OCTOBER 2002

RAIL PROPERTY LTD

01/02 BE4 ASSESSMENT PROGRAMME

ASSESSMENT AND INSPECTION REPORT

WHITCHURCH BRIDGE, BRISTOL

OVERBRIDGE REF: FNS-3/19m76ch

Babtie Group
Multi-disciplinary consultants

Babtie

CONTENTS

1.0 SYNOPSIS

The assessment inspections carried out 12 September 2002 indicated that the bridge was generally in poor condition and with some defects likely to affect the long-term durability.

The main arch barrel showed some signs of movement and settlement.

The assessment showed that the arch structure can carry 24T vehicle to BE4 requirements.

2.0 INTRODUCTION

The bridge was inspected and assessed by Babtie Group on behalf of Rail Property Ltd.

The report covers the assessment of Brislington-Whitchurch Railway Bridge, (Railtrack ref. FNS-3/19m76ch - OB No.44).

The bridge serves as an overbridge over a disused branch line at Keysham, Bristol.

3.0 INSPECTION DETAILS

The bridge was inspected on 12 September 2002. The detailed findings of the inspection are contained in the Assessment Inspection Report dated October 2002. (See Appendix A1).

Generally the structure is in poor condition. The significant defects noted during the inspection which affect the structures durability are summarised as follows:-

1) There is some separation between spandrel and the arch barrel resulting from settlement or movement of the arch. This is exhibited through the crack at the extrados line around the arch below the spandrel.

2) The abutment wall exhibits vertical cracking and ingress of water.

3) There are some areas of staining and efflorescence in stonework accompanied by stone surface delamination.

4.0 ASSESSMENT FINDINGS

4.1 Basis of Assessment

The assessment has been undertaken in accordance with The Ministry of Transport Technical Memorandum (Bridges) No. BE4 " The Assessment of Highway Bridges for Construction and Use Vehicles" dated January 1967 (as amended up to 11th Nov. 1970) ((See Appendix A1).

4.2 Condition Factor

The inspection of the structure revealed some defects but these would affect the durability of the structure and so a condition factor of 0.8 has been assumed for the assessment.

4.3 24 Tonnes Assessment Live Load

The arch barrel was found to carry 24 Tons Vehicle Load. The substructures were assessed qualitatively and were deemed adequate for 24 Tons Vehicle load to BE4.

4.4 Substructure

The substructure is not accessible, however separation of the arch from the spandrel suggests some form of settlement that might adversely affect the structure.

5.0 Conclusion

The MEXE method of assessment to BE4 requirements showed that the arch structure can carry 24 Tons Vehicle Load. The substructure was qualitatively assessed and was found to be capable of carrying 24 Tons Vehicle Load.

Appendix A1

Assessment Inspection Report

Status: Inspection

Zone :	ENGLAND
Structure :	FNS-3/19mi, 76ch
Location :	WHITCHURCH, BRISTOL
Grid Ref :	ST613674
ELR, Mileage :	N/A

Assessment Inspection Report

CONTENTS

Appendices

1. INTRODUCTION

1.1. Overbridge No. FNS-3/19m76ch Whitchurch Railway Bridge was inspected on the 12th of September 2002 for Rail Property Limited.

1.2. The structure is a single arch span circular arch overbridge. The deck is lying square to the track bed. The structure is made entirely from local coursed stonework laid in a random formation. The arch takes the form of a single ring springing from the abutment and with the spandrel and parapet of similar stone construction.

1.3. The clear square span of the structure is 7.800m. The clear width between parapets at deck level is 11.000m. The structure has been partly infilled with ground built up to the abutment wall heights of 2.760m on the south face. On the North face the clearance from the soffit of the arch to ground level varies from about 1m to 2m.

1.4. The bridge serves as an overbridge over a disused branch line at Whitchurch, Bristol. The line has been removed with the majority of the track bed in the vicinity either flattened or infilled.

2. RECORD DATA

2.1. Visual examination reports or detailed examination reports were not made available.

2.2. No form of record or sketches were made available.

2.3. The structure is built from local stone.

3. CONDITION SURVEY

3.1. General

3.1.1. An inspection for assessment was carried out on 12th of September 2002, in accordance with RT/CE/P/016 'The Assessment of Bridge Capacity'.

3.1.2. Photographs of the structure layout and the defects encountered, together with a general arrangement drawing marked up with the location of defects, are included in Appendices B & C.

3.2. Findings

Superstructure.

The single span arch barrel is formed from coursed masonry stone with the main longitudinal joints running in the east-west axis direction. The thickness of the ring is 450mm and sits directly on the stone masonry abutment walls. These two vertical walls are of similar stone, but larger in size than in the arching.

The main arch barrel is generally in poor condition exhibiting some form of settlement at the extrados. This settlement of the arch has resulted in a 40mm crack at the extrados, just below the spandrel (see photos). However, the circular shape of the arch was intact and no deformed shape was noticed. Large areas of carbon staining, varying in depth, upto 5mm at the soffit, was observed accompanied by surface delamination of the coursed stonework ranging from 5mm to 100mm deep in places.

3.2.1. Substructure.

The abutment walls and wingwalls are formed by large coursed stonework and are generally in poor condition. There are areas of staining, water seepage and joint erosion. A large crack was observed at the east end of the south wall and lime deposit on the east end of the north wall with similar cracking and location as that found at the south wall. The remaining lower parts of the walls were not accessible for examination, as the whole disused line has been filled with earth.

The parapets are 430mm thick and the coursed stonework is deemed to be in a reasonable condition. There is evidence of some recent repair work at the west end of the south parapet, which could have been due to vehicle impact damage. No safety barrier was observed at the approaches.

APPENDIX A

Technical Approval Form and Assessment and Check Certificates

STRUCTURE / LINE NAME	**Whitchurch Bridge**
ELR / STRUCTURE No.	**FNS-3/19m76ch**

BRIEF DESCRIPTION OF EXISTING BRIDGE :

(a)	Span Arrangement	Masonry Arch single span over bridge.
(b)	Superstructure Type	Local stone masonry arch barrel with stone masonry spandrels.
(c)	Substructure Type	Stone masonry abutments, wingwalls and parapets.
(d)	Details of any Special Features	None

ASSESSMENT CRITERIA

(a)	Loadings and speed	Assessment loading to BE4. Speed 30mph.
(b)	Codes to be used	BE4.
(c)	*Proposed Method of Structural Analysis*	*Hand calculations using the M.E.X.E. method of* BE4. Material, joint and condition factors will be taken into account in the analysis.
(d)	Details of any Special Requirements	None.

