JACOBS

BRB (Residuary) Ltd

VAR9/830
03/04 BE4 Assessment Programme

ASSESSMENT AND INSPECTION REPORT

BE 4 1967 Assessment

Structure EBD/761

April 2004

JACOBS

Document control sheet Form IP180/B

Client BRB (Residuary) Ltd
Project 03/04 BE4 Assessment Programme Job No J20308B
Title Structure EBD/761

	Prepared by	Reviewed by	Approved by
ORIGINAL	NAME [redacted]	NAME	NAME
DATE 1/7/04			
REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE
REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE
REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE

JACOBS

JacobsGIBB Ltd
West Offices, City Business Centre
Station Rise, York
YO1 6HT, UK
Tel +44 (0)1904 524785
Fax +44 (0)1904 523040

Contact [redacted]
Email [redacted]

Our Ref 041581-NAR-J24110

Date 28 March 2006

[redacted]
BRB (Residuary) Ltd
Room C5
Hudson House
YORK
YO1 6HP

De[redacted]

Structure EBD/761 (VAR9 830)

Bridge EBD/761 currently fails on jack arch details The existing archive sketch states that the jack arch thickness is 6"

Jacobs have reviewed the site levels and trail pit results The trial pit uncovered a concrete backing to the jack arch, the concrete was not broken out so the jack arch extrados was not located The thickness of the jack arch and concrete was calculated as 177mm (6 97") by a closed levelling circuit

The arch barrel thickness (including concrete fill above) is deemed to be compliant if it is greater than 220mm in accordance with the approved pro forma for empirical assessment for jack arches

Therefore the jack arch and concrete thickness at EBD 761 is non compliant

Two options are available to progress the assessment result

1 Carry out another SI to determine the thickness of the jack arch by coring and check the thickness in a number of locations to ensure a representative thickness is obtained (Cost is likely to be £3000 -£4000 but would still need a tie-bar installation scheme)

2 Implement a structural backing and tie-bar scheme to strengthen the bridge to BE4 loading (Cost is likely to be approx £25,000)

[redacted]

Contents

1 General Description and Structural Details

1.1 Location

Structure EBD/761 is located on the Ellan to Bodam disused railway line at a Grid Reference of NJ992319 The structure is named Ackmakoy and carries a public road

1.2 Construction type

The structure is a single span cast iron jack arch The deck comprises of 6 No longitudinal girders with transverse spanning brick jack arches The abutments wingwalls and pilaster are constructed from masonry, the parapet is of metallic construction.

2 Existing Information Search

2.1 Information Used to Form Assessment

The following documents were provided by BRB (Residuary) Ltd

Historical bridge assessment report

Visual and detailed examination reports

2.2 Ground Investigation/ SI Results

An inspection pit was excavated on the bridge deck in the east verge

The excavation determined the depth and composition of the fill and the condition and level of the top flange of the internal girder

See appendix E for the site investigation results

2.3 Existing Drawings

Existing sketches were provided

2.4 Services Search

A comprehensive search of existing services has been carried out in the vicinity of the bridge This involved contacting the Statutory Undertakers who may own plant in the area

Full details of all the organisations contacted and their responses can be found in Appendix F

Unfortunately responses from Scottish Water were not obtained at this stage

3 Structure Condition

3.1 External Girders

The external girders are generally in good condition, however, a complete loss of paint system is apparent over the bottom flange The majority of the paint system is still intact over the web and top flange The bottom flange shows minor corrosion with a section loss of up to 1mm in thickness The web, web stiffeners and top flange are all in good condition with no section loss.

3.2 Internal Girders

The internal girders have only their bottom flanges visible, these are generally in good condition with only minor corrosion (approximately 1mm loss of thickness section) There is a complete loss of paint system over the bottom flanges and the girders are slightly damp with leaching apparent

3.3 Jack arches

The structure comprises 5 jack arch bays The arches are generally in good condition with no major open joints or spalling A transverse fracture can be found near the south abutment in the west external bay, the fracture is approximately 0 5m long and is open to a width of approximately 5mm The fracture indicates that the external girder is moving outwards slightly and thus spreading the arch

3.4 Tie Bars

The structure comprises of three lines of tie bars The bars are situated approximately 100mm above the bottom flange level The bars are generally either severely corroded or completely missing in all the bays

3.5 Abutments

3.5.1 North Abutment

The north abutment is constructed of masonry and is found to be in good condition with no open joints or spalling Three joints have purposely been left open at ground level. These joints are 30mm wide and up to 1 5m in depth The wall is generally dry apart from the north east side which is slightly damp

3.5.2 South Abutment

The south abutment is also in good condition with no open joints or spalling Again three joints are open at ground level to the same width and depth of the north abutment Joint fractures are apparent under each external girder indicating lateral movement of the external girders due to the lack of horizontal restraint The fractures are open to approximately 10mm and are approximately 2m long

The south abutment has pins inserted horizontally behind and beneath the external girder, their purpose is unknown

3.6 Wingwalls

3.6.1 North West Wingwall

The north west wingwall is in good condition with minor open joints and no vegetation growth over the face

3.6.2 North East Wingwall

The north east wingwall is in good condition, no open joints or spalling and no vegetation growth over the face

3.6.3 South East Wingwall

The south east wingwall is generally in good condition with minor open joints The wall has minor vegetation growth over its face.

3.6.4 South West Wingwall

The south west wingwall is also in good condition with minor open joints The wall has minor vegetation growth over its face

3.7 Parapets

Both inside and outside faces of the parapets are in good condition but are found to have a complete loss of paint system The four pilasters are also in good condition with their coping stones in place Wooden fencing is located adjacent to each pilaster, this has collapsed to the east side of the bridge, the west side has been recently replaced.

3.8 Carriageway

The bridge carries a public road, which is found to be in good condition with no surface fractures, two verges are also located on either side of the road

3.9 Formation

The old disused railway formation has now been grassed over and is generally clear from vegetation To the east and west of the bridge the formation is in a steep sided cutting

Appendix A - Photographs

1 **View of carriageway and verges looking south**

2 **Broken fence adjacent to south east pilaster**

3 **West Elevation**

4 **East Edge Girder**

5 **Jack Arches**

6 **Edge jack arch bay and broken tie bars**

7 **South Abutment**

8 **North Abutment**

9 **North West Wingwall**

10 **South East Wingwall**

11 **South West Wingwall**

12 **North East Wingwall**

13 **Trial pit in east verge**

14 **Trial pit reinstatement**

Appendix B - Form AA

FORM 'AA' (BRIDGES)

GC/TP0356
Appendix 4
Issue: 1
Revision B (Nov 2000)

ELR/ Bridge No **EBD 761 (VAR9/830)**

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Bridge/Line Name Auchmacoy bridge

ELR/Bridge No. EBD/761

Brief Description of Existing Bridge:

(a) Span Arrangement

Single square span of 4 540

(b) Superstructure Type

Cast iron girder overbridge with transverse spanning brick jack arches and metallic parapet

(c) Substructure Type

Large coursed masonry abutments and wingwalls

(d) Details of any Special Features

Internal and edge beams are of different section

Assessment Criteria

(a) Loadings and Speed

Dead loads and section sizes shall be determined from site measurements and existing drawings Vehicle loading obtained from and applied in accordance with BE4 Standard BE4 loading representative of 24 ton vehicles will be assessed

(b) Codes to be used

BE4 "The assessment of construction and use vehicles" Ministry of Transport, 1967 With Amendments to 1969

(c) Proposed Method of Structural Analysis

BE4/1967 will be used for the assessment

The longitudinal girders will be treated as simply supported and assessed in accordance with BE4 Part II Section 3

The jack arches and associated ties shall be assessed using an empirical assessment of brick, masonry and concrete jack aches and associated ties This method is a departure from standard and is outlined by RPL in the VAR-671 BE4 Assessment letter dated 16 October 2001

Measured dimensions taken from the site investigation and existing drawings are to be used in the BE4 calculations

(d) Details of any Special Requirements

FORM 'AA' (BRIDGES)

GC/TP0356
Appendix 4
Issue 1
Revision B (Nov 2000)

ELR/ Bridge No . **EBD 761 (VAR9/830)**

APPROVAL IN PRINCIPLE FOR ASSESSMENT

None

Senior Civil Engineer's Comments

None.

Proposed Category for Independent Check .

