

URS

**EAST AYRSHIRE COUNCIL
DEVELOPMENT AND PROPERTY SERVICES
ROADS DIVISION**



**ASSESSMENT REPORT
DISUSED RAIL BRIDGE NOS 1 & 97**



**Structure Ref B751/20
OS Ref. NS 400 396**

**VOLUME 1
December 2009**

FINAL REPORT

Project Title: Disused Rail Bridge Nos 1 & 97
Report Title: Assessment Report
Project No: 49331615
Report Ref:
Status: Final
Client Contact Name: [REDACTED]
Client Company Name: East Ayrshire Council

Document Production / Approval Record

Issue No: 1	Name	Signature	Date	Position
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Document Revision Record

Issue No	Date	Details of Revisions
1	Jan 09	Original issue Draft
2	Dec 09	Final Assessment Report

Volume 1

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B751/20 Disused Rail Bridge Nos 1 & 97

1.0 Summary

Disused rail bridges 1 and 97 form the two spans of a twin span masonry arch structure. Bridge 97 is the north span and Bridge 1 is the south span. The bridge carries the B751, a single carriageway road, over the National Cycle Network Route 73 cycle path. The primary deck element takes the form of an elliptical profile arch barrel constructed from sandstone masonry. The span of both structures is 8600mm with a rise above springing of 1835mm (south span) and 1805mm (north span) respectively at the crown.

The structure was found to be in good condition overall. Although extensively patched, particularly on the parapets and locally on the spandrels the structural elements of the bridge were sound. The barrels of both bridge spans were generally dry and showed no significant deviation in profile. However, local deviations were noted adjacent to the west spandrel string-course and it is recommended that these be monitored over time. Although there was cracking to the abutments, extending up into the lower part of the barrel, this was demonstrated to be no longer active and is therefore judged not to be cause for concern.

The vehicle restraint system on the structure takes the form of unreinforced masonry parapets. When assessed in accordance with Transport Scotland publication TSIA 25, the parapets are found to be inadequate and a low risk upgrading to N1/N2 parapets should be implemented.

Short Term

- None

Medium Term

- Crack repairs and monitoring of cracks on the abutments and arch barrel on annual basis.
- Monitoring of points on the voussoirs for any deviation.
- Minor pointing repairs to the west spandrel wall.
- Removal of minor vegetation from wingwalls and minor pointing repairs.
- Making good of loose copestones at northeast corner of the parapet.

Long Term

- Upgrade parapets to N1/N2.

An assessment of Disused Rail Bridge Nos. 1&97 was carried out in accordance with the Standards listed in the AIP Form, which is included in Annex D. The results of the assessment are as given below.

An assessment of the masonry barrels using the Modified MEXE Method showed the Maximum Gross Vehicle weight to be 40 Tonnes. An assessment using the mechanism

method of the Archie M program also showed the arch barrels to be adequate for 40 Tonnes Assessment Live Loading. An HB rating of 29.5 units was determined for the structure using the Modified MEXE analysis while the Archie analysis also showed that the structure is capable of carrying 45 units of HB Loading.

The assessment of the structure using the Archie analysis showed that the structure is not adequate for any SV vehicle loading.

An Archie_M analysis was used for the central pier using an effective lane width appropriate to the substructure. The analysis showed the line of thrust in the central pier is outside the middle third for vehicle weights above 24 tonnes and Group 1 Fire Engines.

The assessed capacity of the bridge is 24 Tonnes Assessment Live Loading based on the capacity of the central pier. Despite cracking to the abutments, the foundations and abutments show no significant signs of distress and are assessed as having adequate capacity to carry ULS live loading at least equal to the arch barrels.

The structure should be limited to 24 tonne vehicles and Group 1 and 2 fire engines. According to BD21/01, a weight restriction of 18 tonnes is recommended.

The overall maintenance prioritisation ranking of this structure is **2 – minor**, nothing to worry about but likely to deteriorate significantly within 6 years.

2.0 Introduction

- 2.1 East Ayrshire Council commissioned URS to carry out an assessment of Disused Rail bridges 1 & 97 in August 2008, as part of Package 8 bridge assessment programme. The structure is located at OS reference NS 400 396. A location plan and photographs of the structure are given in Appendix A Principal Inspection Report.
- 2.2 The bridge structure is owned by East Ayrshire Council. No record drawings were made available for the bridge.
- 2.3 The assessment of this structure was carried out in accordance with the Standards listed in the AIP Form, which is included in Appendix D.
- 2.4 In accordance with BD 21/01, a quantitative assessment was carried out on the superstructure and a qualitative assessment was carried out on the sub-structure.

3.0 Description of Structure

- 3.1 Disused rail bridges 1 and 97 form the two spans of a twin span masonry arch structure. Bridge 97 is the north span and Bridge 1 is the south span. The arch barrel, substructure, spandrel walls and parapets are all of sandstone masonry construction. The bridge carries the B751, a single carriageway road, over the National Cycle Network Route 73 cyclepath.
- 3.2 The abutments are approximately 3m high constructed from sandstone masonry. Some brickwork repairs were noted to the abutments.
- 3.3 The carriageway is 6.75m wide with a 1.0m wide footway at the East side.
- 3.4 A Structure Data Sheet giving the principal dimensions of the structure is given below.

Structure Data Sheet – Disused Rail Bridge Nos 1 & 97

General

Bridge Name	:	Disused Rail bridge Nos 1 & 97
Bridge Number	:	B751/20
Location	:	Approximately 3km North West of Kilmarnock, East Ayrshire
OS Map Ref.	:	E 640016 N 239664
Class	:	Underbridge
Function	:	Carries a B751 over Route 73 cycleway.
Form	:	Two span
Type	:	Masonry arch.
Designed by	:	Unknown
Built by	:	Unknown
Date of construction	:	Unknown.
Owner	:	East Ayrshire Council

Dimensions

Clear square span	:	2 x 8.6m spans
Skew span	:	N/A
Skew angle	:	N/A

Details of Road Cover

East verge width	:	1.0m
Carriageway width	:	6.75m
West verge width	:	None
Substructure	:	Masonry
Superstructure	:	Elliptical masonry arch. 460mm thick barrel minimum with backing to approximately 1600mm above springing.

4.0 Principal Inspection

- 4.1.1 A Principal Inspection was carried out in December 2008 in accordance with BD63/07.
- 4.1.2 The structure was found to be in good condition overall. Although extensively patched, particularly on the parapets and locally on the spandrels the structural elements of the bridge were sound. The barrels of both bridge spans were generally dry and showed no significant deviation in profile. However, local deviations were noted adjacent to the west spandrel string-course and it is recommended that these be monitored over time. Although there was cracking to the abutments, extending up into the lower part of the barrel, this was demonstrated to be no longer active and is therefore judged not to be cause for concern.
- 4.1.3 The vehicle restraint system on the structure takes the form of unreinforced masonry parapets. When assessed in accordance with Transport Scotland publication TSIA 25, the parapets are found be inadequate and a low risk upgrading to N1/N2 parapets should be implemented.
- 4.2 The recommendations from the Principal Inspection Report (See Appendix A) are:

Short Term

- None

Medium Term

- Crack repairs and monitoring of cracks on the abutments and arch barrel on annual basis.
- Monitoring of points on the voussoirs for any deviation.
- Minor pointing repairs to the west spandrel wall.
- Removal of minor vegetation from wingwalls and minor pointing repairs.
- Making good of loose copestones at northeast corner of the parapet.

Long Term

- Upgrade parapets to N1/N2.

- 4.3 The overall maintenance prioritisation ranking of this structure is:

2 - MINOR - Nothing to worry about but likely to deteriorate significantly within 6 years.

5.0 Conclusions

5.1 General

5.1.1 5.1.1 Material Strengths

A characteristic masonry strength of 6N/mm^2 was adopted for the masonry arch barrel. The compressive strengths of the masonry units obtained from coring ranged from 20N/mm^2 to 42.5N/mm^2 . Using the average strength of 31.8 N/mm^2 and extrapolating from Fig 4.3 from BD 21/01 (using the line corresponding to Ashlar quality construction) gives the characteristic strength of 6 N/mm^2 .

The level of backing used in the Archie model has been determined graphically from the coring results. By plotting the core results onto an elevation of the arch, an indication of the extent can be estimated. A ‘flat topped’ backing profile has been assumed in the assessment. The checker adopted a ‘tangential’ profile, which underestimated the backing over the quarter-points. However, this had no effect on the arch barrel capacities.

5.1.2 Loading

The following permanent loads have been considered:-

- (i) Dead Load
- (ii) Superimposed Dead Loads.

The following transient loads have been considered:-

ULS Live Load + Nominal dead Load:-

- (i) C & U Vehicles with Impact: Single, Double, Triple.
- (ii) EU Vehicles with Impact: Single, Double, Triple.
- (iii) HB Vehicles
- (iv) SV vehicles in accordance BD86/07

ULS Live Load + ULS Dead Load was also checked to confirm this was less critical.

5.1.3 Analysis

The masonry arch has been assessed in accordance with both BD 21/01 and BA 16/97.

A condition factor (F_{cM}) of 0.9 was adopted for the Modified MEXE Assessment based on the condition of the arch barrel; despite small areas of dampness and the dormant cracks running up from the abutment, the barrel was generally judged to be in good structural condition. The minimum barrel thickness of 460mm has been used in the MEXE assessment.

A factor for Load Effect (γ_{F3}) of 1.1 was adopted for the Archie-M (mechanism) assessment, to account for the difference between the model and the structure as built.

Where this factor has a relieving effect a factor of 1.0 was adopted. The minimum value of barrel thickness of 460mm has been used in the Archie assessment.

The worst case loading positions for the pier and for the arches have been considered. In all cases the loading for the pier was more critical. Manual adjustment of the thrust lines through the arches have been used to ensure that the thrust line in the pier remains within the 'middle third' i.e. no tension develops.

5.2 Results

5.2.1 Quantitative Assessment of Arch Barrel

An assessment of the masonry barrels using the Modified MEXE Method showed the Maximum Gross Vehicle weight to be 40 Tonnes. An assessment using the mechanism method of the Archie M program also showed the arch barrels to be adequate for 40 Tonnes Assessment Live Loading. An HB rating of 29.5 units was determined for the structure using the Modified MEXE analysis while the Archie analysis also showed that the structure is capable of carrying 45 units of HB Loading.

The assessment of the structure using the Archie analysis showed that the structure is not adequate for any SV vehicle loading.

An Archie_M analysis was used for the central pier using an effective lane width appropriate to the substructure. The analysis showed the line of thrust in the central pier is outside the middle third for vehicle weights above 24 tonnes and Group 1 Fire Engines.

5.2.2 Qualitative Assessment of Substructure

Despite cracking to the abutments, the foundations and abutments show no significant signs of distress and are assessed as having adequate capacity to carry ULS live loading at least equal to the barrel.

6.0 Recommendations

The assessed capacity of the bridge is 24 Tonnes Assessment Live Loading based on the capacity of the central pier.

Based on the results of this assessment, the structure should be limited to 24 tonne vehicles and Group 1 and 2 fire engines. According to BD21/01, a weight restriction of 18 tonnes is recommended.

It is recommended that the works outlined in section 4.2 and the Principal Inspection report are carried out.

APPENDIX A

Principal Inspection Report

East Ayrshire Council

Disused Rail Bridge

Nos 1& 97

Principal Inspection Report



National Grid Reference: NS 400 396

Route Number: B751

Structure Reference: B751/20

**Disused Rail Bridge Nos 1 & 97
Principal Inspection Report**

December 2009
Final

Issue No: 2

Project Title: Disused Rail Bridge Nos 1 & 97
Report Title: Principal Inspection Report
Project No: 49331615
Report Ref:
Status: Final
Client Contact Name: [REDACTED]
Client Company Name: East Ayrshire Council

Document Production / Approval Record

Issue No: 1	Name	Signature	Date	Position
Prepared by	[REDACTED]	[REDACTED]	Dec 2009	Project Engineer
Checked by	[REDACTED]	[REDACTED]	Dec 2009	Technical Director
Approved by	[REDACTED]	[REDACTED]	Dec 2009	Associate Director

Document Revision Record

Issue No	Date	Details of Revisions
1	Jan 2009	Original issue Draft
2	December 2009	Final Principal Inspection Report

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EXECUTIVE SUMMARY

Disused rail bridges 1 and 97 form the two spans of a twin span masonry arch structure. Bridge 97 is the north span and Bridge 1 is the south span. The bridge carries the B751, a single carriageway road, over the National Cycle network route 73 cyclepath.

The primary deck element takes the form of an elliptical profile arch barrel constructed from sandstone masonry. The span of both structures is 8600mm with a rise above springing of 1835mm (south span) and 1805mm (north span) respectively at the crown.

The structure was found to be in good condition overall. Although extensively patched, particularly on the parapets and locally on the spandrels the structural elements of the bridge were sound.

The barrels of both bridge spans were generally dry and showed no significant deviation in profile. However, local deviations were noted adjacent to the west spandrel string-course and it is recommended that these be monitored over time. Although there was cracking to the abutments, extending up into the lower part of the barrel, this was demonstrated to be no longer active and is therefore judged not to be cause for concern.

The vehicle restraint system on the structure takes the form of un-reinforced masonry parapets. When assessed in accordance with Transport Scotland publication TSIA 25, the parapets are found be inadequate and a low risk upgrading to N1/N2 parapets should be implemented.

Short Term

- None

Medium Term

- Crack repairs and monitoring of cracks on the abutments and arch barrel on annual basis.
- Monitoring of points on the voussoirs for any deviation.
- Minor pointing repairs to the west spandrel wall.
- Removal of minor vegetation from wingwalls and minor pointing repairs.
- Making good of loose copestones at northeast corner of the parapet.

Long Term

- Upgrade parapets to N1/N2.

2 - MINOR	Nothing to worry about but likely to deteriorate significantly within 6 years.
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The estimated cost of these works is £2500.

1. INTRODUCTION

1.1. Brief

East Ayrshire Council (EAC) commissioned URS Corporation Ltd to undertake a Principal Inspection of Disused Rail Bridge Nos 1 & 97 at grid reference NS 400 396, as part of a bridge assessment programme in August 2008.

The objective of the inspection was to verify the form of construction, the dimensions of the structure and the nature and condition of the structural components.

1.2. Principal Inspections

The Principal Inspection (PI) was undertaken in accordance with the requirements set out in BD 63/07 (DMRB 3.1.4) and the Inspection Manual for Highway Structures (Highways Agency).

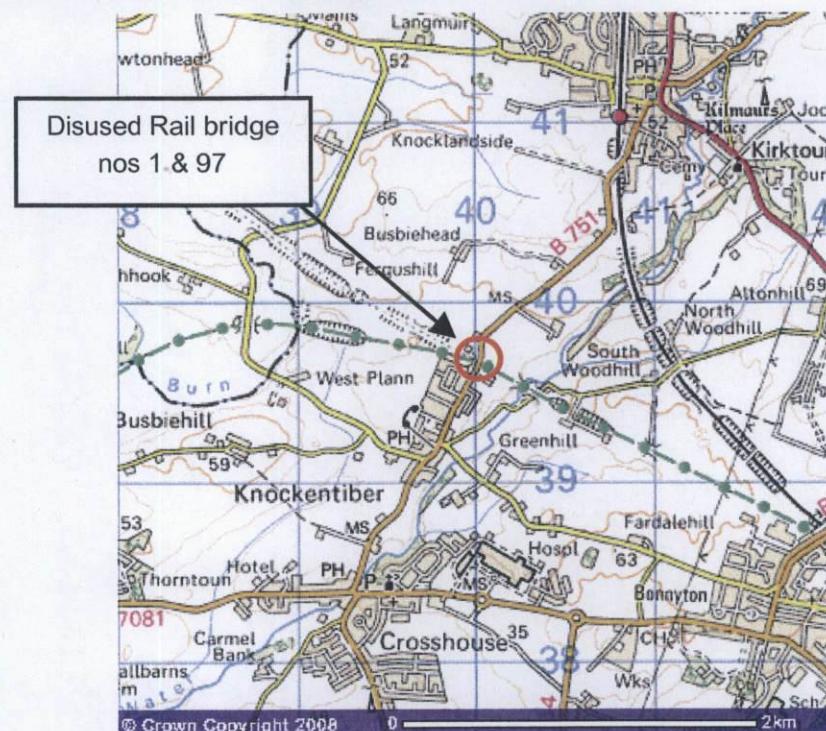
1.3. Report Format

The principal inspection report format is in the form of the County Surveyors Society's (CSS) Bridge Condition Indicators publication Volumes 1 to 3.

2. LOCATION PLAN

2.1. Location Plan

Figure 1: Disused Rail bridge Nos 1 & 97



3. DESCRIPTION OF STRUCTURE

3.1. General Description

Disused rail bridges 1 and 97 form the two spans of a twin span masonry arch structure. Bridge 97 is the North span and Bridge 1 is the south span. The arch barrel, substructure, spandrel walls and parapets are all of sandstone masonry construction. The bridge carries the B751, a single carriageway road, over the National Cycle network route 73 cyclepath.

3.2. Superstructure (Deck Elements)

3.2.1. Primary Deck Elements

The primary deck element takes the form of an elliptical profile arch barrel constructed from sandstone masonry. The span of both structures is 8600mm with a rise above springing of 1835mm (south span) and 1805mm (north span) respectively at the crown. The arch barrel measured by coring was determined as 460mm thick minimum.

3.3. Load Bearing Sub-Structure

3.3.1. Foundations

The foundation construction of the structure is unknown, although, given the likely age of the structure it is expected to be of masonry construction.

3.3.2. Abutments

The abutments take the form of sandstone masonry walls with mortar joints.

3.3.3. Pier and Cutwaters

A central pier approximately 3000mm high supports the two masonry arch spans.

3.4. Durability Elements

3.4.1. Superstructure Drainage

There is no specific superstructure drainage provided.

3.4.2. Substructure Drainage

There is no specific substructure drainage provided.

3.4.3. Waterproofing (Superstructure)

There are no records to indicate the presence of a waterproofing system to the superstructure.

3.4.4. Waterproofing (Substructure)

There are no records to indicate the presence of a waterproofing system to the substructure.

3.4.5. Movement/Expansion Joints

There are no movement / expansion joints present in the structure.

3.5. Safety Elements

3.5.1. Parapets

The parapets are typically constructed from coursed masonry although some repairs have been carried out in brickwork to the West parapet. The typical thickness is 280mm with a 360mm wide coping stone. They range in height from approximately 1210mm to 1360mm at the West side. Due to the footway and kerb on the East side, the parapets are approximately 120mm lower relative to adjacent ground level on this side.

3.5.2. Carriageway Surfacing

The carriageway wearing course appears to be bituminous macadam. The carriageway is 6750mm wide, measured from kerb to West parapet.

3.5.3. Footpaths and Verges

A 1000mm wide footway runs across the east side of the bridge.

3.6. Other Bridge Elements

3.6.1. Inverts

The Route 73 national cycle network cycle path passes under bridge 1 (south span). The invert to Bridge 97 has an uneven surface and rough grass.

3.6.2. Spandrel Walls

The spandrel walls are of masonry construction. Repairs have been carried out to the West face.

3.6.3. Wingwalls

Masonry wingwalls form the edges to the structure retaining the road adjacent to the bridge.

3.6.4. Training Walls

Not applicable.

3.7. Ancillary Elements

3.7.1. Approach rails/barriers/walls

There is a brick wall on the approach to the North West corner of the structure. Post and wire fencing forms the approach at the three other corners.

3.7.2. Lighting

There is no street lighting apparatus within the vicinity of the structure.

4. CONDITION REPORT

4.1. Maintenance History

4.1.1. Previous Principal Inspection(s)

Records show that a previous General Inspection was carried out in May 2006. Comments noted at that time are similar to the present Principal Inspection. However, there has been some deterioration to the structure since the time of the last General Inspection. There are no records of a previous Principal Inspection having been carried out.

The defects noted in the 2006 General Inspection were:

- Cracks in both abutments have extended into both arch rings.
- There are cracks, one in each abutment, extending through full height of abutments and into arch rings. Width of cracks has been stable at 25mm but length has been increasing over the years.
- There are vertical cracks in the southeast and southwest spandrels. These cracks have been stable since first reported but need to be pointed for future checks. Pointing work required.
- There are signs of seepage from both arches.
- Both parapets and stringer courses are dipped over both arches. Could be traffic hammering.

4.1.2. Routine/Cyclical Maintenance

No records of routine or cyclical maintenance were available prior to the inspection.

4.1.3. Description of the Inspection

The inspection was carried out on 2nd December 2008; during the inspection the weather was sunny but with temperatures below zero. Access to the structure was achieved from the Cycle track.

4.1.4. Reporting Criteria

The following tables details the reporting criteria used in sections 4.2 to 4.7 where comments are made on constituent parts of the structure, adopting an overview of the inspection and highlighting the significant findings. The completed BCI pro-forma for this structure, which uses these criteria, can be found in Appendix D of this report.

Code	Description
1	As new condition or defect has no significant effect on the element (visually or functionally).
2	Early signs of deterioration, minor defect/damage, no reduction in functionality of element.
3	Moderate defect/damage, some loss of functionality could be expected
4	Severe defect/damage, significant loss of functionality and/or element is close to failure/collapse
5	The element is non-functional/failed

Code	Description
A	No significant defect
B	Slight, not more than 5% of surface area/length/number
C	Moderate, 5% - 20% of surface area/length/number
D	Wide: 20% - 50% of surface area/length/number
E	Extensive, more than 50% of surface area/length/number

4.2. Superstructure (Deck Elements)

4.2.1. Primary Deck Elements

The masonry arch barrels were in good condition. Despite some evidence on the west spandrel, stringer course and parapet copes to suggest that Bridge 1 (the south span) barrel may have sagged, the arch profiles showed no signs of deviation when measured and compared with the geometry of bridge 97. The barrels were generally dry, with only some minor dampness on the barrel at the east side of bridge 1 barrel. The brickwork repairs at the South quarterpoint of bridge 1 were in good condition.

At the south East corner of bridge 1 and the North west corner of bridge 97, vertical cracks were observed running the full height of the abutments. These extended up into the barrel, although did not extend beyond approximately quarter point in either case. Tell-tales marked 27/8/4 (suggesting a date of probably 2004) show no significant movement since installation.

There was some minor weathering of the stonework noted particularly at the North springing of bridge 97, but is no cause for concern. (See Appendix B photographs 2,5 to 9,18)

The overall defect rating for this element is **3B**.

4.3. Load Bearing Sub-Structure

4.3.1. Foundations

The foundations were not inspected directly. There were cracks found in the barrel and the abutments, however there was no discernible differential movement across the crack. Furthermore, the cracks did not get progressively wider further up the abutment as might be expected if the foundations had allowed the ends of the abutment to rotate outwards. On the above basis it is deemed unlikely that the foundations have moved. With the tell-tales indicating no recent movement, there is no cause for concern. (See Appendix B photograph 12)

The defect rating for this element is **2B**.

4.3.2. Abutments

At the south East corner of bridge 1 and the Northwest corner of bridge 97, vertical cracks were observed running the full height of the abutments. Tell-tales marked 27/8/4 (suggesting a date of probably 2004) show no significant movement since installation. (See Appendix B photographs 10 to 12)

The overall defect rating for this element is **3B**.

4.3.3. Piers and cutwater

The pier was in good condition and showed no signs of weathering, cracking or movement. (See Appendix B photographs 16&17)

The overall defect rating for this element is **1A**.

4.4. Durability Elements

4.4.1. Superstructure Drainage

No superstructure drainage present.

4.4.2. Substructure Drainage

No substructure drainage present.

4.4.3. Waterproofing (Superstructure)

The barrel of bridge 97 was dry and the barrel of bridge 1 showed only small areas of dampness. This suggests the likely presence of some type

of waterproofing and that it is functioning adequately. (See Appendix B photographs 8,9&15)

The overall defect rating for this element is **2C**.

4.4.4. Waterproofing (Substructure)

No substructure drainage present.

4.4.5. Movement/Expansion Joints

There are no movement / expansion joints present in the structure.

4.5. Safety Elements

4.5.1. Parapets

The masonry parapets were in moderate condition at the time of inspection. Some minor displacements were noted along mortar joints. The brickwork repairs to the outer face of the northwest parapet, although visually poor, appear to be structurally adequate. There are loose copestones at northeast corner of the parapet. There is a noticeable 'dip' in the line of both east and west parapet lines over bridge 1. Further inspection however, does not show any corresponding sag in the arch barrel profile and is therefore no cause for concern, see 5 below. (See Appendix B photographs 20,22,23,25&27)

The overall defect rating for this element is **1B**.

4.5.2. Carriageway Surfacing

The carriageway wearing course was in good condition.

The overall defect rating for this element is **1A**.(See Appendix B photographs 22,24&28)

4.5.3. Footpaths and Verges

The footway surfacing and kerbs were in good condition. Some minor vegetation growth was noted at the West side of the carriageway. (See Appendix B photographs 25&26)

The defect rating for this element is **2E**.

4.6. Other Bridge Elements

4.6.1. Inverts

The cycleway carriageway was in good condition. The rough ground in the adjacent span is overgrown and uneven, but is not causing significant

hazard. The defect rating for this element is **1A**. (See Appendix B photographs **2,7&16**)

4.6.2. Spandrel Walls

The spandrel walls of the arch were in fair condition although structurally sound. The string course had been patched in brickwork over bridge 1.

The stringcourse and the masonry courses appear to dip towards the north quarter point of bridge 1. However, level measurements carried out for the assessment report indicates that there is no significant deviation in profile compared to bridge 97.

Some vertical cracking was noted in the spandrel directly above the south springing of bridge 1. (See Appendix B photographs **7,18,19&20, 29**)

The defect rating for this element is **3C**.

4.6.3. Wingwalls

The wingwalls were in moderate to good condition at the time of inspection. There was no deformation noted but some vegetation growth and minor loss of pointing to joints. (See Appendix B photographs **7,18&21**)

The defect rating for this element is **2C**.

4.7. Ancillary Elements

4.7.1. Approach rails/barriers/walls

The wall and fencing at the approaches to the bridge are in acceptable condition.

4.7.2. Lighting

There is no lighting apparatus within the vicinity of the structure.

5. CONCLUSIONS AND RECOMMENDATIONS

The structure was found to be in good condition overall. Although extensively patched, particularly on the parapets and locally on the spandrels the structural elements of the bridge were sound.

The barrels of both bridge spans were generally dry and showed no significant deviation in profile. However, local deviations were noted adjacent to the west spandrel string-course and it is recommended that these be monitored over time. Although there was cracking to the abutments, extending up into the lower part of the barrel, this was demonstrated to be no longer active and is therefore judged not to be cause for concern.

It is concluded that only minor maintenance work will be necessary in the next 6 years.

The vehicle restraint system on the structure takes the form of un reinforced masonry parapets. When assessed in accordance with Transport Scotland publication TSIA 25, the parapets are found be inadequate and a low risk upgrading to N1/N2 parapets should be implemented.

The following maintenance measures are recommended:

Short Term

- None

Medium Term

- Crack repairs and monitoring of cracks on the abutments and arch barrel on annual basis.
- Monitoring of points on the voussoirs for any deviation.
- Minor pointing repairs to the west spandrel wall.
- Removal of minor vegetation from wingwalls and minor pointing repairs.
- Making good of loose copestones at northeast corner of the parapet.

Long Term

- Upgrade parapets to N1/N2.

2 - MINOR	Nothing to worry about but likely to deteriorate significantly within 6 years.
-----------	--

The estimated cost of these works is £2500.

Appendix A: Previous Inspection Reports

East Ayrshire Council – Roads Division – General Bridge Inspection

Road No: B 751	Bridge No: 20		O.S.E: 240016	O.S.N: 639664	M.P.R:
Bridge Name: Rail Bridge No: 1 & 97 [Knockentiber] (Disused)			Bridge Type Code		
Bridge Type: Masonry Arch			Primary deck element form(Table-2) 01		
Number of spans: 2 Span: All of 2 Span Length (m): 8.4 & 8.5			Primary deck element material (Table-4) L		
Number of construction forms: 1 (*delete as appropriate)			Secondary deck element form (Table-3) 20		
All above ground elements inspected: Yes Photographs? No			Secondary deck element material (Table-4) P		
S – Severity: 1, 2, 3, 4, 5		Inspection Date: 17/5/06			Inspected By: [REDACTED]
Ex – Extent: A, B, C, D, E		Next Inspection (month / year):			
Set	No	Element Description	S	Ex	Comments
Deck Elements	1	Primary deck element (Table-2)	3	B	Cracks in both abutments have extended in to both arch rings
	5	Tie beam / rod			
	6	Parapet beam or cantilever			
Load-bearing Substructure	8	Foundation			
	9	Abutments (incl. Arch springing)	3	B	There are cracks, one in each abutment, extending through full height of abutments and in to arch rings. Width of cracks has been stable at 25mm but length has been increasing over the years.
	10	Spandrel walls / Head walls	2	B	There are vertical cracks in southeast and southwest spandrels. These cracks have been stable since first reported but need to be pointed for future checks. Pointing work required.
	11	Piers / Columns	1	A	
	15	Superstructure drainage			
16	Substructure drainage				
17	Water proofing	2	C	There are signs of seepage from both arches.	
18	Movement / Expansion joints				
21	Painting: Parapets / Safety fences				
Durability Elements	23	Parapets / Handrails /Safety fences	1	A	Both parapets and stringer courses are dipped over both arches. Could be traffic hammering.
	24	Carriageway surfacing	1	A	
	25	Foot ways/ Footbridge surfacing	1	A	Foot path on west side only.
Other Bridge Elements	26	Invert / River bed			
	27	Apron			
	29	River training works			
	31	Wing walls	1	A	
32	Retaining walls				
33	Embankments	1	A		
Ancillary Elements	35	Approach rails / Barriers / Walls			
	36	Signs			
	37	Lighting			
	38	Services			
				A cycle way has been constructed through south span	
				North and South along Carriageway.	
				Notes	

Structure Ref:	B751/20	Route:	B751	North Area	Grid:	240016 639664
Database Ref:	B0751/020	Structure Type:	Underbridge			
Structure Name:	RAIL. BRIDGE Nos. 1& 97 [CROSSHOUSE]					
Obstacle:	Dismantled Railway	Last GI Date:	17/05/2006	M P R	Spans	
Structure Owner:	Maintenance Authority:	Construction Date:				
Rail Property Limited	Rail Property Limited		Skew Value:	<input type="text"/>	<input type="checkbox"/> N/A	No. 2
Listed <input type="radio"/> Yes <input checked="" type="radio"/> No <input type="radio"/> Poss Listed Cat: <input type="text"/>			Arched	<input checked="" type="radio"/> Yes	<input type="radio"/> No	<input type="checkbox"/> N/A
Other Information: DISUSED LINE - BRB Ref. DAK/97			Arch Cover:	8.458		
			Decked	<input checked="" type="radio"/> Yes	<input type="radio"/> No	<input type="checkbox"/> N/A
			Overall Deck Len:	8.560		
			Span 3			
			Span 4			
			Span 5			
			Span 6			

Superstructure:	Masonry Arches
Foundation:	Unknown
Abutments:	Masonry
Bearings:	N/A
Waterproofing/Type:	Unknown
Expansion Joints:	N/A
Wingwalls	
Wingwalls Material:	Masonry

Parapets					
<input checked="" type="radio"/> Yes	<input type="radio"/> No	<input type="checkbox"/> N/A	Coursed Masonry - assume 340 thick	Thickness:	<input type="text"/>
Min Height:	1,050	Protective System:	N/A	Ranking:	<input type="text"/>

Piers			
<input checked="" type="radio"/> Yes	<input type="radio"/> No	<input type="checkbox"/> N/A	Masonry - 1.321m thick

Screens			
<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="checkbox"/> N/A	<input type="text"/>

Left Verge	Carriageway	Right Verge	Min Deck width:	7.722	HeadRoom Restriction		
Maximum	<input type="text"/>	<input type="text"/>	Min Soffit width:	8.400	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="checkbox"/> N/A
Minimum	0.000	6.700	Deck Area:	154.048	Headroom Ht:	<input type="text"/>	
No of CWs: 1			Date Measured:	<input type="text"/>			

Assessment Status To be Assessed					
Comment:	Boundary [ER]				
Assessor:	<input type="text"/>				
Year Strengthened:	<input type="text"/>	Target Group:	BRPB		
Restrictions: No Restrictions					
Reported:	<input type="text"/>	Result:	<input type="text"/>	Copy of Report:	<input type="text"/>
HB Capacity:	<input type="text"/>	Copy of Calculations: <input type="text"/>			

Old Bridge Name:	Old Bridge No:	B751/20	Date of last PI:	<input type="text"/>		
B.R. BRIDGE No.1&97 [CROSSHOUSE]			Priority:	<input type="text"/>	Next PI:	2004
			File Reference:	B751/20		

Appendix B: Photographs



Photograph 1: West elevation



Photograph 2: East elevation



Photograph 3: View over bridge looking north



Photograph 4: View over bridge looking south



Photograph 5: South arch (bridge 1), west elevation.
Note no deviation in arch barrel profile despite visible 'sagging' of string course and parapet masonry courses.



Photograph 6: South arch (bridge 1), East elevation



Photograph 7: North arch (bridge 97), East elevation



Photograph 8: South arch, quarter point, south side. Repairs & dampness



Photograph 9: South arch, quarter point, south side. Repairs & crack.