STRUCTURAL ASSESSMENT ENGINEER'S COMMENTS

Superstructure

The arch is generally in a poor condition exhibiting some settlement, which has resulted in cracking at the arch barrels extrados. There are large areas of carbon staining, varying in depth, upto 5mm at the soffit.

Substructure

The masonry abutments and wingwalls are generally in poor condition. There are large areas of staining, water seepage and joint erosion. A large vertical crack was observed at the East end of the North wall with similar cracking found on the south wall. The parapets were found to be in reasonable condition.

CIVIL ENGINEER'S COMMENTS

Babtie

BRB WORKS GROUP COMMENTS – If applicable

None

PROPOSED CATEGORY FOR INDEPENDENT CHECK :

SUPERSTRUCTURE	**Category 1** *(Hand calculations for masonry arch)*
SUBSTRUCTURE	***Qualitative Assessment***

CATEGORY 1

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

SIGNE [redacted]

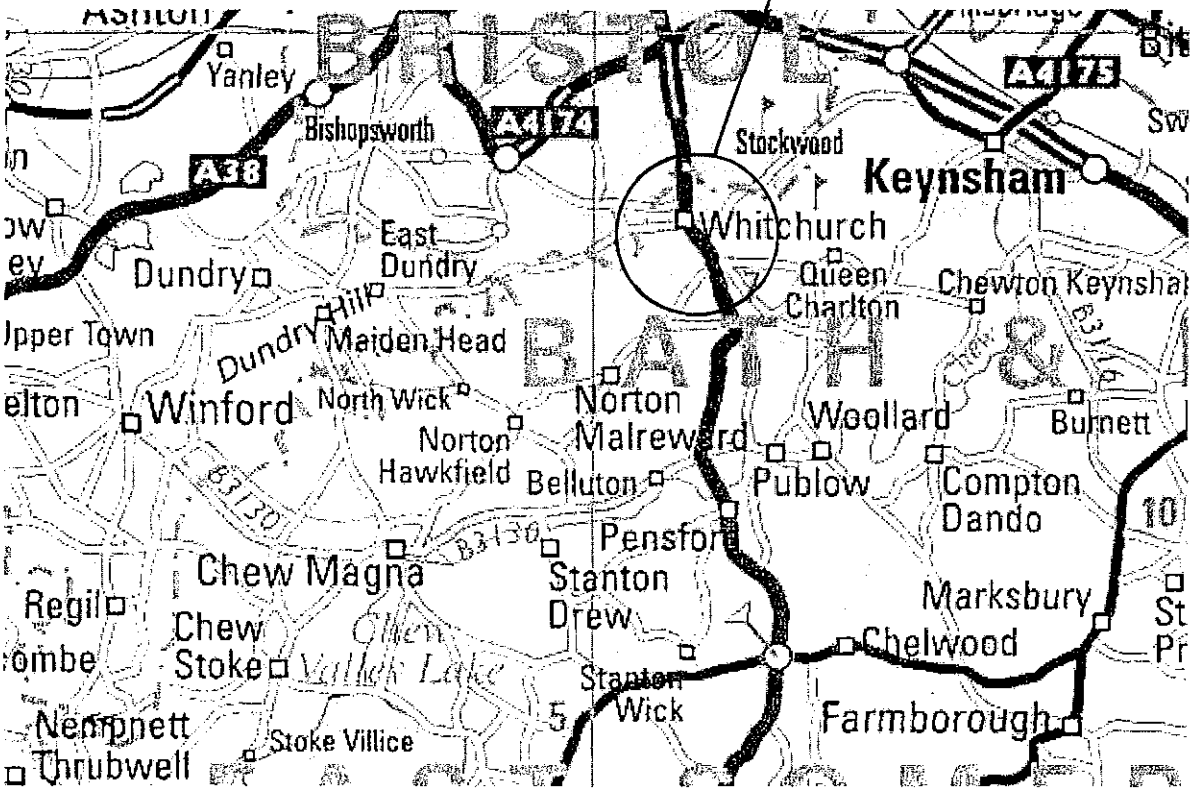
TITLE.

DATE 13th November 2002.

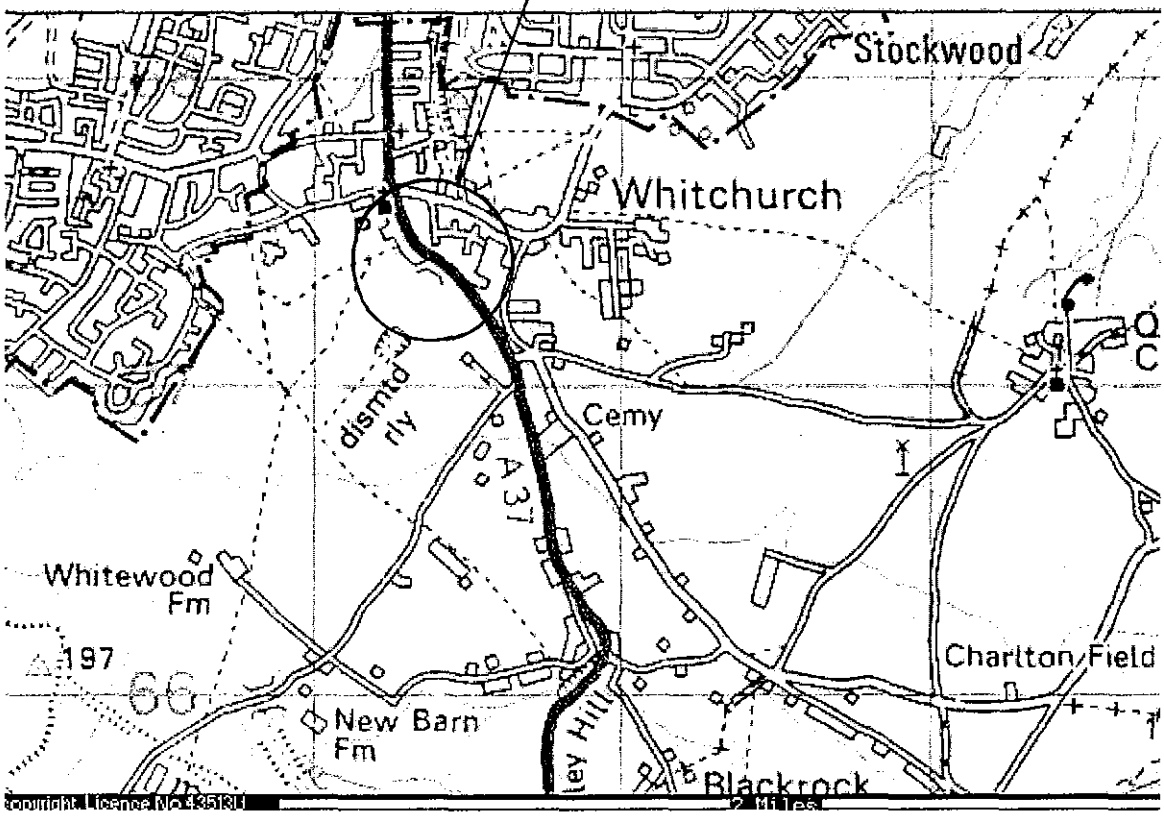
CONTRACT No:
ASSESSMENT REPORT
FNS-3/19m76ch