Superstructure I

Substructure I

Name Of Checker Suggested If Cat 2 Or 3

Category 1

The above assessment, with amendments shown, is approved in principle

Signed [redacted]
Title Civil Engineer
Date 16/4/04

Category 2 and 3

The above assessment, with amendments shown, is approved in principle

Signed
Title
Date

Signed
Title
Date

Appendix C - Summary of BE4 Results and Recommendations

Summary of calculations

The internal and external girders were assessed to BE4 and they were found to PASS the assessment

Considering an empirical assessment of the edge beams and transverse ties, a 24 ton gross vehicle weight capacity has been found if new (or extra) tie rods are installed and the barrel thickness is made compliant

The jack arches are not compliant with the minimum arch barrel thickness stated in the empirical assessment method

Therefore, the capacity of the structure is 24 tons if extra tie rods are installed

Recommendations

Jacobs recommends that additional tie bars are to be placed on the structure for additional lateral restraint The arches can be saddled with 50mm or more of concrete to meet the minimum barrel thickness requirements

Appendix D - Form BA and BAA

FORM 'BA' (BRIDGES)

GC/TP0356
Appendix 4
Issue: 1
Revision A (Feb 1993)

ELR/ Bridge No ...EBD 761 (VAR9/830)

CERTIFICATION FOR ASSESSMENT CHECK

Assessment Group - JacobsGIBB Ltd

Bridge/Line Name – Auchmacoy Bridge

Category Of Check - 1

ELR/ Bridge No. – EBD / 761

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 16/06/04

(2) It has been checked for compliance with the following principal British Standards, Codes of Practice, BRB (Residuary) Limited Technical notes and Assessment standards

BE4 " The assessment of construction and use vehicles" Ministry of Transport, 1967 With Amendments to 1969

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]

te

25/6/04

1/7/04

2/7/04

Assessor

Assessment Checker

Partner Of the Firm Of Consulting Engineers To Whom Assessor/ Checker Is Responsible

Category 2 and 3 (Note Category 1 Check Must Also Be Signed)

(a) Assessment

Name	Signature	Date	
			Assessor
			Assessment Checker
			Partner Of the Firm Of Consulting Engineers

FORM 'BAA' (BRIDGES)

GC/TP0356
Appendix 4
Issue 1
Revision A (Feb 1993)

ELR/ Bridge No ...EBD 761 (VAR9/830)

CERTIFICATION FOR ASSESSMENT CHECK

Notification of Assessment Check

Assessment Group – JacobsGIBB Ltd

Bridge Name/Road No. – Auchmacoy Bridge

Line Name – Ellan to Bodam Branch Line

ELR Code/Structure No. – EBD / 761

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

24 Tons if extra tie rods are installed and the arch barrels are strengthened

Critical member/s Tie bars / jack arch barrels

Recommended Loading Restrictions

A restriction appropriate to the above is to be implemented

Description of Structural Deficiencies and Recommended Strengthening

Jacobs recommends that additional tie bars are to be placed on the structure to provide additional lateral restraint and that the arch barrels are saddled with at least 50mm structural concrete so they comply with the minimum thickness requirement

[redacted] Date 25/6/04 — Assessor

1/7/04 — Assessment Checker

12/7/04 — Partner Of the Firm Of Consulting Engineers To Whom Assessor/

This Certificate Is Accepted By ... [redacted]

FORM 'BA' (BRIDGES) **GC/TP0356**

Appendix: 4

ELR/ Bridge No ...EBD 761 (VAR9/830) Issue: 1

Revision: A (Feb 1993)

CERTIFICATION FOR ASSESSMENT CHECK

To Whom Assessor/
Checker Is Responsible

(b) Check

Name	Signature	Date	
			Assessor
			Assessment Checker
			Partner Of the Firm Of Consulting Engineers To Whom Assessor/ Checker Is Responsible

This Certificate Is Accepted By .. . .

[redacted]

Appendix E - Site Investigation Results

STRUCTURAL SOILS

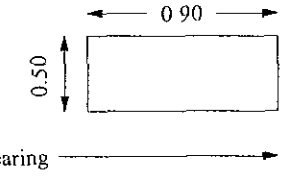
TRIAL PIT LOG

Contract	Client	Trialpit No
BE4 BRIDGES - EBD/761	JACOBS	TP 01

Job No	Date	Ground Level	Co-Ordinates	Sheet
36206	12.02.04			1 of 1

Samples and In-situ Tests				Water	Description of Strata	Depth (Thickness)	Legend
Depth	No	Type	Results				
					Topsoil	0.15	
					MADE GROUND Brown slightly silty very sandy angular to sub angular fine to coarse GRAVEL od granite and assorted volcanic rocks Occasional cobbles.	0.35	
					MADE GROUND Black bitumen sealer 0.37m - steel top flange.	0.37	

Plan (Not to Scale)



General Remarks

1 EASE OF EXCAVCATION EASY
2 SIMILARITY OF FACES ALL SIMILAR (concrete fill noted over jack arch, concrete not excavated)
3 STABILITY OF FACES ALL STABLE
4 WATER NONE ENCOUNTERED

All dimensions in metres	Method	Logged By	Checked By
Scale 1:25	Inspection pit	MD	

Appendix F - Services Search

EAD/761

Transco

95 Kilbirnie Street,
Glasgow G5 8JD

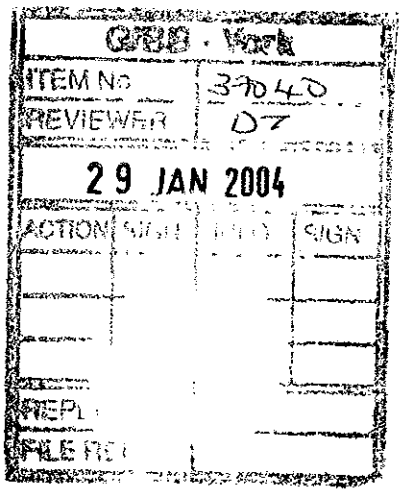
Our Ref SC/27 01 04/AM225/51724

Your Ref 36793-B220-I20308B-DT1

Date 27 January 2004

[redacted]

Jacobs Gibb Ltd
West Offices
City Business Centre
Station Rise
York, YO1 6HT



24 hour gas escape number 0800 111 999

Calls will be recorded and may be monitored

Dear Sir / Madam,

Re: Proposed Works Enquiry at: Various Locations, .

Transco acknowledges receipt of your notice of your intention to carry out work at the above location

Transco will contact you prior to your intended start date indicated in your correspondence.

We enclose an extract from our mains records in the location of the area covered by your proposals together with a comprehensive list of precautions for your guidance This plan shows only those pipes owned by Transco in its role as a Licensed Gas Transporter (GT) Gas pipes owned by other GT's and also privately owned may be present in this area Information with regard to such pipes should be obtained from the owners The information shown on this plan is given without obligation, or warranty, the accuracy thereof cannot be guaranteed Service pipes, valves, siphons, stub connections, etc , are not shown but their presence should be anticipated Your attention is drawn to the information and disclaimer on these plans The information included on the enclosed plan should not be referred to beyond a period of 28 days from the date of issue

You will note the presence of our Low/Medium/Intermediate Pressure gas main in the proximity to your site NO mechanical excavations are to take place above or within 0 5 m of the Low pressure system, 2m of the medium pressure system and 3metres of the intermediate pressure system You should where required CONFIRM THE POSITION of mains using HAND DUG TRIAL HOLES

A colour copy of these plans and the gas safety advice card should be passed to the senior person on site in order to prevent damage to Transco plant and potential direct or consequential costs to your organisation.

Safe digging practices, in accordance with HSE publication HSG47 "Avoiding Danger from Underground Services", must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus In addition please follow the advice given on the gas safety card

It must be stressed that both direct and consequential damage to gas plant can be dangerous both for your employees and the general public, repairs to any such damage will incur a charge Your works should be carried out in such a manner that we are able to gain access to our apparatus throughout the duration of your operations

Should you require any further assistance before starting any works please contact the number below

Yours faithfully,

Please note maps are not sent for areas in which Transco have no gas

[redacted]

NJ9832NW
Map not held by Transco

NJ9832NE
Map not held by Transco

NJ9832SW
Map not held by Transco

NJ9832SE
Map not held by Transco

NK0032SW
Map not held by Transco

NJ9831NW
Map not held by Transco

NJ9831NE
Map not held by Transco

NK0031NW
Map not held by Transco

NJ9831SW
Map not held by Transco

NK0031SW
Map not held by Transco

SCALE: Not to scale

USER ID: am225

DATE: 26/01/2004

Transco INTERNAL USE ONLY

GRID REFERENCE :
399340, 832009, NJ9932

LP MAINS
MP MAINS
IP MAINS
LHP MAINS
NHP MAINS
LAs
GTs
SSSIs

Some examples of Plant Items:
Valve | Depth of Cover | Syphon | Diameter Change | Material Change

This plan shows only those pipes owned by Transco plc in its role as a Licensed Gas Transporter (GT). Gas pipes owned by other GTs and also privately owned may be present in this area. Information with regard to such pipes should be obtained from the owners. The information shown on this plan is given without obligation, or warranty, the accuracy thereof cannot be guaranteed. Service pipes, valves, syphons, stub connections, etc., are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Transco plc, its agents or servants for any error or omission. Safe digging practices, in accordance with HS(G)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus. The information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

Desktop MAPS Version 4.0.1

Transco

Glasgow FBD/761

Atkins Telecoms
PO Box 290
220 Aztec West
Park Avenue
Almondsbury
BRISTOL BS32 4SY

Tel 01454 288808
Fax 0870 2403012
Email osm enquiries@atkinsglobal com

Jacobs Gibb Ltd
WEST OFFICES, CITY BUSINESS CENTRE
STATION RISE
YORK
YO1 6HT

Our Ref NRSWA/544/158498
YourRef 36890-B220-J20308B-DT1

FAO [redacted]

Date 23 January 2004

Dear Sirs,

New Roads and Street Works Act 1991
:2 Plant Enquiry re Highway Land only - Plant Affected

Thank you for your enquiry regarding works at PAL/3, for proposed WORKS

Cable and Wireless UK have apparatus in the vicinity of your proposed scheme We have enclosed plans showing the approximate position of the apparatus, please note the disclaimer on the plans

telecoms

[redacted]

THE OTHER SITES IN THE ENQUIRY ARE NOT AFFECTED.

