ESSEX COUNTY COUNCIL
ASSESSMENT CONTRACT 3

APPROVAL IN PRINCIPLE FOR THE ASSESSMENT OF STOW MARIES HALT BRIDGE

ECC BRIDGE NO. 1658
RAIL PROPERTY Ltd BRIDGE NO. WFM/836

TOPSTOPSTOPS

Essex County Council
Transportation &
Operational Services

APPROVAL IN PRINCIPLE FOR THE ASSESSMENT OF STOW MARIES HALT BRIDGE

ECC Bridge Number 1658

Rail Property Number WFM/836

APPROVAL IN PRINCIPLE CONTENTS

- British Railways Board FORM 'AA' (BRIDGES)
- British Railways Board FORM 'AA/1' (BRIDGES)
- Location Plan
- General Arrangement, Cross Section and Idealisation Drawings
- Technical Approval Schedule "TAS" (June 1989)
- Appendix to TAS Schedule dated (June 1989) WS Atkins amended March 1999
- Appendix: Inspection for Assessment

APPROVAL IN PRINCIPLE FOR ASSESSMENT

STRUCTURE / LINE NAME STOW MARIES HALT BRIDGE

ELR / STRUCTURE NO. WFM/836

BRIEF DESCRIPTION OF EXISTING BRIDGE:

(a) Span Arrangement

The bridge has 3 no. clear square spans of 7.81m, 7.76m and 7.83m. There is no angle of skew.

(b) Superstructure Type

Three span brick arch.

(c) Substructure Type

Brick abutments and piers.

(d) Details of any Special Features

None.

ASSESSMENT CRITERIA

(a) Loadings and Speed

Loadings to be in accordance with BD 21/97. The current permitted traffic speed across the structure is 40mph.

(b) Codes to be used

See attached TAS schedule and March 1999 addendum.

(c) Proposed Method of Structural Analysis

The structure will be analysed as a multi span arch using the MULTI mechanism method computer program. The individual arches will be analysed using the modified MEXE method, detailed in BD 21/97 and BA 16/97, and the ARCHIE computer program. As the fill depth over the arch is less than the arch barrel thickness for all 3 no. spans, the higher capacity of the ARCHIE and MEXE results will be adopted for the individual arches. For the overall capacity of the bridge the results of the MULTI mechanism will be used. For the analysis the following parameters will be adopted:

ARCHIE/MULTI

Backing level (determined from record drawings)	1.5m above springing level
Masonry self weight	21kN/m^3
Fill self weight	19kN/m^3
Surfacing self weight	23kN/m^3
ϕ' for fill	30^o
ARCHIE passive pressure coefficient	0.3
Masonry strength	4.4 N/mm^2

Passive pressures generated behind the arch will be limited to 30% of the full passive pressures.

MEXE:

		North Arch	Centre Arch	South Arch
Condition Factor	F_{cM}	0.9	0.9	0.9
Barrel Factor	F_b	1.0	1.0	1.0
Fill Factor	F_f	0.7	0.7	0.7
Width Factor	F_w	0.9	0.9	0.9
Mortar Factor	F_{mo}	0.9	0.9	0.9
Depth Factor	F_d	0.8	0.8	0.8

Axle lift-off will be considered.

Section sizes and dimensions will be based on drawings AI1658/1/FIG 01, 02, 03, 07, 08 and 09.

(d) Details of any Special Requirements

None

STRUCTURAL ASSESSMENT ENGINEER'S COMMENTS

CIVIL ENGINEER'S COMMENTS

FORM 'AA' (BRIDGES)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

BRB WORKS GROUP COMMENTS - IF APPLICABLE

PROPOSED CATEGORY FOR INDEPENDENT CHECK

SUPERSTRUCTURE 2

SUBSTRUCTURE N/A

NAME OF CHECKER SUGGESTED IF CAT 2 OR 3 Different team within office

THE ABOVE IS SUBMITTED FOR APPROVAL IN PRINCIPLE

SIGNED [redacted]

TITLE

DATE

FOR AND ON BEHALF OF WS ATKINS CONSULTANTS LTD

APPROVAL IN PRINCIPLE FOR ASSESSMENT

CATEGORY 1

THE ABOVE ASSESSMENT, WITH AMENDMENTS SHOWN, IS APPROVED IN PRINCIPLE:

SIGNED N/A

TITLE .....

DATE .....

CATEGORY 2 AND 3

THE ABOVE ASSESSMENT, WITH AMENDMENTS SHOWN, IS APPROVED IN PRINCIPLE:

SIGNED [redacted]

TITLE

DATE 27 March 2000

APPROVAL IN PRINCIPLE FOR ASSESSMENT

ADDITIONAL INFORMATION REQUIRED FOR BRB PUBLIC ROAD OVERBRIDGES ASSESSED AS PART OF BRIDGEGUARD III

STRUCTURE / LINE NAME STOW MARIES HALT BRIDGE

ELR / STRUCTURE NO. WFM/836

SCOPE OF ASSESSMENT

An inspection of the structure has been carried out prior to the assessment in order to confirm section sizes and overall dimensions as shown on the drawings. The substructure shows no signs of distress and is deemed satisfactory, therefore no analysis will be carried out.
The deck will be assessed to determine its load carrying capacity at ULS. HB loading and SLS checks are not applicable to arches. The parapets will not be assessed since they do not meet current standards.

ASSESSMENT CRITERIA

a) Standards and Codes of Practice to be used in assessment

See attached TAS schedule and March 1999 addendum.

b) Proposed method of structural analysis

The structure will be analysed as a multi span arch using the MULTI mechanism method computer program. The individual arches will be analysed using the modified MEXE method, detailed in BD 21/97 and BA 16/97, and the ARCHIE computer program. As the fill depth over the arch is less than the arch barrel thickness for all 3 no. spans, the higher capacity of the ARCHIE and MEXE results will be adopted for the individual arches. For the overall capacity of the bridge the results of the MULTI mechanism will be used. For the analysis the following parameters will be adopted:

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Width Factor	F_w	0.9	0.9	0.9
Mortar Factor	F_{mo}	0.9	0.9	0.9
Depth Factor	F_d	0.8	0.8	0.8

Axle lift-off will be considered.

Section sizes and dimensions will be based on drawings AI1877/1658/FIG 01, 02, 03, 07, 08 and 09.

c) Planned Highway works / modifications at this site

None planned.

d) Road designation / class and whether classed as a heavy load route

Unclassified. The road is not a heavy load route.

e) Any other requirement

None.

The above is agreed subject to the amendments and comments shown below

SIGNE [redacted]

TITLE County Bridges Manager

DATE 22 March 2000

FOR AND ON BEHALF ESSEX COUNTY COUNCIL TRANSPORTATION AND OPERATIONAL SERVICES DIVISION.

LOCATION PLAN, DRAWINGS AND IDEALISATION DIAGRAMS

Essex County Council
Transportation &
Operational Services

[redacted]
HEAD OF TRANSPORTATION AND
OPERATIONAL SERVICES,
ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

Atkins

STOW MARIES BRIDGE

Map Ref: TQ 583510 199144

A4	DRWG.NO. B1204/1658/LP001-
	CAD NO. STO-LP01
	SCALES 1:5000
	DATE AUG 99 — DRAWN/TRACED TNP
	DATE AUG 99 — CHECKED AJS
	DATE — AUTHORISED

SCHEME TITLE

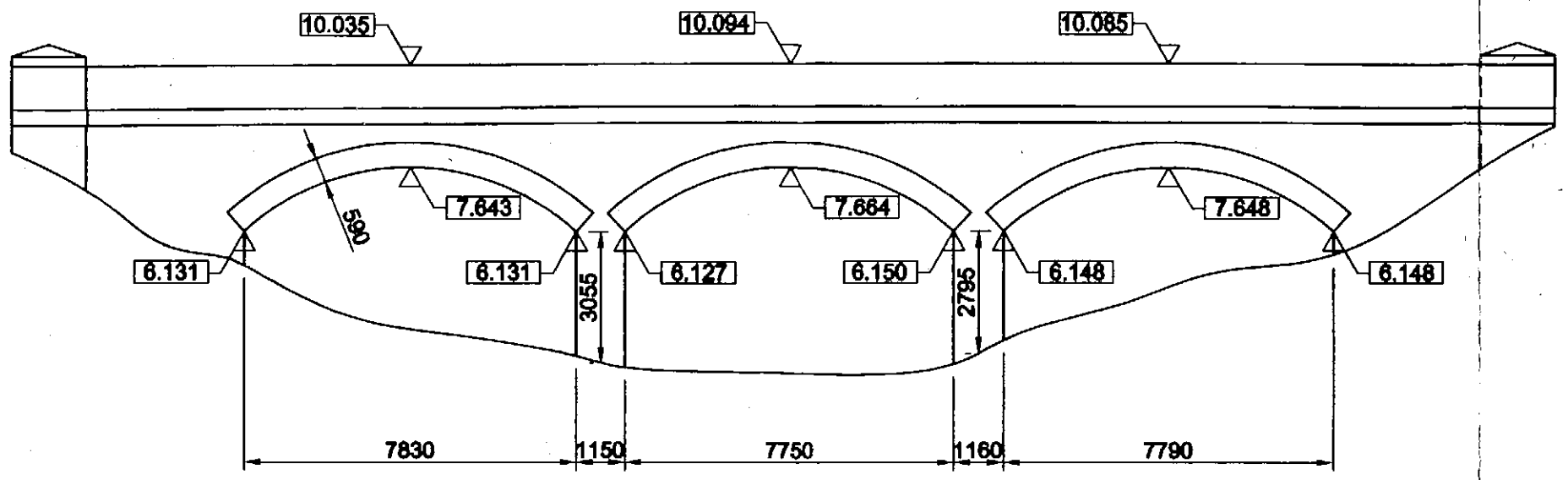
STOW MARIES BRIDGE
STOW MARIES
LOCATION PLAN

DO NOT SCALE

ECC Bridge No. 1658
Rail Property Board No. WFM/836

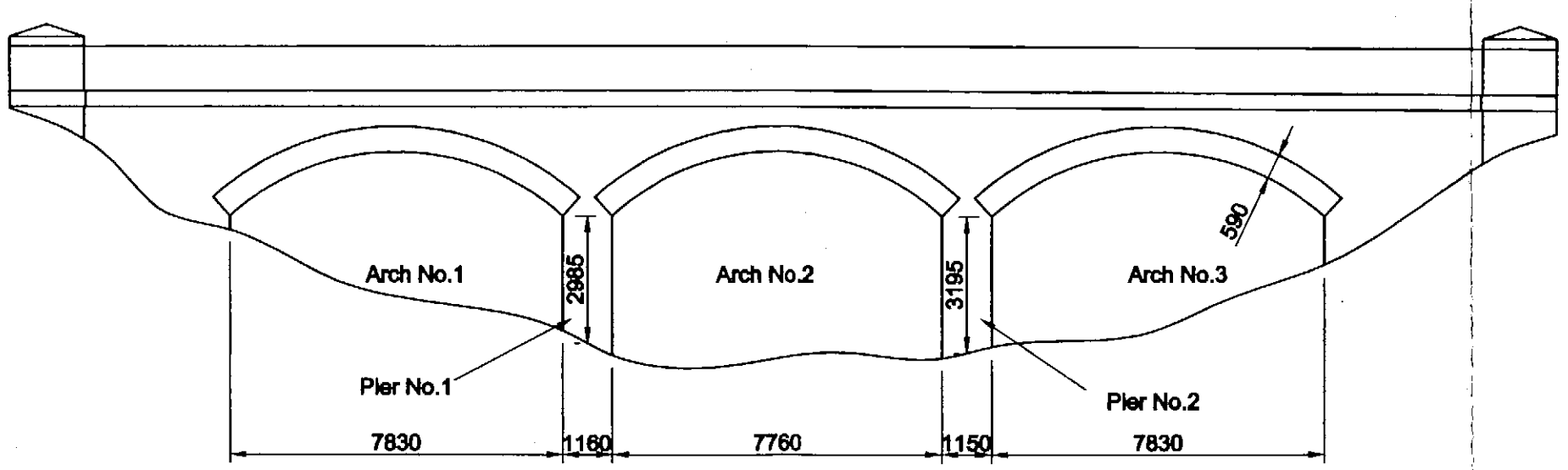
Notes:

All Dimensions in mm
All levels in metres
above local datum



EAST ELEVATION

Note: West elevation arch levels not taken due to tree growth - poor visibility. Arches appear sound in construction (no deformation) therefore the levels are assumed to be as east elevation



WEST ELEVATION

Essex County Council
Transportation & Operational Services

[redacted]RTATION AND OPERATIONAL SERVICES, ENVIRONMENTAL SERVICES DIRECTORATE, COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

WS/Atkins

SCALES: NTS
CAD FILE: N:\AI1877\1658\fig01

	SURVEYED	LEVELLED	DESIGNED	DRAWN/TRACED	CHECKED	AUTHORISED
INITIALS	DW	DW		MAO		
DATE	12/99	12/99		01/00		

REVISION NOTES	REVISION	CHECKED

DESCRIPTION OF DRAWING: STOW MARIES HALT, STOW MARIES ELEVATIONS

Sheet 1 of 1

SCHEME TITLE: ECC ASSESSMENT CONTRACT 3 RAIL PROPERTY LTD BRIDGES

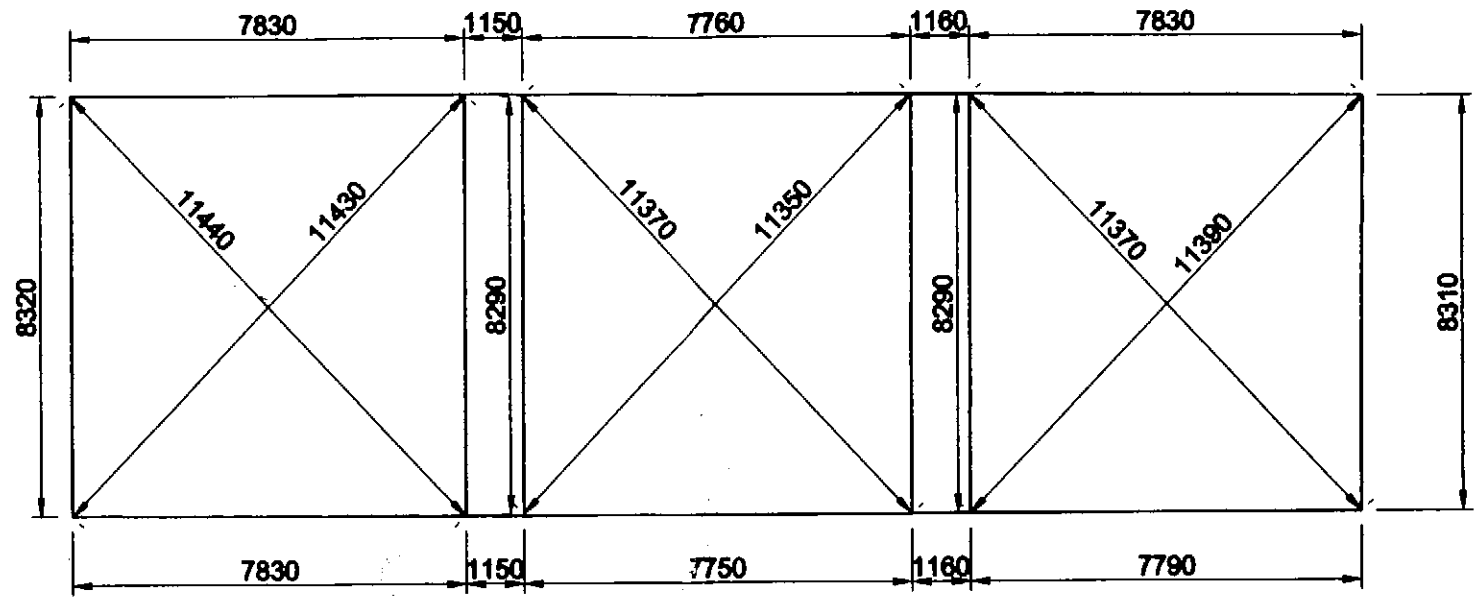
DRAWING NO. AI1877/DWGS/1658/fig01

DO NOT SCALE

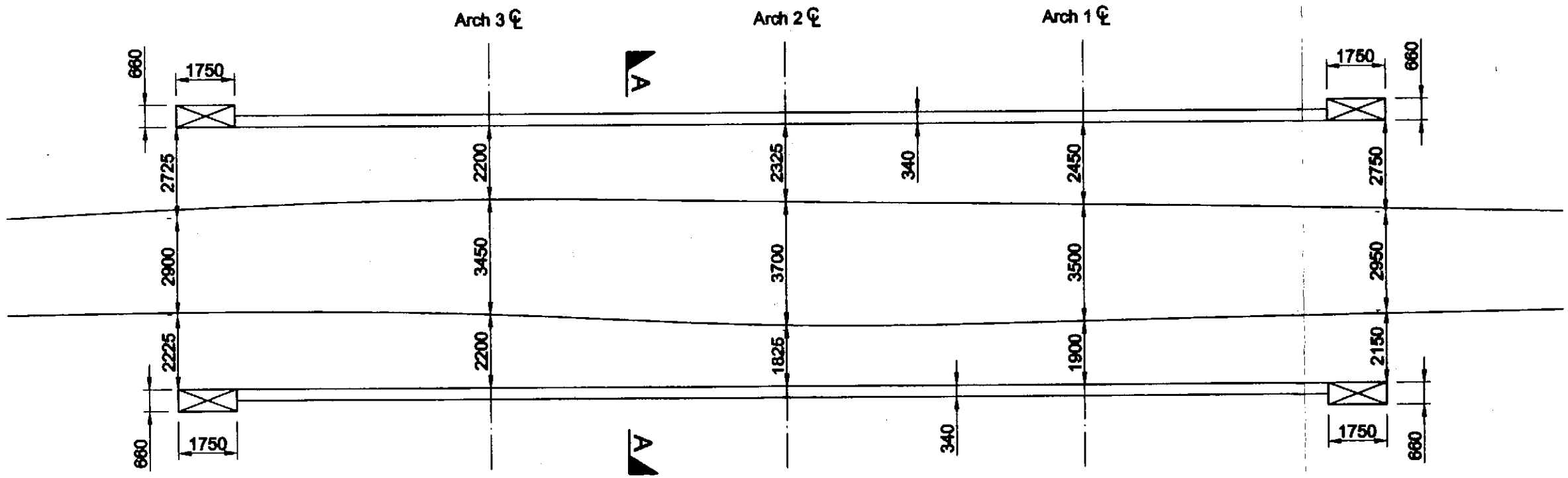
ECC Bridge No. 1658
Rail Property Board No. WFM/836

Notes:

All Dimensions in mm



ARCH DIMENSIONS



PLAN

Essex County Council Transportation and Operational Services	[redacted] ATION AND ES, NCES DIRECTORATE, SSFORD. CM1 1QH 2211	WS/Atkins	SCALES: NTS		SURVEYED	LEVELLED	DESIGNED	DRAWN/TRACED	CHECKED	AUTHORISED
				SIGNALS	DW	DW		MAD		
				DATE	12/99	12/99		01/00		
			CAD FILE: H:\AI1877\1658\fig02	REVISION NOTES			REVISION		CHECKED	

DESCRIPTION OF DRAWING: STOW MARIES HALT, STOW MARIES PLAN

Sheet 1 of 1

SCHEME TITLE: ECC ASSESSMENT CONTRACT 3 RAIL PROPERTY LTD BRIDGES

DRAWING NO. AI1877/DWGS/1658/fig02

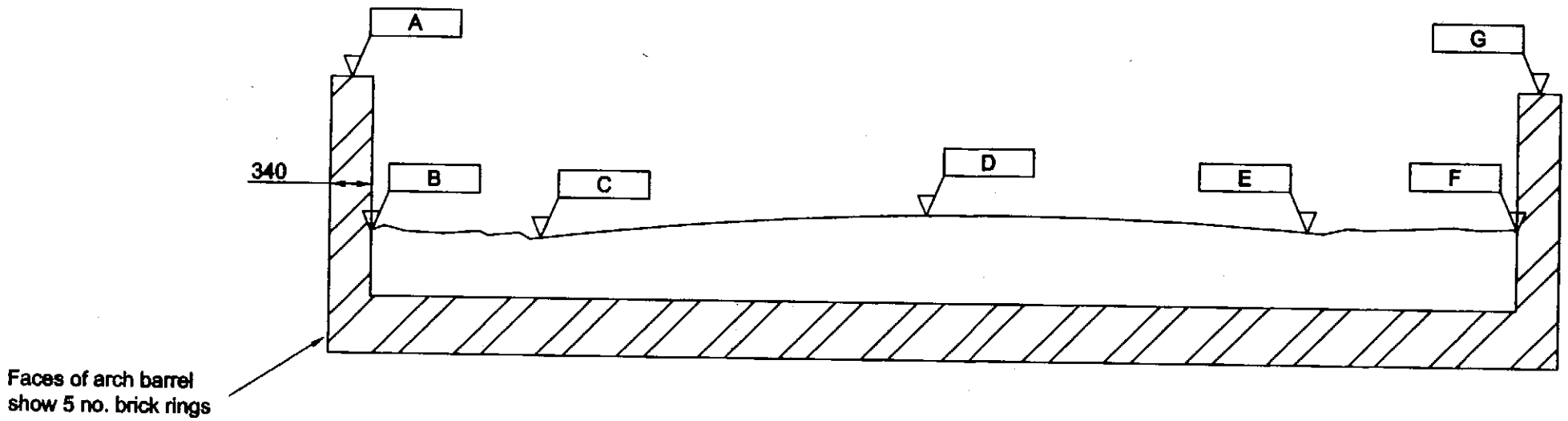
DO NOT SCALE

ECC Bridge No. 1658
Rail Property Board No. WFM/836

Notes:

All Dimensions in mm

All levels in m above local datum



REFER TO DWG 02 FOR LOCATION OF SECTION A-A

TYPICAL CROSS SECTION A-A

Not To Scale

Position	CL Arch 1 (North)	CL Arch 2 (Central)	CL Arch 3 (South)
A Top of West Parapet	10.118	10.130	10.090
B Bottom of West Parapet	8.646	8.662	8.521
C West Edge Carriageway	8.747	8.726	8.612
D CL Carriageway	8.749	8.750	8.615
E East Edge Carriageway	8.735	8.730	8.586
F Bottom of East Parapet	8.669	8.701	8.534
G Top of East Parapet	10.085	10.094	10.035

Essex County Council Transportation & Operational Services

[redacted]N AND ENVIRONMENTAL SERVICES DIRECTORATE, COUNTY HALL, CHELMSFORD. CM1 1QH
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WS/Atkins

SCALES	NTS
CAD FILE	N:\A1877\1658\fig03

	SURVEYED	LEVELLED	DESIGNED	DRAWN/TRACED	CHECKED	AUTHORISED
INITIALS	DJW	DJW		SD		
DATE	12/99	12/99		1/00		

REVISION NOTES | REVISION | CHECKED

DESCRIPTION OF DRAWING: STOW MARIES HALT, STOW MARIES CROSS SECTION

Sheet 1 of 1

SCHEME TITLE: ECC ASSESSMENT CONTRACT 3 RAIL PROPERTY LTD BRIDGES

DRAWING NO. A1877/DWGS/1658/fig03

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ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
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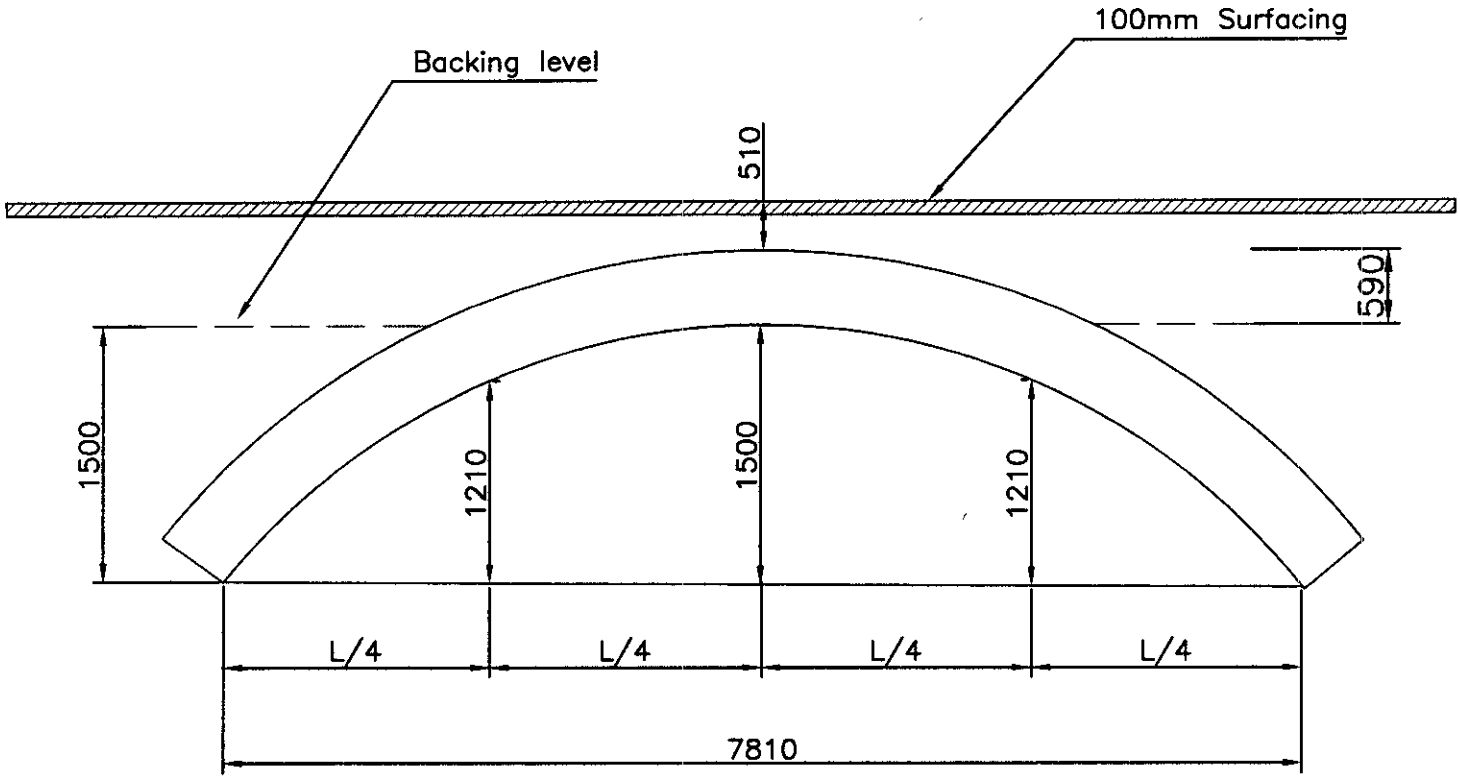
Atkins

ECC Bridge No. 1658
Rail Property Board No. WFM/836



ARCH No.1 (NORTH ARCH) IDEALISATION DIAGRAM NTS

DRWG.NO. AI1877/1658/fig07	
CAD NO. N:1877/1658/fig07	
SCALES NTS	
DATE JAN 00	DRAWN/TRACED SD
DATE JAN 00	CHECKED DW
DATE	AUTHORISED

SCHEME TITLE ECC ASSESSMENT CONTRACT 3
STOW MARIES HALT, STOW MARIES
IDEALISATION DIAGRAM ARCH 1

Essex County Council
Transportation &
Operational Services

[redacted]
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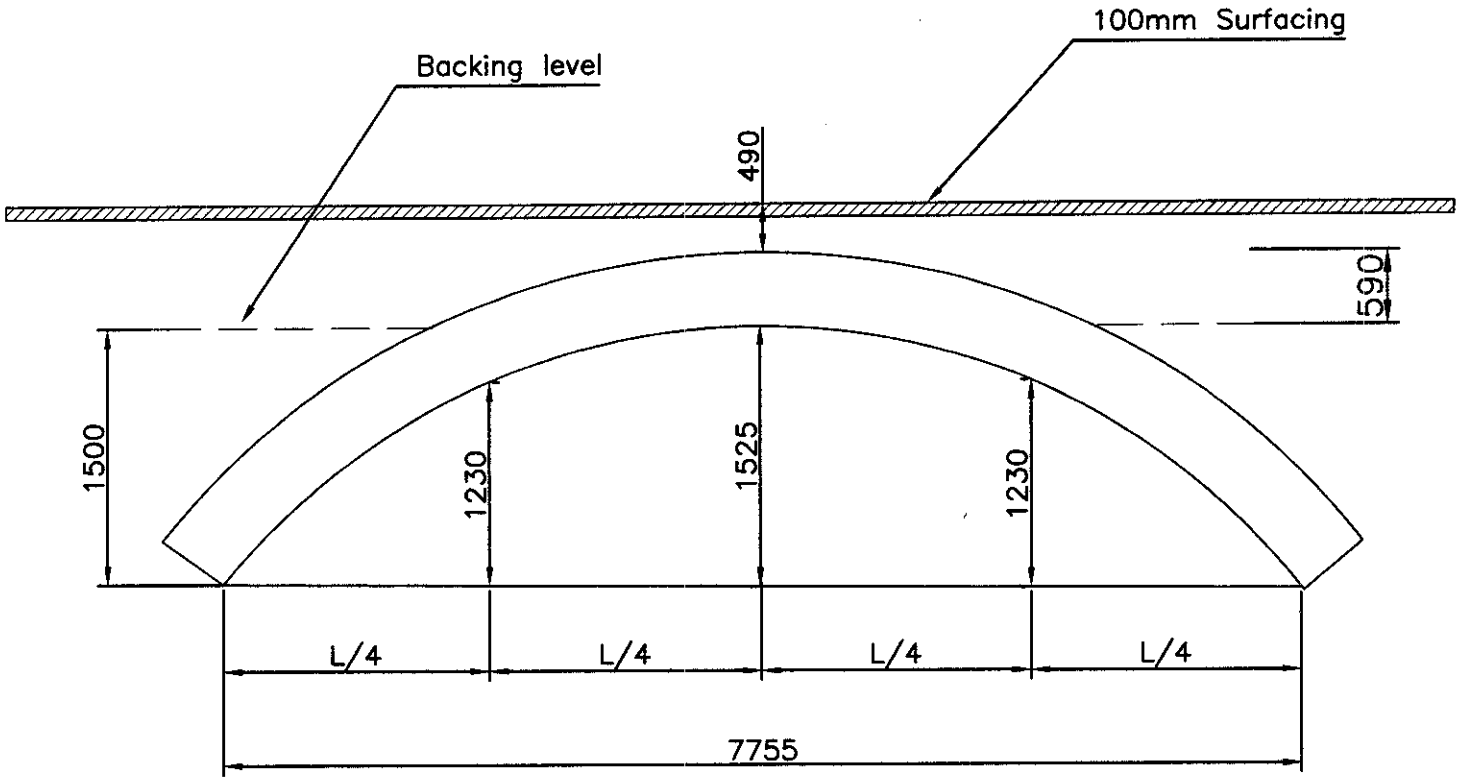
ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

WS Atkins

ECC Bridge No. 1658
Rail Property Board No. WFM/836



ARCH No.2 (CENTRAL ARCH)
IDEALISATION DIAGRAM
NTS

DRWG.NO. AI1877/1658/fig08	
CAD NO. N:1877/1658/fig08	
SCALES NTS	
DATE JAN 00	DRAWN/TRACED SD
DATE JAN 00	CHECKED DW
DATE	AUTHORISED

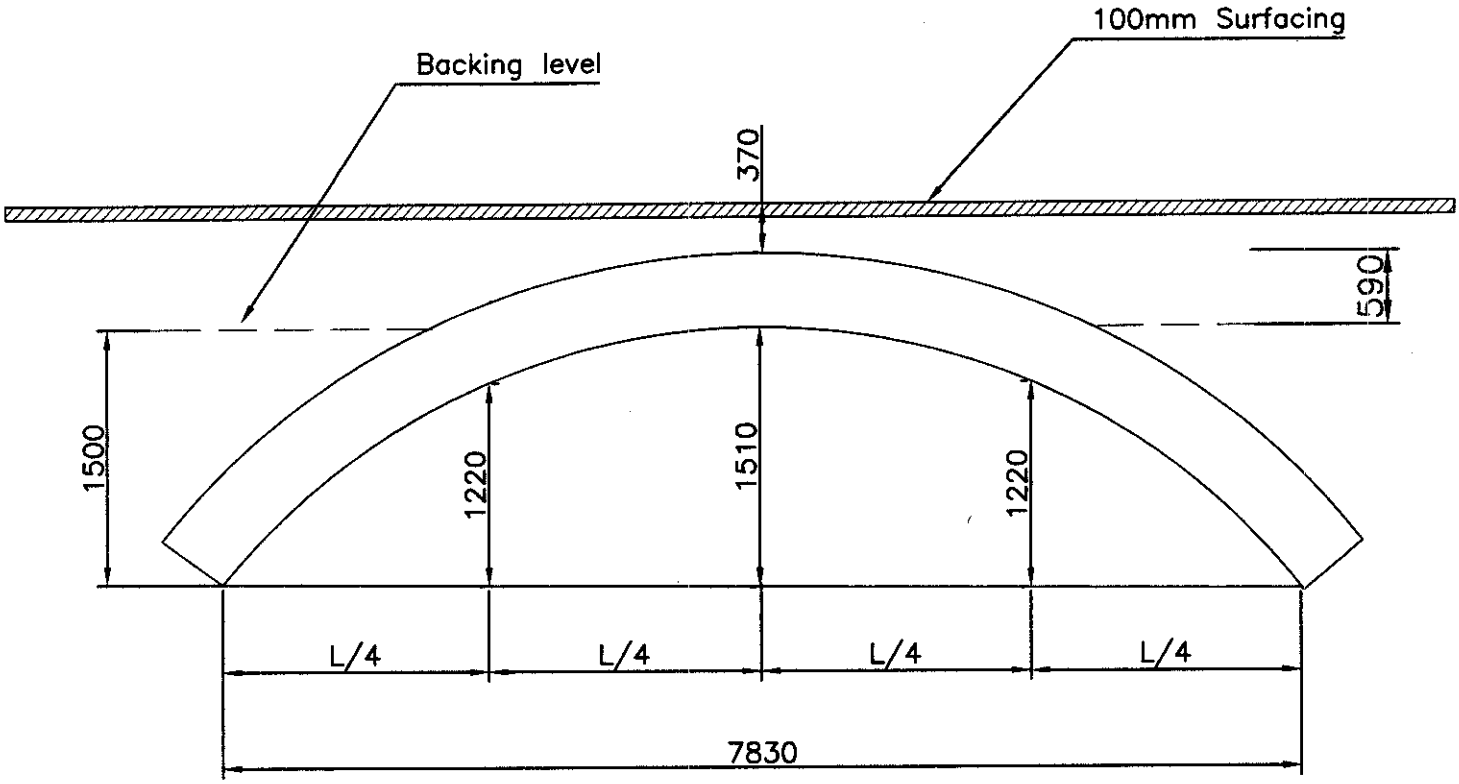
SCHEME TITLE ECC ASSESSMENT CONTRACT 3
STOW MARIES HALT, STOW MARIES
IDEALISATION DIAGRAM ARCH 2

Essex County Council
Transportation & Operational Services

HEAD OF TRANSPORTATION AND OPERATIONAL SERVICES,
ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

WS Atkins

ECC Bridge No. 1658
Rail Property Board No. WFM/836



ARCH No.3 (SOUTH ARCH)
IDEALISATION DIAGRAM
NTS

DRWG.NO. AI1877/1658/fig09	
CAD NO. N:1877/1658/fig09	
SCALES NTS	
DATE JAN 00	DRAWN/TRACED SD
DATE JAN 00	CHECKED DW
DATE	AUTHORISED

SCHEME TITLE ECC ASSESSMENT CONTRACT 3
STOW MARIES HALT, STOW MARIES
IDEALISATION DIAGRAM ARCH 3

TECHNICAL APPROVAL SCHEDULE

TECHNICAL APPROVAL SCHEDULE "TAS" (JUNE 1989)

SCHEDULE OF DESIGN DOCUMENTS RELATING TO HIGHWAY BRIDGES & STRUCTURES (All documents are taken to include revisions current at date of this TAS).