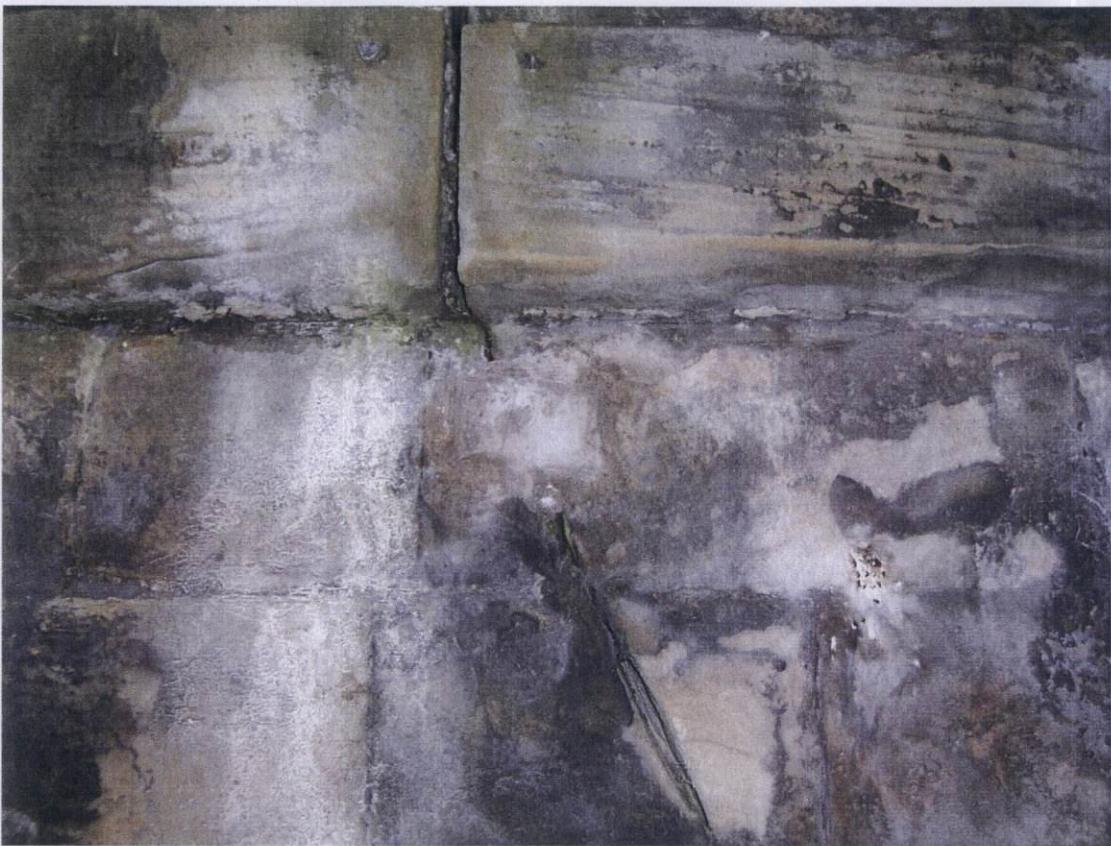
Photograph 10: South arch south abutment. Vertical crack. Tell-tale position circled.



Photograph 11: Tell-tale, south arch, south abutment. Dated 27/8/4



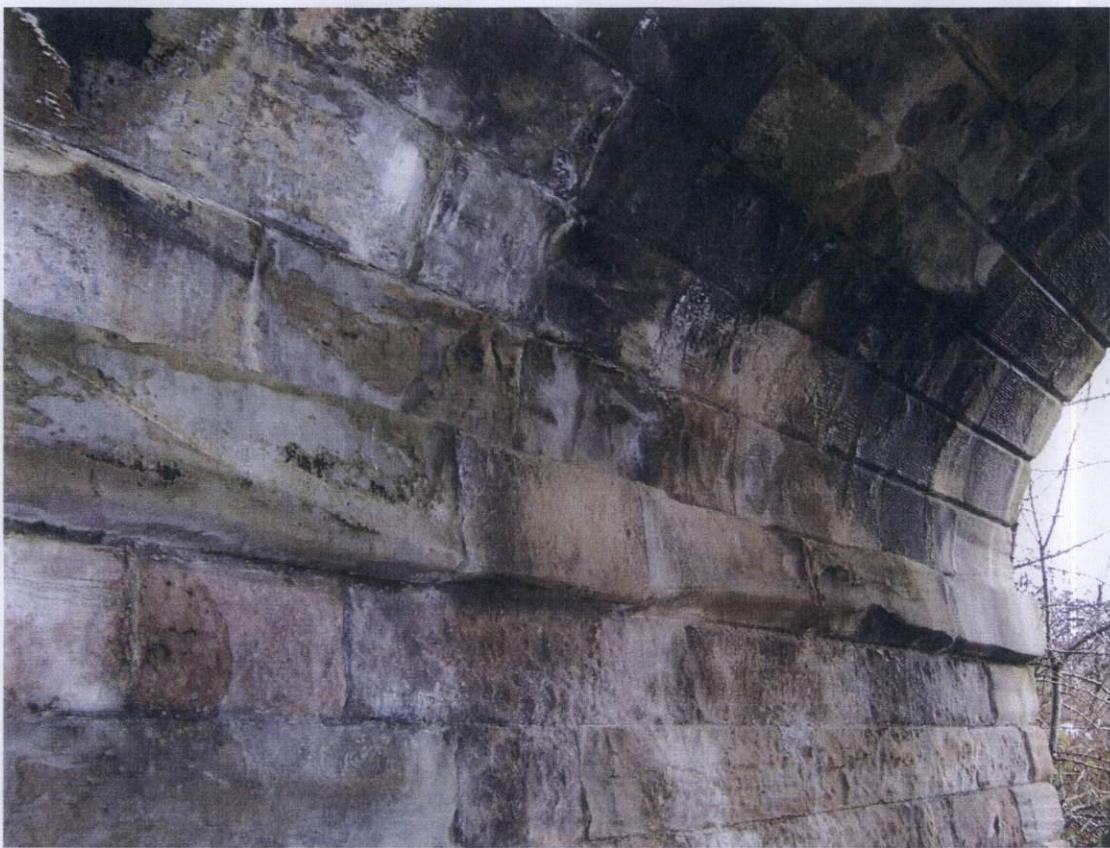
Photograph 12: North arch, north abutment. Crack. Tell-tale positions circled.



Photograph 13: North arch north abutment; tell-tale; upper. Dated 27/8/4



Photograph 14: North arch north abutment; tell-tale; lower. Dated 27/8/4



Photograph 15: North arch, north abutment. Weathering to stone.



Photograph 16: Central pier, west elevation.



Photograph 17: South side of central pier. Damp staining.



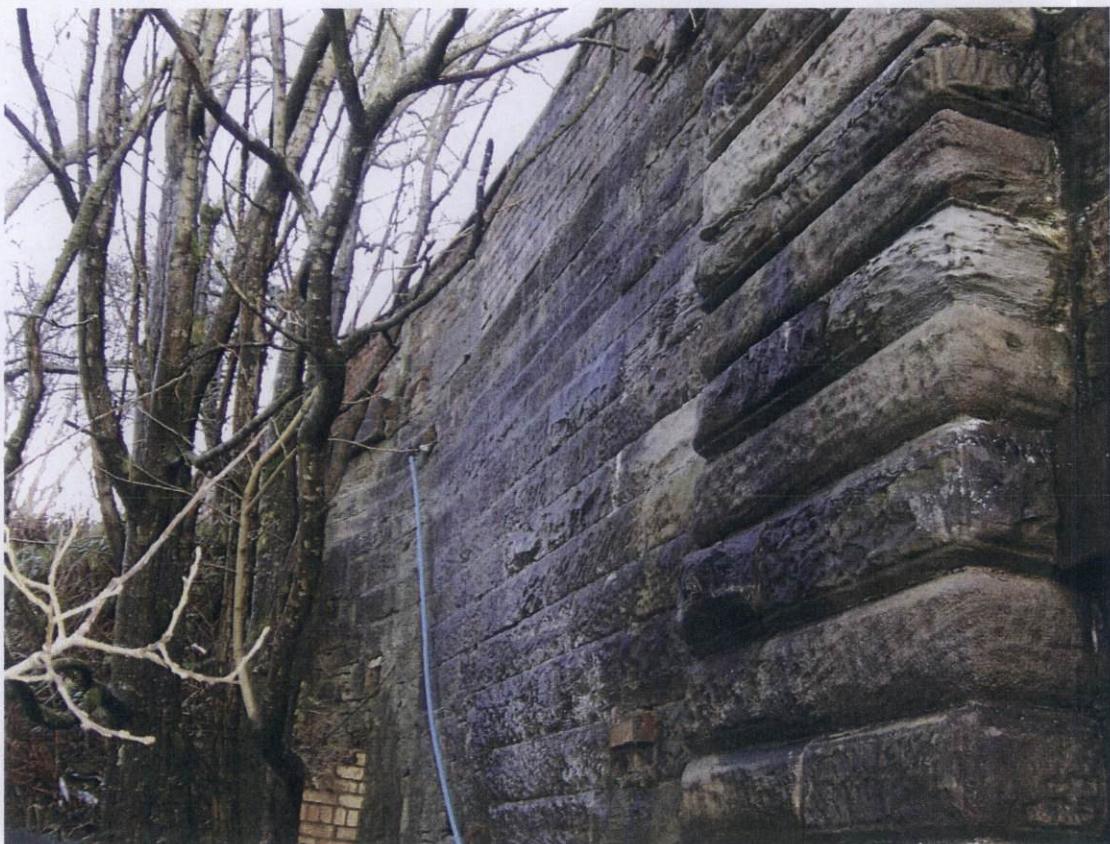
Photograph 18: West Spandrel and SW wingwall



Photograph 19: West spandrel.



Photograph 20: West spandrel/parapet. North span



Photograph 21: North West wingwall.



Photograph 22: West parapet



Photograph 23: NW parapet. End cope loose.



Photograph 24: North West approach wall



Photograph 25: East parapet. North end



Photograph 26: North east spandrel wall



Photograph 27: East parapet. Note sag in line of copes



Photograph 28: Carriageway in good condition



Photograph 29: Minor cracking to west spandrel wall near springing

Appendix C: Drawings

See Appendix E of the Assessment Report for Drawings

Appendix D: Inspection Form

The following priority system is used in this BCI Form:

Priority	Requirement
0	Maintenance required immediately (safety hazard)
1	Maintenance required within 1 year
2	Maintenance required within 2 to 3 years
3	Maintenance required within 4 to 6 years
4	Maintenance not required until next PI

<input type="checkbox"/> Superficial		<input type="checkbox"/> General		<input checked="" type="checkbox"/> Principal		<input type="checkbox"/> Special		Form <u>1</u> of <u>1</u> for this bridge						
Inspector: ET/CW				Date: 03/12/08				Next Inspection Type/Date: December 2014						
Bridge Name: Disused Rail bridge nos 1 & 97								Bridge Ref/No: B751/10			Road Ref/No: B751			
Map Ref: NS 400 396				O.S.E 240016				O.S.N 639664			Bridge Code	Primary deck form	01	
Span 1 of 1		Span Width (m): 8.25		Span Length (m): 8.6					Table 2			L		
All above ground elements inspected: YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>								Photographs? YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>			Secondary deck form		20	
Number of construction forms in bridge/span*: 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> more <input type="checkbox"/> (*delete as appropriate)											Secondary deck material		P	
Set	No	Element Description		S	Ex	Def	W	P	Cost	Comments/Remarks				
Deck Elements	1	Primary deck element (Table 2)		3	B	M	N			Repairs to bridge 1 arch at quarter points. Crack extends from abutment up into arch barrel. Tell-tales show no significant movement recently. Minor weathering of stones. Monitoring of the localised sagging of stringcourse is recommended.				
	2	Secondary deck element/s	Transverse beams											
	3		Element from Table 3											
	4	Half joints												
	5	Tie beam/rod												
	6	Parapet beam or cantilever												
	7	Deck bracing												
Load-bearing Substructure	8	Foundations		2	B	6.1	N			No differential settlement across abutment cracks, suggesting cracking not due to foundation movement.				
	9	Abutments (incl. arch springing)		3	B	3.5	Y		£1000	Cracking at NE and SW corners. Tell-tales show no significant movement recently. Crack repairs required.				
	10	Spandrel wall/head wall		3	C	3.5	Y		£500	Heavily repaired in brick. Some cracking but generally acceptable condition. Pointing recommended.				
	11	Pier/column		1	A	3.5	N			Good condition. Some damp staining.				
	12	Cross-head/capping beam												
	13	Bearings												
	14	Bearing plinth/shelf												
Durability Elements	15	Superstructure drainage												
	16	Substructure drainage												
	17	Waterproofing			2	C	14.1	N		Some dampness noted to intrados of bridge 1.				
	18	Movement/expansion joints												
	19	Finishes: deck elements												
	20	Finishes: substructure elements												
	21	Finishes: parapets/safety fences												
Safety Elements	22	Access/walkways/gantries												
	23	Handrail/parapets/safety fences			2	B	13.2	Y		£500	Generally good condition. Some minor displacement at mortar joints. Cope stone loose at NE corner.			
	24	Carriageway surfacing			1	A	9.1	N			Good condition			
	25	Footway/verge/footbridge surfacing			1	A	9.1	N			Good condition			
	26	Invert/river bed			1	A	9.1	N			Cycle track beneath bridge in good condition.			
Other Bridge	27	Aprons												
	28	Fenders/cutwaters/collision prot.												

29	River training works								
30	Revetment/batter paving								
31	Wing walls	2	C	5.1	Y		£500	Minor pointing repairs	
32	Retaining walls								
33	Embankments								
34	Machinery								
35	Approach rails/barriers/walls								
36	Signs								
37	Lighting								
38	Services								
39	Buttress								
40									
41									
42									

S – severity, Ex – extent, Def – defect, W – work required, P – work priority, Cost – Cost of work

MULTIPLE DEFECTS										
Element No.	Defect 1			Defect 2			Defect 3			Comments
	S	Ex	Def	S	Ex	Def	S	Ex	Def	
1	1	A	3.2	3	B	3.4	1	B	3.6	Repairs to bridge 1 arch at quarter points. Crack extends from abutment up into arch barrel. Tell-tales show no significant movement recently. Minor weathering of stones.

INSPECTOR'S COMMENTS

Dip in parapet alignment and spandrel stone courses at bridge 1, but no corresponding deformation of the arch profile found. Tell-tales show no significant movement in abutment cracks since August 04.

Name: E Thomas

Signed:

Date:

ENGINEER'S COMMENTS

Continue to monitor cracks on the abutment and localized sagging at the stringcourse.

Name: E Thomas

Signed:

Date:

WORK REQUIRED

Ref. No	Suggested Remedial Work	Priority	Estimated Cost	Action/Work Ordered?
9,10,31	Pointing repairs required to spandrel wall, wingwalls, abutments	3	£2000	
23	Make good parapet cope stones	3	£500	

Appendix E: Parapet Priority Ranking

PROJECT TITLE: East Ayrshire Council Bridge Assessment Programme
 Work Package 8

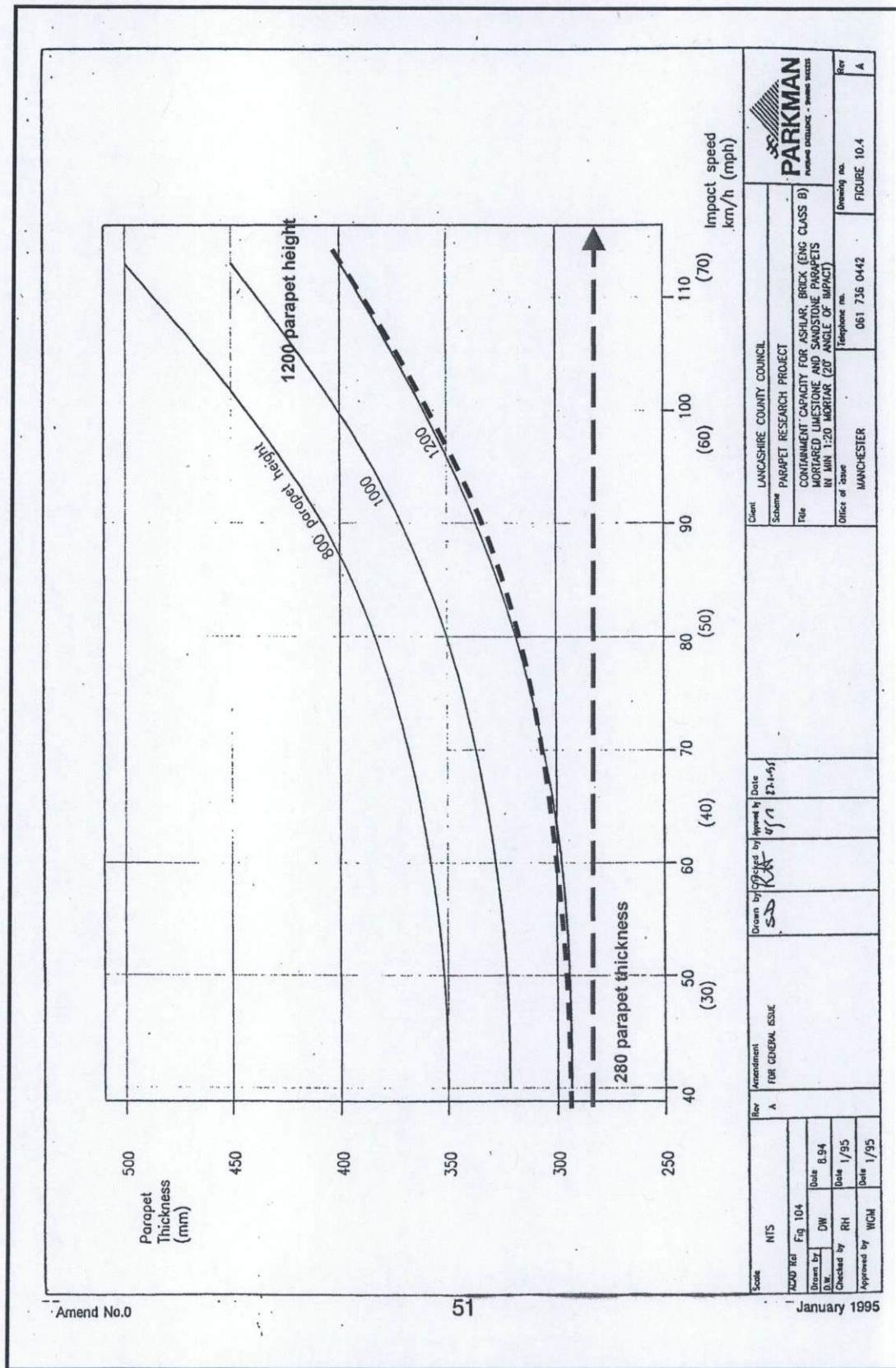
 DESCRIPTION: Bridges 1 & 97
 Parapet Assessment
 West

REFERENCE	CALCULATIONS	SUMMARY
TS IA 25	Assessment of Vehicle Parapets to TS Interim Amendment No. 25	
A2.1a	Required Containment Capacity, C_{REQ} Speed Limit: 60 mph $C_{REQ} = 0.73$ N2	
Table A2.1a	Calculation of remnant strength R_{cont} The containment capacity of the masonry parapets has been assessed using County Surveyor Society publication - 'The assessment and design of unreinforced masonry vehicle parapets - 1995' The dimensions of the masonry parapets were measured and the critical dimensions were found to be as follows: Height: 1200 mm Thickness: 280 mm Permitted Traffic Speed on the road: 60 mph	
Fig 10.4	using Fig 10.4 calculate allowable impact speed: does not intersect mph $R_{CONT} = 0$ % of required capacity, C_{REQ} If lines do not intersect, check whether width >225mm and height >800mm. If the above criteria are met then Cmin is deemed to be have achieved. (EAC guidance 18th August 2008) Rcont meets Cmin? MEETS Cmin If R_{cont} can be derived from the graph, or can be deemed to be greater than Cmin by virtue of it being wider than 225mm and greater than 800m high, then calculation of R_{ALARP} can be carried out. If R_{ALARP} is greater than 1 then, in accordance with the flow chart, a low risk N1/N2 upgrade is required otherwise monitoring is adequate.	
A1	$R_{ALARP} = AADT \cdot F_1 \cdot F_2 \cdot F_3 / 10000$	
Table A1	Road classification: AADT _{min} = 2000 B AADT _{max} = 7000	
Table A2.1b	Parapet Containment Factor, F_1 $F_1 = 5.0$ Note if Cmin is achieved but the lines do not intersect on the graph, then assume 0% < Rcont < 33% and F1 correspondingly = 5	
Table A2.2	Site Features Factor, F_2 Clearance of Parapet from Edge of Nearest Lane: 0 m $F_2 = 1.5$	
Table A2.3	Ease of Upgrading Factor, F_3 Method of Upgrading: New Anchors $F_3 = 0.75$	
Eqn A1	Min $R_{ALARP} = 1.125$ Max $R_{ALARP} = 3.938$	
Fig 5.1	if $R_{ALARP} < 1$ then no upgrade required. if $R_{ALARP} > 1$ then low risk upgrade required LOW RISK UPGRADE REQUIRED	
	Conclusion: <u>LOW RISK, N1/N2 UPGRADE, UNDERTAKE AS PART OF MAINTENANCE WORKS</u>	

PROJECT TITLE: East Ayrshire Council Bridge Assessment Programme
Work Package 8

DESCRIPTION: Bridges 1 & 97
Parapet Assessment
East

REFERENCE	CALCULATIONS	SUMMARY
TS IA 25	Assessment of Vehicle Parapets to TS Interim Amendment No. 25	
A2.1a	Required Containment Capacity, C_{REQ} Speed Limit: 60 mph $C_{REQ} = 0.73$ N2	
Table A2.1a	Calculation of remnant strength R_{cont} The containment capacity of the masonry parapets has been assessed using County Surveyor Society publication - 'The assessment and design of unreinforced masonry vehicle parapets - 1995' The dimensions of the masonry parapets were measured and the critical dimensions were found to be as follows: Height: 1200 mm Thickness: 280 mm Permitted Traffic Speed on the road: 60 mph	
Fig 10.4	sing Fig 10.4 calculate allowable impact speed: does not intersect mph $R_{CONT} = 0 \text{ % of required capacity, } C_{REQ}$ If lines do not intersect, check whether width >225mm and height >800mm. If the above criteria are met then C_{min} is deemed to be have achieved. (EAC guidance 18th August 2008) Rcont meets C_{min}? MEETS C_{min} If R_{cont} can be derived from the graph, or can be deemed to be greater than C_{min} by virtue of it being wider than 225mm and greater than 800m high, then calculation of R_{ALARP} can be carried out. If R_{ALARP} is greater than 1 then, in accordance with the flow chart, a low risk N1/N2 upgrade is required otherwise monitoring is adequate.	
A1	$R_{ALARP} = AADT \cdot F_1 \cdot F_2 \cdot F_3 / 10000$	
Table A1	Road classification: $AADT_{min} = 2000$ B $AADT_{max} = 7000$	
Table A2.1b	Parapet Containment Factor, F_1 $F_1 = 5.0$ Note if C_{min} is achieved but the lines do not intersect on the graph, then assume $0\% < R_{cont} < 33\%$ and F_1 correspondingly = 5	
Table A2.2	Site Features Factor, F_2 Clearance of Parapet from Edge of Nearest Lar 1.00 m $F_2 = 1.25$	
Table A2.3	Ease of Upgrading Factor, F_3 Method of Upgrading: New Anchors $F_3 = 0.75$	
Eqn A1	Min R_{ALARP} 0.938 Max R_{ALARP} 3.281	
Fig 5.1	if $R_{ALARP} < 1$ then no upgrade required. if $R_{ALARP} > 1$ then low risk upgrade required LOW RISK UPGRADE REQUIRED	
	Conclusion: <u>LOW RISK, N1/N2 UPGRADE, UNDERTAKE AS PART OF MAINTENANCE WORKS</u>	



APPENDIX B

Testing Investigation Summary

Summary of Site Investigation – Disused Rail Bridges Nos 1 & 97

Testing Subcontractor : Mattest site services Ltd
Date of Site Investigation : 12th & 15th September 2008

Site Investigation

6 No. 100mm diameter cores were cut in the direction perpendicular to the surface of the intrados, into the arch barrel using a hydraulic coring machine with fresh water flush. The direction of arch thrust was marked on the end of each core prior to cutting. On extraction of the cores, a 50mm diameter core was cut perpendicular through the core. The 50mm diameter core sections were sealed in their wet condition, in plastic bags marked with the bridge identification and core reference. Core holes were reinstated using Nufins Nucem HB cementitious repair mortar.

Core Reference 11 Bridge No. 1 North Springing

Description of masonry	Light brown fine grained sandstone with darker bedding planes visible.
Description of masonry surface	Uniform block with dry dark green staining.
Block dimensions	1185 x 310mm.
Estimated width of mortar joints	5 to 20mm.
Greatest depth of mortar loss	10mm.
Position of test core	160mm from the exposed surface.
Angle of bedding plane to direction of thrust	90°.
Angle of bedding plane to axis of core	0°.
Thickness of arch barrel core length	540mm.
Total length cored	670mm.
Compressive strength of masonry	32.3N/mm ² .
Description of material above barrel	Masonry block to springing of Bridge No. 97.

Core Reference 11 Bridge No. 1 South Springing

Description of masonry	Light brown / grey fine grained sandstone with darker bedding planes visible.
Description of masonry surface	Uniform block with dry dark green / black staining.
Block dimensions	1040 x 310mm.
Estimated width of mortar joints	5mm.
Greatest depth of mortar loss	15mm.
Position of test core	130mm from the exposed surface.
Angle of bedding plane to direction of thrust	90°.
Angle of bedding plane to axis of core	0°.
Thickness of arch barrel core length	480mm.
Total length cored	1295mm.
Compressive strength of masonry	42.6N/mm ² .
Description of material above barrel	Masonry blocks with mortar bed.

Core Reference 11 Bridge No. 1 South Quarter Point

Description of masonry	Light brown / grey fine grained sandstone with darker bedding planes visible.
Description of masonry surface	Uniform block with dry dark green / black staining.
Block dimensions	670 x 150mm.
Estimated width of mortar joints	5 to 35mm.
Greatest depth of mortar loss	Repointed.
Position of test core	130mm from the exposed surface.
Angle of bedding plane to direction of thrust	70°.
Angle of bedding plane to axis of core	20°.
Thickness of arch barrel core length	460mm.
Total length cored	990mm.
Compressive strength of masonry	32.5N/mm ² .
Description of material above barrel	Unbound masonry with dark brown silty sand – noted in the Testing Report, but material is bound from photographs

Core Reference 11 Bridge No. 97 North Springing

Description of masonry	Light brown / grey fine grained sandstone with darker bedding planes visible.
Description of masonry surface	Uniform block with black and green staining.
Block dimensions	980 x 300mm.
Estimated width of mortar joints	5mm.
Greatest depth of mortar loss	0mm.
Position of test core	110mm from the exposed surface.
Angle of bedding plane to direction of thrust	90°.
Angle of bedding plane to axis of core	0°.
Thickness of arch barrel core length	620mm.
Total length cored	740mm.
Compressive strength of masonry	24.7N/mm ² .
Description of material above barrel	Mortar and masonry backfill.

Core Reference 11 Bridge No. 97 North Quarter Point

Description of masonry	Light brown / grey fine grained sandstone with darker bedding planes visible.
Description of masonry surface	Uniform block with black, white and green staining.
Block dimensions	850 x 300mm.
Estimated width of mortar joints	5mm.
Greatest depth of mortar loss	0mm.
Position of test core	80mm from the exposed surface.
Angle of bedding plane to direction of thrust	90°.
Angle of bedding plane to axis of core	0°.
Thickness of arch barrel core length	460mm.
Total length cored	860mm.
Compressive strength of masonry	38.5N/mm ² .
Description of material above barrel	Mortar and masonry infill.

Core Reference 11 Bridge No. 97 South Springing

Description of masonry	Light brown / grey fine grained sandstone with darker bedding planes visible.
Description of masonry surface	Uniform block with black and green staining. Surface erosion visible to a maximum depth of 20mm.
Block dimensions	1030 x 300mm.
Estimated width of mortar joints	5mm.
Greatest depth of mortar loss	0mm.
Position of test core	130mm from the exposed surface.
Angle of bedding plane to direction of thrust	90°.
Angle of bedding plane to axis of core	0°.
Thickness of arch barrel core length	565mm.
Total length cored	650mm.
Compressive strength of masonry	20.5N/mm ² .
Description of material above barrel	Mortar and infill above pier

APPENDIX C**Photographs**

Photographs are contained within Appendix A: Principal Inspection Report

APPENDIX D

AIP and Assessment and Check Certificates

Structure Name: Disused Rail Bridges Nos. 1&97

Structure Ref: B751/20

East Ayrshire Council Assessment and Check Certificate

Name of Project: East Ayrshire Council Bridge Assessment Programme Work Package 8

Name of Structure: Disused Rail Bridges Nos. 1&97

Structure Ref No: B751/20

1. Assessment

We certify that reasonable professional skill and care have been used in the assessment and check of the above structure with a view to securing that:

i. It has been assessed and checked in accordance with:

- a) The Approval in Principle (for Assessment)
And the following ADDENDA

dated Dec 2009
dated N/A

ii. The assessed capacity of the structure is as follows:

24 tonnes Assessment Live Loading.

iii. It has been accurately translated into the Assessment Report dated Dec 2009

Signed:

Name:

Engineering Qualifications:

BSc MSc PhD CEng MICE

Signed:

Name:

Engineering Qualifications:

BEng CEng FICE FIHT MCMI MAPM

Name of Organisation:

URS Corporation Ltd

Date:

.....

Dec 2009

2. Endorsement By TAA

i. The Departures from Standards and additional methods and criteria given in Paragraph 1.a above are agreed.

ii. It has been directed that the following items shall be dealt with as described.

3. Acceptance

This Certificate is accepted by TAA East Ayrshire Council.

Signed

Name

Position held

Engineering Qualifications

Date

.....
DESIGN MANAGER, EAST AYRS
BSc Hons. C.ENG. MICE
FEB 2010.....

THE ABOVE IS ACCEPTED BY THE REVIEWER,

Signed

Name

Assessment Review Team Leader

Engineering Qualifications BEng(Hons) CEng MICE MIHT

Date

8/2/10

JMP

APPLICATION FOR APPROVAL IN PRINCIPLE

AIP FOR ASSESSMENT

1. HIGHWAY DETAILS

1.1 Type of Highway: -

The structure carries the B751, a single-lane single carriageway road with a footway on the east side.

1.2 Permitted Traffic Speed: -

Over/Under 60mph. (96km/h).

1.3 Existing Weight Restriction: -

None.

2. SITE DETAILS

2.1 Obstacles crossed: -

Route 73 National Cycle Network

3. PROPOSED STRUCTURE

3.1 Description of Structure: -

3.1.1. Superstructure

Two span elliptical masonry arch bridge with 2no 8.6m spans and an overall width of 8.27m. The barrel thickness was confirmed by coring and found to be 460mm thick minimum with masonry and mortar backing present to a height of approximately 1600mm above springing level.

3.1.2. Substructure

Masonry abutments.

3.2 Structural type:-

Underbridge.

3.3 Foundation type: -

Unknown. Likely to be of masonry construction.

3.4 Span arrangements: -

The masonry arch clear square span of 8.6m between springings.

3.5 Articulation arrangements: -

Not Applicable.

3.6 Road restraint system type: -

Unreinforced masonry parapets on the east 280mm thick and typically 1.20m high.

Unreinforced masonry parapets on the west 280mm thick and typically 1.20m high.

- 3.7 **Proposed arrangements for Inspection for Assessment: -**
- 3.7.1 **Traffic Management**
 None
- 3.7.2 **Access**
 Access was achieved via the cycle path.
- 3.7.3 **Intrusive or further investigations proposed**
 Coring of the arch barrel was undertaken to confirm barrel thickness, and material testing has been carried out to determine characteristic strength of masonry.
- 3.8 **Materials strengths assumed and basis of assumptions: -**
 Characteristic strength of masonry 6N/mm^2 will be used throughout, derived from BD21/01 Fig 4.3 and based on the average of unit compressive strengths ranging from 20.5 N/mm^2 - 42.6N/mm^2 .
- 3.9 **Risks and Hazards considered: -**
 Specific risks arising from the nature of the site include working at height, slips, trips and falls.
- 3.10 **Year of Construction: -**
 Unknown.
- 3.11 **Reason for Assessment: -**
 Bridge Assessment Programme.
- 3.12 **Part of Structure to be Assessed: -**
 Superstructure – Masonry arch barrel and pier.
 Substructure – Masonry abutments and wingwalls – qualitative assessment.

4. DESIGN CRITERIA

4.1 Live Loading, Headroom

- 4.1.1 **Loading relating to normal traffic under AW regulations and C&U regulations i.e. HA Loading: -**
 40 Tonnes Assessment Live Loading in accordance with BD21/01.
- 4.1.2 **Loading relating to General Order Traffic under STGO regulations i.e. HB Loading No of Units: -**
 45 Units HB Loading in accordance with BD37/01.
 SV 80, SV100, SV150, SV-TT, SV-Train in accordance with BD86/07.
- 4.1.3 **Footway or footbridge live loading: -**
 In accordance with BD 21/01.
- 4.1.4 **Loading relating to Special Order Traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross section: -**

None.

