of these would be

£4450

Alternatively the entire bridge deck could be replaced including the steel beams and the deck. Only the abutments would remain. The cost of replacing this bridge with one of similar construction including any necessary work to the abutments would be approximately

£6400

Date of This Examination: 19.4.93 Date of Last Examination: -

Bridge Number: 3 Over: Mill Head Stream
Type of Construction: Steel and timber Construction Date: Unknown

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	F	C	3	Brickwork. NE: 1 course below concrete bearing seating 7mm horizontal crack, abutment above moved back 20mm. Depth to pointing 11mm above water line and 15-20mm below. SW: wall very damp, water runs down from bearing seatings. Brickwork fair above water level, very poor condition below, depth to pointing 100mm +, some bricks having fallen out.
10	Embankments	F	D	2	Masonry walls
13	Main Beams	F	C	2	NW: fair condition. SE: inside bottom flange suffered impact 2m from SW abutment, flange bent up 10mm. Adjacent NE abutment 9mm rust laminate removed from underside flange. Both beams rusting at connections.
15	Bearings	F	B	2	Beams sit on plate bolted to abutment.
16	Transverse Beams	F	C	2	One cleat transverse beam/ timber to be replaced.
22	Expansion Joints				Nil
28	Deck Timber	VP	D	4	All timber rotten at ends where visible.
34	Paintwork	P/F	C	3	All steelwork requires cleaning down and painting.
35	Parapets	F	B	2	Require painting.

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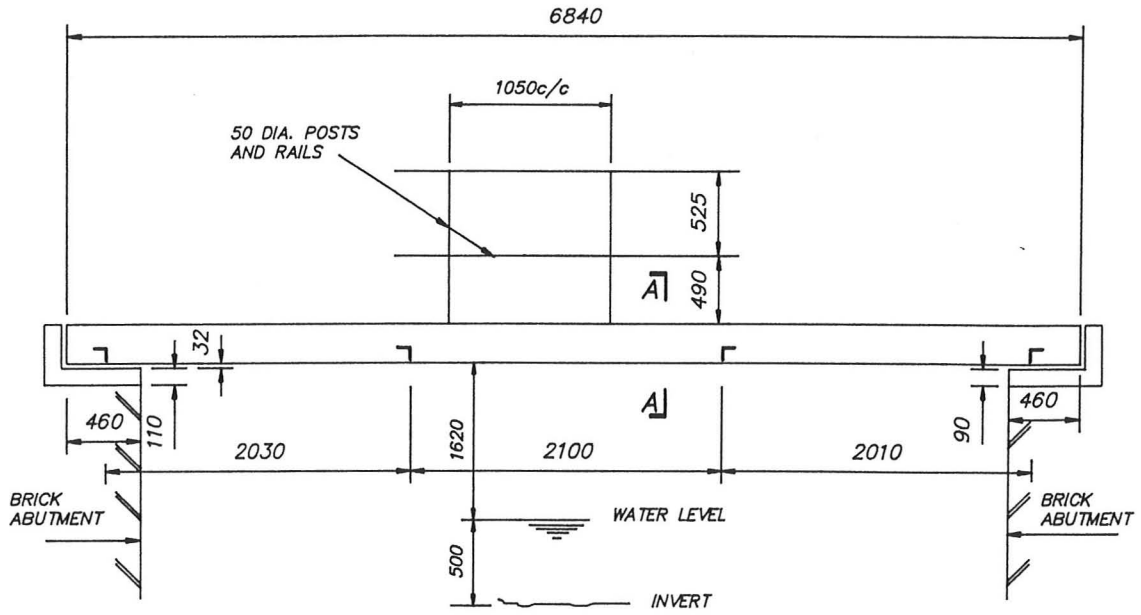
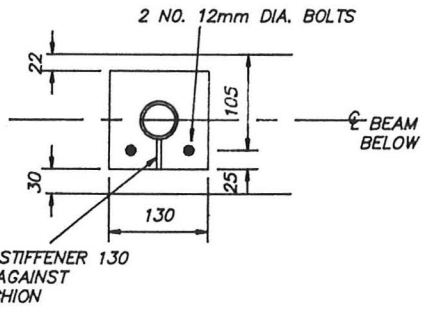
JOB No. ICC657	DRAWING No. 03	REV. A
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

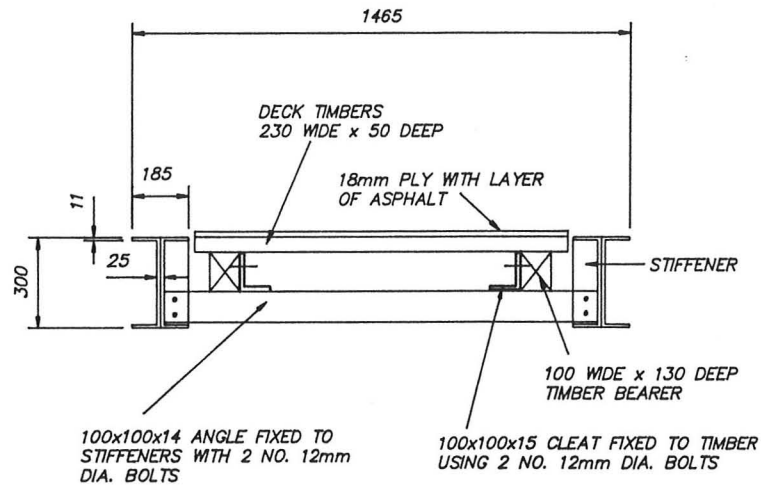
DRAWING TITLE *BRIDGE 3*



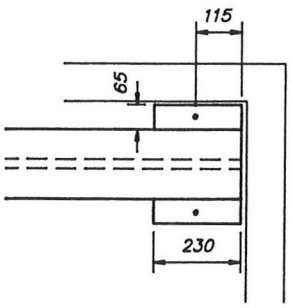
SOUTH EAST ELEVATION



HANDRAIL FIXING



SECTION A–A



CORNER DETAIL

North Elevation.

Underside of bridge showing west abutment.

BRIDGE NO. 3

BRIDGE NO. 4

ROAD BRIDGE OVER MILL HEAD STREAM (WEIGHT LIMIT 5 TONNE AXLE LOAD)

The previous inspection of this bridge was carried out on the 28th October 1991. During our research of the records held at the Ministry of Defence Surveyors office at Chessington we found drawing No. L-B17 showing details of the footpath attached to the north side of this bridge.

4.1 DESCRIPTION

The bridge is a bailey bridge comprising single height, single width panels either side. On each side of the bridge there are four panels which support transoms at alternate 1450mm and 1600mm centres. These transoms support steel joists at an average of 250mm centres which in turn support the timber deck of 220mm wide by 50mm thick timbers. At each end of the bridge the side panels sit on bearings in turn supported on proprietary bailey bridge steel plates.

There is a 900mm wide footbridge fixed to the northern side of the bridge. The footway is supported on angles bolted to the end of the transoms, 230mm wide by 45mm deep deck timbers span between these angles. On the outside of the footway there are tubular steel handrails supported on angle posts in turn fixed to the angle supporting the deck.

4.2 CONDITION SURVEY

The steel plate wearing surface of the bridge is in good condition and comprises 920mm wide by 1860mm long by 6mm thick steel plates screwed down to the timbers. A large number of the timber planks have split longitudinally and rotted; approximately 70% will require replacement with the remainder being cleaned down and thoroughly coated with preservative. There is diagonal cross bracing below the transoms comprising 30mm diameter tie bars with turn buckles. Some of these are loose and need tightening; one turn buckle is severely corroded.

The paintwork on the side panels is in fair condition with only localised areas of rusting. However where the side panels support the transoms the joint has not been protected properly and both the side panels and transoms are very rusty. The transoms themselves are in poor condition. On each side of the bridge, where they support the outer three joists, the top flange has corroded expanding to between 18mm and 20mm. This is applicable to all the transoms. The one adjacent to the west abutment is in very poor condition with severe rusting of the web. The top flange of the joists has surface rusting where they support the timbers.

The handrails of the footway need to be cleaned down and painted. The footway deck timbers are in reasonable condition but need cleaning down and thoroughly coating with preservative. The angles supporting the footway are in reasonable condition except at their ends where they are very corroded adjacent to the connection with the handrail stanchion.

The bearings at all four corners of the bridge are severely corroded.

Both the east and west abutments comprise vertical timber piles. On both sides of the stream these piles are in very poor condition within 450mm of the water level.

4.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

Extensive reference has been made to the Bailey Bridge Uniflot Handbook and The Super Bailey Manual published by Mabey Bridge Company Ltd.

As the carriageway width is less than 3.65m it has been assumed to comprise one notional lane at 2.5m width.

4.4 SURVEY AND ASSESSMENT RESULTS

The side panels are capable of carrying the 17 Tonne assessment live load. However the transoms and stringers can only carry a 3 Tonne vehicle which equates to a 5 Tonne axle load. This complies with the current weight restriction on the bridge. The bridge is closed, the road on the eastern side having been dug up to construct a canal.

In order to upgrade the bridge to carry a 10 Tonne axle load the transoms and stringers would need to be replaced; an operation which would involve replacing the deck timbers with a steel deck.

In order to accept a greater load that is more suited for construction traffic the bridge would need to be replaced with another steel panel bridge or box culvert.

If the existing bridge is to be retained with a 5 Tonne axle load restriction the transoms and stringers would need to be thoroughly cleaned down and repainted. Particular attention would need to be given to the joint between the transoms and side panels and the top flange of the joist. It may be necessary to replace the western transom. The majority of the timbers on the deck would need to be replaced, the remainder being cleaned down and thoroughly coated with preservative.

Where the angles supporting the footway are connected to the handrail stanchions there is severe corrosion and therefore the angles will probably require replacement. The most economic solution would therefore be to replace the entire footway.

The bracing below the bridge deck requires tightening and one turn buckle which is severely corroded will require replacement.

All the bearings are severely corroded and should be replaced. The timber piles on either side of the canal should be replaced with sheet steel piling, the void behind being filled with concrete.

Vehicles are prevented from hitting the sides of the bridge by the steel kerb. Therefore the side panels do not have to comply with the requirements of Technical Memorandum BE5.

4.5 COST ESTIMATES

a/ To remove the deck timbers, replace existing transoms and stringers, lay new steel deck.

£7600

b/ To clean down, repaint tramsoms and joists and replace deck timbers.

£3350

c/ To replace the entire footway including support angles, deck timbers and parapets.

£3500

d/ To repaint side panels.

£2000

e/ To replace all four bridge bearings.

£750

f/ To renew existing timber piles with sheet steel piles in filling the void behind with concrete.

£2500

4.6 OPTIONS

The bridge is currently adequate to carry a vehicle of 5 Tonne axle load. However there are a number of remedial works that are necessary. The cost of these including all works to abutments and replacement of the footway would be

£12100

A 5 Tonne axle load is not deemed sufficient for construction traffic therefore the bridge is likely to need upgrading. There are three options. Either:

1/ Replace the transoms and joists to upgrade the bridge to a 10 Tonne axle load. Including all works to abutments and replacing the footway this option would cost

£16350

or

2/ Replace the bridge with a new steel panel bridge to carry 40 Tonne vehicles (without footway). Replacement of the deck plus any necessary works to the abutments would cost

£17400

or

3/ To replace the entire deck with 3 No. 2.2m x 2.5m side x side 6.15m long box culverts at a cost of

£27000

BRIDGE PRINCIPAL INSPECTION REPORT

ICC657 **Sheet 1**

Date of This Examination: 7.5.93 **Date of Last Examination:** 28.10.91

Bridge Number: 4 **Over:** Mill Head Stream
Type of Construction: Bailey Bridge **Construction Date:** Not Known

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				Canal bed.
8	Abutments	P	D	4	East & West: timber piles rotten within 450mm of water level.
10	Embankments	P	D	4	West: overgrown timber piles. East: sloping bank overgrown.
13	Main Beams	F	C	3	Side panels: rusted where support transoms.
15	Bearings	VP	D	4	Severly corroded.
16	Transverse Beams	VP	D	4	Very rusty where supported by side panels (bottom flange) and where supporting outer 3 joists on each side (top flange) - expanded to 18-20mm. West transom very corroded. Footpath supports severely rusted at ends where connected to handrail stanchion.
17	Crossheads (Joists)	P	D	4	Top flange surface rusting.
20	Bracing and/or Cross Ties	P	C	4	Some bracing loose, one turnbuckle requires replacement.
21	Deck Timbers	P	D	4	70% rotten and require replacement.
28	Deck Plates	G	A	1	Steel plates on timbers.
34	Paintwork	P	D	3	
35	Parapets - Footpath	P	D	3	Require painting.

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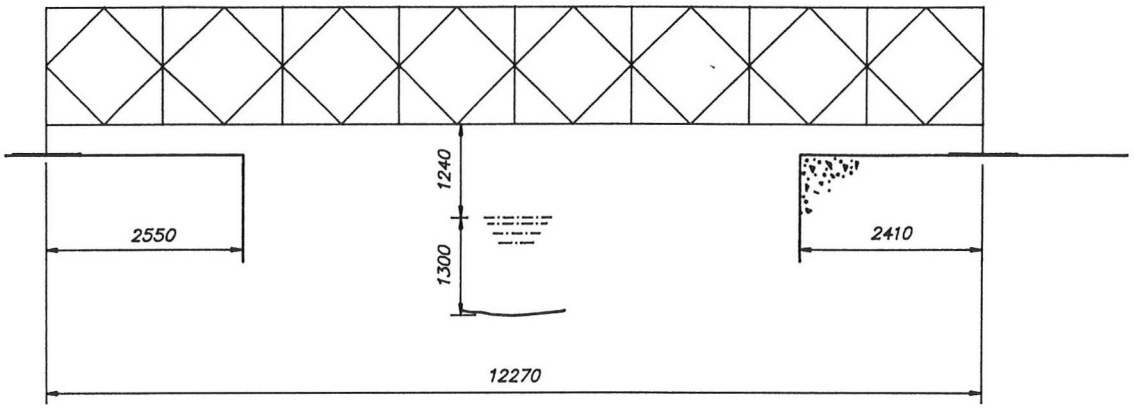
JOB No. ICC657	DRAWING No. 04	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

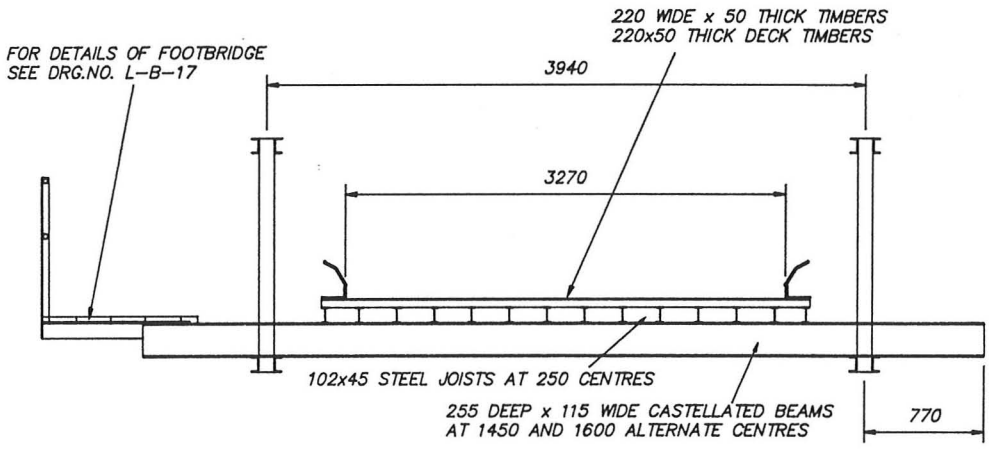
PROJECT RARDE NORTHSITE BRIDGES

DRAWING TITLE BRIDGE 4

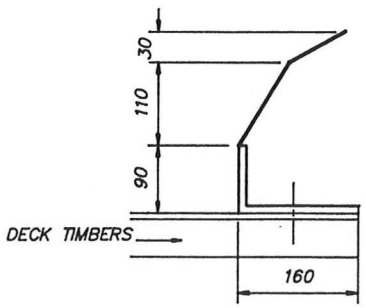
PANELS 3070 LONG x 1550 HIGH 180 WIDE
CROSS BRACING 30 DIA.
BEARING PLATES 1375 x 900



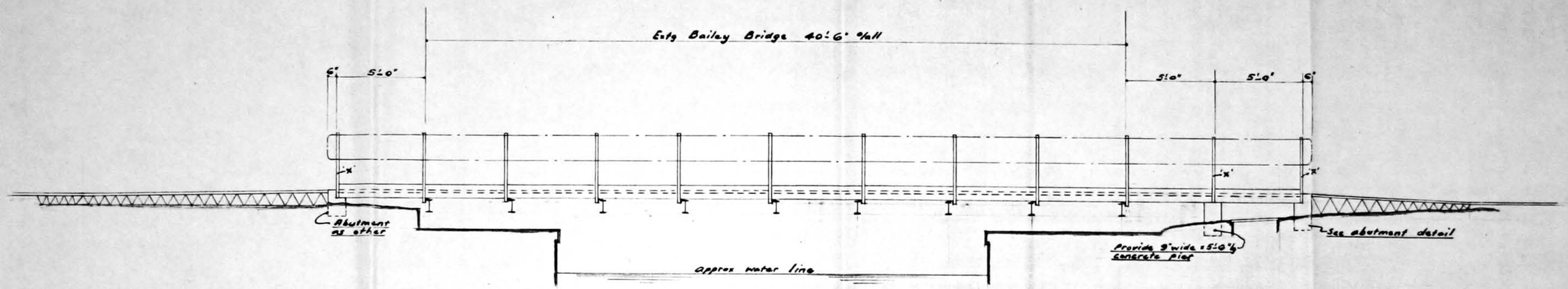
SOUTH ELEVATION



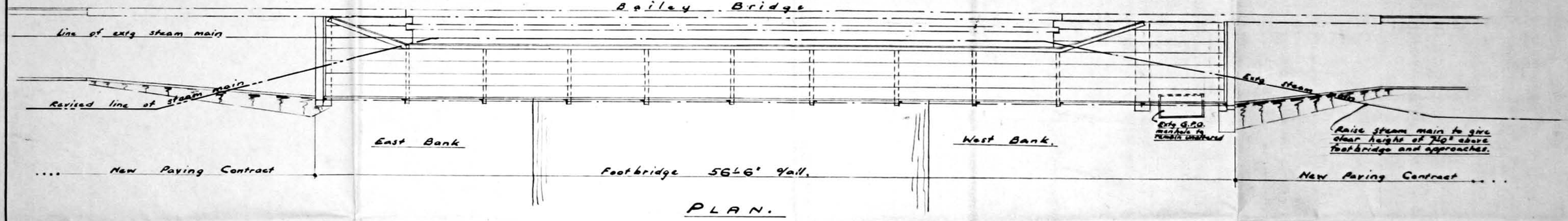
CROSS SECTION



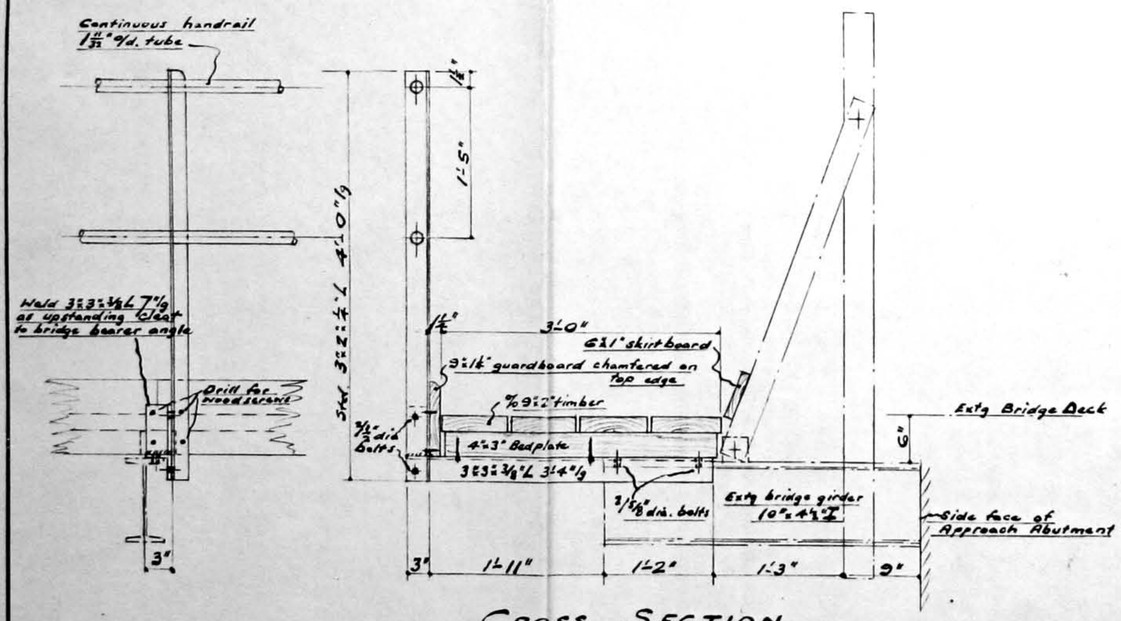
ENLARGED EDGE DETAIL



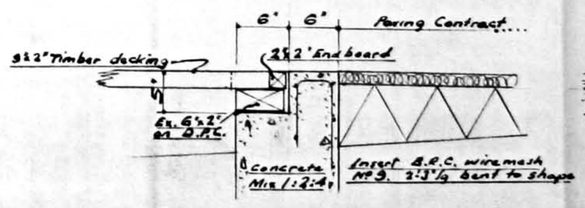
NORTH ELEVATION.



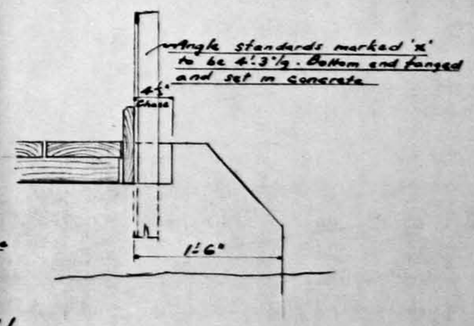
PLAN.



CROSS SECTION.



ABUTMENT DETAIL.



CONCURRENCE	APPROVAL		
E.R.D.E WALTHAM ABBEY	FOOTBRIDGE TO BAILEY BRIDGE, LOOP ROAD FOR C.E.	DRAWN ALH 10/9/45	CHECKED
		TRACED	PASSED
		SCALE 1/4" & 1" to 1'-0"	
		DRAWING NO. L-B. 17.	

Drawing Number L-B.17

North elevation looking west
showing footway.

Underside of deck showing corrosion at
joist, transom connection.

BRIDGE NO. 5

FOOTBRIDGE OVER MILL HEAD STREAM

We have no records of any previous inspections having been carried out on this bridge. During our search through the records at the Ministry of Defence Estate Surveyors office at Chessington we found Drawing No. L-B.10 showing details of this bridge.

5.1 DESCRIPTION

The bridge comprises a 50mm thick timber deck supported on 75mm wide by 150mm deep timber bearers running along the length of the bridge. These bearers are supported on transverse 75mm by 150mm by 10mm angles. The angles are bolted to the universal beams along either side of the bridge, these beams being 375mm deep by 125mm wide. The beams are in turn supported on concrete abutments.

On both sides of the bridge there is a 50mm diameter tubular steel handrail supported on 40mm diameter steel posts in turn bolted to the universal beams.

5.2 CONDITION SURVEY

The timber deck is in fair condition although 20% of the timbers are either split or rotten and require replacement. The remainder need to be cleaned down and thoroughly coated with preservative.

The transverse angles supporting the timber bearers are rusty on their top surface.

The universal beams are in poor condition. They have been painted although a considerable thickness of metal has been lost due to corrosion. Rust laminates 3mm and 4mm thick are coming away from both top and bottom flanges. At either end of the bridge where the beams sit on the bearing shelves there has been a considerable build up of soil and other rubbish which needs to be cleaned off to prevent further decay.

The west abutment is timber piles which are rotting at and below the water level. There is ingress of tree roots. On the east side the ground slopes up to the timber pile abutment, with the timbers being in good condition.

5.3 ASSESSMENT CRITERIA

The calculations have been carried out in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

The material strengths have been taken as follows:

Timbers softwood strength class SC3
Structural steel grade 43 (yield stress 250N/mm^2)

In accordance with BD21/93 the imposed load has been taken as 5KN/m^2 and the horizontal loading on the parapet as 1.4KN per metre run of handrail.

5.4 SURVEY AND ASSESSMENT RESULTS

The deck timbers are adequate in bending, bearing and shear, however 20% are either split or decayed and require replacement. The timber bearers supporting are of adequate size to resist the bending forces.

The transverse angles are adequate to carry the imposed loads although need to be cleaned down and painted. The longitudinal universal beams have suffered a considerable amount of corrosion even though they have been painted. Due to this loss of section the beams fail in bending.

The timber piles to the west abutment and adjacent embankment walls should be replaced with sheet steel piling and any adjacent trees removed. The bearing shelves need to be cleaned off and screeded to a fall.

Although the parapet handrail is satisfactory the stanchions fail in

bending at their base. Although in good condition the parapet does not comply with Technical Memorandum BE5; the frame has not been infilled and no plinth or kicker has been provided.

5.5 COST ESTIMATES

a/ Replace steel beams.

£2400

b/ To clean down and thoroughly coat timber deck with preservative. Replacing 20% of the timbers.

£400

c/ New parapets along either side of the bridge to comply with BE5.

£3050

d/ To clean out bearing shelves and screed to a fall.

£100

e/ To replace abutment and adjacent embankment timber piles with sheet steel piling and remove adjacent trees.

£1000

5.6 OPTIONS

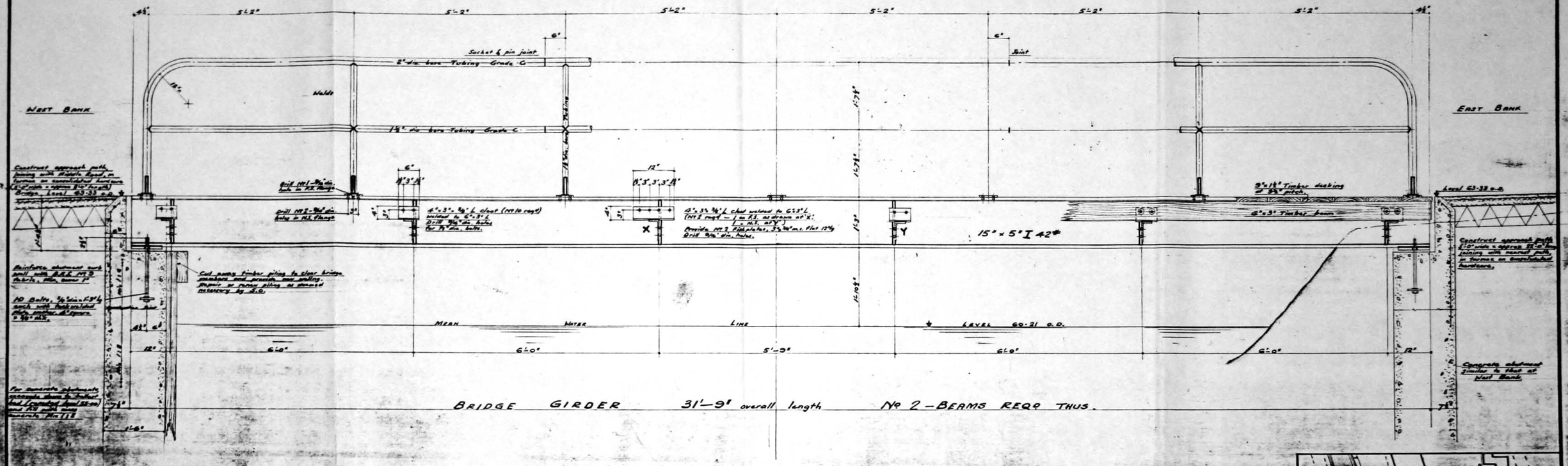
The existing bridge is inadequate with the longitudinal beams unable to support the required loads and the parapets not complying with current requirements. There is no alternative but to replace the entire bridge deck and carry out remedial works to the abutments and adjacent embankments all at a cost of

£6950

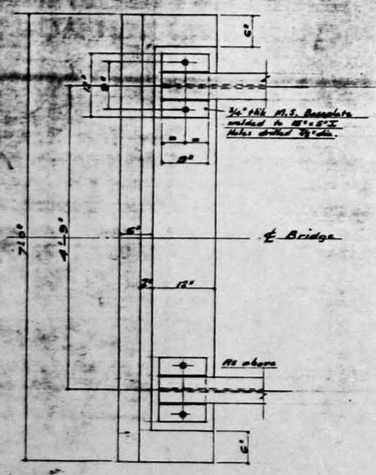
Date of This Examination: 7.5.93 Date of Last Examination: -

Bridge Number: 5 Over: Mill Head Stream
Type of Construction: Steel & Timber Construction Date: Approx 1957

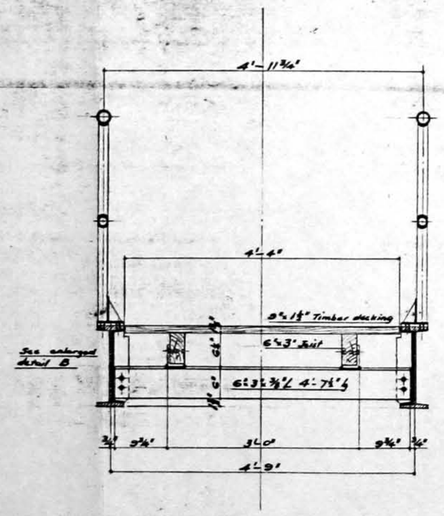
Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	East F West VP	D D	2 4	West: timber piles rotting at and below water level. East Abutment: timber piles fair.
10	Embankments	P	D	4	West: timber piles East: fallen in river bank.
13	Main Beams	P	C	2	South: lost 3mm rust laminate from bottom flange 2m from each end, 3mm laminate from top whole length. 1.5m from East end flange 11.5mm thick. North: lost 4mm rust laminate from top flange whole length; 3m from East end adjacent bolt hole in bottom flange 4mm thick at edge, 8mm thick adjacent web.
15	Bearings	F			Clean off bearing shelves.
16	Transverse Beams	F	D	2	Top surface rusty.
21	Deck Timbers	F	C	3	20% require replacement - remainder cleaned down and coated with preservative.
34	Paintwork	P	D	4	Requires painting.
35	Parapets	G	A	2	



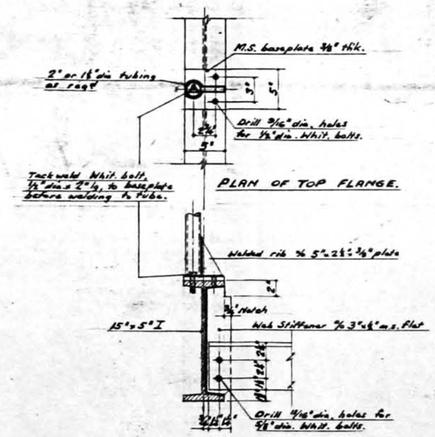
BRIDGE GIRDER 31'-9" overall length No 2 - BEAMS REQD THUS.