1. BRITISH STANDARDS

~~BS 153 Part 3A, Specification for Steel Girder Bridges (see BE 1/77).~~

~~BS 5268 Part 2, Structural Use of Timber~~

~~BS 5400 - Steel concrete and composite bridges~~

~~Part 1: 1978 - General Statement (SEE BD 15/82)~~

~~Part 2: 1978 - Specification for loads (see BD 14/82)~~

~~Part 3: 1982 - CP for design of steel bridges (see BD 13/82)~~

~~Part 4: 1984 - CP for design of concrete bridges (see BD 24/84)~~

~~Part 5: 1979 - CP for design of composite bridges (see BD 16/82)~~

~~Part 9: 1983 - Bridge bearings (see BD 20/83)~~

~~Part 10: 1980 - CP for fatigue (see BD 9/81)~~

~~BS 5628: Part 1: 1978 - Unreinforced Masonry~~

~~BS 5930: 1981 - Site investigations~~

~~BS 6031: 1981 - Earthworks~~

2. BRITISH STANDARD CODES OF PRACTICE

~~CP 114: Part 2 Reinforced concrete in buildings (see Tech Memo BE 1/73)~~

~~CP 116 Part 2 The structural use of precast concrete (see Tech Memo BE 1/73)~~

~~CP 118 The structural use of aluminium~~

~~CP 2 Earth retaining structures~~

~~CP 2004 Foundations~~

3. PUBLICATIONS (HMSO)

~~Railway construction and Operation Requirements, Structural and Electrical clearances (1977).~~

~~Railway construction and operation. Requirements for passenger lines and recommendations for goods lines 1950 (reprinted 1970).~~

~~Roads in urban areas and Metric Supplement (as amended by TA 32/82)~~

~~Layout of roads in rural areas and Metric Supplement (as amended by TA 28/82).~~

~~Specification for Highway Works and Notes for Guidance (1986 Edition).~~

~~Highway Construction Details (1987 Edition).~~

~~Simplified Tables of External loads on Buried Pipelines (1970).~~

4. MISCELLANEOUS

~~Circular Roads No 61/72 - Routes for heavy and high abnormal loads.~~

5. TECHNICAL MEMORANDA (BRIDGES)

~~BE 5 The design of Highway bridge parapets (4th revision)~~

~~BE 27 Waterproofing and surfacing of bridge docks.~~

~~BE 3/72 Expansion joints for use La highway bridge docks.~~

~~BE 1/73 Reinforced concrete for highway structures (Relevant ports for the design of buried precast concrete pipes and sign/signal gantries only).~~

~~BE 1/74 The independent checking of erection proposals and temporary works details for major highway structure an trunk roads and motorways.~~

~~BE 8/75 Painting of concrete highway structures~~

~~BE1/77 Standard highway loadings (Relevant parts for the design of buried precast concrete pipes and sign/signal gantries only)~~

~~BE 7/77 Department standard (interim) motorway sign/signal gantries~~

~~BE 1/78 Design criteria for footbridges and sign/signal gantries (Relevant for the design of sign/signal gantries only)~~

~~BE 3/78 Reinforced earth, and anchored earth retaining walls and bridges abutments for embankments~~

6. HIGHWAYS TECHNICAL MEMORANDA

~~H 14/76 Noise barriers - Standard and Materials~~

7. MEMORANDA (BRIDGES)

~~IM 5 Formation of continuity joints in bridge decks~~

8 DEPARTMENTAL STANDARDS

8.1 TRAFFIC ENGINEERING AND CONTROL

~~TD 2/78 Pedestrian Subways - layout and dimensions~~

~~TD 3/79 Combined pedestrian and cycle subways - layout and dimensions~~

~~TD 9/81 Road layout and geometry. Highway link design~~

~~TD 19/83 Safety fences and barriers~~

~~TD) 27/86 Cross Sections and headroom~~

8.2 BRIDGES AND STRUCTURES

BD 2/89 Technical approval of DTp highway structures on motorways and other trunk roads

~~BD 6/81 Approval in principle and calibrating of computer programs for use in DTp highway structures on trunk roads and motorways~~

~~BD 7/81 Weathering steel for highway structures~~

~~BD 9/81 Implementation of BS 5400 Pt 10, CP for fatigue~~

~~BD 10/82 Design of highway structures in areas of mining subsidence~~

~~BD 12/82 Corrugated steel buried structures~~

~~BD 13/82 Design of steel bridges - 'Use of BS 5400 Pt 3: 1982~~

~~BD 14/82 Loads for highway bridges - Use of BS 5400 Pt 2: 1978~~

~~BD 15/82 General principles - Use of BS 5400 Pt 1 : 1978~~

~~BD 16/82 Design of composite bridges - 'Use of B3 5400 Pt 5-. 1979~~

~~BD 19/83 Standard Bridges~~

~~BD 20/83 Bridge Bearings - 'Use of BS S400 Part 9: 1983~~

~~BD 21/84 The assessment of highway bridges and structures~~

~~BD 24/84 Design of concrete bridges - Use of BS 5400 Pt 4: 1984~~

~~BD 26/86 Design of lighting columns~~

~~BD 27/86 Materials for the repair of concrete highway structures~~

~~BD 28/87 Early thermal cracking of concrete~~

~~BD 29/87 Design criteria for footbridges~~

~~BD 30/87 Backfilled retaining walls and bridge abutments~~

~~BD 31/87 Buried concrete box type structures~~

~~BD 32/88 Piled foundations~~

~~BD 34/88 Assessment and Strengthening of Highway Structures on Motorways and other Trunk Roads~~

~~BD 35/88 Quality Assurance Scheme for paints and similar protective coatings~~

~~BD 36/88 The Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures~~

~~BD 37/88 Loads for Highway Bridges~~

APPENDIX TO TAS SCHEDULE DATED JUNE 1989
(WS Atkins amended March 1999, incorporating relevant technical standards published since June 1989)

1. BRITISH STANDARDS

BS 4360: 1990 – Specification for Weldable Structural Steel.

BS 4466: 1989 – Scheduling, Dimensioning, Bending and Cutting of Steel Reinforcement for Concrete

BS 5400 - Steel, Concrete and Composite Bridges.
Part 1: 1988 – General Statement (see BD 15/92).
Part 4: 1990 – CP for Design of Concrete Bridges (see BD 24/92).

BS 5628 - Use of Masonry.
Part 1: 1992 – Unreinforced Masonry.
Part 2: 1985 – Reinforced and Prestressed Masonry.

BS 5975: 1996 – CP for Falsework

BS 6651: 1992 – CP for Protection of Structures Against Lightning.

BS 6779 - Highway Parapets for Bridges and Other Structures
Part 1: 1998 – Specification for Vehicle Containment Parapets of Metal Construction.
Part 2: 1991 – Specification for Vehicle Containment Parapets of Concrete Construction.
Part 3: 1994 – Specification for Vehicle Containment Parapets of Combined Metal and Concrete Construction.

BS 7295: 1990: Parts 1 & 2 – Fusion Bonded Epoxy Coated Carbon Steel Bars for the Reinforcement of Concrete

BS 7668: 1984 – Weldable Structural Steels. Hot Finished Structural Hollow Sections in Weather Resistant Steels

BS 8002: 1994 – CP for Earth Retaining Structures.

BS 8004: 1986 – CP for Foundations.

BS 8118 – Structural Use of Aluminium.

BS EN 10025: 1993 – Specification for Hot Rolled Products of Non-alloy Structural Steels - Technical Delivery Conditions.

BS EN 10113: Parts 1-3 – Hot Rolled Products in Weldable Fine Grain Structural Steel.

BS EN 10155: 1993 - Structural Steel with Improved Atmospheric Corrosion Resistance. Technical Delivery Conditions.

3. DoT PUBLICATIONS (HMSO)

Manual of Contract Documents for Highways Works:
Volume 1: Specification for Highway Works.
Volume 2: Notes for Guidance on the Specification for Highways Works.
Volume 3: Highway Construction Details.
Volume 4: Bills of Quantities for Highways Works.

8. DEPARTMENTAL STANDARDS

8.1 TRAFFIC ENGINEERING AND CONTROL

TD 9/93 - Road Layout and Geometry. Highway Link Design.

TD 27/96 - Road Geometry Links - Cross Sections and Headrooms.

TD 32/93 - Wire Rope Safety Fences.

TD 36/93 - Subways for Pedestrians and Pedal Cyclists - Layout and Dimensions.

8.2 BRIDGES AND STRUCTURES

BD 10/97 - Design of Highway Structures in Areas of Mining Subsidence.

BD 12/95 - Design of Corrugated Steel Buried Structures with Spans not Exceeding 8m, Including Circular Arches.

BD 13/90 - Design of Steel Bridges. Use of BS 5400 Pt 3: 1982.

BD 15/92 - General Principles for the Design and Construction of Bridges - Use of BS 5400 Pt 1: 1988.

BD 20/92 - Bridge Bearings. Use of BS 5400 Pt 9: 1983.

BD 21/97 - The Assessment of Highway Bridges and Structures.

BD 24/92 - Design of Concrete Bridges - Use of BS 5400 Pt 4: 1990.

BD 26/94 - Design of Lighting Columns.

BD 33/94 - Expansion Joints for Use in Highway Bridge Decks.

BD 34/90 - Technical Requirements for the Assessment and Strengthening Programme for Highway Structures on Motorways and Other Trunk Roads.
Stage 1 - Older Short Span Bridges and Retaining Structures.

~~BD 35/93 - Quality Assurance Schemes for Paints and Similar Protective Coatings.~~

~~BD 36/92 - Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures.~~

~~BD 41/97 - Reinforced Clay Brickwork Retaining Walls of Pocket Type and Grouted Cavity Type Construction.~~

~~BD 42/94 - Design of Embedded Retaining Walls and Bridge Abutments (Unpropped or Propped at the Top).~~

~~BD 43/90 - Criteria and Materials for the Impregnation of Concrete Structures.~~

~~BD 44/95 - The Assessment of Concrete Highway Bridges and Structures.~~

~~BD 45/93 - Identification Marking of Highway Structures.~~

~~BD 46/92 - Technical Requirements for the Assessment and Strengthening Programme for Highway Structures.~~
~~Stage 2 - Modern Short Span Bridges.~~

~~BD 47/94 - Waterproofing and Surfacing of Concrete Bridge Decks.~~

~~BD 48/93 - The Assessment and Strengthening of Highway Bridge Supports.~~

~~BD 49/93 - Design Rules for Aerodynamic Effects on Bridges.~~

~~BD 50/92 - Technical Requirements for the Assessment and Strengthening Programme for Highways Structures.~~
~~Stage 3 - Long Span Bridges.~~

~~BD 51/98 - Design Criteria for Portal and Cantilever Sign/Signal Gantries.~~

BD 52/93 - The Design of Highway Bridge Parapets.

~~BD 53/95 - Inspections and Records for Road Tunnels.~~

~~BD 54/93 - Post Tensioned Concrete Bridges. Prioritisation of Special Inspections.~~

~~BD 56/96 - The Assessment of Steel Highway Bridges and Structures.~~

BD 57/95 — Design for Durability.

BD 58/94 — The Design of Concrete Highway Bridges and Structures with External and Unbonded Prestressing.

BD 60/94 — The Design of Highway Bridges for Vehicle Collision Loads.

BD 61/96 — The Assessment of Composite Highway Bridges.

BD 62/94 — As Built, Operational and Maintenance Records for Highway Structures.

BD 63/94 — Inspection of Highway Structures.

BD 65/97 — Design Criteria for Collision Protector Beams.

BD 67/96 — Enclosures of Bridges.

BD 68/97 — Crib Retaining Walls.

BD 70/97 — Strengthened / Reinforced Soils and Other Fills for Retaining Walls and Bridge Abutments (Use of BS 8006: 1995).

SD 4/92 — Procedure for Adoption of Proprietary Manufactured Structures.

APPENDIX

INSPECTION FOR ASSESSMENT

BRIDGE INSPECTION DETAILS AND CONDITION RATING

ECC Bridge No.: 1658

Rail Property Ltd Bridge No.: WFM/836

Bridge Name: Stow Maries Halt Bridge

Location: Stow Maries, Essex
Grid reference TQ 583510 199144

Date of Inspection: 03 December 1999
Weather:

Description: Three span brick arch bridge with brickwork abutments, piers and parapets.

Inspection Method: Hands on

CONSULTING ENGINEERS CONDITION RATING		
	****	Satisfactory Condition
✓	***	Repairs Required
	**	Urgent Repairs Required
	*	Bridge In Dangerous Condition

To be filled in by Essex County Council

Inspected by	[redacted]	999
Prepared by		00
Checked by		00

BRIDGE CLIENT		BRIDGE NO 1658	
File	Initial	Date	Suggested Condition Rating
Read by			
Read by			
Comments			

Index

1.0 INTRODUCTION

1.1 Essex County Council (ECC) entered into an agreement with Rail Property Ltd to assess Rail Property Ltd owned bridges carrying publicly maintainable highways. WS Atkins Consultants Ltd – Essex (WSAE) have been appointed by ECC to carry out the visual inspections and assessments of the bridges.

1.2 Stow Maries Halt Bridge carries an unclassified road over a dismantled railway to the south of the village of Stow Maries in Essex OS Ref. TQ 583510 199144.

1.4 An inspection of the structure was carried out on 03 December 1999. The inspection included a visual inspection and dimension survey to confirm structural details. The weather was dry, overcast and cold during the inspection.

1.5 The results of the inspection are presented within the text of this report.

1.6 The structure consists of three square span brick arches supported on brick abutments and piers. The arches have clear spans of 7.81m, 7.76m, 7.83m. The parapets are brick.

1.7 The carriageway width varies between 2.9m and 3.7m. The east grass verge varies between 1.8m and 2.2m wide and the west grass verge varies in width between 2.2m and 2.75m. The vertical alignment of the carriageway rises steadily from the southern end with a slight hog curve approximately in the centre of the bridge. The horizontal alignment is straight.

1.8 There is no weight restriction on the structure.

2.0 REFERENCE DRAWINGS

2.1 Rail Property Ltd provided a drawing prior to the inspection. The reference is:

5A/13A/836/1	General Arrangement

2.2 Following the inspection, survey drawings are produced as below and enclosed in the Approval in Principal for Assessment.

AI1877/DWGS/1658/FIG 01	Elevations
AI1877/DWGS/1658/FIG 02	Plan
AI1877/DWGS/1658/FIG 03	Cross section

2.3 Following the inspection, defect diagrams are produced as below and enclosed in appendix B.

AI1877/DWGS/1658/FIG 04	Elevation defects
AI1877/DWGS/1658/FIG 05	Arch soffit, pier and abutment face defects
AI1877/DWGS/1658/FIG 06	Parapet defects

3.0 INSPECTION PROCEDURE

3.1 The inspection was undertaken on 03 December 1999. Reference was made to the Bridge Inspection Guide (HMSO 1983) and the Department of Transport standard BD21/97 and advice note BA16/97.

3.2 The visual inspection of the structure was carried out to determine the condition of the bridge. The inspection was carried out within touching distance. Where required, access to the higher level elements of the structure was gained using a ladder.

3.3 A full level and dimensional survey was undertaken. Details of the levels and dimensions taken during the inspection are indicated on Drawings No. AI1877/DRGS/1658/FIG 01, FIG 02 and FIG 03 which are included in the Approval in Principle for Assessment.

3.4 The extent and severity of all defects were recorded. The photographs in Appendix A and the defect diagrams (Drawing No. AI1877/DRGS/1658/FIG 04, FIG 05 and FIG 06) in Appendix B illustrate the defects.

4.0 CONDITION REPORT

4.1 Foundations

The foundations were not accessible during the inspection. No evidence of any movement or distress was detected.

4.2 Abutments

4.2.1 The substructure of the bridge consists of brickwork abutments and piers.

4.2.2 Both north and south abutments show the effects of leaching and up to 20mm deep mortar loss. The south abutment is also heavily stained and adorned with non-offensive graffiti.

4.3 Piers

4.3.1 The piers appear to be in fair condition with the following defects identified:

- Extensive areas of damp and leaching to both piers (photograph nos. 8 and 9).
- Extensive areas of mortar loss to both piers, up to 50mm in depth.
- Non-offensive graffiti to both piers.
- Pier no. 1 (north pier) has areas of lichen growth on both faces.
- Both piers are heavily stained.
- Both piers have small areas of missing bricks (photograph no. 7).
- Pier no. 2 (south pier) has isolated areas of spalling, up to 30mm deep.

4.4 Arch barrels

4.4.1 The arch barrels are constructed from blue brick with lime mortar. Five brick rings are visible in elevation.

4.4.2 The arch barrels are all in fair condition with the following defects identified:

Arch no. 1 (north arch)

- Isolated area of leaching adjacent to both supports (photograph no. 3).

- Extensive mortar loss approximately 10mm deep to northern half of arch soffit.
- Extensive non-offensive graffiti (photograph no. 3).

Arch no. 2 (central arch)

- Small areas of leaching.
- Minor area of 10mm deep mortar loss.
- Soot staining to centre of arch soffit.

Arch no. 3 (south arch)

- Isolated areas of mortar loss, approximately 10mm deep. There is also a section of mortar loss 30mm deep running across the width of the arch barrel between two courses.
- Minor spalling up to 10mm deep (photograph no. 6).
- A 2mm wide crack at the south end of the arch running from the abutment (photograph no. 5).
- A 2mm wide crack in the mortar running adjacent to the crown of the arch across the entire width of the barrel.
- Leaching to the northern half of the soffit and minor areas of damp concrete (photograph no. 4).

4.5 Spandrels, Wing Walls and Arch Rings

4.5.1 The brickwork is in fair condition with the following defects identified:

- Both elevations show minor areas of mortar loss, with average depth 20mm to 30mm.
- Extensive vegetation growth occurs on both elevations, mainly towards the end of the bridge.
- Lichen growth to both the north-east and north west wing walls.
- Isolated areas of spalling, up to 10mm deep, to the east spandrel above the north arch.

- A 2mm wide crack in the west spandrel wall, between the central and southern arches.
- The arch rings are in good condition with minor mortar loss and staining of the brickwork being the only defects.

4.6 Embankments

4.6.1 The embankments adjacent to the bridge are heavily overgrown and show no signs of any significant erosion or slippage.

4.7 Parapets

4.7.1 The brick parapets comprise 340mm thick brickwork and capping stone units at the parapet ends. No vertical movement joints were found along the parapets.

4.7.2 The parapets are in fair condition with the following defects noted:

- Extensive vegetation growth to both parapets.
- Vertical cracking to the traffic face of both parapets, the largest of which is 5mm wide. The cracks run through the mortar and not through the brickwork.
- Extensive mortar loss to both parapets, average depth 10mm.
- Displacement of coping bricks on the east parapet(photograph no. 10)

4.8 Road Surface

4.8.1 The road surface over the bridge deck is in fair condition. Slight surface damage is evident at the southern end of the bridge where chip loss has occurred (photograph no. 11).

4.8.2 In addition there are three small hollows in the road where the level deviates by approximately 30mm. These are located at the north east, south east and south west corners of the bridge.

4.9 Waterproofing

4.9.1 The numerous areas of damp brickwork on the bridge indicate the absence of an effective bridge waterproofing system.

5.0 CONCLUSION

5.1 The structure is in fair condition overall. As well as element specific remedial work there are several areas of spalling brickwork and mortar loss throughout the structure that require repair.

5.2 The abutments are in fair condition with the mortar loss requiring repair.

5.3 The piers are generally in fair condition. The mortar loss and spalling should be repaired whilst the missing bricks should be replaced.

5.4 The arch barrels are in fair condition. The mortar loss to all three barrels should be repaired as should the spalling and cracking to arch no. 3.

5.5 The spandrel walls, wing walls and arch rings are in fair condition overall. The mortar loss to both elevations should be repaired. The cracking to the west spandrel wall should be monitored whilst the spalling to the east spandrel should be repaired. The vegetation and lichen growth are not considered serious.

5.6 The parapets are generally in fair condition. The mortar loss should be repaired along with the cracks. The displaced coping bricks should be moved back to their original position and secured in position. The vegetation growth is currently not considered serious although this should be monitored to ensure that the structure is not damaged in any fashion.

5.7 The carriageway surfacing is in fair condition. The damaged areas should be repaired under routine highway maintenance.

5.8 The areas of damp brickwork indicate that the bridge is not effectively waterproofed. The extent of this leakage should be monitored to ensure frost damage does not occur.

5.9 Based on the level and dimensional survey the structure has the following geometric features: -

	Arch no. 1 (N)	Arch no. 2 (Central)	Arch no. 3 (S)
Square span (L)	7.810m	7.755m	7.830m
Skew angle (α)	0°	0°	0°
Rise of the arch barrel (r_c)	1.500m	1.525m	1.510m
Rise at quarter points (r_q)	1.210m	1.230m	1.220m

Dimensions were obtained from levels and site measurements. See Approval in Principle for Assessment for drawings showing dimensions.

5.10 Based on the inspection and record drawings each of the arch barrels has the following properties:

Barrel thickness = 590 mm
Masonry strength = 4.4 N/mm^2
(Based on BD 21/97 figure 4.2 assuming Class 'B' engineering bricks and lime mortar)
Backing material present up to a height of 1.5m above springing level.
No structurally significant longitudinal cracking or ring separation.

5.11 Based on the inspection and the recommendations of BA16/97 Annex D, it is suggested that the following factors be used for MEXE analysis: -

		Arch no. 1	Arch no. 2	Arch no. 3
Condition Factor	F_{cM}	0.9	0.9	0.9
Barrel Factor	F_b	1.0	1.0	1.0
Fill Factor	F_f	0.7	0.7	0.7
Width Factor	F_w	0.9	0.9	0.9
Mortar Factor	F_{mo}	0.9	0.9	0.9
Depth Factor	F_d	0.8	0.8	0.8

For alternative analysis by the ARCHIE and MULTI computer programs, it is suggested that the overall condition factor F_c be based on the above factors and the recommendations of BD 21/97 6.21.

5.12 Statutory Undertaker's plant (Essex and Suffolk Water) is present on the structure.

6.0 RECOMMENDATIONS FOR ASSESSMENT

6.1 The information collected from the site inspection, with respect to defects affecting the structural integrity of the bridge, should be incorporated into the Approval in Principle. Defects affecting the assessment are described in section 5.0. It is recommended that, for the Modified MEXE and ARCHIE analyses, the factors in section 5.11 should be adopted. No other allowance need be made for structural deterioration in the assessment calculations.

6.2 For the assessment, the geometrical properties and material strengths in section 5.9 and 5.10 should be adopted.

6.3 For the assessment, axle lift-off should be considered.

6.4 Statutory Undertaker's plant is present in the structure. This can have a detrimental effect on the interaction of the fill with the arch. However, this effect is difficult to measure or quantify and should not be taken into account.

6.5 Abutments, wing walls and foundations should be assessed qualitatively in accordance with BD 21/97 Chapter 8.

Note that the following are maintenance recommendations and will not affect the proposed assessment.

6.6 The weathered and eroded areas of brickwork should be monitored during routine inspections and repairs carried out, as their condition becomes critical. All cracking to the structure should be monitored and repaired as necessary.

APPENDIX A

Photographs

Photograph 1 – West elevation of Stow Maries Halt Bridge

Photograph 2 – View over bridge looking north

Photograph 3 – Leaching and graffiti on arch barrel no. 1 (north arch)

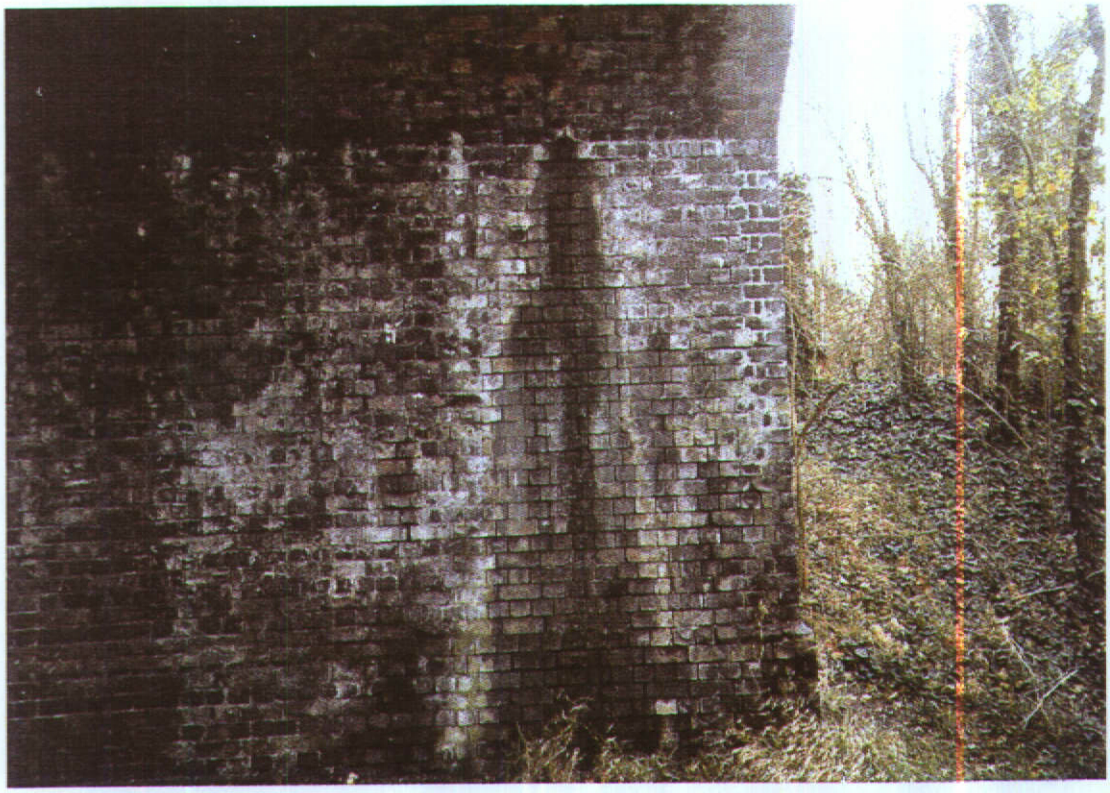
Photograph 4 - Damp and leaching to arch barrel no. 3 (south arch)

Photograph 5 – Cracking to the soffit of arch barrel no. 3 (south arch)

Photograph 6 – Spalling to the soffit of arch barrel no. 3 (south arch)

Photograph 7 – Missing bricks to south face of pier no. 1

Photograph 8 – Damp and leaching to east end of pier no. 2



Photograph 9 – Damp and leaching to north face of pier no. 2

Photograph 10 – Displacement of coping bricks to east parapet

Photograph 11 – Surface damage to carriageway at south end of bridge

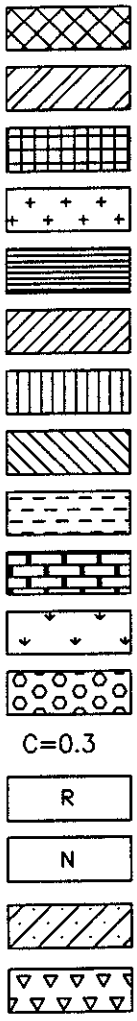
APPENDIX B

Defect Diagrams

ECC ASSESMENT CONTRACT 3 – RAIL PROPERTY Ltd BRIDGES

DETAIL OF STANDARD KEY

KEY

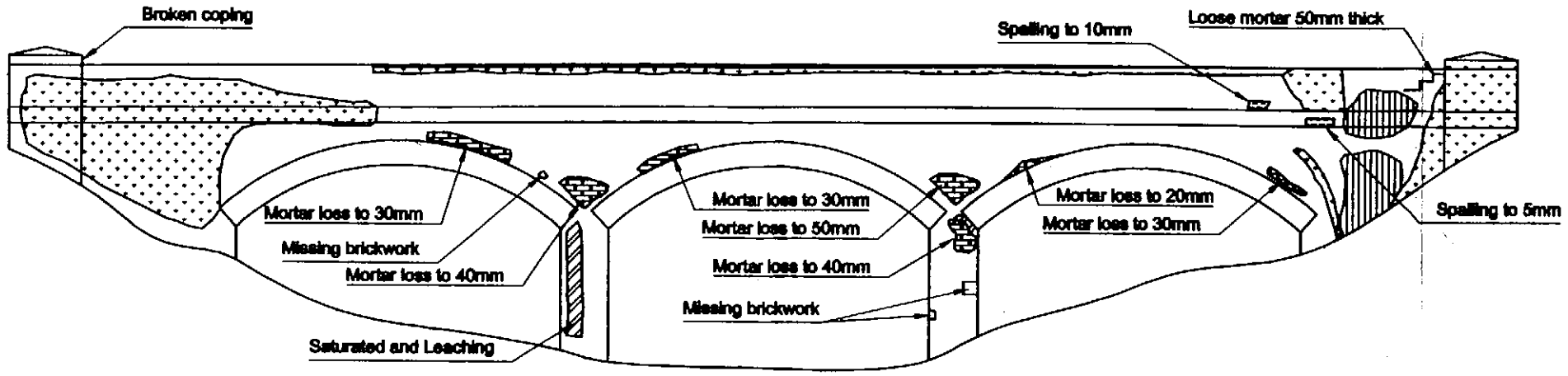


DO NOT SCALE

ECC Bridge No. 1658
Rail Property Board No. WFM/836

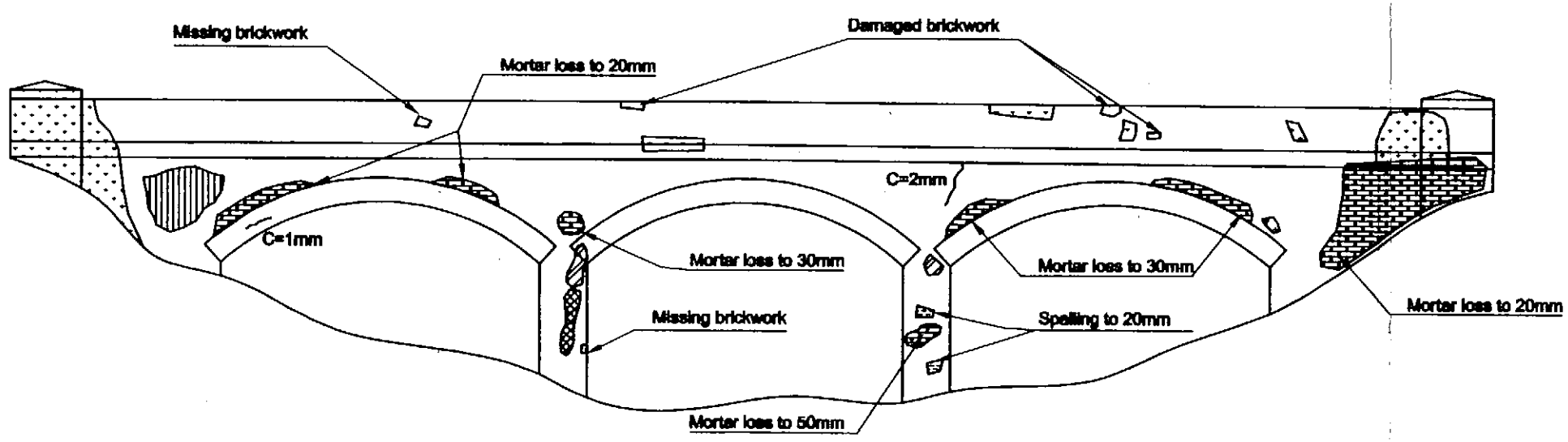
Notes:

