

BRB (Residuary) Ltd

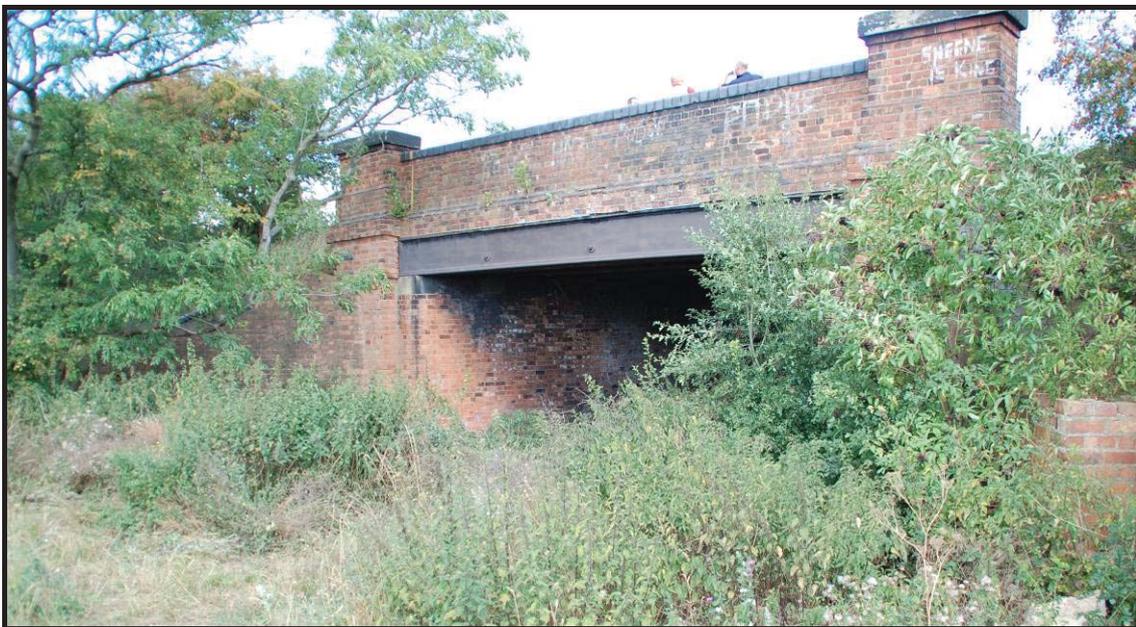
Major Works Programme 2009 - 2012

VAR9/3299 ASSESSMENT PROGRAMME

BE4 ASSESSMENT & INSPECTION REPORT

**Stubbs Road, Walden Stubbs,
North Yorkshire**

BRIDGE REF: HBR3/123



February 2012

Document control sheet

BPP 04 F8
version 7 Apr 2011

Client: BRB (Residuary) Ltd
 Project: Major Works Programme 2009/2012 Project No: B12360BN
 Document title: VAR9/3299 Assessment Programme, BE4 Assessment, HBR3/123
 Ref. No: 0447929

	Originated by	Checked by	Reviewed by	Approved by
ORIGINAL	NAME	NAME	NAME	NAME
Form AA				
DATE	INITIALS	INITIALS	INITIALS	INITIALS
January 2012	Document status Client Issue			

	NAME	NAME	NAME	NAME
REVISION				
Form BA				
DATE				
February 2012				

	NAME	NAME	NAME	NAME
REVISION				
DATE	INITIALS	INITIALS	INITIALS	INITIALS
	Document status			

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1.1 Introduction

Jacobs was appointed by BRB(R) to conduct the site survey at HBR3/123 in sufficient detail to provide data for BE4 assessment work.

Structural Soils Ltd excavated a trial pit to expose the top flange of a girder and the extrados of a jack arch.

1.2 Location and General Description

HBR3/123 is a single span structure carrying the unclassified Stubbs Road over the former Hull and Barnsley railway near Walden Stubbs, North Yorkshire.

The road carried by the bridge is a single carriageway 4.14m wide at the centre of the span. There are verges of 1.78m and 1.63m width on the west and east sides respectively.

The bridge was observed to have little traffic flow during the course of the inspection. HGV use is taken as "Low".

The formation adjacent to the structure has been infilled. Infill material (a mix of soil and fly tipping) partially fills the solum of the bridge leaving the eastern side of the abutments inaccessible.

The Ordnance Survey Grid Reference for the bridge is SE541169.

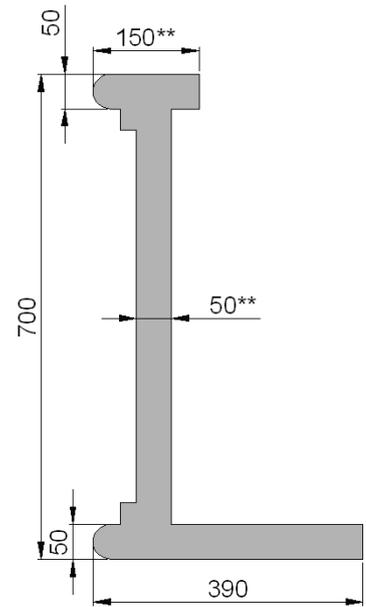
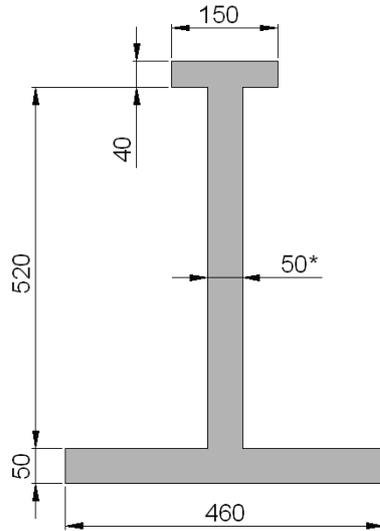
1.3 Construction type

The bridge is a single span with cast iron beams and brick jack arches with concrete backing.

The bridge has a skew of 11° with a skew span of 7.92m (26') and a square span of 7.75m (25' 5").

The bridge is comprised of seven longitudinally spanning cast iron girders spaced at 1.37m (4' 6") centres. The bottom flanges of the five internal girders are 457mm (18") wide and 50mm (2") thick whereas the top flanges are 152mm (6") wide and 40mm (1½") thick. The edge girders have an eccentric web, located 75mm (3") from the outer edge of flanges. Bottom flanges are 387mm (15") wide and 50mm (2") thick.