Atkins Telecoms
220 Aztec West
Park Avenue
Bristol
Avon BS32 4SY
England

Telephone +44 (0)1454 201999
Fax +44 (0)1454 628799

telecoms@atkinsglobal com
www atkinsglobal com/telecoms

with compliments

Yours Faithfully,

OSM , U K and Ireland
Acting as agent for and on behalf of Cable and Wireless UK

Please note To enable us to process your application as quickly as possible, please ensure that you include a post code and/or an Ordnance Survey Grid Reference Thank you for your co-operation

The ntl Tower
Jagger Lane
Emley Moor
Huddersfield
West Yorkshire
HD8 9EQ

www.ntl.com

t 01924 508000
f 01924 508939
e firstname.surname
@ntl.com

ITEM No.	37019
REVIEWER	DT
5 MAY 04	

ACTION	SIGN	INFO	SIGN
REPLY DATE			
FILE REF			

Jacobs Gibb
West Offices
City Business Centre
Station Rise, York
YO1 6HT

26 January 2004

RESPONSE TO YOUR REQUEST FOR PLANT LOCATION INFORMATION
HEALTH & SAFTEY AT WORK ACT 1974 HS (G) 47
NEW ROADS AND STREET WORKS ACT 1991 SECTION 79 (3)

A O [redacted]
Your Ref 103175
Our Ref 36911-B220-J20308B-DT1

Location AGB/3, AGB/5, DAS2/20,
END/714, EBD/761, FHB/1043 +
ELW/9

EBD/761

Dear Sir or Madam

Response to your notice for the above reference we can confirm that, at present, we do not have any apparatus at the location indicated and we do not propose any work in this area in the near future

If we can be of any further assistance, please do not hesitate to contact us on 0870 0130045 or fax on 01924 508939

Yours Faithfully

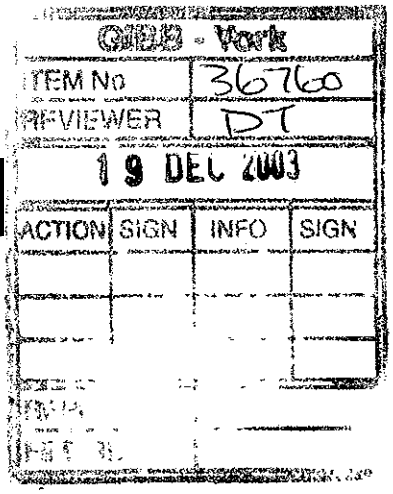
[redacted]
ntl Plant Protection

ntl endeavour to respond to your enquiries within a short timescale Please ensure that OS grid reference numbers and location plans are provided, along with the correct Postal address and fax number

ntl Business Limited
Registered Office:
ntl House
Bartley Wood Business Park
Hook
Hampshire
RG27 9UP

Registered in
England and Wales
number 3076922

Your reference -



[redacted]
West Offices
City Business Centre
Station Rise
YORK
YO1 6HT

Mapping Services (North)
Inveralmond House,
200 Dunkeld Road
Perth
PH1 3AQ
15/12/2003

If you require further information please call the District number on the location plan

EBD/761

FHB/1043

Dear Sir/Madam

FHB/1043, EBD/761

In response to your enquiry of 11 DECEMBER 2003 regarding the location of electricity cables and equipment at the above, copies of our Record Plans are enclosed

The plans show the positions and normal depths for the buried cables etc when they were installed It must be stressed, however, that alterations to road alignments, surface levels and buildings may have been made subsequent to the records being taken If you find plant or cables that are not marked or are incorrectly marked, then you are required to contact us as soon as possible to give us the opportunity to amend our records

It has not been possible to transfer our mains records onto your plan Please note that the plans supplied are based on the location/map information supplied by yourselves and, therefore,
YOU MUST SATISFY YOURSELF THAT OUR PLANS SUPPLIED ADEQUATELY COVER THE AREA THAT YOU REQUIRE

Please note that these records only show plant owned by Scottish and Southern Energy plc There may be other privately owned plant in the area, which is outside the control of Scottish and Southern Energy Electric plc You should check with the Local Authority, National Grid Co , Department of the Environment, other Regional Electricity companies etc. before proceeding

Avoidance of DANGER from BURIED CABLES

For more information, consult the Health & Safety Executive's booklet HS(G) 47 - obtainable from the HMSO Guidance notes are contained in Scottish and Southern Energy's 'Watch-It' leaflet, which sets out various do's and don'ts when digging near buried cables

I would particularly draw your attention to the need to take trial holes to determine the exact position and depth of cables to avoid the risk of injury to staff or damage to the cables

Where our Record plans indicate the presence of cables with a voltage exceeding 11,000 volts then you are advised to contact our Local Depot section on the above telephone number before commencing any excavations within the vicinity of these cables

Avoidance of DANGER from OVERHEAD LINES

For more information, consult the Health and Safety Guidance Note GS.6 obtainable from HMSO Scottish and Southern Energy's 'Watch-It' leaflet outlines the precautions to be taken.

Delivering your electricity

If in any doubt about the safety of working in the vicinity of overhead lines, please do not hesitate to contact our Local Depot at the above number

Cable Records - Service Connections

The location of service cables to individual properties, street lighting, traffic signs, telephone kiosks etc installed prior to the introduction of the Electricity Supply Regulation 1988 dated 1st October 1988 are not shown on the enclosed plans but details are available from our local depot NORTH EAST DISTRICT tel 01224 287600

General Advice

a) Please ensure, where appropriate, that your CONTRACTORS have a copy of this letter and the enclosed plan(s)
b) Please note that the cost of any repairs or claims against Scottish and Southern Energy as a result of your works will be invoiced to you or your contractor
c) Scottish and Southern Energy retains the right to its property, including disconnected cables and recoverable materials

Should you require further information, please do not hesitate to contact me on the above telephone number.

[redacted]

Enclosures

- Mains Record Plans All Voltages	Y
- Mains Record Plans Gas	N
- 'Watch-It' for working near O/H lines	N
- 'Watch-It' for digging near U/G cables	N
- Other	

8800
004ha
01

8700
012ha
03

8500
012ha
03

8999
008ha
02
27 7m

8696
057ha
14

8792
057ha
14

8492
227ha
56

9391
162ha
40

8888
138ha
34

8288
243ha
60

8486
016ha
04

227ha

8182

25 3m

7182
194ha
48

Oldyard

8274
380ha
94

7974
081ha
20

7975
243ha
60

8272
963ha
2 38

9869

9402
024ha
06

9200
405ha
1 00

0005
2 832ha
7 00

0587
437ha
1 08

0784
801ha
1 98

1710
202ha
50

2700
1 734ha
4 29

2700
793ha
1 96

1990
178ha
44

2990
1 432ha
3 54

2983
822ha
2 03

Station House

Station Cottage

4182
251ha
62

3875
822ha
2 03

WARNING

Scottish and Southern Energy plc

BT wholesale

National Notice Handling Centre
PP 404B, Telecom House,
Trinity Street,
Hanley,
Stoke-on-Trent,
ST1 5ND

Freephone 0800 800 865

Our Ref 44668/NNHC/03

Your Ref:

Date AS POSTMARK

Dear Customer,

NR & SW ACT 1991 - PROPOSED WORKS AT :- AYL/2,DAK/86, KBE16 ETC

Thank you for your letter of 10/12/03 describing the above proposals

Enclosed are copies of our drawing marked up to show the approximate locations of BT apparatus which is present in the immediate vicinity of your works It is intended for general guidance only No guarantee is given of its accuracy

It should not be relied upon in the event of excavations or other works made near to British Telecommunications plc apparatus which may exist at various depths and may deviate from the marked route

To avoid damage it is recommended that mechanical excavators or borers are not used within 600mm of British Telecommunications plc plant If scaffolding is erected, please ensure that our equipment is not enclosed, blocked, covered or otherwise obstructed by the scaffolding