All Dimensions in mm



EAST ELEVATION

General elevation defects (East and West) :
Extensive mortar loss - approximately 5mm to 10mm unless shown as individual defects.
Staining of brickwork



WEST ELEVATION

Essex County Council
Transportation & Operational Services

[redacted]RTATION AND
[redacted]CES,
ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

WS/Atkins

SCALES	NTS
CAD FILE	I:\A1877\1658\fig04

	SURVEYED	LEVELLED	DESIGNED	DRAWN/TRACED	CHECKED	AUTHORISED
INITIALS	DW	DW		SD		
DATE	12/99	12/99		01/00		

REVISION NOTES | REVISION | CHECKED

DESCRIPTION OF DRAWING
STOW MARIES HALT, STOW MARIES
ELEVATION DEFECTS

Sheet 1 of 1

SCHEME TITLE
ECC ASSESSMENT CONTRACT 3
RAIL PROPERTY LTD BRIDGES

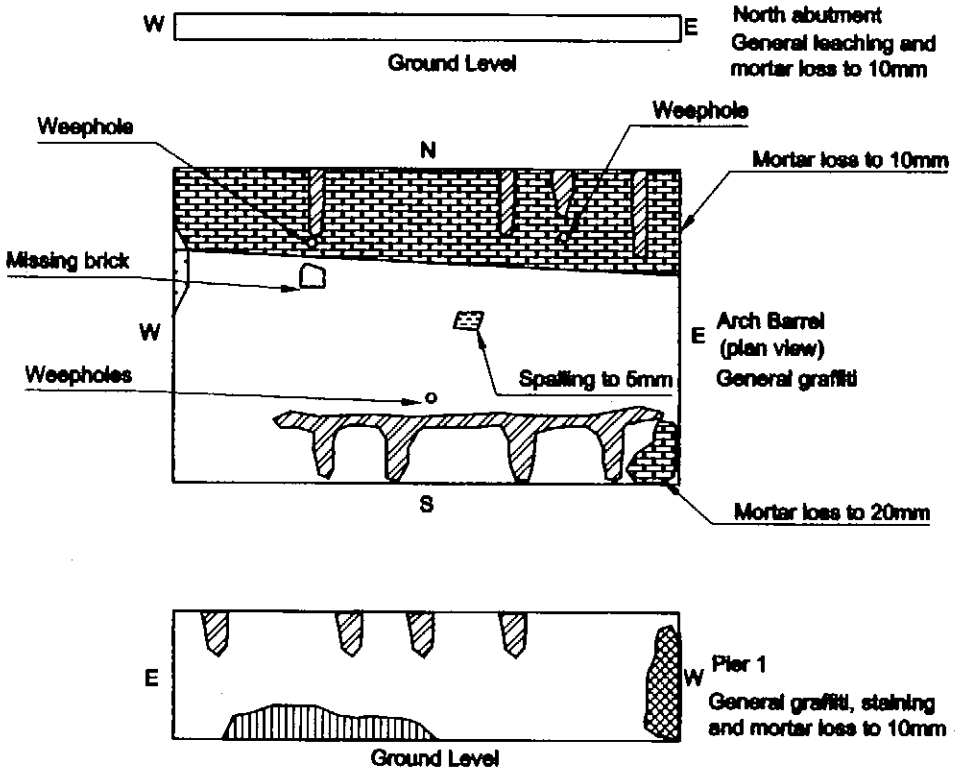
DRAWING NO. A1877/DWGS/1658/fig04

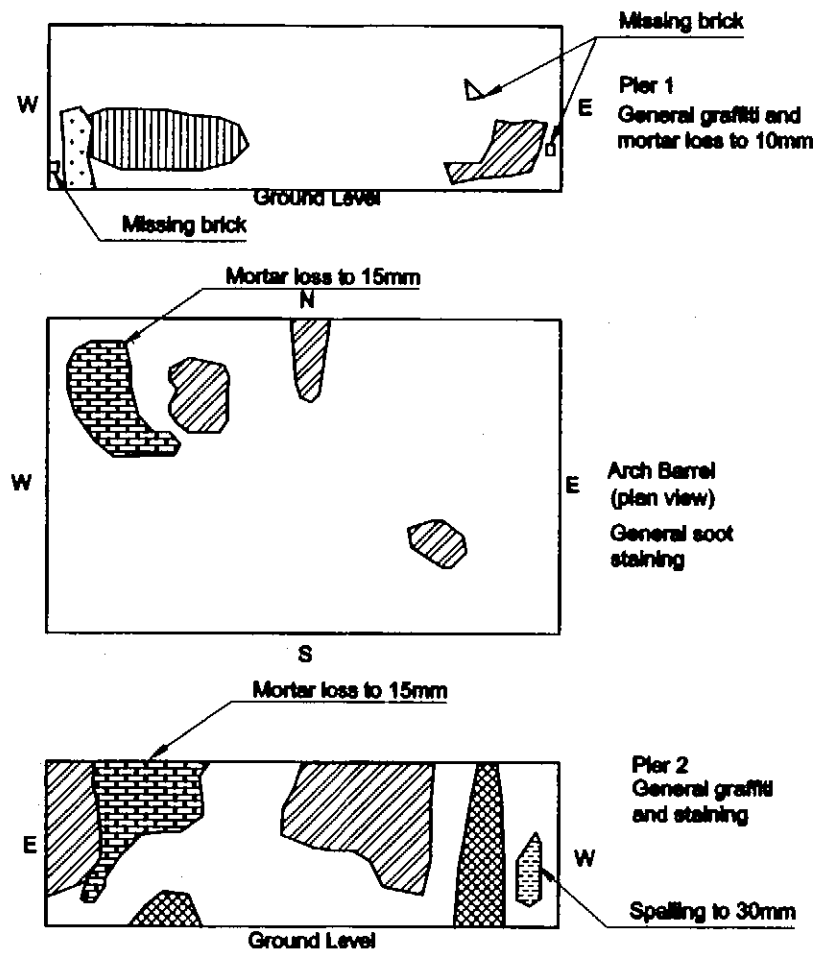
DO NOT SCALE

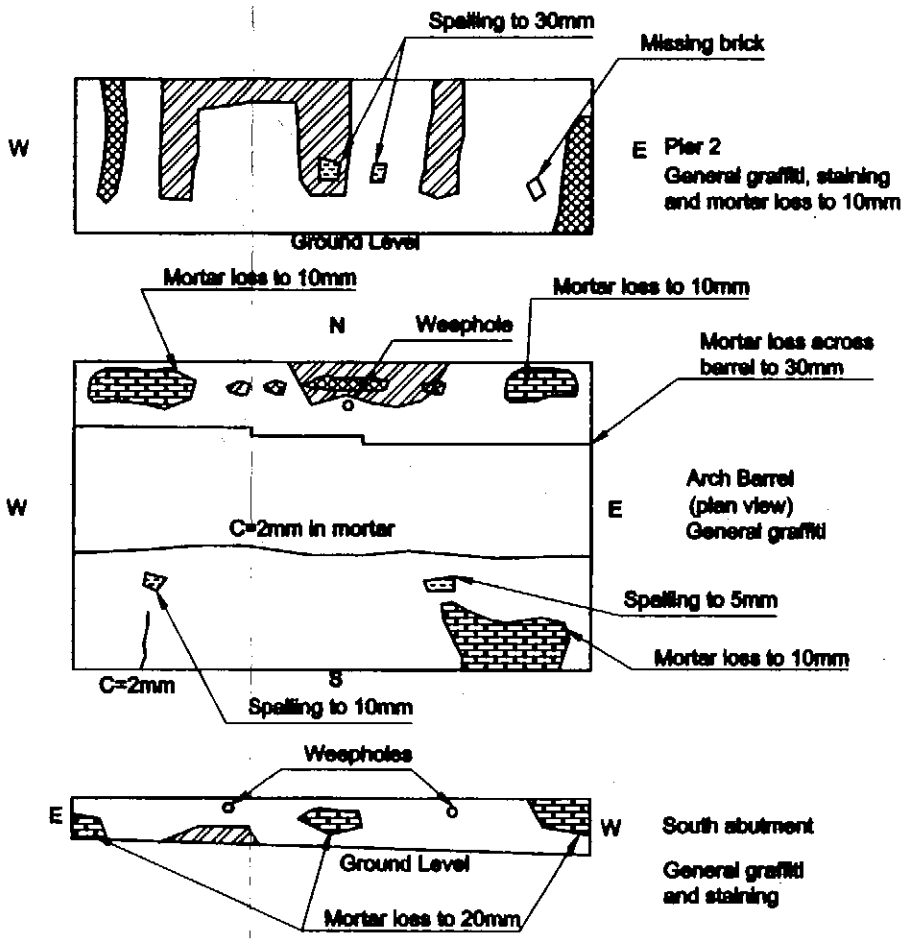
ECC Bridge No. 1658
Rail Property Board No. WFM/836

Notes:

All Dimensions in mm







ARCH 1
North Arch

ARCH 2
Central Arch

ARCH 3
South Arch

Essex County Council
Transportation & Operational Services

[redacted] ATION AND
OPERATIONAL SERVICES,
ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

WS/Atkins

SCALES	NTS
CAD FILE	M:\A1877\1658\fig05

	SURVEYED	LEVELLED	DESIGNED	DRAWN/TRACED	CHECKED	AUTHORISED
INITIALS	DJW	DJW		SD		
DATE	12/98	12/98		2/00		

REVISION NOTES	REVISION	CHECKED

DESCRIPTION OF DRAWING

STOW MARIES HALT, STOW MARIES ARCH SOFFIT, PIER AND ABUTMENT FACE DEFECTS

Sheet 1 of 1

SCHEME TITLE

ECC ASSESSMENT CONTRACT 3
RAIL PROPERTY LTD BRIDGES

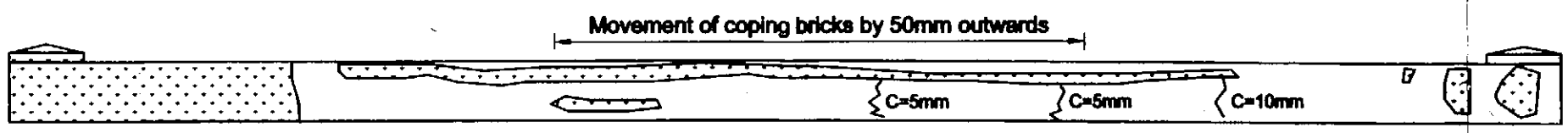
DRAWING NO. A1877/DWGS/1658/fig05

DO NOT SCALE

ECC Bridge No. 1658
Rail Property Board No. WFM/836

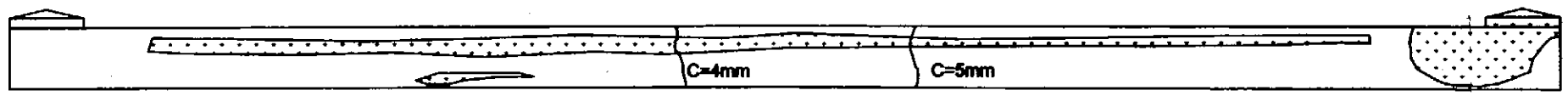
Notes:

All Dimensions in mm



EAST PARAPET (CARRIAGEWAY FACE)

General Defect:
Mortar loss of 10mm to both parapets



WEST PARAPET (CARRIAGEWAY FACE)

Essex County Council
Transportation & Operational Services

[redacted]TATION AND
ES,
ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

WS/Atkins

SCALES		SURVEYED	LEVELLED	DESIGNED	DRAWN/TRACED	CHECKED	AUTHORISED
NTS	INITIALS	DW	DW		SD		
	DATE	12/99	12/99		01/00		
CAD FILE N:\A1877\1658\fig06	REVISION NOTES			REVISION		CHECKED	

DESCRIPTION OF DRAWING
STOW MARIES HALT, STOW MARIES
PARAPET DEFECTS

Sheet 1 of 1

SCHEME TITLE
ECC ASSESSMENT CONTRACT 3
RAIL PROPERTY LTD BRIDGES

DRAWING NO. A1877/DWGS/1658/fig06

APPENDIX C

Statutory Undertakers

New Roads and Street Works Act (NRSWA) notices have been issued to the following companies. The responses are summarised below:

Company	Service
Anglian Water	No existing plant within the vicinity of the bridge.
British Telecom	No existing plant within the vicinity of the bridge.
Cable & Wireless	No existing plant within the vicinity of the bridge.
Transco	No existing plant within the vicinity of the bridge.
Eastern Electricity	No existing plant within the vicinity of the bridge.
Energis	No existing plant within the vicinity of the bridge.
National Grid	No existing plant within the vicinity of the bridge.
Street Lighting	No existing plant within the vicinity of the bridge.
Essex and Suffolk Water	Distribution main in the west verge.
Environment Agency	No comment.

ESSEX COUNTY COUNCIL
ASSESSMENT CONTRACT 3

ASSESSMENT REPORT FOR THE ASSESSMENT OF STOW MARIES HALT BRIDGE

ECC BRIDGE NO. 1658
RAIL PROPERTY Ltd BRIDGE NO. WFM/836

[redacted]

Essex County Council
Transportation and Operational Services Division
County Hall
Chelmsford
Essex
CM1 1QH

WS Atkins Consultants - Essex
Threadneedle House
9 - 10 Market Road
Chelmsford
Essex
CM1 1JQ

Rail Property Ltd
Room C5
Hudson House
York
YO1 6HP

Copy No. 1
Version No. 1.0

Assessment Report Index

EXECUTIVE SUMMARY

Stow Maries Halt Bridge, south of the village of Stow Maries in Essex, has been assessed in accordance with the Approval in Principle dated 27 March 2000. This is situated in appendix C of this report.

The structure consists of three square span brick arches supported on brick abutments and piers. The arches have clear spans of 7.81m, 7.76m, 7.83m. The parapets are brick. There is no weight restriction on the structure. There is no weight restriction on the structure.

Overall the structure is in fair condition.

The results for the whole structure are based on the MULTI mechanism method computer program. Results for the individual arches are based on the modified MEXE method, detailed in BD 21/97 and BA 16/97, and the ARCHIE computer program. As the fill depth over the arch is less than the arch barrel thickness for all 3 no. spans, the higher capacity of the ARCHIE and MEXE results will be adopted for the individual arches. The abutments, wing walls and foundations have been assessed qualitatively.

OVERALL STRUCTURAL CAPACITY	40 TONNES

The load carrying capacity of the main structural elements is listed below.

Spans 1 to 3

Arches:	40 Tonnes Assessment Live Loading
Piers:	40 Tonnes Assessment Live Loading

Sub-structures, foundations, wingwalls and spandrel walls:

A qualitative assessment of the abutments, foundations and wingwalls indicate that they are adequate to carry the present traffic loading. According to Clause 8.5 of BD21/97, they may be assumed to be adequate for 40 Tonne assessment loading without further assessment.

Strengthening Requirements

No strengthening measures are required.

FORM 'BA' (BRIDGES)

CERTIFICATION FOR ASSESSMENT CHECK

STRUCTURE / LINE NAME STOW MARIES HALT CATEGORY OF CHECK 2

ELR / STRUCTURE NO WFM/836

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

(1) It has been assessed in accordance with the Approval in Principle (where appropriate) as recorded on Form AA approved on 27 March 2000

(2) It has been checked for compliance with the following principle British Standards, Codes of Practice and Assessment standards. (SEE TAS SCHEDULE IN AIP)

List any departures from the above and additional methods or criteria adopted, with reference and justification for their acceptance (commenting on the results if appropriate).
NONE

CATEGORY 1

[redacted]

SESSOR) 29 March 2000

SESSMENT CHECKER) 29 March 2000

ECTOR OF THE FIRM OF CONSULTING GINEERS TO WHOM THE ASSESSOR / ECKER IS RESPONSIBLE

UST ALSO BE SIGNED)

SESSOR) 29 March 2000

ECTOR OF THE FIRM OF CONSULTING GINEERS TO WHOM THE ASSESSOR IS PONSIBLE

SESSMENT CHECKER) 29 March 2000

ECTOR OF THE FIRM OF CONSULTING GINEERS TO WHOM CHECKER IS SPONSIBLE

FORM 'BAA' (BRIDGES)

CERTIFICATION FOR ASSESSMENT CHECK

NOTIFICATION OF ASSESSMENT CHECK

STRUCTURE NAME / ROAD NO. STOW MARIES HALT BRIDGE

LINE NAME (DISUSED)

ELR CODE / STRUCTURE NO. WFM/836 ESSEX COUNTY COUNCIL No. 1658

The above bridge has been assessed and checked in accordance with Standards which are listed on the appended Form BA. A summary of the results of the assessment in terms of capacity and restrictions is as follows:

STATEMENT OF CAPACITY

40 tonnes

Critical member/s: N/A

RECOMMENDED LOADING RESTRICTIONS

No weight restriction is required.

DESCRIPTION OF STRUCTURAL DEFICIENCIES AND RECOMMENDED STRENGTHENING

[redacted] Engineer

1.0 INTRODUCTION

1.1 Essex County Council (ECC) entered into an agreement with Rail Property Ltd to assess Rail Property Ltd owned bridges carrying publicly maintainable highways. WS Atkins Consultants Ltd – Essex (WSAE) have been appointed by ECC to carry out the visual inspections and assessments of the bridges.

1.2 An Approval in Principle document was submitted and approved on 27 March 2000. This includes a detailed inspection for assessment report. This assessment report should be read in conjunction with the Approval in Principle and Inspection for Assessment Report.

1.3 An inspection of the structure was carried out on 03 December 1999. The inspection included a visual inspection and dimension survey to confirm structural details. The weather was dry, overcast and cold during the inspection. The results of the inspection are presented in the inspection for assessment report which forms part of the Approval in Principle dated 27 March 2000.

1.4 A summary of the inspection report findings are listed in section 2 of this assessment report. This includes details of the defects to the bridge which affect the load carrying assessment of the structure.

1.5 Stow Maries Halt Bridge carries an unclassified road over a dismantled railway to the south of the village of Stow Maries in Essex OS Ref. TQ 583510 199144.

1.6 The structure consists of three square span brick arches supported on brick abutments and piers. The arches have clear spans of 7.81m, 7.76m, 7.83m. The parapets are brick.

1.7 The carriageway width varies between 2.9m and 3.7m. The east grass verge varies between 1.8m and 2.2m wide and the west grass verge varies in width between 2.2m and 2.75m. The vertical alignment of the carriageway rises steadily from the southern end with a slight hog curve approximately in the centre of the bridge. The horizontal alignment is straight.

1.8 There is no weight restriction on the structure.

2.0 CONCLUSIONS OF INSPECTION REPORT

Details of the key dimensions of the structure are shown on drawings AI1877/DWGS/1658/FIG 01, Fig 02 and FIG 03. These are included in the Approval in Principle document.

Details of the defects in the structure are shown on drawings AI1877/DWGS/1658/FIG 04 to FIG 06. These are situated in the inspection for assessment report which forms an appendix to the Approval in Principle.

The following is a summary of the defects listed in the inspection for assessment report.

2.1 Overall, the bridge is generally in fair condition.

2.2 Based on a visual inspection and the recommendations of BA 16/97 Annex D, the following factors for the Modified MEXE Method were adopted:

		Arch no. 1 (North)	Arch no. 2 (Central)	Arch no. 3 (South)
Condition Factor	F_{cM}	0.9	0.9	0.9
Barrel Factor	F_b	1.0	1.0	1.0
Fill Factor	F_f	0.7	0.7	0.7
Width Factor	F_w	0.9	0.9	0.9
Mortar Factor	F_{mo}	0.9	0.9	0.9
Depth Factor	F_d	0.8	0.8	0.8

For alternative analysis by the ARCHIE and MULTI computer programs, the overall condition factor F_c, based on the above factors and the recommendations of BD 21/97 6.21, has been adopted.

These factors were decided upon by the Engineer based on the inspection and the Standards listed in the Approval in Principle.

2.3 For the assessment, axle lift-off should be considered.

2.4 Backing material has been assumed above the intermediate piers and abutments to levels indicated on Rail Property Ltd drawings 5A/13A/836/1, referenced in Section 4 of the Inspection for Assessment report.

2.5 The weathered and eroded areas of brickwork should be monitored during routine inspections and repairs carried out, as their condition becomes critical. All cracking to the structure should be monitored and repaired as necessary.

2.6 The abutments, wing walls and foundations showed little signs of distress and were assumed to be in sound condition.

3.0 ASSESSMENT METHODS AND FINDINGS

3.1 The assessment of Stow Maries Halt Bridge, south of the village of Stow Maries in Essex, has been carried out in accordance with the approval in principle dated 27 March 2000. The following drawings, included in the Approval in Principle document have been used.

AI1877/DWGS/1658/FIG 01	Elevations
AI1877/DWGS/1658/FIG 02	Plan
AI1877/DWGS/1658/FIG 03	Cross section

3.2 The following assumptions have been made regarding material strengths.

Masonry Strength	4.4 N/mm2

3.3 Detailed results tables are situated in appendix A of this assessment report. Copies of the assessment calculations are situated in appendix B.

ARCHES

3.4 The individual arches have been analysed using the modified MEXE method, detailed in BD 21/97 and BA 16/97, and the ARCHIE computer program. As the fill depth over the arch is less than the arch barrel thickness for all 3 no. spans, the higher capacity of the ARCHIE and MEXE results will be adopted for the individual arches.

3.5 For the assessment axle lift-off has been considered.

3.6 Backing has been assumed above the intermediate piers and abutments as discussed in Section 2 of this report.

3.7 The arches were assessed at **40 TONNES** Assessment Live Loading.

INTERMEDIATE PIERS

3.8 The whole structure was analysed as a multi span arch using the MULTI mechanism method computer program.

3.9 The piers were assessed at **40 TONNES** Assessment Live Loading.

ABUTMENTS, WING WALLS AND FOUNDATIONS

3.10 A qualitative assessment of the abutments, wing walls and foundations indicate that they are adequate to carry the present traffic loading. According to Clause 8.5 of BD21/97, they may be assumed to be adequate for 40 Tonne assessment loading without further assessment.

4.0 CONCLUSIONS

4.1 Stow Maries Halt Bridge, south of the village of Stow Maries in Essex, has been assessed in accordance with the Approval in Principle dated 27 March 2000.

4.2 The results for the whole structure are based on the MULTI mechanism method computer program. Results for the individual arches are based on the modified MEXE method, detailed in BD 21/97 and BA 16/97, and the ARCHIE computer program. As the fill depth over the arch is less than the arch barrel thickness for all 3 no. spans, the higher capacity of the ARCHIE and MEXE results will be adopted for the individual arches. A summary of the results is listed below.

4.3 Spans 1 to 3

Arches:	40 tonnes
Piers:	40 tonnes
Parapets:	The parapets do not conform to current standards and have not been assessed.

4.4 Abutments, wing walls and foundations

A qualitative assessment of the abutments, wing walls and foundations indicate that they are adequate to carry the present traffic loading. According to Clause 8.5 of BD21/97, they may be assumed to be adequate for 40 Tonne assessment loading without further assessment. Spandrel walls are assessed also at 40 Tonne.

4.5 The inspection for assessment showed that the structure requires minor maintenance. Details are included in section 6 of the inspection report.

4.6 Strengthening Requirements

No strengthening measures are required.

APPENDIX A

SUMMARY RESULTS TABLES

Analysis Results: Masonry Arch Analysis.

Span Reference		North Arch	North Arch	Central Arch	Central Arch
Method Used		MEXE	ARCHIE/ MULTI	MEXE	ARCHIE/ MULTI

Single Span Analysis – No Axle Lift Off

Allowable Axle Loads	Single Axle Load	33.3t	>11.5t	32.9t	>11.5t
	Double Axle Load	22.2t	>10t	21.9t	>10t
	Triple Axle Load	20.6t	>8t	20.4t	>8t

Single Span Analysis – Axle Lift Off

AAL	Double Axle Load	16.7t	>11.5t	16.4t	>11.5t

Multi Span Analysis (Assuming Slender Piers)

Overall Global Capacity	N/A	40t	N/A	40t

Maximum Gross Vehicle Weight	40t	40t	40t	40t
Assessment Live Load Rating	40t	40t	40t	40t
HB Rating	N/A	N/A	N/A	N/A

Comments

- Axle lift off has been considered.
- Backing material has been assumed above the intermediate piers and abutments to levels indicated on Rail Property Ltd drawings 5A/13A/836/1, referenced in Section 2 of the Inspection for Assessment report.

Analysis Results: Masonry Arch Analysis.

Span Reference	South Arch	South Arch		
Method Used	MEXE	ARCHIE/ MULTI		

Single Span Analysis – No Axle Lift Off

Allowable Axle Loads	Single Axle Load	25.7t	>11.5t		
	Double Axle Load	17.1t	>10t		
	Triple Axle Load	15.9t	>8t		

Single Span Analysis – Axle Lift Off

AAL	Double Axle Load	12.8t	>11.5t		

Multi Span Analysis (Assuming Slender Piers)

Overall Global Capacity	N/A	40t		

Maximum Gross Vehicle Weight	40t	40t		
Assessment Live Load Rating	40t	40t		
HB Rating	N/A	N/A		

Comments

- Axle lift off has been considered.
- Backing material has been assumed above the intermediate piers and abutments to levels indicated on Rail Property Ltd drawings 5A/13A/836/1, referenced in Section 2 of the Inspection for Assessment report.

APPENDIX B

ASSESSMENT CALCULATIONS

WS/Atkins

CALCULATION INDEX

PROJECT: ECL ASSESSMENT CONTRACT 2

FILE NAME: STOW MARIES MULT BRIDGE

FILE NO: A1 1 8 7 7 - 7 2

C = Calculation
S = Sketch
D = Data

Page

INDEX NO	CALCULATION/SKETCH/DATA	ORIGINATOR	DATE
1	SUMMARY	JF	2/00
2-5	ARCH ANALYSIS DATA	JF	2/00
6	NORTH ARCH - MEXE	JF	2/00
7	CENTRAL ARCH - MEXE	JF	2/00
8	SOUTH ARCH - MEXE	JF	2/00
9-10	MEXE SUMMARY	JF	2/00
11-12	ARCHIE ANALYSIS	JF	2/00
13-24	ARCHIE OUTPUT DATA	JF	2/00
25-28	MULTI ANALYSIS	JF	2/00

Continued on Sheet

WS/Atkins

Project	Job ref
ECC ASSESSMENT CONTRACT 3	A1 1877/72
Part of structure: STOW MARIES	Calc sheet no / rev: 1 / 1
Drawing ref	Calc by: JF; Date: 2/00
	Check by; Date

Ref	Calculations	Output

SUMMARY

ARCH ANALYSIS

ARCH CAPACITY

	NORTH	CENTRAL	SOUTH
MEXE Analysis;	40t	40t	40t
ARCHIE Analysis;	40t	40t	40t

PIER ANALYSIS

MULTI. Analysis; ..... Pier capacity = 40t

∴ OVERALL CAPACITY = 40t

Agree DRL 29/2/00

All OK for 40/44T ALL

WS/Atkins	Project: ECC ASSESSMENT CONTRACT 3	Job ref: A1 1877/72
	Part of structure: STOW MARKET HALT	Calc sheet no / rev: 1 2 1
	Drawing ref	Calc by: JF; Date: 2/00; Check by; Date

Ref	Calculations	Output

ARCH ANALYSIS

	Arch no. 1 (N)	Arch no. 2 (Central)	Arch no. 3 (S)
Square span (L)	7.810m	7.755m	7.830m
Skew angle (α)	0°	0°	0°
Rise of the arch barrel (r_c)	1.500m	1.525m	1.510m
Rise at quarter points (r_q)	1.210m	1.230m	1.220m

Backing level (determined from record drawings)	1.5m above springing level
Masonry self weight	21kN/m^3
Fill self weight	19kN/m^3
Surfacing self weight	23kN/m^3
ϕ' for fill	30°
ARCHIE passive pressure coefficient	0.3
Masonry strength	4.4 N/mm^2

		North Arch	Centre Arch	South Arch
Condition Factor	F_{cM}	0.9	0.9	0.9
Barrel Factor	F_b	1.0	1.0	1.0
Fill Factor	F_f	0.7	0.7	0.7
Width Factor	F_w	0.9	0.9	0.9
Mortar Factor	F_{mo}	0.9	0.9	0.9
Depth Factor	F_d	0.8	0.8	0.8

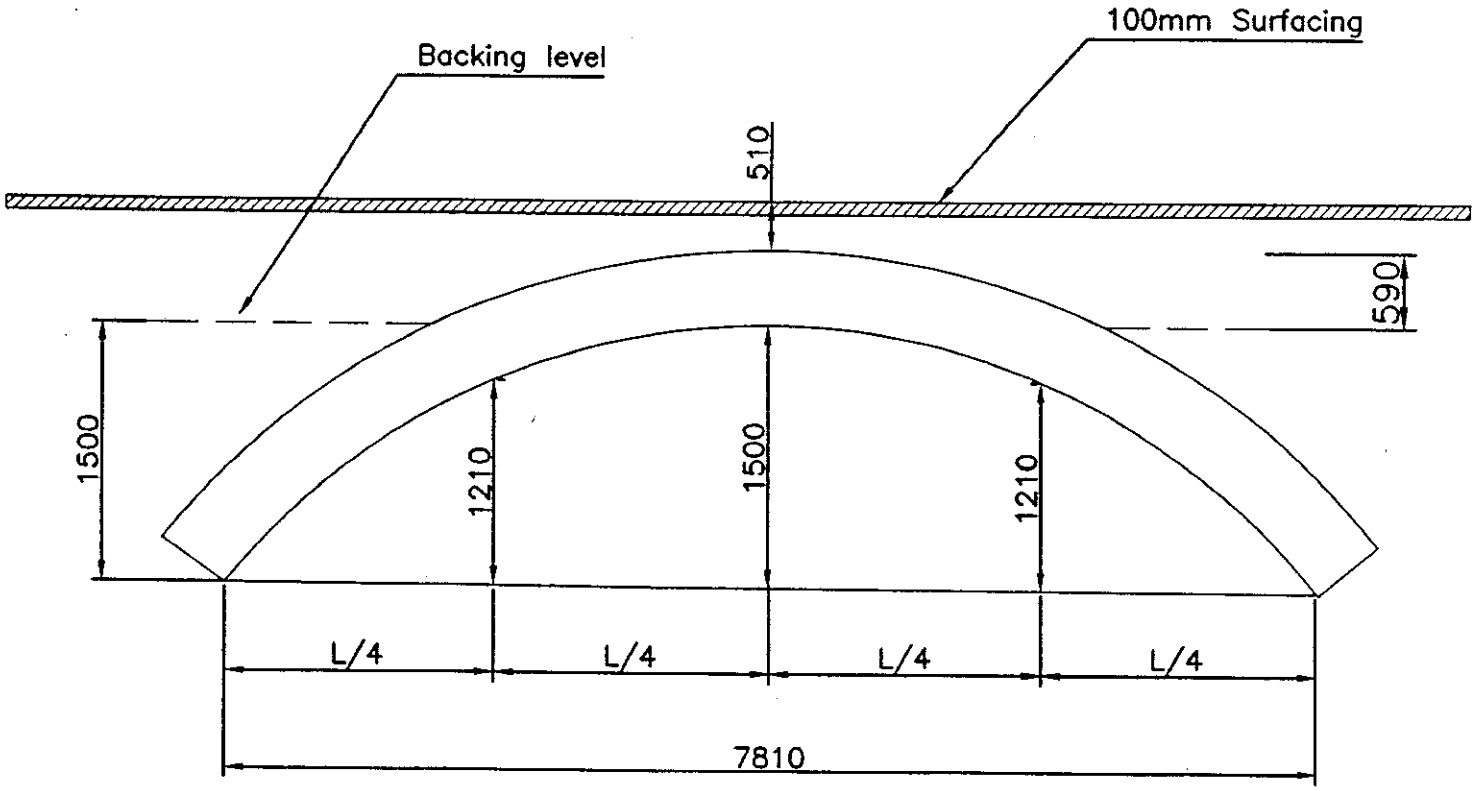
Axle lift-off will be considered.