- 4.1.5 **Any special loading not covered above:**
 None
- 4.1.6 **Heavy or high load route requirements and arrangements made to preserve the route including any provision for future heavier loads or future widening: -**
 None.
- 4.1.7 **Minimum headroom provided: -**
 4.8m approx from invert to arch soffit.
- 4.1.8 **Authorities consulted and any special conditions required: -**
 East Ayrshire Council
- 4.2 **List relevant documents from the TAS: -**
 See Appendix A
- 4.2.1 **Additional relevant Standards: -**
 None
- 4.3 **Proposed departures from Standards given in 4.2 and 4.2.1: -**
 For the assessment of vehicle parapets to TS Interim Amendment No.25, in the determination of C_{MIN} , minimum capacity of the parapet, East Ayrshire Council have stated that C_{MIN} is deemed to be met where the following conditions apply
 parapet width > 225mm **and**
 parapet height > 800mm
- Guidance was received on 18 August 2008.
- 4.4 **Proposed methods of dealing with aspects not covered by standards in 4.2 and 4.2.1: -**
 Not Applicable.

5. STRUCTURAL ANALYSIS

- 5.1 **Methods of analysis proposed for superstructure, substructure and foundations:-**
 Two methods of analysis will be undertaken:
- 1) Modified MEXE assessment to BA16/97
 - a. NOTE: BD 21/01 Cl 6.17 states that when the depth of fill at the crown is greater than the thickness of the arch barrel the MEXE method may be unconservative. In accordance with Railtrack Current Information Sheet No.21 (May 2002), fill depth (h) shall be limited to barrel thickness (d) to ensure conservatism for modified MEXE assessment.
 - 2) Mechanism analysis utilising proprietary software Archie-M, Version 2.1.2

- a. NOTE: Active and passive soil pressures will be used in the Archie-M model (passive pressure proportion limited to 0.30 as a maximum).

NOTE: Axle lift-off and centrifugal effects will not occur on this structure and therefore will not be considered in the assessment.

- 5.2 **Description and diagram of idealised structure to be used for analysis:** -
For the purposes of the assessment a true profile arch shall be used and the condition factor shall be reduced to account for any deviation from true profile. Condition factor to be determined based on results of material testing and inspection of the arch barrel.
The level of backing has been derived from the coring information. Backing was found in all cores and at quarter points this extended 400mm beyond the barrel itself. Graphically plotting this onto the elevation of the arch and assuming a 'flat top' profile, suggests that the backing extends approximately 1600mm above the point of springing.

- 5.3 **Assumptions intended for calculation of structural element stiffness:** -
Gross section properties:

6. GEOTECHNICAL CONDITIONS

- 6.1 **Acceptance of recommendations of the Section 8 of the Geotechnical Report to be used in the assessment and reasons for any proposed changes:** -
Not Applicable.
- 6.2 **Geotechnical Report Highway Structure Summary Information (Form C)**
Not Applicable.
- 6.3 **Differential settlement to be allowed for in assessment of the structure:** -
Not Applicable.

7. CHECKING

- 7.1 **Proposed Category:** -
Category 1.
- 7.2 **If Category 3, name of proposed Independent Checker:** -
Not Applicable.
- 7.3 **Erection proposals or temporary works for which an independent check will be required, listing the parts of the structure affected with reasons for recommending an independent check:** -
Not Applicable.

8. DRAWINGS AND DOCUMENTS

- 8.1 **List of drawings (including numbers) and documents accompanying the submission:** -
49331615/B751/20 Disused Rail bridges 1 & 97 - G.A. & Survey Information

- 8.2 **List of construction and record drawings (including numbers) to be used in the assessment: -**
 None.
- 8.3 **List of pile driving or other construction records: -**
 None.
- 8.4 **List of previous inspection and assessment reports: -**
 General Inspection dated May 2006 is included in Appendix A.

9. THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed

Name

'Assessment/Check Team Leader'

Engineering Qualifications BSc MSc PhD CEng MICE

Name of Organisation URS Corporation Ltd

Date December 2009

10. THE ABOVE IS AGREED SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW: -

Signed

Name

Design Roads Network Manager

Engineering Qualifications

.....BSc(Hons), C. Eng, MICE.....

TAA

East Ayrshire Council

Date

Feb 2010 .

THE ABOVE IS ACCEPTED BY THE REVIEWER

Signed

Name

JMP

Assessment Review Team Leader

Engineering Qualifications BEng(Hons) CEng MICE MIHT

Date

8/2/10

APPENDIX A

LIST RELEVANT DOCUMENTS FROM THE TAS

The Design Manual for Roads and Bridges (DMRB)***Bridges and Structures, Advice Notes (BA Series)***

The following has been reproduced from November 2006 alpha numeric index in the DMRB, Volume 1, Section 0, Part 2.

Document Reference	Title	Date of Issue	Decimal Reference
BA 9/81	The Use of BS 5400: Part 10: 1980. Code of Practice for Fatigue- Amendment No. 1	Dec 1981- Nov 1983	1.3
BA 16/97	The Assessment of Highway Bridges and Structures. Amendment No. 1 Amendment No.2	May 1997 Nov 1997 Nov 2001	3.4.4
BA 19/85	The Use of BS 5400: Part 3: 1982	Jan 1985	1.3
BA 24/87	Early Thermal Cracking of Concrete- Amendment No. 1	Jul 1987- Aug 1989	1.3
BA 26/94	Expansion Joints for Use in Highway Bridge Decks	Nov 1994	2.3.7
BA 28/92	Evaluation of Maintenance Costs in Comparing Alternative- Designs for Highway Structures	Aug 1992	1.2.2
BA 30/94	Strengthening of Concrete Highway Structures Using Externally Bonded Plates	Feb 1994	3.3.1
BA 34/90	Technical Requirements for the Assessment and Strengthening- Programme for Highway Structures	Sep 1990	3.4
BA 35/90	Inspection and Repair of Concrete Highway Structures	Jun 1990	3.3
BA 36/90	The Use of Permanent Formwork	Feb 1991	2.3
BA 37/92	Priority Ranking of Existing Parapets	Oct 1992	2.3.2
BA 38/93	Assessment of the Fatigue Life of Corroded or Damaged- Reinforcing Bars	Oct 1990	3.4.5
BA 39/93	Assessment of Reinforced Concrete Half joints	Apr 1993	3.4.6
BA 40/93	Tack Welding of Reinforcing Bars	Apr 1993	1.3.4
BA 41/98	The Design and Appearance of Bridges	Feb 1998	1.3.11
BA 42/96	The Design of Integral Bridges [Incorporating Amendment No.1 dated May 2003]	Nov 1996	1.3.12
BA 44/96	Assessment of Concrete Highway Bridge and Structures	Nov 1996	3.4.15
BA 47/99	Waterproofing and Surfacing Concrete Bridge Decks	Aug 1999	2.3.5

Document Reference	Title	Date of Issue	Decimal Reference
BA-50/93	Post-tensioned Concrete Bridges: Planning, Organisation and Methods for Carrying Out Special Inspections	Jul 1993	3.1.3
BA-51/95	The Assessment of Concrete Structures Affected by Steel Corrosion	Feb 1995	3.4.13
BA-52/94	The Assessment of Concrete Highway Structures Affected by Alkali-Silica Reaction	Nov 1994	3.4.10
BA-53/94	Bracing Systems and the Use of U-Frames in Steel Highway Bridges	Dec 1994	1.3.13
BA-54/94	Load Testing for Bridge Assessment	Apr 1994	3.4.8
BA-55/06	The Assessment of Bridge Substructures and Foundations, Retaining Walls and Buried Structures	May 2006	3.4.9
BA-56/96	The Assessment of Steel Highway Bridges and Structures	Nov 1996	3.4.12
BA-57/01	Design for Durability	Aug 2001	1.3.8
BA-58/94	Design of Bridges and Concrete Structures with External Unbonded Prestressing	Nov 1994	1.3.10
BA-59/94	Design of Highway Bridges for Hydraulic Action	May 1994	1.3.6
BA-61/96	The Assessment of Composite Highway Bridges	Nov 1996	3.4.17
BA-63/94	Inspection of Highway Structures	Oct 1994	3.1.5
BA-67/96	Enclosure of Bridges	Aug 1996	2.2.8
BA-68/97	Crib Retaining Walls	Feb 1997	2.1.4
BA-72/03	Maintenance of Road Tunnels	May 2003	3.2.3
BA-74/06	Assessment of Seour at Highway Bridges	Aug 2006	3.4.21
BA-80/99	Use of Rock Belts	Feb 1999	2.1.7
BA-82/00	Formation of Continuity Joints in Bridge Decks	Nov 2000	2.3.7
BA-83/02	Cathodic Protection for Use in Reinforced Concrete Highway Structures	Feb 2002	3.3.3
BA-84/02	Use of Stainless Steel Reinforced in Highway Structures	Feb 2002	1.3.15
BA-85/04	Coatings for Concrete Highway Structures and Ancillary Structures	May 2004	2.4.3
BA-86/06	Advice Notes on the Non-Destructive Testing of Highway Structures	Aug 2006	3.1.7

BA-87/04	Management of Corrugated Steel Buried Structures- Correction No. 1	Aug 2004 Feb 2006	3.3.4
BA-88/04	Management of Buried Concrete Box Structures	Aug 2004	3.3.5

Bridges and Structures, Standards (BD Series)

The following has been reproduced from November 2006 alpha numeric index in the DMRB, Volume 1, Section 0, Part 2.

Document Reference	Title	Date of Issue	Decimal Reference
BD 2/05	Technical Approval of Highway Structures	Aug 2005	1.1.1
BD 7/01	Weathering Steel for Highway Structures	Nov 2001	2.3.8
BD 9/81	Implementation of BS 5400: Part 10: 1980. Code of Practice for Fatigue	Dec 1981	1.3
BD 10/97	Design of Highway Structures in Areas of Mining Subsidence	May 1997	1.3.14
BD 12/01	Design of Corrugated Steel Buried Structures with Spans Greater than 0.9 Metres and up to 8.0 Metres	Nov 2001	2.2.6
BD 13/06	Design of Steel Bridges. Use of BS 5400: Part 3: 2000	May 2006	1.3.14
BD 15/92	General Principles for the Design and Construction of Bridges. Use of BS 5400: Part 1: 1988	Dec 1992	1.3.2
BD 16/82	Design of Composite Bridges. Use of BS 5400: Part 5:1979	Nov 1982	1.3
	Amendment No.1	Dec 1987	
BD 20/92	Bridge Bearings. Use of BD 5400: Part 9: 1983	Oct 1992	2.3.1
BD 21/01	The Assessment of Highway Bridges and Structures	May 2001	3.4.3
BD 24/92	Design of Concrete Bridges. Use of BS 5400: Part 4:1990	Nov 1992	1.3.1
BD 26/04	Design of Lighting Columns	Nov 2004	2.2.1
BD 27/86	Materials for the Repair of Concrete Highway Structures	Nov 1986	3.3
BD 28/87	Early Thermal Cracking of Concrete	Jul 1987	1.3
	Amendment No.1	Aug 1989	
BD 29/04	Design Criteria for Footbridges	Aug 2004	2.2.8
BD 30/87	Backfilled Retaining Walls and Bridge Abutments	Aug 1987	2.1
BD 31/01	The Design of Buried Concrete Box and Portal Frame Structures	Nov 2001	2.2.12
BD 33/94	Expansion Joints for Use in Highway Bridge Decks	Nov 1994	2.3.6
BD 34/90	Technical Requirements for the Assessment and Strengthening Programme for Highway Structures	Sep 1990	3.4
BD 35/06	Quality Assurance Scheme for Paints and Similar Protective Coatings	May 2006	2.4.1
BD 36/92	Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures	Aug 1992	1.2.1
BD 37/01	Loads for Highway Bridges	Aug 2001	1.3.14

Document Reference	Title	Date of Issue	Decimal Reference
BD 41/97	Reinforced Clay Brickwork Retaining Walls of Pocket Type and Grouted Cavity type Construction Use of BS 5628: Part 2: 1995	May 1997	2.1.1
BD 42/00	Design of Embedded Retaining Walls and Bridge Abutments	May 2000	2.1.2
BD 43/03	The Impregnation of Reinforced and Prestressed Concrete Highway Structures using Hydrophobic Pore Lining Impregnates	Feb 2003	2.4.2
BD 44/95	The Assessment of Concrete Highway Bridges and Structures	Jan 1995	3.4.14
BD 45/93	Identification Marking of Highway Structures	Aug 1993	3.1.1
BD 46/92	Technical Requirements for the Assessment and Strengthening Programme for Highway Structures [Stage 2 - Modern Short Span Bridges]	Aug 1992	3.4.1
BD 47/99	Waterproofing and Surfacing of Concrete Bridge Decks	Aug 1999	2.3.4
BD 48/93	The Assessment and Strengthening of Highway Bridge Supports	Jun 1993	3.4.7
BD 49/01	Design Rules for Aerodynamic Effects on Bridges	May 2001	1.3.3
BD 50/92	Technical Requirements for the Assessment and Strengthening Programme for Highway Structures Stage 3 - Long Span Bridges	Dec 1992	3.4.2
BD 51/98	Portal and Cantilever Signs/Signal Gantry	May 1998	2.2.4
BD 53/95	Inspection and Records for Road Tunnels	Jul 1995	3.1.6
BD 54/93	Post-tensioned Concrete Bridges Prioritisation of Special Inspections	Apr 1993	3.1.2
BD 56/96	The Assessment of Steel Highway Bridges and Structures	Nov 1996	3.4.11
BD 57/01	Design for Durability	Aug 2001	1.3.7
BD 58/94	The Design of Concrete Highway Bridges and Structures with External and Unbonded Prestressing	Nov 1994	1.3.9
BD 60/04	Design of Highway Bridges for Vehicle Collision Loads	May 2004	1.3.5
BD 61/96	The Assessment of Composite Highway Bridges	Nov 1996	3.4.16
BD 62/94	As Built, Operational and Maintenance Records for Highway Structures Amendment to Appendix D	Oct 1994 Feb 2003	3.2.1
BD 63/07	Inspection of Highway Structures	Feb 2007	3.1.4

Document Reference	Title	Date of Issue	Decimal Reference
BD-65/97	Design Criteria for Collision Protector Beams	Feb 1997	2.2.5
BD-67/96	Enclosure of Bridges	Aug 1996	2.2.7
BD-68/97	Crib Retaining Walls	Feb 1997	2.1.3
BD-70/03	Strengthened/Reinforced Soils and Other Fills for Retaining Walls and Bridge Abutments Use of BS8006: 1995, incorporating Amendment No.1 (Issue 2 March 1999)	May 2003	2.1.5
BD-74/00	Foundations	May 2000	2.1.8
BD-78/99	Design of Road Tunnels	Aug 1999	2.2.9
BD-81/02	Use of Compressive Membrane Action in Bridge Decks	May 2002	3.4.20
BD-82/00	Design of Buried Rigid Pipes	Aug 2000	2.2.10
BD-83/01	Design of CCTV Masts	Aug 2001	2.2.11
BD-84/02	Strengthening of Concrete Bridge Supports Vehicle Impact Using Fibre Reinforced Polymers	Aug 2002	1.3.16
BD 86/07	The Assessment of Highway Bridges and Structures For The Effects of Special Types General Order (STGO) and Special Order (SO) Vehicles	Nov 2007	3.4.19
BD-87/05	Maintenance Painting of Steelwork	May 2005	3.2.2
BD-88/05	Design of Cantilever Masts for Traffic Signals and/or Speed Cameras	May 2005	2.2.13
BD89/03	The Conservation of Highway Structures	Nov 2003	3.2.4
BD-90/05	Design of FRP Bridges and Highway Structures	May 2005	1.3.17
BD 91/04	Unreinforced Masonry Arch Bridges	Nov 2004	2.2.14

Bridges and Structures, Technical Memoranda (BE Series)

The following has been reproduced from November 2006 alpha numeric index in the DMRB, Volume 1, Section 0, Part 2.

Document Reference	Title	Date of Issue	Decimal Reference
BE-13	Fatigue Risk in Bailey Bridges	Apr 1968	3.4
BE-23	Shear Key Decks Amendment No. 1 to Annex	Nov 1970 Jun 1971	1.3
BE-5/75	Rules for the Design and Use of Freyssinet Concrete Hinges in Highway Structures	Mar 1975	1.3
BE-7/04	Departmental Standard (Interim) Motorway Sign/Signal Gantry	Aug 2004	2.2

APPENDIX B

DWG NO. 49331615/B751/20

G.A. & SURVEY INFORMATION

Note: Drawing is contained within Appendix E: Assessment Report

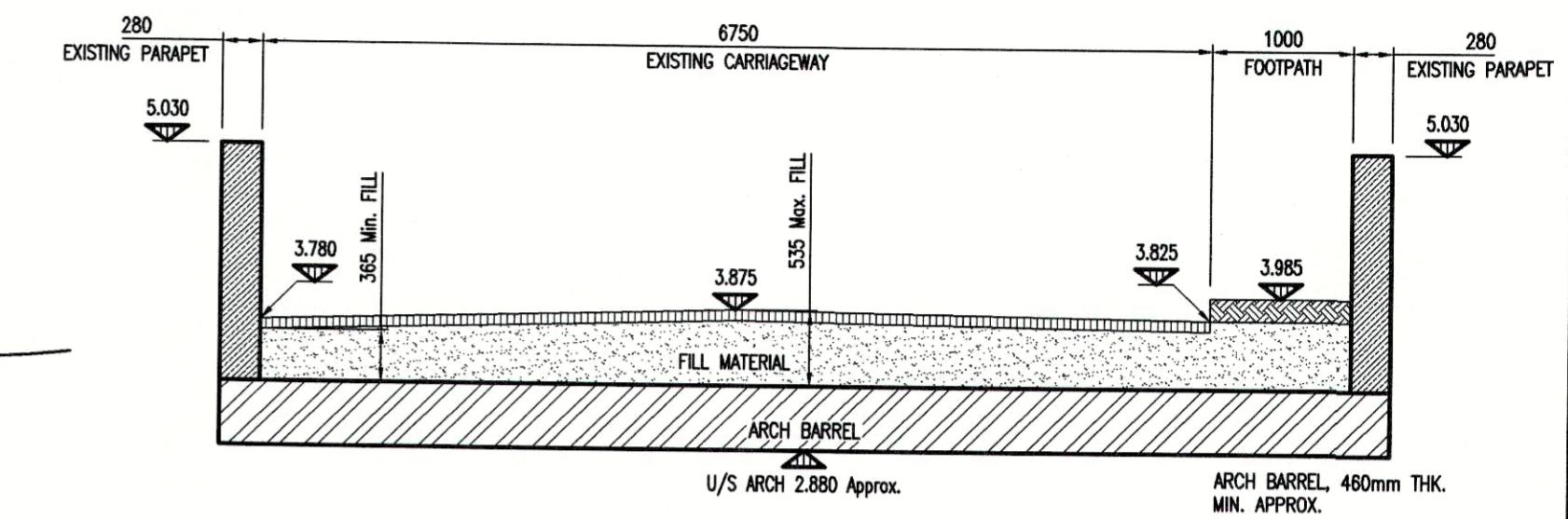
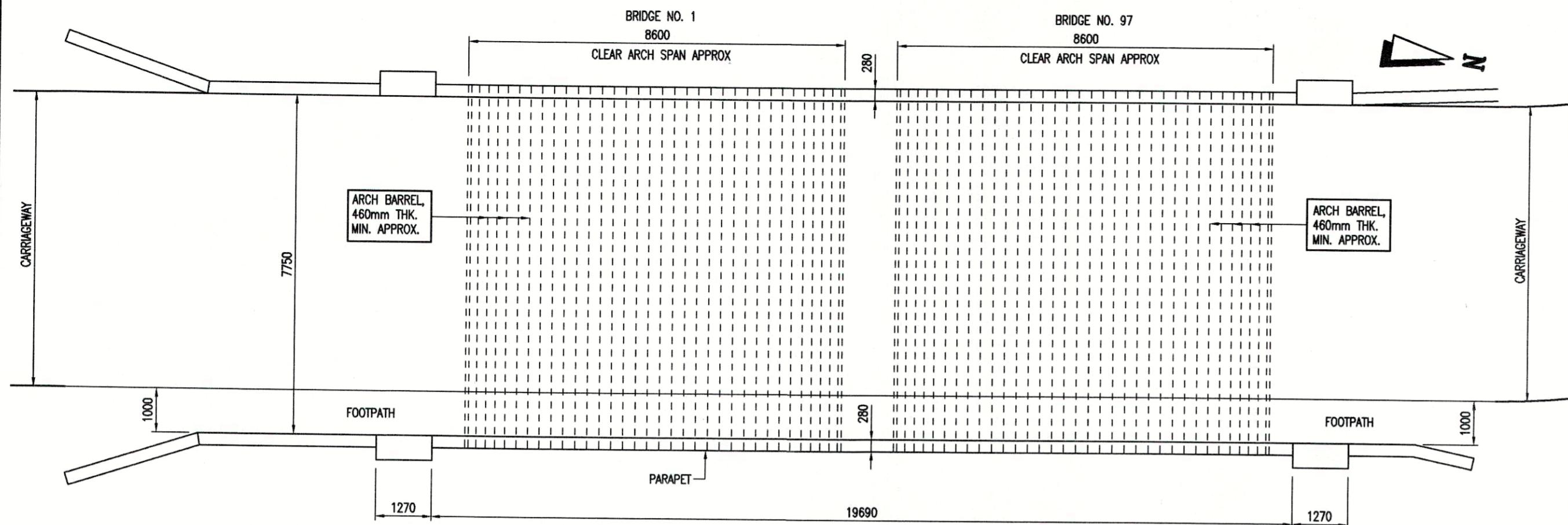
APPENDIX E

General Arrangement Drawing

DO NOT SCALE

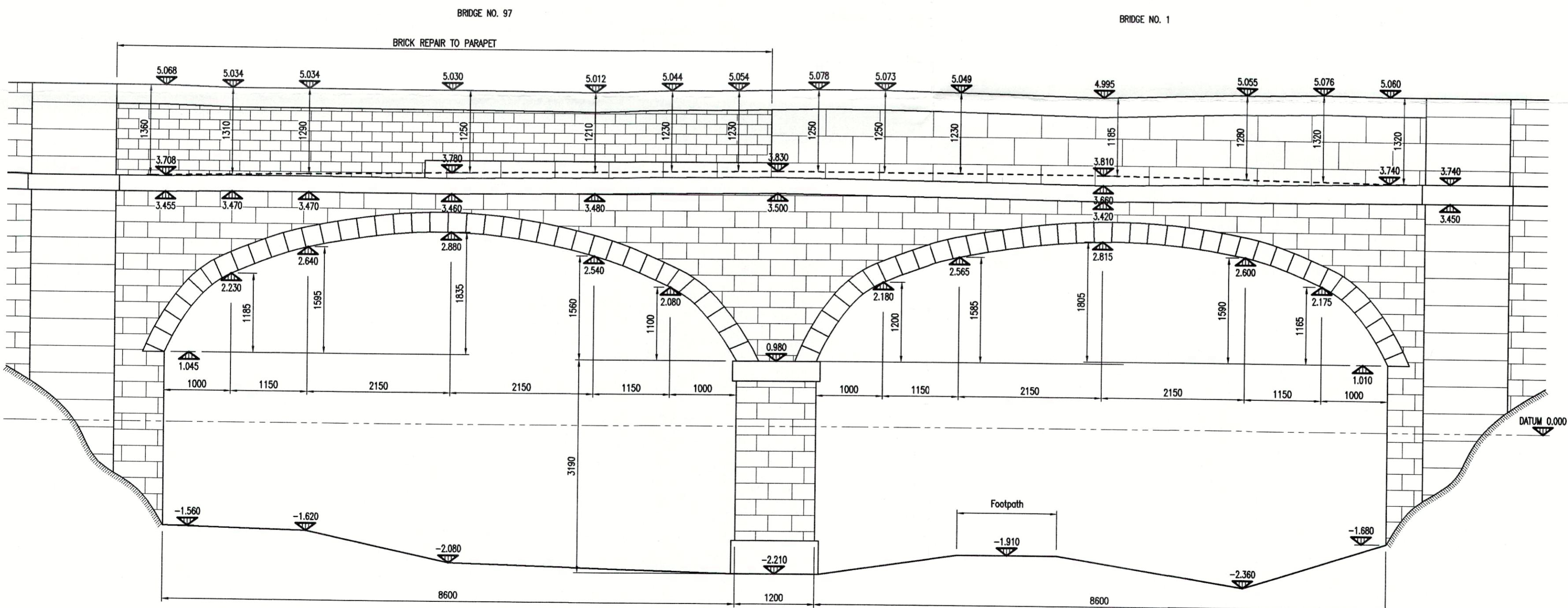
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES
A.O.D. UNLESS NOTED OTHERWISE.



EXISTING SECTION

(SCALE 1:50)



DESCRIPTION	AMM	APPEND	ONE	
STATUS				
FOR INFORMATION				
CONSULTING ENGINEERS				
URS				
243 WEST GEORGE STREET GLASGOW G2 4QE				
TEL 0141-226-3611 FAX 0141-248-3773				
CLIENT				
EAST AYRSHIRE COUNCIL				
PROJECT				
BRIDGE ASSESSMENT PROGRAMME				
WORK PACKAGE 8				
DRAWING TITLE				
DISUSED RAIL BRIDGE 1 & 97				
B751/20 GENERAL ARRANGEMENT				
AND SURVEY INFORMATION				
DRAWN C.W.	RECORDED	CHECKED E.T.	APPROVED E.T.	DATE DEC'08
SCALE As Noted	Dwg No. 49331615/B751-20-0001	REV.		

VOLUME 2**Testing Report**



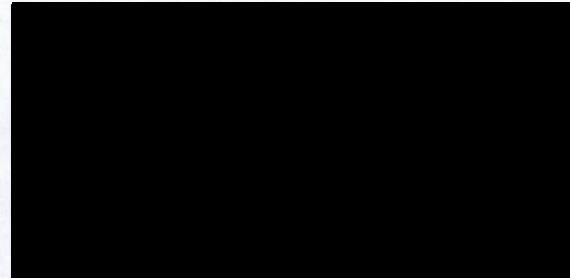
REPORT ON CORING INVESTIGATION OF

MASONRY ARCHES TO

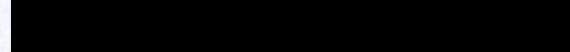
EAST AYRSHIRE COUNCIL,
BRIDGE ASSESSMENT PROGRAMME,
WORK PACKAGE 8,

B751/20 DISUSED RAIL BRIDGE NOS. 1 & 97.

This report was compiled by:



This report was checked by:



**This test report may not be reproduced except in full
without written approval from the laboratory.**

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Core Locations and Cursory Visual Inspection.....	3
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24 November 2008

Job No: 232/08

URS Corporation Ltd,
243 West George Street,
Glasgow G2 4QE.



For the attention of Elwyn Thomas Esq.

**Report On Coring Investigation Of Masonry Arches To
East Ayrshire Council, Bridge Assessment Programme, Work Package 8
B751/20 Disused Rail Bridge Nos. 1 & 97.**

1 INTRODUCTION

In accordance with your instructions, we have carried out cutting 6 No. cores perpendicular through the arches to the above bridge. The work on site was carried out on the 12 and 15 September 2008 by a team led by our Mr. A. McFarlane. This report details our findings.

2 EXTENT OF INVESTIGATION

The investigation was carried out for assessment purposes and comprised the following:-

- a) Cursory visual inspection of both sandstone arch intrados.
- b) Cutting of 3 No. 100mm diameter cores from the springings and quarter points of each of the arch intrados. The cores were cut to determine compressive strength and the thickness of the arch barrel.
- c) Measurement of the depth to which mortar was missing from between the joints.
- d) Measurement of the width of joint between blocks.
- e) A photographic record of the samples was made.

3 INSPECTION AND SITE SAMPLING

3.1 Extraction Of Masonry Cores

6 No. 100mm diameter cores were cut in the direction perpendicular to the surface of the intrados, into the arch barrel using a hydraulic coring machine with fresh water flush. The direction of arch thrust was marked on the end of each core prior to cutting. On extraction of the cores, a 50mm diameter core was cut perpendicular through the core. The 50mm diameter core sections were sealed in their wet condition, in plastic bags marked with the bridge identification and core reference. Core holes were reinstated using Nufins Nucem HB cementitious repair mortar. The location of the cores are detailed in Appendix A. Details of in-situ sampling are shown in Appendix B. Photographic prints of the cores can also be found in Appendix B.

95 Ormonde Drive
Netherlee
Glasgow
G44 3RF

3.2 Depth Of Open Joint

Depths to which mortar was missing from between the joints was measured using a graduated depth gauge. The results of our findings can be found in Appendix B.

3.3 Width Of Joint Between Blocks

The width of joint between blocks were measured using a steel rule. The results of our findings can be found in Appendix B.

4 LABORATORY TESTING

4.1 General

The 50mm diameter masonry core samples were submitted to the Shotts laboratory of MATtest Limited for compressive strength testing.

4.2 Compressive Strength Of Masonry

Test cores were cut from the primary sample cores so that their axes were parallel with the direction of thrust in the arch. The locations from which they were cut from the primary samples can be found in Appendix B. In the absence of a British Standard which includes in its scope the compressive testing of stone masonry core samples, compressive cores were tested for compressive strength following the method of ASTM D2938 except that the ends of the cores were cut using a diamond saw rather than being ground. Samples were received in saturated surface wet condition and soaked at 20°C for 48 hours prior to testing. The results of testing can be found in Appendix C.

APPENDIX A

LOCATION DRAWINGS

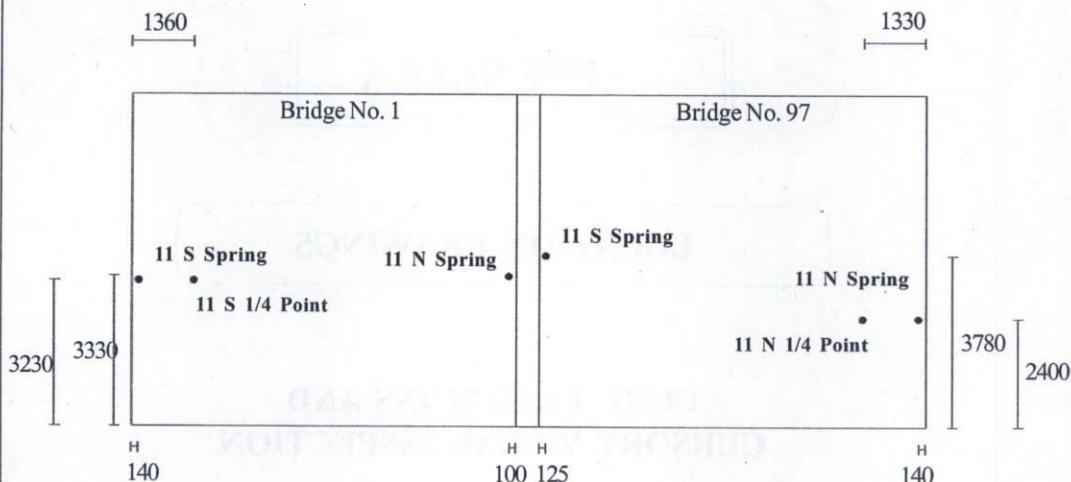
CORE LOCATIONS AND CURSORY VISUAL INSPECTION

Core Locations & Cursory Visual Inspection

Job No.: 232/08

Structure Name: B751/20 Disused Rail Bridges 1 & 97.

Plan View Of Structure Detailing Core Locations



Plan View Of Arch Intrados

Notes

All measurements are in millimetres.

Plan of structure is as viewed from above.

● Denotes core location.

Cursory Visual Inspection

Bridge No. 1

The arch intrados comprised uniform blocks forming a relatively smooth, round arch. Dark green and black staining shown throughout. Surface erosion was visible on the surface of a few blocks. A brick repair was found at the south quarter point. A large crack was visible between the south abutment and the south springing towards the east spandrel. Plates 1 to 3.

Bridge No. 97

The arch intrados comprised uniform blocks forming a relatively smooth, round arch. Dark green and black staining shown throughout. Surface erosion up to 20mm deep was visible on the surface of a few blocks. A large crack was visible between the north springing and the north quarter point towards the west spandrel. Plates 14 to 16.

APPENDIX B

IN-SITU SAMPLING AND TESTING

INVESTIGATION OF MASONRY ARCH

Investigation of Masonry Arch

Job No.: 232/08

Structure Name: B751/20 Disused Rail Bridges 1 & 97.



Core Reference 11 Bridge No. 1 North Springing

Description of masonry:

Light brown fine grained sandstone with darker bedding planes visible.

Description of masonry surface:

Uniform block with dry dark green staining.

Block dimensions:

1185 x 310mm.

Estimated width of mortar joints:

5 to 20mm.

Greatest depth of mortar loss:

10mm.

Position of test core:

160mm from the exposed surface.

Angle of bedding plane to direction of thrust:

90°.

Angle of bedding plane to axis of core:

0°.

Thickness of arch barrel core length:

540mm.

Total length cored:

670mm.

Compressive strength of masonry:

32.3N/mm².

Description of material above barrel:

Masonry block to springing of Bridge No. 97.

Investigation of Masonry Arch

Job No.: 232/08

Structure Name: B751/20 Disused Rail Bridges 1 & 97.



Core Reference 11 Bridge No. 1 South Springing

Description of masonry:

Light brown / grey fine grained sandstone with darker bedding planes visible.

Description of masonry surface:

Uniform block with dry dark green / black staining.

Block dimensions:

1040 x 310mm.

Estimated width of mortar joints:

5mm.

Greatest depth of mortar loss:

15mm.

Position of test core:

130mm from the exposed surface.