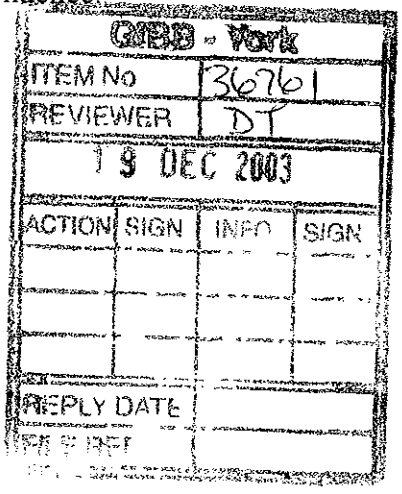
In the event of BT apparatus being in the area of works we recommend that your plant/vehicle crossing is either resited, or apply for a budget estimate by submitting detailed plans to the above address, these will be forwarded to the appropriate department for their comments

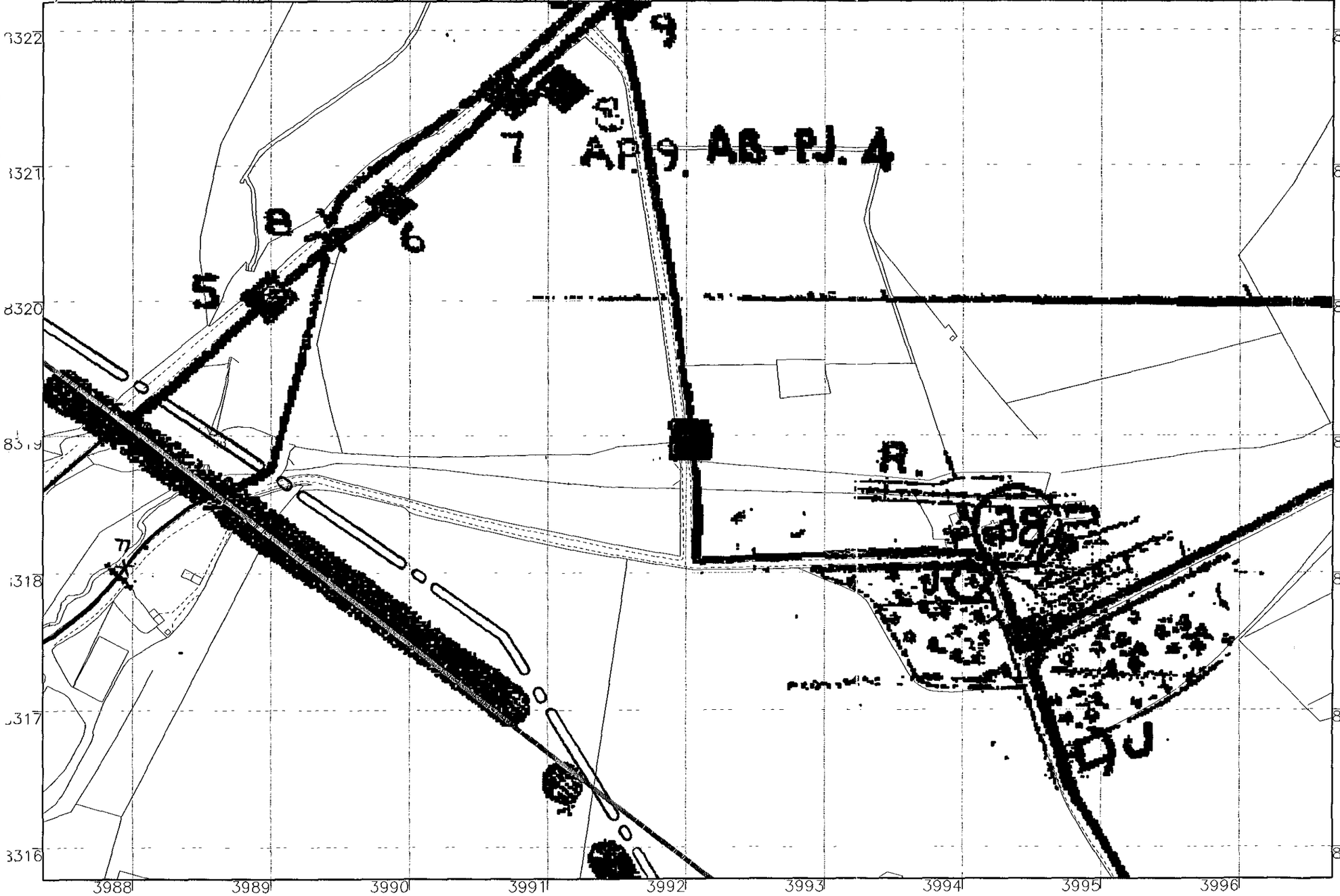
For free on site assistance prior to commencement of work please contact our Plant Protection Service by dialling 0800 9173993, or dial 100 and ask for "Freephone Dial before you dig" or Email DBYD@bt.com
We require 7 working days notice.

Please ensure you quote our reference on any future correspondence

Yours faithfully,

[redacted]





KEY TO BT SYMBOLS

- UNDERGROUND PLANT
- A/C, D/W or W — OVERHEAD PLANT
- JOINT BOX
- DISTRIBUTION POINT
- MANHOLE
- POLE
- CABINET
- BURIED JOINT
- J — JOINTING POST
- PROPOSED U/G
- A/C, D/W or W — PROPOSED O/H
- PROPOSED BOX

Other proposed plant is shown using dashed lines.

BT symbols not listed above may be disregarded.

Existing BT plant may not be recorded.

Information valid at the time of preparation.

FOR FREE ON SITE LOCATION & MARKING SERVICE CALL THE EXCHANGE OPERATOR AND ASK FOR:-

FREEPHONE
0800 9173993

IMPORTANT WARNING
Information regarding the location of BT apparatus is given for your assistance and is intended for general guidance only No guarantee is given of its accuracy It should not be relied upon in the event of excavations or other works being made near to BT apparatus which may exist at various depths and may deviate from the marked route

PLANT INFORMATION REPLY — British Telecommunications plc

Notes:

399200,831900 FBD/761

If more information is required please submit larger scale plans

wmaxw24 15/12/2003

Appendix G - Calculations

JACOBS **CALCULATION SHEET**

Project Title VAR 9/830 BE4 1967 ASSESSMENTS			Sheet No 1
Subject EBD/761			Calc No
Job No J20308B-1142			File
Made by JCW	Date	Revised	Date
Checked by JLR	Date 9/7/04	Checked by	Date

DEAD LOADS

Scale — EXTERNAL GIRDER - SECTIONAL AREA = 27616 mm² = 0.028 m²

1 mm loss of section is reported (inspection report) should be ignored as negligible

1 mm loss of section 29054 mm²
No section loss 29435 mm² OK

BE4, Page 4 — CAST IRON = 450 lbs/ft³ = 70.69 kN/m³

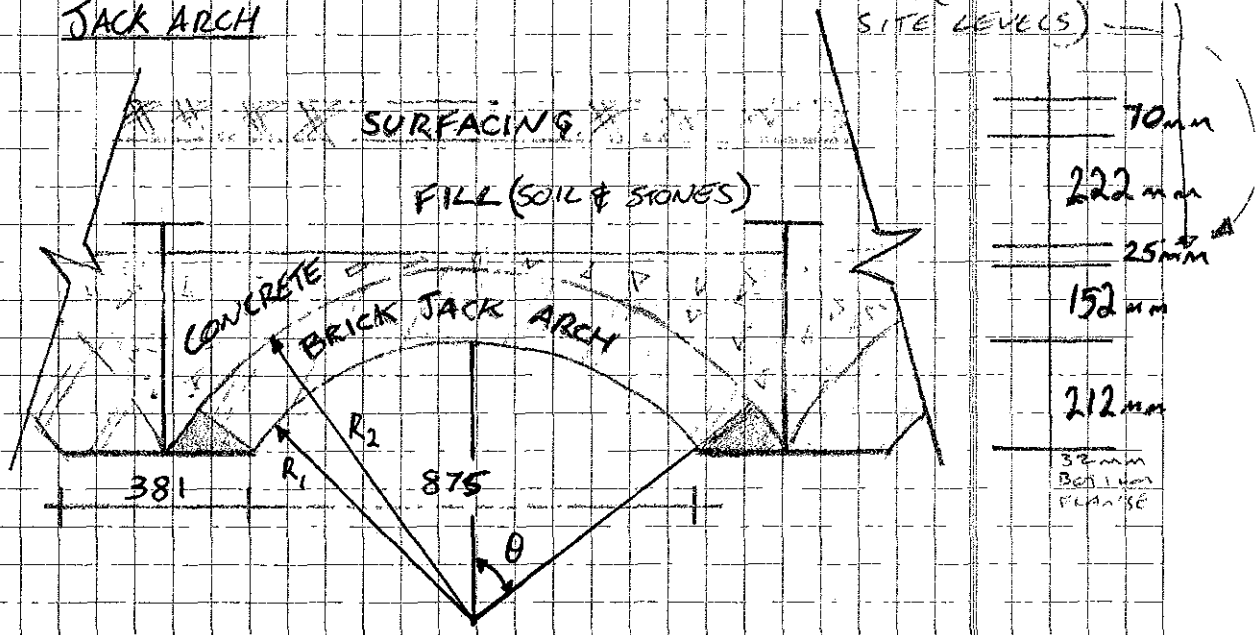
∴ 0.028 × 70.69 = **1.98 kN/m**

Scale — INTERNAL GIRDER - SECTIONAL AREA = 29638 mm² = 0.0296 m²

∴ 0.0296 × 70.69 = **2.1 kN/m**

CONCRETE ABOVE JACK ARCH (TAKEN FROM SITE LEVELS)