Essex County Council
Transportation & Operational Services

[redacted] AND
OPERATIONAL SERVICES,
ENVIRONMENTAL SERVICES DIRECTORATE,
COUNTY HALL, CHELMSFORD. CM1 1QH
Telephone 01245 492211

Atkins

ECC Bridge No. 1658
Rail Property Board No. WFM/836



ARCH No.1 (NORTH ARCH)
IDEALISATION DIAGRAM
NTS

SCHEME TITLE ECC ASSESSMENT CONTRACT 3
STOW MARIES HALT, STOW MARIES
IDEALISATION DIAGRAM ARCH 1

DRWG.NO. AI1877/1658/fig07	
CAD NO. N:1877/1658/fig07	
SCALES NTS	
DATE JAN 00	DRAWN/TRACED SD
DATE JAN 00	CHECKED DW
DATE	AUTHORISED

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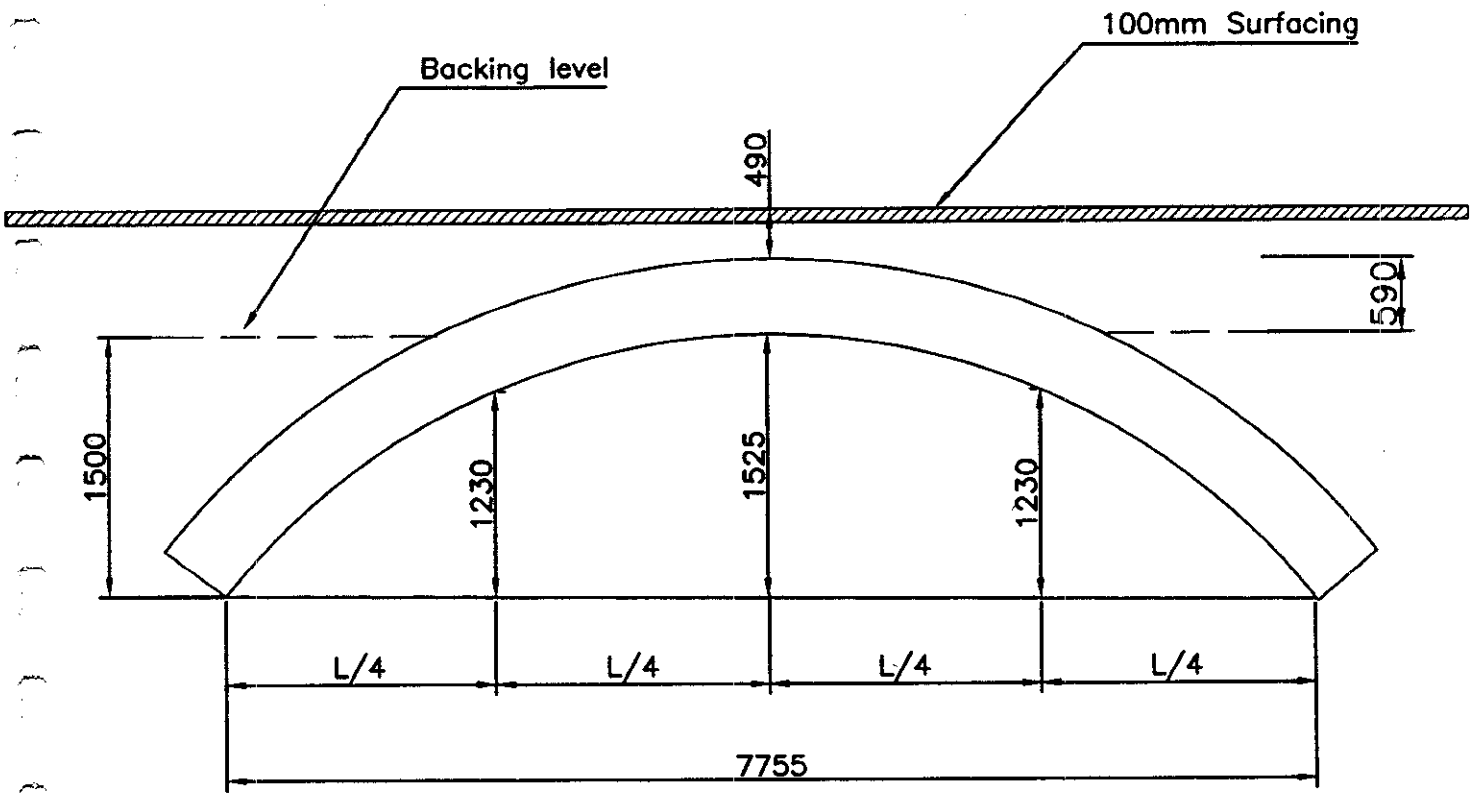
(4)

ECC Bridge No. 1658
Rail Property Board No. WFM/836



ARCH No.2 (CENTRAL ARCH) IDEALISATION DIAGRAM NTS

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CAD NO.	N:1877/1658/fig08
SCALES	NTS
DATE JAN 00	DRAWN/TRACED SD
DATE JAN 00	CHECKED DW
DATE	AUTHORISED

SCHEME TITLE ECC ASSESSMENT CONTRACT 3
STOW MARIES HALT, STOW MARIES
IDEALISATION DIAGRAM ARCH 2

[redacted]

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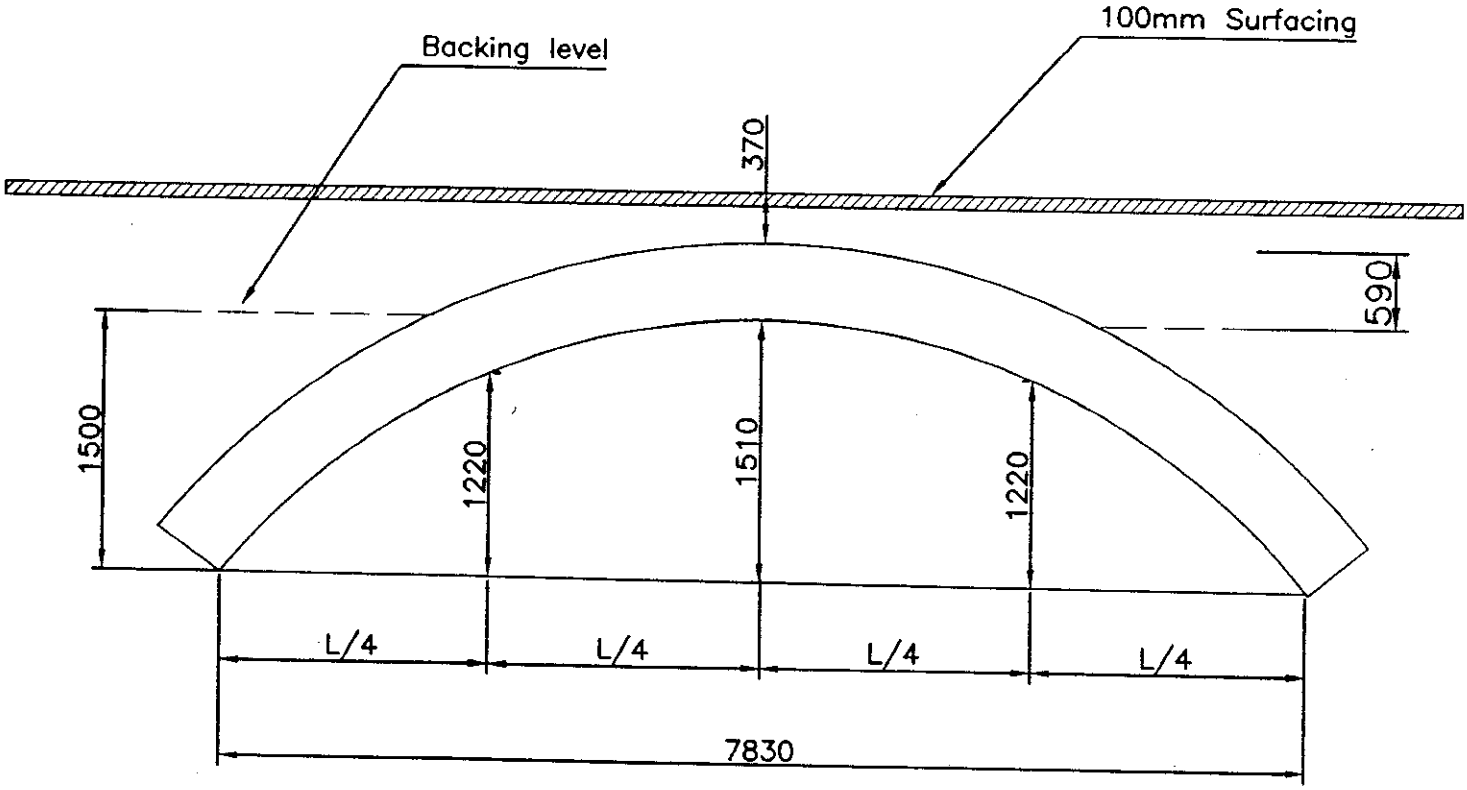
ECC Bridge No. 1658
Rail Property Board No. WFM/836



ARCH No.3 (SOUTH ARCH)
IDEALISATION DIAGRAM
NTS

SCHEME TITLE ECC ASSESSMENT CONTRACT 3
STOW MARIES HALT, STOW MARIES
IDEALISATION DIAGRAM ARCH 3

DRWG.NO. AI1877/1658/fig09	
CAD NO. N:1877/1658/fig09	
SCALES NTS	
DATE JAN 00	DRAWN/TRACED SD
DATE JAN 00	CHECKED DW
DATE	AUTHORISED

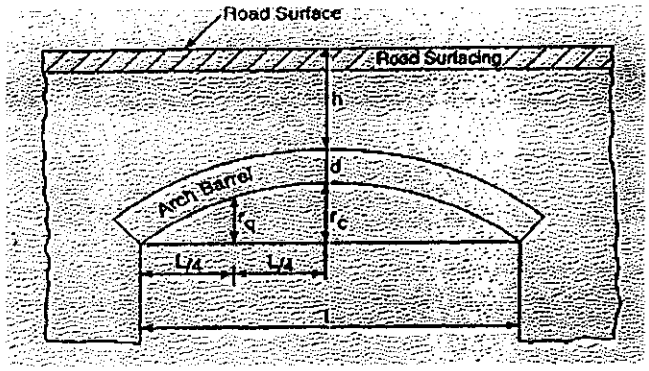
WS/Atkins

(6)

ARCH ASSESSMENT TO MODIFIED MEXE (BA 16/97)

Structure Name: STOW MARIES HALT - NORTH

1. DIMENSIONS



L = 7.810m
rc = 1.500m
rq = 1.210m
d = 0.590m
h = 0.510m
h + d = 1.100m

2. PROVISIONAL ASSESSMENT LOADING (Fig. 3/1)

PAL = 61.9 Tonne

3. SPAN / RISE FACTOR

$\frac{L}{rc} = \frac{7.810}{1.500} = 5.21$ (Fig. 3/3) Fsr = 0.83

4. PROFILE FACTOR

$\frac{rq}{rc} = \frac{1.210}{1.500} = 0.81$ (Fig. 3/4) Fp = 0.86

5. MATERIAL FACTOR

(Tables 3/1 & 3/2)

$Fm = \frac{(Fb.d) + Ff.h)}{d + h} = \frac{(1.0 \times 0.59) + (0.7 \times 0.51)}{0.59 + 0.51}$ Fm = 0.86

6. JOINT FACTOR

(Tables 3/3, 3/4 & 3/5)

Fj = Fw.Fd.Fmo = 0.9 x 0.8 x 0.9 Fj = 0.65

7. CONDITION FACTOR

(Para. 3.17 to 3.23)

Fc = 0.9

8. MODIFIED AXLE LOAD

MAL = PAL x Fsr x Fp x Fm x Fj x Fc

MAL = 22.2 Tonne

9. AXLE LIFT-OFF FACTOR

(Fig. 3/5) SEE FOLLOWING PAGES.

Af = VARIES

10. WEIGHT LIMIT ON ARCH (MAX GROSS VEHICLE WEIGHT)

(Table 3/6)

40 Tonne

11. CONCLUSIONS:

ADEQUATE CAPACITY FOR 40 TONNES

Assessed By: [redacted] Date: 11/2/00

Signed: [redacted]

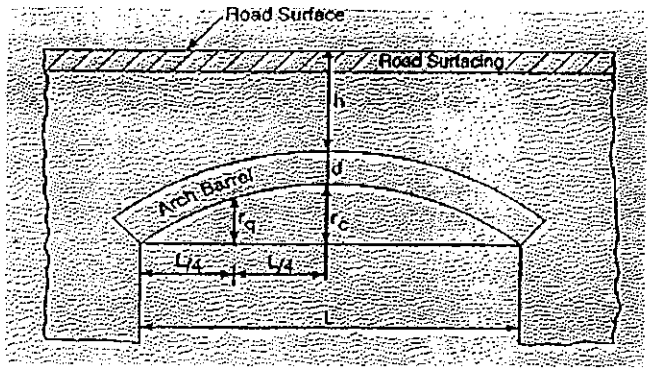
WS/Atkins

(7)

ARCH ASSESSMENT TO MODIFIED MEXE (BA 16/97)

Structure Name: STOW MARIES - CENTRAL

1. DIMENSIONS



L = 7.755m
rc = 1.525m
rq = 1.230m
d = 0.590m
h = 0.490m
h + d = 1.080m

2. PROVISIONAL ASSESSMENT LOADING (Fig. 3/1)

PAL = 60.2 Tonne

3. SPAN / RISE FACTOR

$\frac{L}{rc} = \frac{7.755}{1.525} = 5.09$ (Fig. 3/3) Fsr = 0.84

4. PROFILE FACTOR

$\frac{rq}{rc} = \frac{1.230}{1.525} = 0.81$ (Fig. 3/4) Fp = 0.86

5. MATERIAL FACTOR

(Tables 3/1 & 3/2)

$Fm = \frac{(Fb.d) + Ff.h)}{d + h} = \frac{(1.0 \times 0.59) + (0.7 \times 0.49)}{0.59 + 0.49}$ Fm = 0.86

6. JOINT FACTOR

(Tables 3/3, 3/4 & 3/5)

Fj = Fw.Fd.Fmo = 0.9 x 0.8 x 0.9 Fj = 0.65

7. CONDITION FACTOR

(Para. 3.17 to 3.23)

Fc = 0.90

8. MODIFIED AXLE LOAD

MAL = PAL x Fsr x Fp x Fm x Fj x Fc

MAL = 21.9 Tonne

9. AXLE LIFT-OFF FACTOR

(Fig. 3/5)

SEE FOLLOWING PAGES.

Af = VARIES

10. WEIGHT LIMIT ON ARCH (MAX GROSS VEHICLE WEIGHT)

(Table 3/6)

40 Tonne

11. CONCLUSIONS:

ACCEPTABLE CAPACITY FOR 40TONNES

Assessed By [redacted] Date: 11/2/00

Signed [redacted]

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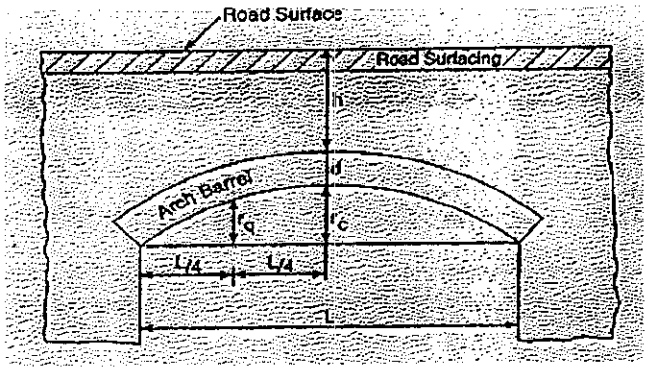
ARCH ASSESSMENT TO MODIFIED MEXE (BA 16/97)

Structure Name: STOW MARIES - SOUTH

1. DIMENSIONS



L = 7.830m
rc = 1.510m
rq = 1.220m
d = 0.590m
h = 0.370m
h + d = 0.960

2. PROVISIONAL ASSESSMENT LOADING (Fig. 3/1)

PAL = 47.0 Tonne

3. SPAN / RISE FACTOR

$\frac{L}{rc} = \frac{7.830}{1.510} = 5.19$ (Fig. 3/3) Fsr = 0.83

4. PROFILE FACTOR

$\frac{rq}{rc} = \frac{1.220}{1.510} = 0.81$ (Fig. 3/4) Fp = 0.85

5. MATERIAL FACTOR

(Tables 3/1 & 3/2)

$Fm = \frac{(Fb.d) + Ff.h)}{d + h} = \frac{(1.0 \times 0.59) + (0.7 \times 0.370)}{0.590 + 0.370}$ Fm = 0.88

6. JOINT FACTOR

(Tables 3/3, 3/4 & 3/5)

Fj = Fw.Fd.Fmo = 0.9 x 0.8 x 0.9 Fj = 0.65

7. CONDITION FACTOR

(Para. 3.17 to 3.23)

Fc = 0.90

8. MODIFIED AXLE LOAD

MAL = PAL x Fsr x Fp x Fm x Fj x Fc

MAL = 17.1 Tonne

9. AXLE LIFT-OFF FACTOR

(Fig. 3/5)

SEE FOLLOWING PAGES.

Af = VARIES

10. WEIGHT LIMIT ON ARCH (MAX GROSS VEHICLE WEIGHT)

(Table 3/6)

40 Tonne

11. CONCLUSIONS:

ADEQUATE CAPACITY FOR 40 TONNES

Assessed By [redacted] Date: 11/2/00

Signed [redacted]

MEXE ANALYSIS

Axle Factors;

As all three spans are very similar → assume the same axle factors for all three.

No Axle Lift Off;

Load case	A_f
Single Axle	1.50
Double Axle	1.00
Triple Axle	0.93

Axle Lift Off;

Load case	A_f
Double Axle	0.75

NORTH ARCH

	Load case	MAL	A_f	Allowable Axle Load
No Lift Off	Single Axle Load	22.2	1.50	33.3t
	Double Axle	22.2	1.00	22.2t
	Triple Axle	22.2	0.93	20.6t
Lift Off	Double Axle	22.2	0.75	16.7t

∴ Max gross vehicle weight = 40 tonnes.

WS Atkins

Project	Job ref
ELL ASSESSMENT CONTRACT 3	A1 1877 /72
Part of structure: STOW MARIES	Calc sheet no / 10 / rev /
Drawing ref	Calc by: JF; Date: 2/00
	Check by; Date

Ref	Calculations	Output

MEXE ANALYSIS

CENTRAL ARCH

	Load case	MAL	Af	Allowable Axle Load
No Lft Off	Single Axle	21.9	1.50	32.9t
	Double Axle	21.9	1.00	21.9t
	Triple Axle	21.9	0.93	20.4t
Lft Off	Double Axle	21.9	0.75	16.4t

∴ Max gross vehicle weight = 40 tonnes.

SOUTH ARCH

	Load case	MAL	Af	Allowable Axle Load
No Lft Off	Single Axle	17.1	1.50	25.7t
	Double Axle	17.1	1.00	17.1t
	Triple Axle	17.1	0.93	15.9t
Lft Off	Double Axle	17.1	0.75	12.8t

∴ Max gross vehicle weight = 40 tonnes.

ARCHIE ANALYSIS

Carriageway width = 3.700m maximum

∴ No. of notional lanes = 1

Minimum verge width = 1.825m

By inspection, no reduction in lane width due to wheel load dispersal being close to edge of arch barrel.

NORTH ARCH

ARCHIE condition factor = $F_{cm} \times F_j$

$= 0.9 \times 0.65 = 0.59$

Depth of fill at crown = 0.510m

Factored lane width = $(1.8 + 1.5 + 0.510) \times 0.59$

$= \underline{2.248m}$

CENTRAL ARCH

ARCHIE condition factor = $0.9 \times 0.65 = 0.59$

Depth of fill at crown = 0.490m

Factored lane width = $(1.8 + 1.5 + 0.490) \times 0.59$

$= \underline{2.236m}$

SOUTH ARCH

ARCHIE condition factor = $0.9 \times 0.65 = 0.59$

Depth of fill at crown = 0.370m

Factored lane width = $(1.8 + 1.5 + 0.370) \times 0.59$

$= \underline{2.165m}$

WS/Atkins

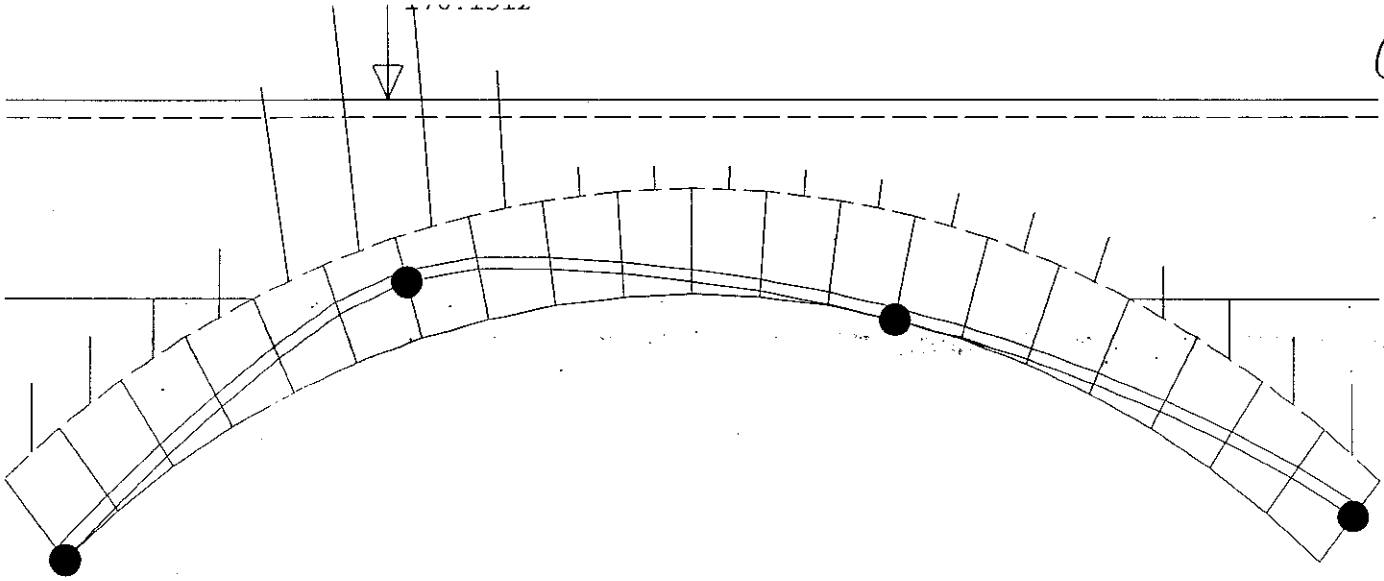
Project	Job ref
ECC ASSESSMENT CONTRACT 3	A11877/72
Part of structure: STOW MARIEN	Calc sheet no / rev: 1 12 /
Drawing ref	Calc by: JF; Date: 2/00; Check by; Date

Ref	Calculations	Output

ARCHIE RESULTS

Factors of Safety

		North	Central	South
No Lift Off	11.5t Single Axle	1.49	1.43	1.36
	20t Double Axle	1.52	1.50	1.42
	24t Triple Axle	1.60	1.56	1.48
Lift Off	Double Axle	1.26	1.34	1.27
	Weight Capacity	40t	40t	40t



Nortarch

()

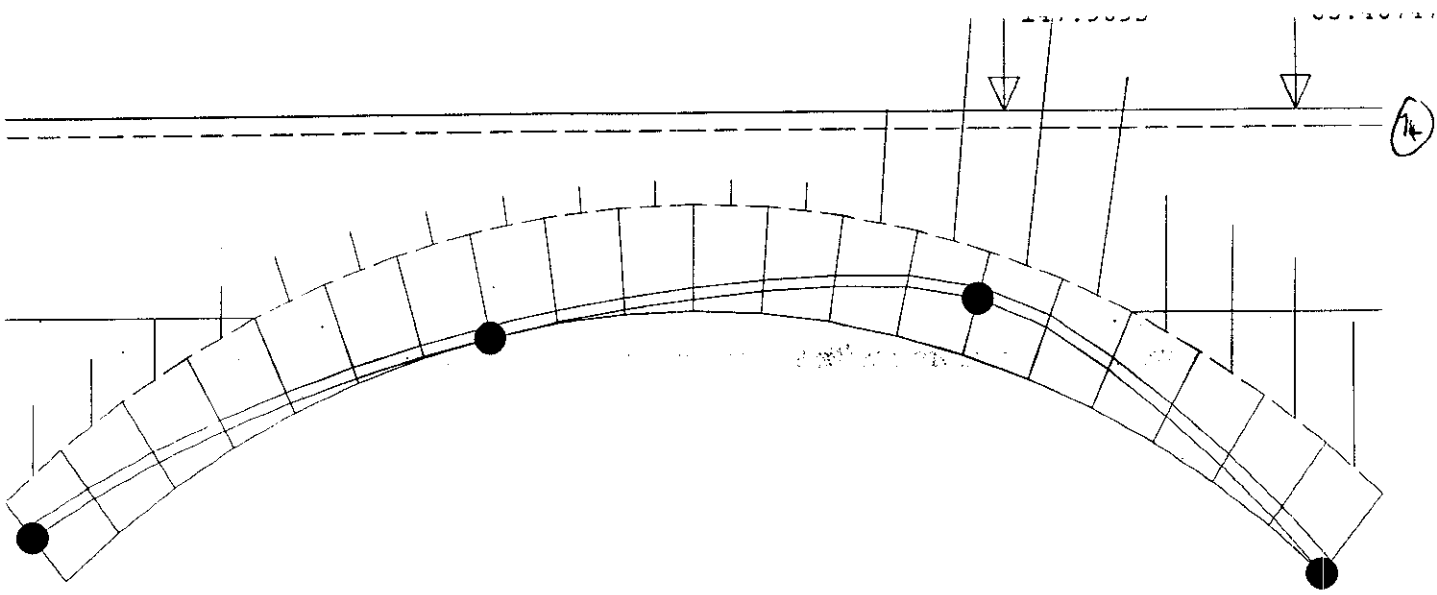
Span	7810 mm	Rise	1500 mm
Depth of fill	510 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Single Axle:11.5t at 2000		
Lane width	2248mm		
Required ring depth	396 mm	Geometric F.O.S	1.49
H Left	267 kN/m	H Right	280 kN/m
V Left	280 kN/m	V Right	175 kN/m
Comp. zone at hinge 2	67 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 7	3 AT 14	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.9	0	0	0	0
2	-5.6	-13.1	0	0	0	0
3	-5.6	-11.6	0	0	0	0
4	-5.6	-10.1	0	-3.3	0	0
5	-5.6	-8.6	1.8	-29.1	4.1	0
6	-5.6	-7.5	1.3	-59.6	6.8	0
7	-5.6	-6.5	.8	-56	4.9	0
8	-5.6	-5.6	.5	-21.3	1.3	0
9	-5.6	-5.1	.3	-.8	0	0
10	-5.6	-4.8	.1	0	0	0
11	-5.6	-4.8	-.1	0	0	0
12	-5.6	-5.1	-.3	0	0	-.1
13	-5.6	-5.6	-.5	0	0	-.3
14	-5.6	-6.5	-.8	0	0	-.7
15	-5.6	-7.5	-1.3	0	0	-1
16	-5.6	-8.6	-1.8	0	0	-1.4
17	-5.6	-10.1	0	0	0	0
18	-5.6	-11.6	0	0	0	0
19	-5.6	-13.2	0	0	0	0
20	-5.4	-13.9	0	0	0	0



Nortarch

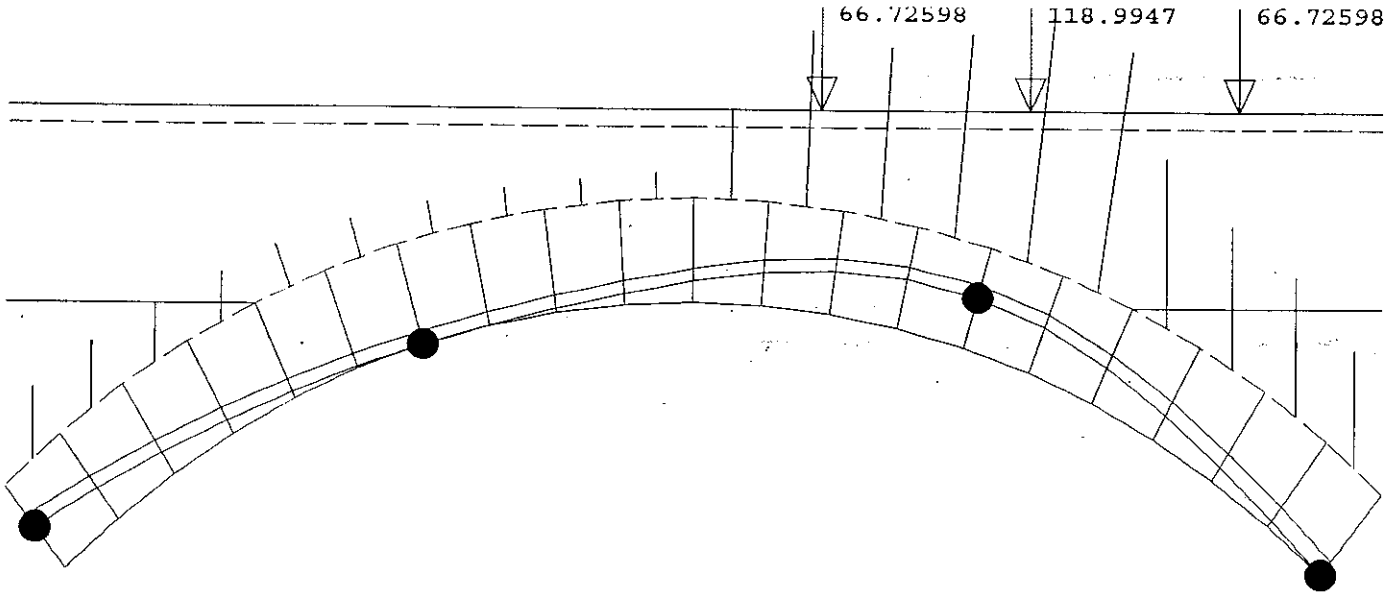
()			
Span	7810 mm	Rise	1500 mm
Depth of fill	510 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20t:Left Heavy at 6500		
Lane width	2248mm		
Required ring depth	388 mm	Geometric F.O.S	1.52
H Left	272 kN/m	H Right	259 kN/m
V Left	172 kN/m	V Right	325 kN/m
Comp. zone at hinge 2	64 mm	Factor on pass. press.	.3

Hinges

1 AT 1 2 AT 8 3 AT 15 4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.9	0	0	0	0
2	-5.6	-13.1	0	0	0	0
3	-5.6	-11.6	0	0	0	0
4	-5.6	-10.1	0	0	0	0
5	-5.6	-8.6	1.8	0	0	1.4
6	-5.6	-7.5	1.3	0	0	1
7	-5.6	-6.5	.8	0	0	.7
8	-5.6	-5.6	.5	0	0	.3
9	-5.6	-5.1	.3	0	0	.1
10	-5.6	-4.8	.1	0	0	0
11	-5.6	-4.8	-.1	0	0	0
12	-5.6	-5.1	-.3	-.4	0	0
13	-5.6	-5.6	-.5	-16.1	-1	0
14	-5.6	-6.5	-.8	-46.4	-4	0
15	-5.6	-7.5	-1.3	-53.2	-6.1	0
16	-5.6	-8.6	-1.8	-33	-4.7	0
17	-5.6	-10.1	0	-15.6	0	0
18	-5.6	-11.6	0	-16.3	0	0
19	-5.6	-13.2	0	-17.5	0	0
20	-5.4	-13.9	0	-14.3	0	0