The beams are linked together by three transverse steel ties at 2.29m (7' 6") spacing from the central tie. Two courses thick brick jack arches span between the bottom flanges of beams. The rise of the jack arches is 159mm (6").



*Dimensions from record drawings
 **Assumed dimensions
 Other dimensions from site measurements

Central Girders

Edge Girders

The abutments and wingwalls are common brick gravity type structures. The deck girders bear onto individual sandstone pad blocks built flush into the abutments.

The parapets are brick with bull nosed blue brick copings. The pilasters have large sandstone copers.

Sketches of the plan at road level and the elevation are included in Appendix F.

2 Existing Information Search

2.1 Service Search

Service search documentation obtained by Structural Soils Ltd is included in Appendix B.

2.2 SI Results

One trial pit was excavated in the west side grass verge in order to expose the top of a jack arch and adjacent top flange of an internal beam allowing levels and measurements to be taken to verify record dimensions.

Logging data for the trial pit and a description of the investigation is included within Appendix C.

2.3 Existing Drawings

A previous 'British Rail Property Board' assessment report contains a general arrangement drawing showing details of the bridge, see Appendix G.

3.1 General

The initial survey and trial pit excavation on 24th August 2011. Weather conditions were sunny and a temperature of 25°C.

Parking was available along with verge of Stubbs Road to the south of the structure. Access to the underside of the structure was gained via a farm track off Stubbs Road through the private field to the south west side of the structure.

3.2 Structure condition

3.2.1 Edge girders

The edge girders are in good condition with little corrosion noted. There was no observed delamination or loss of section. The majority of paint on the girders is still intact with only localised chips of paint missing to the bottom flange.

3.2.2 Internal girders

Internal girders appear to be in good condition with little corrosion noted to the bottom flanges. There was no observed delamination or loss of section. The majority of paint on the girders is still intact with only localised chips of paint missing to the bottom flange. There is no reason to make any allowance for corrosion in determining the section properties of any of the internal or edge girders.

The trial pit exposed a dense concrete backing above the jack arch which encases the internal girders up to a depth which is 95mm below the top flange. The upper 95mm of the internal girders web and the top flange are both embedded within compacted, friable clay material which lies on top of the concrete backing (Refer to Logging data for Trial Pit in Appendix C).

3.2.3 Jack arches and tie rods

The three tie bars present through the lower section of each girder are 25mm (1") in diameter. Heavy corrosion was noted with an estimated 30-50% loss of section.

The inner jack arches are in good condition with localised mortar loss, calcite staining and spalling, mainly located around the tie bars. The outer jack arches are in equally good condition with only minor defects.

3.2.4 Abutments

The abutments are partially infilled with only the central and western side visible for inspection. Brickwork is in good condition with some calcite staining

3.2.5 Wingwalls

The north west wingwall newel is in poor condition with fractures noted and a missing capping stone. The wingwall adjacent to the newel has loose bricks and missing mortar.

The south west newel is in equally poor condition. There are areas of minor spalling and deep open joints to the adjacent wingwall.

The above problems are sufficiently remote from the road that they will not affect the load carrying capacity of the wall.

Due to vegetation and infilling material it was not possible to observe the eastern wingwalls.

3.2.6 Parapets

The west parapet has a stepped fracture to the inside face. The outside face has loose and missing brickwork above the top flange of the edge girder. The outside face also has minor vegetation growth. The parapet is generally in fair condition with all coping intact.

The east parapet was observed to be out of plumb and slightly leaning towards the road. There is minor spalling to the inside face. The parapet is generally in good condition with all coping intact.

3.2.7 Formation

The formation beneath the structure is partially infilled with soil and fly-tipping. The eastern side is heavily vegetated which prevents easy access.

3.2.8 Road surface

The road surface is in good condition with no observed defects or recent repair work.

The road over the bridge is humped. There were no observed speed restrictions on the road so it is assumed vehicles can travel a maximum of 60mph. No weight restriction signs were observed relating to the bridge.

The approaches from the north and south are straights, several hundred metres long.

4 Assessment to BE4

4.1 Methodology

The deck loading was amenable to analysis by the quick assessment method outlined in Part 2 of BE4. The edge girders were unaffected by live loads applied in accordance with BE4 as internal girders are positioned between them and the near-side line of wheels (Clause 302). The edge girders have been checked under dead and superimposed dead load only. Capacities were calculated using measurements of reduced section sizes where corrosion is present, as identified in the Inspection Report. Consequently, a general condition factor has not been applied.

The infill material above the top flange of the girders is clay with siltstone cobbles. Due to the substantial clay content, the material was considered not fully compliant with BE4 Clause 305 b ii 1 therefore D/d enhancement of the live load section modulus was not used in the initial assessment.

Review of the adequacy of the jack arches and tie-rods was based upon the empirical method described in Bridgeguard 3 Current Information Sheet No 22 (Proforma for the empirical assessment of brick, masonry and concrete jack arches and associated ties.)

The substructure was assessed qualitatively.

4.2 Results

Element: Edge girders

Action	Location	Dead load effect	Full C&U load effect	Total load effect	Assessed resistance	Live load capacity
Bending	Mid-span	78.07 ton.ft	0 ton.ft	78.07 ton.ft	193.7 ton.ft	Full C&U loading

- BE4 live load not applied as there is an intervening girder between the nearest line of wheel loads.

Element: Internal girders

Action	Location	Dead load effect	Full C&U load effect	Total load effect	Assessed resistance	Live load capacity
Bending	Mid-span	70.47 ton.ft	35.34 ton.ft	105.81 ton.ft	127.6 ton.ft	Full C&U loading

Element: Jack arches and tie rods

The jack arches fail according to the advice of the Bridgeguard Current Information Sheet No. 22 with regards to the strength of the ties in the edge bays. The current tie arrangements provide approximately 50% of the required 260mm²/m specific area. Approximately 50% of the original 1" diameter has been lost to corrosion.

Element: Substructure

In general, the substructure does not give cause for concern and appears to be satisfactory for single lane C&U loading by qualitative assessment. The defects observed throughout the north west and south west wingwalls are considered to be sufficiently remote from the road, and are therefore considered not to affect the load carrying capacity of the bridge.