PLAN OF ABUTMENT.



SECTION A-A.



ELEVATION.

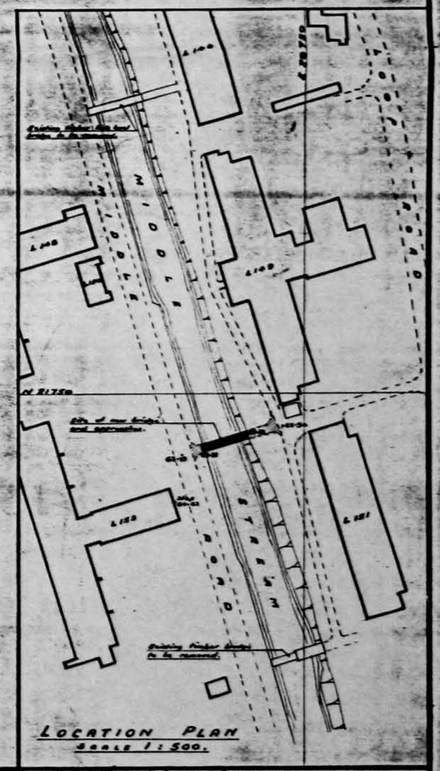
DETAIL B.
Scale 1½" to 1'0"

GENERAL NOTES.

ENGINEERING SERVICES DEPT. to provide material, fabricate & erect.

BUILDING WORKS DEPT to excavate for and pour foundations. Backfill to abutments and lay new tarmac approach paths as described. Provide and fix all timber decking.

PAINTING, etc. Steel to be brushed and scraped free of rust. Paint one coat before erection and one finishing coat after. Colour to be selected by S.O. Timber to be painted in creosote.



LOCATION PLAN
Scale 1:500.

CONCURRENCE	APPROVAL I. Griffiths for C.E.	DRAWN	22/7/57
		TRACED	
		SCALE	1" & ½" to 1'0"
		CHECKED	
		PASSED	

E.R.D.E. WALTHAM ABBEY

BRIDGE OVER MIDDLE STREAM ADJACENT TO BLDGS L149 & L151.

DRAWING NO L-B. 10.

Drawing Number L-B.10

South Elevation.

BRIDGE NO. 5

Looking West.

BRIDGE NO. 6

ROAD BRIDGE OVER STREAM (5 TONNE AXLE LOAD)

A previous inspection of this bridge was carried out on the 28th October 1991. During our search for drawings at the Ministry of Defence Estate Surveyors Office at Chessington Drawing No. XD1/2 was found showing general arrangement and reinforcement details of this bridge.

6.1 DESCRIPTION

The bridge comprises a 175mm concrete deck with 225mm high by 300mm wide upstands either side. The deck has been asphalted to provide the road wearing surface. It is supported by 3 No. 400mm wide by 510mm deep downstand reinforced concrete beams. Each beam sits on a bearing at either end which in turn sits on an abutment. These abutments are supported on 4ft diameter mass concrete pads approximately 8ft deep bearing in the ballast.

There is a handrail along either side of the bridge comprising galvanised tubes and stanchions which are bolted to the bridge upstands.

6.2 CONDITION SURVEY

The bridge deck and abutments all appear to be in sound condition with only minor surface rust marks. The bearings however have had little attention in the past and are very rusty.

The west abutment is protected by vertical rectangular concrete piles one of which has been displaced forward allowing some subsoil behind to be washed away. The east abutment was protected by timber pole boards but these have fallen away and no longer offer any protection. A void 600mm deep has formed under the concrete abutment. Behind the abutment there is a dip in the road indicating settlement. From the levels taken on the bridge deck the east abutment has dropped approximately 10mm.

The asphalt surfacing to the bridge is in poor condition. There are several holes in the wearing course with water being unable to drain away in these areas. There are no expansion joints at the end of the bridge and hence cracks have occurred in these locations which have in the past been repaired. On the north side of the bridge the second handrail stanchion from the west has been hit by a vehicle and requires replacement.

6.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures". The material strengths have been taken as follows:

Reinforcement grade 250 steel
Concrete grade 20

As the carriageway width is less than 5m it has been assumed to comprise one notional lane of 2.5m width with the remaining carriageway carrying an imposed load of 5KN/m^2.

6.4 SURVEY AND ASSESSMENT RESULTS

The longitudinal beams are capable of carrying the 40 Tonne assessment live load in both shear and bending, the only deficit is in the nominal shear reinforcement in the central region of the beams. In this region the area of reinforcement provided is 314mm^2 and that required 325mm^2. The two figures are sufficiently close for the shear reinforcement to be considered acceptable without affecting the integrity of the structure.

The slab spans between the beams and is adequate in both bending and shear. The side cantilevers are also adequate for vertical loading. However the design manual requires that the parapet is capable of resisting a horizontal force of 25KN at 685mm above the adjoining paved surface. The plinth supporting the parapet and the cantilever were found to be under strength when assessed to resist this force.

The parapet handrailing does not comply with the requirements of Technical Memorandum BE5. The moment of resistance at the post is approximately 2KNm where as the applied moment is 28KNm.

The bearings are not functioning as designed. They must either be cleaned off and brought into a working condition or totally replaced.

In order to ensure that the structure remains capable of carrying the design loading the foundations must be protected against scour. The concrete pile on the west abutment must be reinstated whilst against the east abutment a new sheet steel pile or mass concrete wall must be constructed in front of the bridge foundations.

The movement joints in the carriageway at either ends of the bridge should be replaced. In addition the asphalt surfacing on the bridge should be removed, the entire deck waterproofed and the surface reinstated.

The existing carriageway is 3.65m wide. The minimum width for a single carriageway bridge is 2.5m therefore an alternative method of upgrading the bridge to comply with the design manual would be to place Trief safety kerbs along either side of the carriageway. This would prevent any possible vehicular impact on the parapet and remove the necessity for replacing the deck cantilevers. It would however reduce the width of the carriageway to 2.85m. If this solution is adopted it should be noted that it will not be possible to swing from Middle Road onto the bridge without revising the junction layout.

6.5 COST ESTIMATES

a/ To cut away the deck slab side cantilevers, to reinstate with a deeper concrete section including additional reinforcement and provide a new parapet to the requirements of BE5.

£9500

b/ To jack up the bridge and replace bridge bearings.

£7000

c/ Reinstate 1 No. concrete pile on the west abutment and construct new sheet pile or mass concrete wall in front of the east abutment.

£2500

d/ Cut movement joints in the carriageway, remove the asphalt surfacing on the bridge, waterproof the deck and reinstate the surface.

£2600

e/ To place Trief Safety Kerbs along either side of the bridge carriageway.

£1850

f/ To remove the bridge deck and replace with 3 No. 2.4m wide by 2.1m high box culvert sections side by side across width of stream. Length of culvert to be 6.2m sufficient to carry one 3.65m carriageway, 1.8m footpath and verge.

£30700

g/ To remove the bridge deck and replace with a 5.95m wide precast concrete bridge adequate to carry 40 tonne vehicles. Including a cost of £7500 for the footway the total of a replacement reinforced concrete bridge would be

£29000

6.6 **OPTIONS**

The deck is adequate to take 40 Tonne vehicles. Provided the bridge remains in private possession, only being used for construction traffic, it can be deemed to be adequate although the owners attention is drawn to the fact that the parapet does not comply with the Department of Transport Memorandum BE5. If the bridge is to be adopted or used for public vehicles the parapet will have to be strengthed or Trief Safety Kerbs installed. If a bridge with a carriageway width of 2.85m is acceptable, the cost of maintaining the integrity of the structure and laying Trief Safety Kerbs is

£13950

If a 3.65m carriageway is required the cost of maintaining the integrity of the structure and replacing the parapets and cantilevers is

£21600

If the bridge is still not considered to be wide enough an alternative is to replace the entire deck and longitudinal beams with 3 No. side by side 8m long box culverts at at cost of

£30700

To replace with a new 5.95m wide precast concrete bridge including works to abutments

£31500

Date of This Examination: 7.4.93 **Date of Last Examination:** 28.10.91

Bridge Number: 6 **Over:** Stream
Type of Construction: Reinforced Concrete **Construction Date:** Approx 1955

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations	G			Mass concrete
2	Invert				River bed
8	Abutments	East P West F	D B	3 2	West side: rectangular concrete piles - one number pulled away. East side: timber boards fallen away into river, void under concrete, possible settlement behind abutment.
13	Main Beams	G	A	1	3 No. Concrete beams in good condition. Some surface rust marks.
15	Bearings	P	D	3	All rusty
21	Deck Concrete	D	A	1	
22	Expansion Joints				Nil - to be cut in surfacing
29	Waterproofing				None visible
33	Surfacing	F/P	C	3	Several holes in asphalt wearing course
35	Parapets	F	B	2	Galvanised tubular post and rail. One vertical suffered impact damage

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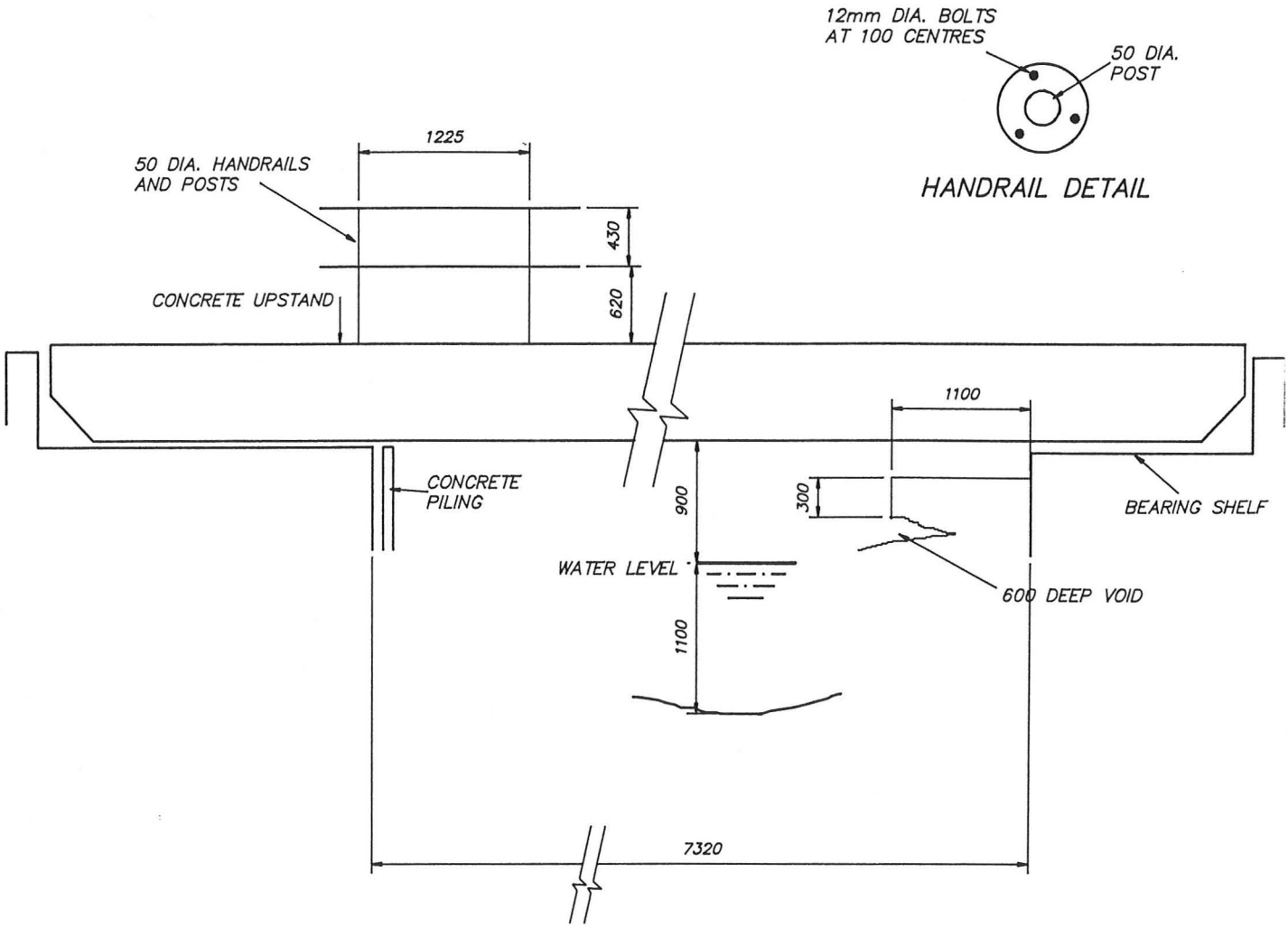
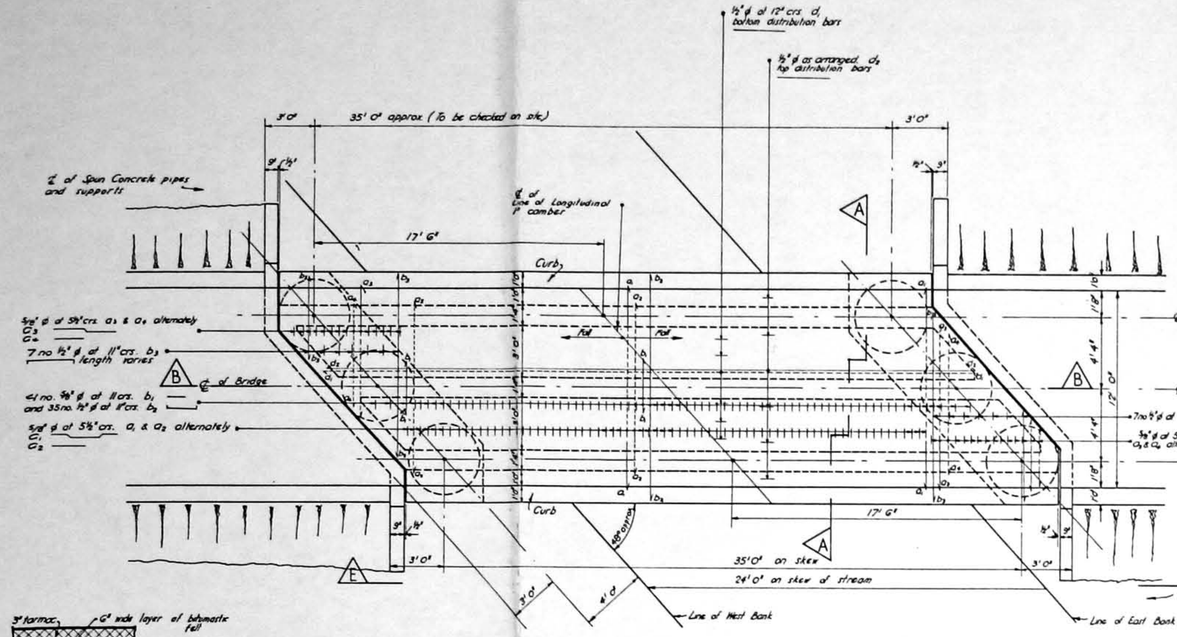
JOB No. ICC657	DRAWING No. 06	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE JUNE 93	PLOTTED	

PROJECT RARDE NORTHSITE BRIDGES

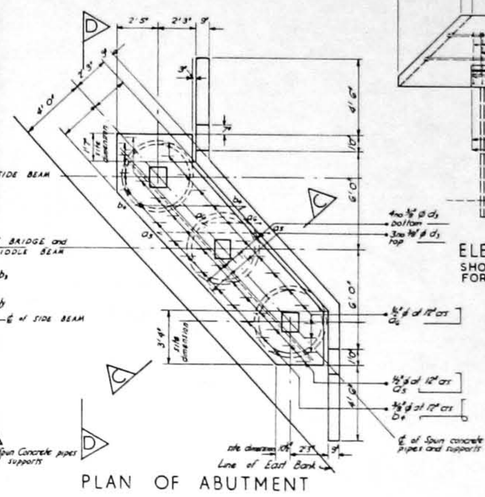
DRAWING TITLE BRIDGE 6



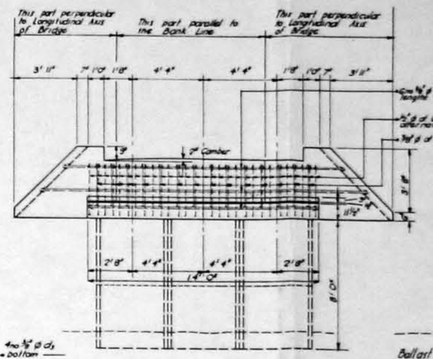
SOUTH ELEVATION



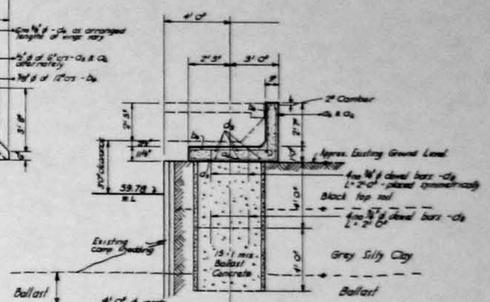
PLAN SHOWING REINFORCEMENT OF SLAB
SCALE 1/4" TO 1' 0"



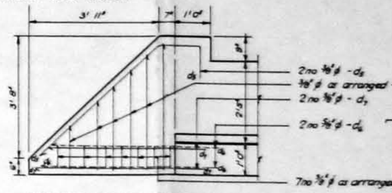
PLAN OF ABUTMENT



ELEVATION OF ABUTMENT D–D
SHOWING REINFORCEMENT IN VERTICAL PART OF ABUTMENTS
FOR WINGS SEE BELOW



SECTION C–C

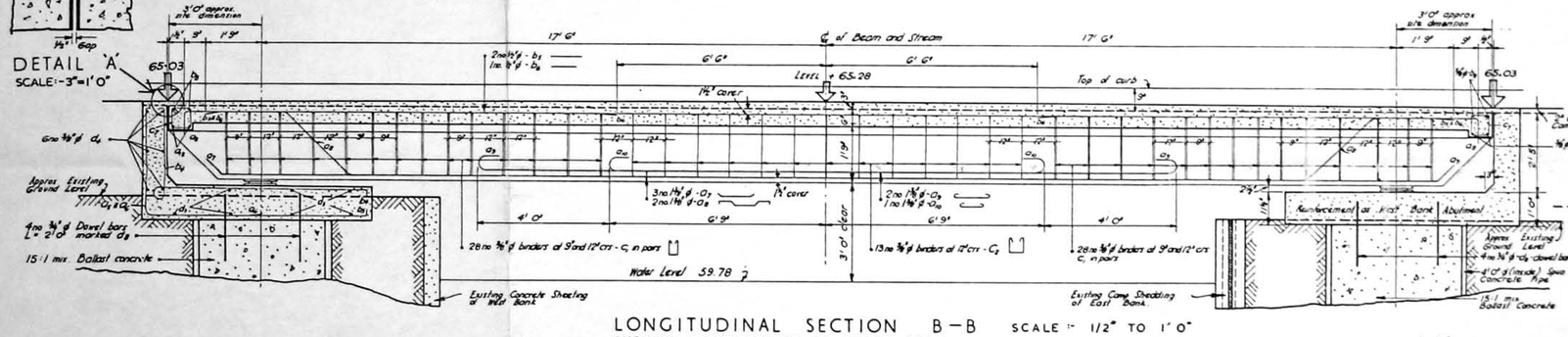


REINFORCEMENT TO ABUTMENT WING
No FOUR REQUIRED THUS

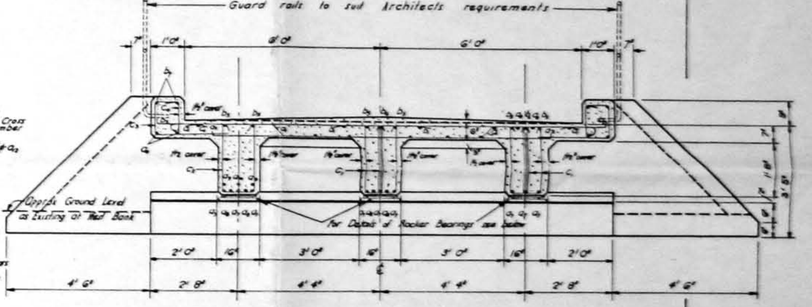
NOTES

This Drawing is to be read in conjunction with Architects' Drawings and the Specification
The Contractor is responsible for the accuracy of all dimensions and the correct setting out of the work on the site
All Reinforced Concrete work to be in the proportion of 1:2:4 mix.
Cover to main bars to be 1" unless otherwise stated

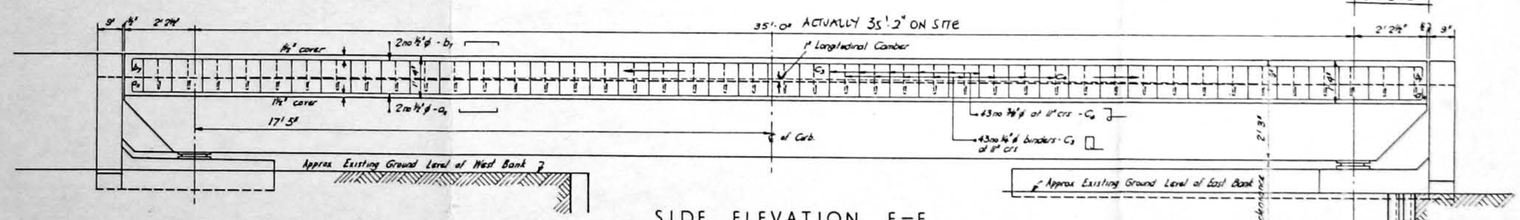
DETAIL 'A'
SCALE:- 3"=1'0"



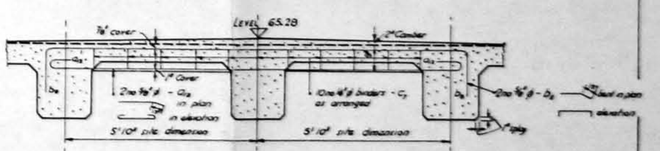
LONGITUDINAL SECTION B–B SCALE :- 1/2" TO 1' 0"
SHOWING REINFORCEMENT OF MIDDLE BEAM
TWO SIDE BEAMS SIMILAR NOTE 3" LONGITUDINAL CAMBER TO BRIDGE



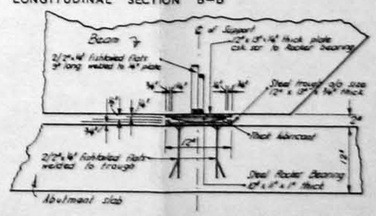
CROSS SECTION A–A
ELEVATION OF ABUTMENT ON WEST BANK



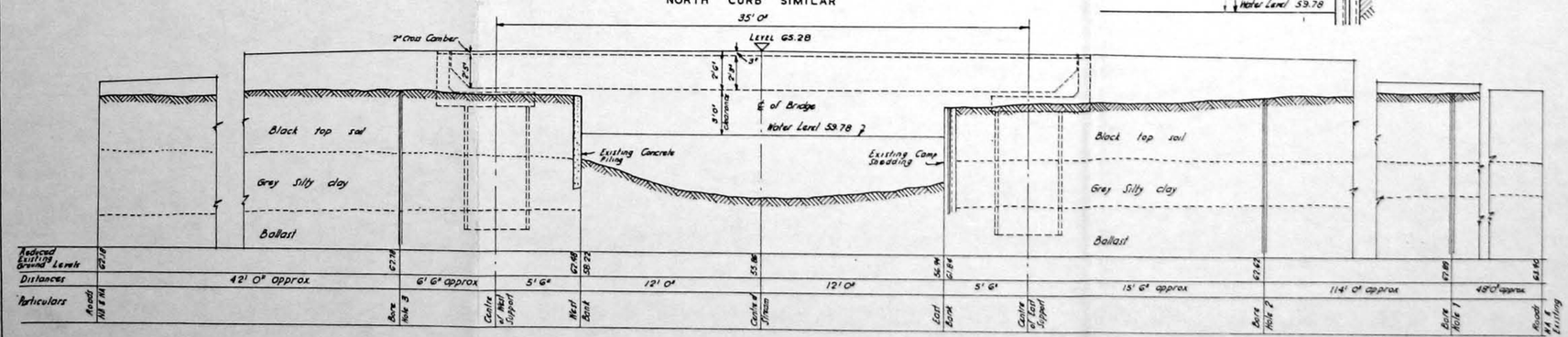
SIDE ELEVATION E–E
SHOWING REINFORCEMENT TO SOUTH CURB
NORTH CURB SIMILAR



DETAILS OF END TRIMMING BEAMS
SEE LONGITUDINAL SECTION B–B



DETAIL OF ROCKER BEARING
No SIX REQUIRED THUS
SCALE :- 1" TO 1' 0"



LONGITUDINAL SECTION ALONG LINE OF NEW BRIDGE
SHOWING EXISTING GENERAL SITE INFORMATION

RECORD DRAWING

REF	PARTICULARS	BY	DATE
	AMENDMENTS		

WALTHAM ABBEY

R. C. BRIDGE

SCALE	DATE
1/4", 1/2" & 1" TO 1'-0"	DEC 1954

JOB. NO. 54295
IDENT. NO. 1
DRG. NO. XD1/2

	BY	DATE
DESIGN	J.M.	DEC 1954
DRAWN	J.M.	DEC 1954
TRACED		
CHECKED		

STRUCT FILE NO.

MINISTRY OF WORKS
LONDON

SENIOR STRUCTURAL ENGINEER
A. E. HEWITT. A.M.I. STRUCT. E.

RECORD DRAWING
FROM
No.

L.—.B.05. 3346/1/60

Drawing Number XD1/2

South Elevation.

West abutment showing damaged pile.

BRIDGE NO. 7

FOOTBRIDGE OVER STREAM

We have no records of any previous inspections having been carried out on this bridge.

7.1 DESCRIPTION

The bridge comprises a 50mm thick timber deck supported on 100mm wide by 140mm deep timber bearers running along the length of the bridge. These bearers in turn are supported on transverse 75mm x 75mm x 8mm angles at approximately 2m centres. The angles are bolted to the RSJ's along either side of the bridge, these joists being 258mm deep by 118mm wide. The joists are in turn supported on concrete abutments.

On both sides of the bridge there is a 50mm diameter tubular steel handrail supported on 50mm diameter steel posts, in turn bolted to the joists.

7.2 CONDITION SURVEY

The timber deck is in reasonable condition although it is beginning to soften on both the top and the underside. One timber requires replacement as it is rotten. The remainder should be thoroughly cleaned down and coated with preservative.

The RSJ's are in fair condition. They have been painted although adjacent to the west abutment the top and bottom flanges of both beams have corroded. There is some corrosion at mid span and at the east end on the bottom flange of both beams. The transverse angles are in fair condition.

The abutments are concrete which is in good condition. However the space over the top of the abutment but below the deck needs to be cleaned out and screeded to a fall to prevent a build up of water against the main joists.

7.3 ASSESSMENT CRITERIA

The calculations have been carried out in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

The material strengths have been taken as follows:

Timbers softwood of strength class SC3
Structural steel grade 43 (yield stress 250N/mm²)

In accordance with BD21/93 the imposed pedestrian load has been taken as 5KN/m² and the horizontal loading on the parapet as 1.4KN per metre run of handrail.

The bridge was also checked to carry a 2 axle 4 tonne vehicle.

7.4 SURVEY AND ASSESSMENT RESULTS

The deck timbers and timber bearers supporting them are adequate in bending bearing and shear to support the pedestrian loads.

For pedestrian loads the transverse angles supporting the timber bearers are adequate in both shear and bending; the longitudinal RSJ's have suffered corrosion but despite the loss of flange thickness the section is adequate in both bending and shear.

Although the parapet handrail is satisfactory the stanchions fail in bending at their base. Although in good condition the parapet does not comply with Technical Memorandum BE5 as the frame has not been infilled and no plinth or kicker has been provided.

The bridge is unable to sustain light vehicle loads as both the timber bearers and longitudinal steel beams are inadequate. In addition the bridge is likely to be too narrow for the majority of construction vehicles. The most economic way to "bridge" this stream for the construction phase would be to lay a culvert in the bed of the stream and

backfill to surrounding ground levels with granular material.

7.5 COST ESTIMATES

a/ To clean down and thoroughly coat timber deck and bearers with preservative and replace 1 rotten timber.