Nortarch

()

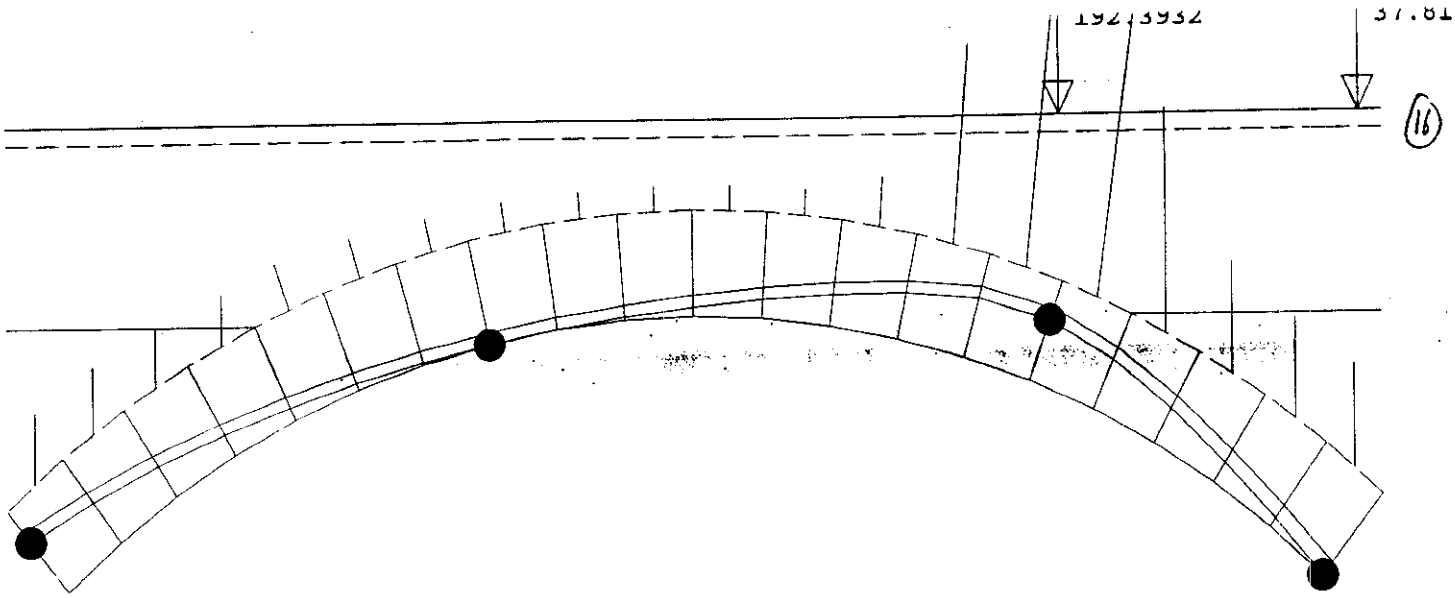
Span	7810 mm	Rise	1500 mm
Depth of fill	510 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Triple Axle:24t:No Lift-off at 6000		
Lane width	2248mm		
Required ring depth	370 mm	Geometric F.O.S	1.6
H Left	308 kN/m	H Right	295 kN/m
V Left	191 kN/m	V Right	342 kN/m
Comp. zone at hinge 2	74 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 7	3 AT 15	4 AT 21

Param(mm).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.9	0	0	0	0
2	-5.6	-13.1	0	0	0	0
3	-5.6	-11.6	0	0	0	0
4	-5.6	-10.1	0	0	0	0
5	-5.6	-8.6	1.8	0	0	1.4
6	-5.6	-7.5	1.3	0	0	1
7	-5.6	-6.5	.8	0	0	.5
8	-5.6	-5.6	.5	0	0	.2
9	-5.6	-5.1	.3	0	0	.1
10	-5.6	-4.8	.1	-.5	0	0
11	-5.6	-4.8	-.1	-13.1	-.2	0
12	-5.6	-5.1	-.3	-29.1	-1.1	0
13	-5.6	-5.6	-.5	-27.9	-1.7	0
14	-5.6	-6.5	-.8	-33.1	-2.9	0
15	-5.6	-7.5	-1.3	-44.4	-5.1	0
16	-5.6	-8.6	-1.8	-38.2	-5.4	0
17	-5.6	-10.1	0	-23	0	0
18	-5.6	-11.6	0	-16.2	0	0
19	-5.6	-13.2	0	-13.7	0	0
20	-5.4	-13.9	0	-8.4	0	0



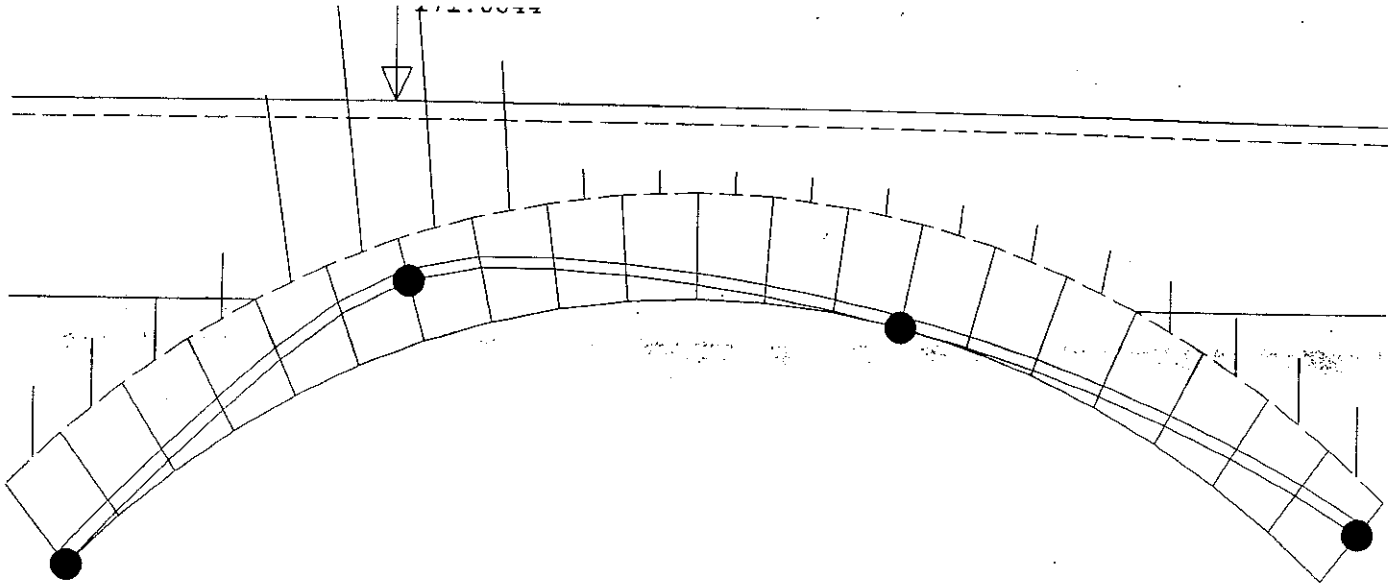
Nortarch

()			
Span	7810 mm	Rise	1500 mm
Depth of fill	510 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20.3t:Right Lift-off at 6500		
Lane width	2248mm		
Required ring depth	432 mm	Geometric F.O.S	1.36
H Left	280 kN/m	H Right	265 kN/m
V Left	171 kN/m	V Right	328 kN/m
Comp. zone at hinge 2	69 mm	Factor on pass. press.	.3

Hinges
1 AT 1 2 AT 8 3 AT 16 4 AT 21

Param(mm).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.9	0	0	0	0
2	-5.6	-13.1	0	0	0	0
3	-5.6	-11.6	0	0	0	0
4	-5.6	-10.1	0	0	0	0
5	-5.6	-8.6	1.8	0	0	1.4
6	-5.6	-7.5	1.3	0	0	1
7	-5.6	-6.5	.8	0	0	.7
8	-5.6	-5.6	.5	0	0	.3
9	-5.6	-5.1	.3	0	0	.1
10	-5.6	-4.8	.1	0	0	0
11	-5.6	-4.8	-.1	0	0	0
12	-5.6	-5.1	-.3	0	0	0
13	-5.6	-5.6	-.5	-3.9	-.2	0
14	-5.6	-6.5	-.8	-32.3	-2.8	0
15	-5.6	-7.5	-1.3	-62	-7.1	0
16	-5.6	-8.6	-1.8	-60.1	-8.6	0
17	-5.6	-10.1	0	-33	0	0
18	-5.6	-11.6	0	-9.8	0	0
19	-5.6	-13.2	0	-6.5	0	0
20	-5.4	-13.9	0	-6.4	0	0



Centarch

()

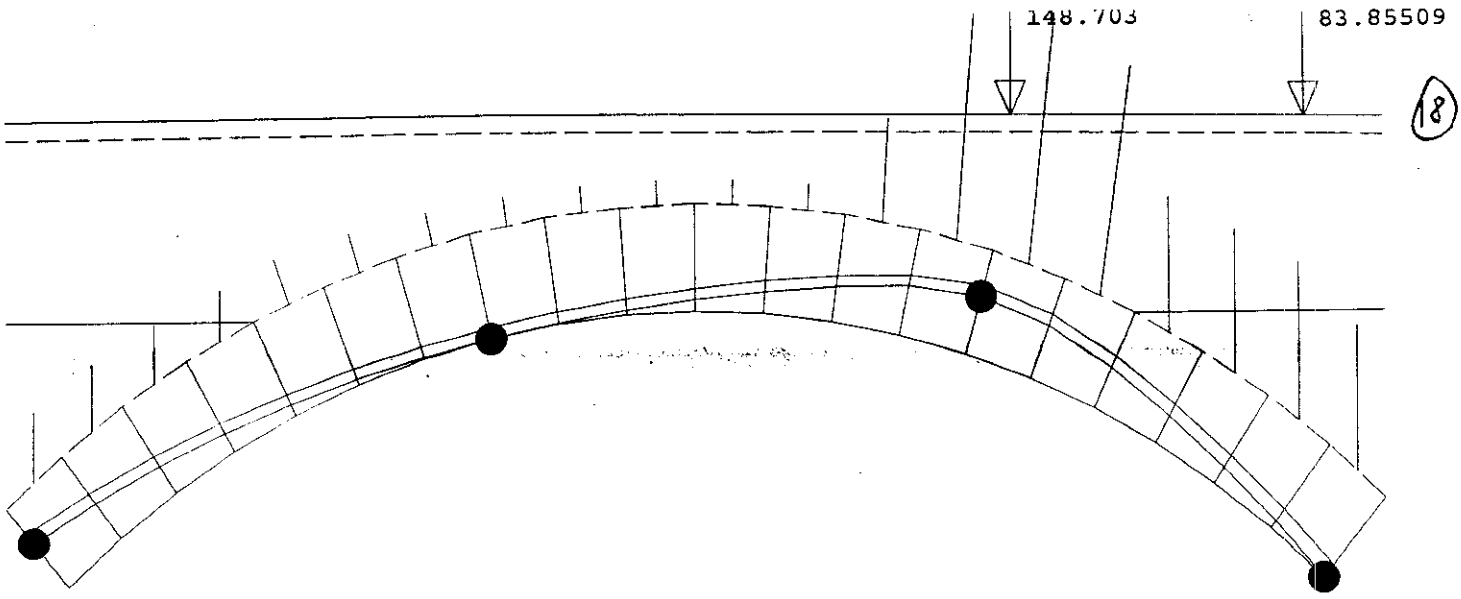
Span	7755 mm	Rise	1525 mm
Depth of fill	490 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Single Axle:11.5t at 10970		
Lane width	2236mm		
Required ring depth	412 mm	Geometric F.O.S	1.43
H Left	257 kN/m	H Right	274 kN/m
V Left	278 kN/m	V Right	173 kN/m
Comp. zone at hinge 2	65 mm	Factor on pass. press.	.1

Hinges

1 AT 1	2 AT 7	3 AT 14	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.8	0	0	0	0
2	-5.6	-13	0	0	0	0
3	-5.6	-11.5	0	0	0	0
4	-5.6	-10	0	-2.6	0	0
5	-5.6	-8.6	1.9	-27.2	4	0
6	-5.6	-7.4	1.3	-59.1	6.9	0
7	-5.6	-6.3	.9	-57.9	5.2	0
8	-5.6	-5.5	.5	-23.3	1.5	0
9	-5.6	-5	.3	-1	0	0
10	-5.6	-4.7	.1	0	0	0
11	-5.6	-4.6	-.1	0	0	0
12	-5.6	-4.9	-.3	0	0	0
13	-5.6	-5.4	-.5	0	0	0
14	-5.6	-6.2	-.8	0	0	0
15	-5.6	-7.1	-1.3	0	0	0
16	-5.6	-8.3	-1.8	0	0	0
17	-5.6	-9.6	0	0	0	0
18	-5.6	-11.2	0	0	0	0
19	-5.6	-12.7	0	0	0	0
20	-5.4	-13.4	0	0	0	0



Centarch

()

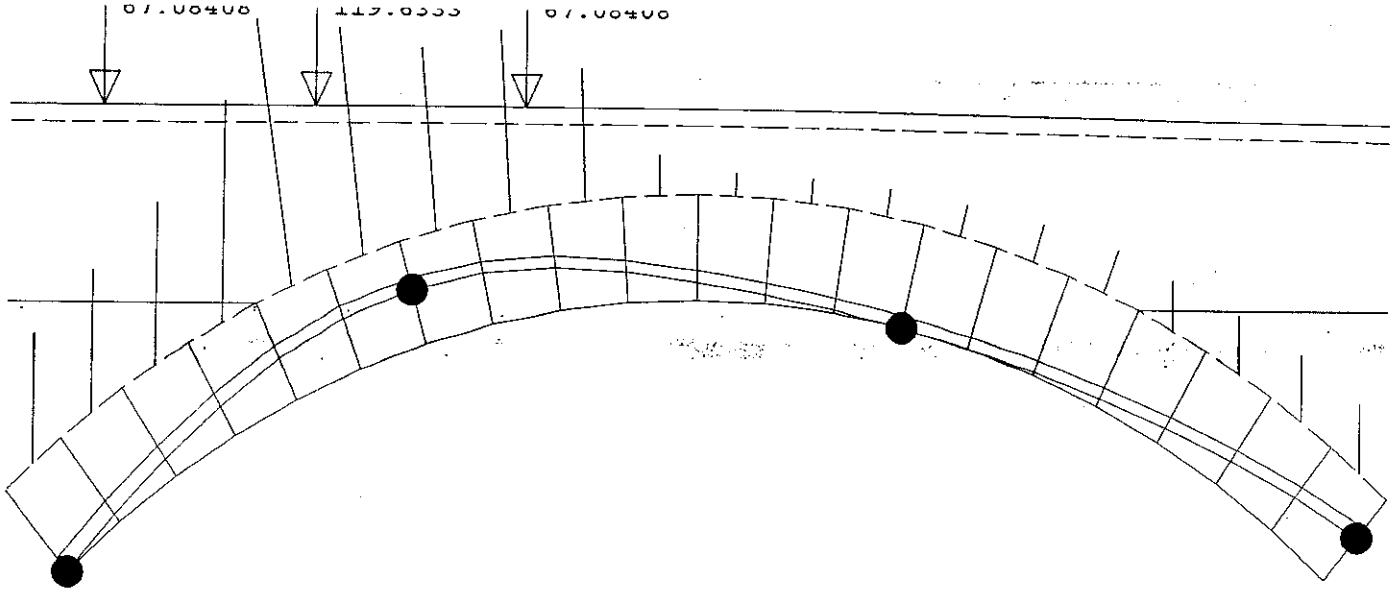
Span	7755 mm	Rise	1525 mm
Depth of fill	490 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20t:Left Heavy at 15470		
Lane width	2236mm		
Required ring depth	394 mm	Geometric F.O.S	1.5
H Left	261 kN/m	H Right	248 kN/m
V Left	170 kN/m	V Right	322 kN/m
Comp. zone at hinge 2	62 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 8	3 AT 15	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.8	0	0	0	0
2	-5.6	-13	0	0	0	0
3	-5.6	-11.5	0	0	0	0
4	-5.6	-10	0	0	0	0
5	-5.6	-8.6	1.9	0	0	1.4
6	-5.6	-7.4	1.3	0	0	1
7	-5.6	-6.3	.9	0	0	.7
8	-5.6	-5.5	.5	0	0	.3
9	-5.6	-5	.3	0	0	.1
10	-5.6	-4.7	.1	0	0	0
11	-5.6	-4.6	-.1	0	0	0
12	-5.6	-4.9	-.3	-.2	0	0
13	-5.6	-5.4	-.5	-14	-.9	0
14	-5.6	-6.2	-.8	-45.2	-4.1	0
15	-5.6	-7.1	-1.3	-54.3	-6.4	0
16	-5.6	-8.3	-1.8	-34.6	-5	0
17	-5.6	-9.6	0	-15.7	0	0
18	-5.6	-11.2	0	-16	0	0
19	-5.6	-12.7	0	-17.5	0	0
20	-5.4	-13.4	0	-14.6	0	0



Centarch

()

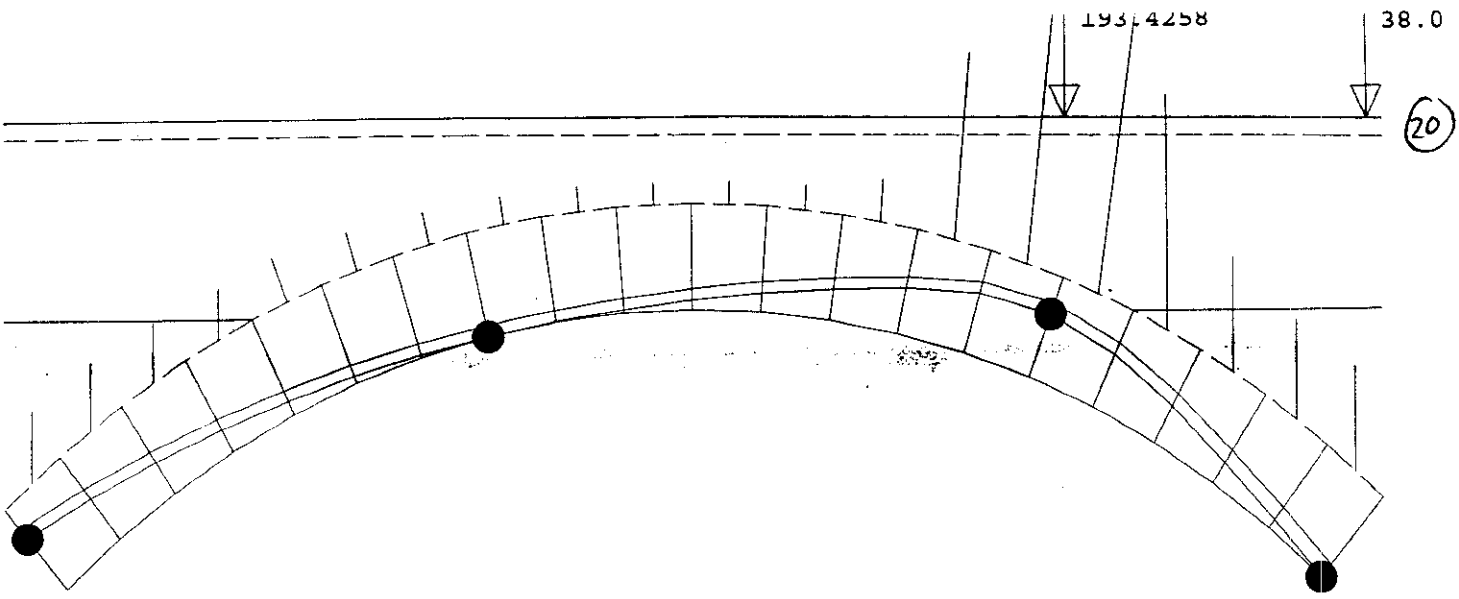
Span	7755 mm	Rise	1525 mm
Depth of fill	490 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Triple Axle:24t:No Lift-off at 10470		
Lane width	2236mm		
Required ring depth	377 mm	Geometric F.O.S	1.56
H Left	268 kN/m	H Right	280 kN/m
V Left	341 kN/m	V Right	179 kN/m
Comp. zone at hinge 2	67 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 7	3 AT 14	4 AT 21

Param(mm).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.8	0	-11.1	0	0
2	-5.6	-13	0	-14.1	0	0
3	-5.6	-11.5	0	-19.5	0	0
4	-5.6	-10	0	-32.9	0	0
5	-5.6	-8.6	1.9	-42.6	6.2	0
6	-5.6	-7.4	1.3	-36.6	4.3	0
7	-5.6	-6.3	.9	-29.3	2.6	0
8	-5.6	-5.5	.5	-29.8	1.9	0
9	-5.6	-5	.3	-21.1	.8	0
10	-5.6	-4.7	.1	-3.5	0	0
11	-5.6	-4.6	-.1	0	0	0
12	-5.6	-4.9	-.3	0	0	-.1
13	-5.6	-5.4	-.5	0	0	-.3
14	-5.6	-6.2	-.8	0	0	-.7
15	-5.6	-7.1	-1.3	0	0	-1
16	-5.6	-8.3	-1.8	0	0	-1.3
17	-5.6	-9.6	0	0	0	0
18	-5.6	-11.2	0	0	0	0
19	-5.6	-12.7	0	0	0	0
20	-5.4	-13.4	0	0	0	0



Centarch

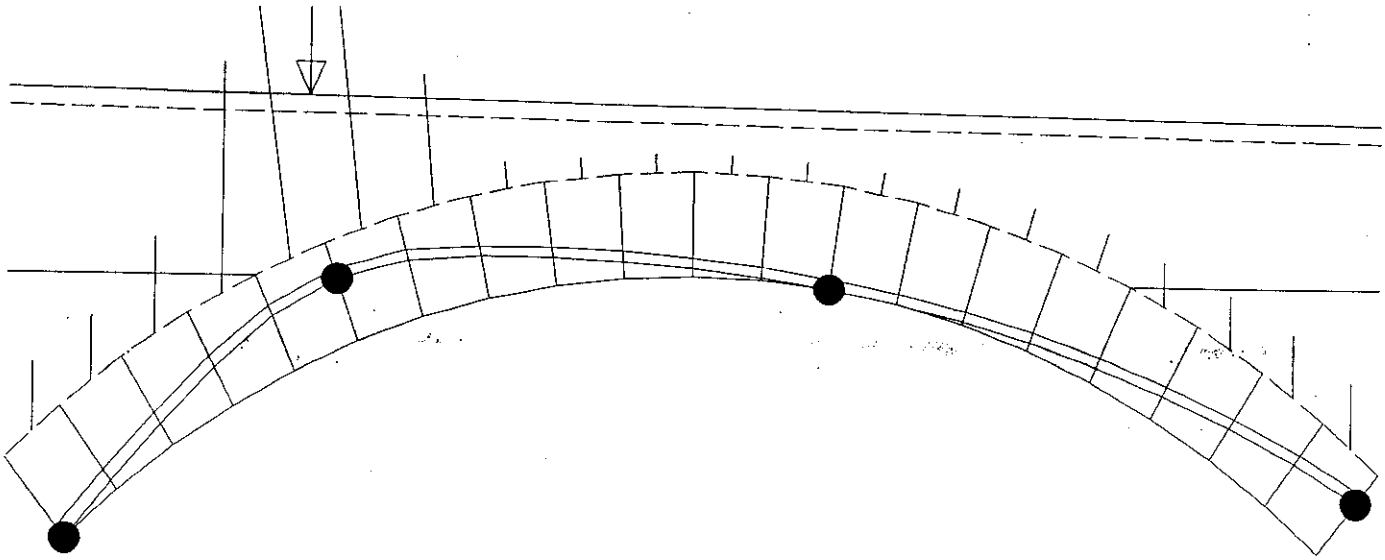
()			
Span	7755 mm	Rise	1525 mm
Depth of fill	490 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20.3t:Right Lift-off at		15470
Lane width	2236mm		
Required ring depth	439 mm	Geometric F.O.S	1.34
H Left	268 kN/m	H Right	253 kN/m
V Left	169 kN/m	V Right	326 kN/m
Comp. zone at hinge 2	66 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 8	3 AT 16	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.8	0	0	0	0
2	-5.6	-13	0	0	0	0
3	-5.6	-11.5	0	0	0	0
4	-5.6	-10	0	0	0	0
5	-5.6	-8.6	1.9	0	0	1.4
6	-5.6	-7.4	1.3	0	0	1
7	-5.6	-6.3	.9	0	0	.7
8	-5.6	-5.5	.5	0	0	.3
9	-5.6	-5	.3	0	0	.1
10	-5.6	-4.7	.1	0	0	0
11	-5.6	-4.6	-.1	0	0	0
12	-5.6	-4.9	-.3	0	0	0
13	-5.6	-5.4	-.5	-2.8	-.2	0
14	-5.6	-6.2	-.8	-29.6	-2.7	0
15	-5.6	-7.1	-1.3	-61.3	-7.2	0
16	-5.6	-8.3	-1.8	-62.1	-9	0
17	-5.6	-9.6	0	-35.2	0	0
18	-5.6	-11.2	0	-10.5	0	0
19	-5.6	-12.7	0	-6.3	0	0
20	-5.4	-13.4	0	-6.4	0	0



Soutarch

()

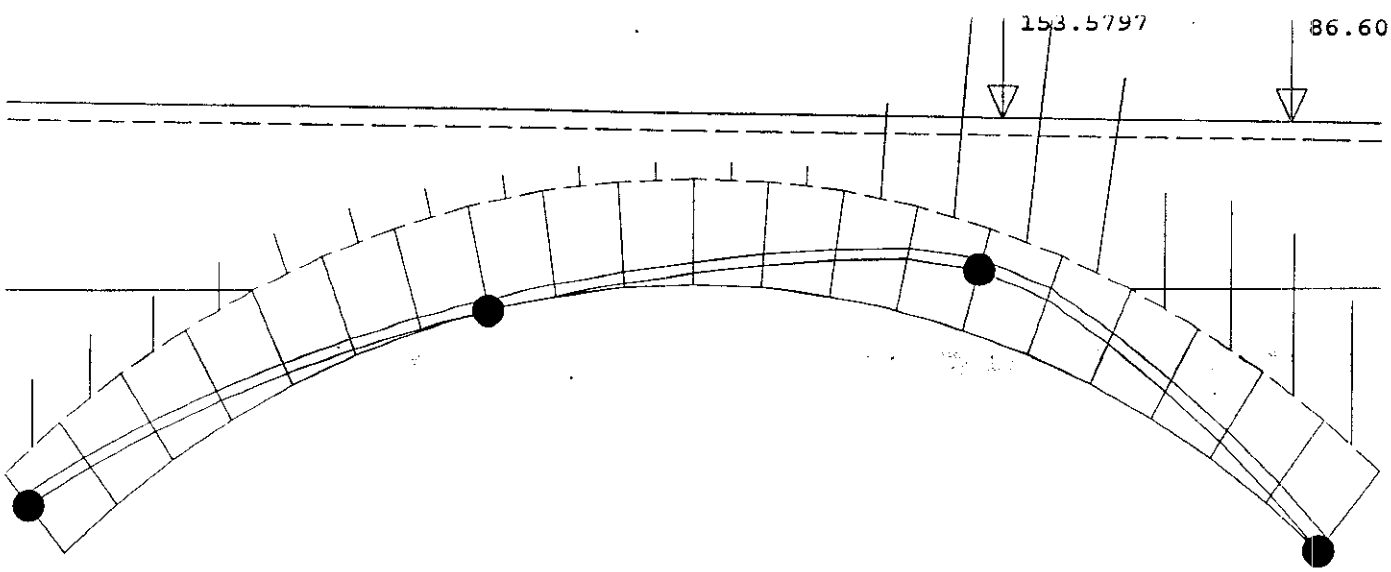
Span	7830 mm	Rise	1510 mm
Depth of fill	370 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Single Axle:11.5t at 19375		
Lane width	2165mm		
Required ring depth	435 mm	Geometric F.O.S	1.36
H Left	232 kN/m	H Right	246 kN/m
V Left	287 kN/m	V Right	153 kN/m
Comp. zone at hinge 2	60 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 6	3 AT 13	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.4	0	0	0	0
2	-5.6	-12.6	0	0	0	0
3	-5.6	-11	0	-8	0	0
4	-5.6	-9.3	0	-35.7	0	0
5	-5.6	-7.8	1.7	-59.6	8.5	0
6	-5.6	-6.6	1.1	-52.6	6.1	0
7	-5.6	-5.5	.7	-20	1.8	0
8	-5.6	-4.6	.4	-.8	.1	0
9	-5.6	-4	.2	0	0	0
10	-5.6	-3.6	.1	0	0	0
11	-5.6	-3.6	-.1	0	0	0
12	-5.6	-3.8	-.2	0	0	-.1
13	-5.6	-4.3	-.4	0	0	-.3
14	-5.6	-5.1	-.7	0	0	-.5
15	-5.6	-6.1	-1.1	0	0	-.8
16	-5.6	-7.2	-1.6	0	0	-1.1
17	-5.6	-8.7	0	0	0	0
18	-5.6	-10.3	0	0	0	0
19	-5.6	-11.8	0	0	0	0
20	-5.4	-12.7	0	0	0	0



Soutarch

()

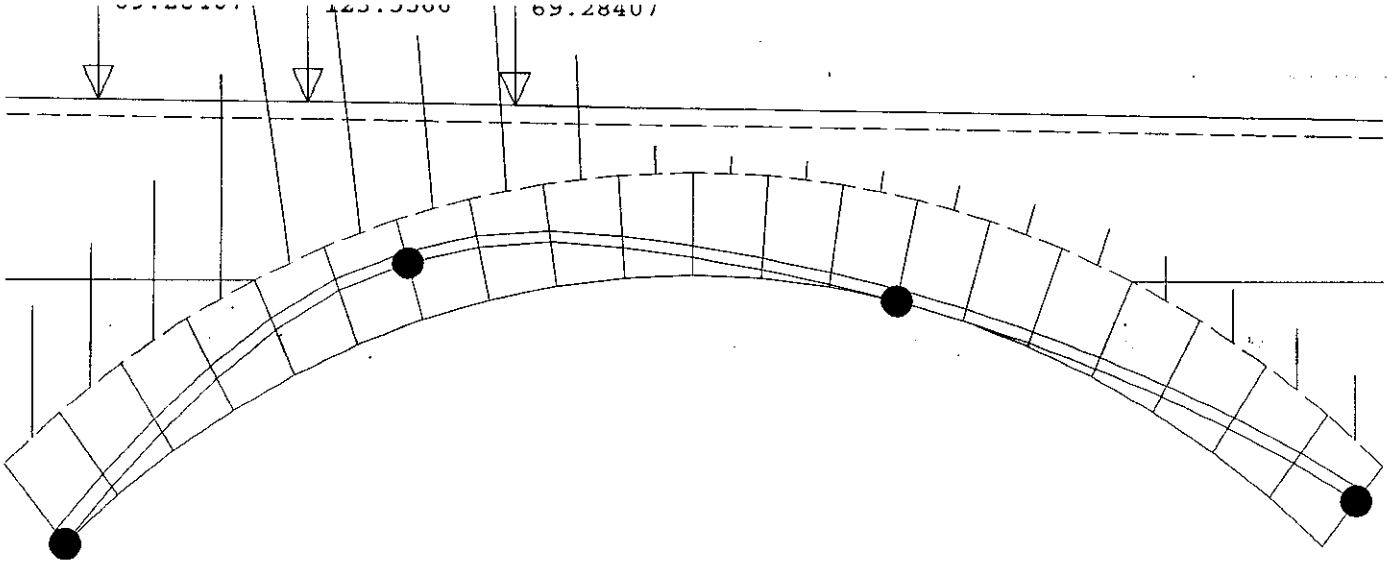
Span	7830 mm	Rise	1510 mm
Depth of fill	370 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20t:Left Heavy at 24375		
Lane width	2165mm		
Required ring depth	414 mm	Geometric F.O.S	1.42
H Left	264 kN/m	H Right	251 kN/m
V Left	165 kN/m	V Right	322 kN/m
Comp. zone at hinge 2	63 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 8	3 AT 15	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.4	0	0	0	0
2	-5.6	-12.6	0	0	0	0
3	-5.6	-11	0	0	0	0
4	-5.6	-9.3	0	0	0	0
5	-5.6	-7.8	1.7	0	0	1.2
6	-5.6	-6.6	1.1	0	0	.9
7	-5.6	-5.5	.7	0	0	.6
8	-5.6	-4.6	.4	0	0	.2
9	-5.6	-4	.2	0	0	.1
10	-5.6	-3.6	.1	0	0	0
11	-5.6	-3.6	-.1	0	0	0
12	-5.6	-3.8	-.2	0	0	0
13	-5.6	-4.3	-.4	-14.1	-.9	0
14	-5.6	-5.1	-.7	-52.2	-4.6	0
15	-5.6	-6.1	-1.1	-59.6	-6.9	0
16	-5.6	-7.2	-1.6	-30.4	-4.3	0
17	-5.6	-8.7	0	-13.6	0	0
18	-5.6	-10.3	0	-18.3	0	0
19	-5.6	-11.8	0	-19.6	0	0
20	-5.4	-12.7	0	-15.5	0	0