LOCATION MAPS

FNS 3/19M 76ch.

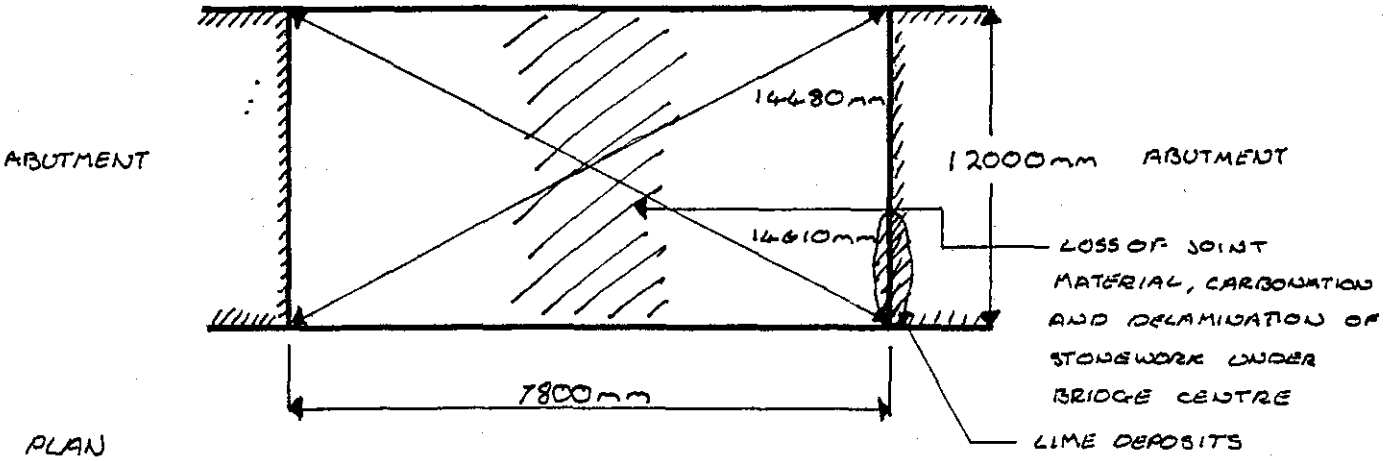


FNS 3/19M 76ch.