£400

b/ To clean down RSJ's by grit blasting and apply two coats of paint.

£650

c/ Clean out space over top abutment and screed to a fall to prevent build up of water.

£150

d/ To replace handrails with parapets that will comply with BE5.

£2200

7.6 OPTIONS

In order to maintain the integrity of the bridge a substantial amount of remedial works need to be carried out for the bridge to have a reasonable life span. Including replacement of the parapets the cost of these would be

£3400

Alternatively the entire bridge deck could be replaced including the steel beams and the deck. Only the abutments would remain. The cost of replacing this bridge with one of a similar construction would be approximately

£5950

BRIDGE PRINCIPAL INSPECTION REPORT

ICC657 **Sheet 1**

Date of This Examination: 7.4.93 **Date of Last Examination:** -

Bridge Number: 7 **Over:** Stream
Type of Construction: Steel and Timber **Construction Date:** Unknown

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	G	A	1	Concrete in good condition.
10	Embankments				River bank.
13	Main Beams	F	C	2	West end: both beams flanges corroded - estimated loss 1mm off top flange 1.5mm off bottom flange. Corrosion of bottom flange of both beams at midspan (expanded to 15mm) and at East end (expanded to 20mm).
15	Bearings				Nil
16	Transverse Beams	F	C	2	Fair condition, require painting.
28	Deck Timbers	F	D	2	Becoming soft on top and underside. One requires replacement, remainder cleaned down and coated with preservative.
34	Paintwork	F/P	D	2/3	Requires painting.
35	Parapets	G	A	2	Require painting.

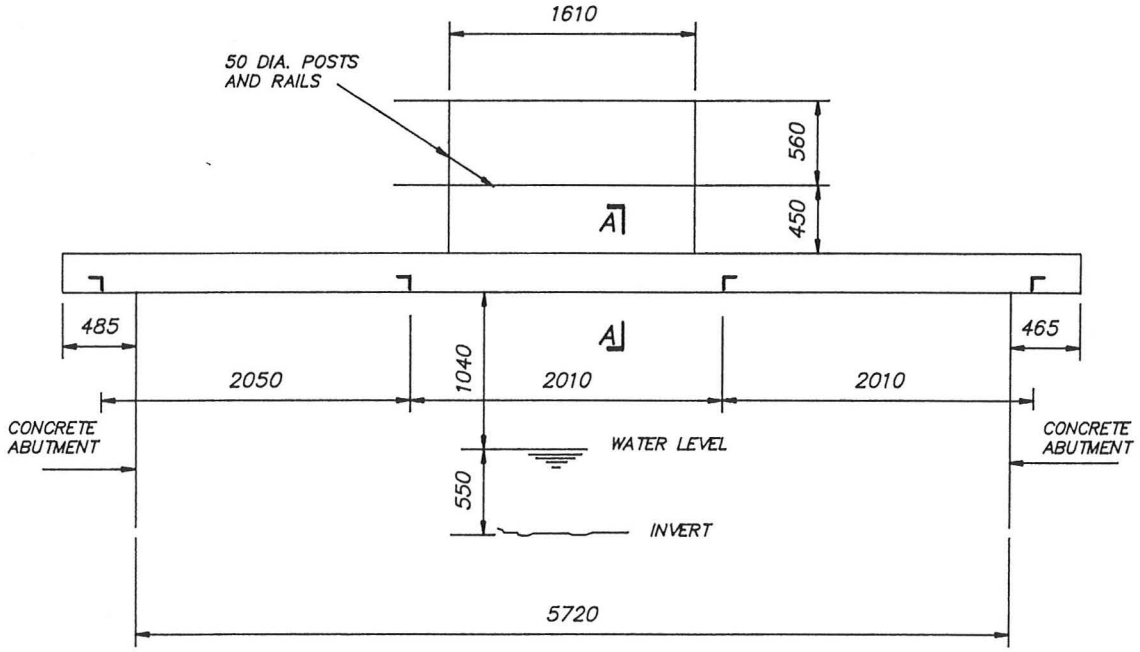
ROUGHTON

59 West Stockwell Street, Colchester CO1 1HE.
Telephone : (0206) 48149 Telefax : (0206) 44257

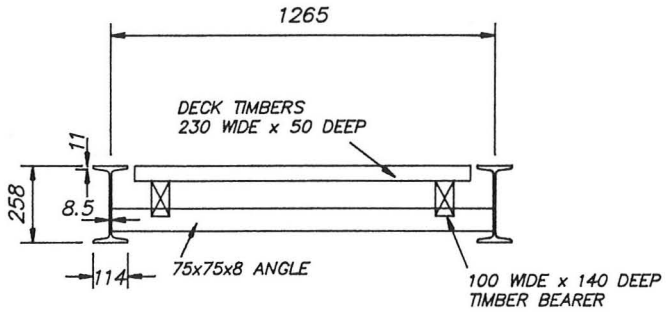
JOB No. ICC657	DRAWING No. 07	REV.
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

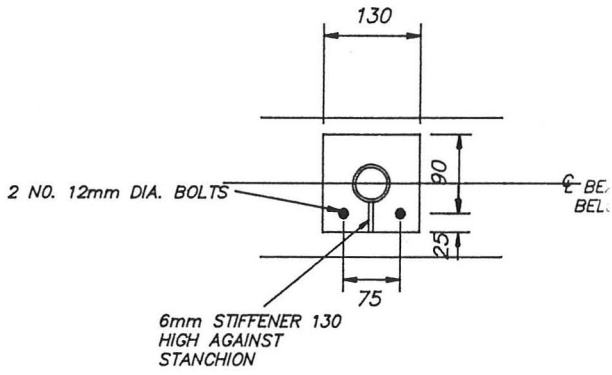
DRAWING TITLE *BRIDGE 7*



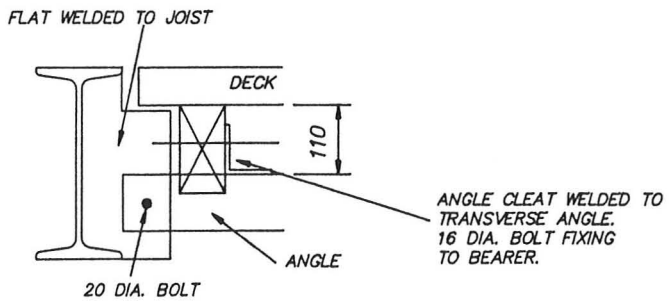
SOUTH ELEVATION



SECTION A–A



HANDRAIL FIXING



CONNECTION DETAIL

South Elevation.

BRIDGE NO. 7

Looking West.

BRIDGE NO. 8
ROAD BRIDGE OVER STREAM

The previous inspection of this bridge was carried out on 29th October 1991.

8.1 DESCRIPTION

The bridge comprises an insitu concrete deck supported on three pairs of back to back channel sections. The top flanges of the steel beams are embedded in the concrete deck. These channels are in turn supported on concrete abutments.

A hole was cut near the centre line of the bridge adjacent the south abutment. The concrete was found to be approximately 325mm thick. Longitudinal bars were 22mm diameter plain round at 125mm centres with transverse reinforcement comprising 12mm diameter plain round bars at 70mm centres.

On each side of the bridge there are tubular steel handrails with the posts bolted to the concrete upstand on either side. The site perimeter fence is fixed to the east side of the bridge.

8.2 CONDITION SURVEY

The wearing surface of the bridge is asphalt in good condition. The handrails on either side of the bridge have sections missing. The fixings to the bridge upstands are inadequate to resist the required horizontal forces.

On the outer faces of the concrete deck there is a limited amount of moss and plant growth; this should be removed. There is a construction joint on each face which appears to be the joint between the upstand and the main concrete deck. The soffit of the deck appeared to be in reasonable condition, however in one area adjacent to the south abutment a laminate of concrete appeared to be coming away; this was removed to expose the

bottom reinforcement running longitudinally. Between 25% and 50% of the cross section of the bars had corroded away. Although there was no evidence of further reinforcement corrosion elsewhere it is quite possible it has occurred as the section of concrete that had spalled had no rust staining and otherwise appeared to be in sound condition.

The back to back steel channels supporting the concrete deck have never been painted. Where exposed to the weather a significant amount of rust is present particularly on the outer webs and underside of flange of the eastern and western beams. The inner face of the webs and the central steel beam are all in fair condition.

The abutments are concrete in sound condition. Near the water level these abutments are protected by vertical timbers held in position by horizontal whalings. On the south abutment these timbers were in fair condition, however on the north abutment there was ingress of tree roots, the whaling had disappeared and the portion of timbers above water level had virtually rotted away. Below the water level the timbers still existed and were continuing to protect the abutments. Slight settlement of the road surface behind the north abutment had occurred but did not appear to have happened in the recent past.

Below the bridge the perimeter fence has been removed. This should be reinstated in order to secure the site.

8.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

The material strengths have been taken as follows:

Reinforcement grade 250 steel
Concrete grade 20
Structural steelwork grade 43 (yield stress 250N/mm^2)

As the carriageway width is less than 5m it has been assumed to comprise one notional lane of 2.5m width with the remaining carriageway carrying an imposed load of 5KN/m².

8.4 SURVEY AND ASSESSMENT RESULTS

The concrete deck contains reinforcement in the bottom of the slab. There is also a top hat section over the central beam, however this does not extend far enough to resist any hogging moments. Therefore the concrete slab has been checked as simply supported spanning between the steel beams and was found to be capable of carrying an axle load in excess of 16 Tonnes.

No evidence was found of any shear connectors between the concrete deck and the steel beams. As this interface would have been subjected to shrinkage, creep, temperature effects and vibrations it has been assumed that the bond between the two materials would have been broken and that there is no composite action. The steel beams are inset into the concrete and therefore have full lateral restraint. They have been checked as simply supported spanning between the abutments and found to be capable of carrying an axle load of 16 Tonnes.

The original weight restriction of 13 Tonnes axle load can therefore be reinstated without any significant financial outlay. If the bridge is required to carry a 40 Tonne assessment live load then the entire deck would have to be replaced, the most economical solution being a twin box culvert.

A large section of concrete has spalled off the underside of the deck exposing the longitudinal steel bars. The main reinforcement in this bridge is the transverse bars spanning between the steel beams, longitudinal steel is secondary. Therefore the concrete can be cut back to behind the bars, any loose corrosion of the steel removed and the area made good with an epoxy high build mortar.

The steel beams need to be grit blasted to remove all rust and subsequently painted with two coats of chlorinated rubber paint.

Any moss and plant growth on the faces of the bridge should be removed.

The abutments are in good condition, however the timber piles protecting them are decaying. In order to prevent scour in the future these piles should be replaced with sheet steel piles and the void behind filled with concrete.

The adjacent embankments are all in poor condition. On the east side of the bridge the trees should be cut down and killed; any attempt to remove the roots will probably damage the embankment. The southern embankment on the western side of the bridge comprises timber piles which are rotating forwards. The timber piles should be removed, the embankment graded, new sheet steel piles driven and the embankment subsequently reinstated.

The parapets do not comply with the requirements of Technical Memorandum BE5. New parapets are therefore required that comply with this document.

8.5 COST ESTIMATES

a/ To grit blast the steel beams and apply two coats of paint.

£1250

b/ To cut back area of spalled concrete, clean up reinforcement and reinstate with epoxy mortar.

£600

c/ To replace timber piles, protecting the abutments with sheet steel piles.

£2500

d/ To south-west embankment replace timber piles with sheet steel piles.

£1750

e/ To replace the handrail with a parapet that complies with the requirements of BE5.

£2400

f/ To cut down and kill the trees in the embankment to the east of the bridge.

£500

8.6 **OPTIONS**

The bridge is adequate to carry vehicles of 16 Tonne axle load. The existing parapets are totally inadequate, are a safety hazard and require immediate replacement. The cost of the remedial works required to maintain the integrity of the existing bridge including the replacement of the parapets to comply with Technical Memorandum BE5 is

£9000

If it is necessary for the bridge to carry vehicles of greater weight than 16 Tonnes axle load the entire deck should be replaced with 2 No. 2.5m wide by 3m high box section culverts approximately 6.2m long. The cost of this would be approximately

£23600

Date of This Examination: 7.4.93 **Date of Last Examination:** 29.10.91

Bridge Number: 8 **Over:** River
Type of Construction: Steel and Concrete **Construction Date:** Unknown

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations	North P South F	D D	4 3	Timber piles protecting abutments, decaying above water level, fair condition below.
8	Abutments	G	A	1	Concrete in good condition.
10	Embankments	P	D	3	SW: timber piles rotated forwards. NW: river bank. N & SE: low concrete wall - tree root ingress
13	Main Beams (Edge)	P	D	4	Back to back RSC's. East: outer web badly rusted underside of flange some rust. Centre: fair condition. West: outer web face badly rusted - lost 2mm, underside of flange some rust.
14	Main Beams (Internal)	F	D	2	
15	Bearings				Corrosion of beams caused slight horizontal cracks at ends.
21	Deck Concrete	P	B	4	500mm x 500mm section spalled away 500mm from south abutment. Exposed 4 No. reinforcement bars 20 @ 125 c/c along length of bridge. 25 - 50% of bar corroded away.
22	Expansion Joints				Nil
29	Waterproofing				Nil
33	Surfacing	G	A	1	Good condition. Slight crack North end. Slight settlement behind abutment.
35	Parapets	VP	D	4	East: 2 of 5 posts missing bottom section. West: 2 of 4 posts missing bottom section. Bottom of post bolted to upstand and mortared over.

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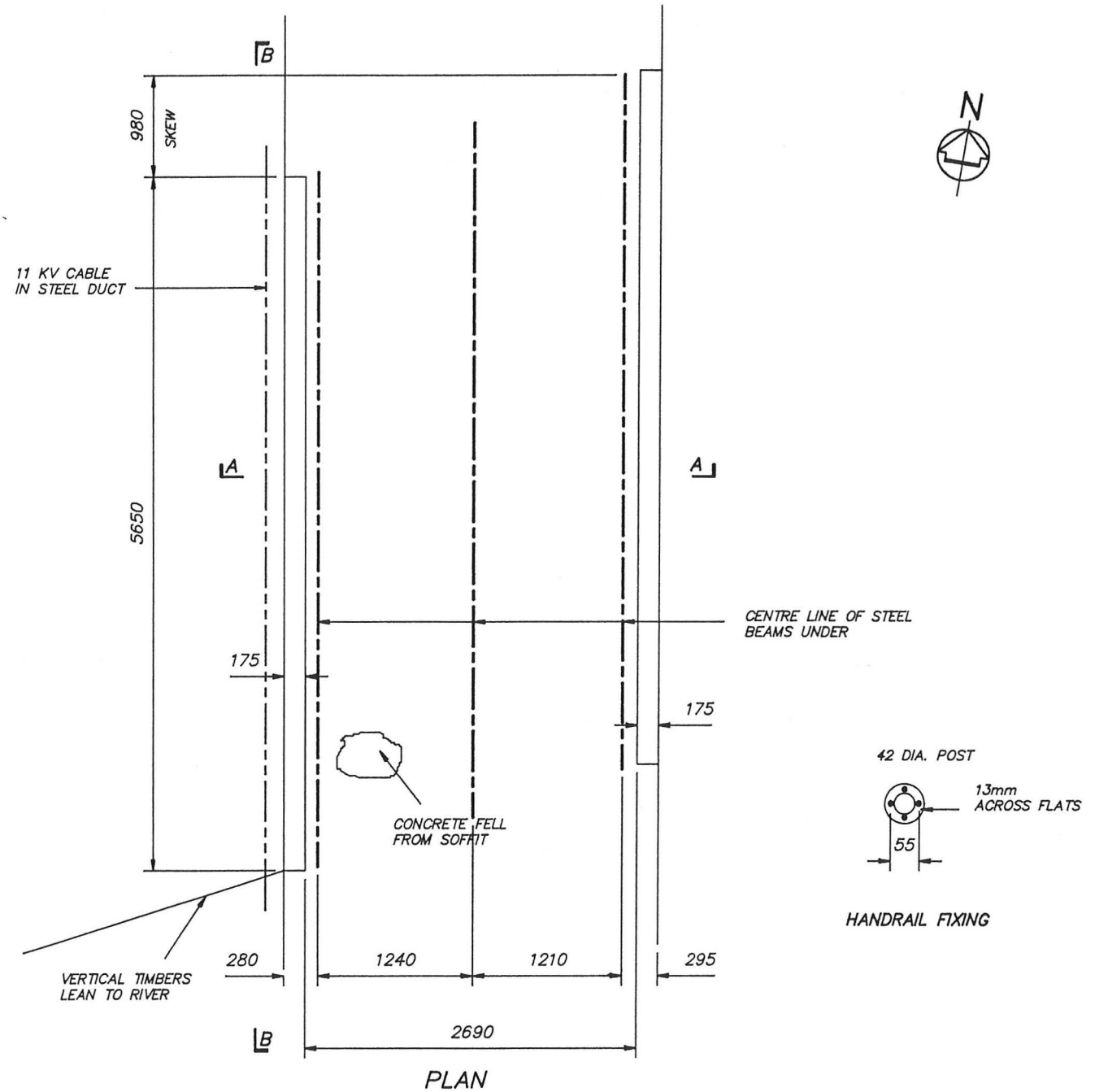
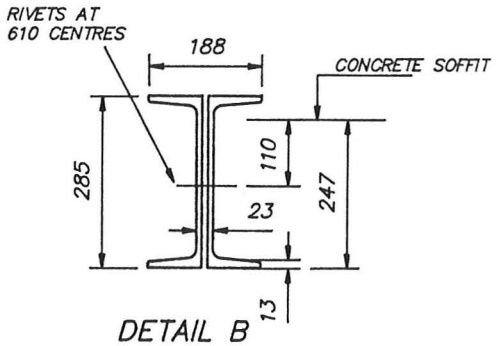
JOB No. ICC657	DRAWING No. 08/1	REV.
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 8*



PLAN



DETAIL B

ROUGHTON
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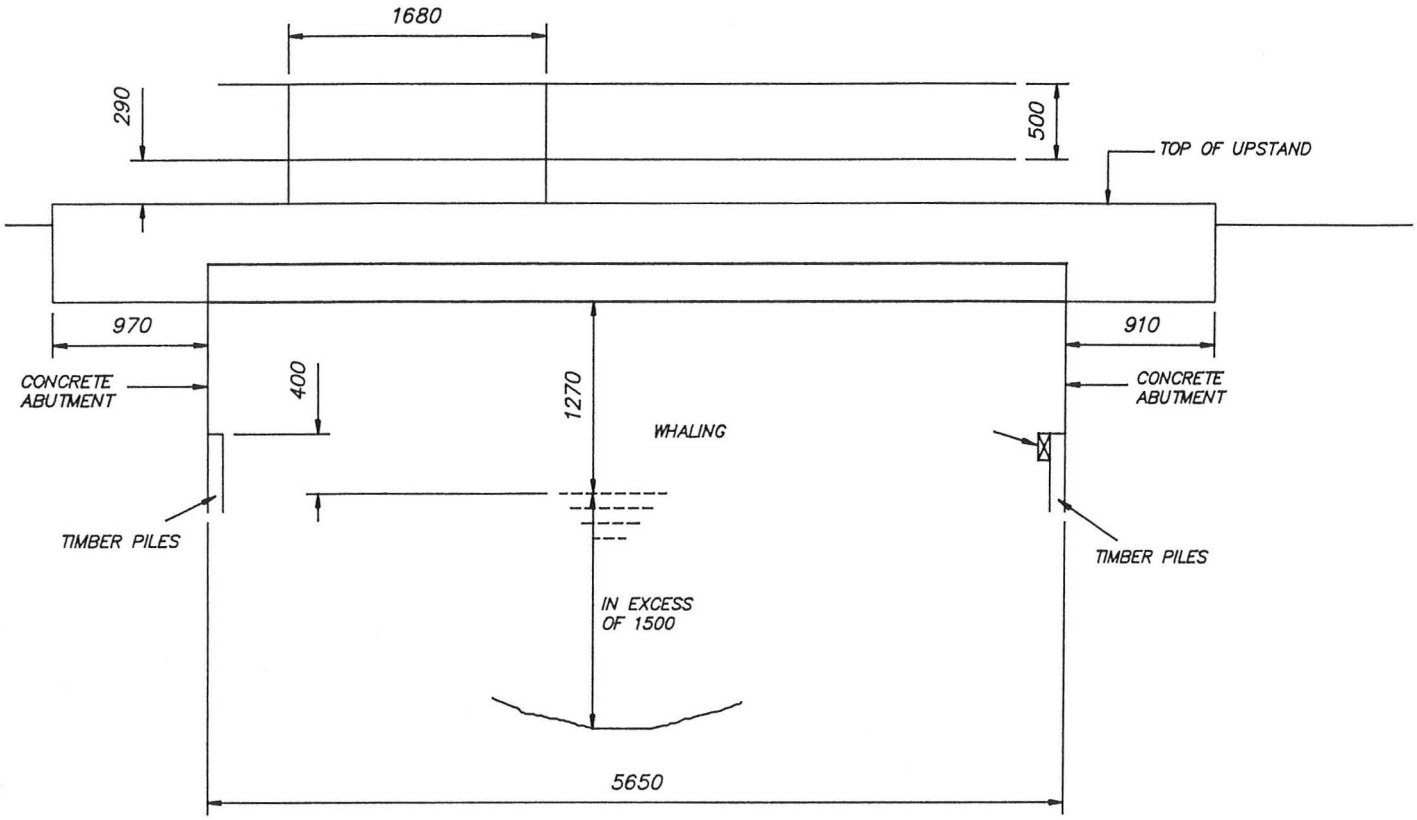
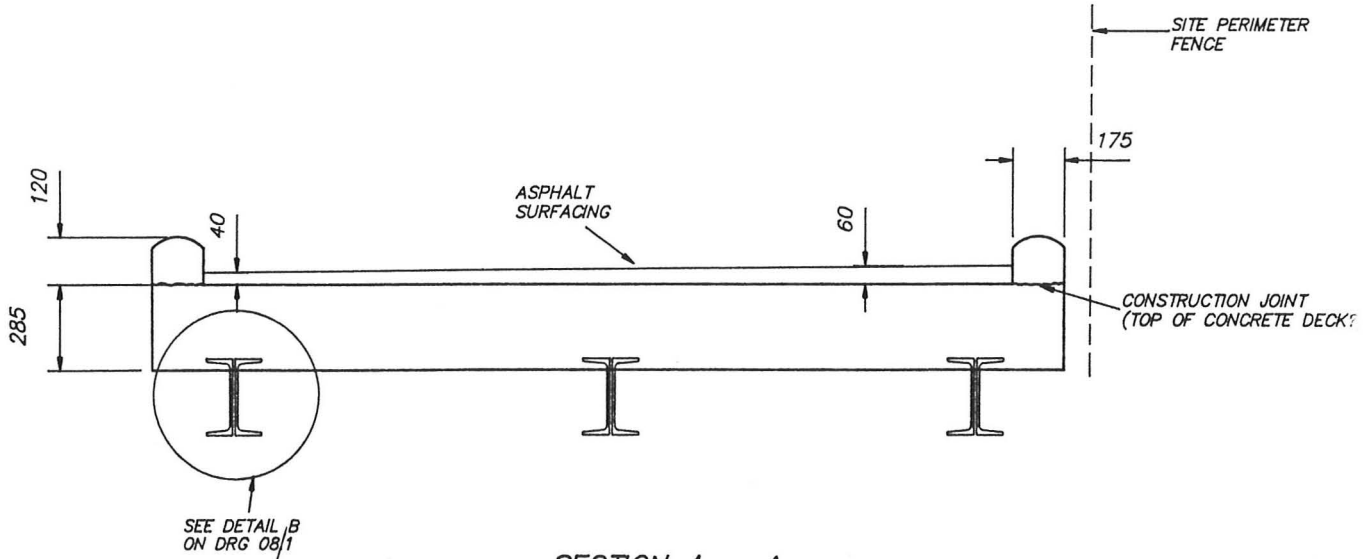
JOB No. ICC657	DRAWING No. 08/2	REV.
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT RARDE NORTHSITE BRIDGES

DRAWING TITLE BRIDGE 8



SECTION B – B



SECTION A – A

West Elevation.

Looking North.

BRIDGE NO. 8

BRIDGE NO. 9

FOOTBRIDGE OVER THE RIVER LEA

We have no records of any previous inspections having been carried out on this bridge.

9.1 DESCRIPTION

The bridge comprises a 75mm thick timber deck supported on 2 No. 250mm deep x 125mm wide RSJ's, these joists in turn supported on concrete abutments.

One side of the bridge there is a timber handrail supported on 50mm diameter steel posts, whilst on the other side there is the site perimeter fence.

9.2 CONDITION SURVEY

The timber deck is in reasonable condition although the timber fillets along either side adjacent to the beams should be removed, the timber cleaned down and thoroughly coated with preservative.

The RSJ's are in poor condition. These have been painted where they were accessible, but the outer half of the south side beam cannot be reached as the site perimeter fence is tight up against this side of the bridge. The bottom flanges of both beams are severely corroded along the whole of their length with limited web corrosion on the outer face of the north side beam at mid span. The inner faces of the webs were not visible but we would anticipate are unprotected and therefore in poor condition.

The abutments were concrete which was in poor condition within 150mm of water level, being severely honeycombed. Below water level there does not appear to be any concrete, it being possible to push a bar in 350mm under the west abutment and 400mm under the east abutment. The material was very silty.

9.3 ASSESSMENT CRITERIA

The calculations have been carried out in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

The materials strengths have been taken as follows:

Timbers softwood strength class SC3
Structural steel grade 43 (yield stress 250N/mm²)

In accordance with BD21/93 the imposed load has been taken as 5KN/m² and horizontal loading on the parapet is 1.4KN per metre run of handrail.

9.4 SURVEY AND ASSESSMENT RESULTS

The deck timbers are adequate in bending bearing and shear. However the timber fillets along either side would need to be removed and the timbers cleaned down and thoroughly coated with preservative.

The joists are inadequate because of their reduced section due to corrosion. There is no alternative but to replace the steel beams in order to carry the required live load.

Both the wooden handrail and steel posts on the north side are inadequate in bending. Neither this parapet nor the site perimeter fence on the south side comply with the requirements of Technical Memorandum BE5. Hence new parapets are required on both sides of the bridge.

Despite the scour to the underside of the abutments they are considered adequate for supporting a footbridge. However in order to provide a reasonable life span, trench sheeting should be driven in front of each abutment and the area behind filled with concrete.

9.5 COST ESTIMATES

With the failure of the steel beams the whole bridge deck needs to be replaced. The costs will be as follows:

a/ Replace steel beams.

£2400

b/ Clean down and thoroughly coat timber deck with preservative replacing any rotten timbers.

£350

c/ New parapets along either side of the bridge to comply with BE5.

£3050

d/ To drive trench sheeting in front of existing abutment and fill void behind with concrete.

£1500

9.6 OPTIONS

The existing bridge is inadequate in many respects including the condition of the main steel beams and the parapets. There is no alternative but to replace the entire bridge deck and carry out remedial works to the abutments all at a cost of

£7300

BRIDGE PRINCIPAL INSPECTION REPORT

ICC657 **Sheet 1**

Date of This Examination: 1.4.93 **Date of Last Examination:** Not known

Bridge Number: 9 - Footbridge **Over:** River Lea
Type of Construction: Steel and Timber **Construction Date:** Unknown

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations	P	D	4	Not visible, no support under outer face of abutment.
2	Invert				River bed.
8	Abutments	P	-	4	Concrete. Very poor quality within 150mm of water level. No concrete below water level, possible to push bar in 350mm below concrete.
10	Embankments				River bank.
13	Main Beams	P	D	4	North: inside half of bottom flange rusted full length now 30mm thick (outside half 12mm thick), web corrosion mid span and 0.5m from West end. South: entire width of bottom flange rusted full length now 30mm thick 300mm long laminates can be pulled away.
15	Bearings				Nil
21	Deck Timber	F	D	2	Needs cleaning and coating with preservative.
34	Paintwork	P	D	4	Outer face of South side beam never painted.
35	Parapets	F	-	2	Parapet on North side only.