Soutarch

()

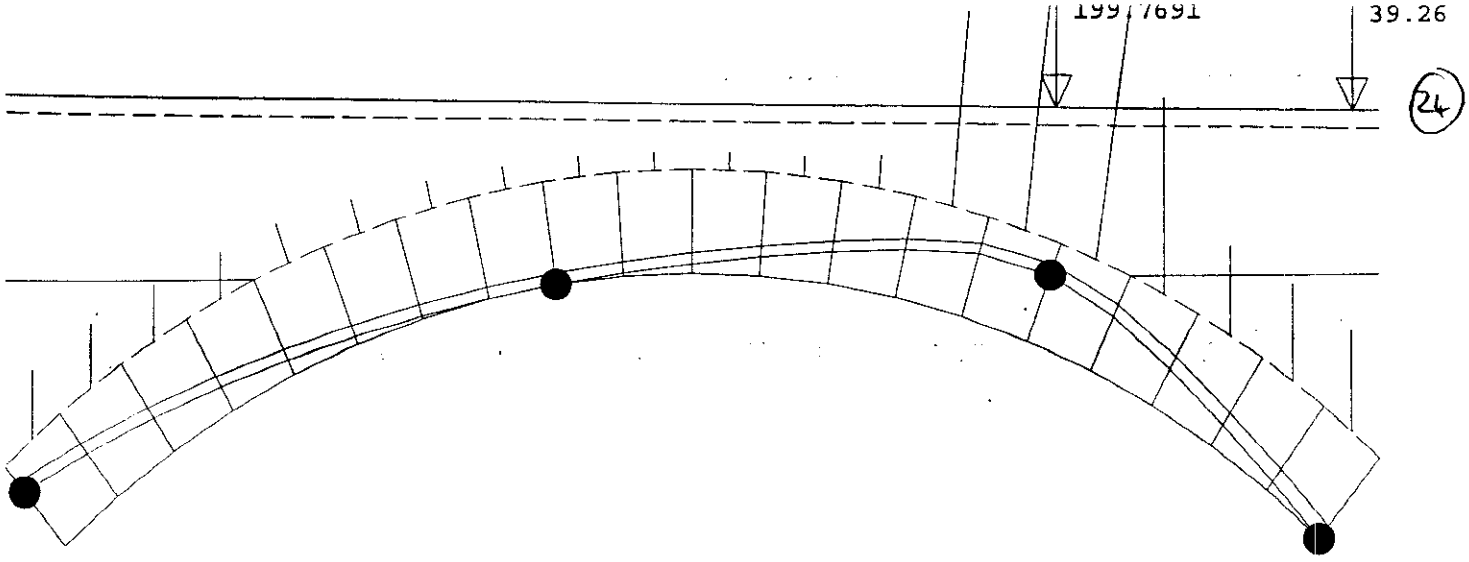
Span	7830 mm	Rise	1510 mm
Depth of fill	370 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Triple Axle:24t:No Lift-off at 19375		
Lane width	2165mm		
Required ring depth	398 mm	Geometric F.O.S	1.48
H Left	267 kN/m	H Right	280 kN/m
V Left	341 kN/m	V Right	171 kN/m
Comp. zone at hinge 2	66 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 7	3 AT 14	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.4	0	-11.9	0	0
2	-5.6	-12.6	0	-15.2	0	0
3	-5.6	-11	0	-20	0	0
4	-5.6	-9.3	0	-34.9	0	0
5	-5.6	-7.8	1.7	-45.7	6.5	0
6	-5.6	-6.6	1.1	-37.8	4.4	0
7	-5.6	-5.5	.7	-28.5	2.5	0
8	-5.6	-4.6	.4	-32.3	2	0
9	-5.6	-4	.2	-20.5	.7	0
10	-5.6	-3.6	.1	-1.9	0	0
11	-5.6	-3.6	-.1	0	0	0
12	-5.6	-3.8	-.2	0	0	-.1
13	-5.6	-4.3	-.4	0	0	-.2
14	-5.6	-5.1	-.7	0	0	-.5
15	-5.6	-6.1	-1.1	0	0	-.8
16	-5.6	-7.2	-1.6	0	0	-1.1
17	-5.6	-8.7	0	0	0	0
18	-5.6	-10.3	0	0	0	0
19	-5.6	-11.8	0	0	0	0
20	-5.4	-12.7	0	0	0	0



Soutarch

()

Span	7830 mm	Rise	1510 mm
Depth of fill	370 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20.3t:Right Lift-off at 24375		
Lane width	2165mm		
Required ring depth	464 mm	Geometric F.O.S	1.27
H Left	274 kN/m	H Right	257 kN/m
V Left	163 kN/m	V Right	323 kN/m
Comp. zone at hinge 2	67 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 9	3 AT 16	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.4	0	0	0	0
2	-5.6	-12.6	0	0	0	0
3	-5.6	-11	0	0	0	0
4	-5.6	-9.3	0	0	0	0
5	-5.6	-7.8	1.7	0	0	1.2
6	-5.6	-6.6	1.1	0	0	.9
7	-5.6	-5.5	.7	0	0	.6
8	-5.6	-4.6	.4	0	0	.3
9	-5.6	-4	.2	0	0	.1
10	-5.6	-3.6	.1	0	0	0
11	-5.6	-3.6	-.1	0	0	0
12	-5.6	-3.8	-.2	0	0	0
13	-5.6	-4.3	-.4	-2.1	-.1	0
14	-5.6	-5.1	-.7	-32.3	-2.8	0
15	-5.6	-6.1	-1.1	-70.7	-8.2	0
16	-5.6	-7.2	-1.6	-66.1	-9.5	0
17	-5.6	-8.7	0	-29.9	0	0
18	-5.6	-10.3	0	-7.3	0	0
19	-5.6	-11.8	0	-7.2	0	0
20	-5.4	-12.7	0	-7.2	0	0

WS/Atkins

Project	Job ref
ECC ASSESSMENT CONTRACT 3	A1 1877/72
Part of structure: STOW MARIES	Calc sheet no / rev: 1 25 /
Drawing ref	Calc by: JF; Date: 2/00
	Check by; Date

Ref	Calculations	Output

MULTI ANALYSIS

Refer to next few pages for MULTI input files and load files.

The load files were obtained from spreadsheet for No Axle Left Off and Axle Left Off Single Lane loading.

Pier Heights.

For a more realistic approach 0.5m has been added to the pier heights shown on the drawing to allow for buried section of pier.

∴ North pier height = 3.195 + 0.5 = 3.695m

South pier height = 2.985 + 0.5 = 3.485m

MULTI RESULTS

PIER CAPACITY = 40 TONNES

Refer to MULTI outputs for proof.

Nortarch.dat

```
Nortarch
 1500
 7810
 20
 590
 1
 4
 21
 19
 30
 1
 602
 4.4
 8000
 0
 0
 100
 23
0,0,2600
328,275,2600
675,524,2600
1040,748,2600
1420,944,2600
1813,1112,2600
2218,1251,2600
2632,1359,2600
3052,1437,2600
3478,1484,2600
3905,1500,2600
4332,1484,2600
4758,1437,2600
5178,1359,2600
5592,1251,2601
5997,1112,2601
6390,944,2601
6770,748,2601
7135,524,2602
7482,275,2602
7810,0,2602
centarch
 0
```

Centarch.dat

```
centarch
 1525
 7755
 20
 590
 1
 4
 21
 19
 30
 1
 599
 4.4
 8000
 8.97
 0
 100
 23
0,0,2603
323,279,2604
666,532,2606
1027,760,2607
1404,959,2609
1795,1130,2609
2197,1271,2610
2609,1382,2610
3028,1461,2609
3452,1509,2608
3878,1525,2605
4304,1509,2601
4728,1461,2597
5147,1382,2591
5559,1271,2585
5961,1130,2579
6352,959,2572
6729,760,2565
7090,532,2559
7433,279,2552
7756,0,2546
soutarch
-3.485
```

Soutarch.dat

```
soutarch
 1510
 7830
 20
 590
 1
 4
 21
 19
 30
 1
 603
 4.4
 8000
 17.875
 0
 100
 23
0,0,2529
328,276,2524
676,528,2519
1042,753,2513
1423,950,2508
1817,1119,2502
2223,1259,2495
2638,1368,2489
3060,1447,2483
3486,1494,2476
3915,1510,2470
4344,1494,2464
4770,1447,2457
5192,1368,2451
5607,1259,2445
6013,1119,2438
6407,950,2432
6788,753,2427
7154,528,2421
7502,276,2416
7830,0,2411
*
-3.695
```

Snow Hill ...
AW. Calcs

arch width	3.790 m	HB parameters	
Fill Depth	0.966 m		
width2 (2 lanes loaded)	0.000 m	0.000 m	
width1 (1 lane loaded)	3.790 m	3.790 m	
gfl1 (BD 21/97, cl 6.20)	3.400	2.000	
gfl2 (BD 21/97, cl 6.20)	1.900		
Fcm	0.900		
Fj	0.650		
g	9.810		

Lift-Off Factors (BD 21/97, Table 6.2)	
dlift1*	1.28
dlift2	0.50
tlifta1	1.50
tlifta2*	1.00
tlifta3	0.50
tliftb1*	1.28
tliftb2	1.00
tliftb3	0.50

HB units	Axle load (kN/m)	
	1 lane	2 lanes
10.00	90.21	0.00
15.00	135.31	0.00
20.00	180.41	0.00
25.00	225.51	0.00
30.00	270.62	0.00
35.00	315.72	0.00
40.00	360.82	0.00
45.00	405.93	0.00

AAL (t)		No-Lift Off		Lift-Off	
		Axle load (kN/m)		Axle load (kN/m)	
		1 lane	2 lanes	1 lane	2 lanes
11.50 SA		173.00	0.00	173.00	0.00
10.50 SA		157.96	0.00	157.96	0.00
9.00 SA		135.39	0.00	135.39	0.00
7.00 SA		105.31	0.00	105.31	0.00
5.50 SA		82.74	0.00	82.74	0.00
2.00 SA		30.09	0.00	30.09	0.00
10.00 DA	Heavy Axle*	150.44	0.00	192.56	0.00
	Light Axle	84.07	0.00	42.03	0.00
9.50 DA	Heavy Axle*	142.91	0.00	182.93	0.00
	Light Axle	79.86	0.00	39.93	0.00
9.00 DA	Heavy Axle*	135.39	0.00	173.30	0.00
	Light Axle	75.66	0.00	37.83	0.00
	Out Axle 1	67.25	0.00		
8.00 TA (a)	Mid Axle 2*	120.35	0.00		
1300	Out Axle 3	67.25	0.00		
	Out Axle 1	63.05	0.00	94.58	0.00
7.50 TA (a)	Mid Axle 2*	112.83	0.00	112.83	0.00
1350	Out Axle 3	63.05	0.00	31.53	0.00
	Out Axle 1	50.44	0.00	75.66	0.00
6.00 TA (a)	Mid Axle 2*	90.26	0.00	90.26	0.00
700	Out Axle 3	50.44	0.00	25.22	0.00
	Out Axle 1*	120.35	0.00		
8.00 TA (b)	Mid Axle 2	67.25	0.00		
1300	Out Axle 3	67.25	0.00		
	Out Axle 1*	112.83	0.00	144.42	0.00
7.50 TA (b)	Mid Axle 2	63.05	0.00	63.05	0.00
1350	Out Axle 3	63.05	0.00	31.53	0.00
	Out Axle 1*	90.26	0.00	115.54	0.00
6.00 TA (b)	Mid Axle 2	50.44	0.00	50.44	0.00
700	Out Axle 3	50.44	0.00	25.22	0.00

```
No-Lift Off 1 lane
0
*
SA:11.5t (40/44t)
173.00
*
DA 20t (38-40/44t)
150.44
1000
84.07
*
DA 20t (38-40/44t)
150.44
1300
84.07
*
DA 20t (38-40/44t)
150.44
1800
84.07
*
TA (a) 24t (38-40/44t)
67.25
1300
120.35
1300
67.25
*
TA (a) 22.5t (38-40/44t)
63.05
1350
112.83
1350
63.05
*
TA (a) 18t (38-40/44t)
50.44
700
90.26
700
50.44
*
TA (b) 24t (38-40/44t)
120.35
1300
67.25
1300
67.25
*
TA (b) 22.5t (38-40/44t)
112.83
1350
63.05
1350
63.05
*
TA (b) 18t (38-40/44t)
90.26
700
50.44
700
```

50.44
*
DA 19t (33t restrict)
142.91
1000
79.86
*
DA 19t (33t restrict)
142.91
1300
79.86
*
DA 19t (33t restrict)
142.91
1800
79.86
*
DA 18t (25t restrict)
135.39
1000
75.66
*
DA 18t (25t restrict)
135.39
1300
75.66
*
DA 18t (25t restrict)
135.39
1800
75.66
*
SA:10.5t (17t-33t restrict)
157.96
*
SA:9t (13t restrict)
135.39
*
SA:7t (10t restrict)
105.31
*
SA:5.5t (7.5t restrict)
82.74
*
SA:2t (3t restrict)
30.09
*
HB 15 Units
102.77
1800
102.77
*
HB 20 Units
137.03
1800
137.03
*
HB 25 Units
171.28
1800
171.28

```
*
HB 30 Units
205.54
1800
205.54
*
HB 35 Units
239.80
1800
239.80
*
HB 40 Units
274.05
1800
274.05
*
HB 45 Units
308.31
1800
308.31
*
```

```
Lift-Off 1 lane
0
*
SA:11.5t (40/44t)
173.00
*
DA 20t (38-40/44t)
192.56
1000
42.03
*
DA 20t (38-40/44t)
192.56
1300
42.03
*
DA 20t (38-40/44t)
192.56
1800
42.03
*
TA (a) 24t (38-40/44t)
0.00
1300
0.00
1300
0.00
*
TA (a) 22.5t (38-40/44t)
94.58
1350
112.83
1350
31.53
*
TA (a) 18t (38-40/44t)
75.66
700
90.26
700
25.22
*
TA (b) 24t (38-40/44t)
0.00
1300
0.00
1300
0.00
*
TA (b) 22.5t (38-40/44t)
144.42
1350
63.05
1350
31.53
*
TA (b) 18t (38-40/44t)
115.54
700
50.44
700
```

25.22
*
DA 19t (33t restrict)
182.93
1000
39.93
*
DA 19t (33t restrict)
182.93
1300
39.93
*
DA 19t (33t restrict)
182.93
1800
39.93
*
DA 18t (25t restrict)
173.30
1000
37.83
*
DA 18t (25t restrict)
173.30
1300
37.83
*
DA 18t (25t restrict)
173.30
1800
37.83
*
SA:10.5t (17t-33t restrict)
157.96
*
SA:9t (13t restrict)
135.39
*
SA:7t (10t restrict)
105.31
*
SA:5.5t (7.5t restrict)
82.74
*
SA:2t (3t restrict)
30.09
*□

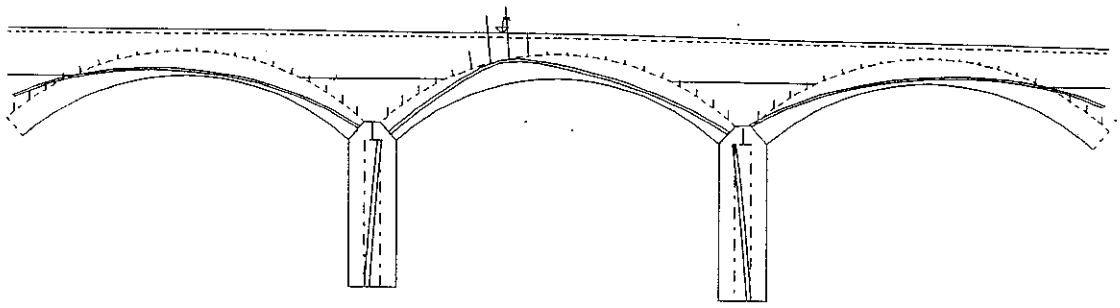
STOW MARIES – MULTI RESULTS – NO AXLE LIFT OFF

No Axle Lift Off – Worst Case Loading Positions

Worst case load positions for all load cases

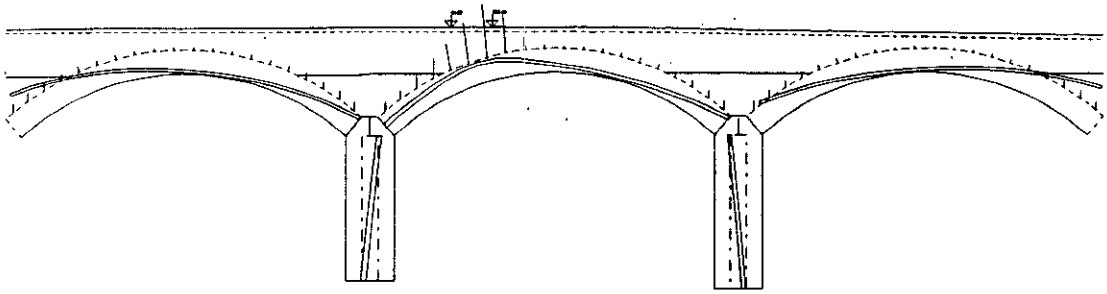
SA:11.5t (10/44t) @ 11500	DA 20t (38-40/44t) @ 11000
DA 20t (38-40/44t) @ 11000	DA 20t (38-40/44t) @ 11500
TA (a) 24t (38-40/44t) @ 12000	TA (a) 22.5t (38-40/44t) @ 12000
TA (a) 18t (38-40/44t) @ 11500	TA (b) 24t (38-40/44t) @ 11000
TA (b) 22.5t (38-40/44t) @ 11000	TA (b) 18t (38-40/44t) @ 11500
DA 19t (33t restrict) @ 11000	DA 19t (33t restrict) @ 11000
DA 19t (33t restrict) @ 11500	DA 18t (25t restrict) @ 11000
DA 18t (25t restrict) @ 11000	DA 18t (25t restrict) @ 11500
SA:10.5t (17t-33t restrict) @ 11000	SA:9t (13t restrict) @ 12000
SA:7t (10t restrict) @ 12000	SA:5.5t (7.5t restrict) @ 12000
SA:2t (3t restrict) @ 13000	HB 15 Units @ 11500
HB 20 Units @ 11500	HB 25 Units @ 11500
HB 30 Units @ 23500	HB 35 Units @ 23500
HB 40 Units @ 23500	HB 45 Units @ 23500

11.5t Single Axle – PASSES



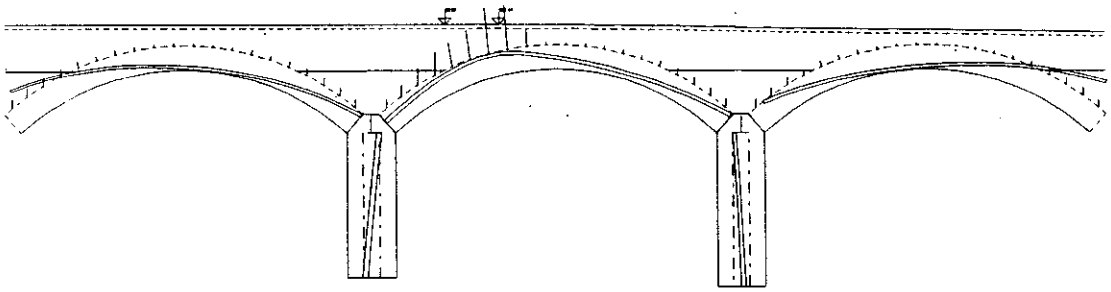
Left H kN	span V kN	Nr	Pier Force	Right H kN	span V kN	Offset from L	Load kN	σL kN/m^2	σR kN/m^2
239	160	1	0	280	258	461	528	736	174
293	195	2	0	253	148	738	455	58	735

20t Double – 1.0m Axle Spacing - PASSES



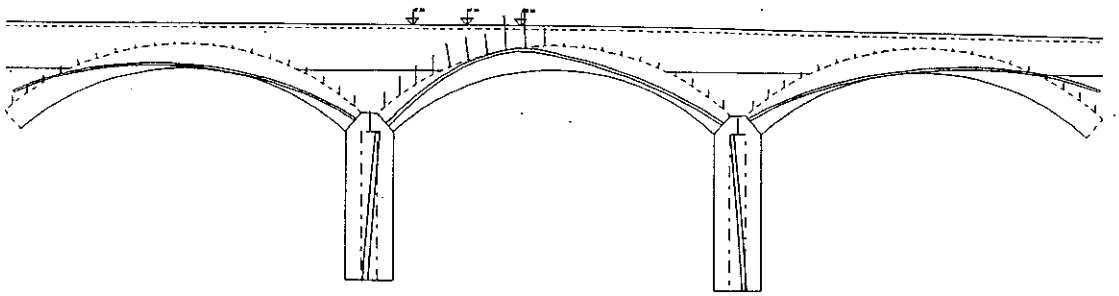
Left span		Pier		Right span		Offset	Load	σL	σR
H kN	V kN	Nr	Force	H kN	V kN	from L	kN	kN/m^2	kN/m^2
286	160	1	0	339	316	430	586	896	114
356	198	2	0	336	158	622	469	307	510

20t Double – 1.3m Axle Spacing – PASSES



Left span		Pier		Right span		Offset	Load	σL	σR
H kN	V kN	Nr	Force	H kN	V kN	from L	kN	kN/m^2	kN/m^2
307	165	1	0	351	299	438	574	859	131
364	215	2	0	336	158	669	486	214	631

24t Triple Axle – PASSES



Left H kN	span V kN	Nr	Pier Force	Right H kN	span V kN	Offset from L	Load kN	σL kN/m^2	σR kN/m^2
235	163	1	0	284	323	466	600	822	212
298	206	2	0	264	157	716	476	109	719

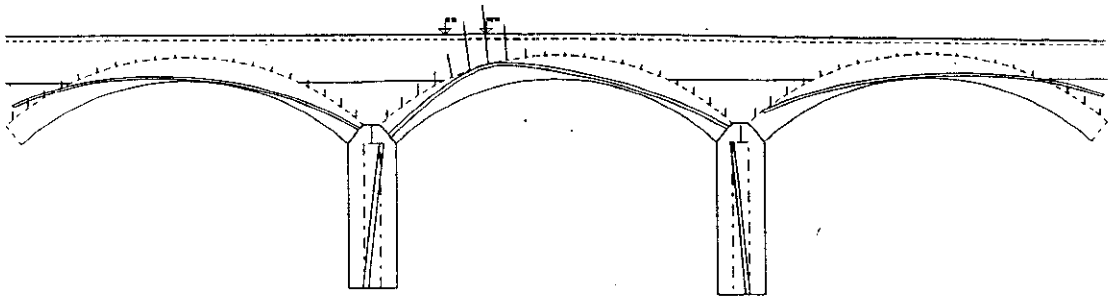
STOW MARIES – MULTI RESULTS – AXLE LIFT OFF

Axle Lift Off – Worst Case Loading Positions

Worst case load positions for all load cases

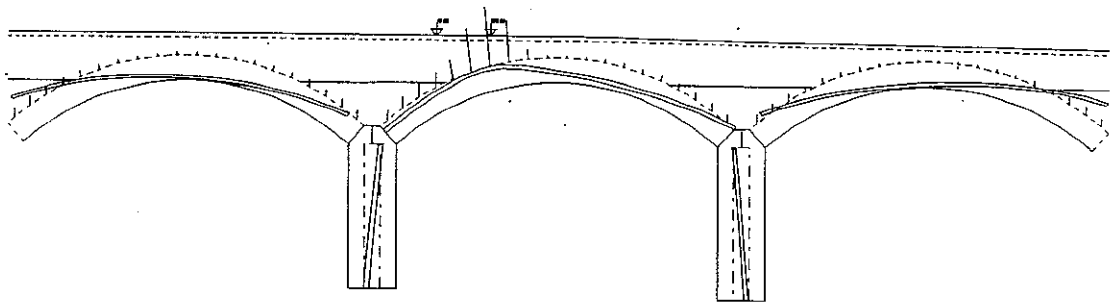
SA:11.5t (40/44t) @ 11500	DA 20t (38-40/44t) @ 11000
DA 20t (38-40/44t) @ 11000	DA 20t (38-40/44t) @ 11000
TA (a) 24t (38-40/44t) @ 13000	TA (a) 22.5t (38-40/44t) @ 11500
TA (a) 18t (38-40/44t) @ 11500	TA (b) 24t (38-40/44t) @ 12000
TA (b) 22.5t (38-40/44t) @ 11500	TA (b) 18t (38-40/44t) @ 11000
DA 19t (33t restrict) @ 11000	DA 19t (33t restrict) @ 11000
DA 19t (33t restrict) @ 11000	DA 18t (25t restrict) @ 11000
DA 18t (25t restrict) @ 11000	DA 18t (25t restrict) @ 11000
SA:10.5t (17t-33t restrict) @ 11000	SA:9t (13t restrict) @ 12000
SA:7t (10t restrict) @ 12000	SA:5.5t (7.5t restrict) @ 12000
SA:2t (3t restrict) @ 13000	

20t Double Axle - 1.0m Axle Spacing – PASSES



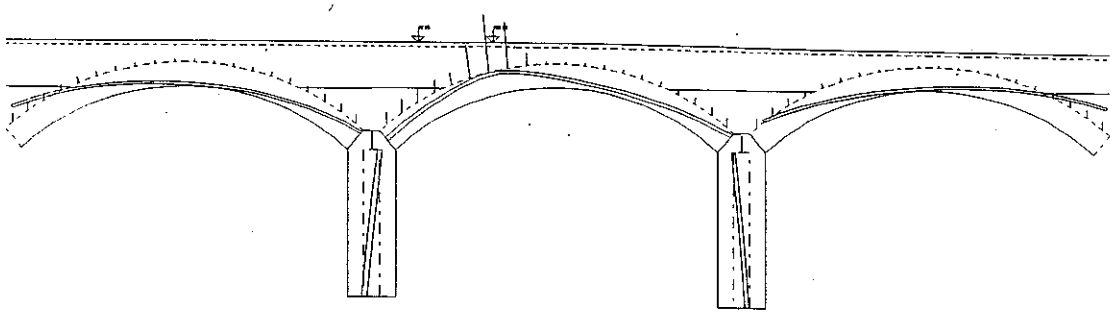
Left H kN	span V kN	Pier Nr	Force	Right H kN	span V kN	Offset from L	Load kN	σL kN/m^2	σR kN/m^2
254	159	1	0	315	318	426	586	909	102
336	197	2	0	297	150	722	460	91	709

20t Double Axle – 1.3m Axle Spacing – PASSES



Left H kN	span V kN	Nr	Pier Force	Right H kN	span V kN	Offset from L	Load kN	σL kN/m^2	σR kN/m^2
268	159	1	0	327	317	428	586	901	109
346	197	2	0	309	150	718	460	100	701

20t Double Axle – 1.8m Axle Spacing – PASSES



Left H kN	span V kN	Nr	Pier Force	Right H kN	span V kN	Offset from L	Load kN	σL kN/m^2	σR kN/m^2
276	161	1	0	334	314	415	587	936	75
351	198	2	0	316	150	708	461	122	680

WS/Atkins

CALCULATION INDEX

C = Calculation
S = Sketch
D = Data

PROJECT: GCC ASSESSMENT CONTRACT 3

FILE NAME: STOW MARIES HALT BRIDGE CHECK CALCS

Page:

FILE NO: A118772-72

INDEX NO.	CALCULATION/SKETCH/DATA	ORIGINATOR	DATE
1-3	ARCH ANALYSIS DATA	DL	2/00
4	NORTH ARCH MEXE	DL	2/00
5	CENTRAL ARCH MEXE	DL	2/00
6	SOUTH ARCH MEXE	DL	2/00
7	NORTH ARCH ARCHIE	DL	2/00
8	CENTRAL ARCH ARCHIE	DL	2/00
9	SOUTH ARCH ARCHIE	DL	2/00
10-16	MULTI ANALYSIS		

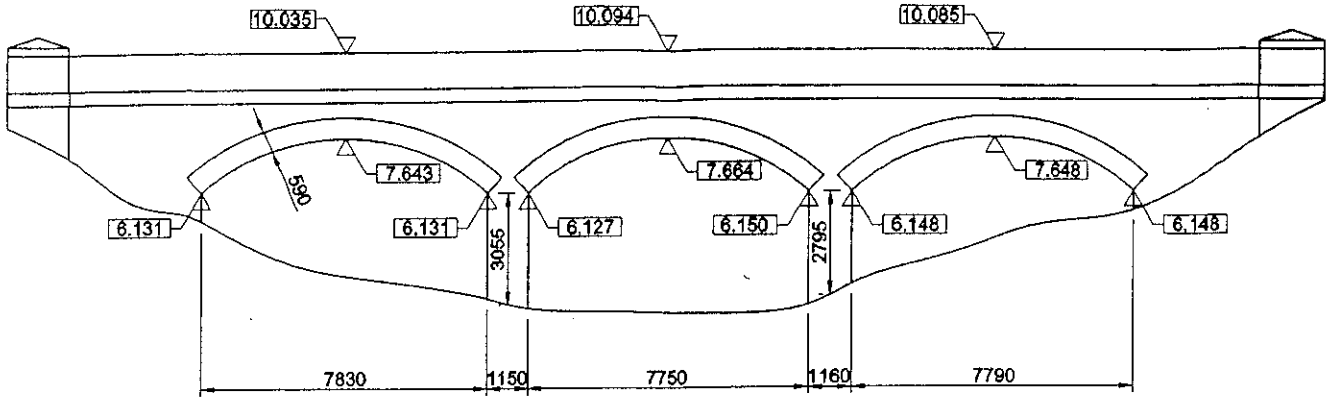
Continued on Sheet

DO NOT SCALE

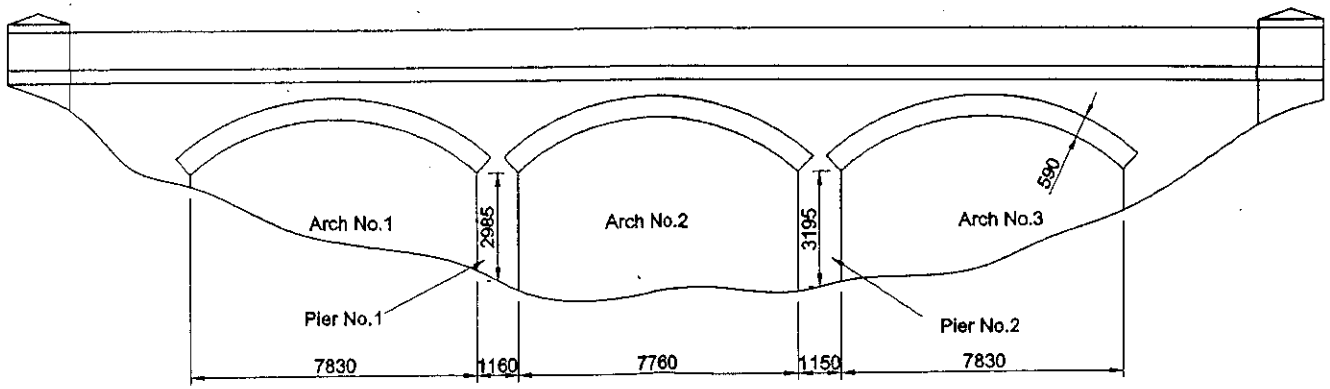
ECC Bridge No. 1658
Rail Property Board No. WFM/836

Notes:

All Dimensions in mm
All levels in metres
above local datum



EAST ELEVATION



WEST ELEVATION

Note: West elevation arch levels not taken due to tree growth - poor visibility. Arches appear sound in construction (no deformation) therefore the levels are assumed to be as east elevation

ECC ASSESSMENT CONTRACT NO 3
STOW MARIES : CHECK BY
D.H. LAWMAN
AI 1877/72
29/2/00
page 1

	SURVEYED	LEVELLED	DESIGNED	DRAWN/TRACED	CHECKED	AUTHORISED
INITIALS	DW	DW		MAD		
DATE	12/99	12/99		01/00		

SCALES: NTS
REVISION NOTES
REVISION CHECKED
DESCRIPTION OF DRAWING: STOW MARIES HALT, STOW MARIES ELEVATIONS
Sheet 1 of 1
SCHEME TITLE: ECC ASSESSMENT CONTRACT 3 RAIL PROPERTY LTD BRIDGES
DRAWING 377/D 38/fig1

WS Atkins

Operational Services

STOW MARIES & CHECK Check by DAL 29/2/00 Page 2

FORM 'AA' (BRIDGES)

GC/TP0356
Appendix: 4
Issue: 1
Revision: A
Date: Feb 93

APPROVAL IN PRINCIPLE FOR ASSESSMENT

STRUCTURE / LINE NAME STOW MARIES HALT BRIDGE

ELR / STRUCTURE NO. WFM/836

BRIEF DESCRIPTION OF EXISTING BRIDGE:

(a) Span Arrangement

The bridge has 3 no. clear square spans of 7.81m, 7.76m and 7.83m. There is no angle of skew.