The girders are quite substantial for the span and despite not considering section modulus enhancement for live load, they are assessed as satisfactory for full C&U loading.

The empirical assessment of the jack arches shows them to be non-compliant with the requirements stated by the Bridgeguard Current Information Sheet No. 22. The specific area of the ties falls well short of the recommendation. While recognising that the empirical assessment is written for the higher BD21 loading and there is no BE4 loading applied on the edge jack arches, in view of the extent of the deficiency it is considered prudent to add additional tie straps.

The additional ties, proposed as part of the jack arch strengthening should ensure the stability of the edge girders; however their condition should continue to be monitored as part of all future inspection works. Reduced tie provision does not currently appear to pose a danger to traffic.

The defects observed throughout the substructure are not considered to affect the load carrying capacity of the bridge. The condition of the bridge is to be monitored through future inspections, vegetation removal and minor re-pointing works may be considered throughout the substructure elements, however these works are not deemed critical in the bridge's current state.

Appendix A Photographs



Photo 1 – West Elevation



Photo 2 – North West wingwall / newel



Photo 3 – South West wingwall / pilaster



Photo 4 – South West newel



Photo 5 – East side jack arch



Photo 6 – Tie bar through jack arch



Photo 7– North side abutment



Photo 8– Looking North East over Structure



Photo 9– Trial pit



Photo 9– View North over bridge



Photo 10– View South over bridge

Appendix B Services Search

National One Call

powered by PlanToDig.com

Response Summary

enquiries@national-one-call.co.uk
Tel: 0844 800 9957 Fax: 0845 280
2040

Enquiry Number	EQ/EJDGI847	Service	Retriever
Location of Enquiry	Disused Railway Line Stubbs Rd, Walden Stubbs, Doncaster, South Yorkshire, DN6 9BT		
Status: Not Affected			
Organisation	Response		
<i>Affiniti - Kingston Communications</i>	Kingston Communications network is not affected by the proposed works at the location specified below. This is valid for 3 months from date of receipt. For further info please call 01482 603479. Please send all future enquiries to the postal address above or alternatively they can be e-mailed to highwaysadmin@kcom.com Kingston Notice Number - 116370 Kingston Planner: SS Undertaker Name National One Call Your Reference No EQ/EJDGI847 Location : From Subject Received Size Categories retriever@national-one-call.co.uk Stubbs Rd,Walden Stubbs,Doncaster,South Yorkshire,DN6 9BT (EQ/EJDGI847) 12:31 10 KB		
<i>BSkyB Telecommunications Services Ltd</i>	RE: Disused Railway Line Stubbs Rd, Walden Stubbs, Doncaster, South Yorkshire, DN6 9BT Thank you for your enquiry. Please be advised that Easynet Telecom will not be affected by these works. . Regards NRSWA Department		
<i>Cable & Wireless</i>	Dear Sirs, Please accept this email as confirmation that Cable&Wireless Worldwide does not have apparatus within the boundary of your proposed works detailed in the reference/location above. Many Thanks, The Plant Enquiry Team ATKINS (working on behalf of Cable&Wireless Worldwide) PLEASE NOTE: The information given is indicative only. No warranty is made as to its accuracy. This information must not be solely relied upon in the event of excavation or other works carried out in the vicinity of Cable & Wireless Worldwide Ltd UK, plant. No liability of any kind whatsoever is accepted by C&W, its servants, or agents, for any error or omission in respect of information contained on this information. The actual position of underground services must be verified and established on site before any mechanical plant is used. Authorities and contractors will be held liable for the full cost of repairs to C&W's apparatus and all claims made against them by Third parties as a result of any interference or damage.		
<i>E S Pipelines Ltd</i>	8 July 2011 Reference: EQ/EJDGI847 Dear Sir/Madam, Thank you for your recent plant enquiry at: Stubbs Rd,Walden Stubbs,Doncaster,South Yorkshire I can confirm that ESP Gas Group Ltd has no gas or electricity apparatus in the vicinity of this site address and will not be affected by your proposed works. ESP are continually laying new gas and electricity networks and this notification is valid for 90 days from the date of this letter. If your proposed works start after this period of time, please re-submit your enquiry. Important Notice Please be advised that any enquiries for ESP Connections Ltd, formerly known as British Gas Connections Ltd, Yours faithfully, Alan Slee Operations Manager		
<i>Energetics</i>	Energetics does not have any plant within the area that you have sent in to us.		
<i>Fibrespan Ltd</i>	With regard to your enquiry below, I can confirm that FibreSpan Ltd. does NOT have any plant affected by your proposed works from the info supplied.		
<i>Fulcrum Pipelines Ltd</i>	We can confirm that Fulcrum Pipelines Limited do not currently have any existing pipes or equipment on or around the above site address. Please note that other Gas Transporters may have plant in this locality which could be affected by your proposed works. Fulcrum Pipelines will not be held responsible for any incident or accident arising from the use of the information associated with this search. The details provided are given in good faith, but no liability whatsoever can be accepted in respect thereof. If you have any future requests for information about our plant, please email these to us at FPLplantprotection@fulcrum.co.uk . [REDACTED] if you require any further assistance or information.		