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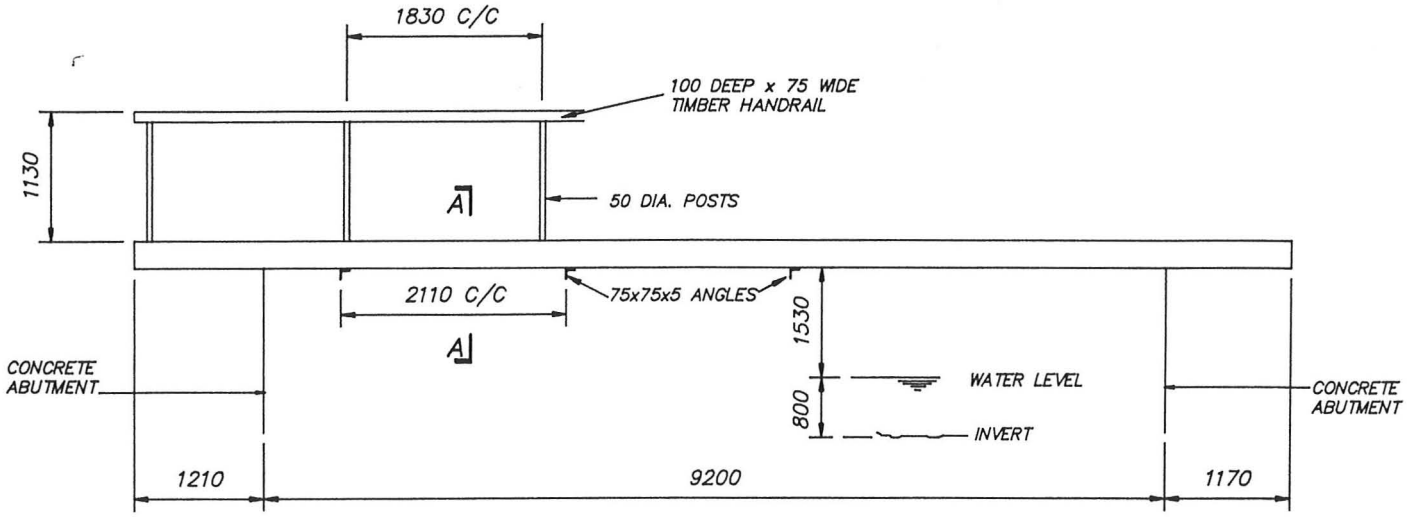
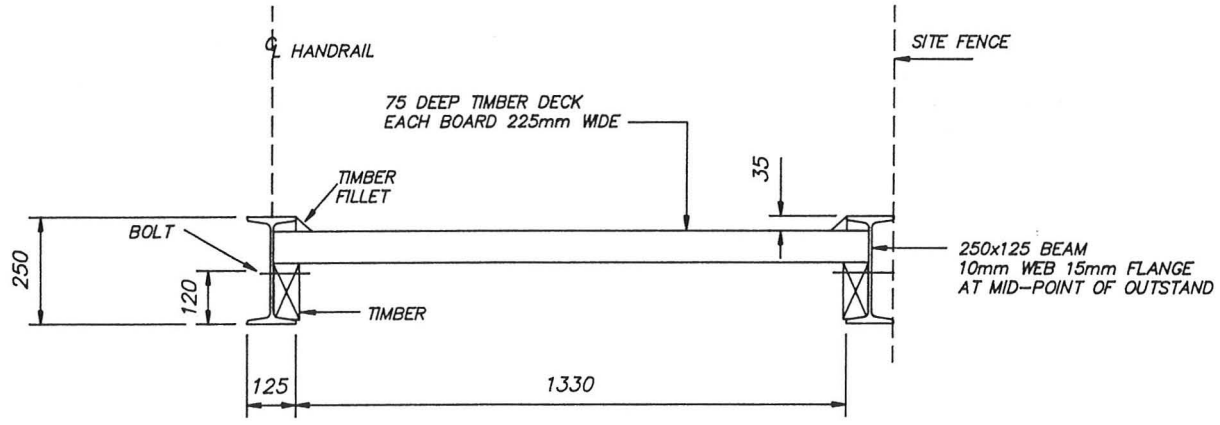
JOB No. ICC657	DRAWING No. 09	REV.
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

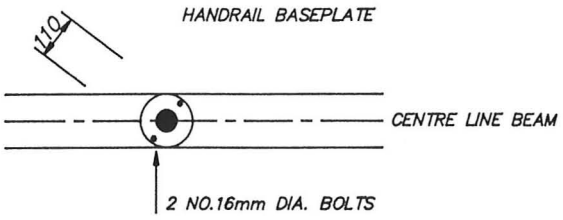
DRAWING TITLE *BRIDGE 9*



NORTH ELEVATION



SECTION A–A



HANDRAIL FIXING

North Elevation.

BRIDGE NO. 9

Looking West.

BRIDGE NO. 10

BRICK ARCH OVER THE RIVER LEA (WEIGHT LIMIT 5 TONNE AXLE LOAD)

The previous inspection of this bridge was carried out on the 28th October 1991.

10.1 DESCRIPTION

The bridge is a brick arch spanning 6.7m, the springing is 1m above the level of the abutment. The arch has a radius of approximately 5.1m. The arch and arch face comprise blue brindle bricks 460mm thick, the remainder of the bridge construction being in stock bricks. The abutments are concrete and protect the wall below the arch springing to just above normal water level.

The road surface is approximately 950mm above the crown of the arch. There is a considerable hump in the road as it crosses the bridge with a tight corner on the approach to the bridge from the north side. The parapet on either side of the road is an average of 790mm high, 330mm thick with large square piers at each corner of the bridge.

10.2 CONDITION SURVEY

The arch, arch ring on either side of the bridge and vertical walls below the arch are all in good condition. The spandrel and wing walls have weathered up to a depth of 35mm in places. The areas where this has occurred are shown on Drawing No. 10/2.

There is evidence of significant water leakage through the arch and spandrel walls and through the vertical face below the arch springing. The north east corner of the parapet has suffered impact damage and although this has been repaired there is a 25mm step in the parapet.

A hole was drilled through the crown on the centre line of the bridge where the arch ring was found to be 460mm thick, identical to the thickness of the arch on the elevations.

The pointing throughout the bridge is generally sound although localised repointing is required to parts of the parapet.

10.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures" and Part 4 BA16/93 Chapter 3 "The Assessment of Masonry Arch Bridges by the Modified MEXE Method".

The bricks in the arch barrel have been taken as engineering bricks.

10.4 SURVEY AND ASSESSMENT RESULTS

A provisional axle load was determined and modified by factors due to span/rise, profile, materials, brickwork joints and condition to achieve a modified axle load. The bridge was found to be capable of carrying the 40 Tonne assessment live load.

Where the spandrel and wing walls have weathered all spalling brickwork should be cut out and replaced, repointing the brickwork where required.

To prevent water leakage through the arch ring, spandrel walls and vertical face below the arch springing the surface of the bridge must be sealed to prevent further water ingress. In addition a drainage system comprising weep holes 0.8m below the arch springing must be provided to prevent water build up behind the masonry.

The parapet walls require localised repointing with specific attention to the joint between the parapet and the road surface to ensure this joint is waterproof.

Consideration should be given to modifying the road layout at the north end to ease the vehicle entry onto the bridge.

Parapets do not comply with requirements of Technical Memorandum BE5. They do not meet the standards of Group P2 "Vehicle Pedestrian Parapets" and should therefore be strengthened by rebuilding with a reinforced concrete core.

10.5 **COST ESTIMATES**

a/ To remove all spalling face work and replace including repointing brickwork where necessary.

£3500

b/ To seal the surface of the bridge including a joint with the parapets and provide drainage system for the superstructure.

£1350

c/ To strengthen the parapets to comply with the requirements of BE5.

£9000

10.6 **OPTIONS**

The bridge is adequate to take 40 Tonne vehicles. Provided the bridge remains in private posession only being used for construction traffic it can be deemed to be adequate although the owners attention is drawn to the fact that the parapet does not comply with the Department of Transport Memorandum BE5.

This bridge is a historic structure and it may be a requirement of English Heritage that the bridge is retained.

The cost of the remedial works required to maintain integrity of the existing bridge plus strengthening the parapets is

£13850

BRIDGE PRINCIPAL INSPECTION REPORT

ICC657 **Sheet 1**

Date of This Examination: 7.4.93 **Date of Last Examination:** 28.10.91

Bridge Number: 10 **Over:** River Lea
Type of Construction: Brick Arch **Construction Date:** 1878

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	G	A	1	Concrete protected by 25mm timber boarding.
9	Wing Walls	F	C	2	Weathered brickwork surface.
10	Embankments	F			River bank.
23	Arch Springing	G	A	1	Stock bricks, water leakage through South side.
24	Arch Ring	G	A	1	Blue brindle bricks, good condition.
25	Voussoirs/Arch Face	G	A	1	450mm blue brindle bricks in good condition.
26	Spandrel Walls	F/P	D	3	Weathered.
29	Waterproofing	P	D	4	Water leaking through arch ring 225mm in from either side. Water leaching through face of spandrel walls near base of arch and through vertical walls under arch.
30	Drainage - Superstructure	P	D	4	Ineffective.
31	Masonry and/or Brickwork	P	D	3	Significant weathering of spandrel walls.
32	Pointing	F	B	2	Good except on parapets where repointing required.
33	Surfacing	G	B	3	Junction between asphalt and parapet to be sealed.
35	Parapets	F	B	2	Sound brick, localised repointing required. North East corner 25mm step where repaired after vehicle impact.

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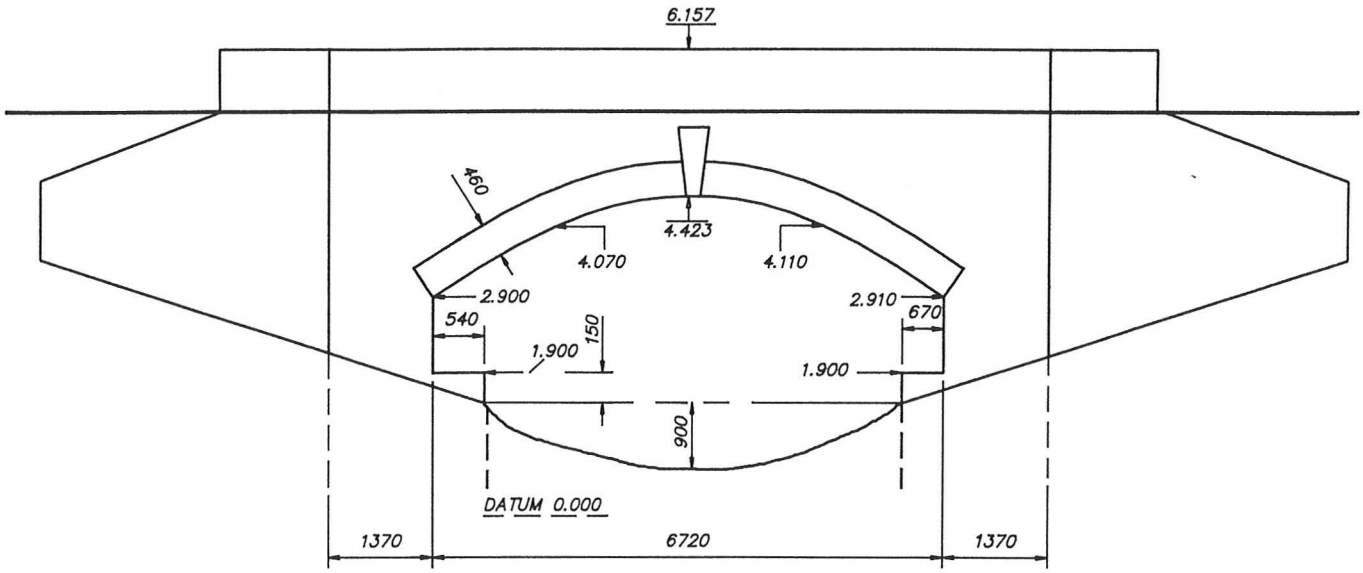
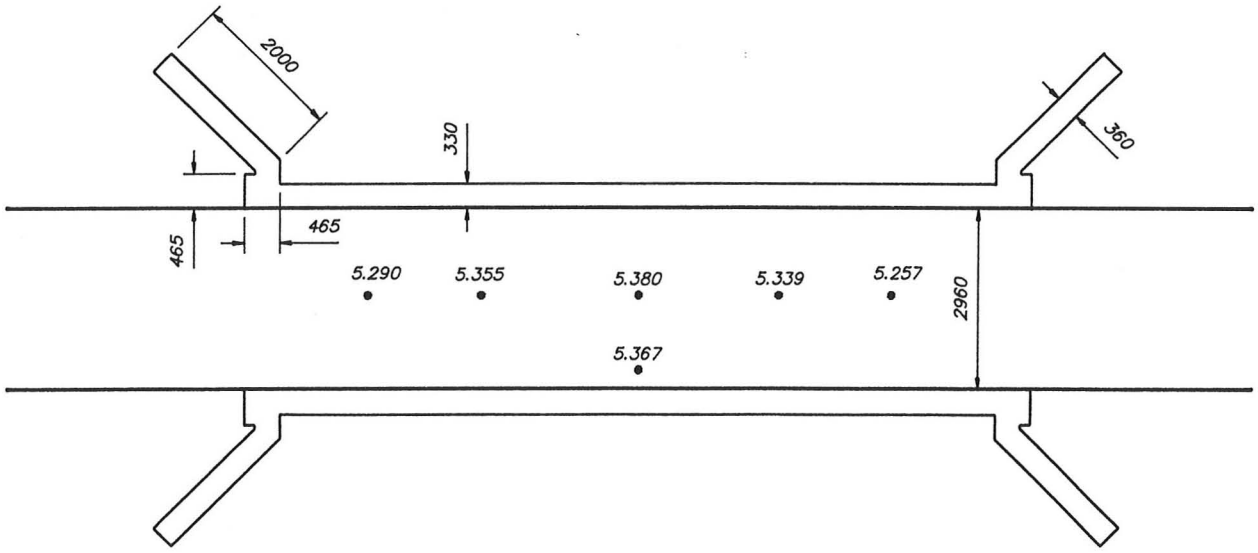
JOB No. ICC657	DRAWING No. 10/1	REV.
SCALE 1:100	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

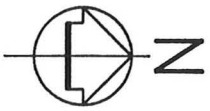
DRAWING TITLE *BRIDGE 10*



EAST ELEVATION



PLAN



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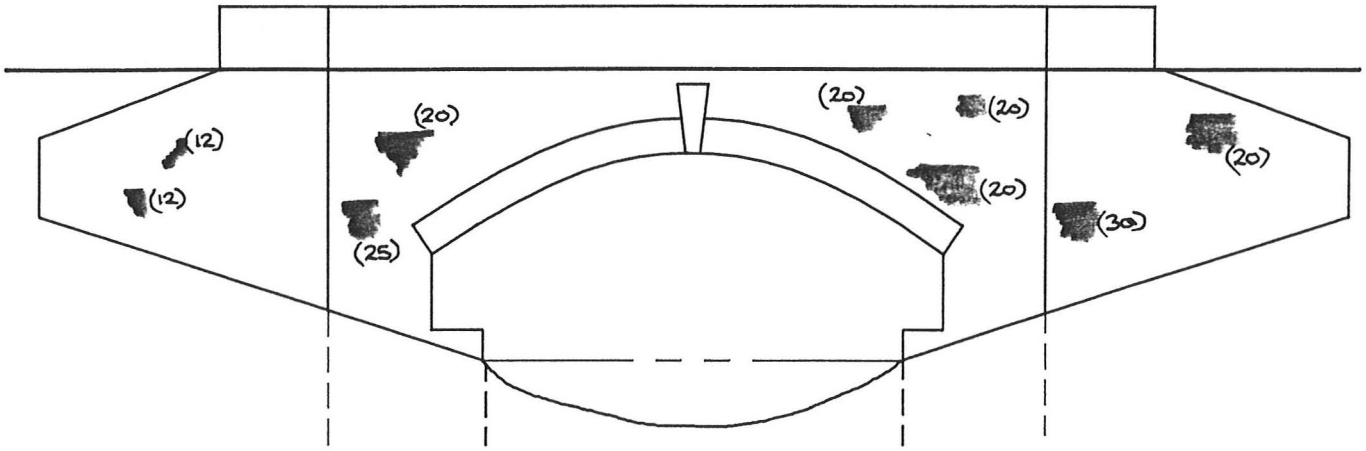
JOB No. ICC657	DRAWING No. 10/2	REV.
SCALE 1:100	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

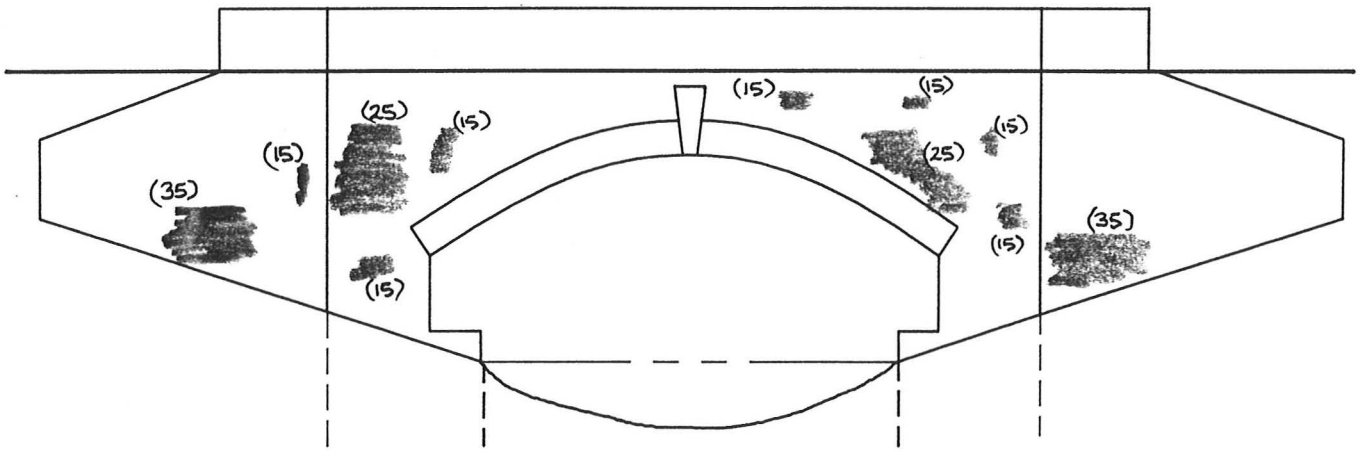
PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 10*

FIGURES IN BRACKETS INDICATE DEPTH OF WEATHERING OF BRICKWORK



WEST ELEVATION



EAST ELEVATION

East Elevation.

BRIDGE NO. 10

North-east spandrel wall showing weathered brickwork and water leakage.

BRIDGE NO. 11

ROAD BRIDGE OVER CORN MILL STREAM (WEIGHT LIMIT 5 TONNE AXLE LOAD)

The previous inspection of this bridge was carried out on 28th October 1991. During our search of the records held at the Ministry of Defence Estate Surveyors Office at Chessington we found Drawing No. S-B.49 showing details of foundations and abutments to this bridge.

11.1 DESCRIPTION

The bridge is a bailey bridge comprising single height, single width panels on either side. On each side of the bridge there are five panels which support transoms at 1450mm centres. These transoms support steel joists at an average of 250mm centres which in turn support the timber deck of 230mm wide by 45mm deep timbers. At each end of the bridge the side panels sit on bearings supported on concrete pad foundations.

11.2 CONDITION SURVEY

A number of the timber deck planks have split along their length, this split being the full length of some timbers. On top the timber is in fair condition but the underside has softened to a depth of 10mm in places. An allowance should be made for replacing 40% of the timbers with the remainder cleaned down and thoroughly coated with preservative. There is diagonal cross bracing below the transoms comprising 30mm diameter tie bars with turn buckles. At present these are loose and need tightening.

The paintwork on the joists, transoms and side panels is in reasonable condition with only localised areas of rusting. If the bridge is to be retained for any length of time all the steel must be cleaned off, any areas of rust blast cleaned and the whole bridge repainted.

The bearings at either end must be cleaned out and thoroughly greased. The west abutment is in good condition. However the east abutment is unprotected and has a 20mm deep void below the concrete.

11.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

Extensive reference has been made to the Bailey Bridge Uniflot Handbook and The Super Bailey Manual published by Mabey Bridge Company Ltd.

The carriageway width is less than 3.65m It has been assumed to comprise of one notional lane of 2.5m.

11.4 SURVEY AND ASSESSMENT RESULTS

The side panels are capable of carrying a 7.5 Tonne assessment live load. However the transoms and joists can only carry a 3 Tonne vehicle which equates to a 5 Tonne axle load. This complies with the current weight restriction on the bridge.

In order to upgrade the bridge to carry a 10 Tonne axle load the transoms and joists would need to be replaced; an operation which would involve replacing the deck timbers with a steel deck.

In order to accept a greater load more suited for construction traffic the bridge would need to be replaced with another steel panel bridge.

If the existing bridge is to be retained with a 5 Tonne axle load restriction, the side panels, transoms and joists need to be cleaned off, any areas of rust blast cleaned and the whole bridge repainted. The timber deck would also need to be cleaned down and thoroughly coated with preservative and approximately 40% of the timbers replaced.

The bearings would need to be cleaned out and thoroughly greased.

The void under the east abutment must be filled. Steel sheet piling must be installed in front of the abutment and the void behind filled with concrete.

The vehicles are prevented from hitting the side panels of the bridge by the steel kerbing. Therefore the side panels do not have to comply with the requirements of Technical Memorandum BE5.

11.5 COST ESTIMATES

a/ To remove the deck timbers, replace existing transoms and joists and lay new steel deck.

£9400

b/ To clean down and repaint transoms and joists clean and coat deck timbers with preservative allowing 40% replacement.

£3500

c/ To repaint side panels.

£2500

d/ To clean out and thoroughly grease bearings.

£200

e/ To install steel sheet piling in front of east abutment, fill void with concrete.

£2000

11.6 OPTIONS

The bridge is currently adequate to carry a vehicle of 5 Tonne axle load. However there are a number of remedial works that are necessary. The cost of these including works to abutments would be

£8200

A 5 Tonne axle load is not deemed sufficient for construction traffic. Therefore the bridge is likely to need upgrading. There are two options. Either:

1/ Replace the joists to upgrade the bridge to a 10 Tonne axle load. Including works to the east abutment, this option would cost

£14100

or

2/ To replace the bridge with a new steel panel bridge to carry 40 tonne vehicles plus any necessary works to the east abutment. This option would cost

£18900

BRIDGE PRINCIPAL INSPECTION REPORT

ICC657 **Sheet 1**

Date of This Examination: 7.4.93 **Date of Last Examination:** 28.10.91

Bridge Number: 11 **Over:** Corn Mill Stream
Type of Construction: Bailey Bridge **Construction Date:** Approx 1971

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations	F	C	3	West: good condition. East: 200 void below concrete.
2	Invert				River bed.
8	Abutments	East P West G	D A	4 1	Void under concrete.
10	Embankments	F	D	2	River bank.
13	Main Beams	F	C	3	Side panels: surface corrosion in areas. Paintwork generally in fair condition.
15	Bearings	P	D	3	Not maintained. Clean out and grease.
16	Transverse Beams	F	C	3	Wire brush/blast clean and paint.
17	Crossheads - Joists	F	C	3	Wire brush/blast clean and paint.
20	Bracing and/or Cross Ties	F			To be tightened.
21	Deck Timbers	F	D	3	Renew 40%. Clean and coat remainder with preservative.
34	Paintwork	F	C	3	Repaint.

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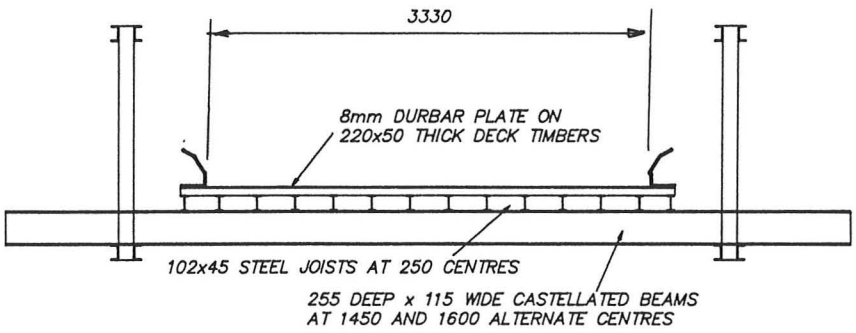
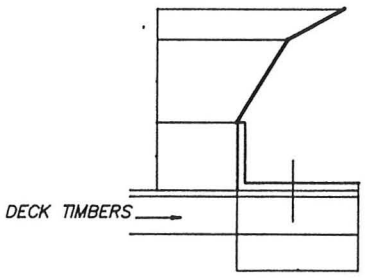
JOB No. ICC657	DRAWING No. 11	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

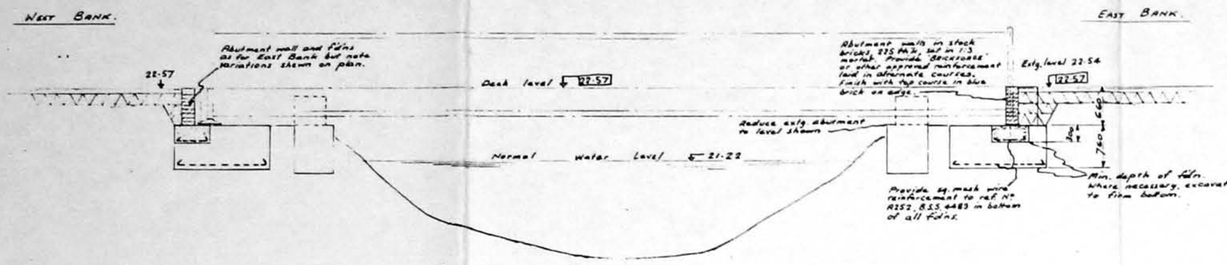
DRAWING TITLE *BRIDGE 11*



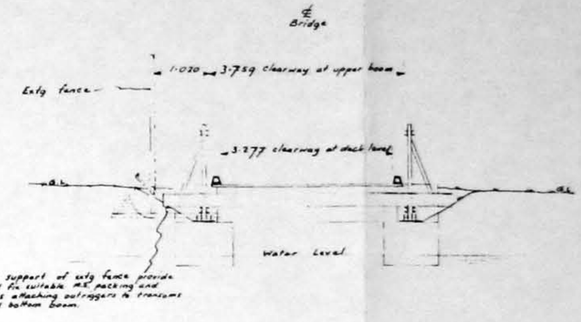
CROSS SECTION



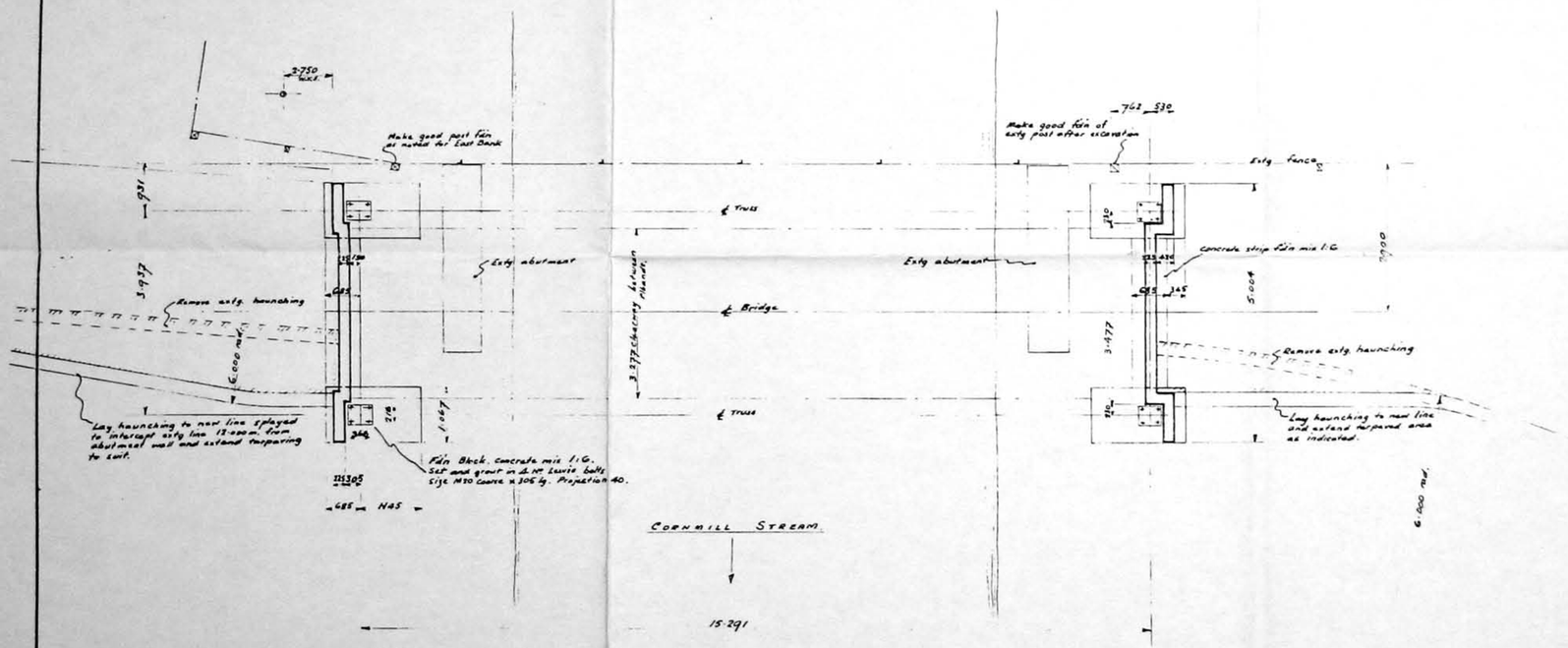
ENLARGED EDGE DETAIL



SOUTH ELEVATION.

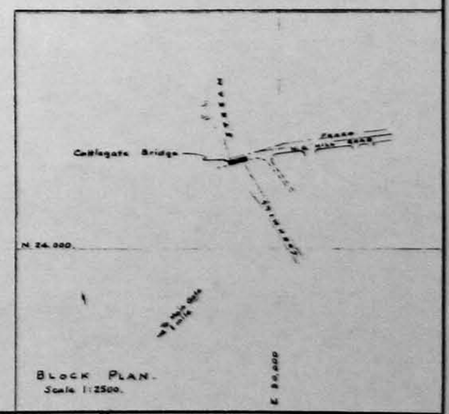


CROSS SECTION, LOOKING EAST.



PLAN.

NOTES.
All dimensions and levels are shown in metric forms.



BLOCK PLAN.
Scale 1:2500.

CONCURRENCE	APPROVAL	DRAWN	CHECKED
E.R.D.E. WALTHAM ABBEY		TRACED	PASSED
		SCALE 1:50	

FOUNDATIONS & ABUTMENTS — REPLACEMENT OF CATTLEGATE BRIDGE.

FOR C.E.

DRAWING No. S-B. 49.

Drawing Number S-B.49

South Elevation.

Looking West.

BRIDGE NO. 11

BRIDGE NO. 12

NEWTONS POOL ROAD BRIDGE

The previous inspection of this bridge was carried out on the 28th October 1991. During our search through the records at the Ministry of Defence Estate Surveyors Office at Chessington we found Drawing No. AB1/1 of the Newtons Pool Replacement Road Bridge.