(b) Superstructure Type

Three span brick arch.

(c) Substructure Type

Brick abutments and piers.

(d) Details of any Special Features

None.

ASSESSMENT CRITERIA

(a) Loadings and Speed

Loadings to be in accordance with BD 21/97. The current permitted traffic speed across the structure is 40mph.

(b) Codes to be used

See attached TAS schedule and March 1999 addendum.

(c) Proposed Method of Structural Analysis

The structure will be analysed as a multi span arch using the MULTI mechanism method computer program. The individual arches will be analysed using the modified MEXE method, detailed in BD 21/97 and BA 16/97, and the ARCHIE computer program. As the fill depth over the arch is less than the arch barrel thickness for all 3 no. spans, the higher capacity of the ARCHIE and MEXE results will be adopted for the individual arches. For the overall capacity of the bridge the results of the MULTI mechanism will be used. For the analysis the following parameters will be adopted:

STOW MARIES: CHECK

RL 181 / 172
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page 3

ARCHIE/MULTI

Backing level (determined from record drawings)	1.5m above springing level
Masonry self weight	21kN/m^3
Fill self weight	19kN/m^3
Surfacing self weight	23kN/m^3
ϕ' for fill	30°
ARCHIE passive pressure coefficient	0.3
Masonry strength	4.4 N/mm^2

Passive pressures generated behind the arch will be limited to 30% of the full passive pressures.

MEXE:

		North Arch	Centre Arch	South Arch
Condition Factor	F_{cM}	0.9	0.9	0.9
Barrel Factor	F_b	1.0	1.0	1.0
Fill Factor	F_f	0.7	0.7	0.7
Width Factor	F_w	0.9	0.9	0.9
Mortar Factor	F_{mo}	0.9	0.9	0.9
Depth Factor	F_d	0.8	0.8	0.8

Axle lift-off will be considered.

Section sizes and dimensions will be based on drawings AI1658/1/FIG 01, 02, 03, 07, 08 and 09.

(d) Details of any Special Requirements

None

STRUCTURAL ASSESSMENT ENGINEER'S COMMENTS

	(N) Arch 1	(C) Arch 2	(S) Arch 3
Square Span	7.81	7.755	7.83
Skew angle	0	0	0
F_c	1.5	1.525	1.51
F_q	1.21	1.23	1.22

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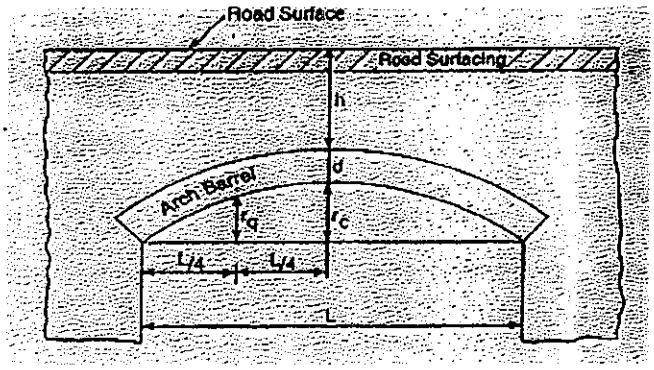
ECC ASSESSMENT CONTRACT NO 3
STOW MARIES : CHECK
AI 1877/72

ARCH ASSESSMENT TO MODIFIED MEXE (BA 16/97)

page 4

Structure Name: STOW MARIES HALT NORTH ARCH

1. DIMENSIONS



L = 7.81
rc = 1.5
rq = 1.21
d = 0.59
h = 0.51
h + d = 1.10

2. PROVISIONAL ASSESSMENT LOADING (Fig. 3/1)

PAL = 61.9 Tonne

3. SPAN / RISE FACTOR

$\frac{L}{rc} = \frac{7.81}{1.5} = 5.21$ (Fig. 3/3) Fsr = 0.83

4. PROFILE FACTOR

$\frac{rq}{rc} = \frac{1.21}{1.5} = 0.81$ (Fig. 3/4) Fp = 0.86

5. MATERIAL FACTOR

(Tables 3/1 & 3/2)

$Fm = \frac{(Fb.d) + Ff.h)}{d + h} = \frac{1.0 \times .59 + 0.7 \times .51}{.59 + .51}$ Fm = 0.86

6. JOINT FACTOR

(Tables 3/3, 3/4 & 3/5)

Fj = Fw.Fd.Fmo = 0.9 x 0.8 x 0.9 Fj = 0.648

7. CONDITION FACTOR

(Para. 3.17 to 3.23) Fc = 0.9

8. MODIFIED AXLE LOAD

MAL = PAL x Fsr x Fp x Fm x Fj x Fc

MAL = 22.2 Tonne

9. AXLE LIFT-OFF FACTOR

(Fig. 3/5) NO LIFT OFF

If Lift Off

Af = 0.72

10. WEIGHT LIMIT ON ARCH (MAX GROSS VEHICLE WEIGHT)

(Table 3/6) 40 Tonne

11. CONCLUSIONS:

Check ~~Assessed~~ By: [redacted] Date: 29/2/00

Signed: [redacted]

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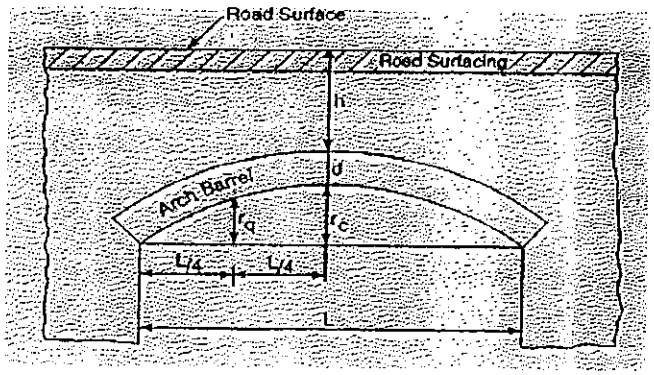
ECC ASSESMENT CONTRACT NO 3
STOW MARIES 1 CHECK
AI 1877/72

ARCH ASSESSMENT TO MODIFIED MEXE (BA 16/97)

page 5

Structure Name: STOW MARIES HALT CENTRAL ARCH

1. DIMENSIONS



L = 7.755
rc = 1.525
rq = 1.23
d = 0.59
h = 0.49
h + d = 1.08

2. PROVISIONAL ASSESSMENT LOADING (Fig. 3/1)

PAL = 60.2 Tonne

3. SPAN / RISE FACTOR

$\frac{L}{rc} = \frac{7.755}{1.525} = 5.09$ (Fig. 3/3) Fsr = 0.845

4. PROFILE FACTOR

$\frac{rq}{rc} = \frac{1.23}{1.525} = 0.81$ (Fig. 3/4) Fp = 0.87

5. MATERIAL FACTOR

(Tables 3/1 & 3/2)

$Fm = \frac{(Fb.d) + Ff.h)}{d + h} = \frac{1.0 \times .59 + .7 \times .49}{.59 + .49}$ Fm = 0.86

6. JOINT FACTOR

(Tables 3/3, 3/4 & 3/5)

Fj = Fw.Fd.Fmo = .9 x .8 x .9 Fj = 0.648

7. CONDITION FACTOR

(Para. 3.17 to 3.23)

Fc = 0.9

8. MODIFIED AXLE LOAD

MAL = PAL x Fsr x Fp x Fm x Fj x Fc

MAL = 22.2 Tonne

9. AXLE LIFT-OFF FACTOR

(Fig. 3/5)

NO LIFT OFF

If Lift Off
Af = 0.72

10. WEIGHT LIMIT ON ARCH (MAX GROSS VEHICLE WEIGHT)

(Table 3/6)

40 Tonne

11. CONCLUSIONS:

Checked ~~Accessed~~ By: [redacted] Date: 29/2/00

Signed:

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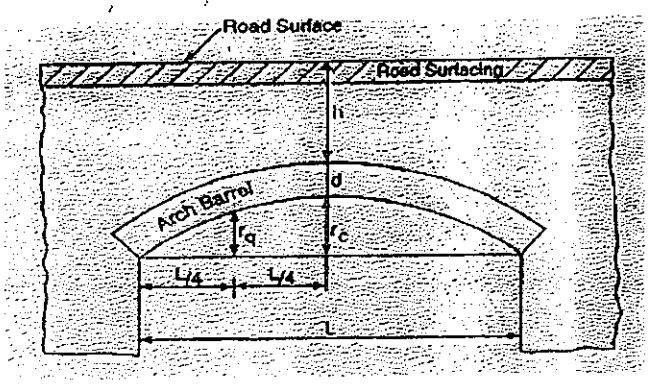
ECC ASSESSMENT CONTRACT NO3
STOW MARIES : CHECK AI:877/72

ARCH ASSESSMENT TO MODIFIED MEXE (BA 16/97)

Structure Name: STOW MARIE MALT SOUTH. Page 6

1. DIMENSIONS



L = 7.83
rc = 1.51
rq = 1.22
d = 0.59
h = 0.37
h + d = 0.96

2. PROVISIONAL ASSESSMENT LOADING (Fig. 3/1)

PAL = 470 Tonne

3. SPAN / RISE FACTOR

$\frac{L}{rc} = \frac{7.83}{1.51} = 5.2$ (Fig. 3/3) Fsr = 0.84

4. PROFILE FACTOR

$\frac{rq}{rc} = \frac{1.22}{1.51} = 0.81$ (Fig. 3/4) Fp = 0.86

5. MATERIAL FACTOR

(Tables 3/1 & 3/2)

$Fm = \frac{(Fb.d) + Ff.h)}{d + h} = \frac{1 \times .59 + .7 \times .37}{.59 + .37}$ Fm = 0.88

6. JOINT FACTOR

(Tables 3/3, 3/4 & 3/5)

Fj = Fw.Fd.Fmo = .9 x .8 x .9 Fj = .648

7. CONDITION FACTOR

(Para. 3.17 to 3.23) Fc = .9

8. MODIFIED AXLE LOAD

MAL = PAL x Fsr x Fp x Fm x Fj x Fc

MAL = 17.42 Tonne

9. AXLE LIFT-OFF FACTOR

(Fig. 3/5) NO LIFT OFF If Lift 5ft Af = .72

10. WEIGHT LIMIT ON ARCH (MAX GROSS VEHICLE WEIGHT)

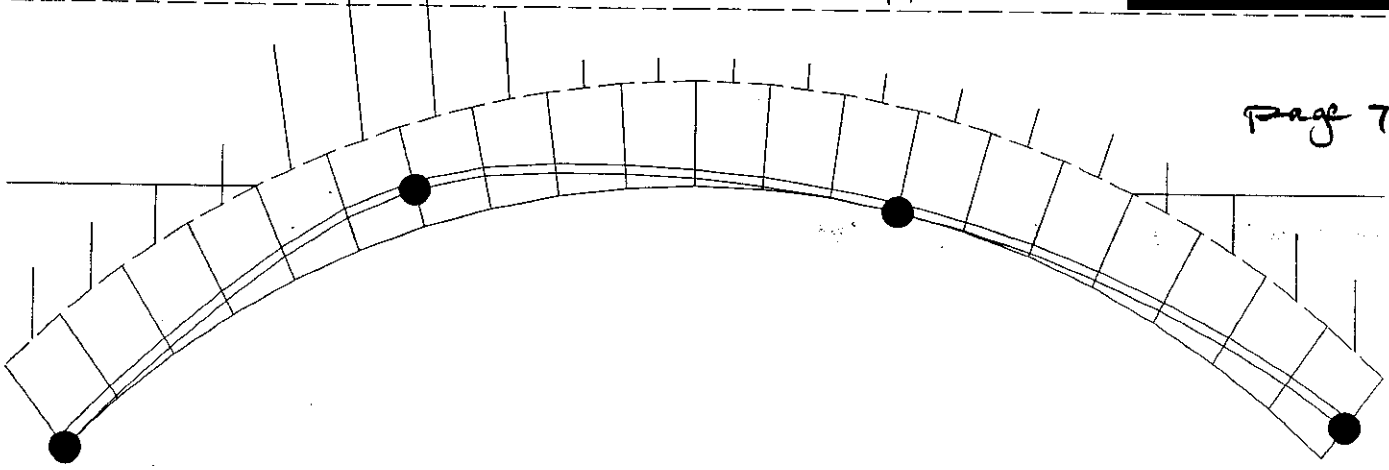
(Table 3/6) 40 Tonne

11. CONCLUSIONS:

Checked ~~Assessed~~ By: [redacted] Date: 29/2/00

Signed: [redacted]

KCC ASSESSMENT CONTRACT
STOW MARIES : CHECK
AI 1877/72



Page 7

()

Span	7810 mm	Rise	1500 mm
Depth of fill	510 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Single Axle:11.5t at 2000		
Lane width	4237mm		
Required ring depth	273 mm	Geometric F.O.S	2.16
H Left	208 kN/m	H Right	213 kN/m
V Left	216 kN/m	V Right	159 kN/m
Comp. zone at hinge 2	52 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 7	3 AT 14	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.9	0	0	0	0
2	-5.6	-13.1	0	0	0	0
3	-5.6	-11.6	0	0	0	0
4	-5.6	-10.1	0	-1.8	0	0
5	-5.6	-8.6	1.8	-15.4	2.2	0
6	-5.6	-7.5	1.3	-31.6	3.6	0
7	-5.6	-6.5	.8	-29.7	2.6	0
8	-5.6	-5.6	.5	-11.3	.7	0
9	-5.6	-5.1	.3	-.4	0	0
10	-5.6	-4.8	.1	0	0	0
11	-5.6	-4.8	-.1	0	0	0
12	-5.6	-5.1	-.3	0	0	-.1
13	-5.6	-5.6	-.5	0	0	-.3
14	-5.6	-6.5	-.8	0	0	-.7
15	-5.6	-7.5	-1.3	0	0	-1
16	-5.6	-8.6	-1.8	0	0	-1.4
17	-5.6	-10.1	0	0	0	0
18	-5.6	-11.6	0	0	0	0
19	-5.6	-13.2	0	0	0	0
20	-5.4	-13.9	0	0	0	0

Checked
29/2/00

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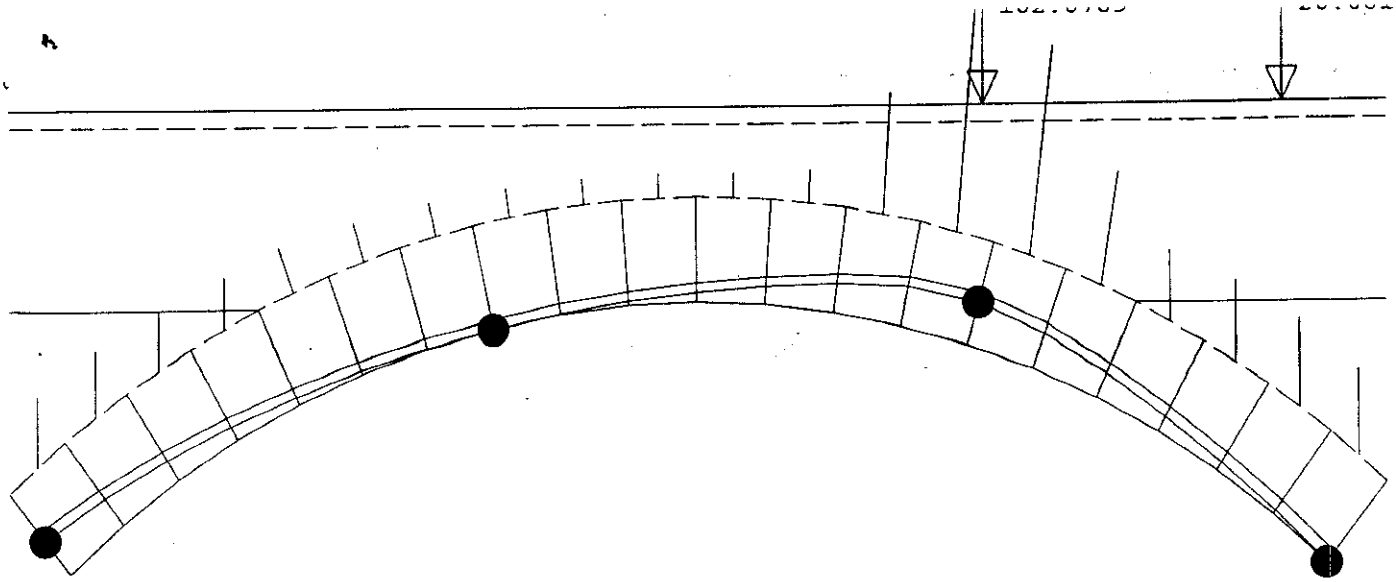


Nortarch

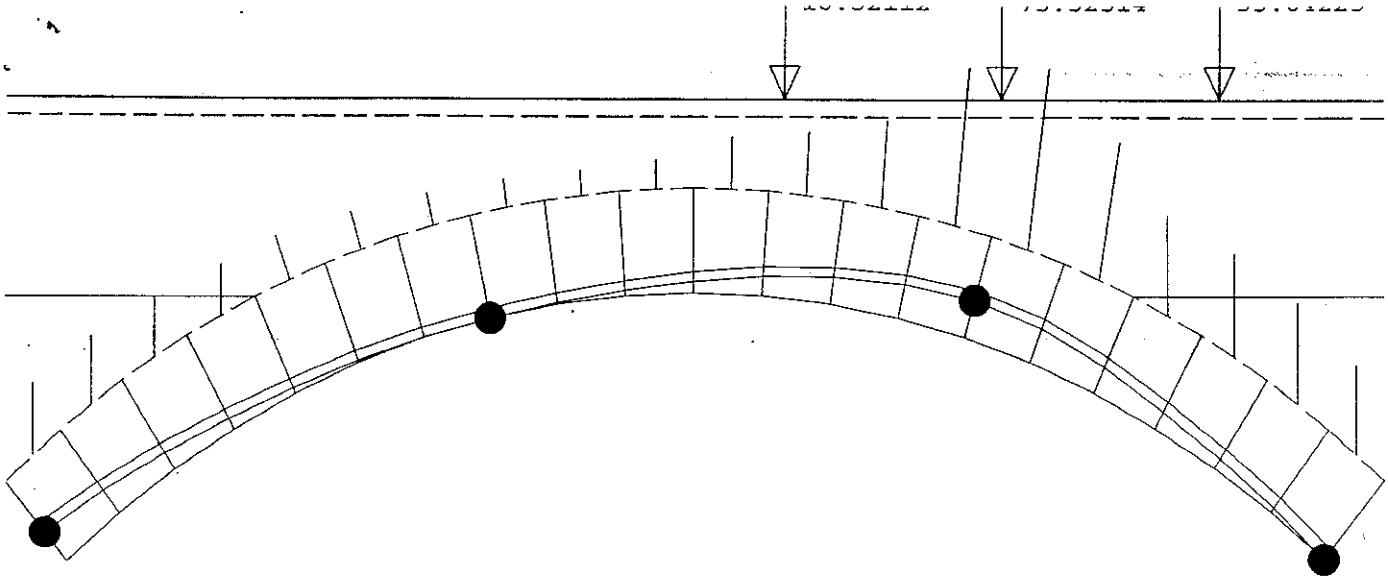
()			
Span	7810 mm	Rise	1500 mm
Depth of fill	510 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20.3t:Right Lift-off at 6000		
Lane width	4237mm		
Required ring depth	300 mm	Geometric F.O.S	1.97
H Left	229 kN/m	H Right	223 kN/m
V Left	164 kN/m	V Right	240 kN/m
Comp. zone at hinge 2	56 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 8	3 AT 15	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.9	0	0	0	0
2	-5.6	-13.1	0	0	0	0
3	-5.6	-11.6	0	0	0	0
4	-5.6	-10.1	0	0	0	0
5	-5.6	-8.6	1.8	0	0	1.4
6	-5.6	-7.5	1.3	0	0	1
7	-5.6	-6.5	.8	0	0	.7
8	-5.6	-5.6	.5	0	0	.3
9	-5.6	-5.1	.3	0	0	.1
10	-5.6	-4.8	.1	0	0	0
11	-5.6	-4.8	-.1	0	0	0
12	-5.6	-5.1	-.3	-1.4	-.1	0
13	-5.6	-5.6	-.5	-18.1	-1.1	0
14	-5.6	-6.5	-.8	-37.4	-3.2	0
15	-5.6	-7.5	-1.3	-33.2	-3.8	0
16	-5.6	-8.6	-1.8	-13.3	-1.9	0
17	-5.6	-10.1	0	-3.6	0	0
18	-5.6	-11.6	0	-4.2	0	0
19	-5.6	-13.2	0	-4.3	0	0
20	-5.4	-13.9	0	-3.3	0	0



Nortarch

()

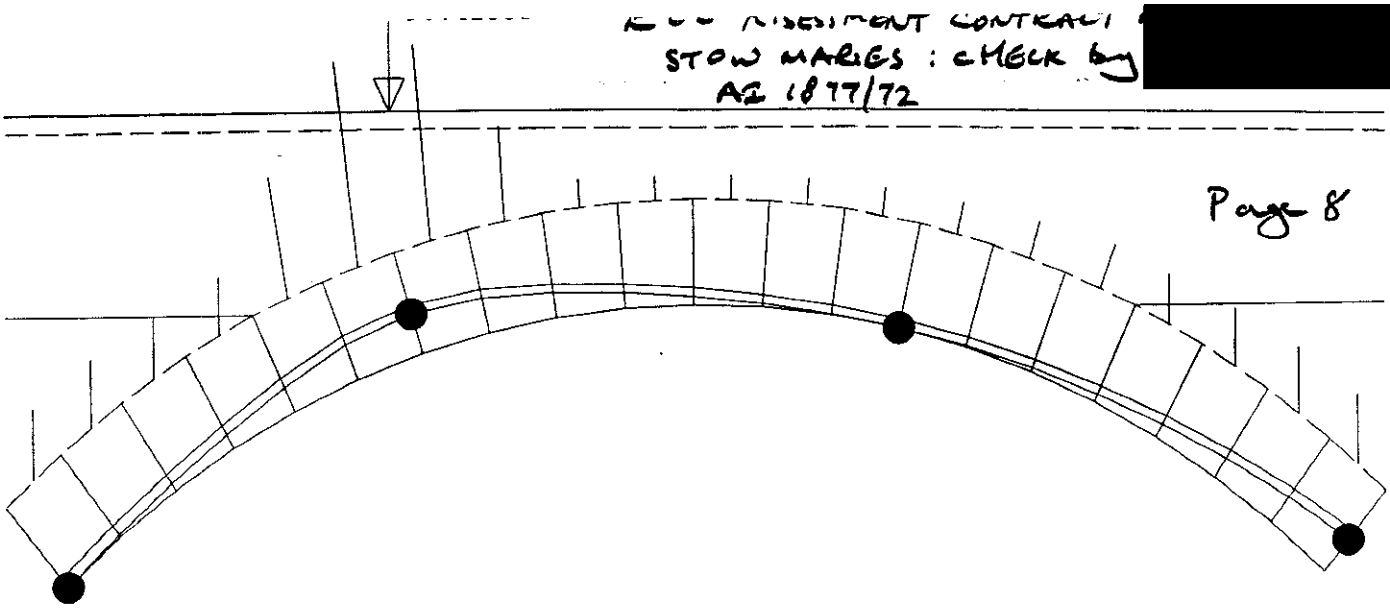
Span	7810 mm	Rise	1500 mm
Depth of fill	510 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Triple Axle:22.5t:Right Lift-off at 6000		
Lane width	4237mm		
Required ring depth	269 mm	Geometric F.O.S	2.19
H Left	225 kN/m	H Right	220 kN/m
V Left	165 kN/m	V Right	244 kN/m
Comp. zone at hinge 2	55 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 8	3 AT 15	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.9	0	0	0	0
2	-5.6	-13.1	0	0	0	0
3	-5.6	-11.6	0	0	0	0
4	-5.6	-10.1	0	0	0	0
5	-5.6	-8.6	1.8	0	0	1.4
6	-5.6	-7.5	1.3	0	0	1
7	-5.6	-6.5	.8	0	0	.7
8	-5.6	-5.6	.5	0	0	.3
9	-5.6	-5.1	.3	0	0	.1
10	-5.6	-4.8	.1	-1	0	0
11	-5.6	-4.8	-.1	-5.7	-.1	0
12	-5.6	-5.1	-.3	-7.4	-.3	0
13	-5.6	-5.6	-.5	-11.8	-.7	0
14	-5.6	-6.5	-.8	-24.6	-2.1	0
15	-5.6	-7.5	-1.3	-28.1	-3.2	0
16	-5.6	-8.6	-1.8	-18.2	-2.6	0
17	-5.6	-10.1	0	-9.4	0	0
18	-5.6	-11.6	0	-8.2	0	0
19	-5.6	-13.2	0	-6.2	0	0
20	-5.4	-13.9	0	-3.2	0	0



()	[redacted]		
Span	7755 mm ✓	Rise	1525 mm ✓
Depth of fill	490 mm ✓	Depth of surfacing	100 mm ✓
Ring depth	590 mm ✓	Ring depth factor	1 ✓
Position of backing	4 ✓	Depth of mortar loss	0 mm ✓
Fill density	19 kN/m^3 ✓	Masonry density	21 kN/m^3 ✓
Surfacing density	23 kN/m^3 ✓		
Phi for fill	30 deg ✓	Masonry strength	4.4 N/mm^2 ✓
Load	Single Axle:11.5t at 10970		
Lane width	4230mm ✓		
Required ring depth	281 mm	Geometric F.O.S	2.1
H Left	200 kN/m	H Right	206 kN/m
V Left	214 kN/m	V Right	156 kN/m
Comp. zone at hinge 2	50 mm	Factor on pass. press.	.3 ✓

Hinges

1 AT 1	2 AT 7	3 AT 14	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.8	0	0	0	0
2	-5.6	-13	0	0	0	0
3	-5.6	-11.5	0	0	0	0
4	-5.6	-10	0	-1.4	0	0
5	-5.6	-8.6	1.9	-14.4	2.1	0
6	-5.6	-7.4	1.3	-31.3	3.7	0
7	-5.6	-6.3	.9	-30.6	2.7	0
8	-5.6	-5.5	.5	-12.3	.8	0
9	-5.6	-5	.3	-.5	0	0
10	-5.6	-4.7	.1	0	0	0
11	-5.6	-4.6	-.1	0	0	0
12	-5.6	-4.9	-.3	0	0	-.1
13	-5.6	-5.4	-.5	0	0	-.3
14	-5.6	-6.2	-.8	0	0	-.7
15	-5.6	-7.1	-1.3	0	0	-1
16	-5.6	-8.3	-1.8	0	0	-1.3
17	-5.6	-9.6	0	0	0	0
18	-5.6	-11.2	0	0	0	0
19	-5.6	-12.7	0	0	0	0
20	-5.4	-13.4	0	0	0	0

Checked [redacted] 29/2/00

OK

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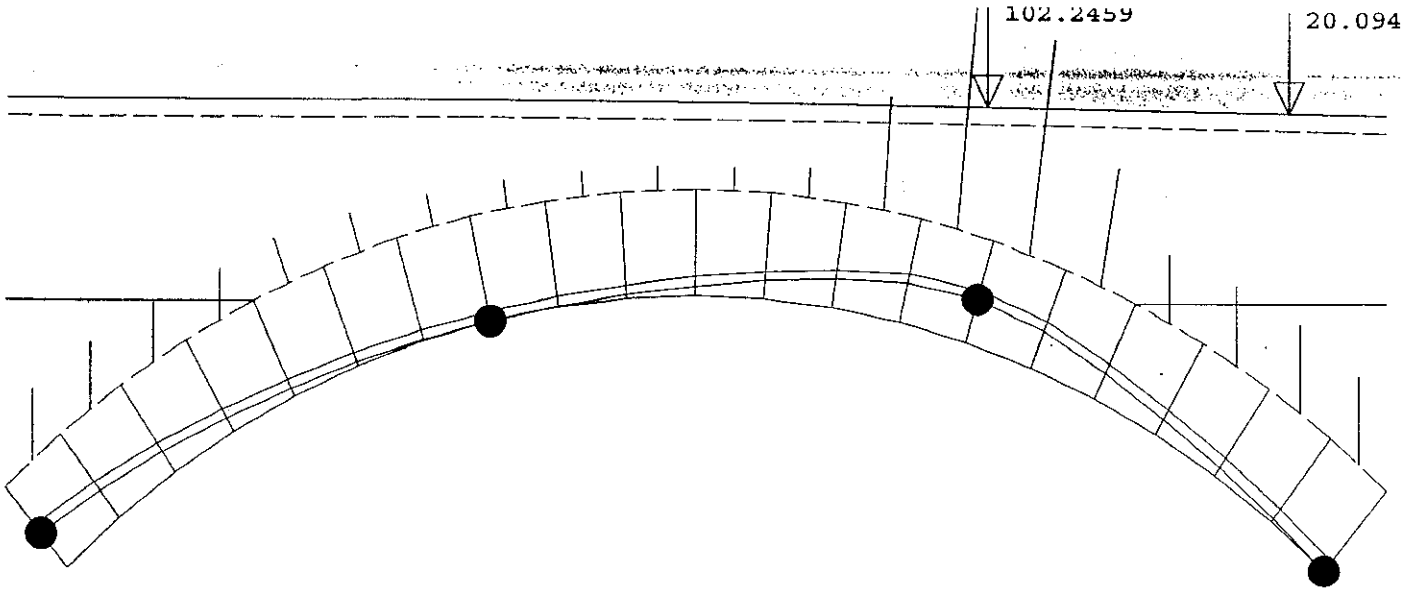


Centarch

()

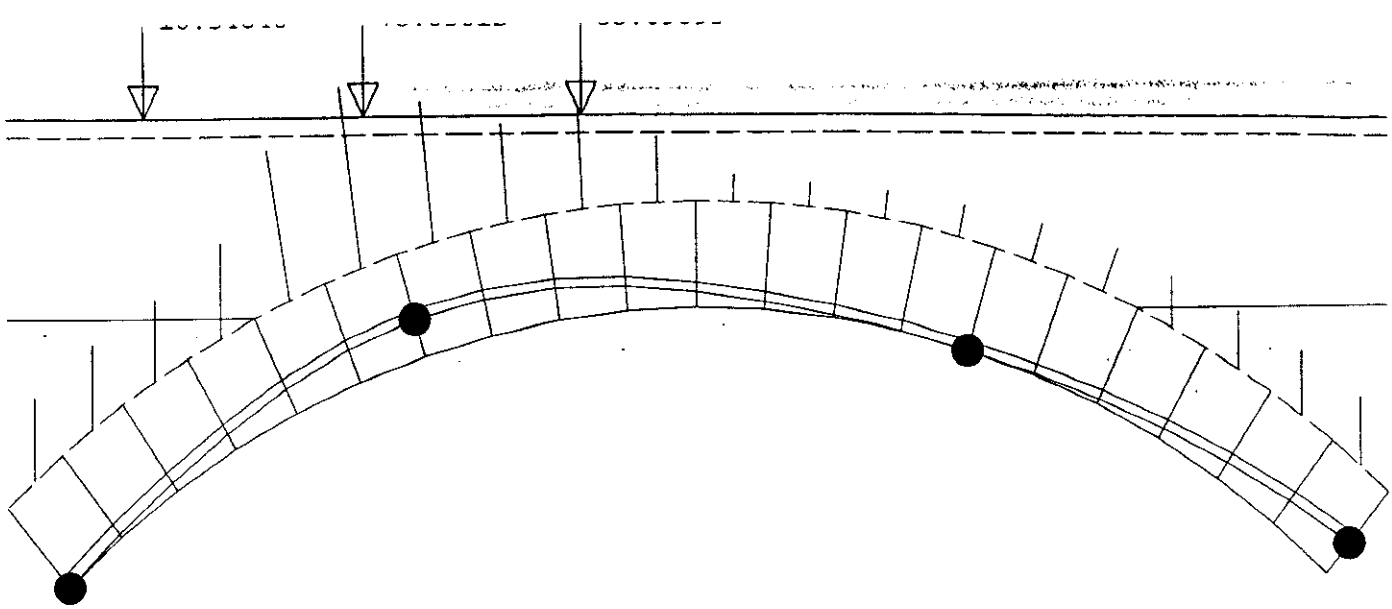
Span	7755 mm	Rise	1525 mm
Depth of fill	490 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20.3t:Right Lift-off at 14970		
Lane width	4230mm		
Required ring depth	305 mm	Geometric F.O.S	1.94
H Left	220 kN/m	H Right	213 kN/m
V Left	162 kN/m	V Right	237 kN/m
Comp. zone at hinge 2	53 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 8	3 AT 15	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.8	0	0	0	0
2	-5.6	-13	0	0	0	0
3	-5.6	-11.5	0	0	0	0
4	-5.6	-10	0	0	0	0
5	-5.6	-8.6	1.9	0	0	1.4
6	-5.6	-7.4	1.3	0	0	1
7	-5.6	-6.3	.9	0	0	.7
8	-5.6	-5.5	.5	0	0	.3
9	-5.6	-5	.3	0	0	.1
10	-5.6	-4.7	.1	0	0	0
11	-5.6	-4.6	-.1	0	0	0
12	-5.6	-4.9	-.3	-.9	0	0
13	-5.6	-5.4	-.5	-16.5	-1	0
14	-5.6	-6.2	-.8	-37.1	-3.3	0
15	-5.6	-7.1	-1.3	-34.4	-4	0
16	-5.6	-8.3	-1.8	-14.3	-2.1	0
17	-5.6	-9.6	0	-3.6	0	0
18	-5.6	-11.2	0	-4.2	0	0
19	-5.6	-12.7	0	-4.3	0	0
20	-5.4	-13.4	0	-3.4	0	0