<i>Gamma Telecom</i>	Having examined my records, I can confirm that Gamma Telecom has no owned apparatus within the search area of your enquiry below:- Regards Ray Gamma Telecom
<i>Gas Transportation Co & Electric Network Co</i>	Site Ref: EQ/EJDGI847 Date: 07 July 2011 Dear Sir/Madam Re: Stubbs Rd,Walden Stubbs,Doncaster,South Yorkshire Thank you for your enquiry concerning apparatus in the vicinity of your proposed work. GTC/ENC can confirm that we have no apparatus in the vicinity but please note that other Gas Transporters/Electricity Distributors may have and that you should ensure that all transporters/ distributors have been consulted. All future plant enquiries must contain accurate Easting and Northing references to enable us to process your enquiry efficiently. Yours sincerely Tom Anderson Engineering Support Officer GTC
<i>Independent Pipelines & Power Networks</i>	Indpendent Pipelines has no plant in the vicinity of the proposed works
<i>Instalcom</i>	Your Ref: EQEJDGI847 Our Ref: E07/11-0474 With reference to your enquiry regarding the above noted location, I can confirm that GLOBAL CROSSING (UK) LTD, GLOBAL CROSSING PEC and FIBERNET UK LTD networks DO NOT have any apparatus within the immediate proximity of your proposed works. Instalcom responds to plant enquiries for GLOBAL CROSSING (UK) LTD, GLOBAL CROSSING PEC and FIBERNET UK LTD simultaneously and therefore you only need send one copy of a plant enquiry to cover all of these companies. If you would like to query the location further, please email us accordingly and we can arrange an in depth survey, which will be charged at a cost. As we are moving towards a fully electronic database we urge our customers to request plant enquiries by email which will result in a higher level of service, please forward future plant enquiries to plantenquiries@instalcom.co.uk If you require any further information, please do not hesitate to contact me. Plant Protection Administrator
<i>Interoute</i>	Thank you for your enquiry regarding the above proposals at the above location We would advise that we are unaware of any Interoute plant or services in this Location as indicated in your enquiry. We bring to your attention the fact that whilst we try to ensure the information we provide is accurate, the information is provided Without Prejudice and Interoute and its Agents accept no liability for claims arising from any inaccuracy, omissions or errors contained in this response. Yours faithfully PLANCAST Plant Enquiry Department
<i>National Grid Gas</i>	standard assessment has been carried out with respect to our operational gas and electricity apparatus. National Grid's records show no apparatus in the vicinity of your enquiry. This location falls outside the National Grid Gas Distribution Network area. This means that another Gas Distribution company operates in this area. Apparatus owned by other operators may be present in this area. It is your responsibility to make contact with these operators.
<i>Northern Gas Networks</i>	No Gas Mains in the area
<i>Orange pcs</i>	Your reference: GI847 Stubbs Rd Location: X = 454142 Y = 416977 With reference to your enquiry regarding the above noted location, please be advised that you have confirmed our records show that we do not currently hold any ORANGE PCS assets within your stated area of interest. Please note, whilst we endeavour to provide accurate information, the information is intended as a general guide only and must not be relied upon in the event of any excavations or other work in the vicinity. Also, the responsibility is on you, the client, to determine the area of works is clear. May Gurney will accept no liability for claims arising from any inaccuracy, omissions or errors contained herein. If you require any further information then please do not hesitate to contact us. Kind Regards Plant Protection Administrator
<i>Spectrum Interactive plc</i>	No Kiosks in the vicinity of the proposed works
<i>Verizon Business</i>	Verizon Business is a licensed Statutory Undertaker. We have reviewed your plans and have determined that Verizon Business (Formally known as MCI WorldCom, MFS) has no apparatus in the areas concerned. If you have any further queries please do not

	hesitate to call. Yours faithfully Chris Pile
<i>Virgin Media</i>	Plant Enquiry Ref: VM/CIP/62607 Your Letter Date: 06/07/2011 Your Ref: EQ/EJDGI847 Date: 22/07/2011 Enquiry Location: DISUSED RAILWAY LINE STUBBS RD, WALDEN STUBBS Thank you for your enquiry regarding work at the above location. Virgin Media and Viatel plant should not be affected by your proposed work and no strategic additions to our existing network are envisaged in the immediate future. Should your request be in relation to a New Development and you require an estimate to be prepared for Virgin Media to service your proposed development, please submit this request for costs along with site drawings (scale 1:500) to: Virgin Media New Build Virgin Media 1 Dove Wynd Strathclyde Business Park Bellshill ML4 3AL This information is only valid on the date of issue. If your start date is 3 months or more from the date of this letter, please re-apply for updated information. Yours faithfully, National Plant Enquiries Team
<i>Vtesse Networks Ltd</i>	Our Ref 0711/496 I confirm that Vtesse Networks do not have any plant within a 250metre radius of your enquiry. Plant Enquiry Team Vtesse Networks
Copyright National One Call 2008 all rights reserved	

Our Ref: Refer to Plan
Your Ref: **EQ/EJDGI847**

07/07/2011

National Notice Handling Centre
PP 3EW45, Telecom House,
Trinity Street,
Hanley,
Stoke-on-Trent,
ST1 5ND.

Freephone: 0800 800865

Dear Customer,

NR & SW ACT 1991 – PROPOSED WORKS AT: Disused Railway Line Stubbs Rd, Walden Stubbs, Doncaster, South Yorkshire, DN6 9BT

Prior to commencement of work: for free onsite guidance and accurate up to date location of BT plant please contact our Plant Protection Service by the following methods

Tele 0800 9173993

Fax 01332 578650

Email Dial before you dig DBYD@openreach.co.uk

Visit the website www.dialbeforeyoudig.com

Thank you for your request of **EQ/EJDGI847** 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.