Angle of bedding plane to direction of thrust:

90°.

Angle of bedding plane to axis of core:

0°.

Thickness of arch barrel core length:

480mm.

Total length cored:

1295mm.

Compressive strength of masonry:

42.6N/mm².

Description of material above barrel:

Masonry blocks with mortar bed.

Investigation of Masonry Arch

Job No.: 232/08

Structure Name: B751/20 Disused Rail Bridges 1 & 97.



Core Reference 11 Bridge No. 1 South Quarter Point

Description of masonry:

Light brown / grey fine grained sandstone with darker bedding planes visible.

Description of masonry surface:

Uniform block with dry dark green / black staining.

Block dimensions:

670 x 150mm.

Estimated width of mortar joints:

5 to 35mm.

Greatest depth of mortar loss:

Repointed.

Position of test core:

130mm from the exposed surface.

Angle of bedding plane to direction of thrust:

70°.

Angle of bedding plane to axis of core:

20°.

Thickness of arch barrel core length:

460mm.

Total length cored:

990mm.

Compressive strength of masonry:

32.5N/mm².

Description of material above barrel:

Unbound masonry with dark brown silty sand.

* SEE NOTE IN APPENDIX B -
TEST INVESTIGATION SUMMARY

Investigation of Masonry Arch

Job No.: 232/08

Structure Name: B751/20 Disused Rail Bridges 1 & 97.



Core Reference 11 Bridge No. 97 North Springing

Description of masonry:

Light brown / grey fine grained sandstone with darker bedding planes visible.

Description of masonry surface:

Uniform block with black and green staining.

Block dimensions:

980 x 300mm.

Estimated width of mortar joints:

5mm.

Greatest depth of mortar loss:

0mm.

Position of test core:

110mm from the exposed surface.

Angle of bedding plane to direction of thrust:

90°.

Angle of bedding plane to axis of core:

0°.

Thickness of arch barrel core length:

620mm.

Total length cored:

740mm.

Compressive strength of masonry:

24.7N/mm².

Description of material above barrel:

Mortar and masonry backfill.

Investigation of Masonry Arch

Job No.: 232/08

Structure Name: B751/20 Disused Rail Bridges 1 & 97.



Core Reference 11 Bridge No. 97 North Quarter Point

Description of masonry:

Light brown / grey fine grained sandstone with darker bedding planes visible.

Description of masonry surface:

Uniform block with black, white and green staining.
850 x 300mm.

Block dimensions:

5mm.

Estimated width of mortar joints:

0mm.

Greatest depth of mortar loss:

80mm from the exposed surface.

Position of test core:

90°.

Angle of bedding plane to direction of thrust:

0°.

Angle of bedding plane to axis of core:

460mm.

Thickness of arch barrel core length:

860mm.

Total length cored:

38.5N/mm².

Compressive strength of masonry:

Mortar and masonry infill.

Description of material above barrel:

Investigation of Masonry Arch

Job No.: 232/08

Structure Name: B751/20 Disused Rail Bridges 1 & 97.



Core Reference 11 Bridge No. 97 South Springing

Description of masonry:

Light brown / grey fine grained sandstone with darker bedding planes visible.

Description of masonry surface:

Uniform block with black and green staining. Surface erosion visible to a maximum depth of 20mm.

Block dimensions:

1030 x 300mm.

Estimated width of mortar joints:

5mm.

Greatest depth of mortar loss:

0mm.

Position of test core:

130mm from the exposed surface.

Angle of bedding plane to direction of thrust:

90°.

Angle of bedding plane to axis of core:

0°.

Thickness of arch barrel core length:

565mm.

Total length cored:

650mm.

Compressive strength of masonry:

20.5N/mm².

Description of material above barrel:

Mortar and infill above pier

APPENDIX C

LABORATORY TESTING AND ANALYSIS

COMPRESSIVE STRENGTH TEST CERTIFICATES



Materials Testing & Consultancy

Edinburgh Road
Springhill
Shotts
ML7 5DT

LABORATORY TEST CERTIFICATE MATERIALS LABORATORY

Certificate No 08/544 - 07

To : [REDACTED]

Client : MATtest Site Services
 95 Ormane Drive
 Netherlee
 Glasgow
 G44 3RF

Dear Sirs,

LABORATORY TESTING OF ROCK

Introduction

We refer to samples delivered to our laboratory on 20th October 2008.

Material & Source

Sampling	:	Sampled by Client
Sample Reference	:	See Report Plates
Description	:	N/A
Date Sampled	:	Not Given
Date Tested	:	20th October 2008 Onwards
Source	:	Bridge No. B751/20 - Disused Rail Bridge No. 1

Test Results;

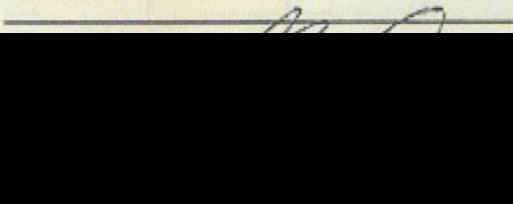
As Detailed On Page 2 to Page 3 Inclusive

Comments;

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
All remaining samples for this project will be disposed of 28 days after issue of this test certificate

Remarks;

Uniaxial Compressive Strength - Cores did not meet required length / diameter ratio specification



29/10/2008



Issue No. 01

Registration No. 253253

Page 1 of 3

2643

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m³)	DRY DENSITY (Mg/m³)
-	North 1/4 Point	-	4.4	2.35	2.25
-	South Springing	-	0.3	2.31	2.30
-	North Springing	-	5.1	2.43	2.31

Tested in accordance with "ISRM Suggested Methods"

SUMMARY OF MOISTURE CONTENT AND DENSITY TEST RESULTS

BOREHOLE		-	North 1/4 Point	SAMPLE FAILURE SHAPES	
CORE RUN	DEPTH			External	Internal
SAMPLE DIAMETER	mm	47.32			
SAMPLE HEIGHT	mm	70.77			
WATER CONTENT	%	4.4			
DEGREE OF SATURATION	%	N/A			
STRESS RATE	kN/s	0.100			
TEST DURATION	min.sec	3.42	27-Oct-08		
DATE OF TESTING			Impact		
LOAD FRAME USED			Axial		
ORIENTATION OF LOADING				External	Internal
FAILURE LOAD	kN	57.2			
UNIAXIAL COMPRESSIVE STRENGTH	MPa	32.5			

The above sample does not meet specified length / diameter ratio requirements

BOREHOLE		-	South Springing	SAMPLE FAILURE SHAPES	
CORE RUN	DEPTH			External	Internal
SAMPLE DIAMETER	mm	47.22			
SAMPLE HEIGHT	mm	73.84			
WATER CONTENT	%	0.3			
DEGREE OF SATURATION	%	N/A			
STRESS RATE	kN/s	0.200			
TEST DURATION	min.sec	7.14	24-Oct-08		
DATE OF TESTING			Impact		
LOAD FRAME USED			Axial		
ORIENTATION OF LOADING				External	Internal
FAILURE LOAD	kN	74.6			
UNIAXIAL COMPRESSIVE STRENGTH	MPa	42.6			

The above sample does not meet specified length / diameter ratio requirements

BOREHOLE		-	North Springing	SAMPLE FAILURE SHAPES	
CORE RUN	DEPTH			External	Internal
SAMPLE DIAMETER	mm	47.08			
SAMPLE HEIGHT	mm	64.79			
WATER CONTENT	%	5.1			
DEGREE OF SATURATION	%	N/A			
STRESS RATE	kN/s	0.300			
TEST DURATION	min.sec	3.49	24-Oct-08		
DATE OF TESTING			Impact		
LOAD FRAME USED			Axial		
ORIENTATION OF LOADING				External	Internal
FAILURE LOAD	kN	56.3			
UNIAXIAL COMPRESSIVE STRENGTH	MPa	32.3			

The above sample does not meet specified length / diameter ratio requirements

Tested in accordance with ASTM D2938 - 4.08

SUMMARY OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK MATERIALS



Materials Testing & Consultancy

Edinburgh Road
Springhill
Shotts
ML7 5DT

LABORATORY TEST CERTIFICATE MATERIALS LABORATORY

Certificate No 08/544 - 08

To :

Client : MATtest Site Services
95 Ormane Drive
Netherlee
Glasgow
G44 3RF

Dear Sirs,

LABORATORY TESTING OF ROCK

Introduction

We refer to samples delivered to our laboratory on 20th October 2008.

Material & Source

Sampling : Sampled by Client
Sample Reference : See Report Plates
Description : N/A
Date Sampled : Not Given
Date Tested : 20th October 2008 Onwards
Source : Bridge No. B751/20 - Disused Rail Bridge No. 97

Test Results;

As Detailed On Page 2 to Page 3 Inclusive

Comments;

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
All remaining samples for this project will be disposed of 28 days after issue of this test certificate

Remarks;

Uniaxial Compressive Strength - Cores did not meet required length / diameter ratio specification

Date

29/10/2008

Quality Manager



2643

Issue No. 01

Registration No. 253253
Page 1 of 3



BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (Mg/m³)	DRY DENSITY (Mg/m³)
-	North Springing	-	8.1	2.28	2.14
-	South 1/4 Point	-	6.0	2.61	2.47
-	South Springing	-	4.7	2.36	2.25

Tested in accordance with "ISRM Suggested Methods"

SUMMARY OF MOISTURE CONTENT AND DENSITY TEST RESULTS

BOREHOLE CORE RUN		North Springing	SAMPLE FAILURE SHAPES	
DEPTH	-		External	Internal
SAMPLE DIAMETER	mm	47.26		
SAMPLE HEIGHT	mm	71.33		
WATER CONTENT	%	6.1		
DEGREE OF SATURATION	%	N/A		
STRESS RATE	kN/s	0.200		
TEST DURATION	min.sec	4.58		
DATE OF TESTING		24-Oct-08		
LOAD FRAME USED		Impact		
ORIENTATION OF LOADING		Axial		
FAILURE LOAD	kN	43.3		
UNIAXIAL COMPRESSIVE STRENGTH	MPa	24.7		

The above sample does not meet specified length / diameter ratio requirements

BOREHOLE CORE RUN		South 1/4 Point	SAMPLE FAILURE SHAPES	
DEPTH	-		External	Internal
SAMPLE DIAMETER	mm	47.07		
SAMPLE HEIGHT	mm	47.87		
WATER CONTENT	%	6.0		
DEGREE OF SATURATION	%	N/A		
STRESS RATE	kN/s	0.100		
TEST DURATION	min.sec	4.26		
DATE OF TESTING		24-Oct-08		
LOAD FRAME USED		Impact		
ORIENTATION OF LOADING		Axial		
FAILURE LOAD	kN	66.9		
UNIAXIAL COMPRESSIVE STRENGTH	MPa	38.5		

The above sample does not meet specified length / diameter ratio requirements

BOREHOLE CORE RUN		South Springing	SAMPLE FAILURE SHAPES	
DEPTH	-		External	Internal
SAMPLE DIAMETER	mm	47.11		
SAMPLE HEIGHT	mm	71.81		
WATER CONTENT	%	4.7		
DEGREE OF SATURATION	%	N/A		
STRESS RATE	kN/s	0.100		
TEST DURATION	min.sec	3.31		
DATE OF TESTING		24-Oct-08		
LOAD FRAME USED		Impact		
ORIENTATION OF LOADING		Axial		
FAILURE LOAD	kN	35.8		
UNIAXIAL COMPRESSIVE STRENGTH	MPa	20.5		

The above sample does not meet specified length / diameter ratio requirements

Tested in accordance with ASTM D2938 - 4.08

SUMMARY OF UNIAXIAL COMPRESSIVE STRENGTH OF ROCK MATERIALS

Certificate Number 08/544 - 08

Page 3 of 3

APPENDIX D

PHOTOGRAPHIC PRINTS

GENERAL PHOTOGRAPHS



Plate 1. **Bridge Ref 01**
General View of the North Springing



Plate 2. **Bridge Ref 01**
General View of the South Springing



Plate 3

Bridge Ref 1
Crack Spanning between South Abutment and Quarter Point



Plate 4.

Bridge Ref 01
View of North Springing Corehole



Plate 5.

Bridge Ref 01
View of South Springing Corehole



Plate 6. **Bridge Ref 01**
View of South Quarter Point Corehole



Plate 7. **Bridge Ref 01**
Close Up View of South Springing Core, Outer Section



Plate 8.

Bridge Ref 01

Close Up View of South Springing Core, Centre Section



Plate 9.

Bridge Ref 01

Close Up View of South Springing Core, Centre Section



Plate 10.

Bridge Ref 01

Close Up View of South Springing Core, Inner Section



Plate 11.

Bridge Ref 01

Close Up View of South Quarter Point Core, Outer Section



Plate 12.

Bridge Ref 01

Close Up View of South Quarter Point Core, Centre Section



Plate 13.

Bridge Ref 01

Close Up View of South Quarter Point Core, Inner Section



Plate 14.

Bridge Ref 97
General View of the North Springing



Plate 15.

Bridge Ref 97
General View of the South Springing

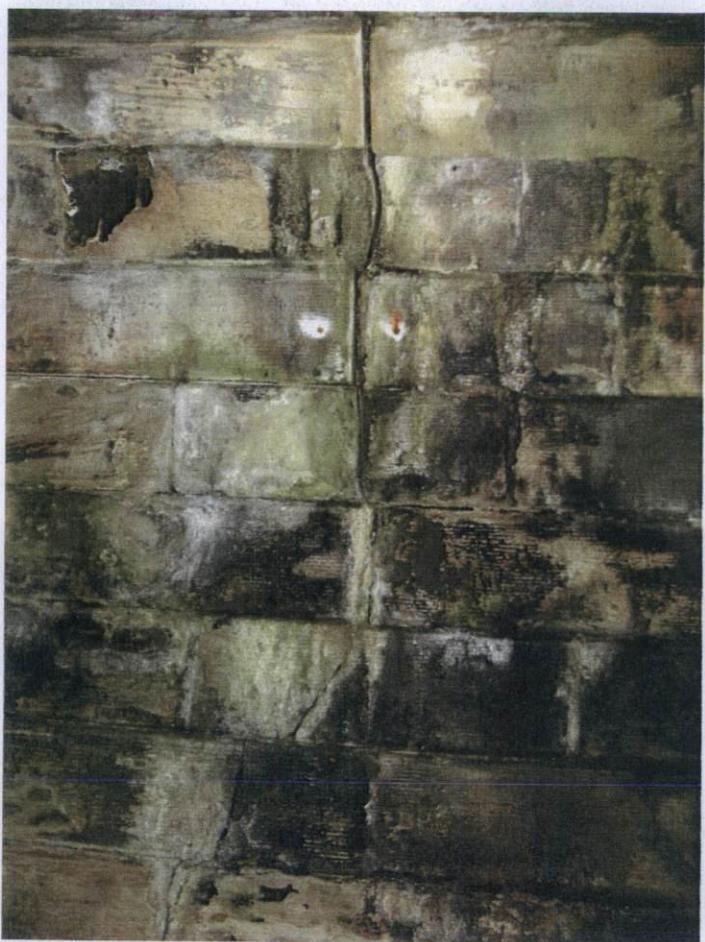


Plate 16

Bridge Ref 97
Crack Spanning between North Springing and Quarter Point



Plate 17.

Bridge Ref 97
View of North Springing Corehole



Plate 18.

Bridge Ref 97
View of North Quarter Point Corehole



Plate 19.

Bridge Ref 97
View of South Springing Corehole

VOLUME 3a

Assessment Calculations

ASSESSMENT CALCULATIONS

URS

PROJECT No:

49331615

SHEET No:

i

DRG REF:

PROJECT TITLE East Ayrshire Council Bridge Assessment Programme
Work Package 8DESCRIPTION: Disused bridge 1 & 97
Kilmarnock

REFERENCE	CALCULATIONS	SUMMARY										
	<p><u>CALCULATION CONTENTS PAGE</u></p> <table><thead><tr><th><u>CONTENTS</u></th><th><u>PAGE</u></th></tr></thead><tbody><tr><td>1 - Introduction</td><td>1</td></tr><tr><td>2 - MEXE Assessment</td><td>2,3</td></tr><tr><td>3 - ARCHIE-M Assessment</td><td>4,5</td></tr><tr><td>4 - Summary of Results</td><td>6</td></tr></tbody></table>	<u>CONTENTS</u>	<u>PAGE</u>	1 - Introduction	1	2 - MEXE Assessment	2,3	3 - ARCHIE-M Assessment	4,5	4 - Summary of Results	6	
<u>CONTENTS</u>	<u>PAGE</u>											
1 - Introduction	1											
2 - MEXE Assessment	2,3											
3 - ARCHIE-M Assessment	4,5											
4 - Summary of Results	6											

PROJECT TITLE East Ayrshire Council Bridge Assessment Programme
Work Package 8DESCRIPTION: Disused Bridges 1 & 97
Kilmarnock

REFERENCE	CALCULATIONS	SUMMARY
	<p><u>INTRODUCTION</u></p> <p>The following calculation are for the assessment of Disused Rail Bridges nos 1 & 97</p> <p>The assessment was carried out using the Modified MEXE method in accordance with BA 16/97. The structure was also checked using the ARCHIE-M Program (A Mechanism Analysis Package) in accordance with the recommendation in in BA 16/97 & BD 21/ 01.</p>	

PROJECT TITLE East Ayrshire Council Bridge Assessment Programme
Work Package 8DESCRIPTION: Disused bridge 1 & 97
Kilmarnock

REFERENCE	CALCULATIONS	SUMMARY												
Railtrack CIS 27	<p><u>MODIFIED MEXE ASSESSMENT</u></p> <p>The Modified MEXE Method was used to estimate the axle load capacity of Disused Rail Bridges 1&97, Kilmarnock in accordance with BA 16/97.</p> <p>Disused Rail Bridges 1&97, Kilmarnock is a single span arch structure with a square clear span of 8.6m.</p> <p>The barrel thickness has been determined by measurements at the elevations and confirmed by coring and found to be 460mm thick (min).</p> <p>Fill depth has been determined by a level survey over the structure.</p> <p>No Axle lift off was considered in the assessment</p> <p>(see the following pages for MEXE calculations)</p> <p><u>THE RESULTS</u></p> <p>MAL* = 21.92 tonnes</p> <p><u>Allowable Axle Load</u></p> <table border="1"><thead><tr><th>Axle</th><th>Load</th><th>Summary</th></tr></thead><tbody><tr><td>Single</td><td>33.8</td><td>> 11.5 t, ok 40T</td></tr><tr><td>Double</td><td>21.92</td><td>> 9.5 t, ok 40T</td></tr><tr><td>Triple</td><td>19.54</td><td>> 8 t, ok 40T</td></tr></tbody></table> <p style="text-align: right;">Capacity 40/44t</p> <p><u>HB LOADING CAPACITY</u></p> <p>ALLOWABLE HB LOAD = MAL*1.6</p> <p>ALLOWABLE HB LOAD = 21.92 * 1.6 = 35</p> <p>HB units = 35 units</p> <p style="text-align: right;">35 HB units</p> <p>* MAL=modified Axle Load determined using Modified MEXE Method.</p>	Axle	Load	Summary	Single	33.8	> 11.5 t, ok 40T	Double	21.92	> 9.5 t, ok 40T	Triple	19.54	> 8 t, ok 40T	
Axle	Load	Summary												
Single	33.8	> 11.5 t, ok 40T												
Double	21.92	> 9.5 t, ok 40T												
Triple	19.54	> 8 t, ok 40T												

PROJECT TITLE

East Ayrshire Council, Bridge Assessment Package 8

DESCRIPTION

MEXE Assessment

Name of Structure	Location	ELR	Line No.	Mileage	OS grid ref:	Structure N°	Council Ref:
Disused Rail bridge nos 1 & 97	East Ayrshire	N/A	N/A	N/A	NS 400 396	B751/20	B751/20

BA16/97 Section 3 Assessment of Masonry Arch Bridges by the Modified MEXE Method

All dimensions to be in metres

NOTE: cells marked blue require manual input

Span	L =	8.600 m
Rise, Crown	R _c =	1.835 m
Rise, Quarter Point 1	R _{q1} =	1.595 m
Rise, Quarter Point 2	R _{q2} =	1.595 m
Rise, Quarter Point Critical	R _{qcritical} =	1.595 m
Barrel Thickness	d =	0.460 m
Average Fill Depth	h =	0.460 m
Provisional Assessment		0.535 actual but reduced to d to ensure conse

3.10 Provisional Axle Load, PAL

$$PAL = \text{MIN} [(740 * (d + h)^2 / L^{1.3}), 70] = 38.19 \text{ tonnes}$$

$$PAL = 38.19 \text{ t}$$

Modifying Factors

3.11 Span Rise Factor	F _{sr} =	MIN [Figure 3.3, 1] =	0.895	F _{sr} =	0.895
3.12 Profile Factor	F _p =	MIN [(2.3 * ((R _c - R _q) / R _c) ^{0.6} , 1] =	0.679	F _p =	0.679
Barrel Factor	F _b =	see Table 3/1	= 1.400		
Fill Factor	F _f =	see Table 3/2	= 0.700		
3.13 Material Factor	F _m =	[(F _b * d) + (F _f * h)] / (d + h) =	1.050	F _m =	1.050
Joint Width Factor	F _w =	see Table 3/3	= 1.000		
Joint Condition Factor	F _{mo} =	see Table 3/4	= 1.000		
Joint Construction Factor	F _d =	see Table 3/5	= 1.000		
3.16 Joint Factor	F _j =	(F _w * F _d * F _{mo}) =	1.000	F _j =	1.000
Condition Factor	F _{cM} =	refer to Form AA =	0.900	F _{cM} =	0.900

Application

$$3.24 \text{ Modified Axle Load} \quad MAL = F_{sr} * F_p * F_m * F_j * F_{cM} * PAL = 21.92 \text{ tonnes} \quad MAL = 21.92 \text{ t}$$

Axle Factors

 does axle lift-off apply? n (y OR n)

single axle factor	A _{fs} =	1.542	A _{fs} =	1.542
double axle factor	A _{fd} =	1.000	A _{fd} =	1.000
triple axle factor	A _{ft} =	0.892	A _{ft} =	0.892

Allowable Axle Loads

AAL _{single}	A _{fs} * MAL =	33.80 tonnes	AAL _{single} =	33.80 t
AAL _{double}	A _{fd} * MAL =	21.92 tonnes	AAL _{double} =	21.92 t
AAL _{triple}	A _{ft} * MAL =	19.54 tonnes	AAL _{triple} =	19.54 t

AAL _{single}	AAL _{double}	AAL _{triple}	Capacity	Weight Restriction	Vehicle
11.5 t	10 t	8 t*	40 t	N/A	HGV-6 axles
11.5 t	9.5 t	-	32 t	33 t	HGV-4 axles
11.5 t	9.5 t	-	26 t	26 t	HGV-3 axles
11.5 t	-	-	18 t	18 t	HGV-2 axles
9 t	-	-	12.5 t	13 t	HGV-2 axles
7 t	-	-	10 t	10 t	HGV-2 axles
5.5 t	-	-	7.5 t	7.5 t	LGV
2 t	-	-	3 t	3 t	Car/Van

* Note: An assessment for the 24 tonne 3 axle bogie (8 tonne axle) is only necessary for arches where 'no axle lift-off' conditions prevail.

PROJECT TITLE East Ayrshire Council Bridge Assessment Programme
Work Package 8DESCRIPTION: Disused bridge 1 & 97
Kilmarnock

REFERENCE	CALCULATIONS	SUMMARY
	<p><u>ARCHIE-M ASSESSMENT</u></p> <p>Archie-M Software was used to determine the load capacity of Disused Rail bridge nos 1 & 97. The software calculates the minimum thrust needed in an arch to support specified loads. Provided the zone of thrust remains inside the barrel or structural backing, then the arch has sufficient capacity to resist the load (see Archie-M output diagrams).</p> <p>The live load partial factor γ_{FL} value was adjusted to apply the condition factor as there is no option within the program for applying the condition factor. This is done by dividing γ_{FL} factor by the appropriate condition factor.</p> <p>$\gamma_{FL}=1.9$ for highway loading & 2.0 for HB vehicles. The bridge condition factor=0.9</p> <p>Adjusted $\gamma_{FL}=1.9/0.9=2.11$ (highway loading) & 2/0.9=2.22 (HB vehicles)</p> <p>Loads considered in the assessment were:</p> <ul style="list-style-type: none">(a) - C & U Vehicles with Impact: Single, Double, Triple.(b) - EU Vehicles with Impact: Single, Double, Triple.(c) - HB Vehicles. (only where structure passes 40T assessment)(d) - SV Vehicles. (only where structure passes 40T assessment) <p>RESULTS:</p> <p>The result table from Archie-M contain the following parameters:</p> <ul style="list-style-type: none">(1) - Thrust In: distance from soffit thrust (nearest edge).(2) - Thrust Out: distance from soffit to thrust (far edge).(3) - Extra Thrust: difference between thrust out and ring thickness.	

PROJECT TITLE East Ayrshire Council Bridge Assessment Programme
Work Package 8DESCRIPTION: Disused bridge 1 & 97
Kilmarnock

REFERENCE	CALCULATIONS	SUMMARY
	<p><u>ARCHIE-M ASSESSMENT CONTINUED</u></p> <p>Provided neither (1) or (3) are negative, the thrust will be contained within the barrel</p> <p>Where (3) is negative, the thrust is outside the barrel. This is still OK providing the thrust is inside the backing level.</p> <p>Passive soil pressure is used in the Archie-M model where required however the proportion of passive pressure utilised is limited to 0.30 as greater pressure may result in distortion of the arch barrel.</p> <p>An elliptical arch profile was used in the assessment. The barrel thickness was measured at both elevations and confirmed by coring and found to be 460mm thick minimum. Material testing found the barrel masonry strength to be 6N/mm²</p> <p>The coring investigation found extensive structural backing behind the arch barrel. Plotting the core results on an elevation of the structure allowed an approximate backing level to be determined.</p> <p>No Axle lift off was considered in the assessment of the structure.</p> <p>Live Loading capacity of Disused Rail bridge nos 1 & 97 was found to be 40/44 tonnes.</p> <p>The HB rating for the structure was determined as 20 units</p> <p>All results and diagrams are enclosed in the following sheets.</p>	



PROJECT No: 49331615

SHEET No: 6

DRG REF:

PROJECT TITLE East Ayrshire Council Bridge Assessment Programme
Work Package 8

DESCRIPTION: Disused bridge 1 & 97
Kilmarnock

REFERENCE	CALCULATIONS				SUMMARY
	<u>SUMMARY</u>				
	Method	Live Loading	HB Loading	SV loading	
	Modified MEXE	40/44t	35 units		
	ARCHIE-M	40/44t	20 units	None	
	<p>The results giving the greater capacity will stand in accordance with BD 21/01 Cl. 6.17 & 6.19</p> <p>The Archie_M assessment of HB loading will be used in preference to the approximation obtained from the MEXE calculation.</p> <p>The assessment of Disused Rail bridge nos 1 & 97 concludes that the structure has a capacity of 40/44 tonnes Assessment Live Loading and 20 units of HB</p>				

PROJECT TITLE BRIDGES 1 + 97

DESCRIPTION

REFERENCE

CALCULATIONS

SUMMARY

BASIC PARAMETERS(Bridge 97 = North span)
(Bridge 1 = South span.)

Span 2600

$$\text{Rise - From levels } 2.880 - 1.045 = 1.835 \text{ m (N)}$$

$$2.815 - 1.010 = 1.805 \text{ m (S)}$$

G.P. rise	(levels)	$2.64 - 1.045 = 1.595$	(N) ← use
		$2.54 - 0.98 = 1.560$	(N)
		$2.565 - 0.980 = 1.585$	(S)
		$2.600 - 1.010 = 1.590$	(S) ← use

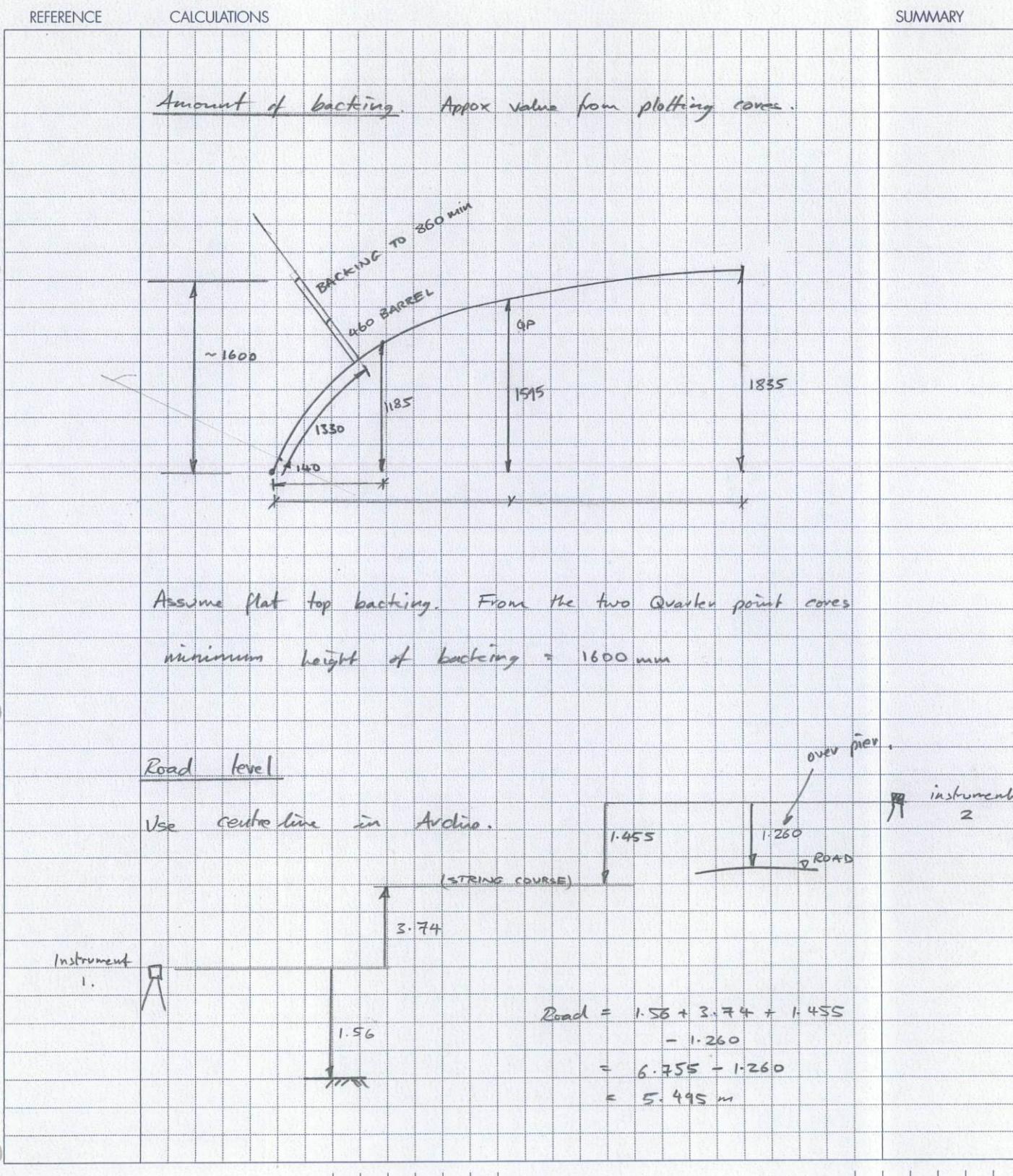
(Use the higher rise; this will give a flatter centre section)
(which by inspection is worst case.)Masonry strength

From testing reports, compressive strength as follows:

br1 32.3, 42.6, 32.5 $A_v = 35.8 \text{ N/mm}^2$ br97 24.7, 38.5, 20.5 $A_v = 27.9 \text{ N/mm}^2$ Average of both arches = 31.8 N/mm^2 BD21/01 using fig 4.3 characteristic strength = 6 N/mm^2 using Ashlar quality construction

PROJECT TITLE BRIDGES 1+ 97

DESCRIPTION



PROJECT TITLE BRIDGES 1 + 97

DESCRIPTION

REFERENCE	CALCULATIONS	SUMMARY
	Road at position over;	
	South arch, south spring = 1.400 ∵ distance from ground = 6.755 - 1.4 = <u>5.355 m</u>	
	South arch midspan = 1.300 ∵ above gl. = 6.755 - 1.3 = <u>5.455 m</u>	
	Above central pier = 1.26 above GL = <u>5.495 m</u>	
	N span midspan = 1.32 ∵ above GL = <u>5.435 m</u>	
	<u>Cover from arch extrados to road</u>	
	$h = 3.74 + 1.455 - 1.260 - 2.88 - 0.146 = 0.595 \text{ m}$	
*	NOTE —	
	<p>Maximum depth of fill determined as 535 mm in CAD. Value limited by ad road levels input to Archie to determine fill to arch ✓ Accepted as OK</p>	
PREPARED BY	ET 031208	CHECKED BY

PROJECT TITLE DISUSED BRIDGE 1-97

DESCRIPTION

REFERENCE	CALCULATIONS	SUMMARY
	<p>MEXE parameters.</p> <p>Geometry + condition of both are identical. Assess one only.</p> <p>(Elliptical shape accounted for by $F_{profile}$)</p> <p>Barrel factor - Ashlar quality - very close joints, well shaped stones.</p> <p>$F_b = 1.4$</p> <p>Fill factor $F_f = 0.7$ well compacted.</p> <p>Width factor $F_w = 1.0$ < 6mm joints</p> <p>Mortar factor $F_m = 1.0$ good condition mortar</p> <p>Depth factor $F_d = 1.0$ Use mortar loss to reduce barrel thickness if necessary. (Not necessary in this bridge)</p>	