12.1 DESCRIPTION

This skew bridge spans approximately 4.75m and comprises 3 No. 395mm deep pressed steel troughs 12mm thick filled with concrete with an additional 150mm concrete fill over the top. On the west side there is a rough stone block abutment whilst on the east side a relatively new engineering brick wall.

There are tubular steel handrails on either side comprising 3 rails 230mm, 680mm and 1140mm above kerb level. These are supported on angle standards in turn fixed to the outside face of the bridge.

12.2 CONDITION SURVEY

The asphalt surfacing is in fair condition. The underside of the steel troughing has heavy surface rusting with laminates coming away on the north trough adjacent to both abutments. It is possible that the underside of the troughing has been cleaned down in the past and a thickness of metal removed. However given the age of the bridge and the lack of maintenance on the remainder of the bridges around the site we would anticipate that this has not occurred and the remaining thickness of metal is only slightly less than the 12mm originally detailed.

The east abutment appears to have been rebuilt fairly recently, 215mm brickwork replacing the original stone abutment. The brick wall is in good condition with sound pointing. The west abutment is rough hewn stone blocks cemented together. An average of 50mm - 75mm of pointing is missing and 2 stone blocks have fallen out completely. There is ivy

growing up the wall. There is evidence of water having leaked down the face of both abutments from the outer troughs.

12.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures". The material strengths have been taken as follows:

Steel trough section yield stress 250N/mm^2
Concrete Grade 20

The carriageway width fills the structure. As it is less than 5m it has been assumed to comprise one notional lane of 2.5m width.

12.4 SURVEY AND ASSESSMENT RESULTS

The deck is capable of carrying the 40 Tonne assessment live load. In determining the allowable load, no account has been taken of the composite action between the concrete and the steel trough decking as corrosion may have affected the bond due to water permeating through the concrete to this interface. There is no way of draining the steel trough section and no waterproof membrane preventing water entering the concrete.

In order to ensure the long term durability of the bridge, the surfacing should be removed down to the top surface of the concrete, a waterproof membrane installed and the surfacing replaced. Holes should be drilled in the bottom of each end of each trough to allow any water which penetrates the deck to escape. The underside of the steel troughs should be grit blasted to remove the corrosion and then the steel troughs coated with chlorinated rubber paint.

The parapet hand railing does not comply with the requirements of Technical Memorandum BE5. The moment of resistance of the post is inadequate, the frame has not been infilled and no plinth or kicker has

been provided. The parapet should therefore be replaced.

The west abutment requires all vegetation to be removed. It must then be repointed and where stone blocks are loose or have fallen out these need to be rebedded or replaced respectively.

12.5 COST ESTIMATES

a/ To remove the road surface down to the concrete, apply waterproof membrane and replace the surfacing.

£1000

b/ To grit blast the steel trough deck and apply 2 coats of paint.

£1650

c/ To replace the handrail with a parapet that complies with the requirements of BE5.

£2100

d/ To repoint the west abutment, replacing stone blocks which have become displaced.

£300

12.6 OPTIONS

The deck is adequate to take 40 Tonne vehicles. Provided the bridge remains in private possession only being used for construction traffic it can be deemed to be adequate although the owners attention is drawn to the fact that the parapet does not comply with Technical Memorandum BE5. If the bridge is to be adopted or used for public vehicles the parapet will have to be strengthened.

The cost of the remedial works required to maintain the integrity of the existing bridge plus replacing the parapets is

£5050

If the bridge is not considered to be wide enough an alternative is to replace the entire deck with 2 No. 2.5m wide by 1.9m high box section culverts approximately 6.2m long in order to accommodate a 3.65m wide carriageway and 1.8m wide footway. The cost of this would be

£20250

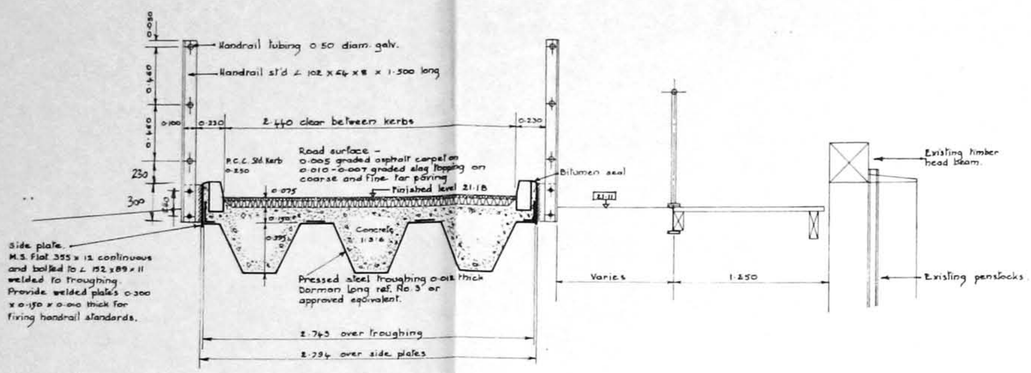
BRIDGE PRINCIPAL INSPECTION REPORT

ICC657 **Sheet 1**

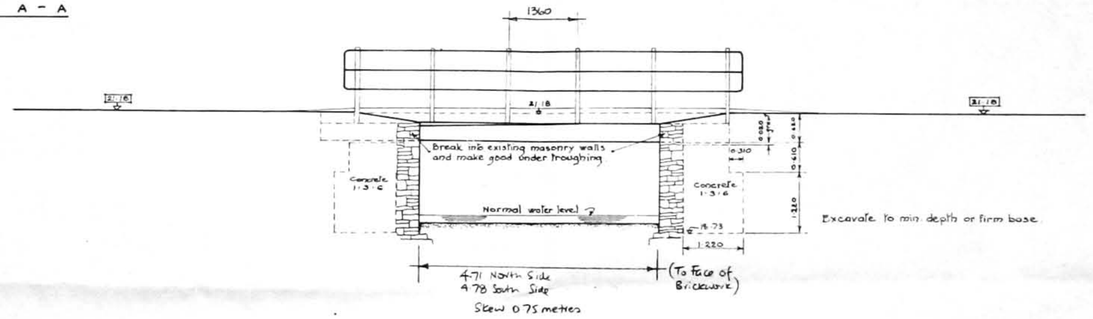
Date of This Examination: 7.4.93 **Date of Last Examination:** 28.10.91

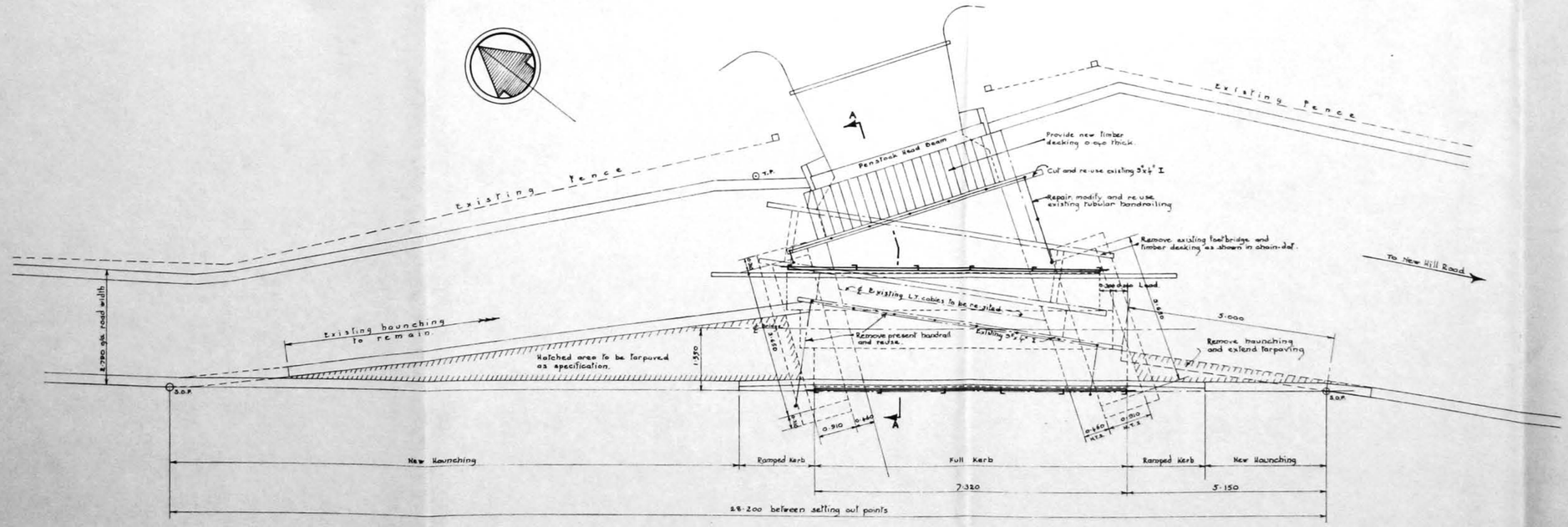
Bridge Number: 12 **Over:** River Lea
Type of Construction: Steel Trough **Construction Date:** Approx 1972

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert	F		2	Concrete.
8	Abutments	West VP East G	D A	4 1	West: concrete padstone on loose rough stone blocks. Ivy growing up abutment. 50-75mm pointing missing. East: relatively new 215mm thick engineering bricks. Good condition.
10	Embankments	West VP East G	D A	4 1	As abutments.
13	Main Beams	P	D	4	Heavy surface rusting on steel troughing, laminates coming away on North trough at each abutment. Requires painting.
15	Bearings				Nil
21	Deck Concrete				Not visible.
22	Expansion Joints				Nil
33	Surfacing	F	D	2	Asphalt in fair condition.
35	Parapets	F	D	2	



SECTION A-A





NOTES

All dimensions expressed in metric terms.

This drawing to be read in conjunction with Specl. No. 2/71.

The bridge is designed for single lane traffic in accordance with M.O.T. Standard Highway Loading Type HA and conforms to B.S.S. No. 153 Parts 3 and 4. Steel to conform to B.S.S. 15. Faces in contact with concrete to be cement washed. Exposed surfaces of steel and like surfaces in contact to receive 2 No. coats of rust-preventing bituminous paint of approved manufacture.

During construction, the contractor must maintain existing decking adjacent to the penstocks as a temporary footbridge suitable for pedestrian traffic and the occasional use of handtrucks conveying explosives.

Existing levels shown thus 21·16 New levels thus 21·18

NEW WORK SHOWN IN RED

REMOVALS SHOWN GREEN.

S.—.B. 53.

AMENDMENTS

E.R.D.E. WALTHAM ABBEY	JOB NO. 71027/DWL/DDG/H DRAWING NO. AB1/1
REPLACEMENT OF ROAD BRIDGE AT NEWTONS POOL – OLD RIVER LEA.	SUPERINTENDING MANAGER DEFENCE DEPARTMENTS GROUP DEPARTMENT OF THE ENVIRONMENT WEST WING, CAVALRY BARRACKS HOUNSLOW WEST, MIDDX.
SCALE LAYOUT 1:50, DETAIL 1:20	DATE 30th NOV 71
JOB ARCHITECT/MGR.	DRAWN A.P.S. CHECKED TRACED J.J.

SHEET SIZE A1+ TYPE A

1844 45234 ET 3/70

Drawing Number AB1/1

Looking East.

South elevation showing west abutment and
Newtons Pool sluice beyond.

BRIDGE NO. 13

We have no records of any previous inspections having been carried out on this bridge.

13.1 DESCRIPTION

The bridge is a type of aquaduct where a canal crossed the River Lea. The river has been culverted with 5 concrete pipes side by side, the middle three being 1840mm in diameter and the outer two being 1220mm diameter. The overall width of the aquaduct is 15.5m. The individual pipe sections are 1250mm long although in places half sections have been used. The pipes have been surrounded with concrete, the top of the concrete fill being 230mm above the crown of the central pipes. Headwalls at each end have been formed with concrete probably unreinforced.

The canal crossing the river was formed with earth banks and a tow path either side. From the outside of the tow path the ground slopes down to the tops of the ends of the pipes. The canal, at present a muddy track, would have been made watertight by conventional means such as puddled clay. Considerable works would be required if it was ever to be filled with water in the future. A number of trees are growing in the canal banks and the roots could be damaging the culverts below.

13.2 CONDITION SURVEY

The three larger pipes are in good condition except for the joints where the salts from the concrete have been washed through to the inside of the pipe; at river water level there is a build up of 50mm - 75mm of salts. It was not possible to take the boat through the outer pipes so a close examination could not be made, however looking through the pipes they appeared to be in good condition with no significant damage. Headwalls at either ends of the pipes are in reasonable condition. On the north headwall there is a vertical crack down to the top of the pipe and in the south headwall a crack around the circumference of one pipe section.

The trees growing in the canal banks should be removed. If the canal is to be refilled with water the concrete slab immediately under the canal bed should be cleaned off and examined (at present there is a mud covering of 200mm - 300mm). Specialist advise should be sought in terms of waterproofing the canal bed and sides.

13.3 ASSESSMENT CRITERIA

The maximum loading conditions for which the pipes have been assessed are a) when the insitu mass concrete was placed; these forces will have been reduced by shrinkage to the self weight forces only. b) to carry the load of the concrete 1.2m of embankment and a canal section full of water.

In order to obtain allowable vehicle loads, the culverts have been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures" and Part 4 BA16/93 Chapter 3 "The Assessment of Masonry Arch Bridges By The Modified MEXE Method".

13.4 SURVEY AND ASSESSMENT RESULTS

The pipe sections are capable of carrying the required loads for the embankment and canal section full of water.

When assessed for vehicular loads the bridge was found to be capable of carrying an axle load of 9.6 tonnes.

The cracking in the head walls at either end is of no structural significance. However the cracks should be cut back and repaired with a specialist mortar suitable for the purpose.

To aid water flow through the pipes the build up of salts inside the section should be cleaned off and the base of the pipe sections cleaned out to remove any mud or silt which has accumulated. The river bed immediately upstream requires dredging.

To prevent further water passing through the pipe joints it is necessary to seal the top surface of the concrete surround. This can be achieved by removing the existing earth embankments, cleaning the surface to sound concrete and replacing the existing embankment with lean concrete. A waterproof membrane can then be laid lining the base and sides of the

canal running over the top of the pipes and protected with 150mm of dense concrete.

13.5 **COST ESTIMATES**

a/ To clean out the pipe sections removing salts from joints and silt from invert.

£650

b/ To cut out and fill cracks in north and south headwalls.

£200

c/ To reinstate canal over, using lean concrete embankments and waterproof membrane.

£5000

13.6 **OPTIONS**

The existing pipe sections are in a fair condition although some remedial works need to be carried out. These would cost approximately

£850

If the canal over was to be reinstated and subsequently filled with water the cost of this work would be a further.

£5000

Date of This Examination: 7.5.93 **Date of Last Examination:** -

Bridge Number: 13 **Over:** River Lea
Type of Construction: Concrete Pipes **Construction Date:** 1940

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				Concrete pipe.
10	Embankments	F	D	2	River bank overgrown.
13	Main Beams	F	D	2	Concrete pipes in good condition. Water ingress through joints.
21	Deck Concrete				Not visible.
25	Headwall Face	F	B	2	Vertical crack North face. Crack around circumference of one pipe in South face.

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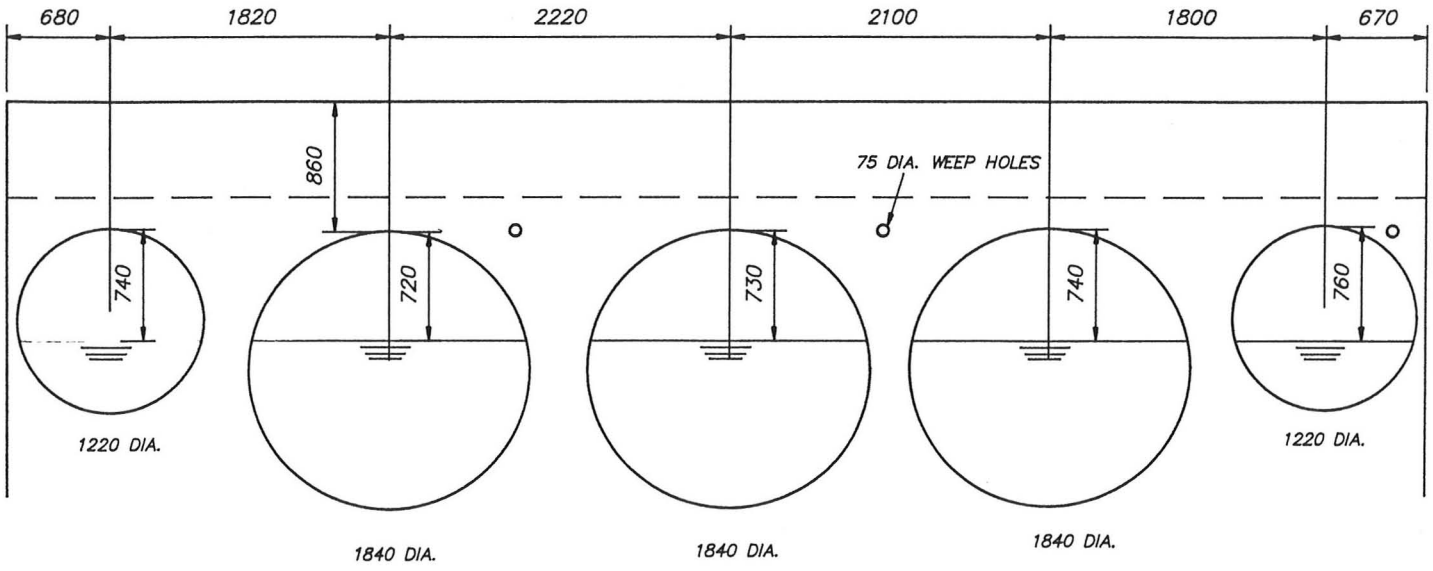
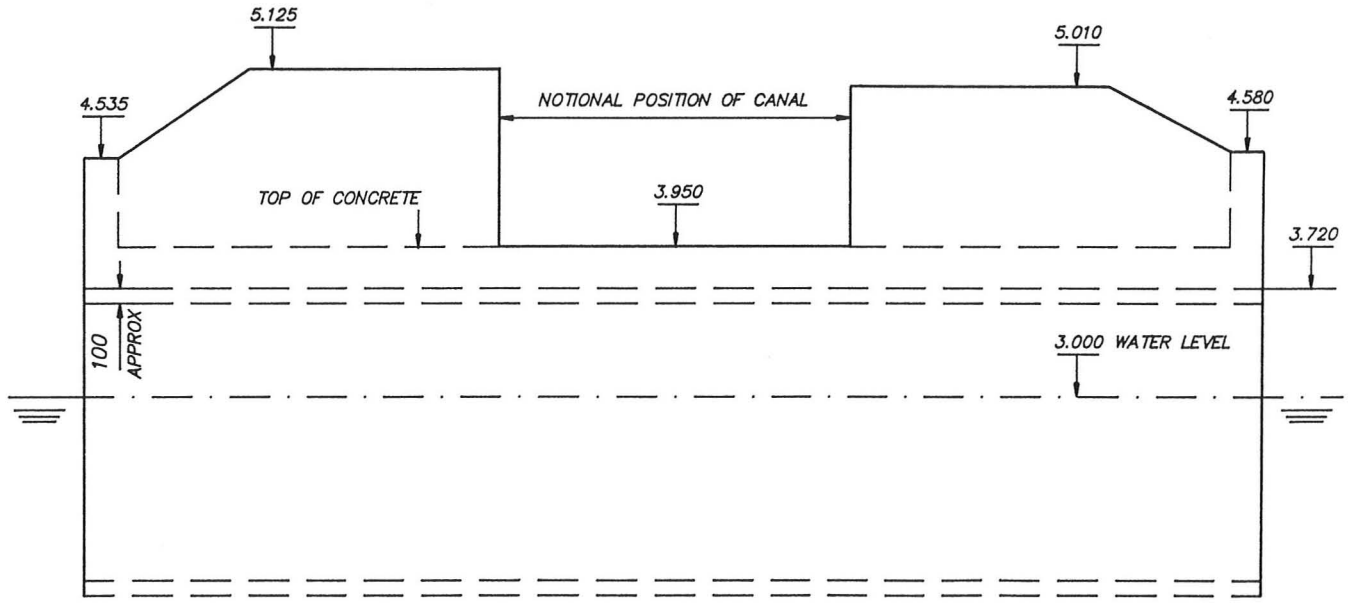
JOB No. ICC657	DRAWING No. 13/1	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 13*



SOUTH ELEVATION



SECTION A–A

ROUGHTON

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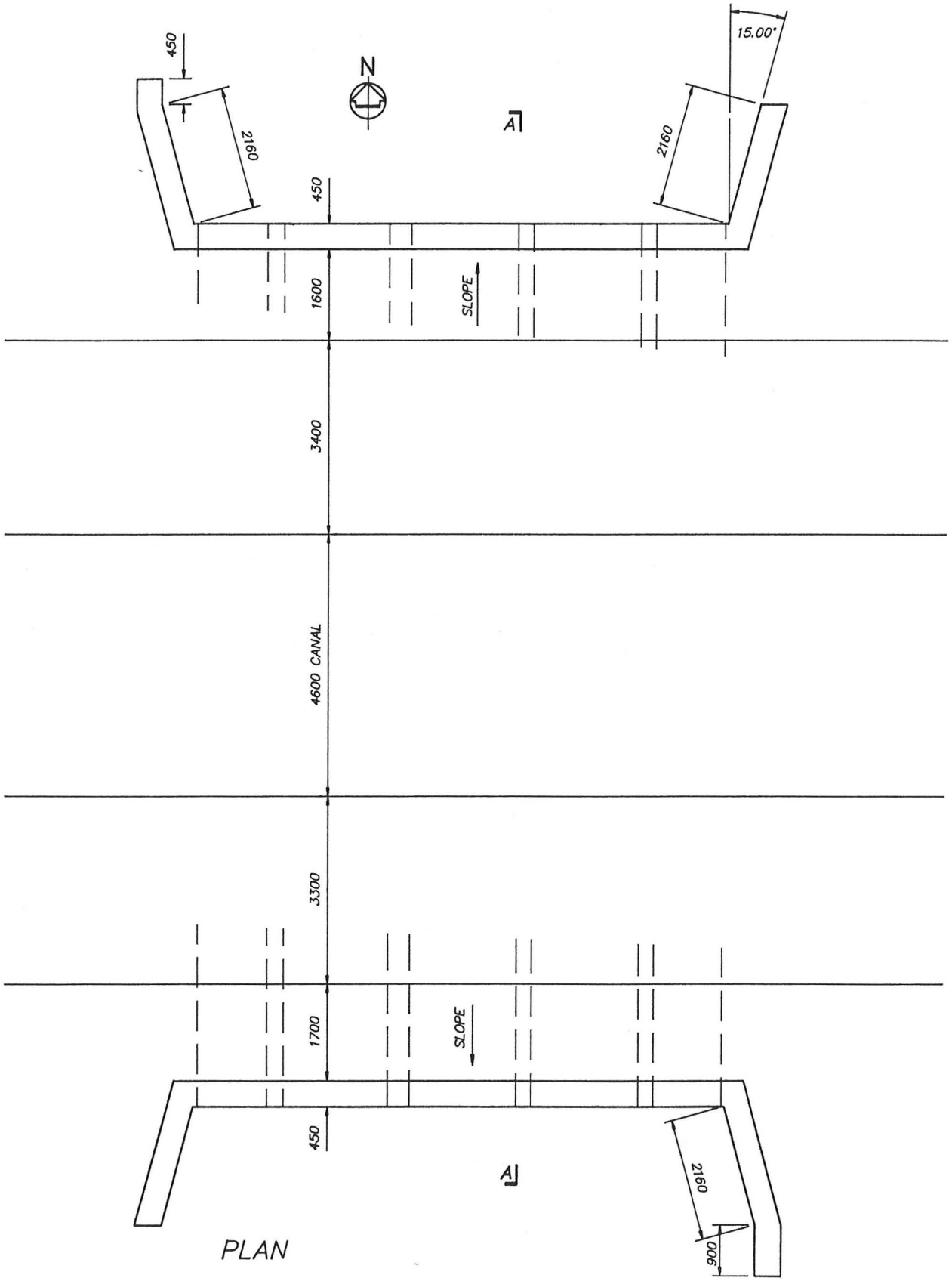
JOB No. ICC657	DRAWING No. 13/2	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE JUNE 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 13*



PLAN

South Elevation.

Looking East along disused canal.

BRIDGE NO. 13

BRIDGE NO. 14
AQUADUCT OVER RIVER LEA

We have no records of any previous inspection having been carried out on this aquaduct.

14.1 DESCRIPTION

At the time of the inspection the canal was empty and the aquaduct had been cleaned out. Work has been carried out to the training walls removing trees, bushes etc whose roots have grown into the brickwork.

The deck and sides to the aquaduct are cast iron segments, bolted together. It is skewed by 1.22m with the cast iron sections being built in to the brick abutments on either side. The training walls at either end are 215mm thick brickwork thickening out to 825mm adjacent to the end of the cast iron bridge section. Within this thickened brickwork will be the waterproof joint between the cast iron and brickwork although this was not visible.

14.2 CONDITION SURVEY

The cast iron sections have never been painted although are in good condition. The brick abutments require repointing at and immediately below water level. The north abutment has stepped forward by 25mm just above water level.

Recently a large amount of vegetation including trees has been removed from the vicinity of the bridge, some of which have severely damaged the tops of the training walls to the aquaduct. A minimum of the top four courses on all training walls will need to be rebuilt. In addition if the canal is to be refilled the waterproof joint between the bridge and retaining walls will have to be repaired. There is evidence of considerable water leakage at all four corners of the cast iron trough.

14.3 ASSESSMENT CRITERIA

The aquaduct has been assessed assuming it is full of water to the very top of the section.

The permissible stresses in the cast iron have been taken in accordance with Figure 4/1 of BD21/93.

14.4 SURVEY AND ASSESSMENT RESULTS

The cast iron sides of the aquaduct are satisfactory, both as beams spanning between the abutments and resisting the lateral forces of the retained water.

The base section is slightly under strength being overstressed by approximately 4% when the aquaduct is brim full of water when assessed against the allowable stresses in BD21/93. However the aquaduct is known to have satisfactorily carried water in the past and that the normal water level is 290mm below the top of the section.

The brim full situation is therefore a short term loading condition. A 4% overstress can be considered acceptable and the aquaduct trough section deemed to be adequate.

If the aquaduct is to be retained it should be cleaned down. It has never been painted, therefore unless required for aesthetic reasons it can remain in its present condition. The waterproof joint between the cast iron section and the brickwork training walls will need to be repaired. Where the training walls have been damaged by tree roots the brickwork will need to be dismantled and rebuilt. Generally this applies to the top four courses of all training walls. The brick abutments will require repointing at and below water level. Where the brick wall has stepped out on the north abutment just above water level the cause of the damage is unknown. This joint should be infilled and checked on an annual basis to ensure that the damage is not progressive.

14.5 COST ESTIMATES

a/ To paint all cast iron surfaces with two coats of paint.

£4650

b/ To repair the waterproof joint between the cast iron aquaduct and the brick abutment.

£1350

c/ To repoint the north and south abutment brickwork at and below water level.

£1000

d/ To repair the training walls including a minimum of the top 4 courses of each wall.

£2000

14.6 OPTIONS

The aquaduct is in reasonable condition and can therefore be retained. It should be noted that this is a historic aquaduct in which English Heritage are likely to have an interest. There are some remedial works required. Excluding painting the total remedial cost would be approximately

£4350

BRIDGE PRINCIPAL INSPECTION REPORT

ICC657 **Sheet 1**

Date of This Examination: 1.4.93 **Date of Last Examination:** Not Known

Bridge Number: 14 **Over:** River Lea
Type of Construction: Cast Iron Aquaduct **Construction Date:** 1878

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	F	C	3	Brick. Both abutments require repointing below water level. North side brickwork stepped forward by 25mm at joint immediately above water level.
10	Embankments	F	D	2	River bank.
11	Training Walls	P	C	3	Top of walls damaged by tree roots.
13	Main Beams	G	A	1	Cast iron trough.
15	Bearings				Nil
28	Deck Plates	G	A	1	Cast iron trough.
29	Waterproofing	P	-	2	Leakage from all four corners of aquaduct. Repair if canal to be refilled.
32	Pointing	P	C	3	Requires repointing just below water level.