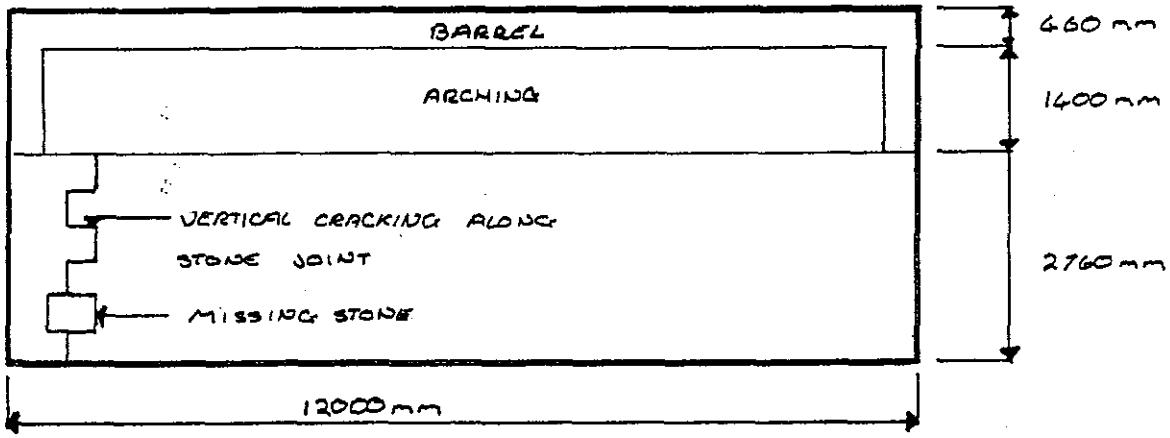


APPENDIX B

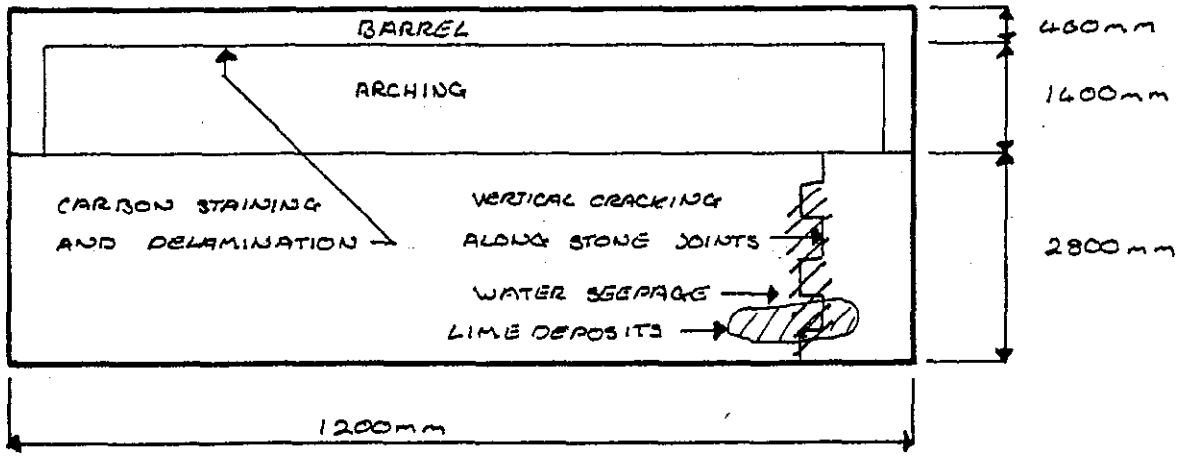
Sketch Drawings



PLAN



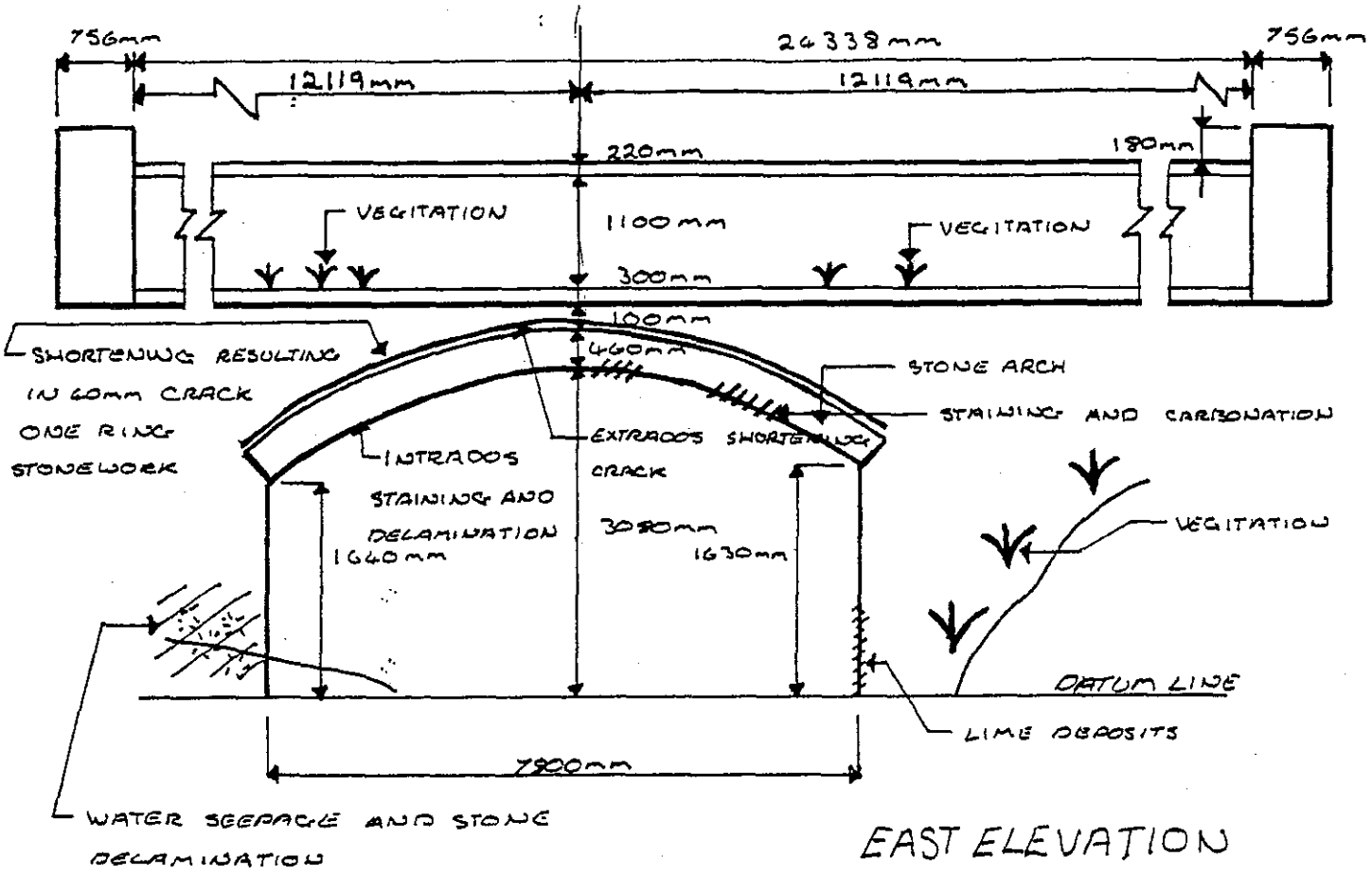
SOUTH ABUTMENT



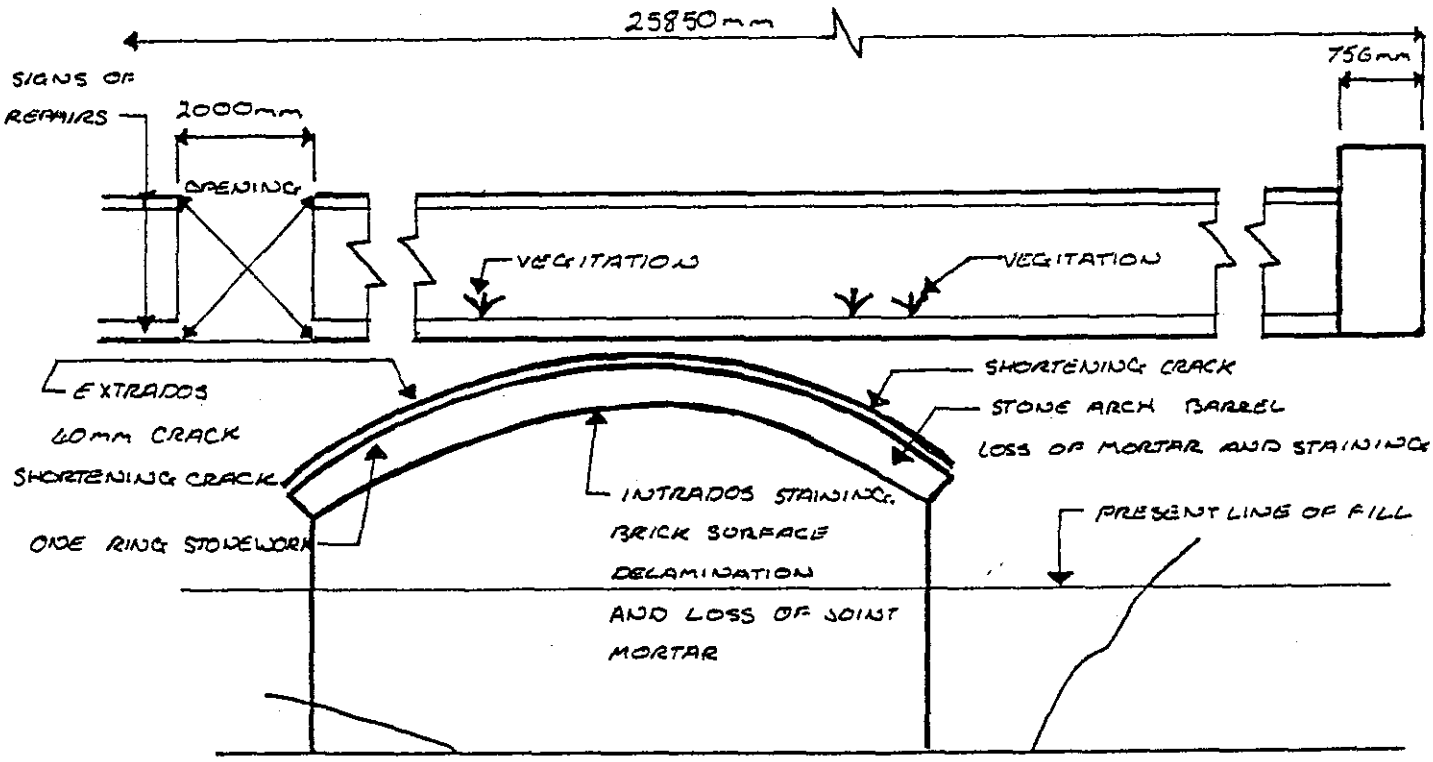
NORTH ABUTMENT

NOT TO SCALE

Babtie	Project: Whitchurch Bridge Inspection	Drawing No.
Client: Rail Property Limited.	Title: FNS3/19m76ch.	Scale / Date Sep02; Drawn / Checked