Bridge Name: Disused Rail bridge 1&97
Bridge Number: B751/20
Number of spans: 2

Factor for deadload: 1.00 Factor for superimposed deadload: 1.00 Factor for surfacing: 1.00
Factor for live load: 2.22 Factor for load effect: 1.10 Factor for material strength: 1.00

SAFETY FACTORS

Factor for deadload: 1.00 Factor for superimposed deadload: 1.00 Factor for surfacing: 1.00
Factor for live load: 2.22 Factor for load effect: 1.10 Factor for material strength: 1.00

APPLIED LOAD CASES

Applied distribution mode: Archie/Multi
Applied live load pressure: Active pressure

STRUCTURE PROPERTIES

Road shape: True shape (multi-point method)
(-1000, 5435) (4300, 5435)
Road points: 50 Depth of overlay: 0
Surface unit weight: 15.00 Overlay unit weight: 15.00 [kN/m³]
Lane width: 2500

Total weight: 313.92 [kN] Position: 21115 [mm]

Base level:0 Height: 2600 [mm]
Base level:0 Height: 2600 [mm]

Width: 1000 [mm]
Width: 1000 [mm]

Quarter Rise: 1595 [mm]
Ring Thickness at springing: 460 [mm]

Fx live 0.00 My live 0.00
Fx dead 0.00 My dead 0.00
Fz dead 0.00 -6.64 0.19
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -12.70 -0.54
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -14.95 0.08
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -15.66 1.04
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -15.63 1.98
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -15.24 2.76
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -14.64 3.34
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -13.97 3.75
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -13.43 4.05
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -13.17 4.32
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -13.28 4.60
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -13.73 4.90
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -14.42 5.20
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -15.18 5.45
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -15.81 5.60
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -16.17 5.65
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -16.13 5.62
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -15.32 5.45
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -12.95 4.94
Fz live 0.00 -0.00 0.00
Fz dead 0.00 -6.72 2.75

My total -136.19 -491.36 2422 -1995 ***
Fz total -372.62 -372.62 -372.62 -129.55 -1120 ***
Fz live 0.00 0.00 0.00 0.00 0.00
Fz dead 0.00 -6.64 0.19 -0.54 -0.54
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -12.70 -0.54 -14.95 -14.95
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -14.95 0.08 -15.66 -15.66
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.63 1.98 -15.63 -15.63
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.24 2.76 -15.24 -15.24
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -14.64 3.34 -14.64 -14.64
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.97 3.75 -13.97 -13.97
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.43 4.05 -13.43 -13.43
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.17 4.32 -13.17 -13.17
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.28 4.60 -13.28 -13.28
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.73 4.90 -13.73 -13.73
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -14.42 5.20 -14.42 -14.42
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.18 5.45 -15.18 -15.18
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.81 5.60 -15.81 -15.81
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -16.17 5.65 -16.17 -16.17
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -16.13 5.62 -16.13 -16.13
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.32 5.45 -15.32 -15.32
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -12.95 4.94 -12.95 -12.95
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -6.72 2.75 -6.72 -6.72

Thrust in 2455 -1995 ***
Thrust out 1538 -1120 ***
My total -136.19 -491.36 2422 -1995 ***
Fz total -372.62 -372.62 -372.62 -129.55 -1120 ***
Fz live 0.00 0.00 0.00 0.00 0.00
Fz dead 0.00 -6.64 0.19 -0.54 -0.54
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -12.70 -0.54 -14.95 -14.95
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -14.95 0.08 -15.66 -15.66
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.63 1.98 -15.63 -15.63
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.24 2.76 -15.24 -15.24
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -14.64 3.34 -14.64 -14.64
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.97 3.75 -13.97 -13.97
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.43 4.05 -13.43 -13.43
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.17 4.32 -13.17 -13.17
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.28 4.60 -13.28 -13.28
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -13.73 4.90 -13.73 -13.73
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -14.42 5.20 -14.42 -14.42
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.18 5.45 -15.18 -15.18
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.81 5.60 -15.81 -15.81
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -16.17 5.65 -16.17 -16.17
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -16.13 5.62 -16.13 -16.13
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -15.32 5.45 -15.32 -15.32
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -12.95 4.94 -12.95 -12.95
Fz live 0.00 -0.00 0.00 -0.00 -0.00
Fz dead 0.00 -6.72 2.75 -6.72 -6.72

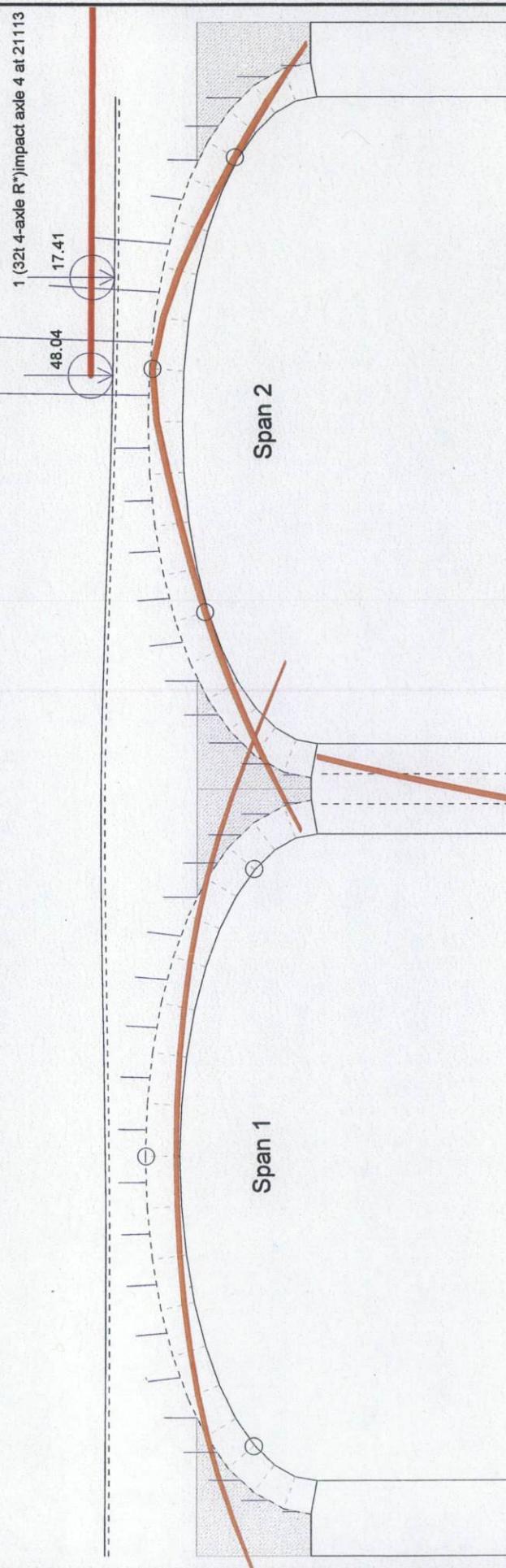
PIER 1

Base level: 0 [mm]

Top level: 2600 [mm]

Thickness at top: 1200 [mm]

Disused Rail bridge 1&97



NOTE ENVELOPE LOADING, BUT
DISTORTED LOAD TO CENTER
PIER FRAMES CONSTRAINED WIDENED

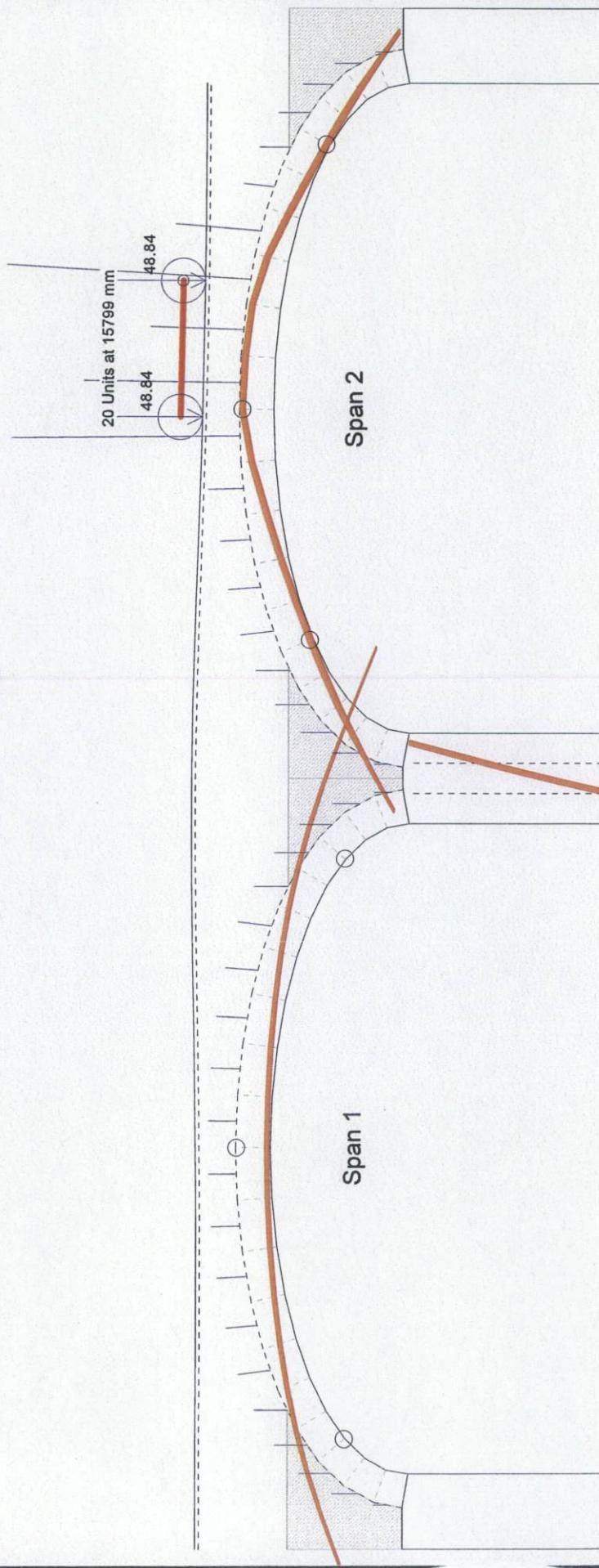
6N/mm² masonry. F_cm = 0.9. 2500mm lane width. Thrust manually modified

gammaF1 dead load: 1.00
gammaF1 superimposed: 1.00
gammaF1 live load: 2.11
gammaF3 load effect: 1.10
gammaM material: 1.00
File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11. Disused Rail Bridge Nos. 1 & 97\Assessment\bridge1&97.brg n: Wednesday, December 03, 2008 14:25:02

1 (32t 4-axle R*) impact axle 4 @ 21113 [mm]

NAME: Disused Rail bridge 1&97
LOCATION: Kilmarnock
NUMBER: B75120
URS Corporation Ltd

Disused Rail bridge 1&97



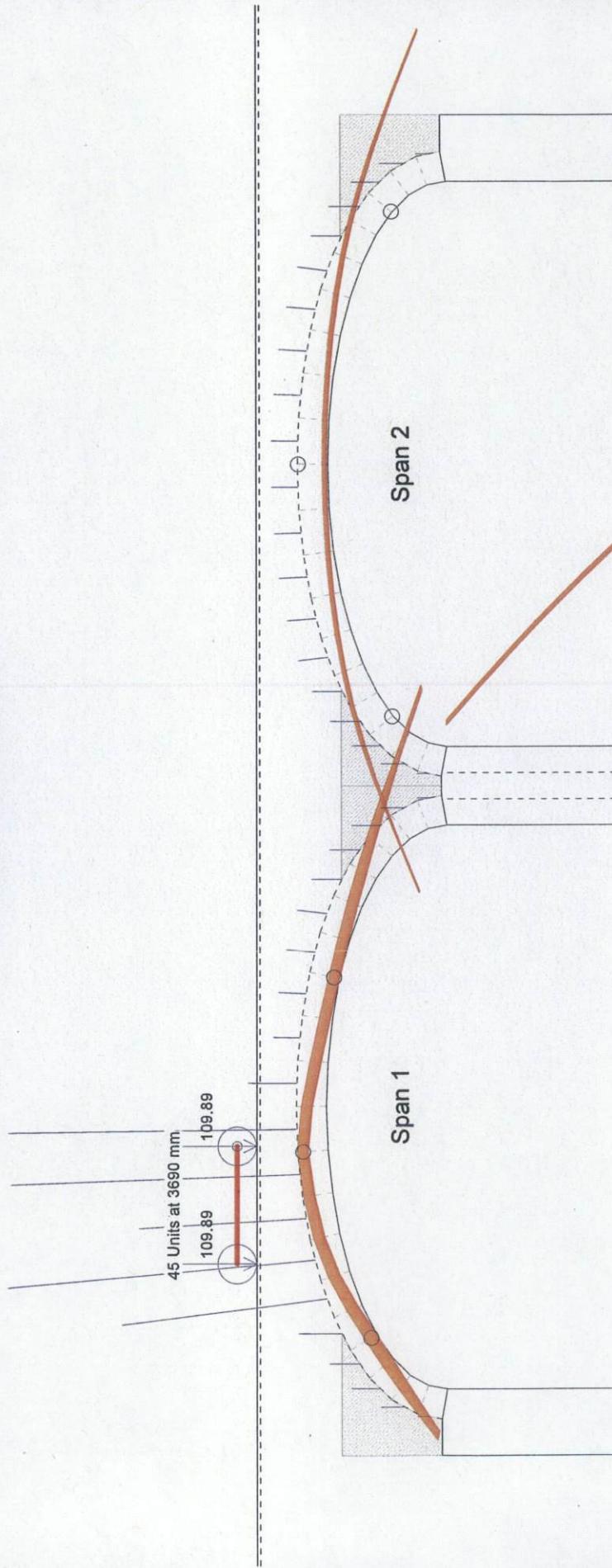
6N/mm² masonry. F_{cm} = 0.9. 2500mm lane width. Thrust manually modified

gammaF1 dead load: 1.00 20 Units @ 15799 [mm]
gammaF1 superimposed: 1.00
gammaF1 live load: 2.22
gammaF3 load effect: 1.10
gammaM material: 1.00
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NAME: Disused Rail bridge 1&97
LOCATION: Kilmarnock
NUMBER: B75/120
URS Corporation Ltd
DATE: 03 December 2008

F

Disused Rail bridge 1&97

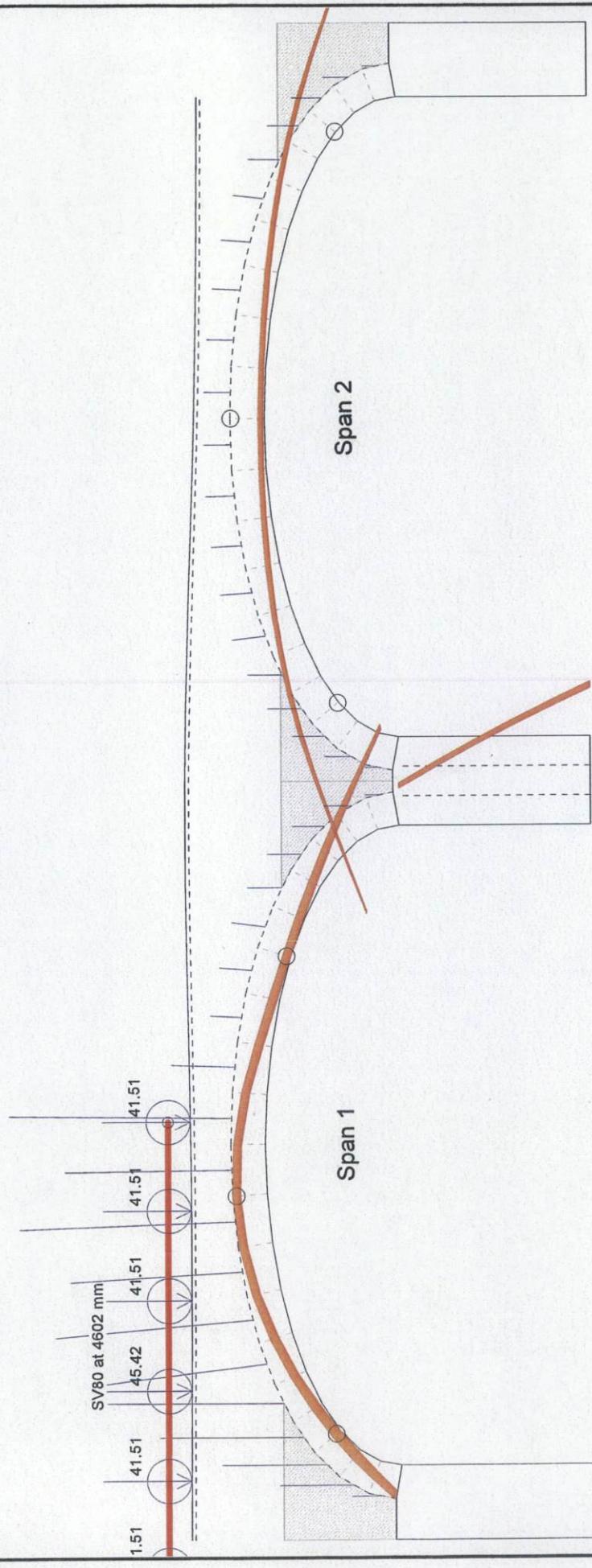


gammaF1 dead load: 1.00
gammaF1 superimposed: 1.00
gammaF1 live load: 2.22
gammaF3 load effect: 1.10
gammaM material: 1.00
File path:

6N/mm² masonry. $F_{cm} = 0.9$. 3000mm lane width. Thrust manually modified

NAME: Disused Rail bridge 1&97
LOCATION: Kilmarnock
NUMBER: B751/20
URS Corporation Ltd
DATE: 03 December 2008
Printed on: Wednesday, December 03, 2008 14:02:47

Disused Rail bridge 1&97



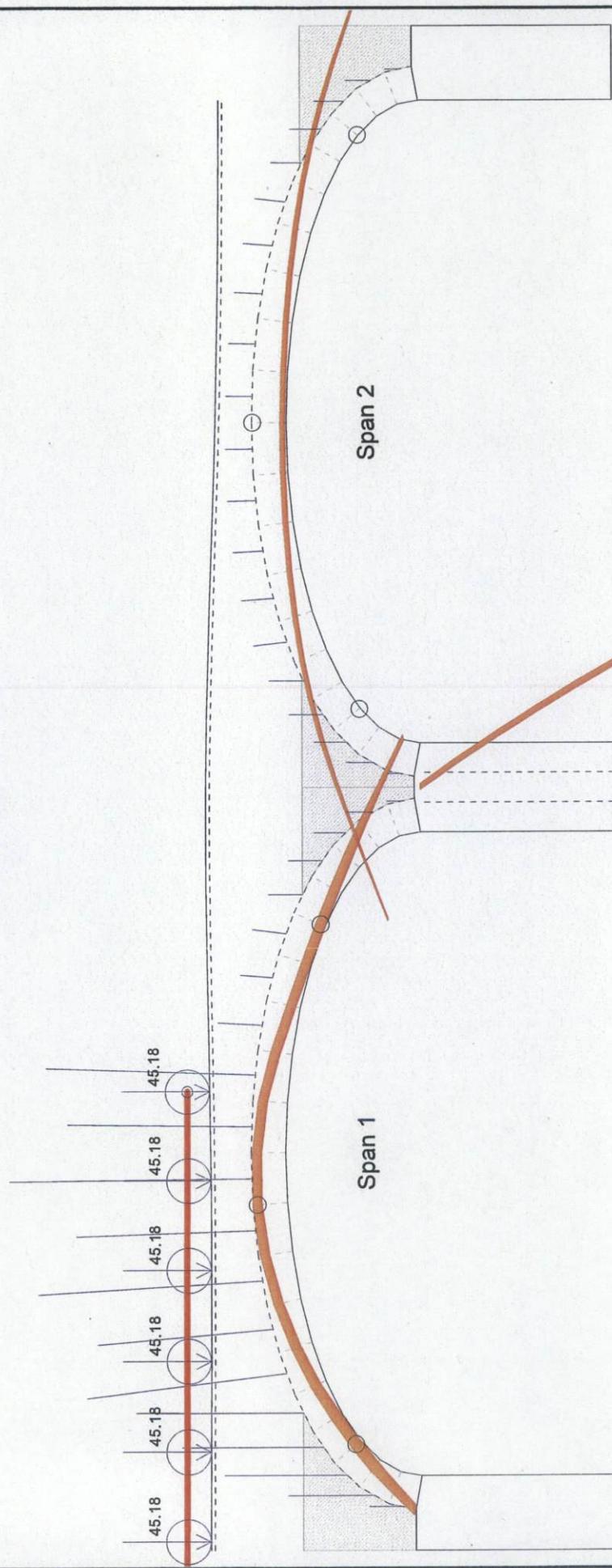
gammaF1 dead load: 1.00
 gammaF1 superimposed: 1.00
 gammaF1 live load: 2.22
 gammaF3 load effect: 1.10
 gammaM material: 1.00

6N/mm² masonry. $F_{cm} = 0.9 \cdot 3000\text{mm}$ lane width. Thrust manually modified

NAME: Disused Rail bridge 1&97
LOCATION: Kilmarnock
NUMBER: B751/20
URS Corporation Ltd

File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11. Disused Rail Bridge Nos. 1 & 97Assessment\bridge1&97 brg n: Wednesday, December 03, 2008 14:18:32
DAIE: 03 December 2008
gammaM material: 1.00

Disused Rail bridge 1&97



gammaF1 dead load: 1.00
gammaF1 superimposed: 1.00
gammaF1 live load: 2.22
gammaF3 load effect: 1.10
gammaM material: 1.00
File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11. Disused Rail Bridge Nos. 1 & 97\Assessment\bridge1&97.brg n: Wednesday, December 03, 2008 14:19:44

DATE: 03 December 2008

NAME: Disused Rail bridge 1&97

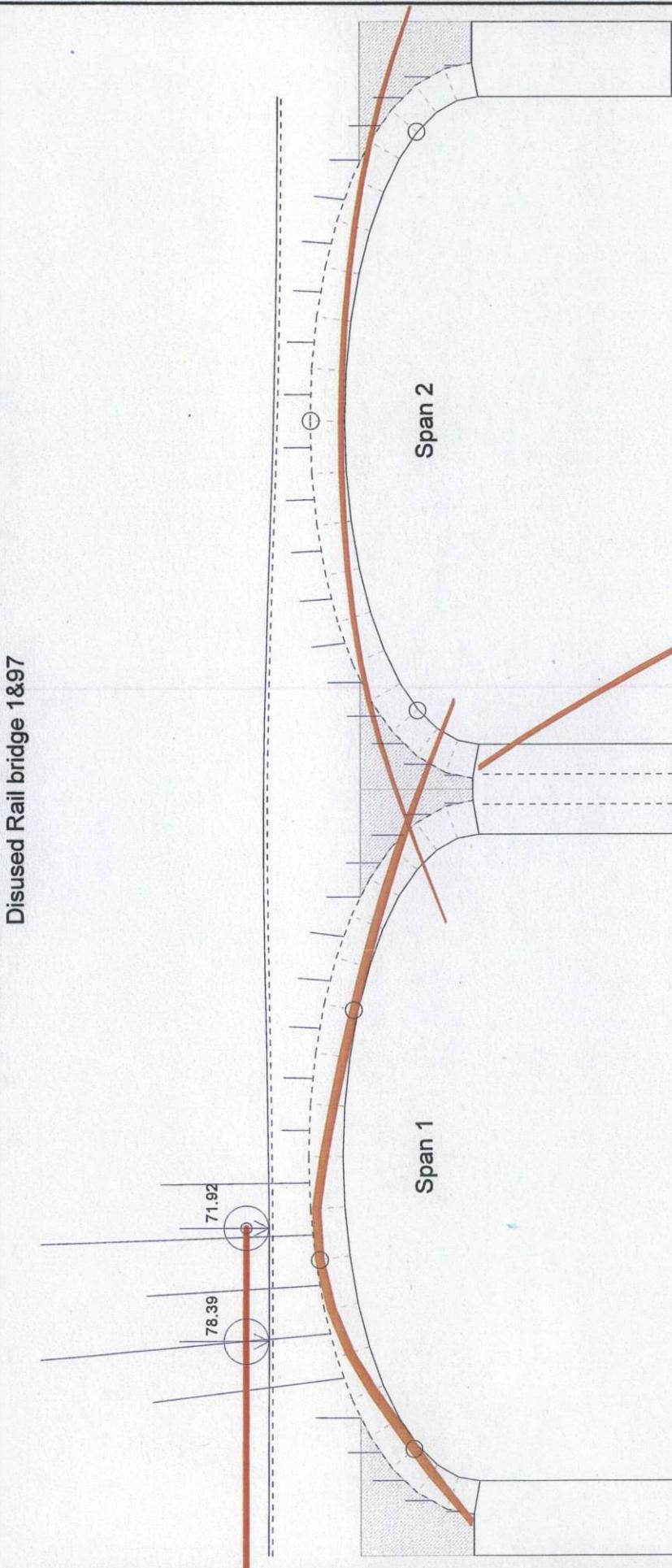
LOCATION: Kilmarnock

NUMBER: B751/20

URS Corporation Ltd

DATE: 03 December 2008

Disused Rail bridge 1&97



6N/mm² masonry. F_{cm} = 0.9. 3000mm lane width. Thrust manually modified

gammaF1 dead load: 1.00
gammaF1 superimposed: 1.00
gammaF1 live load: 2.22
gammaF3 load effect: 1.10
gammaM material: 1.00
File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11. Disused Rail Bridge Nos. 1 & 97\Assessment\bridge1&97.brg n: Wednesday, December 03, 2008 14:20:29

NAME: Disused Rail bridge 1&97
LOCATION: Kilmarnock
NUMBER: B751/20
URS Corporation Ltd
DATE: 03 December 2008

VOLUME 3b

Assessment Check Calculations

PROJECT No. 49381615

SHEET No. 1.

DRG REF.

PROJECT TITLE

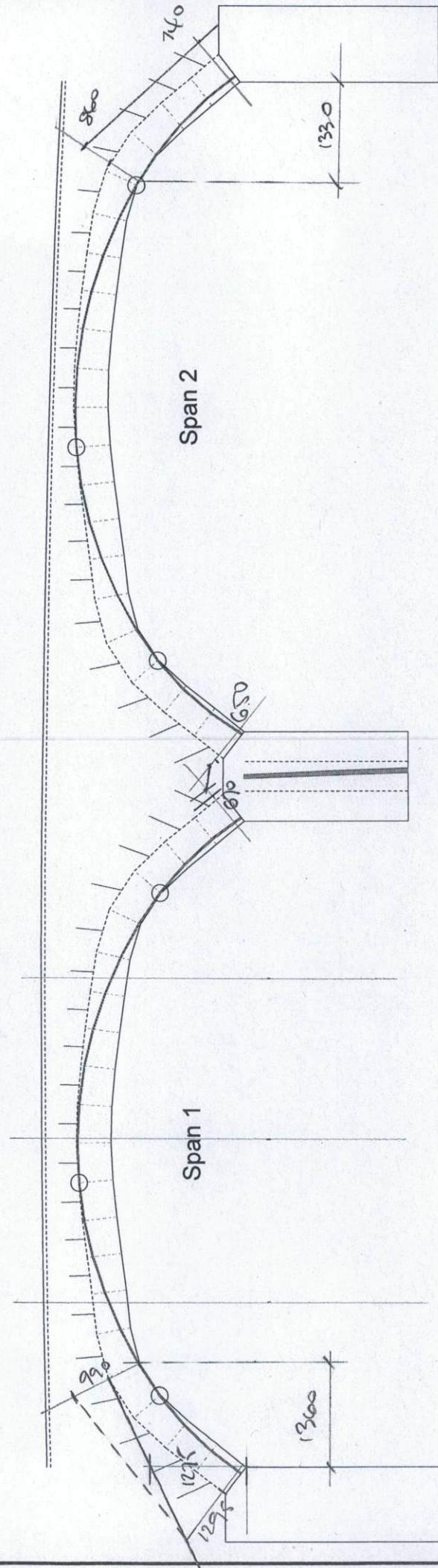
DESCRIPTION

DIFUSED R. BR 1491

REFERENCE	CALCULATIONS	SUMMARY
	Summary of RESULTS.	
i).	MODIFIED MEDE.	
	PADS for all VENTS up to 40/44TE	
	HS CAPACITY = 29.8 \Rightarrow 29.5 UNITS HB.	
ii)	Archie - M	
	A restriction is required from the Archie M analysis based on the twist live in the central pier support.	
	RESTRICTED VENTS to 24TE & GROUP PE1, PE2.	
	Arch passes 40TE & 45 HS VENTS.	
	RESULT GOVERNED by ii). Archie - M	
	PAGE CONTENTS.	
1 -	Summary	
1A-1B	Arch ANALYSIS USING ARCHIE - M	
19-39	PIER ANALYSIS USING ARCHIE - M	
40-41	Arch ANALYSIS USING MOD. MEDE	

Disused Rail Bridge 1 & 97

SCALE 1:25 FOR BACKING. DEPTHS.



AS A MINIMUM AVAIL BACKING AT END THROUGHT.

gammaM dead load: 1.00
gammaM superimposed: 1.00
gammaM live load: 1.90
gammaM load effect: 1.00
gammaM material: 1.00
File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11. Disused Rail Bridge Nos. 1 & 97\Check\Structure1.brg

(A)
NAME: Disused Rail Bridge 1 & 97
LOCATION: East Ayrshire
NUMBER: B751 -20
URS Corporation Ltd
DATE: 13 January 2009

Printed on: Tuesday, January 13, 2009 17:26:06

PROJECT TITLE

DESCRIPTION

DRAFTED R.BR. 1/97

CHECK

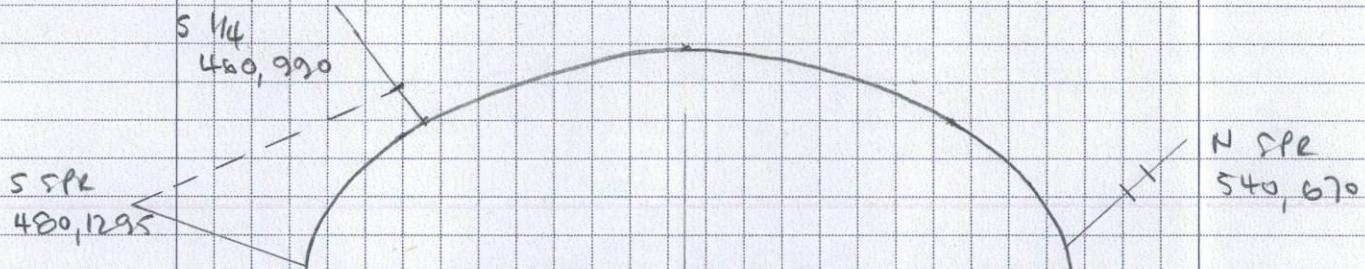
REFERENCE

CALCULATIONS

SUMMARY

Geometry.

As per attached A3 drawing

Span 1 (S0vth)

S SPR - masonry blocks with mortar bed
 S 114 PT - unbonded masonry with some
 N SPR. masonry block to Br 97 spv.