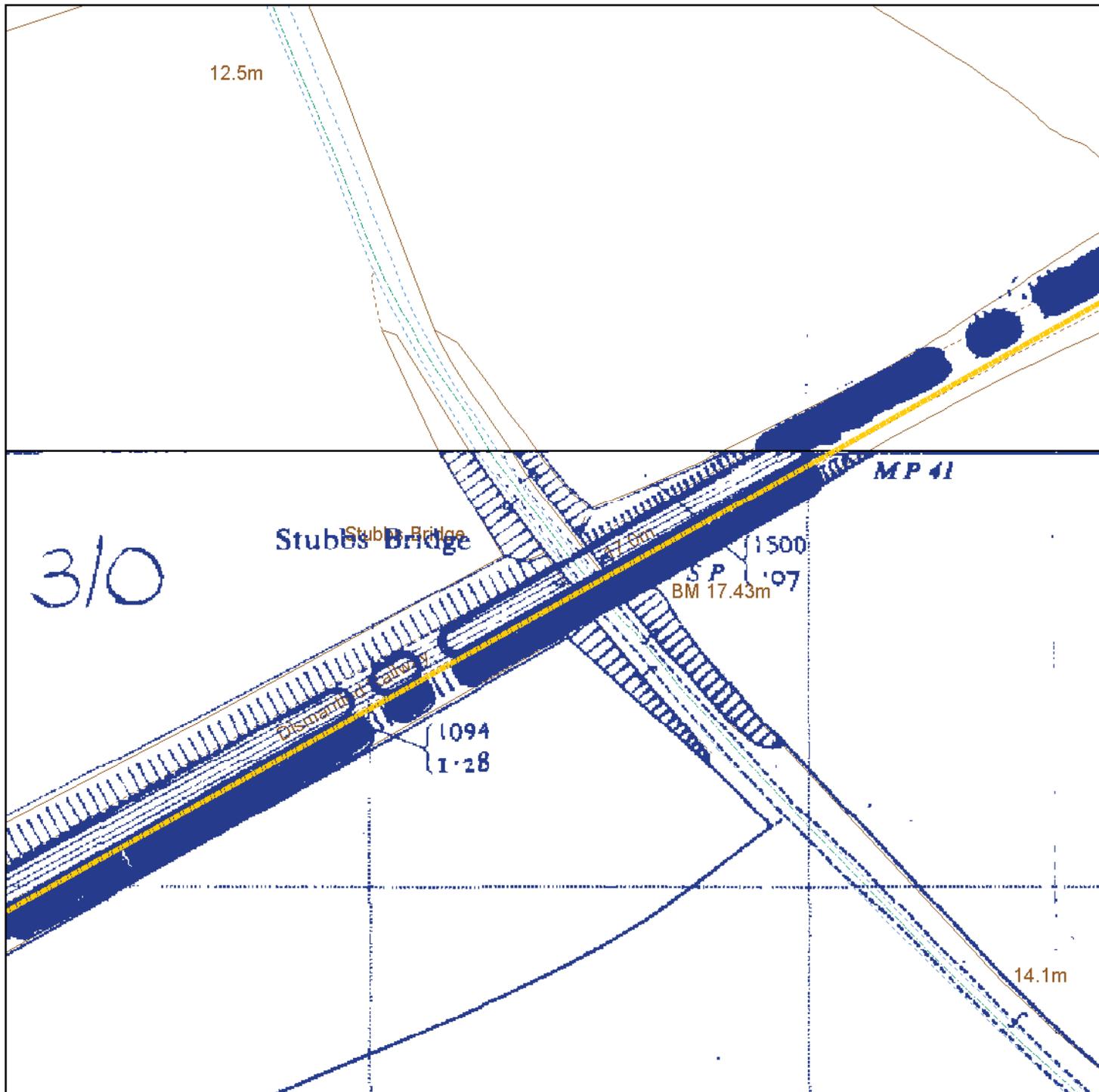
In the event of BT apparatus being in the area of works we recommend that your plant/vehicle crossing is either resited, or apply for a budget estimate by submitting detailed plans to the above address, these will be forwarded to the appropriate department for their comments.

Please ensure you quote our reference on any future correspondence.

Yours faithfully,

BT Openreach

Maps by email Plant Information Reply



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.

DIAL BEFORE YOU DIG

FOR PROFESSIONAL ON SITE ASSISTANCE PRIOR TO COMMENCEMENT OF EXCAVATION WORKS

ADVANCE NOTICE REQUIRED
(Office hours: Monday-Friday 08.00 to 17.00)

Tel: 0800 9173993
E-mail: dbyd@openreach.co.uk
Website: www.dialbeforeyoudig.com

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KEY TO BT SYMBOLS

	UNDERGROUND PLANT		POLE
	OVERHEAD PLANT		CABINET
	JOINT BOX		BURIED JOINT
	DISTRIBUTION POINT		JOINTING POST
	MANHOLE		PROPOSED U/G
	DP BOUNDARY		PROPOSED O/H
	OTHER BT BOUNDARY		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.

openreach
a BT Group business

BT ref: UCH16290Y

Map reference (centre): SE5414216977

Issued: 07/07/11 16:41:17



If telephoning or calling please ask for:

Peter Liddle
0191 2294294

Our Ref: 11/300148

Your Ref: EQ/EJDG1847

Date: 08 July 2011

National One Call
1 Mill Place
Mill Road Industrial Estate
Linlithgow Bridge
West Lothian
EH49 7TL

Dear Sir/Madam

REQUEST FOR RECORDS SHOWING LOCATION OF APPARATUS at:

Disused Railway Bridge Off Stubbs Road

Thank you for your enquiry dated 06/07/2011 concerning the above. The enclosed Mains Records only give the approximate location of known Yorkshire Electric apparatus in the area. Great care is therefore needed and all cables and overhead lines must be assumed to be live.

Please note that while all efforts are made to ensure the accuracy of the data, no guarantee can be given. We would refer you to the Health & Safety Executive's publication HS(G)47 "Avoiding Danger From Underground Services" which emphasises that:

* Plans must only be used as a guide in the location of underground cables. The use of a suitable cable-tracing device is essential and careful hand digging of trial holes must be carried out to positively identify and mark the exact route of the cable. You should also bear in mind that a cable is unmistakably located only when it has been safely exposed.

* Cable depths are not generally indicated on our records and can vary considerably even when shown.

* Great caution must be exercised at all times when using mechanical plant. Careful trial digging should always be carried out on the whole route of the planned excavation to ascertain no cables exist.

The Health & Safety Executive have another publication, GS6 "Avoidance of Danger from Overhead Electric Lines" that you should be aware of if your work is near overhead power lines. Both of these documents provide comprehensive guidance for observance of statutory duties under the Electricity at Work Regulations 1989 and the Health & Safety at Work Act 1974. Our provision of these records is based upon the assumption that people using them will have sufficient competence to interpret the information given. Any damage or injury caused will be the responsibility of the organisation concerned who will be charged for any repairs.

Please note ground cover must not be altered either above our cables or below overhead lines, in addition no trees should be planted within 3 metres of existing underground cables or 10 metres of overhead lines. All our apparatus is legally covered by a wayleaves agreement, lease or deed or alternatively protected under the Electricity Act 1989. Should any alteration / diversion of our Company's apparatus be necessary to allow your work to be carried out, budget costs can be provided by writing to Network Connections, Northumbria Works, Mill Street East, Dewsbury. WF12 9AH.

Yours faithfully



CE Electric UK Records Information Centre

Yorkshire Electric Mains Records enclosed:

SE542170.TIF

Records Information Centre, New York Road, Shiremoor, Newcastle upon Tyne NE27 0LP.

CE ELECTRIC UK FUNDING CO.

Registered Office: Lloyds Court, 78 Grey Street, Newcastle upon Tyne NE1 6AF.

Registered in England and Wales. Registered Number 03476201.

Cables should always be located by hand excavation prior to use of machinery.

GIS Mains Records Symbology at 1:250 Scale

At smaller Scales (e.g. 1:500) the sizes of the symbology are reduced in proportion.