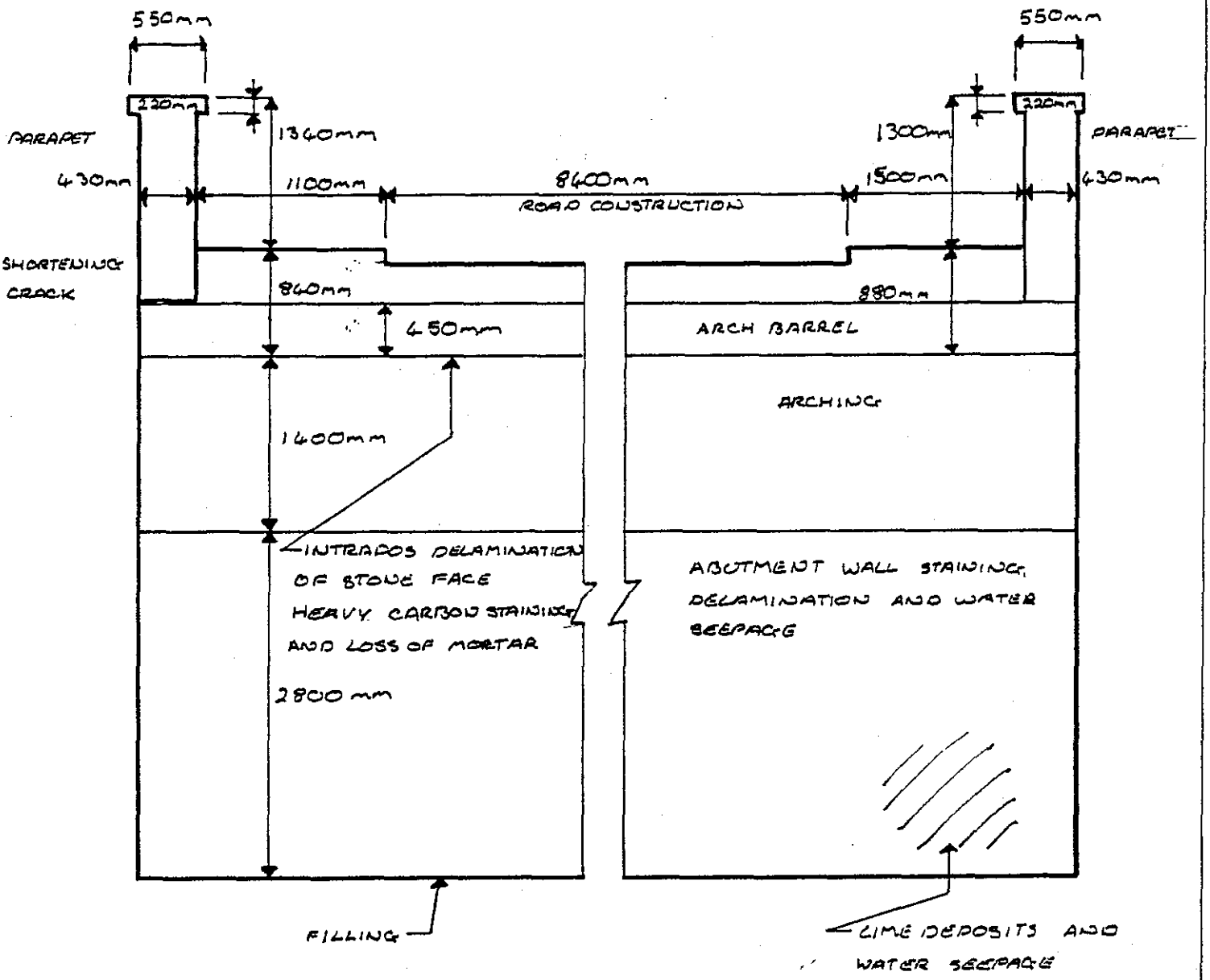
EAST ELEVATION



WEST ELEVATION

NOT TO SCALE

Babtie	Project: Whitchurch Bridge inspection	Drawing No.
Client: Rail Property Limited.	Title: FN53/19m76ch.	Scale / Date Sept 02.
		Drawn / Checked



SECTION THROUGH BRIDGE DECK

NOT TO SCALE

Babtie	Project: Whitchurch Bridge Inspection	Drawing No.
Client: Rail Property Limited	Title: RNS 3/19m Track.	Scale / Date: Sept 02
		Drawn / Checked