SPAN 2 /97 N

N 114 PT
460,860

N SPR.
620,740

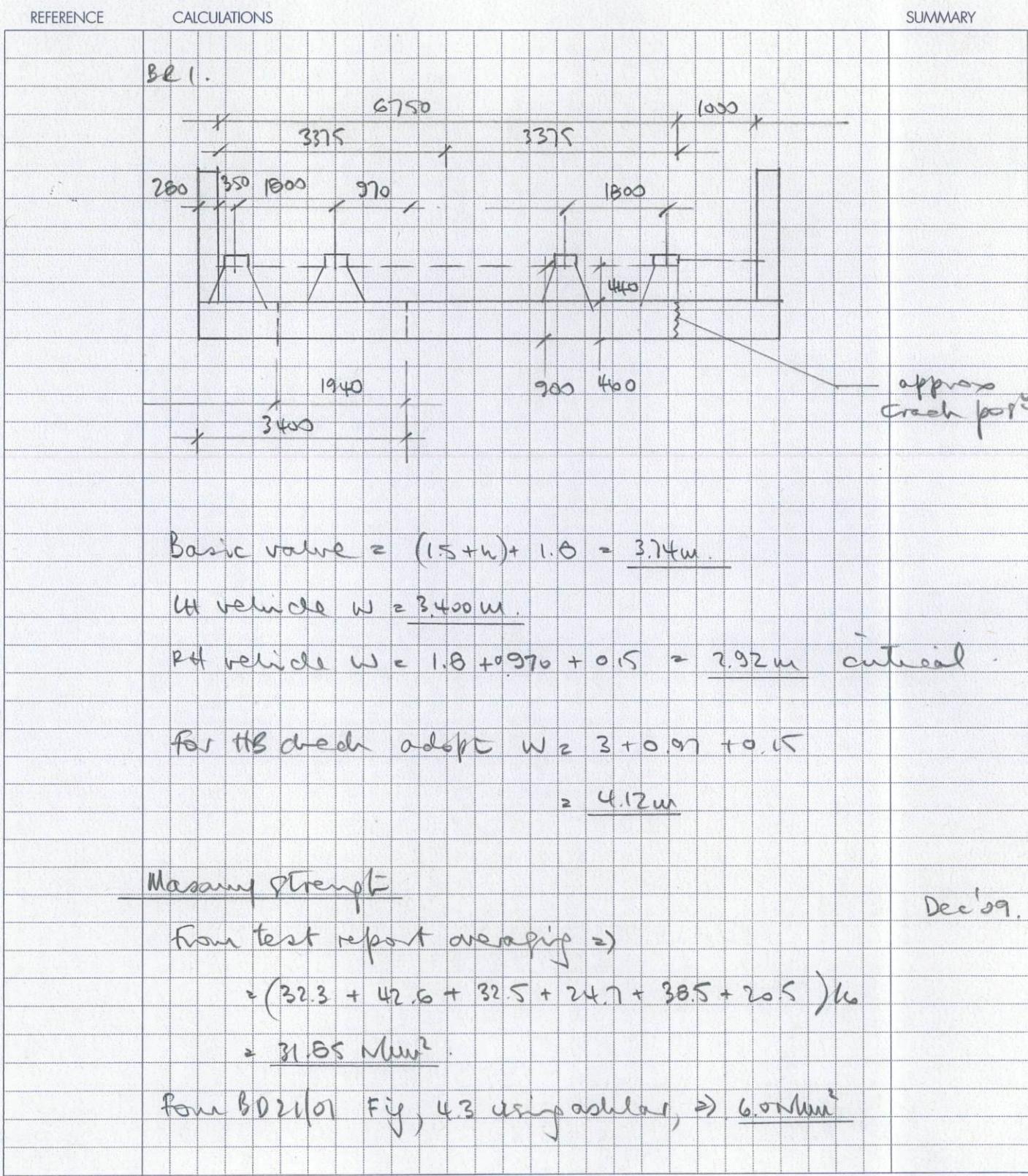
S SPR
505,650

S SPR. - mortar and infill above pier
 N 114 PT - mortar & masonry infill.
 N SPR - " " " "

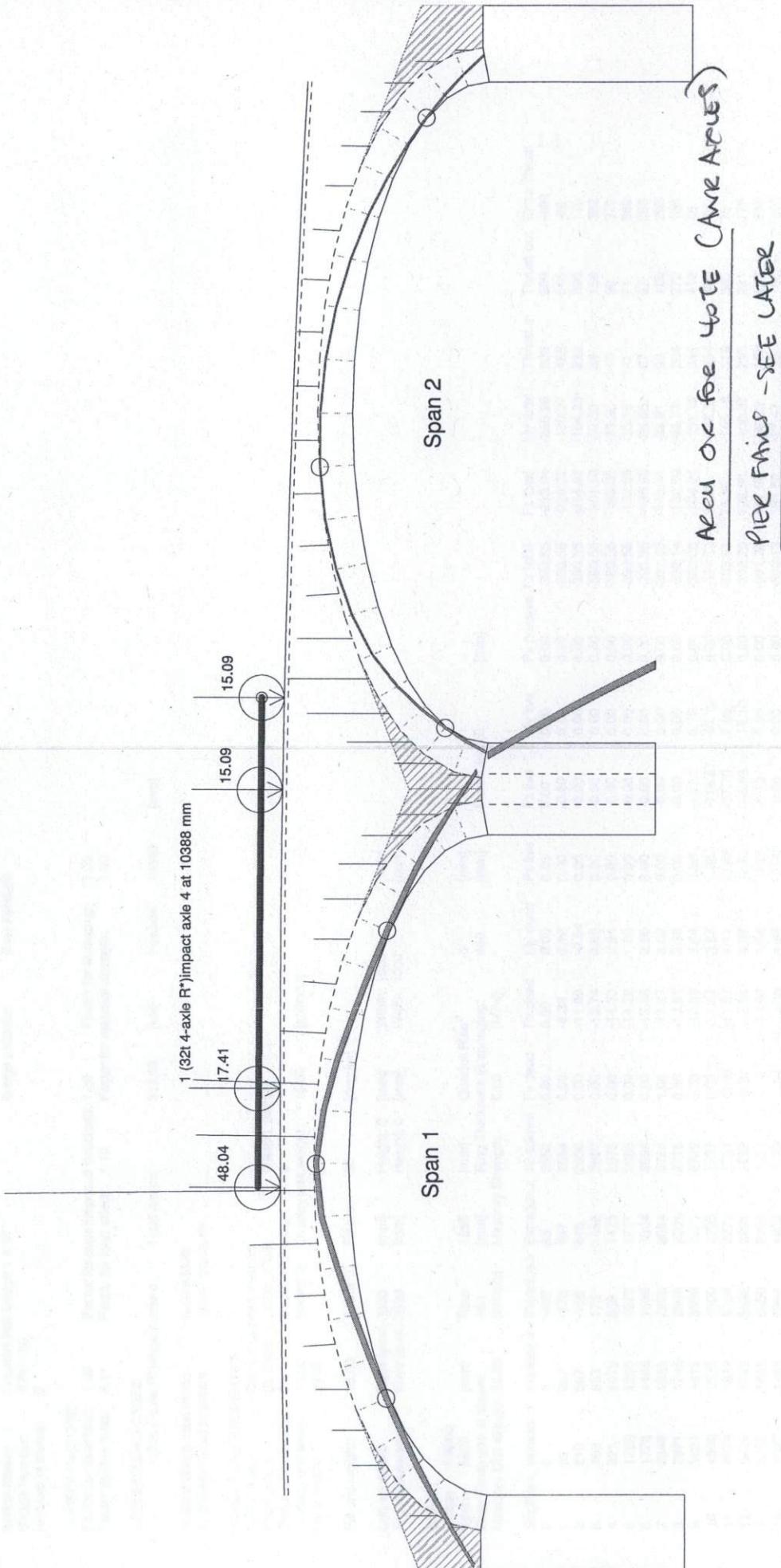
PROJECT TITLE

DESCRIPTION

DISUSED R. Sc 1897



Disused Rail Bridge 1 & 97



gammaFI dead load: 1,00 1 (32t 4-axle R*)impact axle 4 @ 10388 [mm]

gammaEl superimposed: 1.00

112

gammaFlive load: 2.11

gammaF3 load effect: 1.10

gammaM load effect: 1.10 gammaM material: 1.00

NAME: Disused Rail Bridge 1 & 97

LOCATION: East Ayrshire

LOCATION: East Ayissime

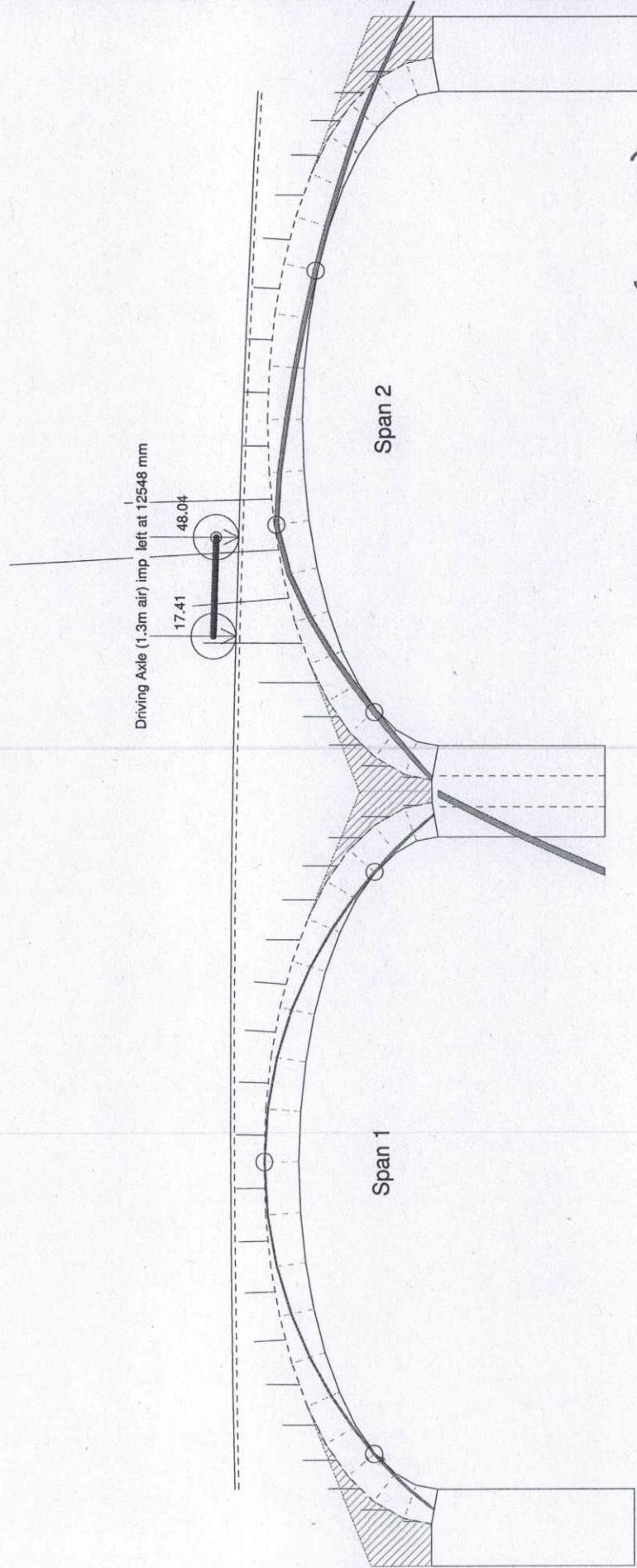
NUMBER: B751 -20

URS Corporation Ltd

DATE: 13 January 2009

Segment	Rise: [mm]	Thickness at crown: [mm]	Ring Strength: [kNm3]	Quarter Rise: [mm]	Ring Thickness at springing: [mm]	Masonry Strength: [MPa]	0	460	[mm]	Mortar loss:0	[mm]	Fz live	Fx live	Fy live	Fz dead	Fx dead	Fy dead	Fz live	Fx live	Fy live	Fz total	Fx total	Fy total	My total	Thrust in	Thrust out	Extra-Thrust	
0	8600	20.00	9800	1805	85	9348	0	9800	2706	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-100.95	-189.02	-25.45	107	142	318			
1			9853	282	9423	445			2705	0.00	-6.39	0.11	0.00	-12.03	-0.56	0.00	-14.00	-0.05	-0.05	-2.06	0.03	-100.95	-180.58	-6.65	15	50	410	
2			10010	568	9947	839			2701	0.00	-12.03	-0.56	0.00	-7.20	-0.71	0.00	-10.95	-0.05	-0.05	-1.71	0.00	-100.95	-161.34	-2.99	-0	32	428	
3			10269	819	9976	1174			2696	0.00	-14.00	-0.05	0.00	-13.52	-0.51	0.00	-10.95	-0.05	-0.05	-13.52	-0.51	-100.95	-153.83	-10.67	52	79	381	
4			10621	1061	10391	1459			2688	0.00	-14.57	0.96	0.00	-19.82	0.60	0.00	-100.95	-0.05	-0.05	-19.82	0.60	-100.95	-99.44	-22.91	156	178	282	
5			11059	1276	10881	1700			2679	0.00	-14.44	1.83	0.00	-19.71	1.59	0.00	-100.95	-0.05	-0.05	-19.71	1.59	-100.95	-65.28	-33.20	271	290	170	
6			11573	1460	11438	1900			2666	0.00	-13.89	2.51	0.00	-9.18	0.79	0.00	-100.95	-0.05	-0.05	-9.18	0.79	-100.95	-42.22	-39.59	355	373	87	
7			12148	1608	12052	2058			2651	0.95	-13.06	2.97	0.04	-0.50	-0.01	0.00	-101.95	-0.05	-0.05	-28.65	-43.95	-101.95	-28.65	-40.7	425	425	35	
8			12771	1717	12709	2172			2634	0.53	-12.12	3.24	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-102.48	-16.54	-46.39	438	456	4	***	
9			13427	1783	13397	2242			2613	0.25	-11.26	3.37	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-102.73	-5.28	-46.43	443	460	-0		
10			14100	1805	14100	2285			2590	0.07	-10.63	3.46	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-102.81	5.35	-44.01	420	437	23		
11			14773	1783	14803	2242			2565	-0.07	-10.33	3.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-102.74	15.67	-39.30	371	388	72		
12			15429	1717	15491	2172			2538	-0.21	-10.37	3.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-102.53	26.05	-32.67	302	320	140		
13			16052	1608	16148	2058			2511	-0.41	-10.73	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-102.12	36.77	-24.67	220	238	222		
14			16627	1460	16762	1900			2484	-0.73	-11.28	4.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-101.39	48.06	-16.06	135	154	306		
15			17141	1276	17319	1700			2459	0.00	-11.88	4.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-101.39	59.93	-8.14	60	79	381		
16			17579	1061	17809	1459			2435	0.00	-12.35	4.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-101.39	72.29	-2.57	10	31	429		
17			17931	819	18224	1174			2414	0.00	-12.57	4.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-101.39	84.86	-1.46	-0	22	438		
18			18190	558	18553	839			2397	0.00	-12.26	4.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-101.39	97.11	-7.19	40	63	397		
19			18347	282	18777	445			2385	0.00	-10.77	4.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-101.39	107.89	-22.14	150	173	287		
20			18400	0	18852	85			2381	0.00	-5.96	2.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-101.39	113.84	-47.06	350	371	89		

Disused Rail Bridge 1 & 97



gammaM1 dead load: 1.00 Driving Axle (1.3m air) imp left @ 12548 [mm]

gammaM1 superimposed: 1.00

gammaM1 live load: 2.11

gammaM3 load effect: 1.10

gammaM material: 1.00

File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11_Disused Rail Bridge Nos. 1 & 97\Structure1.brg

NAME: Disused Rail Bridge 1 & 97
LOCATION: East Ayrshire
NUMBER: BT51-20
URS Corporation Ltd
DATE: 13 January 2009

Printed on: Tuesday, December 22, 2009 15:31:19

Bridge Name: Disused Rail Bridge 1 & 97
 Bridge Number: B751 -20
 Number of spans: 2

SAFETY FACTORS

Factor for deadload: 1.00 Factor for superimposed deadload: 1.00 Factor for surfacing: 1.00
 Factor for live load: 2.11 Factor for load effect: 1.10 Factor for material strength: 1.00

APPLIED LOAD CASES

1. Driving Axle (1.3m air) imp left Total weight: 186.39 [kN] Position: 12548 [mm]

Applied distribution mode:

Applied live load pressure:

STRUCTURE PROPERTIES

Road shape: Curved (3-point method)
 Road points: (0 2663) (9200 2708)
 Depth of surfacing: 50 Depth of overlay: 0
 Surface unit weight: 15.00 Overlay unit weight: 15.00
 Lane width: 2920

Fill unit weight: 18.00 [kN/m³] Fill phi: 30 [degree]
 Left abutment Base level:-2600 [mm] Height: 0 [mm] Width: 1000 [mm]
 Right abutment Base level:-2690 [mm] Height: 0 [mm] Width: 1000 [mm]

SPAN 1 Shape Elliptic
 Span: 8600 Ring Thickness at crown: [mm]
 Masonry Unit Weight: 20.00 Masonry Strength: [kN/m³]

Rise: 1835 [mm]

Quarter Rise: 0 [mm]

Ring Thickness at springing: 460 [mm]

Masonry Strength: 6.00 [MPa]

Segment Intrados.x

Intrados.z

Extrados.z

Extrados.y

Roadlevel

Fx dead

Fz dead

Fx live

Fz live

My live

Fx passive

Fx total

Fz total

My total

Thrust in

Thrust out

Extra-Thrust

0 0 -452 83 2652 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

1 53 287 -378 447 2654 0.00 -6.33 0.00 -0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

2 210 567 -156 846 2659 0.00 -11.80 -0.54 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

3 469 833 173 1186 2667 0.00 -13.74 0.05 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

4 821 1079 588 1475 2676 0.00 -14.33 0.94 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

5 1259 1288 1079 1721 2686 0.00 -14.28 1.80 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

6 1773 1485 1636 1924 2696 0.00 -13.88 2.50 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

7 2348 1635 2250 2084 2706 1.00 -13.27 3.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

8 2971 1745 2201 2715 0.59 -12.61 3.38 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

9 3627 1812 3596 2722 0.30 -12.08 3.64 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

10 4300 1835 4300 2727 0.09 -11.82 3.87 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

11 4973 1812 5004 2271 2731 -0.09 -11.87 4.11 -0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

12 5629 1745 2250 2201 2732 -0.31 -12.24 4.37 -0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

13 6252 1635 6350 2084 2731 -0.61 -12.86 4.64 -0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

14 6827 1485 6964 1924 2729 -1.04 -13.59 4.88 -0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

15 7341 1298 7521 1721 2726 0.00 -14.25 5.05 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

16 7779 1079 8012 1475 2722 0.00 -14.66 5.12 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

17 8131 833 8427 1186 2718 0.00 -14.69 5.10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

18 8390 567 8756 2714 0.00 -14.05 4.97 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

19 8547 287 8978 447 2711 0.00 -12.03 4.56 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

20 8600 0 9052 83 2710 0.00 -6.40 2.58 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

PIER 1
 Base level: -2210 [mm]
 Batter: 1.0 Masonry Unit Weight: 20.00 [kN/m³]

Top level: 0 [mm]

Thickness at top: 1200 [mm]

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

SPAN 2 Shape Elliptic

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2 8600 9800 -1105 -13.26 -225.36 -454.38 -282.42 8577 8668 -1.47 0.71

3 8600 9800 -1658 -13.26 -225.36 -467.64 -386.93 8326 8419 -2.00 1.22

4 8600 9800 -2210 -13.26 -225.36 -480.90 -511.44 8088 8185 -2.53 1.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 8600 9800 0 427.86 -225.36 -13.39 9126 9211 -0.41 -0.30

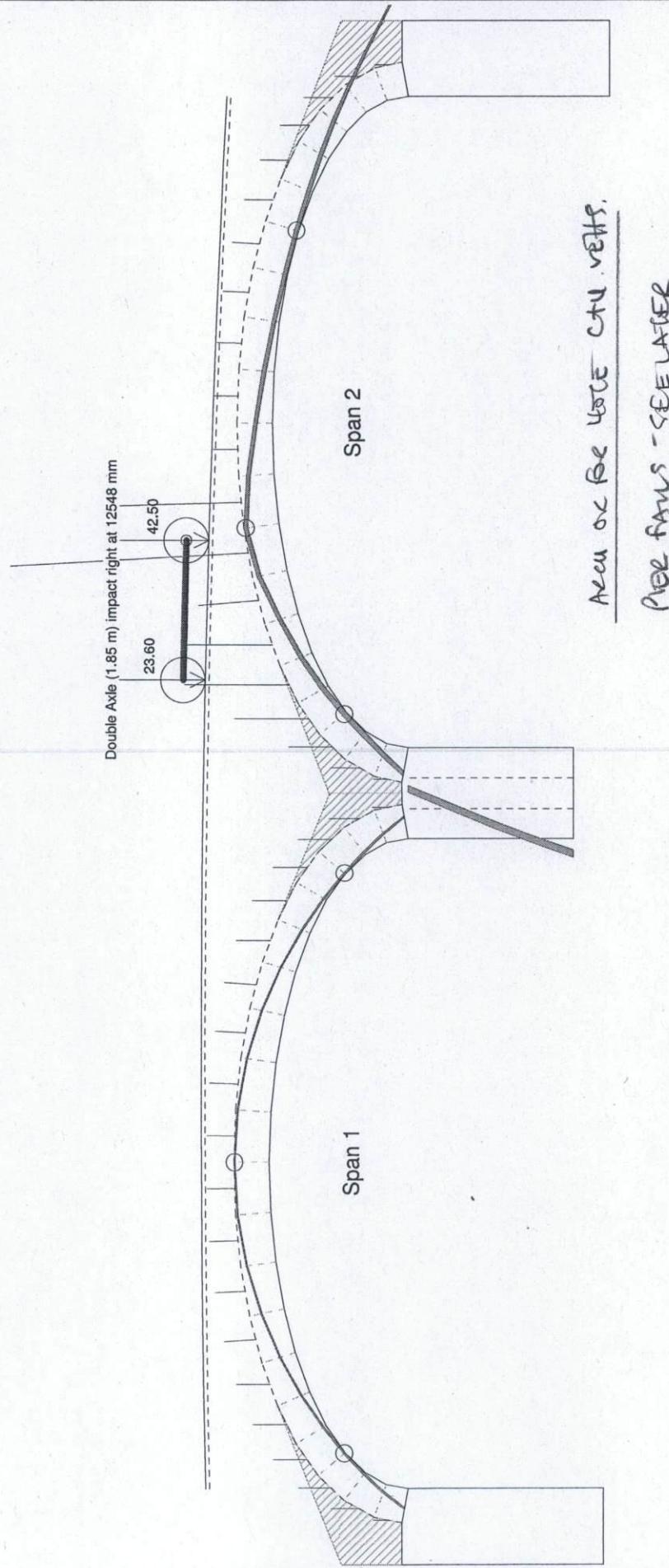
1 8600 9800 -553 -13.26 -225.36 -441.12 -137.30 8843 8931 -0.94 0.21

2

Span: 8600 [mm] Rise: 1805 [mm] Quarter Rise: 0 [mm]
 Ring Thickness at crown: 460 [mm] Ring Thickness at springing: 460 [mm] Mortar loss: 0 [mm]
 Masonry Unit Weight: 20.00 [kN/m³] Masonry Strength: 6.00 [MPa]

Segment	Intrados.x	Extrados.x	Intrados.z	Extrados.z	Roadlevel	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	9800 0	9348 852706	0.00 0.00	0.00 0.00	0.00 0.00	-324.46	-292.42	-155.21	418 476	-16 ***								
1	9853 282	9423 445	2705 0.00	6.39 0.11	0.00 -0.00	0.00 0.00	-324.46	-286.03	-78.85	174 238	222							
2	10010	558	2701 0.00	-12.03	-0.56 0.00	-0.00 0.00	-324.46	-274.00	-32.09	43112 348								
3	10269	819	9376 1174	2696 0.00	-14.00	0.05 0.00	-0.00 0.00	-324.46	-260.01	-14.37	69391							
4	10621	1061	10391	1459	2688 0.00	-14.57	0.96 0.00	-0.49 0.10	0.00 0.00	-324.46	-244.95	-23.43	2492368					
5	11059	1276	10881	1700	2679 0.00	-14.44	1.83 0.00	-10.90	1.85 0.00	-324.46	-219.61	-53.46	107 171	289				
6	11573	1460	11438	1900	2666 0.00	-13.89	2.51 0.00	-27.78	4.80 0.00	-324.46	-177.93	-92.38	225 285	175				
7	12148	1608	12052	2058	2651 0.95	-13.06	2.97 2.36	-27.55	6.59 0.00	-327.78	-137.33	-132.44	350 408	52	***			
8	12771	1717	12709	2172	2634 0.53	-12.12	3.24 5.91	-101.98	30.57 0.00	-334.23	-23.23	-144.50	404 460	-0	***			
9	13427	1783	13397	2242	2613 0.25	-11.26	3.37 1.72	-51.19	7.60 0.00	-336.20	39.22	-107.51	295 351	109				
10	14100	1805	14100	2265	2590 0.07	-10.63	3.46 0.00	-0.00	-0.00 0.00	-336.27	49.85	-69.97	180 236	224				
11	14773	1783	14803	2242	2565 0.07	-10.33	3.55 0.00	0.00	0.00 0.00	-336.21	60.18	-40.51	91148 312					
12	15429	1717	15491	2172	2538 0.21	-10.37	3.68 0.00	0.00	0.00 0.00	-336.00	70.55	-20.12	3087373					
13	16052	1608	16148	2058	2511 0.41	-10.73	3.85 0.00	0.00	0.00 0.00	-335.58	81.27	-9.68	-1 57403					
14	16627	1460	16762	1900	2484 0.73	-11.28	4.03 0.00	0.00	0.00 0.00	-334.86	92.56	-10.02	-0 58402					
15	17141	1276	17319	1700	2459 0.00	-11.88	4.18 0.00	0.00	0.00 0.00	-334.86	104.44	-22.21	3593367					
16	17579	1061	17809	1459	2435 0.00	-12.35	4.27 0.00	0.00	0.00 0.00	-334.86	116.79	-47.43	107 165	295				
17	17931	819	18224	1174	2414 0.00	-12.57	4.32 0.00	0.00	0.00 0.00	-334.86	129.36	-87.01	227 284	176				
18	18190	558	18353	839	2397 0.00	-12.26	4.28 0.00	0.00	0.00 0.00	-334.86	141.62	-142.35	423 476	-16	***			
19	18347	282	18777	445	2385 0.00	-10.77	4.01 0.00	0.00	0.00 0.00	-334.86	152.39	-214.58	801 845	-385	***			
20	18400	0	18852	852381	0.00	-5.96	2.32	0.00	0.00	-334.86	158.34	-303.07	1376 1413	-953	***			

Disused Rail Bridge 1 & 97



gammaM1 dead load: 1.00 Double Axle (1.85 m) impact right @ 12548 [mm]

gammaM1 superimposed: 1.00

gammaM1 live load: 2.11

gammaF3 load effect: 1.10

gammaM material: 1.00

File path: J:\Glasgow\Jobs\East Ayrshire Council\4933161 EAC Bridge Assessment Work\Technical\11_Disused Rail Bridge Nos. 1 & 97\Check\Structure1.brg

NAME: Disused Rail Bridge 1 & 97

LOCATION: East Ayrshire

NUMBER: B751 -20

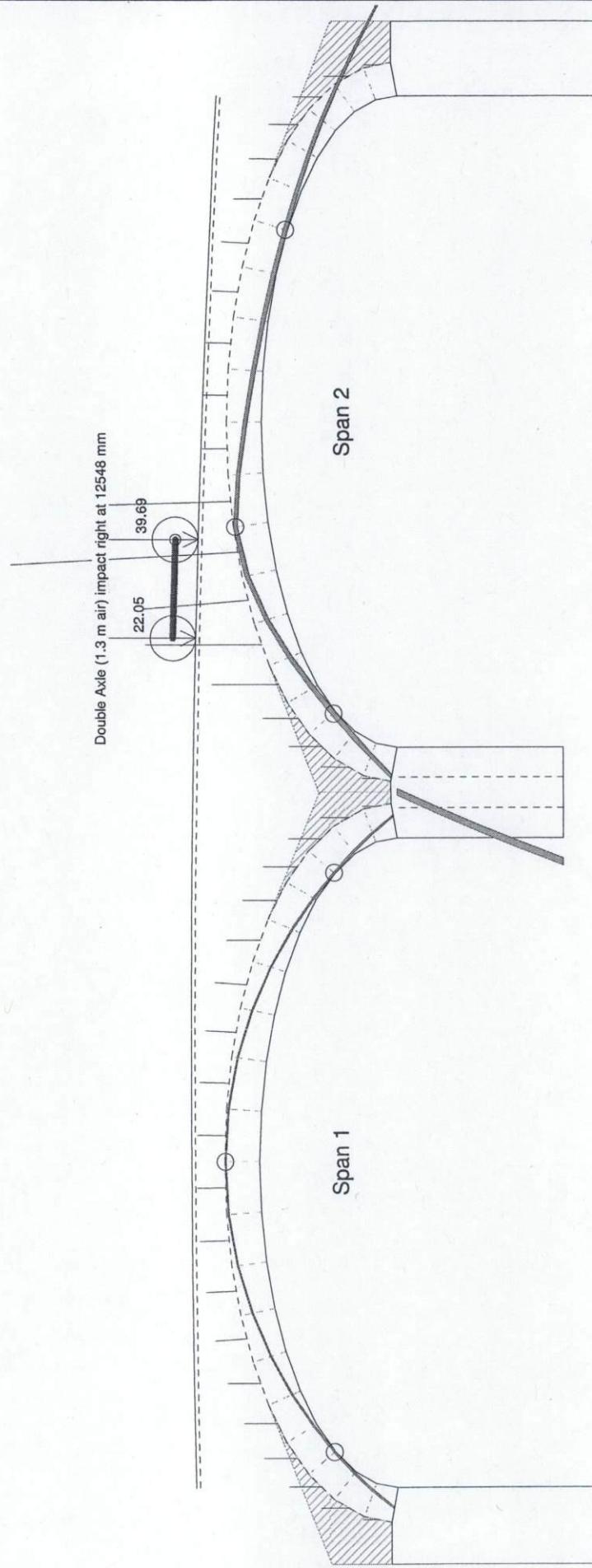
URS Corporation Ltd

DATE: 13 January 2009

Printed on: Tuesday, December 22, 2009 15:52:32

Segment	Span:	Rise: [mm]	[mm]	Quarter Rise: [MPa]	[mm]	[mm]	[mm]	Mortar loss:0 [mm]	[mm]	Fx total	My total	Thrust in	Thrust out	Extra-Thrust
0	8600	[mm]								-300.71	-121.91	320	379	81
	Ring Thickness at crown: 20.00	[kN/m3]								-284.32	-55.95	117	180	280
	Masonry Unit Weight: 20.00									-282.01	-20.19	17	84	376
1	9800	0	9348	85	2706	0.00	0.00	0.00	0.00	-289.14	-289.14	0	65	395
2	9853	282	9423	445	2705	0.00	-6.39	0.11	0.00	-289.14	-289.14	-289.14	104	356
3	10010	558	9647	839	2701	0.00	-12.03	-0.56	-0.28	0.00	0.00	-26.80	43	279
4	10269	819	9976	1174	2696	0.00	-14.00	0.05	0.00	-4.32	0.05	-263.69	-12.71	181
5	10621	1061	10391	1459	2688	0.00	-14.57	0.96	0.00	-16.62	0.99	-289.14	-289.14	280
6	11059	1276	10881	1700	2679	0.00	-14.44	1.83	0.00	-28.82	3.11	-188.24	-51.95	180
7	11573	1460	11438	1900	2666	0.00	-13.89	2.51	0.00	-24.10	2.90	-150.24	-81.26	227
8	12148	1608	12052	2058	2651	0.95	-13.06	2.97	1.05	-12.21	3.67	-291.14	-124.97	350
9	12771	1717	12709	2172	2634	0.53	-12.12	3.24	5.19	-88.44	27.04	-296.86	-23.42	401
10	13427	1783	13397	2242	2613	0.25	-11.26	3.37	1.52	-45.28	6.73	-298.64	-33.12	59
11	14100	1805	14100	2285	2590	0.07	-10.63	3.46	0.00	-0.00	0.00	-298.71	43.75	244
12	14773	1783	14803	2242	2565	-0.07	-10.33	3.55	0.00	0.00	0.00	-298.64	54.07	305
13	15429	1717	15491	2172	2538	-0.21	-10.37	3.68	0.00	0.00	0.00	-298.43	64.44	368
14	16052	1608	16148	2058	2511	-0.41	-10.73	3.85	0.00	0.00	0.00	-298.02	75.17	403
15	16627	1460	16762	1900	2484	-0.73	-11.28	4.03	0.00	0.00	0.00	-297.30	86.45	57
16	17141	1276	17319	1700	2459	0.00	-11.88	4.18	0.00	0.00	0.00	-297.30	98.33	408
17	17579	1061	17809	1459	2435	0.00	-12.35	4.27	0.00	0.00	0.00	-297.30	110.68	382
18	17931	819	18224	1774	2414	0.00	-12.57	4.32	0.00	0.00	0.00	-297.30	123.25	318
19	18190	558	18553	839	2397	0.00	-12.26	4.28	0.00	0.00	0.00	-297.30	135.51	249
20	18347	282	18777	445	2385	0.00	-10.77	4.01	0.00	0.00	0.00	-297.30	146.28	211
	18400	0	18852	85	2381	0.00	-5.96	2.32	0.00	0.00	0.00	-297.30	152.24	35
												-256.99	1240	-814
												-299	759	227
												-814	1274	305

Disused Rail Bridge 1 & 97



AECU or At 40% (CEU value)

Pier radius - SEE LATER

gammaF1 dead load: 1.00 Double Axle (1.3 m air) impact right @ 12548 [mm]

gammaF1 superimposed: 1.00

gammaF1 live load: 2.11

gammaF3 load effect: 1.10

gammaM material: 1.00

File path: J:\Glasgow\Jobs\East Ayrshire Council\w9331615 EAC Bridge Assessment Work\Technical\11_Disused Rail Bridge Nos. 1 & 97\CheckStructure1.brg

NAME: Disused Rail Bridge 1 & 97

LOCATION: East Ayrshire

NUMBER: B751 -20

URS Corporation Ltd

DATE: 13 January 2009

Printed on: Tuesday, December 22, 2009 15:55:46

Bridge Name: Disused Rail Bridge 1 & 97
Bridge Number: B751 -20
Number of spans: 2

SAFETY FACTORS

Factor for deadload: 1.00
Factor for live load: 2.11

APPLIED LOAD CASES

1. Double Axle (1.3 m air) impact right Total weight:

Applied distribution mode: Arch/Multi
Applied live load pressure: Active pressure

STRUCTURE PROPERTIES

Road shape: Curved (3-point method)
Road points: (0, 2663) (920, 2708)
Depth of overlay: 0
Surface unit weight: 15.00 [kN/m³]
Lane width: 2920

Fill unit weight: 18.00 [kN/m³] Fill phi: 30 [degree]

Left abutment Base level=2600 [mm] Height: 0 [mm]
Right abutment Base level=2690 [mm] Height: 0 [mm]

SPAN 1 Shape Elliptic
Span: 8600 [mm]
Ring Thickness at crown: Masonry Unit Weight: 20.00

Rise: 460 [kN/m³]