Cables & Overhead Lines

	HV & EHV Cables
	LV Mains & Services
	Surface Wiring
	Pilot/Telephone
	Assumed Route of Cable
	Indicates end of Assumed Route
	Duct Route

Overhead Symbology

	Tower
	Steel Mast
	H Pole
	Single Wooden Pole
	Stay
	Strut
	Pole Mounted Transformer
	Street Lamp on a Pole

Underground Symbology

	Joint (11kV & above)
	Joint (LV)
	Meter Cabinet
	Insulated End Wall Mounted Termination Pole Mounted Termination
	Cable Repair
	Street Lamp Traffic Sign Telephone Call Box Street Furniture
	Cut Out
	Link Box
	Switch Status
	Earthing

Notes:

1. Cables may be laid with no tile cover or marker tape.
2. Cables laid in tiers are shown side by side and the formation indicated in sections on the cross section sheet

Please establish on site the position of equipment or service cables that may have changed since production of the plan.

ASSUME ALL LINES ARE LIVE

**FOR ANY FURTHER INFORMATION REGARDING
SAFE DIGGING PLANS –**

PLEASE CONTACT-

Public Safety - 0845 070 7172

Option 1 - New Connections, Moving Meter, Increased Supply / Fuse Size
Option 2 – To Request more Safe Digging Plans
Option 3 - Other General Enquiries including booking site visits and disconnections

Public Safety Emergency Line - 0800 375 675

(Exposed cable type emergencies)

Network Connections / Diversions - 0113 2415335

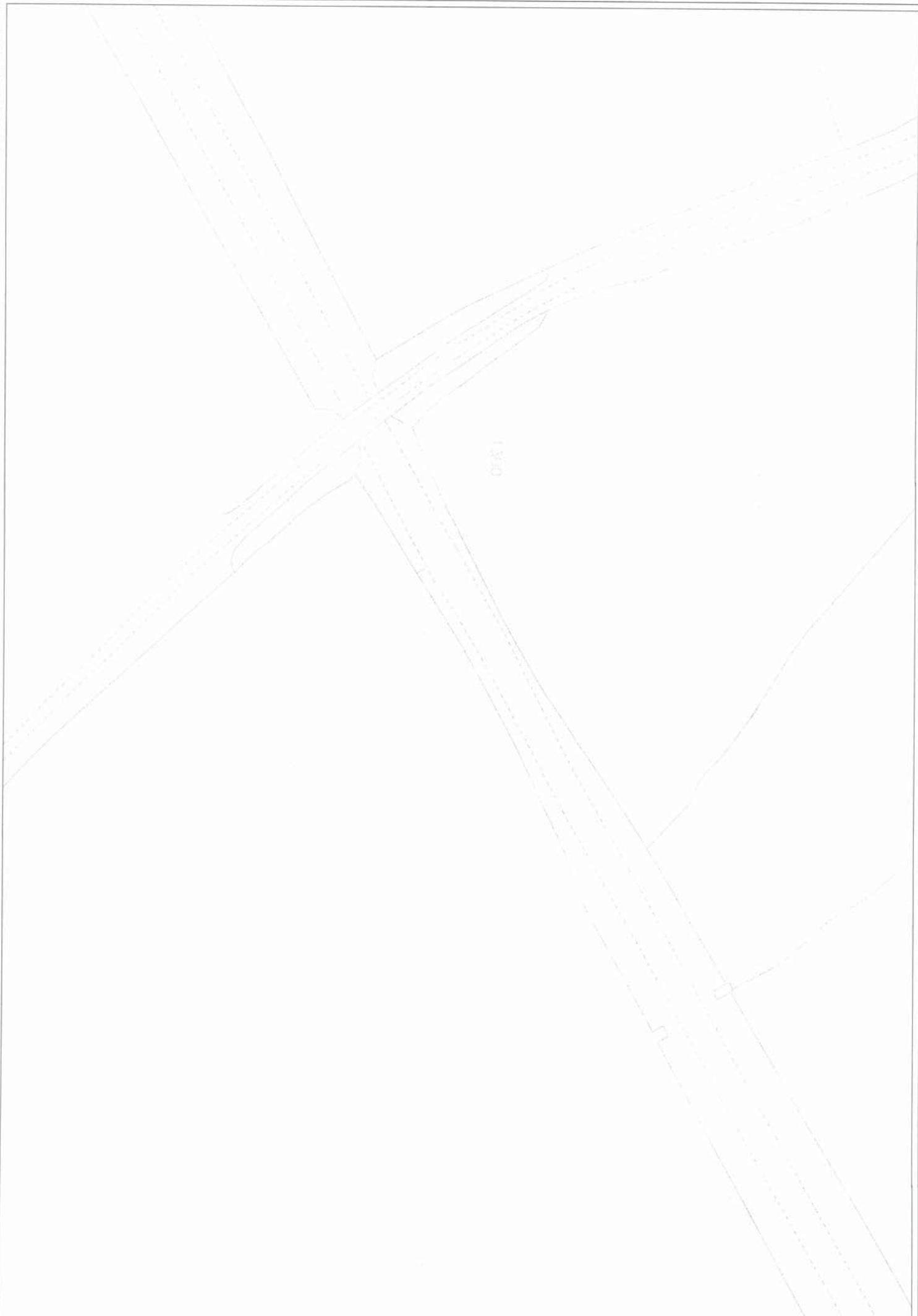
(Maximum load enquiries, quotes etc)

Wayleave Enquires - NEDL– 0191 2294667

YEDL – 01977 605104

(Wayleave Agreements and Ownership of cables, Stopping Up Orders)

If work is to be carried out **more than 3 months after** you have received safe digging plans then it is advisable that you request more up to date copies.



Disused Railway Bridge Off Stubbs Road

The position of our equipment is shown on this plan as accurately as possible. However, it may have changed since the plan was produced. Therefore, the position of our equipment and those of service cables which should not be regarded as accurate and should be used for guidance purposes only. In all cases, accurate information should be obtained from the ground truth survey prior to the construction of any new work.

Yorkshire Electricity Distribution plc.

Yorkshire Electricity Distribution plc
Safe Digging Map
454023,416864

08-07-2011
1:500
PEU



Northern Gas Networks
1st Floor
1 Emperor Way
Doxford International Business Park
Sunderland
SR3 3XR

Telephone No: 0845 634 0508*
www.northerngasnetworks.co.uk

**24 hour gas escape
number 0800 111 999**

*calls will be recorded and may be monitored

Our Ref: 300932837
Your Ref: EQ/EJDGI847
Date: 11.07.2011

Brian McMaster
National One Call
1 Mill Place Mill Road Industrial Estate
Linlithgow Bridge EH49 7TL

Dear Sir / Madam,

Re: Proposed Structure Works, Disused Railway Line, Stubbs Road, Waldon Stubbs, Doncaster, DN6 9BT.