APPENDIX C

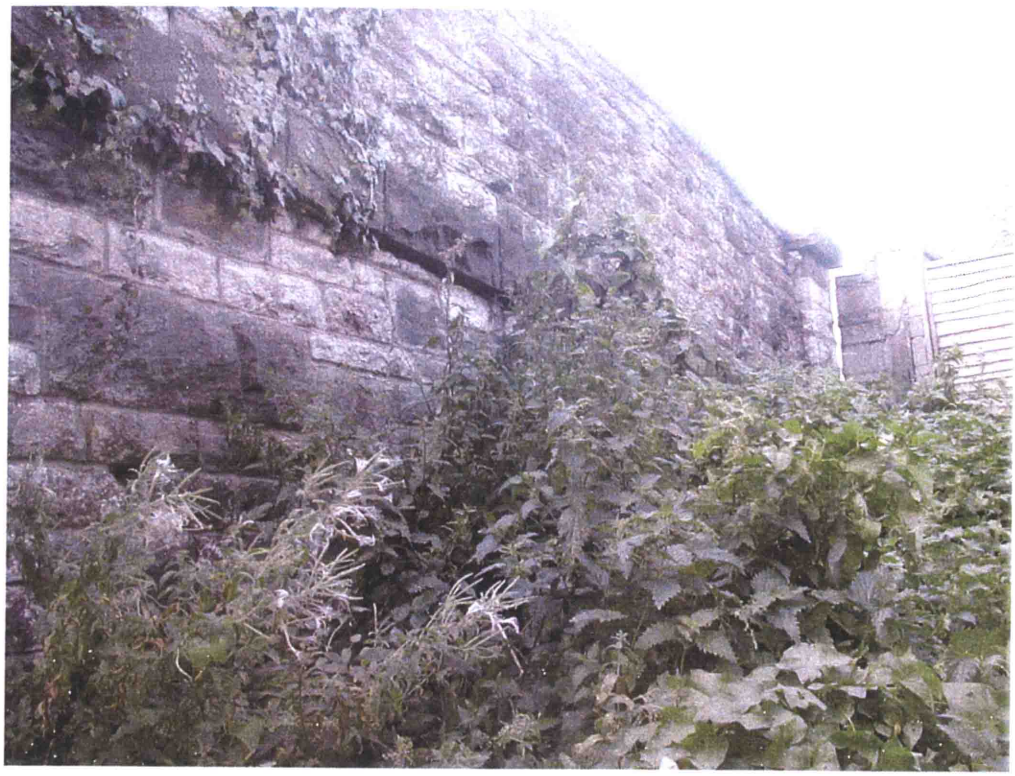
Photographs and Location of Defects

APPENDIX C – PHOTOGRAPH SCHEDULE

Photograph No	Title
1	General view looking west from underside of arch
2	General view looking southwest at east elevation
3	General view of northeast wingwall
4	View of northeast abutment showing mortar loss around the arch barrel and vegetation growth.
5	View of east section of north abutment
6	View of west section of north abutment
7	View of east section of south abutment
8	View of west section of south abutment
9	View of west section of south abutment and arch ring showing extensive mortar loss and staining indicating water seepage at springing
10	View of west section of north abutment and arch ring showing extensive mortar loss and staining indicating water seepage at springing
11	View of west section of south abutment showing extensive mortar loss and staining indicating water seepage at springing
12	View of springing level at the north abutment exhibiting evidence of water seepage.
13	Close up of west section of south abutment showing extent of mortar loss
14	View of east section of soffit of arch barrel exhibiting widespread mortar loss and staining due to extensive water seepage
15	View of west parapet
16	View of east parapet
17	General view of carriageway (shows likelihood of axle lift off)

Photograph 1 General view looking west from underside of arch

Photograph 2 General view looking southwest at east elevation



Photograph 3 General view of northeast wingwall

Photograph 4 View of northeast abutment showing mortar loss around the arch barrel and vegetation growth.

Photograph 5 View of east section of north abutment

Photograph 6 View of west section of north abutment

Photograph 9 View of west section of south abutment and arch ring showing extensive mortar loss and staining indicating water seepage at springing

Photograph10 View of west section of north abutment and arch ring showing extensive mortar loss and staining indicating water seepage at springing

Photograph 11 View of west section of south abutment showing extensive mortar loss and staining indicating water seepage at springing

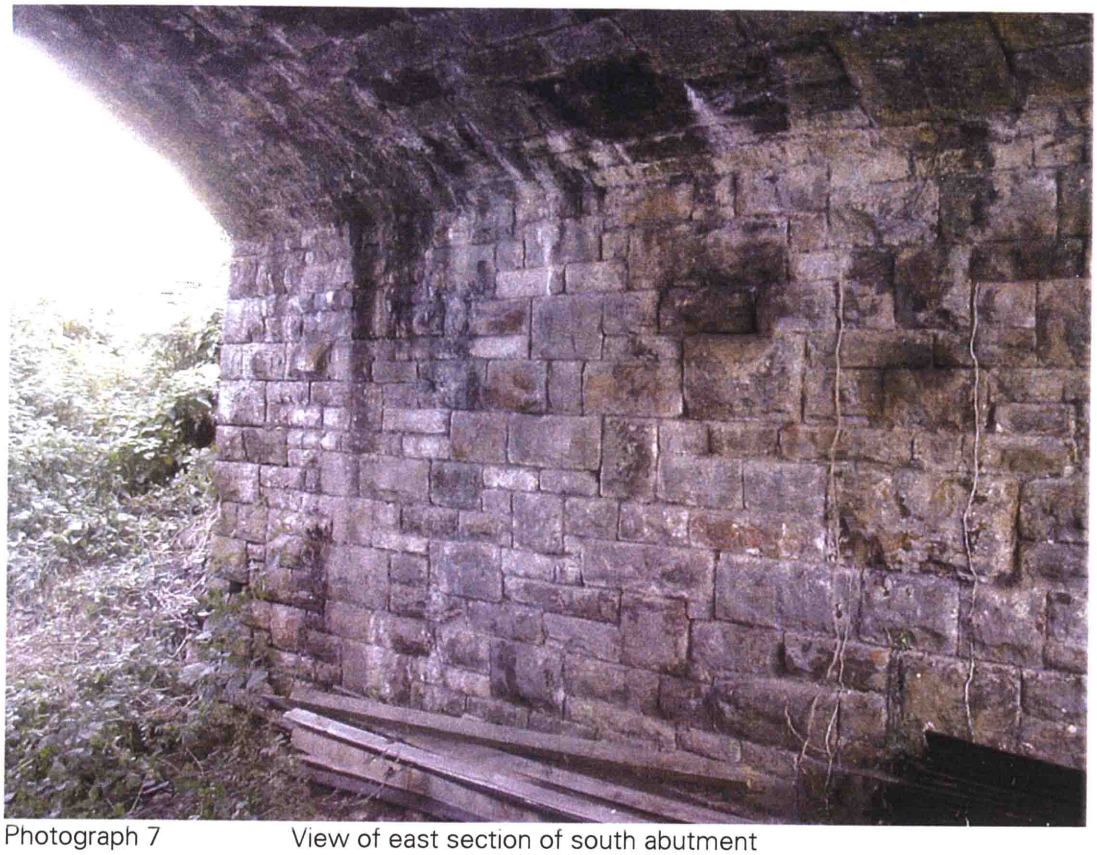
Photograph 12 View of springing level at the north abutment exhibiting evidence of water seepage.