JACK ARCH



$$R_1 = \frac{212}{2} + \frac{875^2}{8 \times 212} = 106 + 451.43 = 557.43\text{mm}$$ ✓

$$R_2 = R_1 + \text{JACK ARCH} = 557.43 + 152.4 = 709.83\text{mm}$$ ✓

• AREA OF JACK ARCH BETWEEN RADIAL LINES

$= \tan\theta = \dfrac{(875/2)}{(557.43-212)} = \dfrac{437.5}{345.43} = 1.266537$

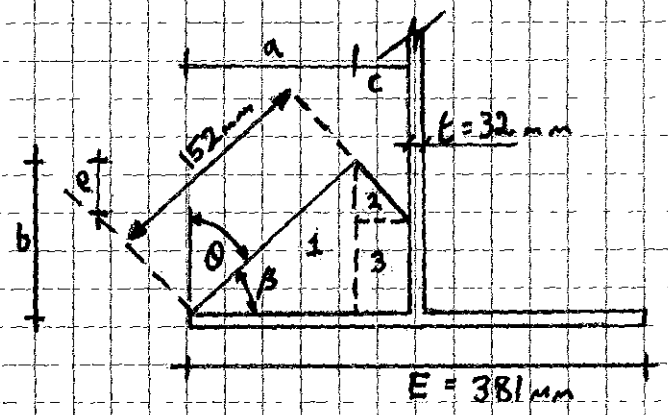
$\therefore \theta = 51.707°$ ✓

AREA $= \pi\left(R_2^2 - R_1^2\right)\dfrac{\theta}{180} = 3.14159\left(709.83^2 - 557.43^2\right)\dfrac{51.707}{180}$

$= 3.14159 \times 193130.424 \times 0.2873$

AREA $= 174315\,mm^2$ ✓

• AREA OF JACK ARCH OVER BOTTOM FLANGE



$\beta = 90 - \theta$

$= 90 - 51.707$

$= 38.29°$

$\therefore \cos\beta = 0.7849$

$\sin\beta = 0.6196$

$\tan\beta = 0.7895$

JACOBS **CALCULATION SHEET**

Project Title			Sheet No 3.
Subject			Calc No
Job No			File
Made by	Date	Revised	Date
Checked by JLR	Date 1/7/04	Checked by	Date

AREA 1

$= (152 \times 0.7849) \times (152 \times 0.6196) \times 0.5$

$= 0.5 \times 152^2 \times 0.7849 \times 0.6196$

AREA 1 = 5618 mm² ✓

AREA 2

$= \frac{ce}{2} = \frac{c^2}{2\tan\beta} = \left(\frac{E-t}{2} - 152\cos\beta\right)^2 \times \frac{1}{2\tan\beta}$

$\therefore \left(\left(\frac{381-32}{2}\right) - 152 \times 0.7849\right)^2 \frac{1}{2 \times 0.7895}$

$\therefore \frac{(174.5 - 119.3)^2}{1.579}$

AREA 2 = 1930 mm² ✓

AREA 3

$C = \left(\frac{E-t}{2}\right) - 152 \times 0.7849 = 174.5 - 119.3$

$C = 55.2\,mm$

$\text{AREA 3} = (b-e)C = \left(152\sin\beta - \frac{C}{\tan\beta}\right)C$

$= \left(94.18 - \frac{55.2}{0.7895}\right) \times 55.2$

AREA 3 = 1339 mm² ✓

JACOBS **CALCULATION SHEET**

Project Title			Sheet No 4
Subject			Calc No
Job No			File
Made by	Date	Revised	Date
Checked by JLR.	Date 1/7/04	Checked by	Date

TOTAL AREA OF JACK ARCH

$= 174315 + (2 \times (\text{AREA } 1+2+3))$

$= 174315 + (2 \times 8887)$

$= 192089\ mm^2 = \underline{0.19 m^2}$ ✓

MASONRY $= 144\ lbs/ft^3 = 22.62\ kN/m^3$

$\therefore 0.19 \times 22.62 = \underline{4.3\ kN/m}$ ✓

FILL - CONCRETE

$= 1257.3 \times (212 + 152 + 25)$ - AREA OF JACK ARCH

- ARCH SEGMENT - AREA OF INTERNAL GIRDER

UP TO CONCRETE LEVEL FROM TOP OF BOTTOM FLANGE.

$\therefore (1257.3 \times 389) - 192089 - \left[\pi \frac{557.4^2 \times 51.707}{180} - (557.4 - 212)\frac{875}{2}\right]$

$-(389 \times 32)$

$\therefore 489090 - (192089 + 129453 + 12448)$

$= 155100\ mm^2 = \underline{0.155 m^2}$ ✓

CONCRETE $= 150\ lbs/ft^3 = 23.56\ kN/m^3$ ✓

$\therefore 0.155 \times 23.56 = \underline{3.65\ kN/m}$ ✓

JACOBS **CALCULATION SHEET**

Project Title		Sheet No 5	
Subject		Calc No	
Job No		File	
Made by	Date	Revised	Date
Checked by GLR	Date 1/7/04	Checked by	Date

FILL - SOIL & STONES

AREA - AREA OF INTERNAL GIRDER PROTRUDING FROM THE CONCRETE.

$\therefore 1257.3 \times 212 - \left((152.4 \times 32) + (4.2 \times 32)\right)$

$279121 - 5027 = 274094\,mm^2$

$= 266548 - 5011$

$= 261537\,mm^2 = \underline{0.26\,m^2}$

EARTH, SAND, GRAVEL ETC. $= 135\,lb/ft^3 = 21.2\,KN/m^3$

$\therefore 0.26 \times 21.2 = \underline{5.5\,KN/m}$ $(= 5.8\,KN/m)$ ✓ accept

SURFACING

$1257.3 \times 70 = 88011\,mm^2 = \underline{0.09\,m^2}$

MACADAM $= 144\,lb/ft^3 = 22.62\,KN/m^3$

$\therefore 0.09 \times 22.62 = \underline{2.03\,KN/m}$

TOTAL DEAD LOAD - INTERNAL GIRDER

p.1	GIRDER S/W	= 2.1 KN/m	✓
p.4	JACK ARCH	= 4.3 KN/m	✓
p.4	CONCRETE	= 3.65 KN/m	✓
p.5	FILL	= 5.5 KN/m	
p.5	SURFACING	= 2.03 KN/m	✓
	TOTAL	= 17.6 KN/m	✓

JACOBS **CALCULATION SHEET**

Project Title			Sheet No 6
Subject			Calc No
Job No			File
Made by	Date	Revised	Date
Checked by GLR	Date 1/7/04	Checked by	Date

PARAPET - CAST IRON PLATE

Ref 2 SITE NOTES

1120 x 56 = 62720 mm² = 0.063 m²

CAST IRON = 450 lbs/ft³ = 70.69 kN/m³

∴ 0.063 x 70.69 = 4.45 kN/m ✓

VERGE - FILL IN PLACE OF SURFACING

$\frac{0.09}{2}$ = 0.045 m² ✓

EARTH, SAND, GRAVEL ETC. = 135 lbs/ft³ = 21.2 kN/m³

∴ 0.045 x 21.2 = 0.95 kN/m ✓

TOTAL DEAD LOAD - EXTERNAL GIRDER

GIRDER S/W	=	1.98 kN/m	✓
JACK ARCH /2	=	2.15 kN/m	✓
CONCRETE /2	=	1.83 kN/m	✓
FILL /2	=	2.75 kN/m	✓
PARAPET	=	4.45 kN/m	✓
VERGE	=	0.95 kN/m	✓
TOTAL	=	14.11 kN/m	✓

CALCULATION SHEET		Sheet No 1
Project Title VAR9-830 BE4		
Assessment EBD 761	Made by JCW	Date 16/12/03
Job No J20308B-1142	Checked by JK	Date. 1/1/04

Summary of calculations

External girders

	Dead load moment	12 59 tonft
Moment of resistance for live load		29 83 tonft
	M / K =	69 37 tonft
Graph 5	Assessed capacity =	24 tons Gross Vehicle Weight