Intrados.x Intrados.z Extrados.x Extrados.z Roadlevel

Fx dead 0.00 2652 0.00

Fz dead 0.00 -6.33

Fx live 0.00 0.12

Fz live 0.00 -0.00

My dead 0.00 0.00

My live 0.00 0.00

Fx passive 0 [mm]

Fz passive 0 [mm]

My total 0 [mm]

Fz total 0 [mm]

Thrust in 257 0 [mm]

Thrust out 281 0 [mm]

Extra-Thrust 179 0 [mm]

My total 37.72 0 [mm]

Fz total -124.22 0 [mm]

Thrust in 257 0 [mm]

Thrust out 281 0 [mm]

Extra-Thrust 179 0 [mm]

Segment 0 0 -452 83 -378 447 1835 6.00

1 53 287 833 156 846 2654 460

2 210 567 833 173 186 2667 460

3 469 833 1079 588 1475 2676 460

4 821 1259 1298 1079 1721 2686 460

5 6 1773 1485 1636 1924 2696 460

6 17348 1635 2250 2084 2706 1.00

7 2971 1745 2908 2201 2715 0.59

8 3627 1812 3596 2271 2722 0.30

9 4300 1835 4300 2285 2727 0.09

10 11 4973 1812 5004 2271 2731 -0.09

12 5629 1745 5692 2201 2732 -0.31

13 6252 1635 6350 2084 2731 -0.61

14 6827 1485 6964 1924 2729 -1.04

15 7341 1298 7521 1721 2726 0.00

16 7779 1079 8012 1475 2722 0.00

17 8131 833 8427 1186 2718 0.00

18 8390 567 8756 846 2714 0.00

19 8547 287 8978 447 2711 0.00

20 8600 0 9052 83 2710 0.00

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left

0 6600 9800 0 -553 0 -420.34 -197.57 -420.34 3.02 9165 9249 -0.34 -0.36

1 8600 9800 -1105 -13.26 -13.26 -197.57 -433.60 -106.14 8912 8899 -0.80 0.08

2 8600 9800 -1658 -13.26 -13.26 -197.57 -446.86 -215.30 8674 8763 -1.27 0.52

3 8600 9800 -2210 -13.26 -13.26 -197.57 -460.12 -324.45 8449 8541 -1.74 0.97

4 8600 9800 -2210 -13.26 -13.26 -197.57 -473.38 -433.61 8237 8331 -2.20 1.41

PIER 1 Base level: -2210 [mm] Top level: 0 [mm] Thickness at top: 1200 [mm]

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right

0 6600 9800 0 -553 0 -420.34 -197.57 -420.34 3.02 9165 9249 -0.34 -0.36 565.15 550.79

1 8600 9800 -1105 -13.26 -13.26 -197.57 -433.60 -106.14 8912 8899 -0.80 0.08 311.85 801.43

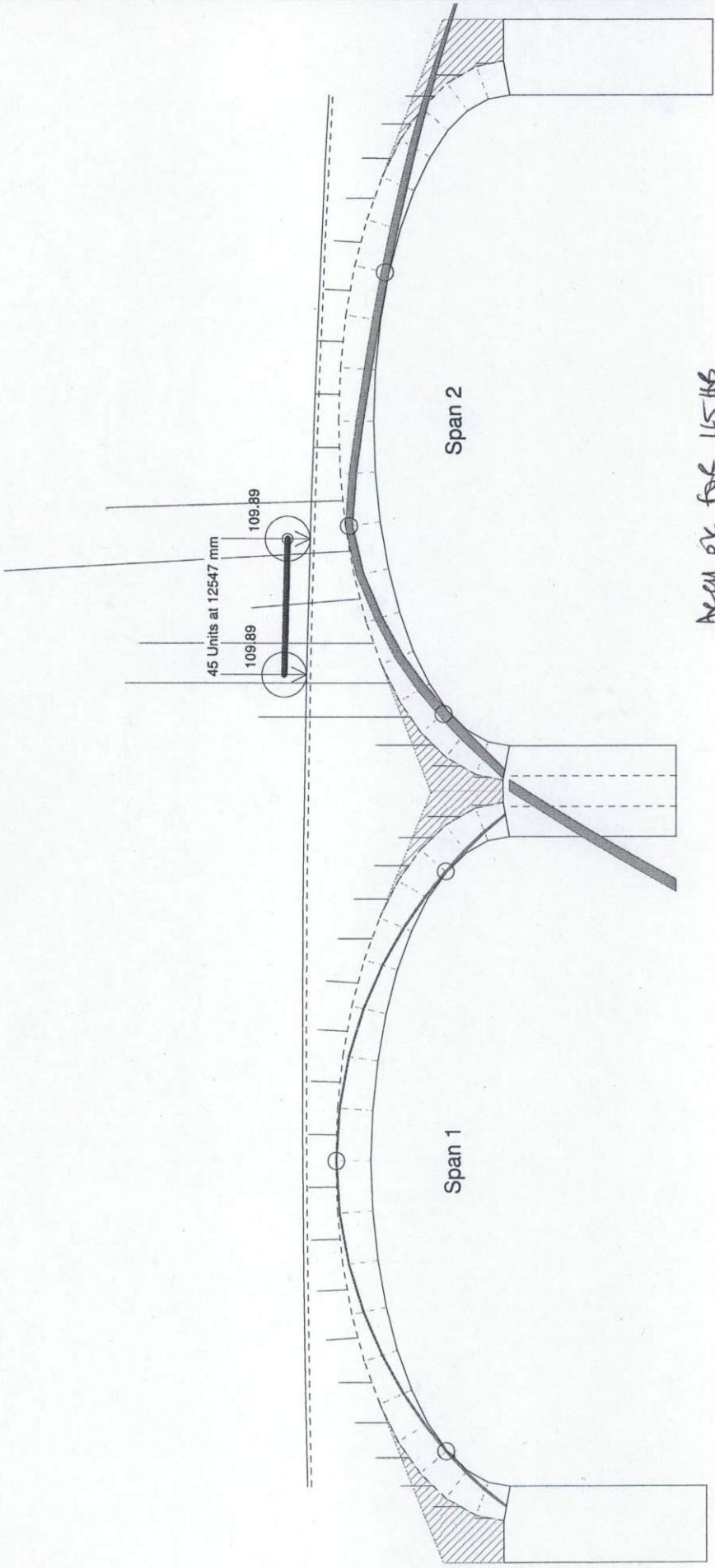
2 8600 9800 -1658 -13.26 -13.26 -197.57 -446.86 -215.30 8674 8763 -1.27 0.52 73.51 1037.11

3 8600 9800 -2210 -13.26 -13.26 -197.57 -460.12 -324.45 8449 8541 -1.74 0.97 1259.14 ***

4 8600 9800 -2210 -13.26 -13.26 -197.57 -473.38 -433.61 8237 8331 -2.20 1.41 363.33 ***

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Roadlevel	Fx dead	Fz dead	Fx live	Fz live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust	
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	
0	9800	0	8600	Rise: 460 [kN/m3]	1805	[mm] Ring Thickness at crown: 20.00	[mm] Masonry Strength: 6.00	0	460	[mm] Quarter Rise: 6.00	[mm]	[mm] Ring Thickness at springing: 6.00	[MPa]	[mm] Mortar loss:0	[mm]		
1	9853	282	9348	9423	85	445	2705	0.00	-6.39	0.11	0.00	-296.67	-284.83	373	429	31	
2	10010	558	9647	839	2701	0.00	-12.03	-0.56	0.00	-0.00	0.00	-296.67	-278.44	148	209	251	
3	10259	819	9976	1174	2696	0.00	-14.00	0.05	0.00	0.00	0.00	-296.67	-266.41	31	96	364	
4	10621	1061	10391	1459	2688	0.00	-14.57	0.96	0.00	-0.62	0.12	0.00	-296.67	-252.41	12.62	0	395
5	11059	1276	10881	1700	2679	0.00	-14.44	1.83	0.00	-13.81	2.35	0.00	-296.67	-237.23	25.70	37	360
6	11573	1460	11438	1900	2666	0.00	-13.89	2.51	0.00	-35.19	6.08	0.00	-296.67	-208.98	57.55	133	268
7	12148	1608	12052	2058	2651	0.95	-13.06	2.97	2.65	-30.88	6.60	0.00	-300.27	-159.90	93.60	311	149
8	12771	1717	12709	2172	2634	0.53	-12.12	3.24	4.91	-84.63	25.28	0.00	-305.71	-115.96	125.45	368	421
9	13427	1783	13397	2242	2613	0.25	-11.26	3.37	1.42	-42.29	6.28	0.00	-307.39	-19.21	132.78	409	460
10	14100	1805	14100	2265	2590	0.07	-10.63	3.46	0.00	-0.00	0.00	0.00	-307.46	-34.34	99.58	302	352
11	14773	1783	14803	2242	2565	-0.07	-10.33	3.55	0.00	0.00	0.00	0.00	-307.40	-44.97	65.96	189	240
12	15429	1717	15491	2172	2538	-0.21	-10.37	3.68	0.00	0.00	0.00	0.00	-307.19	55.29	39.15	100	152
13	16052	1608	16148	2058	2511	-0.41	-10.73	3.85	0.00	0.00	0.00	0.00	-306.77	65.66	20.06	38	370
14	16627	1460	16762	1900	2484	-0.73	-11.28	4.03	0.00	0.00	0.00	0.00	-306.05	76.39	9.54	4	403
15	17141	1276	17319	1700	2459	0.00	-11.88	4.18	0.00	0.00	0.00	0.00	-306.05	87.67	-8.42	53	407
16	17579	1061	17809	1459	2435	0.00	-12.35	4.27	0.00	0.00	0.00	0.00	-306.05	99.55	-17.82	29	378
17	17931	819	18224	1174	2414	0.00	-12.57	4.32	0.00	0.00	0.00	0.00	-306.05	111.90	-58.97	95	148
18	18190	558	18553	839	2397	0.00	-12.26	4.28	0.00	0.00	0.00	0.00	-306.05	124.47	-73.31	206	21
19	18347	282	18777	445	2385	0.00	-10.77	4.01	0.00	0.00	0.00	0.00	-306.05	136.73	-122.38	390	439
20	18400	0	18852	85	2381	-5.96	2.32	0.00	0.00	0.00	0.00	0.00	-306.05	147.50	-187.44	741	782

Disused Rail Bridge 1 & 97



gammaF1 dead load: 1.00 45 Units @ 12547 [mm]
gammaF1 superimposed: 1.00
gammaF1 live load: 2.22
gammaF3 load effect: 1.10
gammaM material: 1.00
File path: J:\Glasgow\Jobs\East Ayrshire Council\49331615 EAO Bridge Assessment Work\Technical\11. Disused Rail Bridge Nos. 1 & 97\Check\Structure1.brg

NAME: Disused Rail Bridge 1 & 97
LOCATION: East Ayrshire
NUMBER: B751 -20
URS Corporation Ltd
DATE: 13 January 2009

Bridge Name:		Disused Rail Bridge 1 & 97		Bridge Location:		East Ayrshire	
Bridge Number:		B751 -20		Number of spans:		2	
SAFETY FACTORS				APPLIED LOAD CASES			
Factor for deadload:		1.00		Factor for superimposed deadload: 1.00		Factor for surfacing: 1.00	
Factor for live load:		2.22		Factor for load effect: 1.10		Factor for material strength: 1.00	
1.	45 Units	Total weight:	882.90	[kN]	Position:	12547	[mm]
Applied distribution mode:				Applied live load pressure:			
STRUCTURE PROPERTIES							
Road shape:		Curved (3-point method)		(18400, 2405)			
Road points:		(0, 2663)		(9200, 2708)			
Depth of surfacing:		50		Depth of overlay: 0			
Surface unit weight:		15.00		Overlay unit weight: 15.00		[kN/m³]	
Lane width:		4120					
Fill unit weight:		18.00		[kN/m³]			
Left abutment		Base level:-2660		[mm]		Height: 0	
Right abutment		Base level:-2690		[mm]		Height: 0	
SPAN 1		Shape		Rise: 460		[mm]	
Span:		8600		Ring Thickness at crown: [mm]		Quarter Rise: 0	
Masonry Unit Weight:20.00		[kN/m³]		Ring Thickness at springing: 6.00		Width: 1000	
Segment Intrados.x		Intrados.z		Extrados.x		Extrados.z	
0		0		-452		2652	
1		53		-378		2654	
2		210		-156		2659	
3		469		833		1186	
4		821		1079		2667	
5		1259		1298		2676	
6		1773		1485		1475	
7		2348		1635		1924	
8		2971		1745		2084	
9		3627		1812		2706	
10		4300		1835		2201	
11		4973		1812		2271	
12		5629		1745		2731	
13		6252		1635		2732	
14		6827		1485		2731	
15		7341		1298		2729	
16		7779		1079		2722	
17		8131		833		2718	
18		8390		567		2714	
19		8547		287		2711	
20		8600		0		2710	
Segment Left x		Right x		-2210		[mm]	
Batter:		1.0		Top level: 0		[mm]	
Masonry Unit Weight:20.00		[kN/m³]		Masonry Strength: 5.00		Thickness at top: 1200	
PIER 1							
Base level:		-2210		Weight z		Fz	
Batter:		0		-732.21		My	
Masonry Unit Weight:20.00		-553		-471.83		Thrust left	
Segment Left x		8600		-13.26		57.05	
1		8600		-471.83		9205	
2		8600		-13.26		883.64	
3		8600		-471.83		8512	
4		8600		-13.26		8184	
Base level:		-2210		-471.83		785.25	
Batter:		-13.26		-985.69		7866	
Masonry Unit Weight:20.00		0		-471.83		8023	
STRUCTURE PROPERTIES							
Road shape:		Curved (3-point method)		(18400, 2405)			
Road points:		(0, 2663)		(9200, 2708)			
Depth of surfacing:		50		Depth of overlay: 0			
Surface unit weight:		15.00		Overlay unit weight: 15.00		[kN/m³]	
Lane width:		4120					
Fill unit weight:		18.00		[kN/m³]			
Left abutment		Base level:-2660		[mm]		Height: 0	
Right abutment		Base level:-2690		[mm]		Height: 0	
SPAN 1		Shape		Rise: 460		[mm]	
Span:		8600		Ring Thickness at crown: [mm]		Quarter Rise: 0	
Masonry Unit Weight:20.00		[kN/m³]		Ring Thickness at springing: 6.00		Width: 1000	
Segment Intrados.x		Intrados.z		Extrados.x		Extrados.z	
0		0		-452		2652	
1		53		-378		2654	
2		210		-156		2659	
3		469		833		1186	
4		821		1079		2667	
5		1259		1298		2676	
6		1773		1485		2686	
7		2348		1635		13.88	
8		2971		1745		2.50	
9		3627		1812		-13.88	
10		4300		1835		-12.24	
11		4973		1812		-12.24	
12		5629		1745		-0.61	
13		6252		1635		-12.86	
14		6827		1485		-1.04	
15		7341		1298		-14.59	
16		7779		1079		-14.66	
17		8131		8427		-14.69	
18		8390		8756		5.10	
19		8547		846		-14.05	
20		8600		287		4.97	
Segment Left x		Right x		-2210		-14.05	
Batter:		1.0		Top level: 0		[mm]	
Masonry Unit Weight:20.00		[kN/m³]		Masonry Strength: 5.00		Thickness at top: 1200	
STRUCTURE PROPERTIES							
Road shape:		Curved (3-point method)		(18400, 2405)			
Road points:		(0, 2663)		(9200, 2708)			
Depth of surfacing:		50		Depth of overlay: 0			
Surface unit weight:		15.00		Overlay unit weight: 15.00		[kN/m³]	
Lane width:		4120					
Fill unit weight:		18.00		[kN/m³]			
Left abutment		Base level:-2660		[mm]		Height: 0	
Right abutment		Base level:-2690		[mm]		Height: 0	
SPAN 1		Shape		Rise: 460		[mm]	
Span:		8600		Ring Thickness at crown: [mm]		Quarter Rise: 0	
Masonry Unit Weight:20.00		[kN/m³]		Ring Thickness at springing: 6.00		Width: 1000	
Segment Intrados.x		Intrados.z		Extrados.x		Extrados.z	
0		0		-452		2652	
1		53		-378		2654	
2		210		-156		2659	
3		469		833			

Span:	8600	[mm]	Rise:	1805	[mm]	Quarter Rise:	0	[mm]	Mortar loss:0	[mm]	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust	
						Ring Thickness at springing:					Fx dead	Fz dead	My dead	Fx dead	Fz dead	Fx total	Fz total				
						Masonry Strength:	6.00				0.00	0.00	0.00	0.00	0.00	-570.94	-584.82	-258.88	324	437	23
Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Roadlevel	Fx dead	Fz dead	My dead	Fx live	Fz live	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust	
0	9800	0	9348	85	2706	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-570.94	-584.82	-258.88	324	437	23	
1	9853	282	9423	445	2705	0.00	-6.39	0.11	0.00	-0.00	0.00	0.00	0.00	0.00	-570.94	-578.43	-128.39	111	235	225	
2	10010	558	9647	839	2701	0.00	-12.03	-0.56	0.00	-0.30	0.02	0.00	-0.30	0.00	-570.94	-566.10	-59.78	9	141	319	
3	10269	819	9976	1174	2696	0.00	-14.00	0.05	0.00	-10.55	0.24	0.00	-10.55	0.00	-570.94	-541.55	-130	-1	130	330	
4	10621	1061	10391	1459	2688	0.00	-14.57	0.96	0.00	-49.79	3.21	0.00	-49.79	0.00	-570.94	-477.20	-85.03	55	177	283	
5	11059	1276	10881	1700	2679	0.00	-14.44	1.83	0.00	-98.37	10.60	0.00	-98.37	0.00	-570.94	-364.39	-134.17	145	257	203	
6	11573	1460	11438	1900	2666	0.00	-13.89	2.51	0.00	-85.80	10.68	0.00	-85.80	0.00	-570.94	-264.70	-178.15	234	338	122	
7	12148	1608	12052	2058	2651	0.95	-13.06	2.97	0.00	-33.03	7.84	0.00	-33.03	0.00	-574.73	-218.61	327	31	429	31	
8	12771	1717	12709	2172	2634	0.53	-12.12	3.24	10.33	-178.15	53.82	0.00	-178.15	0.00	-585.59	-28.35	-240.94	364	461	-1	
9	13427	1783	13397	2242	2613	0.25	-11.26	3.37	3.02	-89.82	13.31	0.00	-89.82	0.00	-588.86	72.73	-170.97	245	342	118	
10	14100	1805	14100	2265	2590	0.07	-10.63	3.46	0.00	-0.00	-0.00	0.00	-0.00	0.00	-588.89	83.36	-105.27	130	228	232	
11	14773	1783	14803	2242	2565	-0.07	-10.33	3.55	0.00	0.00	0.00	0.00	0.00	0.00	-588.87	93.69	50	149	311	311	
12	15429	1717	15491	2172	2538	-0.21	-10.37	3.68	0.00	0.00	0.00	0.00	0.00	0.00	-588.66	104.06	-33.22	6	105	355	
13	16052	1608	16148	2058	2511	-0.41	-10.73	3.85	0.00	0.00	0.00	0.00	0.00	0.00	-588.25	114.78	-29.28	-1	99	361	
14	16627	1460	16762	1900	2484	-0.73	-11.28	4.03	0.00	0.00	0.00	0.00	0.00	0.00	-587.52	126.07	-47.73	30	130	330	
15	17141	1276	17319	1700	2459	0.00	-11.88	4.18	0.00	0.00	0.00	0.00	0.00	0.00	-587.52	137.94	-89.20	100	199	261	
16	17579	1061	17809	1459	2435	0.00	-12.35	4.27	0.00	0.00	0.00	0.00	0.00	0.00	-587.52	150.30	-154.15	215	313	147	
17	17931	819	18224	1174	2414	0.00	-12.57	4.32	0.00	0.00	0.00	0.00	0.00	0.00	-587.52	162.87	-242.93	390	483	-23	
18	18190	558	18553	839	2397	0.00	-12.26	4.28	0.00	0.00	0.00	0.00	0.00	0.00	-587.52	175.13	-355.74	673	756	-296	
19	18347	282	18777	445	2385	0.00	-10.77	4.01	0.00	0.00	0.00	0.00	0.00	0.00	-587.52	185.90	-492.28	1259	1323	-863	
20	18400	0	18852	85	2381	0.00	-5.96	2.32	0.00	0.00	0.00	0.00	0.00	0.00	-587.52	191.85	-650.33	2166	2216	-1756	

PROJECT No. 49331615

SHEET No.

DRG REF.

PROJECT TITLE

DESCRIPTION

DISTRICT R BR. 1 E 09

PIER CHECKS

REFERENCE

CALCULATIONS

SUMMARY

PIER CHECKS

Assessment of the central pier in Archie based on an arch effective width is considered to be overly conservative.

See attached references.

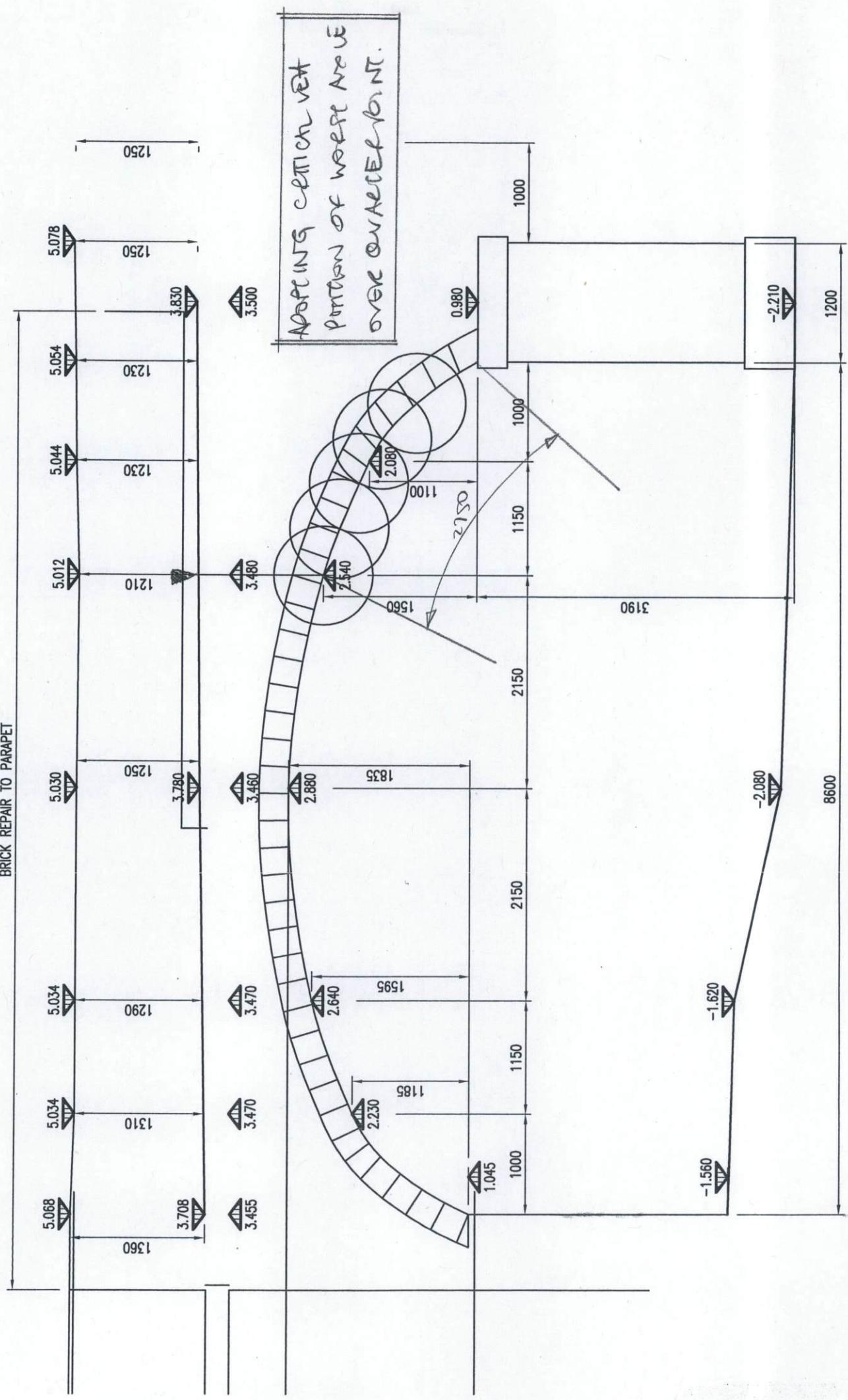
For a) one lane loaded $W = 5552 \text{ mm}$

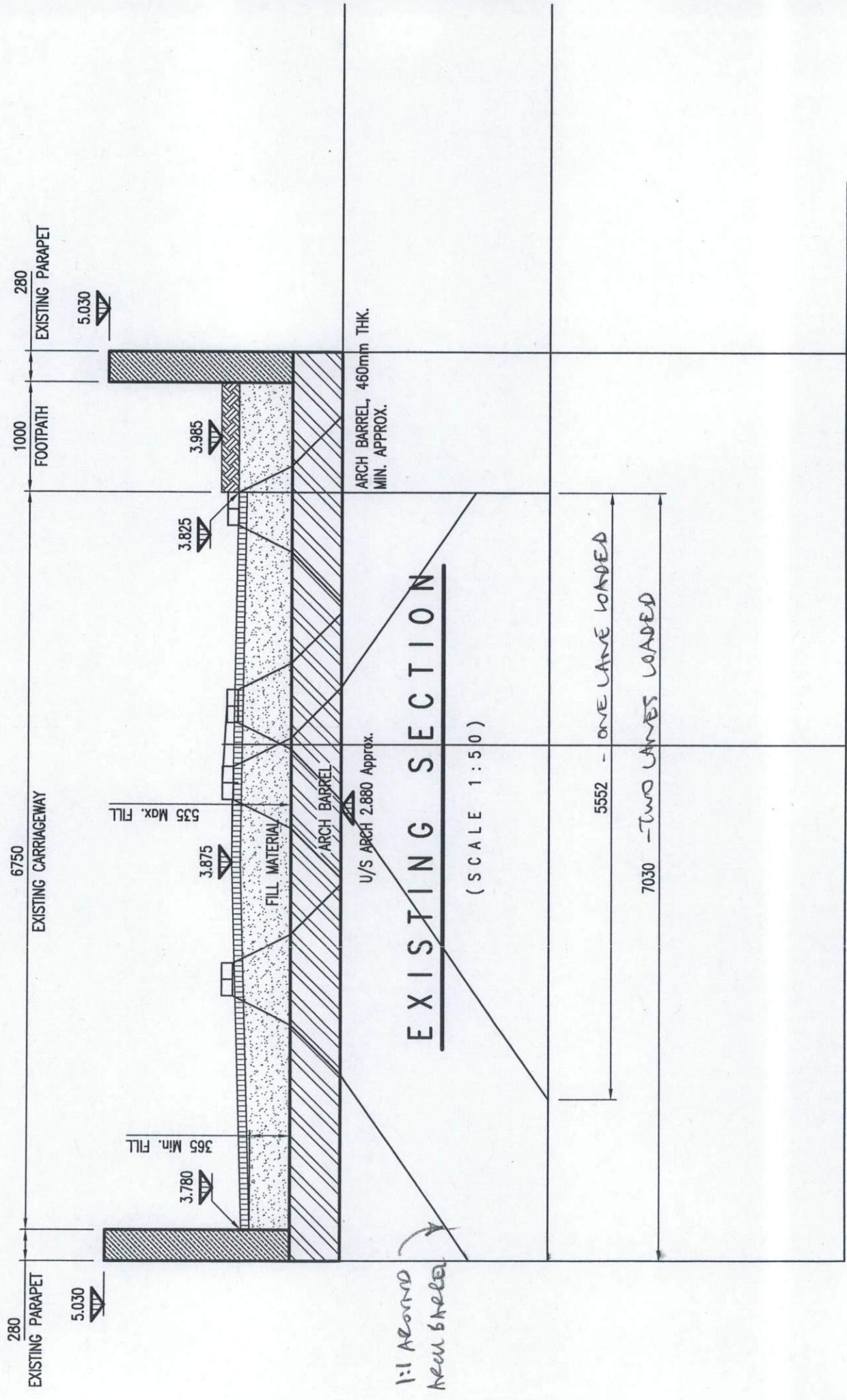
b) two lanes loaded $W = 7030 = 3515 \text{ mm}$.
2

Hence use an effective width of 3515 mm and check critical vehicles.

20

BRICK REPAIR TO PARAPET





ACUTE THRESCHOLD AGREEMENTS.

40te vehicles envelope thrust adjustments required - fails

Thrust modification for Disused Rail Bridge 1 & 97: Span 1

H [kN]	143.72	-30.97	<input type="button" value="◀"/>	<input type="button" value="▶"/>	247.80
V [kN]	-2.5313	-12.66	<input type="button" value="◀"/>	<input type="button" value="▶"/>	12.66
Alpha [%]	68	0%	<input type="button" value="◀"/>	<input type="button" value="▶"/>	100%

Thrust modification for Disused Rail Bridge 1 & 97: Span 2

H [kN]	62.247	-27.79	<input type="button" value="◀"/>	<input type="button" value="▶"/>	222.31
V [kN]	-1.3587	-15.10	<input type="button" value="◀"/>	<input type="button" value="▶"/>	15.10
Alpha [%]	42	0%	<input type="button" value="◀"/>	<input type="button" value="▶"/>	100%

26te reduced vehicles envelope thrust adjustments required – fails

Thrust modification for Disused Rail Bridge 1 & 97: Span 1

H [kN]	99.118	-30.97	<input type="button" value="◀"/>	<input type="button" value="▶"/>	247.80	
V [kN]	-7.9737	-12.66	<input type="button" value="◀"/>	<input type="button" value="▶"/>	12.66	
Alpha [%]	31	0%	<input type="button" value="◀"/>	<input checked="" type="button" value="■"/>	<input type="button" value="▶"/>	100%

Thrust modification for Disused Rail Bridge 1 & 97: Span 2

H [kN]	2.2231	-27.79	<input type="button" value="◀"/>	<input type="button" value="▶"/>	222.31	
V [kN]	-1.3587	-15.10	<input type="button" value="◀"/>	<input type="button" value="▶"/>	15.10	
Alpha [%]	48	0%	<input type="button" value="◀"/>	<input checked="" type="button" value="■"/>	<input type="button" value="▶"/>	100%

18te reduced vehicles envelope thrust adjustments required – pass

Thrust modification for Disused Rail Bridge 1 & 97: Span 1

H [kN]	121.42	-30.97	<input type="button" value="◀"/>	<input type="button" value="▶"/>	247.80
V [kN]	-10.125	-12.66	<input type="button" value="◀"/>	<input type="button" value="▶"/>	12.66
Alpha [%]	15	0%	<input type="button" value="◀"/>	<input type="button" value="▶"/>	100%

Thrust modification for Disused Rail Bridge 1 & 97: Span 2

H [kN]	22.231	-27.79	<input type="button" value="◀"/>	<input type="button" value="▶"/>	222.31	
V [kN]	-4.8147	-14.59	<input type="button" value="◀"/>	<input checked="" type="button" value="■"/>	<input type="button" value="▶"/>	14.59
Alpha [%]	51	0%	<input type="button" value="◀"/>	<input type="button" value="▶"/>	100%	

fire engine envelope thrust adjustments required – pass

Thrust modification for Disused Rail Bridge 1 & 97: Span 1

H [kN]	119.56	-30.97	<input type="button" value="◀"/>	<input type="button" value="▶"/>	247.80	
V [kN]	-10.125	-12.66	<input type="button" value="◀"/>	<input type="button" value="▶"/>	12.66	
Alpha [%]	15	0%	<input type="button" value="◀"/>	<input checked="" type="button" value="■"/>	<input type="button" value="▶"/>	100%

Thrust modification for Disused Rail Bridge 1 & 97: Span 2

H [kN]	32.235	-27.79	<input type="button" value="◀"/>	<input type="button" value="▶"/>	222.31
V [kN]	-4.9631	-14.18	<input type="button" value="◀"/>	<input type="button" value="▶"/>	14.18
Alpha [%]	51	0%	<input type="button" value="◀"/>	<input type="button" value="▶"/>	100%