ROUGHTON

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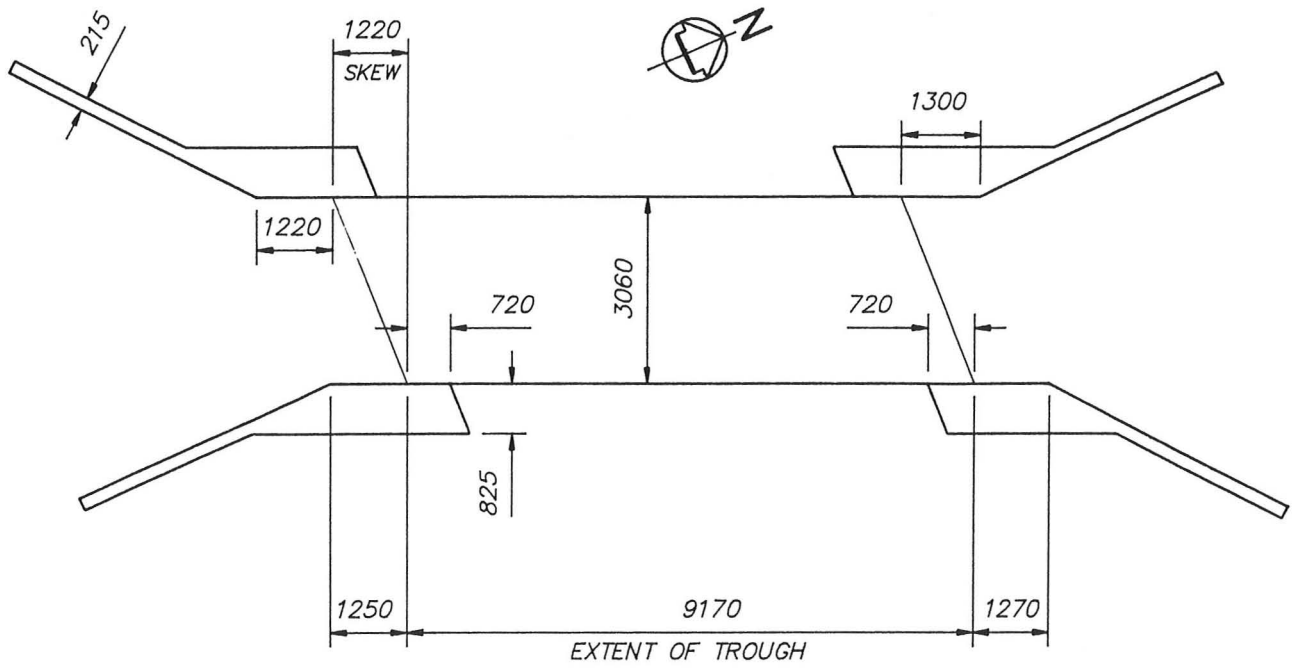
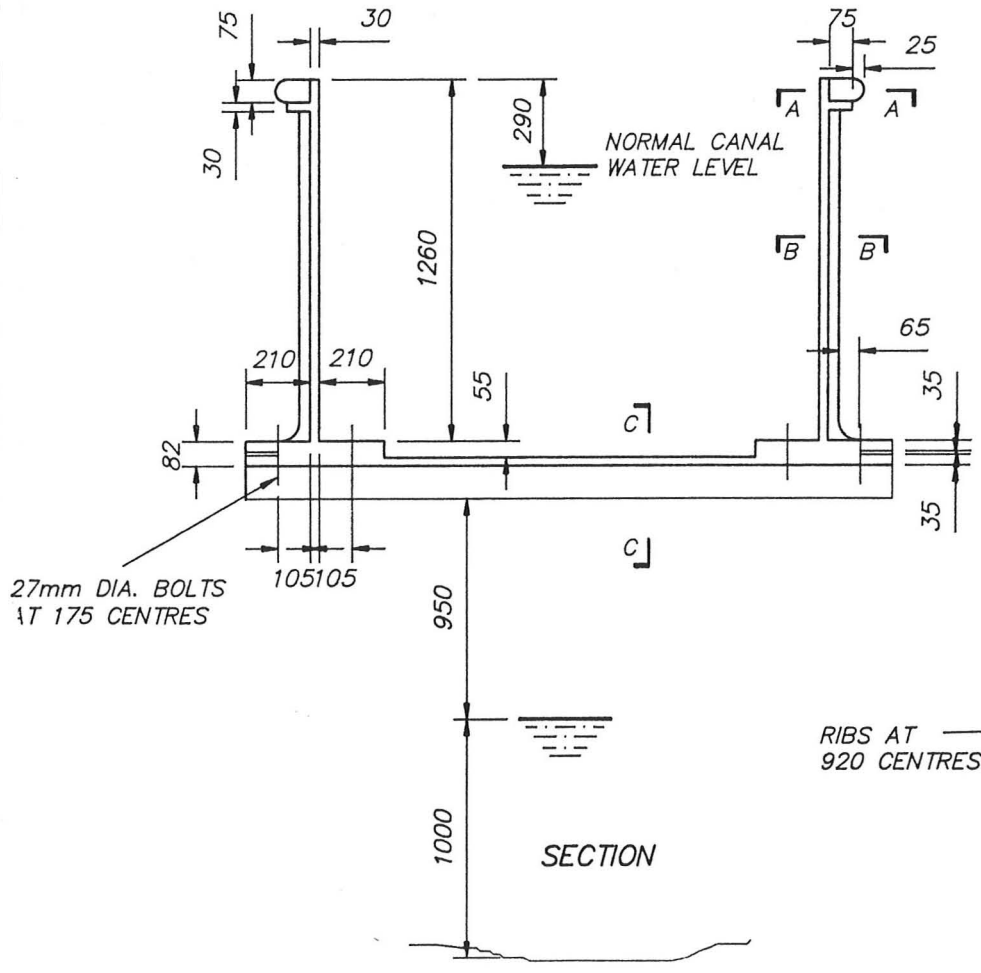
JOB No.	DRAWING No.	REV.
ICC657	14	
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

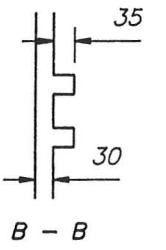
DRAWING TITLE *BRIDGE 14*



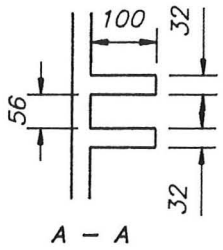
PLAN



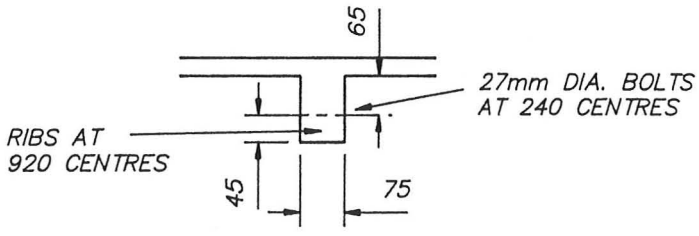
SECTION



B – B



A – A



C – C

East Elevation.

Looking South along aquaduct trough.

BRIDGE NO. 15
AQUADUCT OVER RIVER LEA

We have no records of any previous inspection having been carried out on this aquaduct. During our search through the records at the Ministry of Defence Surveyors Office at Chessington we found Drawing No. E-B.01 showing details of the footbridge fixed over this aquaduct.

15.1 DESCRIPTION

The whole of the bridge was very overgrown with trees from the north side hanging over it, close examination of this side from either land or boat not being possible. Barbed wire criss crossed each end of the bridge making access difficult. At the time of the inspection there was 75mm sludge in the bottom of the trough hence the base could not be inspected.

The aquaduct comprises cast iron sides and base sections bolted together. The cast iron sections are built into the brick abutments on either side. The foundation to the abutments appears to be corbelled out brickwork.

In about 1964 a footbridge was constructed over the aquaduct. This comprised channels spanning the aquaduct and bolted to each side. These channels supported longitudinal channels in turn supporting a timber deck. At each end of the bridge the longitudinal channels were supported on brick walls across the width of the aquaduct, the ground behind these brick walls having been backfilled to the top of the bridge. Recently the timber deck which was in very poor condition was removed.

A pipe has been laid across the bridge supported on concrete plinths constructed off the deck. This pipe which is approximately 300mm above the bottom of the aquaduct trough passes through the brick wall at either end.

15.2 CONDITION SURVEY

The sides of the aquaduct have been painted although the paintwork is now in poor condition with rust patches showing through. The underside of the base has never been painted and although there is surface rust there is no apparent significant damage. The channels which supported the footbridge are severely corroded in places the top flange having expanded to 15mm - 20mm due to rusting.

Water is leaking down the west abutment below the cast iron trough. Below a point 150mm above water level the mortar pointing is missing to a depth of approximately 50mm. Either side of the trough the abutments are overgrown and not visible.

The embankment immediately to the north of this abutment comprises timber piles. These have been pushed forward at their base probably by tree roots but in any case are rotten close to water level.

On the east abutment the pointing is missing to a depth of 25mm below a point 150mm above water level. Immediately below the cast iron trough there is a horizontal crack. On the south side this is 3mm wide and continues around to the south face of the abutment where it is horizontal for 800mm before angling diagonally downwards until hidden by the embankment. On the north side of the trough this crack is 20mm wide continuing along to the corner with the north face of the abutment where it became hidden by the infill behind the timber piles. This crack is believed to be due to tree roots behind the abutment encroaching underneath the cast iron trough. The top 300mm of both north and south sides of this abutment had been damaged by tree roots and will need to be removed and rebuilt.

The embankment immediately to the north of this abutment comprises timber piles with concrete filled bags behind. These piles have moved forward by 400mm over their entire height and there is an extreme danger that the river bank could collapse at any time. This could have a serious affect on the stability of the east abutment.

15.3 ASSESSMENT CRITERIA

The aquaduct has been assessed assuming it is full of water to the very top of the section.

The permissible stresses in the cast iron have been taken in accordance with Figure 4/1 of BD21/93.

15.4 SURVEY AND ASSESSMENT RESULTS

The sides of the aquaduct are satisfactory, both as beams spanning between the abutments and resisting the lateral forces of the retained water.

The base section is slightly under strength being overstressed by approximately 4% when the aquaduct is brim full of water when assessed against the allowable stresses in BD21/93. However the aquaduct is known to have satisfactorily carried water in the past and the water level will be below the top of the cast iron section. The brim full situation is therefore a short term loading condition and hence a 4% overstress can be considered acceptable and the aquaduct trough section deemed to be adequate.

The steelwork which supported the footbridge is in very poor condition and uneconomic to renovate. It should therefore be removed and if a footbridge is required in this location a new one should be constructed, either over the aquaduct or totally independent.

If the canal is to be re-opened the pipe laid across the bridge would have to be removed together with the brick walls at either end of the aquaduct.

The cast iron section is generally in good condition although it should be cleaned down and any paintwork removed. Unless required for aesthetic reasons the cast iron can remain unpainted. The waterproof joint between the cast iron section and the west abutment will have to be resealed.

The general area must be cleared of trees and other vegetation including the ivy from the west abutment. The tree roots must also be removed, in particular those that are damaging the east and west embankment walls on the north side of the aquaduct and the roots immediately behind east abutment which are believed to be causing the horizontal crack in the brickwork immediately under the cast iron trough.

Both abutments need to be repointed at water level and below. Crack damage on the east abutment must be repaired by repointing and cutting out and replacing damaged bricks once the cause of the damage has been removed. The top 300mm of all the training walls have been damaged by tree roots and will need to be removed and subsequently rebuilt.

On both sides of the river to the north of the aquaduct the timber piles forming the river bank have rotted at their base and been pushed forward. These should be removed and replaced by sheet steel piles.

15.5 COST ESTIMATES

a/ To remove footbridge, brick walls at either end and steam pipe and fill connection holes in aquaduct.

£650

b/ Clean down and paint all cast iron surfaces with two coats of paint.

£4650

c/ Repair waterproof joint between cast iron aquaduct and west abutment.

£600

d/ Repoint brickwork on the north and south abutments at and below water level.

£1000

e/ To remove trees and other vegetation from the vicinity of bridge including removal of tree roots and repair crack on east abutment.

£1300

f/ To repair training walls including a minimum of the top 300mm of each wall.

£2000

g/ To replace the timber piles to the north of the aquaduct with sheet steel piles for a 4m length along each side of the river.

£2000

15.6 **OPTIONS**

The remains of the footbridge over the aquaduct is in very poor condition and should be removed. The cast iron trough section itself is in reasonable condition and can therefore be retained. Remedial works are required to both abutments but in particular the eastern abutment. The embankment walls to the north of the aquaduct require replacement. All vegetation in the vicinity of the bridge must be removed. Total cost of remedial works excluding painting.

£7550

If the canal is to be filled with water a footbridge could not be constructed over the top of the aquaduct and would therefore have to be an independent structure. The new sheet steel piled embankment walls could form the abutments for this new footbridge. The cost of steel beams, handrails and timber deck would therefore be approximately.

£7100

Date of This Examination: 14.5.93 **Date of Last Examination:** Not Known

Bridge Number: 15 **Over:** River Lea
Type of Construction: Cast Iron Aquaduct **Construction Date:** 1878

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Corbelled brickwork.
2	Invert				River bed.
8	Abutments	P		3	West: leakage from underside aquaduct. 50mm depth to pointing below and within 150mm of water level. East: 25mm depth to pointing below and within 150mm of water line. Horizontal crack below cast iron trough 3mm wide South side, 20mm wide North side.
10	Embankments	VP	D	4	South East and South West overgrown river bank. North West timber piles rotting at water level and been pushed forward at base. North East timber piles been pushed forward by 400mm - concrete bags behind.
11	Training Walls				Not visible, canal filled in either side of aquaduct.
13	Main Beams - Aquaduct Footbridge	F VP	D D	1/2 4	Cast iron trough has surface rust. Footbridge over: severely corroded - uneconomical to refurbish.
15	Bearings				Aquaduct sits on concrete padstones at all four corners.
28	Deck Plates				Cast iron trough-top not visible.
29	Waterproofing	P	-	2	Aquaduct leaking at west abutment.
32	Pointing	P	D	3	Requires repointing at and below water level.

ROUGHTON

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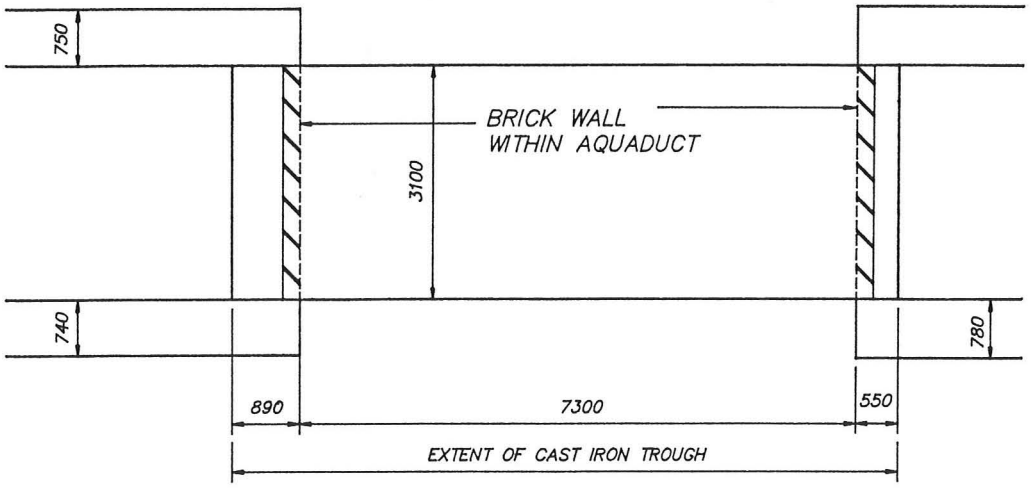
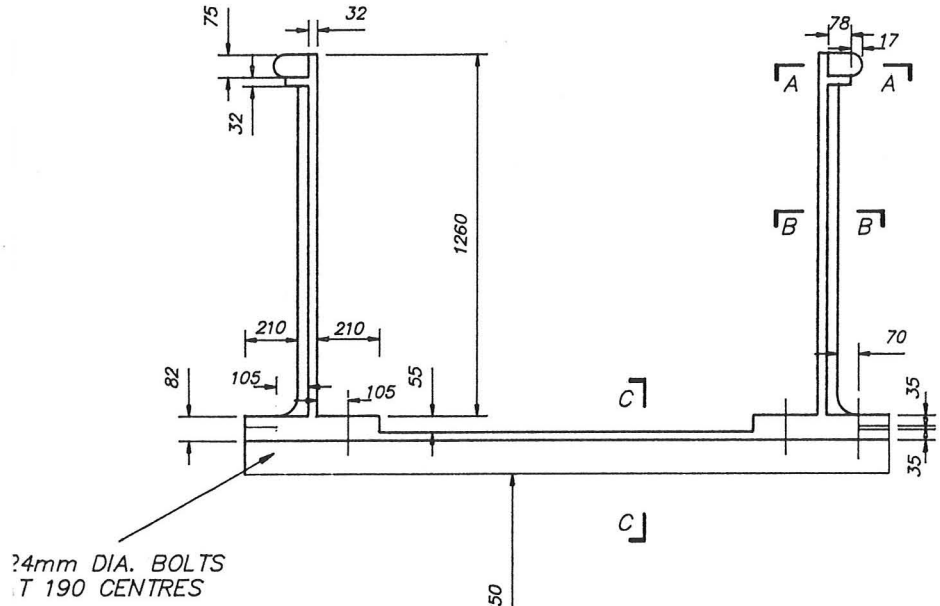
JOB No. ICC657	DRAWING No. 15	REV.
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

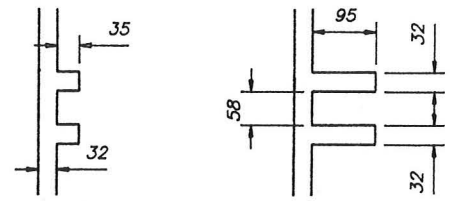
DRAWING TITLE *BRIDGE 15*



PLAN

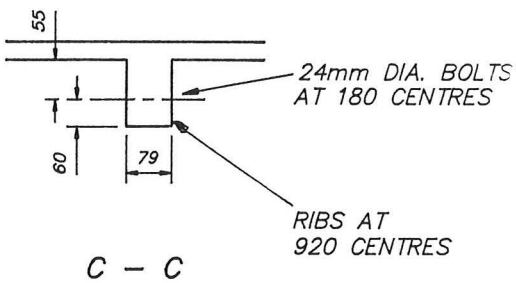


CROSS SECTION



B – B A – A

AT 840mm CENTRES



C – C

South Elevation.

Looking west along aquaduct trough showing disused footbridge supports.

BRIDGE NO. 16
BRICK ARCH OVER DRY CANAL

We have no records of any previous inspections having been carried out on this bridge.

16.1 DESCRIPTION

The bridge is a brick arch spanning 3.04m. The springing is 2.48m above the level of the base of the invert, with the arch having a radius of approximately 1.75m. The arch and arch face comprise blue brindle bricks, the remainder of the bridge construction being in stock bricks. The track surface is approximately 580mm above the crown of the arch, the parapet on either side being an average of 925mm high.

16.2 CONDITION SURVEY

The arch, arch ring on either side of the bridge and the vertical walls below the arch are all in good condition.

The north east wing wall has a slight bulge in it where it is being pushed by a tree growing in the embankment behind. At the original canal water level there is a leak through the wall in a localised area; here the brickwork has weathered to a depth of 20mm. There are two isolated patches of weathering in the north west wing wall, the brick having weathered to a depth of 10mm. There is water leakage through the arch ring in the vicinity of the south elevation key stone and a horizontal crack across the top of the key stone.

A hole was drilled at the crown on the centre line of the bridge. The arch ring was found to be 360mm thick similar to the thickness of the arch on the elevations.

The parapets have suffered a certain amount of damage. Near surface level a brick is missing in both south east and north west corners. There is a vertical crack at the centre of the north parapet with a

number of bricks missing on the external face around the date stone. One coping stone is missing at the north east corner whilst at the south east corner the top of the parapet has suffered impact damage and has recently been repaired. There is some localised weathering of the inner face of the south parapet just above surface level.

A 100mm diameter water main currently runs through the bridge with minimal cover. This main is exposed both sides of the bridge and is leaking on the west side.

16.3 ASSESSMENT CRITERIA

The bridge has been assessed in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures" and Part 4 BA16/93 Chapter 3 "The Assessment of Masonry Arch Bridges By The Modified MEXE Method".

The bricks in the arch barrel have been taken as engineering bricks.

16.4 SURVEY AND ASSESSMENT RESULTS

A provisional axle load was determined and modified by factors for span/rise, profile, materials, brickwork and general conditions to achieve a modified axle load. The bridge was found to be capable of carrying a 40 Tonne assessment live load.

The tree behind the north east wing wall should be removed, including any roots. Where water is leaking through the wall it is likely it originates from the 100 diameter water main running through the bridge. The main should be repaired and the road surface sealed to prevent ingress of water. This should also eliminate any water leakage through the arch ring in the vicinity of the south elevation key stone.

There are localised areas of weathering in the spandrel and wing walls. In addition there is a crack across the south elevation keystone, bricks missing around the north elevation date stone and a vertical crack in the

parapet behind. In all these areas the spalled or damaged brickwork should be cut out and replaced, repointing the brickwork where necessary.

The parapets have suffered a certain amount of impact damage and loss of coping stones; these areas should be repaired. The parapets do not meet the requirements of Technical Memorandum BE5 Group 2 Vehicle/Pedestrian Parapets and should therefore be strengthened by rebuilding with a reinforced concrete core.

16.5 COST ESTIMATES

a/ To repair all spalled face work and all damage to parapets. Replacing brickwork and repointing where necessary.

£1200

b/ To seal the surface of the bridge including a joint with the parapets.

£1250

c/ To remove trees and associated roots in vicinity of north east wing wall.

£500

d/ If necessary strengthen the parapets to comply with the requirements of BE5 for vehicular impact.

£4200

e/ To raise the parapets to comply with the requirements of BE5 for pedestrian traffic.

£1000

16.6 OPTIONS

The bridge is adequate to take 40 Tonne vehicles. Provided the bridge remains in private possession only being used for construction traffic it can be deemed to be adequate, although the owners attention is drawn to

the fact that the parapet does not comply with the Technical Memorandum BE5.

This bridge is a historic structure and it may be a requirement of English Heritage that the bridge is retained.

The cost of the remedial works required to maintain the integrity of the existing bridge plus strengthening the parapets for vehicular traffic is

£7150

If the bridge is only open to pedestrian traffic, to carry out remedial works to maintain the integrity of the existing bridge plus raising the parapets.

£3950

Date of This Examination: 14.5.93 Date of Last Examination: Not Known

Bridge Number: 16 Over: Canal
Type of Construction: Brick Arch Construction Date: 1878

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				Concrete.
9	Wing Walls	G	B	2	Slight weathering, water ingress through North East wing wall and slight bulge due to tree behind.
10	Embankments	G			Recently excavated canal bank.
23	Arch Springing	G	A	1	Blue Brindle bricks.
24	Arch Ring	G	A	1	Blue Brindle bricks.
25	Voussoirs/Arch Face	G	A	1	300mm Blue Brindle bricks.
26	Spandrel Walls	G	B	2	Stock bricks. Slight weathering.
29	Waterproofing	F	B	3	Water leaking through crown of arch at South side.
31	Masonry and/or Brickwork	F	B	2	Slight weathering.
32	Pointing	G	B	2	
33	Surfacing	P	D	4	Broken-up asphalt.
35	Parapets	F	C	2	Stock bricks. Vertical crack centre North parapet. Top of South East corner repaired after impact damage.

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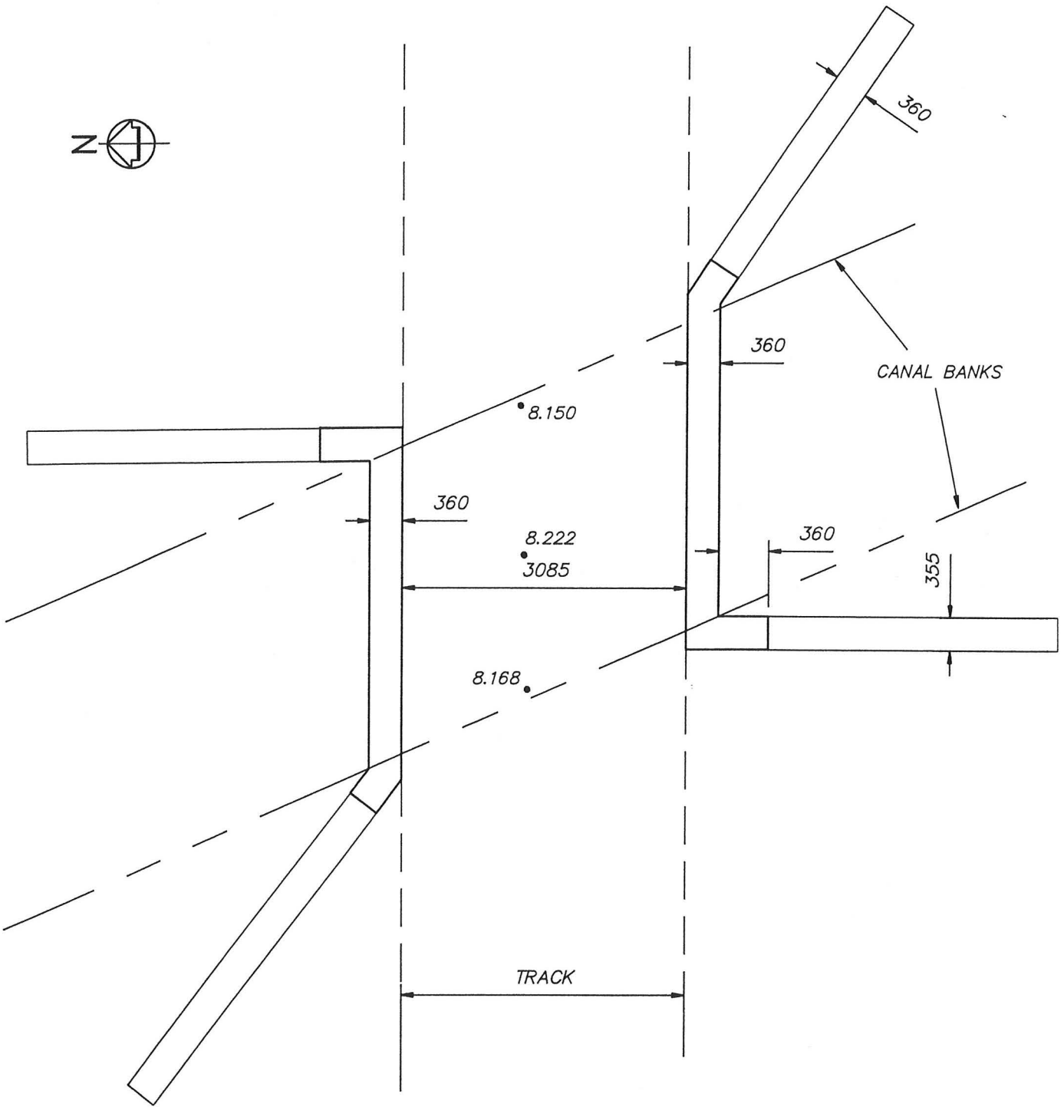
JOB No. ICC657	DRAWING No. 16/1	REV.
SCALE 1:50	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

PROJECT RARDE NORTHSITE BRIDGES

DRAWING TITLE BRIDGE 16



PLAN

ROUGHTON
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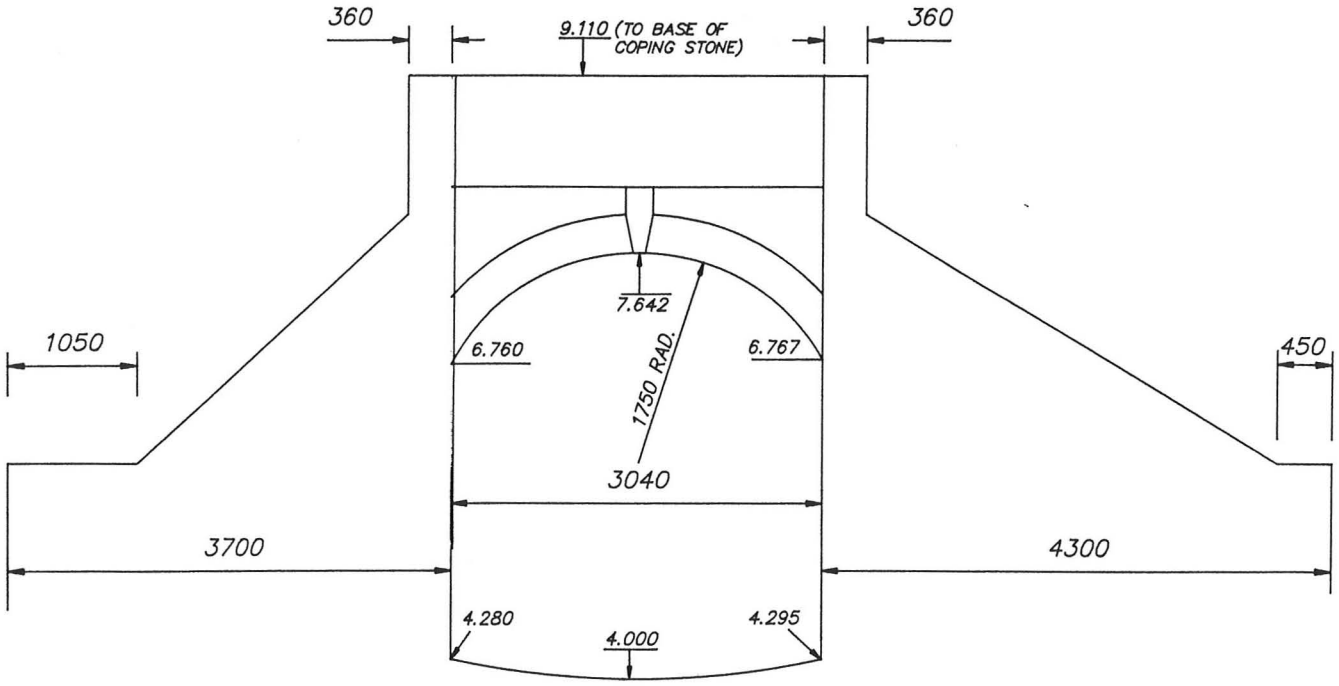
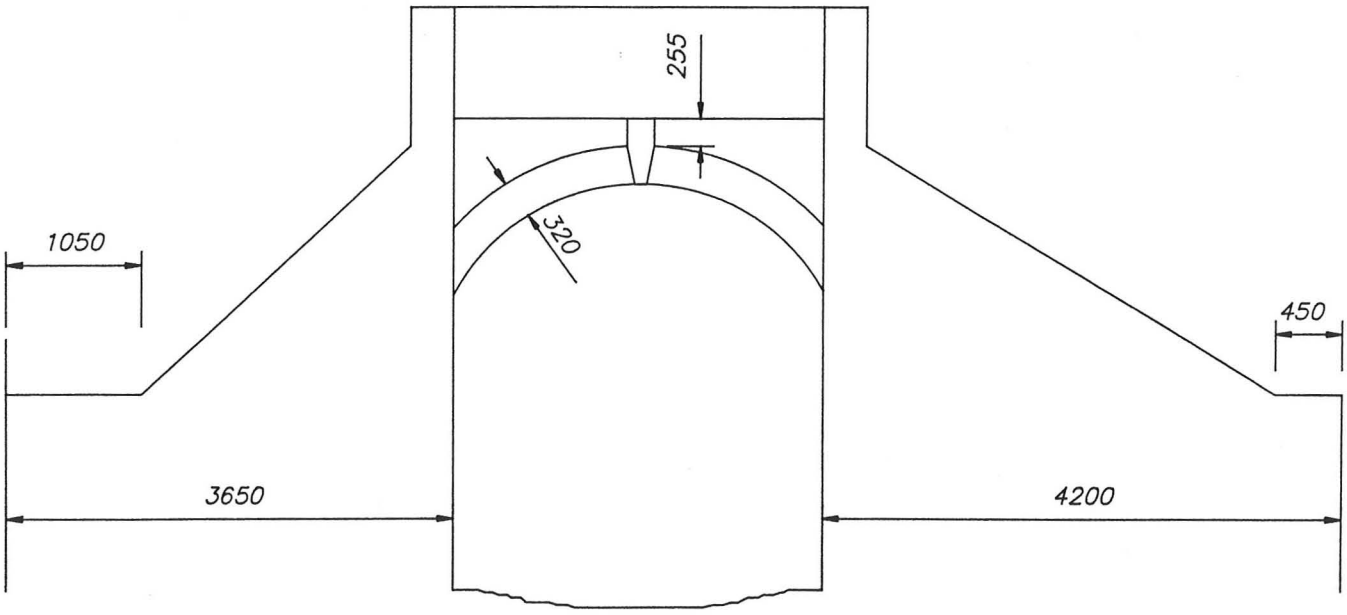
JOB No. ICC657	DRAWING No. 16/2	REV.
SCALE 1:50	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 16*



NORTH ELEVATION
WING WALLS SHOWN IN TRUE ELEVATION
SEE PLAN ON DRG.16/1 FOR ACTUAL POSITIONS



SOUTH ELEVATION
WING WALLS SHOWN IN TRUE ELEVATION
SEE PLAN ON DRG.16/1 FOR ACTUAL POSITIONS

Looking West.