Internal girders

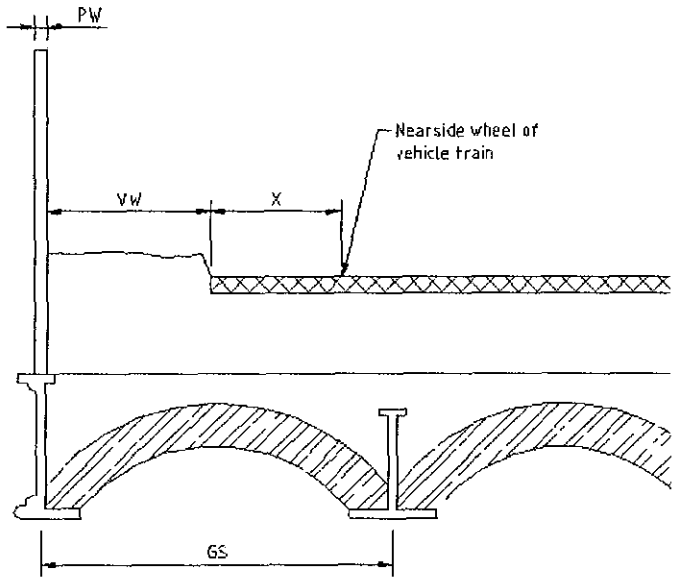
	Dead load moment	17 58 tonft
Moment of resistance for live load		45 31 tonft
	M / K =	138 13 tonft
Graph 5	Assessed capacity =	24 tons Gross Vehicle Weight

External girders - Empirical Assessment

Fails, due to heavily corroded tie bars

CALCULATION SHEET		Sheet No. 2
Project Title VAR9-830 BE4		
Assessment EBD 761	Made by: JCW	Date: 16/12/03
Job No J20308B-1142	Checked by JCR	Date. 1/7/04

Assessment of Longitudinal members



Parapet Width $P_w = 13mm$

Verge Width $V_w = 1100mm$

BE4 Part 1 302 — Line of Nearside Wheel (X) $X = 229mm$

External Girder to Nearside Wheel

$$Dist_{wheel} = \frac{P_w}{2} + V_w + X$$

$$Dist_{wheel} = 1335.5\,mm$$

Girder Spacing $G_s = 1257mm$ ✓

$$G_s < Dist_{wheel}$$

BE4 Part 2 301 — Therefore nearside wheels of the vehicle train has another member between them and the edge member

Edge girder is <u>not</u> therefore subject to live loading ✓

CALCULATION SHEET		Sheet No 3
Project Title. VAR9-830 BE4		
Assessment EBD 761	Made by JCW	Date· 16/12/03
Job No· J20308B-1142	Checked by	Date 1/7/04

External Girder Assessment

Dead Loads

From BD 21/97

Girder Self Weight	$G_{sw} = 1\,98\,\frac{kN}{m}$	✓
Jack Arch	$JA_{sw} = 2\,15\,\frac{kN}{m}$	✓
Concrete	$C_{sw} = 1\,83\,\frac{kN}{m}$	✓
Fill (soil & stones)	$SS_{sw} = 2\,75\,\frac{kN}{m}$	✓
C I Parapet	$P_1 = 4\,45\,\frac{kN}{m}$	✓
Verge	$Vsw = 0\,95\,\frac{kN}{m}$	✓

Total Loading

$$W_{total} = G_{sw} + JA_{sw} + C_{sw} + SS_{sw} + P_J + Vsw$$

$$W_{total} = 14\,11\,\frac{kN}{m}$$

Dead Load Moment

BE4-Part 1-303a (iv) Effective span where the beam rests directly on hard material and there are no bearing stiffners

Clear Span $C_{span} = 4572mm$ ✓

Beam depth (at support) $B_{depth} = 508mm$ ✓

Span L = Clear Span + (2/3 x 1/4 x beam depth)

$$Span_L = C_{span} + \left[\left(\frac{2}{3}\right)\left(\frac{1}{4}\right)B_{depth}\right]$$

$$Span_L = 4657\,mm$$

Therefore $M_d = \frac{W_{total}\left(Span_L^{\,2}\right)}{8}$ $M_d = 38\,246\,kN\,m$

$M_d = 12\,59\,ton\,ft$ ✓

CALCULATION SHEET		Sheet No 4
Project Title VAR9-830 BE4		
Assessment EBD 761	Made by: JCW	Date 16/12/03
Job No J20308B-1142	Checked by JCR.	Date 1/7/04

Stress due to dead load

$I_{xx} = 0.96626 \times 10^9 mm^4$ $\quad I_{xx} = 2321.45\ in^4$

$y_{bot} = 222.29mm$ $\quad y_{bot} = 8.75\ in$

$D = 508mm$ $\quad D = 20\ in$

$y_{top} = D - y_{bot}$

$y_{top} = 285.71\ mm$ $\quad y_{top} = 11.25\ in$

Therefore $Z_{bot} = \frac{I_{xx}}{y_{bot}}$ $\quad Z_{bot} = 265.26\ in^3$

$Z_{top} = \frac{I_{xx}}{y_{top}}$ $\quad Z_{top} = 206.38\ in^3$

$f_{d\,bot} = \frac{M_d}{Z_{bot}}$ $\quad f_{d\,bot} = 0.57 \frac{ton}{in^2}$

$f_{d\,top} = \frac{M_d}{Z_{top}}$ $\quad f_{d\,top} = 0.732 \frac{ton}{in^2}$

External Girder Assessment

Stress due to dead load

Up to 3 tons/sq in tension the actual permissible tensile stress shall be based on the following ratio of dead to live load

BE4-Part 1-304c $\quad 5f_l + 2.2f_d = 8$

Therefore $f_{l\,bot} = \frac{\left(8 \frac{ton}{in^2} - 2.2 f_{d\,bot}\right)}{5}$

$f_{l\,bot} = 1.349 \frac{ton}{in^2}$

$f_{l\,bot} + f_{d\,bot} = 1.92 \frac{ton}{in^2}$

$f_{l\,bot} = if\left(f_{l\,bot} + f_{d\,bot} < 3 \frac{ton}{in^2}, f_{l\,bot}, 3 \frac{ton}{in^2} - f_{d\,bot}\right)$

$f_{l\,bot} = 1.349 \frac{ton}{in^2}$

$f_{l\,top} = \left(10 \frac{ton}{in^2} - f_{d\,top}\right)$ $\quad f_{l\,top} = 9.27 \frac{ton}{in^2}$

This is irrevelant if there is no live load to be considered.

$f_{d\,bot} < 3\ ton/in^2$ ∴ ok.

CALCULATION SHEET		Sheet No 5
Project Title: VAR9-830 BE4		
Assessment EBD 761	Made by JCW	Date 16/12/03
Job No J20308B-1142	Checked by JCR	Date 1/7/04

BE4-Part 2-301a(11) $M_{l\,bot} = f_{l\,bot} Z_{bot}$ $M_{l\,bot} = 29\,83\,\text{ton ft}$

$M_{l\,top} = f_{l\,top} Z_{top}$ $M_{l\,top} = 159\,39\,\text{ton ft}$

$M_l = \left(\text{if}\left(M_{l\,bot} < M_{l\,top}, M_{l\,bot}, M_{l\,top}\right)\right)$ $M_l = 29\,83\,\text{ton ft}$

BE4-Part 2-301a(11) Girder Spacing = $G_s = 1257\,3\text{mm}$ $G_s = 4\,13\,\text{ft}$

Span = Span_L Span = 4657 mm Span = 15 28 ft

Carrageway width = $C_w = 3686\text{mm}$ $C_w = 12\,09\,\text{ft}$

BE4-Part 1-302a If carriageway is less than 18', single lane applies

Reduction factor = $K = 0\,43$

BE4-Part 2-301a(11) $\frac{M_l}{K} = 69\,37\,\text{ton ft}$

BE4-Part 2-301a(11) Graph 5 Assessed capacity = 24 tons Gross Vehicle Weight ?

Already stated that edge girder is not subject to live loading

CALCULATION SHEET		Sheet No. 6
Project Title VAR9-830 BE4		
Assessment EBD 761	Made by JCW	Date 16/12/03
Job No J20308B-1142	Checked by JLR	Date 1/7/04

Internal Girder Assessment

Dead Loads

From BD 21/97

Girder Self Weight	$G_{sw} = 2\,1\,\frac{kN}{m}$	✓
Jack Arch	$JA_{sw} = 4\,3\,\frac{kN}{m}$	✓
Concrete	$C_{sw} = 3\,65\,\frac{kN}{m}$	✓
Fill (Soil & stones)	$SS_{sw} = 5\,5\,\frac{kN}{m}$	5·8 ?
Carriageway	$CA_{sw} = 2\,03\,\frac{kN}{m}$	✓

Total Loading

$$W_{total} = G_{sw} + JA_{sw} + C_{sw} + SS_{sw} + CA_{sw}$$

$$W_{total} = 17\,58\,\frac{kN}{m}$$ ✓

Dead Load Moment

BE4-Part 1-303a (iv) Effective span where the beam rests directly on hard material and there are no bearing stiffners