Photograph 13 Close up of west section of south abutment showing extent of mortar loss

Photograph 14 View of east section of soffit of arch barrel exhibiting widespread mortar loss and staining due to extensive water seepage

Photograph 15 View of west parapet

Photograph 16 View of east parapet



Photograph 7 View of east section of south abutment

Photograph 8 View of west section of south abutment

Photograph 17 General view of carriageway (shows likelihood of axle lift off)

Appendix B1

Assessment Calculations

BABTIE			CALCULATION SHEET	
OFFICE Reading	PAGE No.	01	CONT'N PAGE No.	
JOB No. & TITLE WHITCHURCH BRIDGE FNS-3/4H	ORIGINATOR	VKC	DATE	Oct-02
SECTION	CHECKER	IM 4/11	DATE	Nov 02 22/11/02

Introduction

Whitchurch Bridge is a single span (26'1½") stone masonry arch structure which is in poor condition and with some defects which are likely to affect the long-term durability. These defects have been taken into account in the assessment calculations.

The MEXE method described in BE4 Part III has been used for the assessment/analysis exercise.

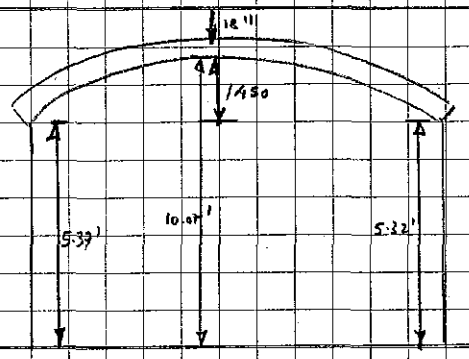
Results

The single span arch structure can carry 24T veh to BE4 requirements.

BABTIE **CALCULATION SHEET**

OFFICE	Reading	PAGE No.	02	CONT'N PAGE No.	
JOB No. & TITLE	Whitchurch Bridge FNS 3/44	ORIGINATOR	VKC	DATE	Oct. 02
SECTION		CHECKER	IM	DATE	Nov 02.

MEXE method to BE4



10.07' - 5.37' 10.07' - 5.32'

r_c = 4.70' 4.75'

= 1.4478 ≈ 1.45 m ✓

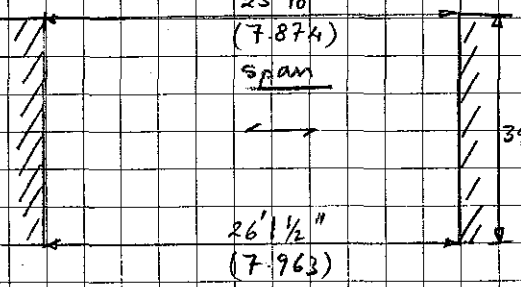
r_q = 8.77' - 5.32' = 3.45' = 1.052 m ✓

h = 0.400 m @ crown. Fill

d = 18" ≈ 0.457 m

(h+d) = 0.4 + 0.457 = 0.857 m

= 33.74" ✓



(Measurements taken from as built drawings and checked against site measurements)

F_b = 1.0 ✓

F_f = 0.7 ✓

F_w = 0.9 ✓

F_d = 0.8 ✓

F_{mo} = 0.9 ✓

F_c = 0.8 ✓

Span/Rise Ratio $\ell/r_c = \frac{7.963}{1.45} = 5.49$ ✓

Fig. 7 : F_{sr} = 0.805 ✓

Profile Factor : $r_q/r_c = \frac{1.054}{1.45} = 0.726 < 0.75 \Rightarrow F_p = 1.0$ ✓

Material Factor $F_m = \frac{F_b \times d + F_f \times h}{(h+d)}$

$F_m = \frac{1.0 \times 0.457 + 0.7 \times 0.4}{(0.457 + 0.4)} = 0.8599 \simeq 0.86$ ✓

BABTIE **CALCULATION SHEET**

OFFICE		PAGE No.	03	CONT'N PAGE No.	
	Reading				
JOB No. & TITLE	Whitchurch Bridge FNS 3/44	ORIGINATOR	VKC	DATE	Oct. 02
SECTION		CHECKER	IM	DATE	Nov 02