Centarch

()			
Span	7755 mm	Rise	1525 mm
Depth of fill	490 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Triple Axle:22.5t:Right Lift-off at 10970		
Lane width	4230mm		
Required ring depth	272 mm	Geometric F.O.S	2.17
H Left	217 kN/m	H Right	223 kN/m
V Left	239 kN/m	V Right	165 kN/m
Comp. zone at hinge 2	54 mm	Factor on pass. press.	.3

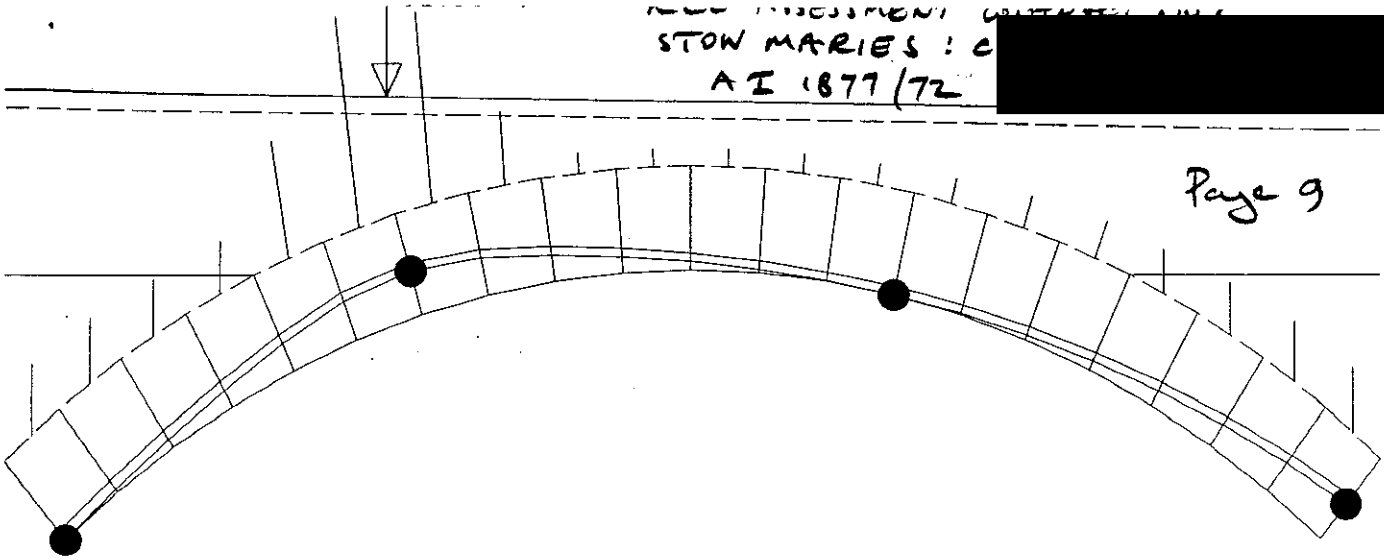
Hinges

1 AT 1	2 AT 7	3 AT 15	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.8	0	-2.1	0	0
2	-5.6	-13	0	-3.4	0	0
3	-5.6	-11.5	0	-4	0	0
4	-5.6	-10	0	-8.1	0	0
5	-5.6	-8.6	1.9	-20.1	2.9	0
6	-5.6	-7.4	1.3	-27.6	3.2	0
7	-5.6	-6.3	.9	-20.9	1.9	0
8	-5.6	-5.5	.5	-13.7	.9	0
9	-5.6	-5	.3	-14.9	.6	0
10	-5.6	-4.7	.1	-8.4	.1	0
11	-5.6	-4.6	-.1	-.6	0	0
12	-5.6	-4.9	-.3	0	0	-.1
13	-5.6	-5.4	-.5	0	0	-.2
14	-5.6	-6.2	-.8	0	0	-.5
15	-5.6	-7.1	-1.3	0	0	-1
16	-5.6	-8.3	-1.8	0	0	-1.4
17	-5.6	-9.6	0	0	0	0
18	-5.6	-11.2	0	0	0	0
19	-5.6	-12.7	0	0	0	0
20	-5.4	-13.4	0	0	0	0

STOW MARIES : C [redacted]
AI 1877/72



[redacted]

()

Span	7830 mm ✓	Rise	1510 mm ✓
Depth of fill	370 mm ✓	Depth of surfacing	100 mm ✓
Ring depth	590 mm ✓	Ring depth factor	1
Position of backing	4 ✓	Depth of mortar loss	0 mm
Fill density	19 kN/m^3 ✓	Masonry density	21 kN/m^3 ✓
Surfacing density	23 kN/m^3 ✓		
Phi for fill	30 deg ✓	Masonry strength	4.4 N/mm^2 ✓
Load	Single Axle:11.5t at 19875		
Lane width	4133mm ✓		
Required ring depth	302 mm	Geometric F.O.S	1.95
H Left	196 kN/m	H Right	203 kN/m
V Left	209 kN/m	V Right	147 kN/m
Comp. zone at hinge 2	49 mm	Factor on pass. press.	.3

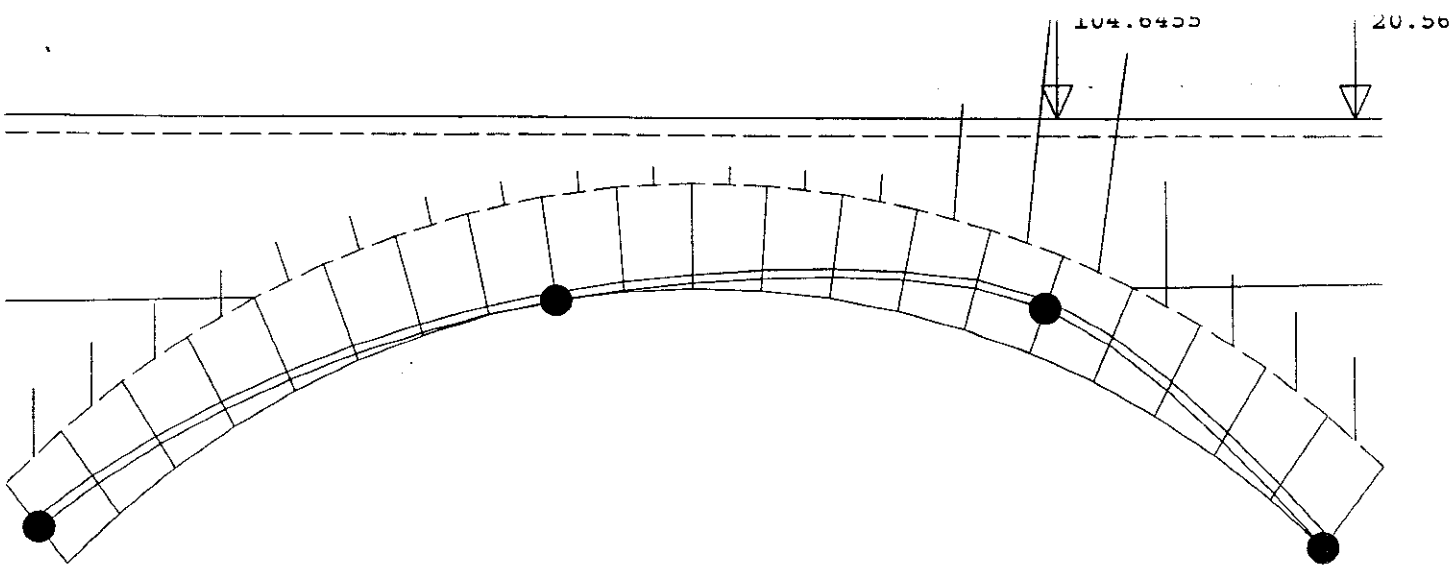
Hinges

1 AT 1	2 AT 7	3 AT 14	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.4	0	0	0	0
2	-5.6	-12.6	0	0	0	0
3	-5.6	-11	0	0	0	0
4	-5.6	-9.3	0	-1.1	0	0
5	-5.6	-7.8	1.7	-15.1	2.2	0
6	-5.6	-6.6	1.1	-34.4	4	0
7	-5.6	-5.5	.7	-31.7	2.8	0
8	-5.6	-4.6	.4	-10	.6	0
9	-5.6	-4	.2	-.1	0	0
10	-5.6	-3.6	.1	0	0	0
11	-5.6	-3.6	-.1	0	0	0
12	-5.6	-3.8	-.2	0	0	-.1
13	-5.6	-4.3	-.4	0	0	-.2
14	-5.6	-5.1	-.7	0	0	-.5
15	-5.6	-6.1	-1.1	0	0	-.8
16	-5.6	-7.2	-1.6	0	0	-1.1
17	-5.6	-8.7	0	0	0	0
18	-5.6	-10.3	0	0	0	0
19	-5.6	-11.8	0	0	0	0
20	-5.4	-12.7	0	0	0	0

Checked
29/2/00
OK for 40/44T



Soutarch

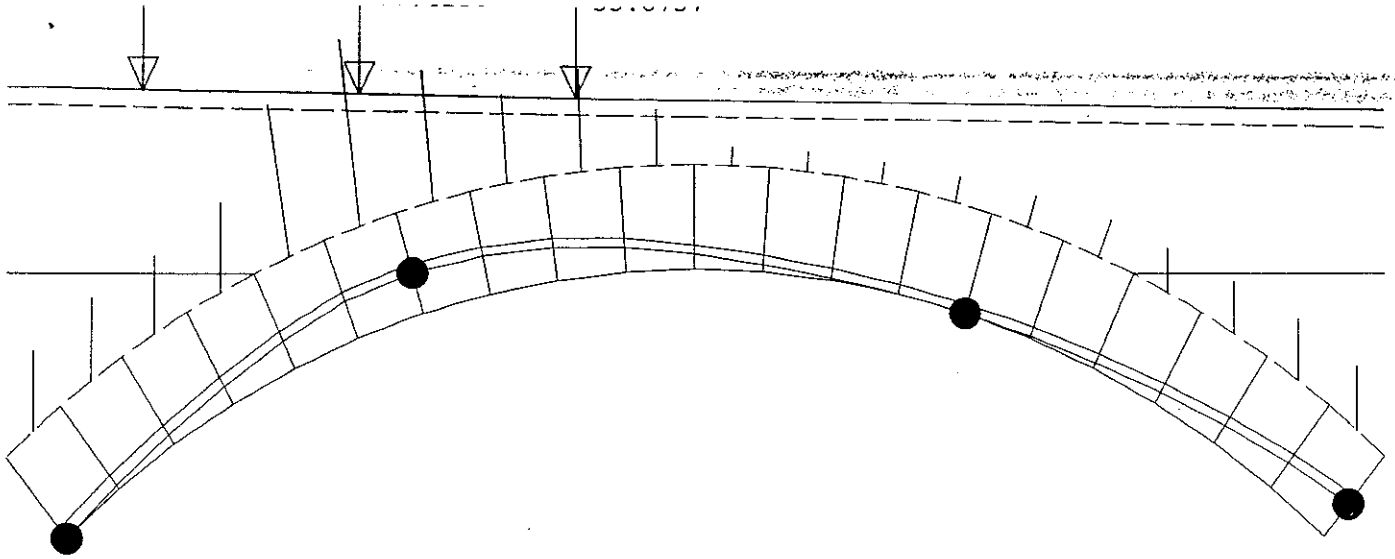
()			
Span	7830 mm	Rise	1510 mm
Depth of fill	370 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Double Axle:20.3t:Right Lift-off at 24375		
Lane width	4133mm		
Required ring depth	322 mm	Geometric F.O.S	1.83
H Left	203 kN/m	H Right	195 kN/m
V Left	148 kN/m	V Right	231 kN/m
Comp. zone at hinge 2	50 mm	Factor on pass. press.	.3

Hinges

1 AT 1	2 AT 9	3 AT 16	4 AT 21

Param(mn).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.4	0	0	0	0
2	-5.6	-12.6	0	0	0	0
3	-5.6	-11	0	0	0	0
4	-5.6	-9.3	0	0	0	0
5	-5.6	-7.8	1.7	0	0	1.2
6	-5.6	-6.6	1.1	0	0	.9
7	-5.6	-5.5	.7	0	0	.6
8	-5.6	-4.6	.4	0	0	.3
9	-5.6	-4	.2	0	0	.1
10	-5.6	-3.6	.1	0	0	0
11	-5.6	-3.6	-.1	0	0	0
12	-5.6	-3.8	-.2	0	0	0
13	-5.6	-4.3	-.4	-1.1	-.1	0
14	-5.6	-5.1	-.7	-16.9	-1.5	0
15	-5.6	-6.1	-1.1	-37	-4.3	0
16	-5.6	-7.2	-1.6	-34.6	-5	0
17	-5.6	-8.7	0	-15.7	0	0
18	-5.6	-10.3	0	-3.8	0	0
19	-5.6	-11.8	0	-3.8	0	0
20	-5.4	-12.7	0	-3.7	0	0



Soutarch

()

Span	7830 mm	Rise	1510 mm
Depth of fill	370 mm	Depth of surfacing	100 mm
Ring depth	590 mm	Ring depth factor	1
Position of backing	4	Depth of mortar loss	0 mm
Fill density	19 kN/m^3	Masonry density	21 kN/m^3
Surfacing density	23 kN/m^3		
Phi for fill	30 deg	Masonry strength	4.4 N/mm^2
Load	Triple Axle:22.5t:Right Lift-off at 19875		
Lane width	4133mm		
Required ring depth	289 mm	Geometric F.O.S	2.04
H Left	213 kN/m	H Right	221 kN/m
V Left	234 kN/m	V Right	156 kN/m
Comp. zone at hinge 2	53 mm	Factor on pass. press.	.3

Hinges

1 AT 1 2 AT 7 3 AT 15 4 AT 21

Param(mm).segment

	Stone Weight	Vertical Dead Load	Horizontal Deadload	Vertical Live Load	Horizontal Live Load	Additional Pass Press
1	-5.4	-13.4	0	-2.2	0	0
2	-5.6	-12.6	0	-3.6	0	0
3	-5.6	-11	0	-4.2	0	0
4	-5.6	-9.3	0	-8	0	0
5	-5.6	-7.8	1.7	-21.6	3.1	0
6	-5.6	-6.6	1.1	-29.8	3.4	0
7	-5.6	-5.5	.7	-20.5	1.8	0
8	-5.6	-4.6	.4	-13	.8	0
9	-5.6	-4	.2	-16.4	.6	0
10	-5.6	-3.6	.1	-7.4	.1	0
11	-5.6	-3.6	-.1	-.2	0	0
12	-5.6	-3.8	-.2	0	0	0
13	-5.6	-4.3	-.4	0	0	-.2
14	-5.6	-5.1	-.7	0	0	-.4
15	-5.6	-6.1	-1.1	0	0	-.8
16	-5.6	-7.2	-1.6	0	0	-1.2
17	-5.6	-8.7	0	0	0	0
18	-5.6	-10.3	0	0	0	0
19	-5.6	-11.8	0	0	0	0
20	-5.4	-12.7	0	0	0	0

MULTI INPUT

Nortarch
1500
7810
20
590
1
4
21
19
30
1
602
4.4
8000
0
0
100
23
0,0,2600
328,275,2600
675,524,2600
1040,748,2600
1420,944,2600
1813,1112,2600
2218,1251,2600
2632,1359,2600
3052,1437,2600
3478,1484,2600
3905,1500,2600
4332,1484,2600
4758,1437,2600
5178,1359,2600
5592,1251,2601
5997,1112,2601
6390,944,2601
6770,748,2601
7135,524,2602
7482,275,2602
7810,0,2602
centarch
0

OK SHL
29/2/00

centarch
1525
7755
20
590
1
4
21
19
30
1
599
4.4
8000
8.97 7810 + 1160
0
100
23
0,0,2603
323,279,2604
666,532,2606
1027,760,2607
1404,959,2609
1795,1130,2609
2197,1271,2610
2609,1382,2610
3028,1461,2609
3452,1509,2608
3878,1525,2605 1525 + 1080
4304,1509,2601
4728,1461,2597
5147,1382,2591
5559,1271,2585
5961,1130,2579
6352,959,2572
6729,760,2565
7090,532,2559
7433,279,2552
7756,0,2546
soutarch
-3.485 (-2985 - 0.5)

OK GL
29/2/00

```
soutarch
 1510
 7830
 20
 590
 1
 4
 21
 19
 30
 1
 603
 4.4
 8000
 17.875   (8.97 + 7.755 + 1.15)
 0
 100
 23
0,0,2529
328,276,2524
676,528,2519
1042,753,2513
1423,950,2508
1817,1119,2502
2223,1259,2495
2638,1368,2489
3060,1447,2483
3486,1494,2476
3915,1510,2470   (1510 + 960 + 2470)
4344,1494,2464
4770,1447,2457
5192,1368,2451
5607,1259,2445
6013,1119,2438
6407,950,2432
6788,753,2427
7154,528,2421
7502,276,2416
7830,0,2411
*
-3.695          -(3.195 + 0.5)
```

OK [illegible]
29/2/00

MULTI CHECK SHEET AI 1877/72

[redacted]

Page 11

no1	Bridge or arch name
1390	Rise
2780	Span
20	Number of segments
350	Ring thickness
1	Ring thickness factor
5	Backing level
20	Masonry Self weight kN/m^3
18	Fill self weight
35	Φ for fill
1	Passive pressure coefficient (*10)
218	Segment length
3	Masonry strength
8000	A notional E value for later developments
0	Chainage of start of arch in m
1.64	Height of springing in m
100	Surfacing depth
20	Surfacing density
-1390,0,2020	intrados x,y and surface y in mm origin at
-1373,217,2020	centre of span
-1322,430,2020	
-1238,631,2020	
-1125,817,2020	
-983,983,2020	
-817,1125,2020	
-631,1238,2020	
-430,1322,2020	
-217,1373,2020	
0,1390,2020	
217,1373,2020	
430,1322,2020	
631,1238,2020	
817,1125,2020	
983,983,2020	
1125,817,2020	
1238,631,2020	
1322,430,2020	
1373,217,2020	
1390,0,2020	
no2	Next span file name for multi, * for last span
0	Pier base height in m

WS/Atkins

Project	Job ref
ECC ASSESSMENT CONTRACT NO 3 STOW MARIES: CHECK	AJ 1877/72
Part of structure: MULTI	Calc sheet no / 12 / rev
Drawing ref / Calc by / Date	Check by: BJC / Date: 29/2/00

Ref	Calculations		Output
	WORST LOAD POSITIONS (From multi run)		
		T	
	SA	11.5	11500
	DA	20	11000
	TA	24	12000
	TA	18	11500
	TA	22.5	11000
	DA	19	11000
	DA	19	11500
	DA	18	11000
	SA	10.5	11000
	SA	7	12000
	SA	2	13000
	DA	20	11000
	DA	20	11500
	TA	22.5	12000
	TA	24	11000
	TA	18	11500
	DA	19	11000
	DA	18	11000
	DA	18	11500
	SA	9	12000
	SA	5.5	12000

WS/Atkins

Project	Job ref
ECC ASSESS CONTRACT NO 3 STOW MARIES : CHECK	AI 1877/72
Part of structure: MULTI	Calc sheet no / 13 / rev
Drawing ref / Calc by / Date	Check by: DHL / Date: 29/2/00

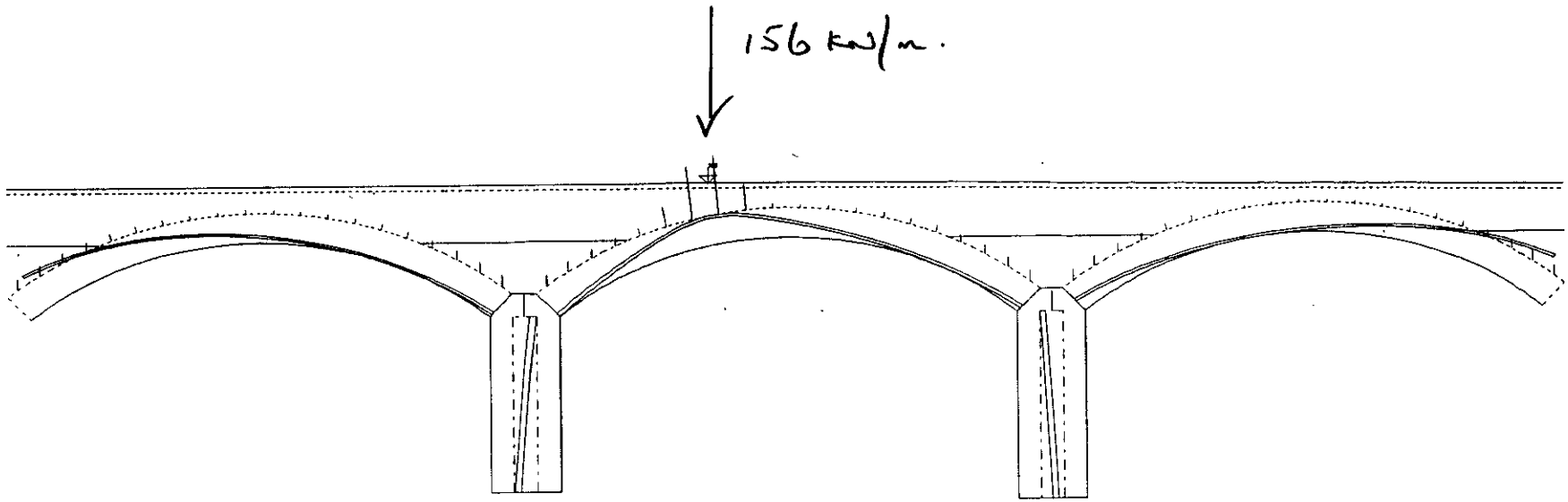
Ref	Calculations	Output
	For Central Arch (worst case)	
SA at 11.000	11.5 T Axle ⇒ $\frac{11.5 \times 9.81 \times 3.4}{0.648 \times 0.9 \times 4.23}$ =	156 KN/m
DA at 11000	10.0 T Axle ⇒ $\frac{10.0 \times 9.81 \times 3.4}{0.648 \times 0.9 \times 4.23}$ =	135
	10.0 T Axle ⇒ $\frac{10 \times 9.81 \times 1.9}{0.648 \times 0.9 \times 4.23}$ =	75
TA at 11500	8 T Axle ⇒ $\frac{8 \times 9.81 \times 3.4}{0.648 \times 0.9 \times 4.23}$ =	108
	8 T Axle ⇒ $\frac{8 \times 9.81 \times 1.9}{0.648 \times 0.9 \times 4.23}$ =	60
	8 T Axle ⇒ $\frac{8 \times 9.81 \times 1.9}{0.648 \times 0.9 \times 4.23}$ =	60

ECC ASSESSMENT CONTRACT No 3
STOW MARIES : CHE
AI 1877/72

Page 14

11.5T S.A @ 11500

File AC.23



OK

EGC
28/2/00

MULTI ANALYSIS
TABULATED RESULTS

Loadcase: 11.5 T axle 11500 Central Pier

Left span		Pier		Right span		Offset	Load	σL	σR
H (kN)	V (kN)	Nr	Force	H (kN)	V (kN)	From L	(kN)	(KN/m^2)	(KN/m^2)
185	162	1	0	221	246	450	517	746	146
232	190	2	0	211	154	621	456	300	494

ABUTMENT REACTIONS

Left H= 185 kN V= 123 kN @ 868 mm from springing
Right H= 212 kN V= 110 kN @ 269 mm from springing

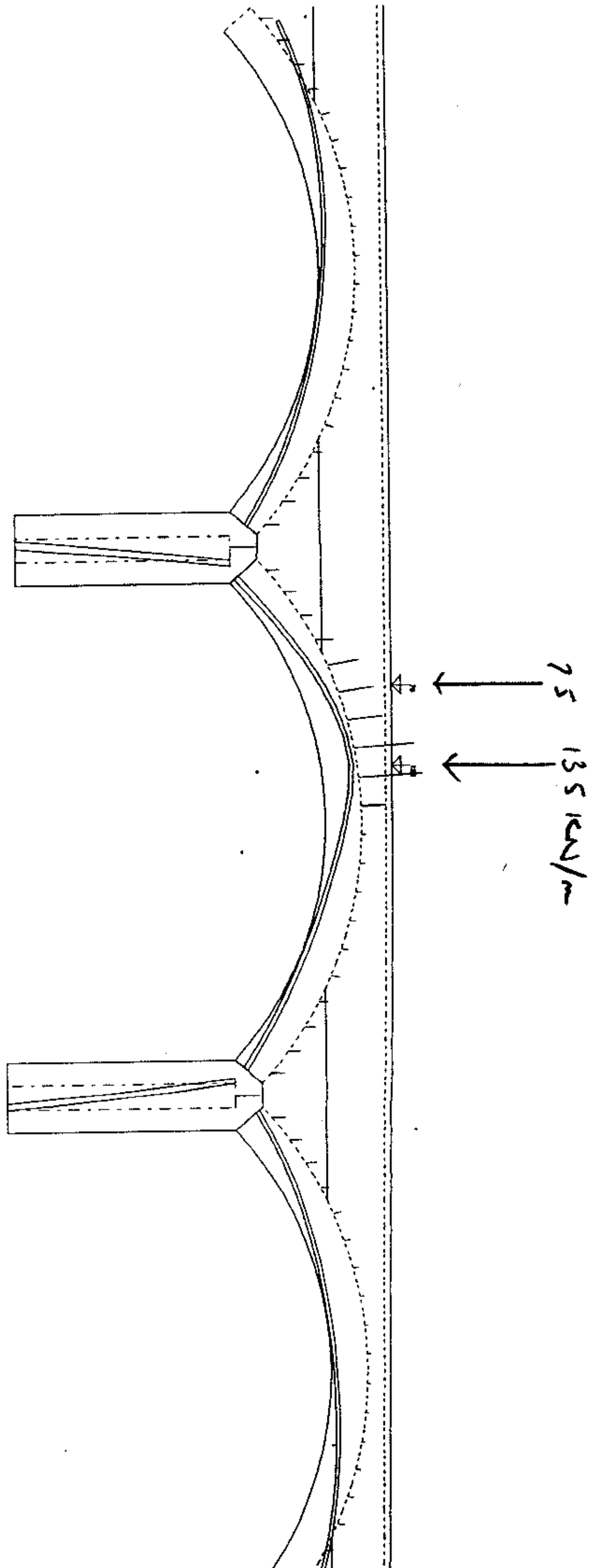
+c.23

BRC 28/2/00

ECC ASSESSMENT CONTRACT No 3
STOW MARIES : CHECK BY [redacted]
AT 1877/72

Page 15

DA at 11000



OK
[illegible]
29/1/00

File AD.23

MULTI ANALYSIS
TABULATED RESULTS

Loadcase: DA @ 11000

Left span		Pier		Right span		Offset	Load	σL	σR
H (kN)	V (kN)	Nr	Force	H (kN)	V (kN)	From L	(kN)	(KN/m^2)	(KN/m^2)
233	159	1	0	279	283	501	551	668	282
294	207	2	0	252	153	719	472	102	720

ABUTMENT REACTIONS

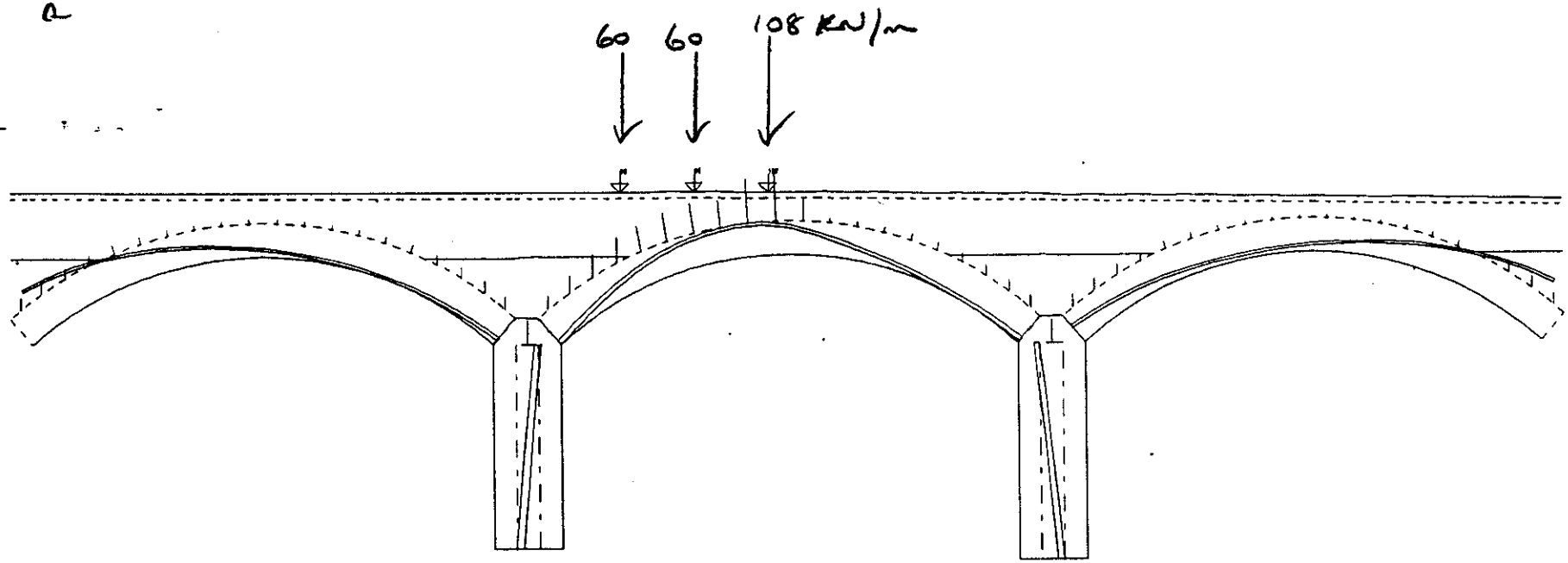
Left H= 233 kN V= 126 kN @ 902 mm from springing
Right H= 252 kN V= 111 kN @ 473 mm from springing

AD, 23

[redacted]

ECC ASSESSMENT CONTRACT N/
STOW MARIES : CHECK BY
AI 1877/7Z

Page 16



OK DGL
29/2/00

MULTI ANALYSIS
TABULATED RESULTS

Loadcase: TA at 11500

Left span		Pier		Right span		Offset	Load	σL	σR
H (kN)	V (kN)	Nr	Force	H (kN)	V (kN)	From L	(kN)	(KN/m^2)	(KN/m^2)
174	159	1	0	231	304	437	576	863	129
244	200	2	0	215	154	654	466	237	574

ABUTMENT REACTIONS

Left H= 174 kN V= 129 kN @ 818 mm from springing
Right H= 215 kN V= 110 kN @ 287 mm from springing

All stresses +ve ie compressive

∴ No tension in piers.

APPENDIX C

APPROVAL IN PRINCIPLE

AND

INSPECTION FOR ASSESSMENT

APPENDIX C

APPROVAL IN PRINCIPLE

AND

INSPECTION FOR ASSESSMENT