Clear Span $C_{span} = 4572mm$ ✓

Beam depth (at support) $B_{depth} = 457\,2mm$

Span L = Clear Span + (2/3 x 1/4 x beam depth)

$$Span_L = C_{span} + \left[\left(\frac{2}{3}\right)\left(\frac{1}{4}\right)B_{depth}\right]$$

$$Span_t = 4648\,mm$$ ✓

Therefore $M_d = \frac{W_{total}\left(Span_L^{\,2}\right)}{8}$ $M_d = 47\,479\,kN\,m$ ✓

$M_d = 15\,63\,ton\,ft$ ✓

Stress due to dead load

From BD 21/97

$I_{xx} = 0.85258 \times 10^9 mm^4$ ✓ $I_{xx} = 2048.33 in^4$

$y_{bot} = 176.04 mm$ $y_{bot} = 6.93 in$

$D = 457.2 mm$ ✓ $D = 18 in$

$y_{top} = D - y_{bot}$

$y_{top} = 281.16 mm$ $y_{top} = 11.07 in$

Therefore $Z_{bot} = \frac{I_{xx}}{y_{bot}}$ $Z_{bot} = 295.54 in^3$ ✓

$Z_{top} = \frac{I_{xx}}{y_{top}}$ $Z_{top} = 185.05 in^3$

$f_{d\,bot} = \frac{M_d}{Z_{bot}}$ $f_{d\,bot} = 0.635 \frac{ton}{in^2}$ ✓

$f_{d\,top} = \frac{M_d}{Z_{top}}$ $f_{d\,top} = 1.013 \frac{ton}{in^2}$

Internal Girder Assessment

Stress due to dead load

Up to 3 tons/sq in tension the actual permissible tensile stress shall be based on the following ratio of dead to live load

BE4-Part 1-304c $5f_l + 2.2f_d = 8$

Therefore $f_{l\,bot} = \frac{\left(8 \frac{ton}{in^2} - 2.2 f_{d\,bot}\right)}{5}$

$f_{l\,bot} = 1.321 \frac{ton}{in^2}$

$f_{l\,bot} + f_{d\,bot} = 1.96 \frac{ton}{in^2}$

$f_{l\,bot} = if\left(f_{l\,bot} + f_{d\,bot} < 3 \frac{ton}{in^2}, f_{l\,bot}, 3 \frac{ton}{in^2} - f_{d\,bot}\right)$

$f_{l\,bot} = 1.321 \frac{ton}{in^2}$ ✓

$f_{l\,top} = \left(10 \frac{ton}{in^2} - f_{d\,top}\right)$ $f_{l\,top} = 8.99 \frac{ton}{in^2}$

CALCULATION SHEET		Sheet No. 8
Project Title: VAR9-830 BE4		
Assessment EBD 761	Made by: JCW	Date 16/12/03
Job No: J20308B-1142	Checked by JZR	Date: 1/7/04

BE4-Part 1-305b The section modulus of the girder may be increased for live load by the factor D/d

D = Overall depth of deck less 3" for surfacing

d = Depth of girder at mid span

Overall depth of deck = $O_d = 713\text{mm}$

$D_l = O_d - (3 \times 25.4)\text{mm}$ $D_l = 636.8\text{mm}$

$d = D$ $d = 457.2\text{mm}$

$\frac{D_l}{d} = 1.39$

BE4-Part 2-301a(11)

$M_{l\,bot} = f_{l\,bot} Z_{bot} \left(\frac{D_l}{d}\right)$ $M_{l\,bot} = 45.31\text{ ton ft}$

$M_{l\,top} = f_{l\,top} Z_{top} \left(\frac{D_l}{d}\right)$ $M_{l\,top} = 193.01\text{ ton ft}$

$M_l = \left(\text{if}\left(M_{l\,bot} < M_{l\,top}, M_{l\,bot}, M_{l\,top}\right)\right)$ $M_l = 45.31\text{ ton ft}$

BE4-Part 2-301a(11) Girder Spacing = $G_s = 1257.3\text{mm}$ $G_s = 4.13\text{ ft}$

Span = Span_L Span = 4657mm Span = 15.28 ft

Carrageway width = $C_w = 3686\text{mm}$ $C_w = 12.09\text{ ft}$ 13.4 ft? see historic drawings Does not affect result.

BE4-Part 1-302a If carriageway is less than 18', single lane applies

Reduction factor = $K = 0.328$

BE4-Part 2-301a(11) $\frac{M_l}{K} = 138.13\text{ ton ft}$

BE4-Part 2-301a(11) Graph 5 Assessed capacity = 24 tons Gross Vehicle Weight

EDGE GIRDER

Office: 6114

Location: ~~Properties of typical channel section~~ Edge girder

Properties of any plane section

The section is defined by coordinates of corner points taken in anti-clockwise order round the section. The cross section is kept to the left of the edge running from a previous point to the next point. The section is closed when the original point is specified again.

Coordinates of points in order:

Point 1	: X-coordinate	x(1)=0 mm
	Y-coordinate	y(1)=0 mm
Point 2	: X-coordinate	x(2)=267 mm
	Y-coordinate	y(2)=0 mm
Point 3	: X-coordinate	x(3)=267 mm
	Y-coordinate	y(3)=32 mm
Point 4	: X-coordinate	x(4)=207 mm
	Y-coordinate	y(4)=32 mm — 30.75mm ≡ 31.75-1mm (loss of section)
Point 5	: X-coordinate	x(5)=207 mm
	Y-coordinate	y(5)=476 mm
Point 6	: X-coordinate	x(6)=267 mm
	Y-coordinate	y(6)=476 mm
Point 7	: X-coordinate	x(7)=267 mm
	Y-coordinate	y(7)=508 mm
Point 8	: X-coordinate	x(8)=115 mm
	Y-coordinate	y(8)=508 mm
Point 9	: X-coordinate	x(9)=115 mm
	Y-coordinate	y(9)=476 mm
Point 10	: X-coordinate	x(10)=175 mm
	Y-coordinate	y(10)=476 mm
Point 11	: X-coordinate	x(11)=175 mm
	Y-coordinate	y(11)=32 mm
Point 12	: X-coordinate	x(12)=0 mm
	Y-coordinate	y(12)=32 mm
Point 13	: X-coordinate	x(13)=0 mm
	Y-coordinate	y(13)=0 mm

Sectional properties

Cross-sectional area	27616 mm^2
Second moments of area (inertias)	Ixx=0.96626E9 mm^4
	Iyy=80.844E6 mm^4
Product of inertia $\int dA\, xy$	Ixy=0.10134E9 mm^4
Distance of centroid from origin	X=173 21 mm
	Y=222.29 mm
Principal second moments of area	Iu=0.97771E9 mm^4
	Iv=69.392E6 mm^4

Check :- (Input only) JLR 1/7/04

Office: 6114

Angle of principal U
counter-clockwise from XX-axis -6 4469 degrees

No650

Office: 6114

Section properties of a ~~plate~~ internal girder ~~with welded connections~~

Location Int beam

Number of bottom flange plates	nobfp=1
Number of top flange plates	notfp=1
Bottom flange plate	
Breadth	bbf(1)=381 mm
Depth	dbf(1)=32 mm
Web plate	
Breadth	bw=32 mm
Depth	dw=393.2 mm
Top flange plate	
Breadth	btf(1)=152 mm
Depth	dtf(1)=32 mm
Section properties	
Bottom flange	
Bottom flange plate	
Breadth	b(1)=bbf(i)=381 mm
Depth	d(1)=dbf(i)=32 mm
Second moment of area	Ix(1)=b(n)*d(n)^3/12=381*32^3/12 =1 0404E6 mm^4
Second moment of area	Iy(1)=d(n)*b(n)^3/12=32*381^3/12 =0 14748E9 mm^4
Area	A(1)=b(n)*d(n)=381*32=12192 mm^2
Distance from top of plate to bottom of section	
Distance	Db(1)=d(n)=32 mm
Distance of centroid from bottom	Cb(1)=Db(n)-d(n)/2=32-32/2 =16 mm
Total depth of bottom flange	tdbf=Db(n)=32 mm
Total area of bottom flange	12192 mm^2
Web	
Breadth of section	b(2)=bw=32 mm
Depth of section	d(2)=dw=393.2 mm
Second moment of area	Ix(2)=b(n)*d(n)^3/12=32*393 2^3/12 =0.16211E9 mm^4
Second moment of area	Iy(2)=d(n)*b(n)^3/12=393 2*32^3/12 =1 0737E6 mm^4
Area	A(2)=b(n)*d(n)=32*393 2=12582 mm^2
Distance from top of web to bottom of section	
Distance	Db(2)=Db(p)+d(n)=32+393.2 =425.2 mm
Distance of centroid from bottom	Cb(2)=Db(n)-d(n)/2=425.2-393.2/2 =228.6 mm
Top flange	
Top flange plate	
Breadth	b(3)=btf(i)=152 mm
Depth	d(3)=dtf(i)=32 mm
Second moment of area	Ix(3)=b(n)*d(n)^3/12=152*32^3/12 =415061 mm^4

Check: GJR 1/7/04.
(Input only)