Northern Gas Networks acknowledges receipt of your notice of your intention to carry out work at the above location.

According to our records Northern Gas Networks has no gas mains in the area of your enquiry.

Gas pipes owned by other Gas Transporters and also privately owned may be present in this area. Information with regard to such pipes should be obtained from the owners.

If you have any further enquiries please contact the Telephone number below.

Yours faithfully,



Northern Gas Networks Limited
Registered in England & Wales No 5167070
Registered Office
1100 Century Way Colton
Leeds LS15 8TU

██████████
National One Call
1 Mill Place
Mill Road Ind Estate
Linlithgow
West Lothian
EH49 7TL

Safe-Move
PO Box 682
Bradford
BD3 7YT

Tel: 0800 1 385 385
Fax:(01274) 253502

Your Ref: EQ/EJDG1847
Our Ref: D111109/FS

11th July 2011

Dear ██████████,

LOCATION: STUBBS ROAD, DN6 9BT + THIRSK BANK, COXWOLD, YO61 4AA

Thank you for your enquiry dated 11/07/2011 concerning the above.

As requested I enclose copies of Yorkshire Water's records, for water mains, also enclosed is a 'Protection of Mains and Services' form listing the necessary precautions when working within the vicinity of the Company's apparatus. The information on the plans is believed to be correct, but there may be departures from the positions indicated. The Company accepts no responsibility for any inaccuracy or omissions.

Water mains & services generally have a minimum cover of 900mm and 750mm respectively, although this is not guaranteed, as some mains are laid with less cover than this depth. Any excavations undertaken should anticipate the presence of mains with minimal ground cover.

The exact position of the Company's apparatus must be located on site prior to commencing works, if necessary by excavating trial holes. Yorkshire Water's staff will render any assistance in locating and safeguarding our apparatus provided advance notification is received of the commencement of works. This assistance will in no way affect your legal liability. Any damage to our apparatus, as a result of your work, may have serious consequences and payment for all remedial works and other related expenses will be the responsibility of yourselves or your contractor.

The Company has no responsibility for recording the locations of privately owned apparatus.

If you have any further queries, please do not hesitate to contact me.

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Yours sincerely

██████████
Safe-Move

██████████
National One Call
1 Mill Place
Mill Road Ind Estate
Linlithgow
West Lothian
EH49 7TL

Safe-Move
PO Box 682
Bradford
BD3 7YT

Tel: 0800 1 385 385
Fax:(01274) 253502

Your Ref: EQ/EJDG1847
Our Ref: D111109/FS

11th July 2011

Dear ██████████,

LOCATION: STUBBS ROAD, DN6 9BT + THIRSK BANK, COXWOLD, YO61 4AA

Thank you for your enquiry dated 11/07/2011 concerning the above.

The Company's sewerage apparatus does not appear to be affected in this instance, we are therefore unable to enclose a plan due to copyright regulations.

I enclose a 'Protection of Mains and Services' form listing the necessary precautions when working within the vicinity of the Company's apparatus. The Company accepts no responsibility for any inaccuracy or omissions, the actual position of any apparatus and that of services pipes must be established on site prior to commencement of any works.

Public Sewers generally have a minimum cover of 1200mm, although this is not guaranteed as some sewers are laid with less than this depth. Any excavations undertaken should anticipate the presence of sewers with minimal ground cover.

The Company has no responsibility for recording the locations of privately owned apparatus.

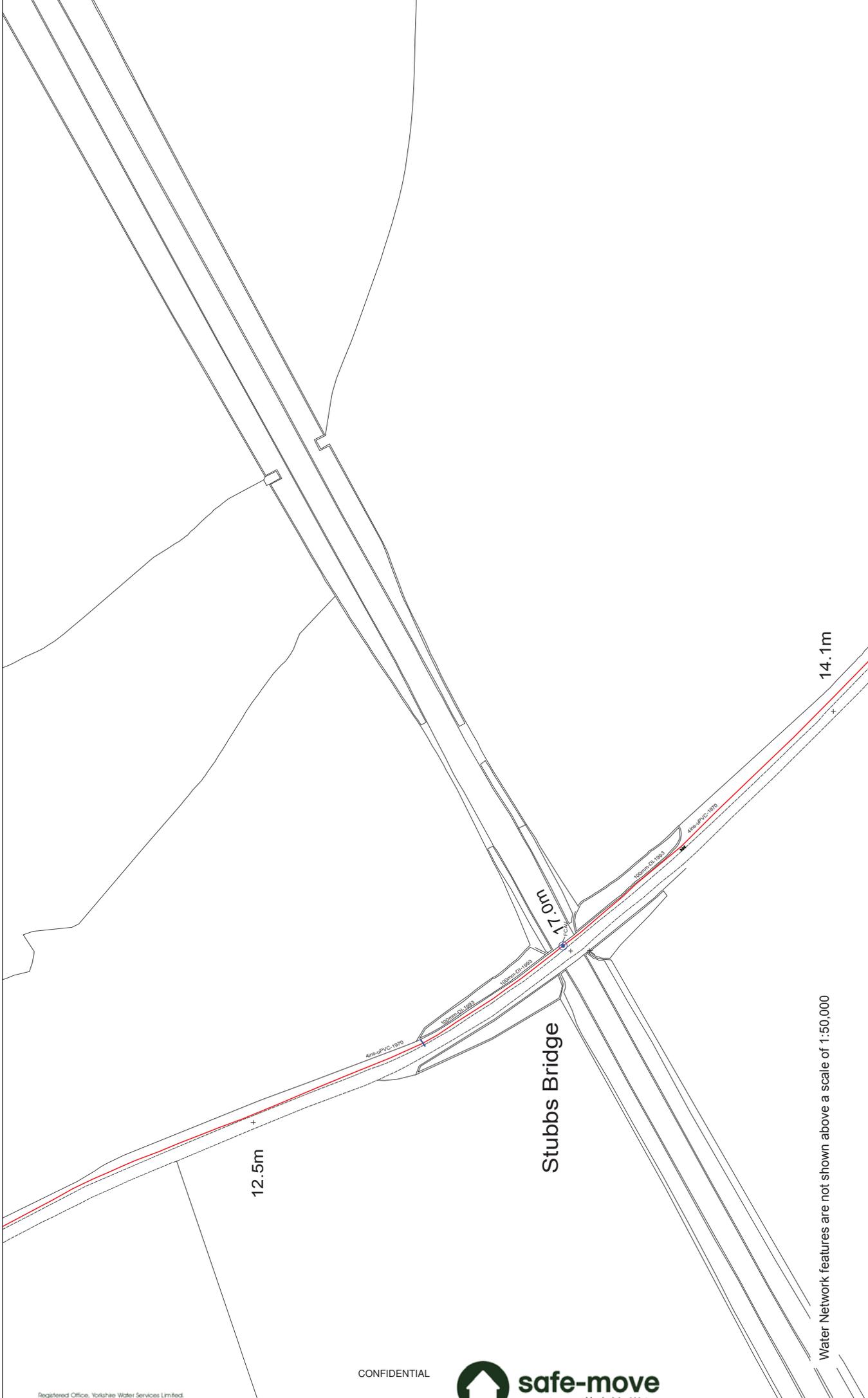
If you have any further queries, please do not hesitate to contact me.