C&u vehicles 24te envelope thrust adjustments required – pass

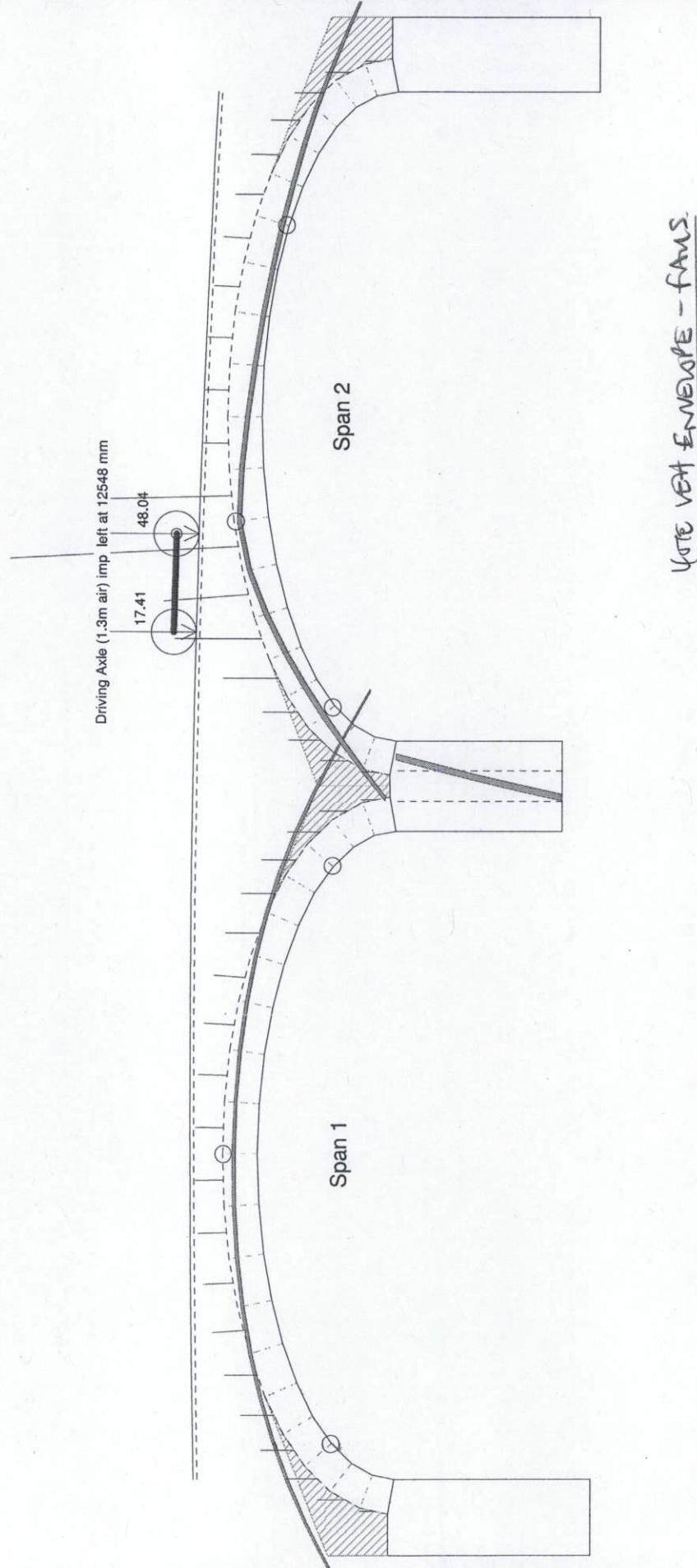
Thrust modification for Disused Rail Bridge 1 & 97: Span 1

H [kN]	87.967	-30.97	◀	■	▶	247.80
V [kN]	-1.7683	-25.26	◀	□	▶	25.26
Alpha [%]	59	0%	◀	□	▶	100%

Thrust modification for Disused Rail Bridge 1 & 97: Span 2

H [kN]	197.30	-27.79	◀	□	▶	222.31
V [kN]	6.6813	-11.32	◀	□	▶	11.32
Alpha [%]	6	0%	◀	□	▶	100%

Disused Rail Bridge 1 & 97



Driving Axle (1.3m air) imp left @ 12548 [mm]
 gammaF1 dead load: 1.00
 gammaF1 superimposed: 1.00
 gammaF1 live load: 2.11
 gammaF3 load effect: 1.10
 gammaM material: 1.00
 File path: J:\Glasgow\Jobs\East Ayrshire Council\49331615 EAC Bridge Assess

NAME: Disused Rail Bridge 1 & 97
LOCATION: East Ayrshire
NUMBER: B751-20
URS Corporation Ltd
DATE: 13 January 2009
Printed on: Tuesday December 22, 2009

Span:	8600	[mm]	Rise:	1805	[mm]	Quarter Rise:	0	[mm]	Mortar loss:0	[mm]	Fz live	Fx live	My dead	Fx dead	Fz dead	Ring Thickness at springing:	Thickness at springing:	Masonry Strength:	[mm]	[mm]	Fz live	Fx live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust	
				9348	85	6.00	460	460								[MPa]	[MPa]														
Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Roadlevel	Fx dead	Fz dead	Fx dead	Fz dead	Fx live	Fz live	My dead	Fx live	Fz live	Fx live	Fz live	Fx total	Fz total	Fx total	Fz total	Fx total	Fz total	Fx total	Fz total	Fx total	Fz total	Fx total	Fz total			
0	9800	0	9348	85	2706	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-261.59	-251.06	757	810	-350	810	-350	-251.06	-255.20	-167.65	436	496	-36	151	***	
1	9853	282	9423	445	2705	0.00	-6.39	0.11	0.00	-0.00	0.00	0.00	0.00	0.00	-343.62	-343.62	-243.17	-110.76	242	309	151	-36	151	***	***	***	***	***	***	***	***
2	10010	558	9647	839	2701	0.00	-12.03	-0.56	0.00	-0.00	0.00	0.00	0.00	0.00	-343.62	-343.62	-243.17	-110.76	242	309	151	151	151	151	151	151	151	151	151		
3	10269	819	9976	1174	2686	0.00	-14.00	0.05	0.00	-0.00	0.00	0.00	0.00	0.00	-229.18	-229.18	-214.20	-73.65	161	229	231	231	231	231	231	231	231	231	231		
4	10621	1061	10391	1459	2688	0.00	-14.57	0.96	0.00	-0.41	0.08	0.00	0.00	0.00	-343.62	-343.62	-214.20	-190.71	148	216	244	216	244	244	244	244	244	244	244		
5	11059	1276	10881	1700	2679	0.00	-14.44	1.83	0.00	-9.06	1.54	0.00	-23.08	3.99	0.00	-343.62	-343.62	-153.74	-108.74	260	322	322	322	322	322	322	322	322	322		
6	11573	1460	11438	1900	2666	0.00	-13.89	2.51	0.00	-23.08	5.47	0.00	-22.88	5.47	0.00	-346.54	-346.54	-117.79	-133.66	398	62	62	62	62	62	62	62	62	62		
7	12148	1608	12052	2058	2651	0.95	-13.06	1.96	0.00	-12.88	4.91	-84.72	25.40	0.00	-351.98	-351.98	-20.95	-137.21	361	420	40	40	40	40	40	40	40	40			
8	12771	1717	12709	2172	2634	0.53	-12.12	3.24	0.00	-12.12	4.91	-84.72	25.40	0.00	-353.67	-353.67	-20.95	-137.21	361	420	40	40	40	40	40	40	40	40			
9	13427	1783	13397	2242	2613	0.25	-11.26	3.37	1.43	-42.52	6.32	0.00	-353.74	-353.74	-32.83	-101.98	262	320	140	140	140	140	140	140	140	140	140				
10	14100	1805	14100	2265	2590	0.07	-10.63	3.46	0.00	-0.00	0.00	0.00	0.00	0.00	-353.67	-353.67	-43.46	-68.34	164	223	237	223	237	237	237	237	237	237			
11	14773	1783	14803	2242	2565	-0.07	-10.33	3.55	0.00	0.00	0.00	0.00	0.00	0.00	-353.67	-353.67	53.78	93	152	152	152	152	152	152	152	152	152				
12	15429	1717	15491	2172	2538	-0.21	-10.37	3.68	0.00	0.00	0.00	0.00	0.00	0.00	-353.46	-353.46	64.16	-28.54	50	109	351	351	351	351	351	351	351	351			
13	16052	1608	16148	2058	2511	-0.41	-10.73	3.85	0.00	0.00	0.00	0.00	0.00	0.00	-353.05	-353.05	74.88	-23.97	36	97	363	363	363	363	363	363	363	363			
14	16627	1460	16762	1900	2484	-0.73	-11.28	4.03	0.00	0.00	0.00	0.00	0.00	0.00	-352.32	-352.32	86.17	-30.57	54	115	345	345	345	345	345	345	345	345			
15	17141	1276	17319	1700	2459	0.00	-11.88	4.18	0.00	0.00	0.00	0.00	0.00	0.00	-352.32	-352.32	98.04	-49.26	106	166	294	294	294	294	294	294	294	294			
16	17579	1061	17809	1459	2435	0.00	-12.35	4.27	0.00	0.00	0.00	0.00	0.00	0.00	-352.32	-352.32	110.40	-81.04	195	255	205	205	205	205	205	205	205				
17	17931	819	18224	1174	2414	0.00	-12.57	4.32	0.00	0.00	0.00	0.00	0.00	0.00	-352.32	-352.32	122.97	-127.09	334	392	68	68	68	68	68	68	68	68			
18	18190	558	18853	839	2397	0.00	-12.26	4.28	0.00	0.00	0.00	0.00	0.00	0.00	-352.32	-352.32	135.22	-188.65	558	612	152	152	152	152	152	152	152	152			
19	18347	282	18777	445	2385	0.00	-10.77	4.01	0.00	0.00	0.00	0.00	0.00	0.00	-352.32	-352.32	145.99	-266.70	1000	1044	584	584	584	584	584	584	584	584			
20	18400	0	18852	85	2381	0.00	-5.96	2.32	0.00	0.00	0.00	0.00	0.00	0.00	-352.32	-352.32	151.95	-360.46	1664	1700	-1240	-1240	-1240	-1240	-1240	-1240	-1240	-1240			

Disused Rail Bridge 1 & 97

Driving Axle (1.3m air) Impact L at 12548 mm

17.41

48.04

Span 2

Span 1

Note per. vft - flaws.

gammaF1 dead load: 1.00
gammaF1 superimposed: 1.00

gammaF1 live load: 2.11

gammaF3 load effect: 1.10

gammaM material: 1.00

File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11. Disused Rail Bridge Nos. 1 & 97\Check\Structure1.brg

NAME: Disused Rail Bridge 1 & 97

LOCATION: East Ayrshire

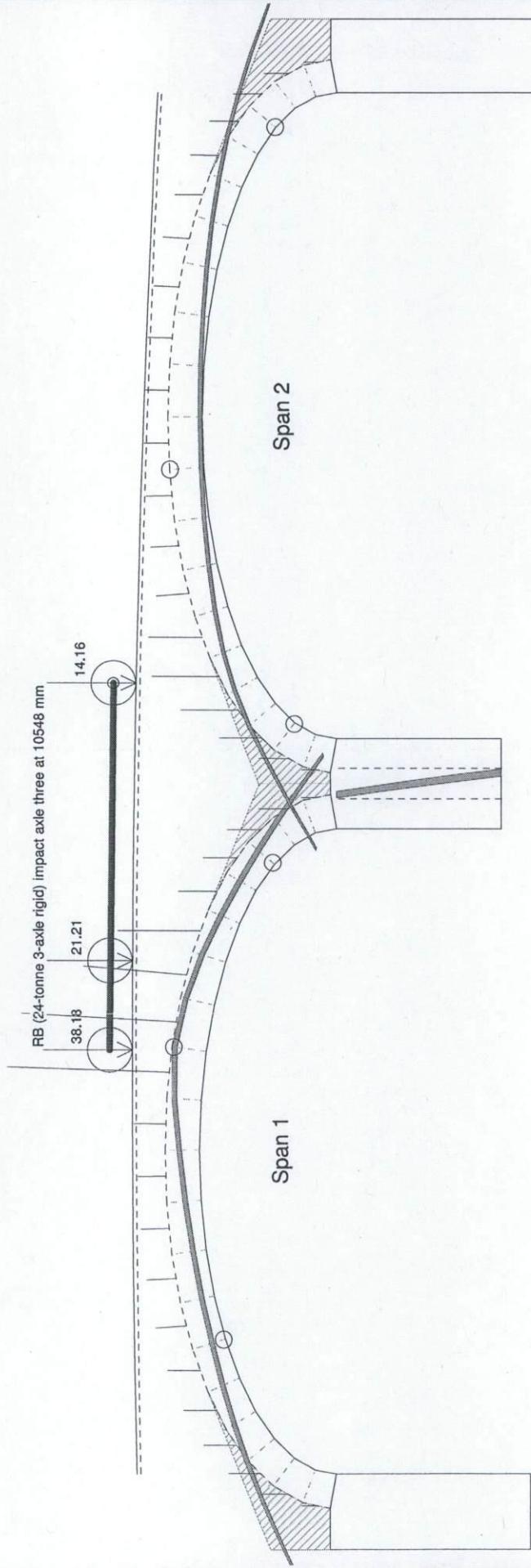
NUMBER: B751 -20

URS Corporation Ltd

DATE: 13 January 2009

Span:	8600	[mm]	Rise:	1805	[mm]	Quarter Rise:	0	[mm]	Mortar loss:0	[mm]		
Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Roadlevel	Fx dead	Fz dead	Fx live	Fz live	Fy live	Fx passive	Fx total
0	9800	0	9348	85	2706	0.00	0.00	0.00	0.00	0.00	-283.60	-139.22
1	9853	282	9423	445	2705	0.00	-6.39	0.11	0.00	0.00	-283.60	-72.76
2	10010	558	9647	839	2701	0.00	-12.03	-0.56	0.00	0.00	-283.60	-32.40
3	10269	819	9976	1174	2696	0.00	-14.00	0.05	0.00	0.00	-283.60	-243.17
4	10621	1061	10391	1459	2688	0.00	-14.57	0.96	0.00	0.08	-283.60	-214.20
5	11059	1276	10881	1700	2679	0.00	-14.44	1.83	0.00	-9.06	-283.60	-190.71
6	11573	1460	11438	1900	2666	0.00	-13.89	2.51	0.00	-23.08	-283.60	-153.74
7	12148	1608	12052	2058	2651	0.95	-13.06	1.96	-22.88	5.47	-286.51	-117.79
8	12771	1717	12709	2172	2634	0.53	-12.12	3.24	4.91	-84.72	25.40	0.00
9	13427	1783	13397	2242	2613	0.25	-11.26	3.37	1.43	-42.52	6.32	0.00
10	14100	1805	14100	2265	2590	0.07	-10.63	3.46	0.00	-0.00	0.00	43.46
11	14773	1783	14803	2242	2565	-0.07	-10.33	3.55	0.00	0.00	0.00	53.78
12	15429	1717	15491	2172	2538	-0.21	-10.37	3.68	0.00	0.00	0.00	-38.75
13	16052	1608	16148	2058	2511	-0.41	-10.73	3.85	0.00	0.00	0.00	-19.74
14	16627	1460	16762	1900	2484	-0.73	-11.28	4.03	0.00	0.00	0.00	-293.02
15	17141	1276	17319	1700	2459	0.00	-11.88	4.18	0.00	0.00	0.00	-292.30
16	17579	1061	17809	1459	2435	0.00	-12.35	4.27	0.00	0.00	0.00	-292.30
17	17931	819	18224	1174	2414	0.00	-12.57	4.32	0.00	0.00	0.00	-292.30
18	18190	558	18553	839	2397	0.00	-12.26	4.28	0.00	0.00	0.00	-292.30
19	18347	282	18777	445	2365	0.00	-10.77	4.01	0.00	0.00	0.00	-292.30
20	18400	0	18852	85	2381	0.00	-5.96	2.32	0.00	0.00	0.00	-292.30

Disused Rail Bridge 1 & 97



24T_E TEST. VEH EN - PASS.

gammaF1 dead load: 1.00

RB (24-tonne 3-axle rigid) impact axle three @ 10548 [mm]

gammaF1 superimposed: 1.00

gammaF1 live load: 2.11

gammaF3 load effect: 1.10

gammaM material: 1.00

File path: J:\Glasgow-Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11. Disused Rail Bridge 1 & 97\Structure1.brg

NAME: Disused Rail Bridge 1 & 97

LOCATION: East Ayrshire

NUMBER: B751 -20

URS Corporation Ltd

DATE: 13 January 2009
Printed on: Tuesday, December 22, 2009 18:05:31

Bridge Name: Disused Rail Bridge 1 & 97
 Bridge Number: B751-20
 Number of spans: 2

SAFETY FACTORS

Factor for deadload: 1.00
 Factor for live load: 2.11

APPLIED LOAD CASES

1. RB (24-tonne 3-axle rigid) impact axle three

Applied distribution mode: Arch/Multi

Applied live load pressure: Active pressure

STRUCTURE PROPERTIES

Road shape: Curved (3-point method)
 Road points: (0, 2663) (9200, 2708)
 Depth of surfacing: 50 Depth of overlay: 0 [kN/m^3]
 Surface unit weight: 15.00 Overlay unit weight: 15.00
 Lane width: 3515

Fill unit weight: 18.00 [kN/m^3] Fill phi: 30 [degree]

Left abutment Base level:-2600 [mm] Height: 0 [mm]
 Right abutment Base level:-2690 [mm] Height: 0 [mm]

SPAN 1

Shape Elliptic
 Span: 8600 [mm]
 Ring Thickness at crown: 20.00
 Masonry Unit Weight: 20.00

Rise: 460 [mm]
 Extrados.x 0 -452 [mm]
 Intrados.z 0 287 [mm]

Extrados.z 83 447 [mm]
 Intrados.x 452 -378 [mm]
 Masonry Strength: 6.00 [kN/m^3]

Segment 0 0
 1 53 287
 2 210 567
 3 469 833
 4 821 1079
 5 1259 1298
 6 1773 1485
 7 2348 1635
 8 2971 1745
 9 3627 1812
 10 4300 1835
 11 4973 1812
 12 5629 1745
 13 6252 1635
 14 6827 1485
 15 7341 1298
 16 7779 1079
 17 8131 833
 18 8390 567
 19 8547 287
 20 8600 0

Extrados.z 2652 2654 [mm]
 Intrados.x 83 447 [mm]
 Masonry Strength: 6.00 [kN/m^3]

Fx dead 0.00 [N]
 Fz dead 0.00 [N]
 My dead 0.00 [Nm]

Fx live 0.00 [N]
 Fz live 0.00 [N]
 My live 0.00 [Nm]

Fx passive 0.00 [N]
 Fz passive 0.00 [N]
 My total 0.00 [Nm]

Fx total 0.00 [N]
 Fz total 0.00 [N]
 My total 0.00 [Nm]

Fx thrust 0.00 [N]
 Fz thrust 0.00 [N]
 My thrust 0.00 [Nm]

Fx extra-thrust 0.00 [N]
 Fz extra-thrust 0.00 [N]
 My extra-thrust 0.00 [Nm]

Fx thrust out 0.00 [N]
 Fz thrust out 0.00 [N]
 My thrust out 0.00 [Nm]

Fx extra-thrust 0.00 [N]
 Fz extra-thrust 0.00 [N]
 My extra-thrust 0.00 [Nm]

Fx total 0.00 [N]
 Fz total 0.00 [N]
 My total 0.00 [Nm]

Fx total 0.00 [N]
 Fz total 0.00 [N]
 My total 0.00 [Nm]

Fx total 0.00 [N]
 Fz total 0.00 [N]
 My total 0.00 [Nm]

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Fx total 0.00 [N]
 Fz total 0.00 [N]
 My total 0.00 [Nm]

Fx total 0.00 [N]
 Fz total 0.00 [N]
 My total 0.00 [Nm]

PIER 1

Base level: -2210 [mm]
 Batter: 1.0
 Masonry Unit Weight: 20.00

Right x 9800 0
 Left x 8600 1
 Right x 9800 1
 Left x 8600 2
 Right x 9800 2
 Left x 8600 3
 Right x 9800 3
 Left x 8600 4

Top level: 0 [mm]
 Masonry Strength: 5.00 [MPa]

Weight z -428.73 0
 Weight z -553 -13.26
 Weight z -1105 -13.26
 Weight z -1658 -13.26
 Weight z -2210 -13.26

Fx -428.73 -62.16
 Fz -441.99 -29.01
 My 4.14 9179
 Thrust left 9012 9098
 Thrust right 9090 9179

Weight z 60.00 60.00
 Weight z 60.00 60.00
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 Weight z 60.00 60.00

Span 2 Elliptic

Disused Rail Bridge 1 & 97

18-t Single Axle with Impact at 12548 mm

48.04

Span 2

Span 1

18 tE best. VEH - 4 Axs.

18-t Single Axle with Impact @ 12548 [mm]

gammaM1 dead load: 1.00

gammaM1 superimposed: 1.00

gammaM1 live load: 2.11

gammaF3 load effect: 1.10

gammaM material: 1.00

File path: J:\Glasgow-Jobs\East Ayrshire Council\499331615 EAC Bridge Assessment\Work\Technical\1. Disused Rail Bridge 1 & 97\Check\Structure1.brg

NAME: Disused Rail Bridge 1 & 97

LOCATION: East Ayrshire

NUMBER: B751 -20

URS Corporation Ltd

DATE: 13 January 2009
Printed on: Tuesday, December 22, 2009 17:53:12

Bridge Name:
Disused Rail Bridge 1 & 97
Bridge Number:
B751 -20
Number of spans:
2

SAFETY FACTORS

Factor for deadload: 1.00

Factor for live load: 2.11

APPLIED LOAD CASES

1. 18-t Single Axle with Impact

Applied distribution mode:
Applied live load pressure:

Archie/Multi

Active pressure

STRUCTURE PROPERTIES

Road shape: Curved (3-point method)

(0, 2663) (200, 2708)

Depth of surfacing: 50

Depth of overlay: 0

Surface unit weight: 15.00

Lane width: 3515

Overlay unit weight: 15.00

[kN/m³][kN/m³]

[mm]

PIER 1

Base level:
Batter: 1:0

Masonry Unit Weight: 20.00

[kN/m³]

Masonry Strength:

5.00

[MPa]

Top level: 0

[mm]

Thickness at top:
1200 [mm]

Segment Left x Right x

Right x 0 9800

Weight z 0 -360.80

My 55.10

Thrust left 9317

Thrust right 9389

Stress left -0.07

Stress right -0.53

Dist. left 716.63

Dist. right 411.21

411.21

492.68

568.48

639.17

705.25

Elliptic

Span 2

Span 1

Elliptic

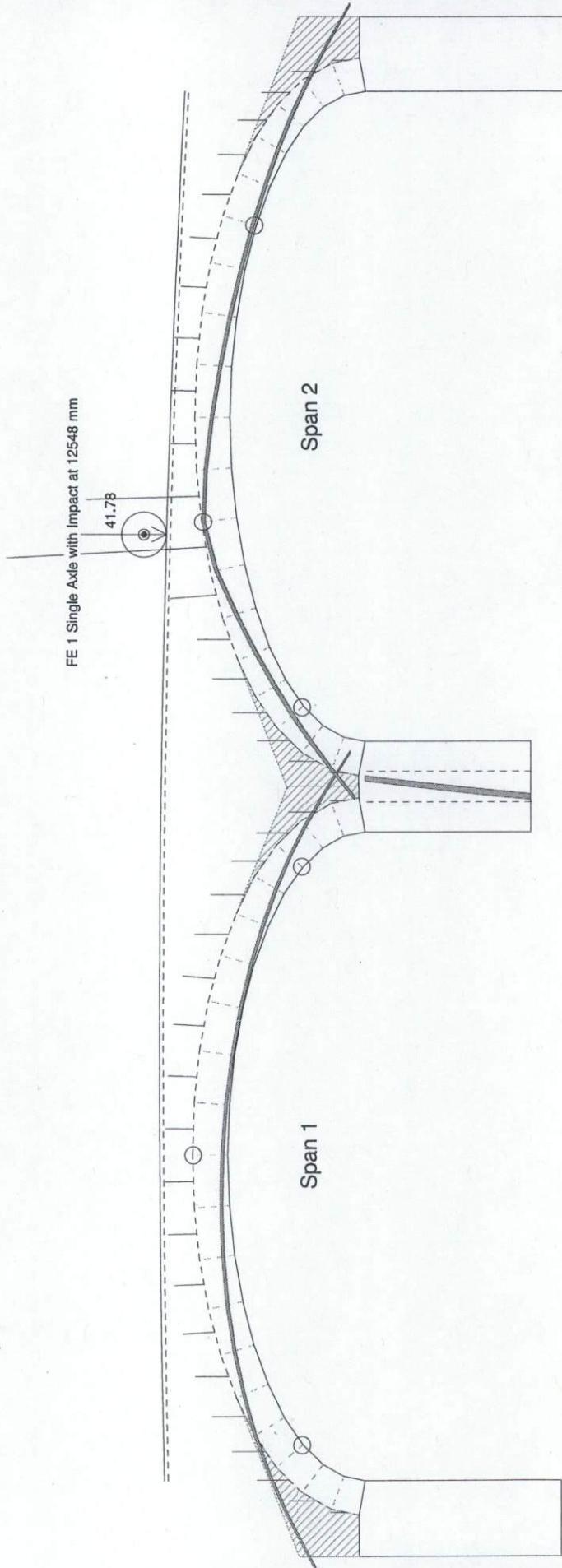
Span 1

Elliptic

Span 2

Span 1

Disused Rail Bridge 1 & 97

free engine env. p.195.

gammaF1 dead load: 1.00 FE 1 Single Axle with Impact @ 12548 [mm]
 gammaF1 superimposed: 1.00
 gammaF1 live load: 2.11
 gammaF3 load effect: 1.10
 gammaM material: 1.00
 File path: J:\Glasgow\Jobs\East Ayrshire Council\49331615 EAC Bridge Assessment Work\Technical\11_Disused Rail Bridge Nos. 1 & 97\Check\Structure1.brg

NAME: Disused Rail Bridge 1 & 97
 LOCATION: East Ayrshire
 NUMBER: B751 -20
 URS Corporation Ltd
 DATE: 13 January 2009
 Printed on: Tuesday, December 22, 2009 17:56:47

Bridge Name: Disused Rail Bridge 1 & 97
 Bridge Number: B751 -20
 Number of spans: 2

SAFETY FACTORS

Factor for deadload: 1.00
 Factor for live load: 2.11

APPLIED LOAD CASES

1. FE 1 Single Axle with Impact

Applied distribution mode:
 Applied live load pressure:

Arch/Multi
 Active pressure

STRUCTURE PROPERTIES

Road shape: Curved (3-point method)

Road points: (0, 2663) Depth of overlay: 0

Surface of surfacing: 50 Depth of overlay: 0

Surface unit weight: 15.00 [kN/m³] Overlay unit weight: 15.00 [kN/m³]

Lane width: 3515

Fill unit weight: 18.00 [kN/m³]

Base level:-2690 [mm]

Base level:-2690 [mm]

Height: 0 [mm]

Height: 0 [mm]

[degree]

Width: 1000 [mm]

Width: 1000 [mm]

Quarter Rise: 0 [mm]

Ring Thickness at springing: 460 [mm]

Masonry Strength: 6.00 [MPa]

Segment Intrados.x

Intrados.z

Extrados.z

Extrados.x

Roadlevel

Fx dead

Fz dead

My dead

Fx live

Fz live

My live

Fx passive

Fx total

Fz total

My total

Segment Left x

Right x

Weight

Fx

Fz

My

Thrust left

Thrust right

Stress left

Stress right

Dist. left

Dist. right

454.90

520.96

582.24

639.22

692.34

Bridge Location: East Ayrshire

Bridge Location: East Ayrshire

Base level: -2210 [mm]

Top level: 0 [mm]

Thickness at top: 1200 [mm]

Batter: 1.0

Masonry Unit Weight: 20.00 [kN/m³]

Masonry Strength: 5.00 [MPa]

Segment Left x

Right x

z

Weight

-347.19

-41.31

-13.26

-41.31

-360.45

15.50

9207

9279

9207

9218

9143

-373.71

-7.33

-386.97

-30.15

9083

9161

-0.45

-0.20

483.38

-0.55

-0.11

427.61

PIER 1

Base level: -2210 [mm]

Top level: 0 [mm]

Thickness at top: 1200 [mm]

Segment Left x

Right x

z

Weight

-347.19

38.32

9345

-0.13

-0.45

675.66

38

0

9800

-553

-1105

-1658

-13.26

-41.31

-341.31

-400.23

-13.26

-41.31

-400.23

SPAN 2

Span:	8600	[mm]	Rise:	1805	[mm]	Quarter Rise:	0	[mm]	Mortar loss:0	[mm]	Fx live	Fx dead	Fz live	Fz dead	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
						Ring Thickness at springing:															
						Masonry Strength:	6.00														
Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Roadlevel	Fx dead	Fz dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust	***	***	***	
0	9800	0	9348	85	2706	0.00	-6.39	0.11	0.00	0.00	0.00	-259.97	-201.87	745	786	-326	-20	***			
1	9853	282	9423	445	2705	0.00	-12.03	-0.56	0.00	0.00	0.00	-259.97	-195.48	434	480	-20	164				
2	10010	558	9647	839	2701	0.00	-14.00	0.05	0.00	0.00	0.00	-259.97	-183.45	245	296	245	214	246			
3	10269	819	9976	1174	2696	0.00	-14.57	0.96	0.00	0.00	0.00	-259.97	-169.45	163	193	267	193	267			
4	10621	1061	10391	1459	2688	0.00	-14.44	1.83	0.00	0.00	0.00	-259.97	-154.89	143	173	222	222	238			
5	11059	1276	10881	1700	2679	0.00	-13.89	2.51	0.00	0.00	0.00	-259.97	-140.44	143	173	222	222	238			
6	11573	1460	11438	1900	2666	0.00	-13.06	2.97	0.56	0.00	0.00	-259.97	-126.55	126	164	164	164	164			
7	12148	1608	12052	2058	2651	0.95	-12.12	3.24	4.23	0.00	0.00	-261.49	-106.91	106	146	146	146	146			
8	12771	1717	12799	2172	2634	0.53	-12.12	3.24	-73.04	22.08	0.00	-266.26	-21.76	21.76	414	459	1	459	1		
9	13427	1783	13397	2242	2613	0.25	-11.26	3.37	1.24	-36.98	5.49	0.00	-267.76	26.48	98	318	362	98	362		
10	14100	1805	14100	2265	2590	0.07	-10.63	3.46	0.00	-0.00	0.00	-267.83	37.11	62	83	257	257	203			
11	14773	1783	14803	2242	2565	-0.07	-10.33	3.55	0.00	0.00	0.00	-267.76	47.44	40	43	127	127	172			
12	15429	1717	15491	2172	2538	-0.21	-10.37	3.68	0.00	0.00	0.00	-267.55	57.81	23	87	65	110	350			
13	16052	1608	16148	2058	2511	-0.41	-10.73	3.85	0.00	0.00	0.00	-267.14	68.53	13	95	28	74	386			
14	16627	1460	16762	1900	2484	-0.73	-11.28	4.03	0.00	0.00	0.00	-266.41	79.82	11	49	18	65	395			
15	17141	1276	17319	1700	2459	0.00	-11.88	4.18	0.00	0.00	0.00	-266.41	91.69	17	63	39	86	374			
16	17579	1061	17809	1459	2435	0.00	-12.35	4.27	0.00	0.00	0.00	-266.41	104.05	33	69	96	143	317			
17	17931	819	18224	1174	2414	0.00	-12.57	4.32	0.00	0.00	0.00	-266.41	116.62	61	23	196	242	218			
18	18190	558	18553	839	2397	0.00	-12.26	4.28	0.00	0.00	0.00	-266.41	128.88	101	95	363	407	53			
19	18347	282	18777	445	2385	0.00	-10.77	4.01	0.00	0.00	0.00	-266.41	139.65	157	34	681	719	-259			
20	18400	0	18852	85	2381	0.00	-5.96	2.32	0.00	0.00	0.00	-266.41	145.60	227	18	1166	1198	-738			

PROJECT TITLE

DESCRIPTION

DISUSED R.R. (F97)

REFERENCE	CALCULATIONS	SUMMARY
	<p><u>MODIFIED WEEF</u></p> <p>Considering br. 97.</p> <p>span = 8.6m.</p> <p>r_c, rise of arch barrel at crown = 1.805 m</p> <p>r_q, rise of arch barrel at 1/4. = 1.585 m</p> <p>d, thickness of arch at crown = 0.46 m</p> <p>h, air depth till at crown = 0.535 m limited to 0.46m</p> <p>$f_{mk} = \frac{740 (d+h)}{L^{1.3}}$</p> <p>= $\frac{740 (0.46 + 0.460)}{8.6^{1.3}} = 30.2 \text{ te}$</p> <p>$f_{sr}$, $\frac{\text{span}}{\text{rise}} = \frac{8600}{1805} = 4.76$</p> <p>Fig 3/3, $f_{sr} = 0.88$</p> <p>$f_p = 2.3 \left[\frac{r_c - r_q}{r_c} \right]^{0.50}$</p> <p>= $2.3 \left[\frac{1.805 - 1.585}{1.805} \right]^{0.50} = 0.651$</p> <p>$f_{mk} = \frac{(f_p d) + (f_f h)}{(d+h)}$</p> <p>$\approx \frac{(1.4 \times 0.46) + (0.7 \times 0.46)}{(0.46 + 0.46)}$</p> <p>= 1.05</p>	

PROJECT TITLE

DESCRIPTION

DISUSED R. BR. 1\$97

REFERENCE	CALCULATIONS	SUMMARY
	$F_j = F_w f_d F_{w0}$ $= 0.9 \times 1.0 \times 1.0$ $= 0.9$	$F_w = 0.9 \text{ Table 3/3}$ $f_d = 1.0$ $F_{w0} = 1.0$
	fcu agreed at 0.9	
	$M_{AR} = F_{sr}, F_p F_m F_j F_{cu} P/A.C.$ $= 0.88 \times 0.651 \times 1.05 \times 0.9 \times 0.9 \times 38.2$ $= 18.6 \text{ t.e}$	
	$F_j 3/5a, \text{ single axle} = 1.54 \Rightarrow 18.7 \text{ t.e} > 11.5 \Rightarrow \text{40tE}$ $\text{Double axle} = 1.0 \Rightarrow 18.6 \text{ t.e} > 10 \Rightarrow \text{40tE}$ $\text{Triple axle} = 0.9 = 14.7 \text{ t.e} > 8 \Rightarrow \text{40tE}$	
	Accept 40tE capacity	
	$\text{For HB analogy HB units} = 18.6 \approx 1.6$ $= 29.8 \text{ UNITS}$	