Second moment of area	Iy(3)=d(n)*b(n)^3/12=32*152^3/12
	=9 3648E6 mm⁴
Area	A(3)=b(n)*d(n)=152*32=4864 mm²
Distance to top of plate from bottom of section	
Distance	Db(3)=Db(p)+d(n)=425.2+32
	=457 2 mm
Distance to centroid from bottom	Cb(3)=Db(n)-d(n)/2=457.2-32/2
	=441.2 mm
Total depth of top flange	tdtf=Db(n)-dw-tdbf=457.2-393 2-32
	=32 mm
Total area of top flange	4864 mm²

SECTION SUMMARY

Gross section elastic properties

Depth of girder	dob=Db(n)=457.2 mm
Area	29638 mm²
1st moment of area about soffit	5 2174E6 mm³
Centroid of section from soffit	CGga=Mga/Ga=5 2174E6/29638
	=176 04 mm
Second moments of area about centroidal axes	
About x-x axis	0 85258E9 mm⁴
About y-y axis	0 15792E9 mm⁴
Elastic section moduli	
Top	Ztg=Igxx/(dob-CGga)
	=0.85258E9/(457.2-176.04)
	=3 0323E6 mm³
Bottom	Zbg=Igxx/CGga=0.85258E9/176 04
	=4.8432E6 mm³

Gross section plastic properties

Half gross area	hga=Ga/2=29638/2=14819 mm²
Equal area line is in web	
Distance from beam soffit	eal=Db(m)-(ca-hga)/b(m)
	=425 2-(24774-14819)/32
	=114.1 mm
Plastic modulus	4 4434E6 mm³

PRO FORMA FOR EMPIRICAL ASSESSMENT OF BRICK, MASONRY AND CONCRETE JACK ARCHES AND ASSOCIATED TIES

(To be included with the Assessment Report Calculations)

BRIDGE NAME Auchmacoy
RAILTRACK NO· EBD 761

Assessment should include completion of all three Sections even where Section 1 has shown the bridge deck to be non-compliant

SECTION 1 CHECKS FOR COMPLIANCE WITH 24 T CONFIGURATION REQUIREMENTS

		Compliant Yes/No
What is maximum clear span of the arch *Non-compliant if greater than 2 0m*	1 25m 0.875m ✓	Yes
Do jack arches spring from bottom flanges of beams? *If not, non compliant*	Yes	Yes
What is the beam spacing?	b = ~~1.25m~~ 1.256	Yes
What is the rise of the arch?	r_c = ~~0.229m~~ 0.212	
Gross aspect ratio *Non-compliant if greater than 10*	$\frac{b}{r_c}$ = ~~5.459~~ 5.92	
What is the arch barrel thickness (including concrete fill above) and how is it derived ie from record drawings or site investigation? *Non-compliant if thickness less than 220*	d = 177mm ✓	No

Check - JKR 1/7/04

PRO FORMA FOR EMPIRICAL ASSESSMENT OF BRICK, MASONRY AND CONCRETE JACK ARCHES AND ASSOCIATED TIES

(To be included with the Assessment Report Calculations)

BRIDGE NAME.	Auchmacoy
RAILTRACK NO	EBD 761

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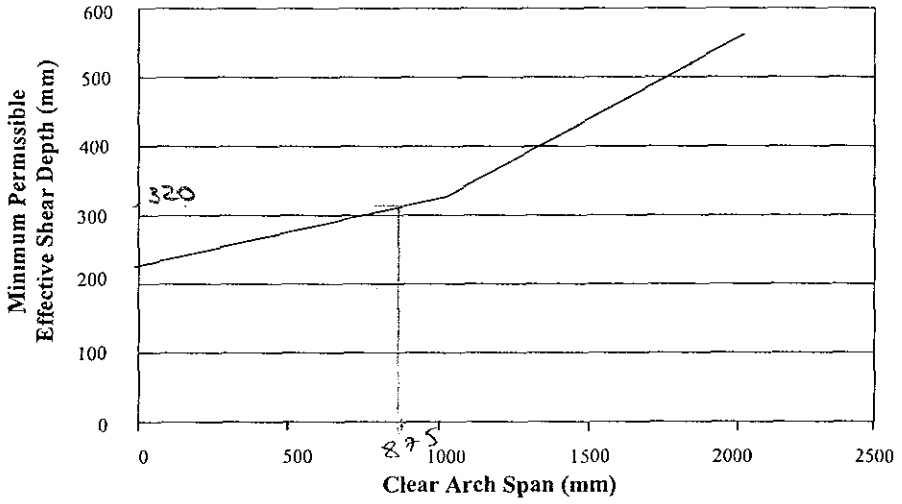
SECTION 2 CHECKS FOR DEFICIENCY

Type No	Deficiency	Pass/ Fail
		Pass
2	What is the backing material? Is it structural? Concrete, soil and stones Yes Does the structural backing extend to at least the crown level of the arch extrados? *If not, then fail (1) (4)* Yes Height of structural fill above crown d_f = 25mm What is effective shear depth of deck? (= arch rise + barrel thickness + depth of structural fill above crown of extrados) $D_s = r_c + d + d_f$ D_s = 431 mm 212 + 152 + 25 = 389 mm > 320 mm OK Is $D_s \geq$ "minimum requirements of Fig 1 " Fail if < Fig 1  *Figure 1*	Pass Pass
	Do jack arches span longitudinally (eg in half through girder construction) or transversely between longitudinal girders? Transversely For longitudinal spanning jack arches, ignore following questions on ties/lateral restraint and state N/A Are ties provided in edge bays of transversely spanning jack arches?	Fail

Check:- JFR 1/7/04. The existing ties are not efficient any more

	If yes, go to 3a/3b *If not, fail unless edge bay is 'hard' (see 5)*	
3a CI	What is the cross sectional area of one tie? (allowing for corrosion losses) Diameter of tie Dia = 32mm Therefore Area $A = \pi \frac{(Dia)^2}{4}$ $A = 804\ 248\ mm^2$ What is number of ties per beam length? $n = 2$ What is the clear skew span? $L = 5m$ Specific area of tie $A_s = \frac{(n+1)\,A}{L}$ $A_s = 482\ 549\ \frac{mm^2}{m}$ *Non-compliant if less than 260mm²/m*	Fail
	What is maximum tie spacing? $S = 1\ 5m$ *Non-compliant if greater than 2 5m for cast iron*	Fail
3b WI/ST	What is the cross sectional area of one tie? (allowing for corrosion losses) Diameter of tie Dia = 35mm Therefore Area $A = \pi \frac{(Dia)^2}{4}$ $A = 962\ 113\ mm^2$ What is number of ties per beam length? $n = 2$ What is the clear skew span? $L = 5m$ Specific area of tie $A_s = \frac{(n+1)\,A}{L}$ $A_s = 577\ 268\ \frac{mm^2}{m}$ *Non-compliant if less than 260mm²/m* What is maximum tie spacing? $S = 2m$ *Non-compliant if greater than 3 0m for wrought iron/steel*	Pass
4	Are ties located within crown of external arch? No *If so, then fail CI or possible fail for WI/steel*	
5	Does external bay construction provide alternative lateral restraint? (ie not soft edge)? *If so, pass* *If not, are ties provided in first Jack Arch bay? if yes, treat as 3a (or 3b) otherwise fail*	Pass

Notes (1) Results also in loss of D/d (composite action) for cast iron beams
(4) A trial hole should be undertaken to confirm the existence of structural backing if there is any doubt

PRO FORMA FOR EMPIRICAL ASSESSMENT OF BRICK, MASONRY AND CONCRETE JACK ARCHES AND ASSOCIATED TIES

(To be included with the Assessment Report Calculations)

BRIDGE NAME	Auchmacoy
RAILTRACK NO.	= BD 761

Check: GKR 1/7/04

Assessment should include completion of all three Sections even where Section 1 has shown the bridge deck to be non-compliant

SECTION 3 CHECKS FOR DEFICIENCY

Type No	Defect	Empirical Assessment		Pass/ Fail
		CI Decks	WI/Steel Decks	
6	Rotation of supporting beam No rotation	Fail	Fail	Pass
7	Horizontal displacement of supporting beam None -	Fail	Fail	Pass
8	Inadequate support to springings eg corrosion of bottom flange of supporting beam over a significant length, missing bedding mortar ok	Possible Fail	Possible Fail	Pass
9	Transversely bowed bottom flange of supporting beam No.	Fail	Fail	Pass
10	Cracking at crown of arch owing to spreading of springings (other than 12, 13) None.	Fail	Fail	Pass
11	Distortion and any associated cracking of jack arch barrel None	Fail	Fail	Pass
12	Arch crack resulting in substructure crack None	Fail	Fail (5)	Pass
13	Substructure crack or other distress resulting in crack to jack arch None	Possible Fail (3)	Possible Fail (3) (5)	Pass

Notes (3) 'Substructure renovation' or 'Monitoring' as appropriate, 'Repair of arch' (if appropriate)
(5) Not applicable in general to longitudinally spanning arches

Check: GKR 1/7/04.