Joint Factor : $F_j = F_w \times F_d \times F_{mo}$

$F_j = 0.9 \times 0.8 \times 0.9 = \underline{0.648}$ ✓

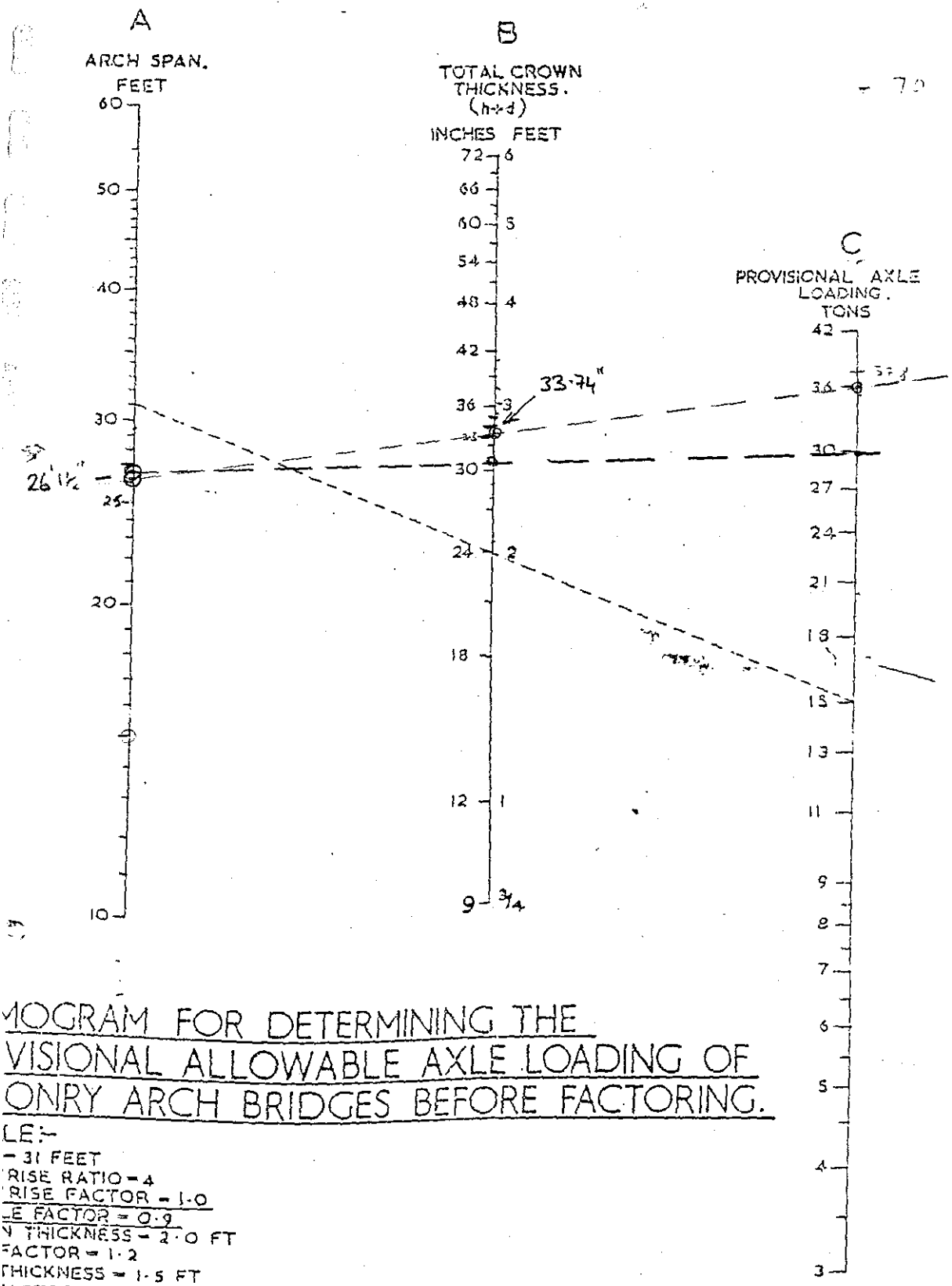
PAL from Graph No. 13 = 36 Tons

Allowable Axle Load = $36 \times 0.805 \times 1.0 \times 0.86 \times 0.648 \times 0.8$
(F_{sr} F_p F_m F_j F_c)

= 12.92 Tons ✓

BE4, Part III, 2.0 > 9 tons ∴ O.K for 24T

Arch Ring can carry 24T veh. ✓



MOGRAM FOR DETERMINING THE VISIONAL ALLOWABLE AXLE LOADING OF ONRY ARCH BRIDGES BEFORE FACTORING.

LE:-

= 31 FEET
RISE RATIO = 4
RISE FACTOR = 1·0
E FACTOR = 0·9
N THICKNESS = 2·0 FT
FACTOR = 1·2
THICKNESS = 1·5 FT
ACTOR = 0·7
DEPTH = 0·50 FT
RIAL FACTOR = 1·07 — $\frac{1·2 \times 1·5 + 0·7 \times 0·5}{2·0}$
FACTOR = 0·9
FACTOR = 0·9
AR FACTOR = 1·0
FACTOR = 0·81 — $0·9 \times 0·9 \times 1·0$
TION FACTOR = 0·6

ROVISIONAL AXLE LOADING FOR AN ARCH, 31 FT SPAN AND CROWN THICKNESS OF 2·0 F
OM THE NOMOGRAM, 15 TONS.
WABLE AXLE LOAD = 15 X 1·0 X 0·9 X 1·07 X 0·81 X 0·6 = 7·42 TONS
-Y A 7 TON AXLE LOAD RESTRICTION TO THE BRIDGE.

Appendix C1

Form BA

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FORM 'BA' (BRIDGES)

Document prepared in accordance with: **GC/TP0356**
Appendix: 5
Issue: 1
Revision: A
Date: FEB 93

CERTIFICATION FOR ASSESSMENT CHECK

NOTIFICATION OF ASSESSMENT CHECK

STRUCTURE NAME/ROAD NO. Whitchurch Bridge, Bristol

LINE NAME (Disused Branch Line) ELR CODE/STRUCTURE NO. FNS-3/144

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 restriction is as follows:

STATEMENT OF CAPACITY

24 tonnes

Critical member/s: None

RECOMMENDED LOADING RESTRICTIONS

N/A

DESCRIPTION OF STRUCTURAL DEFICIENCIES AND RECOMMENDED STRENGTHENING

N/A

[redacted]

	Date
(Structural Assessment Engineer)	14/1/03
	Date
(Civil Engineer)	13/1/2003

Babtie

FORM `BA' (BRIDGES)

Document prepared in accordance with: **GC/TP0356**
Appendix: 5
Issue: 1
Revision: A
Date: FEB 93

CERTIFICATION FOR ASSESSMENT CHECK

STRUCTURE/LINE NAME.....WHITCHURCH BRIDGE, BRISTOL.....

CATEGORY OF CHECK.....1..... ELR CODE/STRUCTURE NO...FNS-3/144.

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

(i) It has been assessed in accordance with the Approval in Principle (where appropriate) as recorded on Form AA approved on ..13/11/02..... (DATE).

(ii) It has been checked for compliance with the following principal British Standards, Codes of Practise, BR Technical note and the Assessment standards.

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).

CATEGORY 1

[redacted]

	Date
(Assessor)	22/11/02
(Assessment Checker)	22/11/02
(Partner of the firm of consulting engineers to whom checker is responsible)	22/11/02

CATEGORY 2 AND 3 (Note: Category 1 Check Must Also Be Signed

(a) ASSESSMENT

Name & Qualifications	Signature		Date
		(Assessor)	
		(BRB section engineer or the partner in firm of consulting engineers to whom checker/assessor is responsible)	

(b) CHECK

Name & Qualifications	Signature		Date
		(Assessor)	
		(BRB section engineer or the partner in firm of consulting engineers to whom checker/assessor is responsible)	

THE CERTIFICATE IS ACCEPTED BY... [redacted] .....03.