BRIDGE NO. 16

South Elevation.

BRIDGE NO. 17

FOOTBRIDGE OVER LIBRARY BASIN

We have no records of any previous inspections having been carried out on this bridge.

17.1 DESCRIPTION

The bridge comprises 32mm deep longitudinal timber boards on 70mm wide by 30mm deep transverse timber bearers. These bearers sit on 50mm by 50mm steel angles at 610mm centres. The top flange of these angles sits on but does not appear to be fixed to 75mm by 75mm angles. These angles form the bottom boom of the truss along either side of the footbridge. At third points along the bridge there is a structural T fixed to the underside of the truss with a 1250mm outstand. 20mm diameter square bars run between the ends of these structural T's and the adjacent vertical truss members.

The bridge supports a 115mm diameter cast iron pipe and 3 No. electric cables all on the south side. On the north side there is a 150mm ductile iron steam main.

At the west end the bridge sits on a concrete abutment with precast concrete piles, the top of which are 780mm above water level. The east abutment comprises masonry with a brick plinth supporting the end of the bridge. There are steps up to both ends of the bridge comprising risers each 150mm high, 7 at the east and 6 at the west end. The timber handrails at either end from the bridge to the top of the steps are rotten.

17.2 CONDITION SURVEY

The timber deck is in reasonable condition although the timber bearers that support it were not visible. However the transverse angles and flats immediately below the deck are corroded on their upper face. The majority of the truss members on either side are in reasonable condition.

However the connection between the vertical flats and the bottom angle member is in places extremely poor; the table below shows the condition of the vertical members at this connection.

Bridge 17 - Condition of bottom of vertical flats (reference detail C on drawing no. 17)			
Flats numbered from west side			
North		South	
1	Failure	1	50% remaining
2	50% remaining	2	Fair
3	75% remaining	3	Failure
4	Fair	4	50% remaining
5	Fair	5	Failure
6	Fair	6	Fair
7	Fair	7	Failure
8	Fair	8	Failure
9	75% remaining	9	Failure
10	Failure	10	Fair

The truss on the south side is in the worst condition and has started to deflect; the deck now slopes across the bridge from north to south.

Reinforcement has become exposed in the west abutment, both in the vertical face of the abutment where a 130mm x 110mm corner of concrete has spalled and the underside of the 65mm thick concrete shelf below the end of the bridge.

The east abutment has started to tilt backwards most likely due to the horizontal thrust being created as the south truss has deflected vertically. One person can sway the bridge laterally indicating that the bridge does not have adequate transverse stiffness.

We believe this bridge is very close to failure, should be closed immediately and not be re-opened until the remedial works have been carried out.

17.3 ASSESSMENT CRITERIA

The calculations have been carried out in accordance with the Design Manual for Roads and Bridges Part 3 BD21/93 "The Assessment of Highway Bridges and Structures".

The material strengths have been taken as follows:

Timber softwood strength class SC3
Structural steel grade 43 (yield stress 250N/mm²)

In accordance with BD21/93 the imposed load has been taken as 5KN/m² plus the weight of cables and pipes which are to remain. The horizontal loading on the parapet has been taken as 1.4KN per metre run of handrail.

17.4 SURVEY AND ASSESSMENT RESULTS

The sides of the bridge have been analysed as a truss with the top member and the vertical flats in compression and the bottom member and one set of diagonal flats in tension. The other set of diagonal flats was considered to be redundant. The timbers fixed to the vertical flats were not considered to form any part of the structure. The majority of the members were found to be capable of taking the vertical imposed load although the vertical flats require strengthening.

The resistance to transverse loading is not adequate, the bridge swaying far too easily. This could be overcome by either welding the transverse members to the longitudinal bottom cord of the truss such that the steel supporting the deck acts as a vierendeel girder or adding diagonal members below the timber deck to form a truss in the horizontal plane.

The connection between the vertical flats and the bottom boom of the truss is in places severely corroded. At these locations the members cannot carry the required compressive force resulting in the remains of the steel flat bending, the truss deflecting and pushing the east abutment backwards. This joint should be repaired by welding a new 60mm x 60mm x 6mm angle to the truss bottom boom and outside face of the

vertical flat. If this angle is taken up as far as the connection of the flat with the top boom of the truss the strength of the entire bridge will be increased. Where timber posts are attached to the outside of the flats providing a fixing for the raking square bars these timbers should be cut 100mm below the bar fixing and bolted through to the flats. The new angles should then terminate immediately below the bottom of these shortened timbers.

The timber boards are in reasonable condition but would need to be cleaned down and thoroughly coated with preservative. The timber bearers supporting these boards have not been inspected but we would anticipate are probably rotting and hence need replacing.

The whole bridge including all the steel underneath the deck should be cleaned down, grit blasted if necessary and subsequently repainted.

Where reinforcement is exposed in the vertical face of the west abutment the concrete should be cut back to behind the bar and reinstated using a proprietary mortar mix. The 65mm thick concrete shelf immediately below the west end of the bridge is extremely slender with exposed reinforcement on the underside. This shelf can carry very little load and we recommend it is cut away to prevent collapse in the future.

The top 600mm of the east abutment, which is 350mm thick brickwork has tilted backwards. The back of this pier must be buttressed with brickwork or concrete to prevent further movement; this buttress to be constructed on a foundation a minimum of 1.2m below the top of the steps.

In order for the parapet to comply with Technical Memorandum BE5 the frame must be infilled. The deck of the existing bridge is only 850mm wide and is very narrow if heavily used. If the bridge is replaced, the new structure must be a minimum of 1800mm wide.

17.5 COST ESTIMATES

a/ To clean down and thoroughly coat timber deck and bearers with preservative, replacing any rotten timbers.

£450

b/ To install new diagonal steel bracing in the horizontal plane below the timber deck.

£1000

c/ To cut away vertical timber posts below square bar rakers and weld new angles to all vertical steel flats.

£2000

d/ To clean down the steelwork by grit blasting and apply two coats of paint.

£2650

e/ Access scaffold for b, c and d

£2000

f/ To replace timber handrails at either end of the bridge and infill trusses on either side.

£1500

g/ To cut away concrete shelf below west end of bridge and repair concrete where reinforcement exposed.

£650

h/ To buttress brick pier at east end of bridge.

£1000

17.6 OPTIONS

The bridge is adequate to carry the imposed vertical loading provided the vertical flats are strengthened. It is not sufficiently stiff to resist lateral forces. Additional diagonal bracing therefore needs to be

installed below the timber deck to provide the necessary rigidity. There are a substantial amount of remedial works which need to be carried out for the bridge to be able to carry the necessary loads. The cost of these including remedial works to the abutments would be.

£11250

Alternatively the entire bridge could be replaced. Only the west abutment would remain, the east being rebuilt in concrete from a level approximately 1m below the top of the adjacent embankment wall. The cost of a new bridge of sufficient width with parapets of adequate height to comply with current requirements would be approximately

£12500

Date of This Examination: 19.4.93 **Date of Last Examination:** -

Bridge Number: 17 **Over:** Library Basin
Type of Construction: Steel Truss **Construction Date:** Not Known

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	P	C	4	West: concrete with exposed reinforcement. East: rendered brickwork poor pointing below water level. Very overgrown. Top of abutment tilted backwards.
10	Embankments	F	D	2	East: brickwork overgrown. West: precast concrete piles.
13	Main Beams	VP	C	4	Steel truss each side. Top and bottom members fair. Detail C connection on Drg 17 condition varies from good to totally failed.
15	Bearings				Nil.
16	Transverse Beams	P	D	3	Tops of angles and flats corroded.
20	Bracing and/or Cross Ties				To be installed.
21	Deck Timbers	F	D	3	Need cleaning and preservative.
34	Paintwork	P	B	4	At joints with lower boom paintwork flaked away.
35	Parapets				Steel truss.

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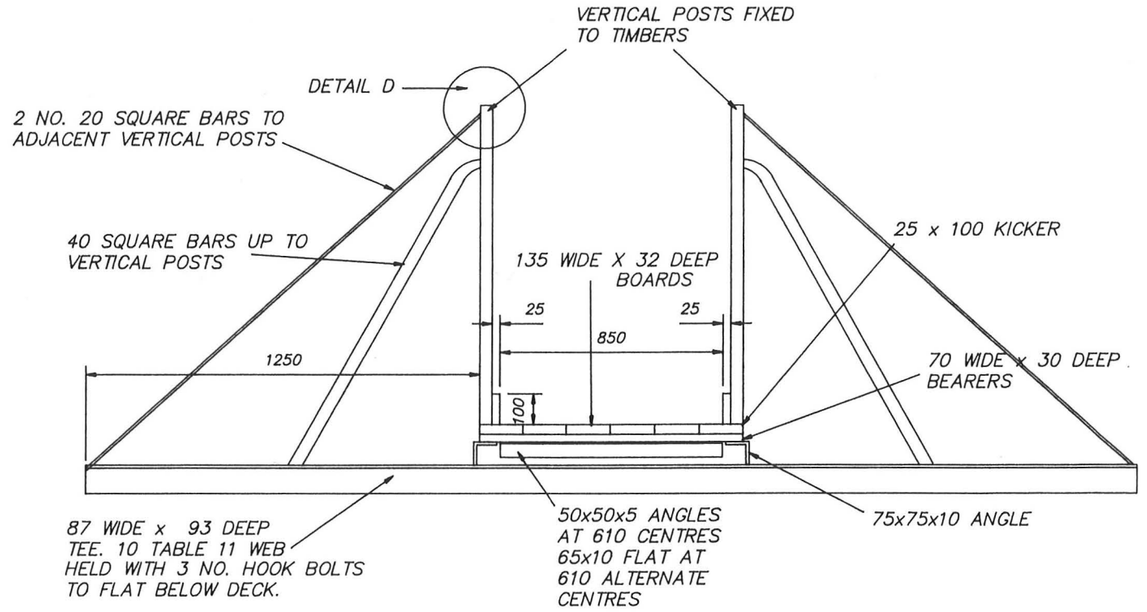
JOB No. ICC657	DRAWING No. 17	REV. A
SCALE	DRAWN ARP	
DESIGNED	APPROVED MGR	
DATE APRIL 93	PLOTTED	

PROJECT *RARDE NORTHSITE BRIDGES*

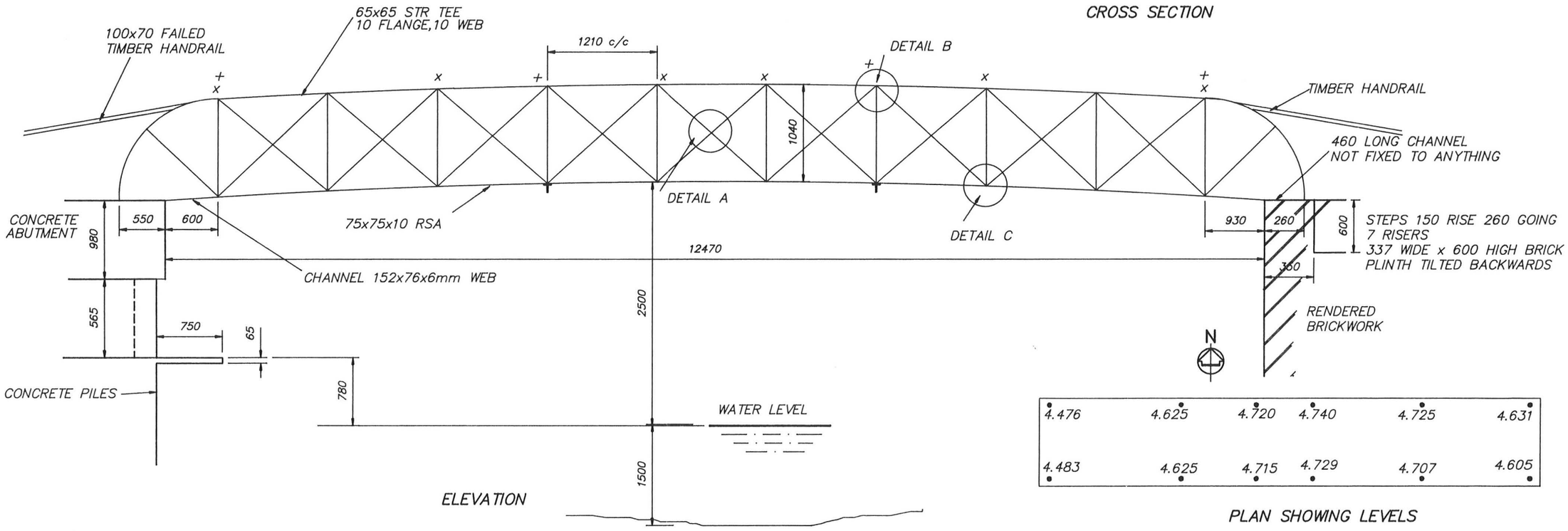
DRAWING TITLE *BRIDGE 17*



CROSS SECTION

\+ 40 SQUARE BAR

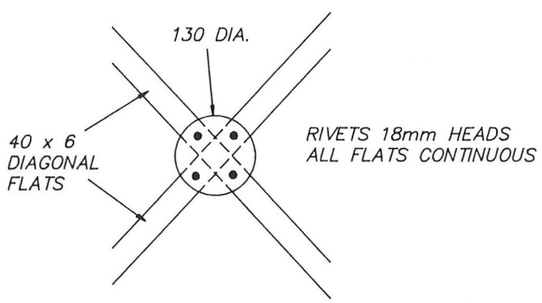
x TIMBER 100 WIDE x 75 DEEP FIXED TO OUTSIDE OF FLATS



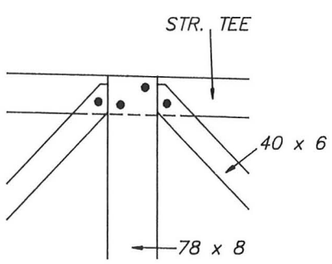
ELEVATION

4.476	4.625	4.720	4.740	4.725	4.631
4.483	4.625	4.715	4.729	4.707	4.605

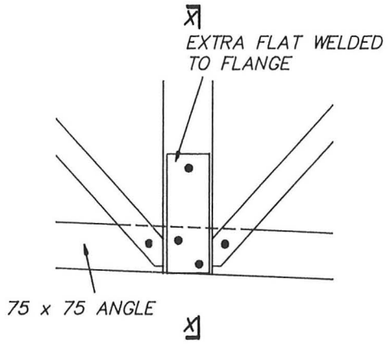
PLAN SHOWING LEVELS



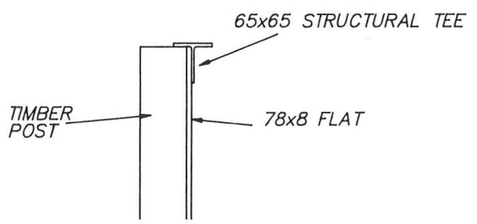
DETAIL A



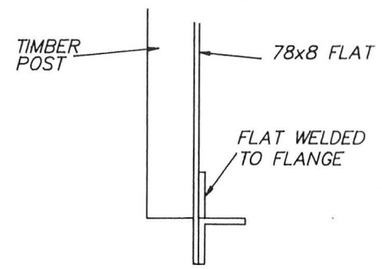
DETAIL B



DETAIL C



DETAIL D



SECTION X–X

South Elevation.

Looking West.

BRIDGE NO. 17

BRIDGE NO. 18
CULVERT UNDER ROAD

We have no records of any previous inspections having been carried out on this culvert.

18.1 DESCRIPTION AND CONDITION SURVEY

The culvert comprises a 450mm diameter spigot and socket vitrified clay pipe starting 1200mm from the west edge of the road. The head wall on the west side of the road has collapsed leaving a 1m vertical face adjacent to the road edge.

On the east side of the road the culvert is a 525mm diameter concrete pipe with a 45mm wall thickness, extending some 2.35m from the east edge of the road. 450mm from the end of the pipe there is a loose brick headwall, the bricks having been laid dry with no mortar in the joints. An inspection inside the pipe revealed that only the last 2 sections at the east end are concrete pipes and that there is a milk crate midway along the length of the culvert blocking it completely.

The road surface in the area near the culvert is potholed asphalt in poor condition.

18.2 ASSESSMENT CRITERIA

For loading purposes it has been assumed that the road over this culvert is a main road and that the pipe has a Class B bedding.

The concrete pipe has been assessed against manufacturers tables for limitations of depth of cover for concrete pipes to BS 5911.

The vitrified clay pipe has been assessed against the design tables for determining the bedding construction for vitrified clay pipes

18.3 SURVEY AND ASSESSMENT RESULTS

Both the vitrified clay and concrete pipes were found to be of satisfactory strength for laying under a main road with a cover of 1.2m.

The pipes have been laid at a level such that considerable ponding can occur upstream prior to any flow through the culvert. Two different sizes of pipe have been used and although we were unable to inspect the joint between the two we suspect there could be considerable leakage of water at this point washing away the material surrounding the pipe.

The headwalls at either end are very dilapidated. On the west side there is a vertical face very close to the edge of the road and if any more material is dislodged the road will become undermined and subsequently collapse.

It has been assumed that the existing pipes are capable of passing the design flow of water in this ditch; we have not been able to determine how much water will flow in this ditch.

The existing pipes should be removed and replaced with new concrete pipes of 450mm diameter. These pipes should be laid to a minimum gradient of 1:150 and be extended far enough each side of the road to enable a 1m wide verge and a slope no steeper than 1:2 to be constructed on either side of the road. 215mm thick brick headwalls should then be constructed at each end of the culvert to retain the bank around the end of the pipe.

18.4 OPTIONS

The existing culvert is adequate to carry vehicle loads. However the headwalls at either end are very dilapidated and there is danger of the road collapsing particularly on the west side. We therefore recommend that the culvert is removed and replaced by a new pipe. To excavate, lay a new culvert 9.5m long with headwalls at either end, backfill and reinstate road would cost

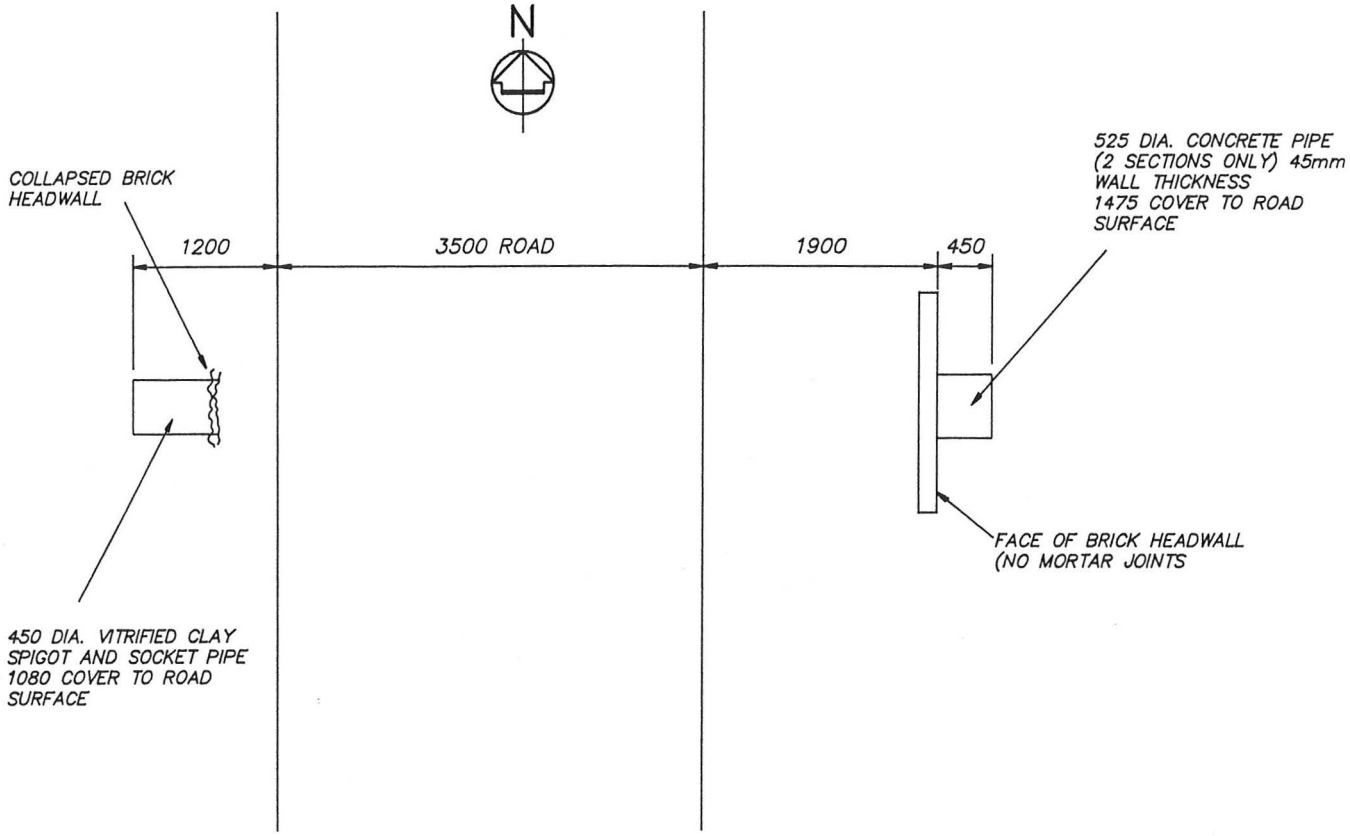
£1650

ROUGHTON
59 West Stockwell Street, Colchester CO1 1HE.
Telephone : (0206) 48149 Telefax : (0206) 44257

JOB No. ICC657	DRAWING No. 18	REV.
SCALE NTS	DRAWN ARP	
DESIGNED	APPROVED	
DATE APRIL 93	PLOTTED	

PROJECT RARDE NORTHSITE BRIDGES

DRAWING TITLE BRIDGE 18



West Elevation.

East Elevation.

BRIDGE NO. 18

(CULVERT)

BRIDGE NO. 19

We have no records of any previous inspections having been carried out on this bridge.

19.1 DESCRIPTION AND CONDITION SURVEY

This bridge is a hybrid, part masonry, part reinforced concrete. It has an overall width of 3.15m, 1.15m of this being a brick arch and 2m being a 290mm thick reinforced concrete slab. The west abutment is entirely brickwork whilst the east abutment is brickwork underneath the masonry arch and concrete under the concrete deck. It would appear that the entire bridge used to be a masonry arch which was severely damaged, the west half of the arch being destroyed and subsequently re-built in concrete. The section of masonry arch that remains together with the abutment and embankment walls between the bridge and the river are all in very poor condition.

19.2 RECOMMENDATIONS

This bridge is in such poor condition that it should not carry anything greater than pedestrian loads and even then the parapet is not acceptable. It will therefore be necessary is to demolish the concrete deck and what is left of the masonry arch leaving only the abutment walls. If English Heritage are interested in the structure the abutment walls would need to be repaired and a new masonry arch constructed. However the most cost effective solution would be to place a culvert in the bed of the water course between the remaining abutment walls and the whole section backfilled up to the existing track level.

Further along this ditch there is a 450mm diameter pipe under a road. Unless flooding is known to have occurred in this area due to inadequate pipe size we suggest this culvert also comprises a 450mm diameter pipe.

The cost of demolishing the bridge deck and laying a 450mm diameter culvert 9m long in the bed of the existing water course, constructing a small head wall at either end and backfilling with granular material would be

£5800

South Elevation.

Looking North, showing part of masonry arch and river beyond.

BRIDGE NO. 20

DAMAGED AQUADUCT OVER RIVER LEA

We have no records of any previous inspections having been carried out on this aquaduct.

20.1 DESCRIPTION

This aquaduct used to form part of the canal. However it has suffered severe damage, the majority of the base is missing and both sides have been severely damaged.

The deck and sides of the aquaduct were cast iron sections bolted together spanning approximately 9m. The deck had a slight curve, the bolted flange between sections being below the deck in the middle of the aquaduct and above the deck at the sides. The side sections were supported on steel beams 500mm deep by 185mm wide on each side of the cast iron trough section.

The cast iron sections were built into brick abutments at either end.

The training walls at either end are 590mm thick brickwork increasing to 825mm thick adjacent to the end of the cast iron trough section. Within this thickened brickwork would have been the waterproof joint between the cast iron and the brickwork, although this was not visible.

20.2 CONDITION SURVEY

The majority of the base of the aquaduct is missing with only a short length remaining at the east end. Three side panels on the north side of the trough appear to be intact, the two at the west end being severely damaged. On the south side all the cast iron sections are damaged beyond repair.

The steel beams along each side of the aquaduct are severely corroded, the bottom flange having expanded up to 80mm in places. Adjacent to the

west abutment the entire web of the southern beam is missing, the beam having been bent outwards by approximately 200mm at this position. We would anticipate that an explosion occurred within the aquaduct very close to this point.

The east abutment has a horizontal crack below the cast iron trough with some bricks missing on the southern corner. There is considerable tree root damage to the top four courses of the abutment and top eight courses of both training walls on the eastern side.

The western abutment has numerous bricks missing at the northern corner, whilst on the southern corner there has been severe damage with virtually total collapse of the brickwork.

Both abutments are protected by timber at and below the water level, this timber having decayed severely adjacent to the west abutment. The top eight courses of the training walls on the west side have been damaged by tree roots.

There is a large amount of vegetation including trees which has to be removed from the vicinity of the bridge.

The displaced base sections of the aquaduct are in the bottom of the river.

20.3 RECOMMENDATIONS

Very little of the remains of the aquaduct can be salvaged, only three sections of the northern side can feasibly be re-used.

All of the cast iron sections, the steel beams either side and the base sections in the river bed should be removed. The aquaduct can then be replaced by either:

1/ A new steel aquaduct of similar profile to the original structure.

or

2/ A new steel aquaduct designed using current practice.

or

3/ The river can be culverted and a canal formed over the top of the culverts.

Depending upon which solution is adopted a number of other remedial works will also need to be carried out. Both abutments need to be repaired, particularly at the corners where brickwork has fallen away, with the southern corner of the western abutment requiring complete rebuilding.

The training walls on both sides of the aquaduct require remedial work. On the east side where there has been tree root damage, the top eight courses of the training walls and four courses of the thickened pier adjacent to the cast iron section need to be removed and subsequently rebuilt. On the western side the situation is similar with eight courses of brickwork needing to be dismantled and rebuilt.

20.4 DESIGN CRITERIA

Costings for a new steel aquaduct have been derived based on a preliminary design assuming a 3.8m wide 1.3m deep aquaduct full of water.

20.5 COST ESTIMATES

a/ To repair the training walls including a minimum of the top 8 courses of each wall.

£3500

b/ To repair abutments.

£2000

c/ To remove trees and other vegetation in the vicinity of the bridge.

£800

d/ New steel aquaduct of similar profile to the original.

£48000

e/ New steel aquaduct designed using current practice.

£35000

f/ 5 side by side pipe sections encased in concrete with canal over formed with concrete embankments similar to sections shown on drawing 13/1.

£33800

20.6 **OPTIONS**

To remove existing damaged aquaduct, repair training walls and abutments and replace with a new steel aquaduct of similar profile to the original.

£54300

To remove the existing damaged aquaduct, repair all training walls and abutments and replace with a new steel aquaduct designed using current practice.

£41300

To remove existing damaged aquaduct, repair all training walls and culvert the river reinstating the canal over with lean concrete embankments similar to bridge 13.

£38100

Date of This Examination: 24.5.93 **Date of Last Examination:** -

Bridge Number: 20 **Over:** River Lea
Type of Construction: Cast Iron Aquaduct **Construction Date:** Not Known

Item No.	Item Description	Condition G - Good F - Fair P - Poor	Defects		Remarks
			Extent	Severity	
1	Foundations				Not visible.
2	Invert				River bed.
8	Abutments	West VP East P	D C	4 3	West: bricks missing North corner, South corner severely damaged. East: South corner bricks missing tree root ingress to top of wall.
10	Embankments	VP	D	4	Overgrown river bank.
11	Training Walls	VP	D	4	Top damaged by tree roots.
13	Main Beams		D	4	Replacement required.
15	Bearings				Nil.
28	Deck Plates		D	4	Cast iron trough non-existent.

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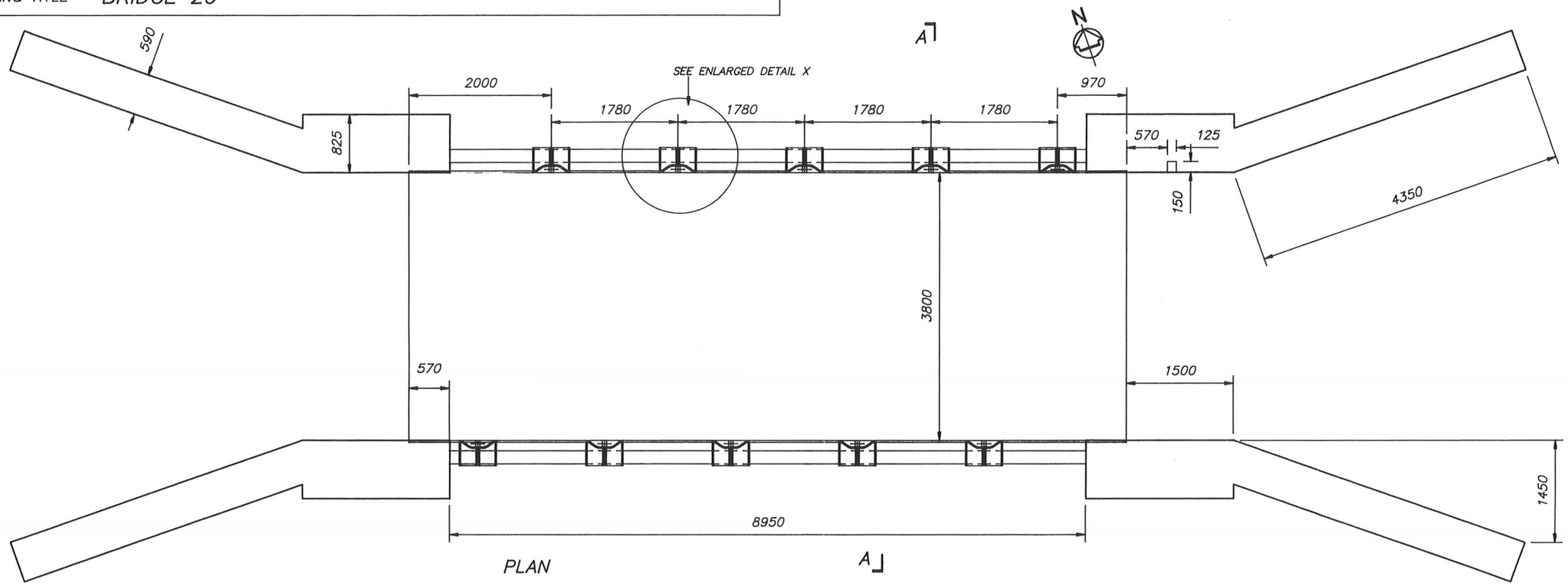
JOB No. ICC657	DRAWING No. 20	REV.
SCALE	DRAWN ARP	
DESIGNED	APPROVED	
DATE MAY 93	PLOTTED	

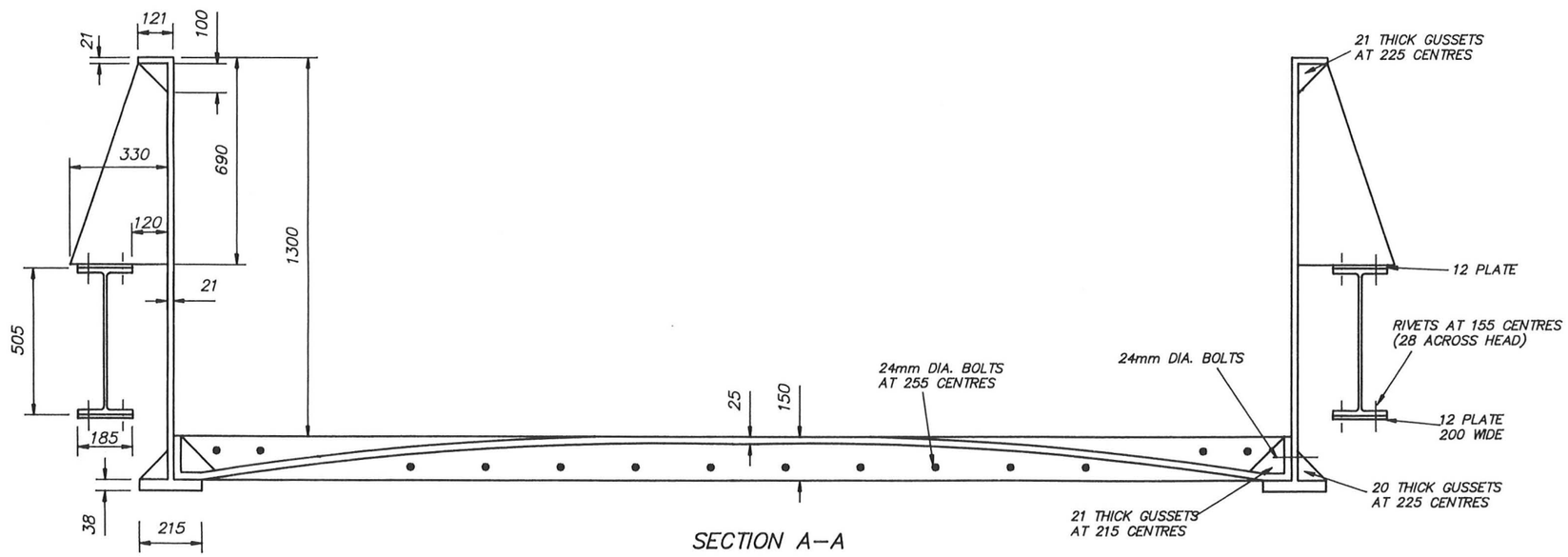
PROJECT *RARDE NORTHSITE BRIDGES*

DRAWING TITLE *BRIDGE 20*

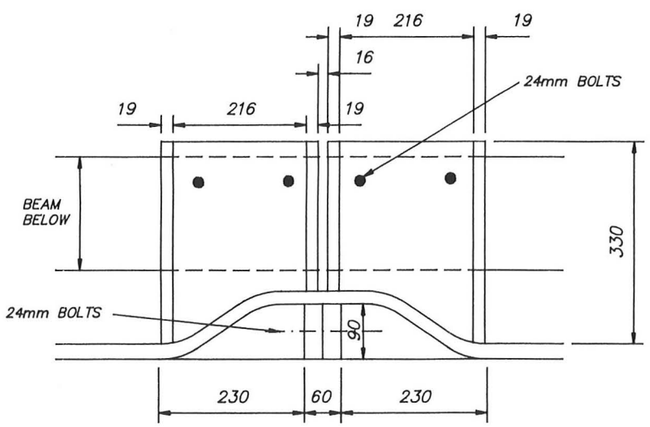


PLAN

A



SECTION A–A



ENLARGED DETAIL X

Looking east showing base missing
from cast iron trough.

South internal side showing damage to cast
iron sections and hole in web of plate girder.

SUMMARY

SUMMARY

Twenty bridges on the North site have been surveyed and assessed; the majority of them require varying degrees of remedial works in order to have a reasonable life expectancy. There are five exceptions - Footbridges 5 and 9, Culvert 18, Bridge 19 and Aquaduct 20 - all of which need to be demolished and totally new structures constructed.

The ability of the remainder of the bridges to carry the required imposed load varies according to the type of bridge:-

Bailey Bridges (2, 4 and 11): only able to sustain current weight restriction which is considered insufficient for construction traffic.

Footbridges (3, 7 and 17): able to sustain required imposed loads.

Brick Arches (10 & 16): able to carry 40 Tonne assessment live loads.

Cast Iron Arch Rib (1): existing weight restriction needs to be downgraded.

Aquaducts (13, 14 and 15): able to carry required loads.

Concrete Bridges (6, 8 and 12): able to sustain either a 40 Tonne assessment live load or the original weight restriction.

Where the cost of the remedial works or upgrading the weight restriction on the bridge is high, estimates have been given for either a replacement Bailey Bridge or reinforced concrete box culverts. The latter have been priced assuming they carry a single carriageway and footpath. If a wider road is required the cost of the culvert will be greater.

Very few of the bridge parapets comply with the Department of Transport Technical Memorandum BE5. If the bridges are to be adopted or used for public vehicles the majority of these parapets will have to be strengthened or possible vehicular impact prevented.

The absolute minimum width for a single carriageway bridge is 2.5m for heavy goods vehicles, although ideally the carriageway should be 3.65m. When the bridge is only to be used by construction traffic, reduced carriageway widths should be adequate.

Where it is proposed the bridges are replaced with either a steel panel bridge or reinforced concrete box culverts, the cost of these alternative structures has been estimated. Depending upon the location, span, condition of existing abutments and the likely water flow in the river or canal alternatives such as precast or prestressed inverted T beams may be marginally cheaper. Although these other options should be investigated at a preliminary design stage for replacement structures, the order of cost will be similar to the estimates for culverts given in this report.

In determining whether any particular bridge requires upgrading the following load imposed by construction traffic can be used as a guide. The Road Vehicles (Construction and Use) Regulations 1986 permit maximum gross and axle weights for various types of vehicle. The Freight Transport Association publication "Designing for Deliveries" gives typical vehicle weights as follows:-

Fire Engine	13.5 Tonnes
Refuse Vehicle (2 axle)	16.3 Tonnes
2 Axle Tipper Truck	16.3 Tonnes
Skip Lorry	16.3 Tonnes
3 Axle Tipper Truck	24.4 Tonnes
4 Axle Tipper Truck	30.5 Tonnes

The following table summarises for each bridge the assessment weight restriction, the cost of remedial works required to maintain this weight restriction and the cost of upgrading to the original weight restriction. In addition the cost of replacing the bridge is given together with the type of structure considered. It must be noted that these costs are approximate and will be subject to variation when prices are obtained from contractors. It has been assumed that all bridge works will be carried out under the same contract to keep preliminaries, overheads and establishment costs to a minimum. The costs are to be used only as a guide to enable economic choices to be made.

COST SUMMARY

Bridge No.	Assessment weight restriction (Tonnes)	Cost of remedial works to maintain assessment weight restriction £	Cost of upgrading to original weight restriction £	Replacement Option	
				Cost £	Type
1	1.9 Axle	7050	N/A	32200 17500	Culvert New Road
2	5.0 Axle	11200	15650	18000	Steel Panel
3	Footbridge	4450	N/A	6400	Steel Beams
4	5.0 Axle	12100	16350	17400	Steel Panel
5	Footbridge	N\A	N\A	6950	Steel Beams
6	40 Tonnes	13950	N\A	30700	Culvert
7	Footbridge	3400	N/A	5950	Steel Beams
8	16 Axle	9000	N/A	23600	Culvert
9	Footbridge	N/A	N\A	7300	Steel Beams
10	40 Tonnes	13850	N\A	N\A	
11	5.0 Axle	8200	14100	18900	Steel Panel
12	40 Tonnes	5050	N\A	20250	Culvert
13	N/A	850	N\A	N\A	
14	Aquaduct	4350	N\A	N\A	
15	Aquaduct	7550	N\A	7100	Footbridge only
16	40 Tonnes	7150	N\A	N\A	
17	Footbridge	11250	N\A	12500	Steel Truss
18	40 Tonnes	1650	N\A	1650	Pipe
19	Nil	N\A	N/A	5800	Pipe
20	Aquaduct	N\A	N\A	41300	Steel Trough

RECOMMENDATIONS

RECOMMENDATIONS

Various options for maintaining or replacing each particular bridge have been included in this report. A cost summary of these options has been given on Page No. 153.

A table showing proposed loads that the bridges will be required to carry has been prepared by PSA Projects and is included in Appendix A. The recommendations given in this section have been compiled to comply with the proposals given in that table. Where applicable significant upgrading of a bridge has been recommended where there would only be a marginal increase in cost. This would allow greater flexibility for traffic movements around the site, however the final decision will have to be taken by the client.

Bridge No. 1

To construct a new service road to the island site from Hoppit Road to the North. For a 3.5m wide road this option would cost.

£17500

Bridge No. 2

To replace the bridge with a new steel panelled bridge without footway to carry 40 tonne vehicles plus necessary abutments works.

£18000

Bridge No. 3

To carry out remedial works to bridge including replacement of parapets.

£4450

Bridge No. 4

To replace the bridge with a new steel panelled bridge without footway to carry 40 tonne vehicles plus necessary abutment works.

£17400

Bridge No. 5

To replace the bridge with a new steel beam and timber deck footbridge and necessary abutment works.

£6950

Bridge No. 6

To carry out remedial works to existing structure and lay safety kerbs along either side of the bridge.

£13950

Bridge No. 7

To carry out remedial works including replacement of the parapets.

£3400

Bridge No. 8

In order to carry 40 tonne vehicles remove the existing bridge and replace with box section culverts.

£23600

Bridge No. 9

To replace the entire bridge deck with a steel beam and timber deck footbridge and carry out remedial works to the abutments.

£7300

Bridge No. 10

To carry out remedial works and strengthen the parapets.

£13850

Bridge No. 11

To replace the bridge with a new steel panel bridge capable of carrying 40 tonne vehicles plus any necessary works to the East abutment.

£18900

Bridge No. 12

To carry out remedial works and replacement of the parapets.

£5050

Bridge No. 13

To carry out remedial works to the structure.

£850

Bridge No. 14

To carry out remedial works to the existing aquaduct. Excluding the cost of painting.

£4350

Bridge No. 15

To carry out remedial works to the existing aquaduct and construct a new adjacent footbridge. Excluding painting of the aquaduct.

£14650

Bridge No. 16

To close the bridge to all except pedestrian traffic, carry out remedial works to the bridge and raise the parapets.

£3950

Bridge No. 17

To replace the entire bridge with a new footbridge and carry out remedial works to the West abutment.

£12500

Bridge No. 18

To relay the existing culvert with new headwalls at either end.

£1650

Bridge No. 19

To demolish the existing bridge, lay a culvert in the bed of the existing water course and backfill.

£5800

Bridge No. 20

To remove the existing damaged aquaduct, repair all training walls and abutments and replace with new steel aquaduct designed using current practice.

£41300

Total £235400

The total estimated cost of recommended works to the bridges around the site is £235,400 provided all the work is carried out under the same contract.

Report Prepared by

M. G. Reed.

M.G. Reed BSc CEng MICE
Roughton

30th June 1993

APPENDIX A

PROPOSED BRIDGE CONSTRUCTION LOADS
WALTHAM ABBEY NORTH SITE

Bridge No	Comment	Max. Loading required (tonnes)
1	Private cars and vans only.	1.9
2	This bridge is not essential to construction traffic. An alternative route via Highbridge Street is available.	5.0 Axle
3	Footbridge. The need to retain a bridge at this point is to be reviewed.	Pedestrian
4	This bridge is closed at the moment. If the canal remains open the bridge may not be retained.	5.0 Axle
5	Footbridge.	Pedestrian
6	This bridge is essential for construction traffic use. Permitting access to western part of the site from Area M.	40
7	Footbridge - but would be useful if dumpers and small kubota type excavators could traffick it during construction. Maximum loading 4 tonne all up weight dumper on 2 axles.	4
8	This bridge is essential for construction traffic use.	Minimum 17 Axle (40 preferred)
9	Footbridge. Essential for easy pedestrian access to building 102. An option is to traffick bridge 10 and use track on Eastern side of River Lea.	Pedestrian

PROPOSED BRIDGE CONSTRUCTION LOADS
WALTHAM ABBEY NORTH SITE

Bridge No	Comment	Max. Loading required (tonnes)
10	This bridge is essential for construction traffic use. An option is to cross the Burning Ground Westwards, North along Long Walk then either use track Eastwards or follow road around Northern limit of site.	40
11	Cattlegate Bridge - this bridge is an essential link between N Area and the remainder of the site. Crooked Mile is also an alternative access point for disposal of arisings. A replacement may be required.	Minimum 5 Axle (40 preferred)
12	This bridge may be replaced by a culvert as part of the project to replace the sluice. It is essential for construction traffic use.	40
13	This culvert structure is useful as a route for light construction traffic (Dumpers and Excavators) across the River Lea. An assessment of permissible loading is required.	
14	Aquaduct.	Water only
15	Aquaduct.	Water only
16	This bridge will only be trafficked by Dumpers and small Excavators.	40

PROPOSED BRIDGE CONSTRUCTION LOADS
WALTHAM ABBEY NORTH SITE

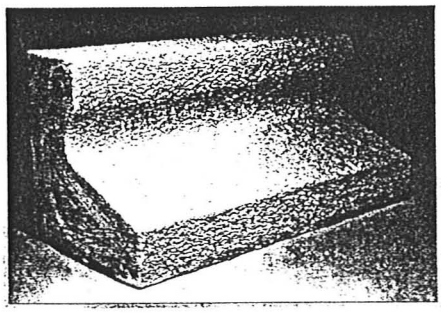
Bridge No	Comment	Max. Loading required (tonnes)
17	Footbridge - this bridge supports essential services to the Island Site and provides a route to H Area. Essential.	Pedestrian
18	This structure is essential for construction traffic along Long Walk and the Western sector of the site.	40
19	English Heritage may have an interest in this structure. It could be used by light construction traffic (Dumpers and Excavators). An assessment of Permissible Loading required.	
20	Aquaduct.	Water only

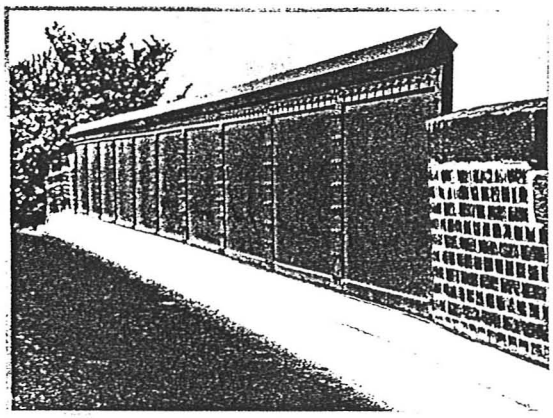
TRIEF KERB RANGE

The Redland Trief Kerb has made a significant contribution to improving road safety, traffic management, roadside protection and vehicle direction. Trief's distinctive and proven design has led to its use in a large variety of traffic control applications.

As a safety kerb, Trief is designed to re-direct vehicles along their intended course without excessive jolting or loss of control. Not only has it proven its worth on the public highway but also in many off highway applications where clearly defined safe traffic separation and direction are required. Typical applications include protection around petrol filling pumps, weighbridges and areas where vehicle over-run can be a problem, directional control at motorway service areas, dockyards, warehouses, distribution centres, shopping complexes and supermarkets.

The Redland Trief Kerb is available in two finishes. A natural finish and an exposed granite aggregate finish. The exposed aggregate kerb is the safety solution which blends sympathetically with natural stone.





ADVANTAGES

Risk Reduction

The design of the Redland Trief Kerb helps reduce risk of injury to drivers and passengers by re-directing the vehicle onto its intended course. This is done with a reduced risk of sudden jolting or stopping. As the re-directed vehicle keeps moving there is less likelihood of collision by following vehicles.

Barrier Durability

Maintenance and replacement costs are kept low because the Redland Trief Kerb is designed to withstand damage by vehicles more effectively than standard impact barriers.

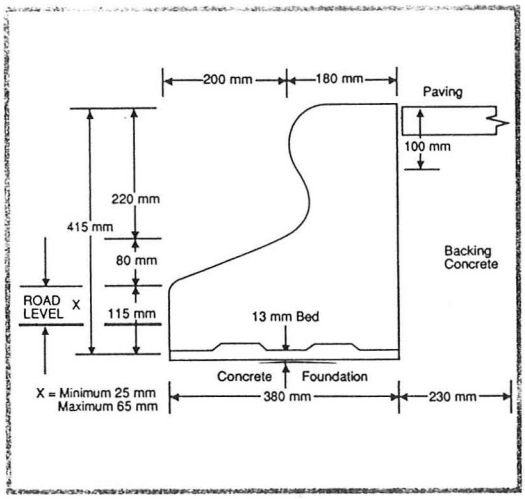
Vehicle Damage

The profile of the Redland Trief Kerb is designed to deflect vehicles back onto their intended course while at the same time reducing the risk of excessive tyre and wheel damage.

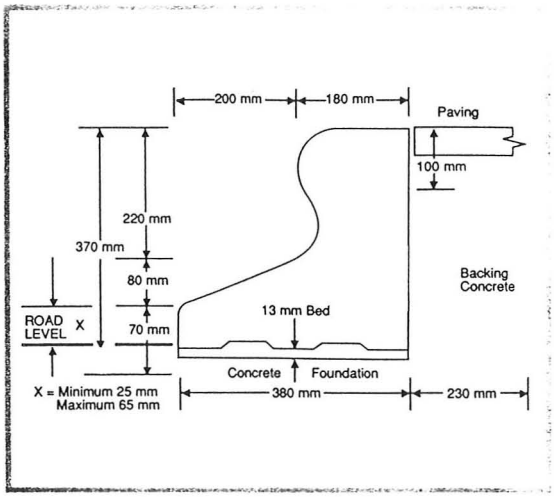
SPECIFICATION

Redland Trief Kerb is manufactured from Portland cement and carefully selected and blended Mountsorrel coarse and fine granite aggregate. This results in a very durable, high strength concrete.

Minimum compressive strength - 55 N/mm² at 28 days.
Surface finish - British Standard 8100. Type C.
Patent No.806620.



GST 2A Profile
For standard applications and carriageway design.



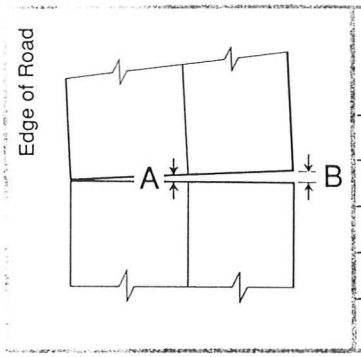
GST 2 Profile
For application where the kerb race depth is restricted. For example, underpasses and over bridges.

RADIUS

To assist the engineer and project planner, the details below illustrate how various radii can be achieved.

INTERNAL RADIUS

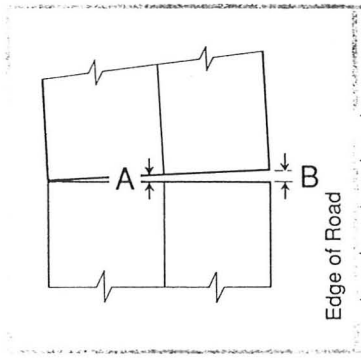
The table opposite shows the radii achievable using both standard and short lengths. The radii are achieved by varying the joint width.



JOINT WIDTH		UNIT LENGTHS			
		914 mm	669 mm	543 mm	455 mm
At A	At B	INTERNAL RADIUS ACHIEVED			
16 mm	25 mm	14 m	10 m	8 m	7 m
11 mm	20 mm	18 m	13 m	10 m	9 m
10 mm	16 mm	21 m	15 m	12 m	11 m
6 mm	13 mm	23 m	17 m	14 m	12 m

EXTERNAL RADIUS

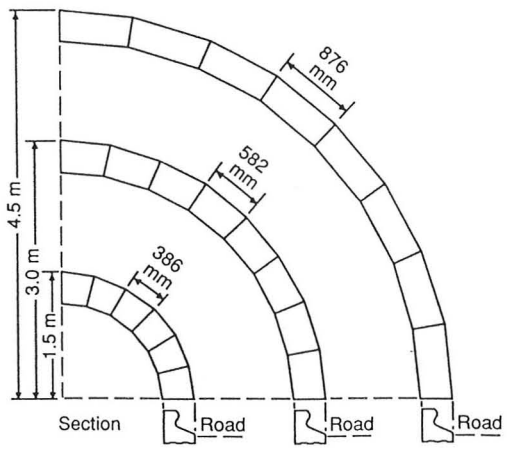
The table opposite shows the radii achievable using both standard and short lengths. The radii are achieved by varying the joint widths. For external radii less than shown in the opposite table a range of special short lengths with splay ends is available.



JOINT WIDTH		UNIT LENGTHS			
		914 mm	669 mm	543 mm	455 mm
At A	At B	EXTERNAL RADIUS ACHIEVED			
16 mm	25 mm	14 m	10 m	8 m	7 m
11 mm	20 mm	18 m	13 m	10 m	9 m
10 mm	16 mm	21 m	15 m	12 m	11 m
6 mm	13 mm	23 m	17 m	14 m	12 m

To effect the required radius an amount of joint opening is allowable.

The radii that can be achieved are detailed on the diagram opposite.



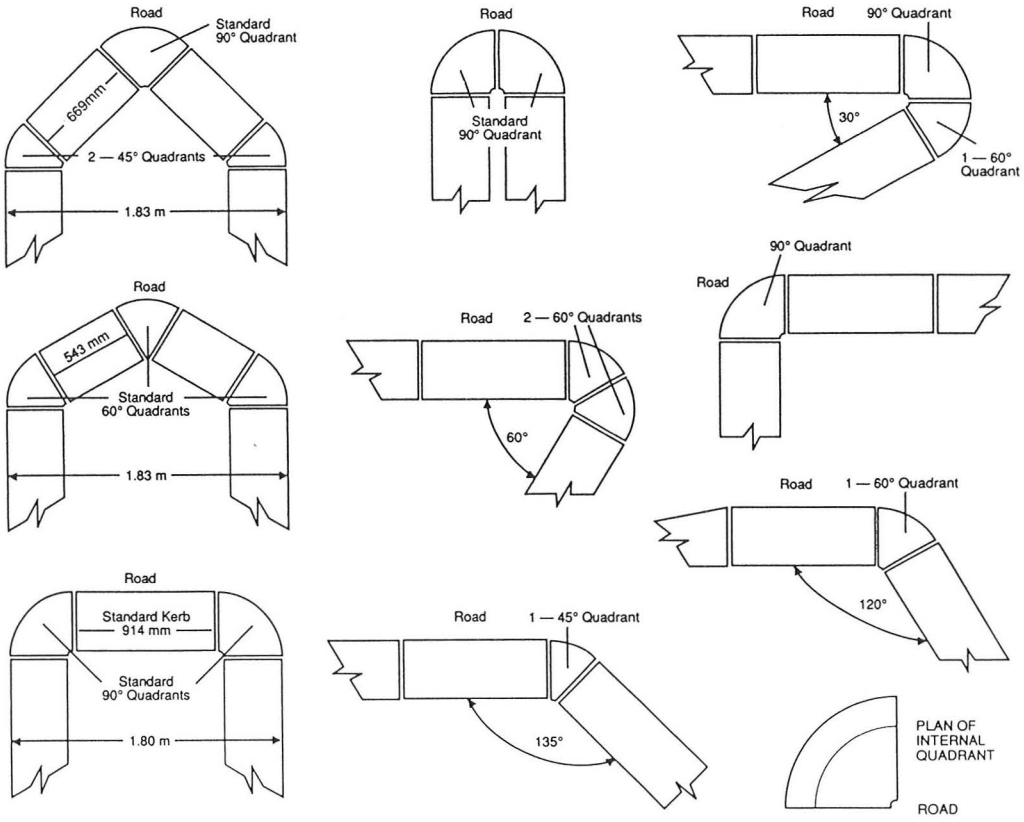
QUADRANTS

By using a range of quadrants and the various lengths of Redland Trief Kerb, many different traffic and petrol pump islands, road junctions and highway separation points can be designed.

The range of external quadrants is 45°, 60° and 90°. All quadrant radii are 430mm.

A 90° internal quadrant is available.

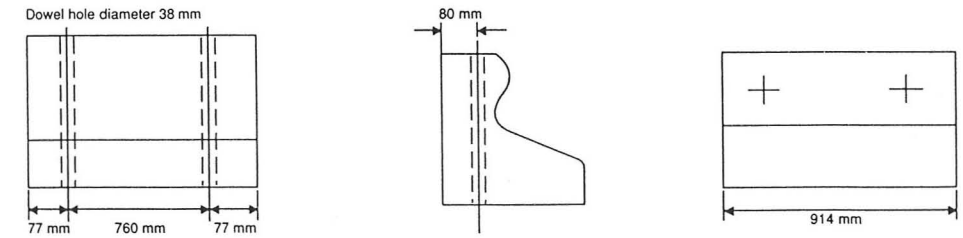
A range of designs using Trief quadrants is illustrated opposite.



All diagrams are shown with 3mm joints. Quadrant radius is 430mm.

DOWEL HOLES

Where insufficient haunching is available Redland Trief Kerb can be supplied with vertical dowel holes moulded into the unit. Dowel bars can then be put through the unit and anchored securely.



TAPERS

To allow Redland Trief Kerb to return to the normal lower profile of the roadside kerb a taper unit has been developed. The tapering Trief profile to normal roadside kerb is completed in two units. The Trief Kerbs match to half batter and splayed roadside kerbs.