Yours sincerely

██████████
Safe-Move

CONFIDENTIAL





The positions and depths of apparatus shown on this plan are approximate only. The exact positions and depths should be obtained by excavation trial holes.

Partial Key	Water mains up to 4" in diameter
	Water mains over 4" in diameter
	Raw water mains
	Private water mains
Scale :	1:1250
Map's No :	11/07/2011, 12/26/21
Date Req :	11/07/2011, 12/26/38
Source :	Water Network Enquiry

Title
Notes

Map Name : SE5316NE
 Yorkshire Water,
 PO Box 500,
 Halifax Road,
 Bradford BD6 2LZ
 Contact Name :
 Mrs F Sorsby
 Contact Tel : 75 4934

Map No : 11/07/2011, 12/26/21
Date Req : 11/07/2011, 12/26/38
Source : Water Network Enquiry

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454044 : 476599



Map Name : SE5316NE
 Yorkshire Water,
 PO Box 500,
 Halifax Road,
 Bradford BD6 2LZ
 Contact Name :
 Mrs F Sorsby
 Contact Tel : 75 4934

Water Network features are not shown above a scale of 1:50,000

YORKSHIRE WATER PROTECTION OF MAINS AND SERVICES - CLEAN WATER

1. Please note the positions of clean water apparatus shown on the enclosed plans are believed to be correct. However, Yorkshire Water (YW) will accept no responsibility in the event of any inaccuracy or omission. The actual position of such apparatus and that of service pipes which have not been indicated must be established on site by contacting the Customer Helpline (0845 124 24 24) for water and (0845 120 8482) for sewerage.
 2. To enable future repair works to be carried out without hindrance; any pipe, cable, duct, etc. installed parallel to a water main or service pipe should not be installed directly over or within 300mm of a water main or service pipe. A minimum clearance of 150mm must be maintained at any perpendicular crossing. These requirements apply to activities within an existing highway and are relevant to the installations of pipes, cables, ducts, etc. up to and including 250mm in diameter. Necessary protection measures for installations greater than 250mm in diameter and/or in private land will need to be agreed on an individual basis.
- Installations within a new development site must comply with the National Joint Utilities Group publication Volume 2. NJUG Guidelines On The Positioning Of Underground Utilities Apparatus For New Development Sites.
3. All excavation works near to YW apparatus should be by hand digging only.
 4. Backfilling with a suitable material to a minimum 300mm above YW apparatus is required.
 5. If surface levels are to be decreased/increased significantly the effects on existing apparatus will be carefully considered and if any alterations are necessary, the costs of the alterations will be recharged to you in full. Outlets on fire hydrants must be no more than 300mm below the new levels and all surface boxes must be adjusted as part of the scheme.
 6. Adequate support must be provided where any works pass under YW apparatus.
 7. Jointing chambers, lighting columns and other structures must be installed in such a way that future repair or maintenance works to YW apparatus will not be hindered.
 8. Apparatus such as; railings, sign posts, etc. must not be placed in such a way that they prevents access to or full operation of controlling valves, hydrants or similar apparatus. Care must also be taken not to bury or cover chamber lids for similar reasons.
 9. Explosives shall not be used within 100 meters of any Yorkshire Water Services apparatus or installations.
 10. Vibrating plant should not be used directly over any apparatus.
 11. **Under no circumstances** should thrust boring or similar trenchless techniques commence until the actual position of the Company's mains/services along the proposed route have been confirmed by trial holes.
 12. Any alterations to the highway should be notified following the procedures outlined in the New Road and Street Works Act 1991 Code of Practice; Measures Necessary Where Apparatus Is Affected By Major Works (Diversionary Works).
 13. Should YW incur any costs as a result of non-compliance with the above, all costs will be recharged in full.

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YORKSHIRE WATER PROTECTION OF MAINS AND SERVICES - WASTE WATER

1. The position of Yorkshire Water Services Ltd (YWS) apparatus shown on the existing mains record drawing(s) indicates the **general** position and nature of our apparatus and the accuracy of this information cannot be guaranteed. Any damage to YWS apparatus as a result of your works may have serious consequences and you will be held responsible for all costs incurred. Prior to commencing major works, the exact location of apparatus must be determined on site, if necessary by excavating trial holes. The actual position of such apparatus and that of service pipes which have not been indicated must be established on site by contacting the Customer Helpline (0845 124 24 24) for water and (0845 120 8482) for sewerage.
2. The public sewer network is lawfully retained in its existing position and the sewerage undertaker is entitled to have it remain so without any disturbance. The provisions of section 159 of the Water Industry Act 1991 provides that the sewerage undertaker may "inspect, maintain, adjust, repair or alter" the network. Those rights are given to enable the sewerage undertaker to perform its statutory duties. Any development of the land or any other action that unacceptably hindered the exercise of those rights would be unlawful.
3. Sewers in highways will **generally** be laid to give 1200mm of cover from finished ground level working to kerb races, other permanent identification of the limits of the road or to an agreed line and level. Substantial increases or decreases to this 1200mm depth of cover will result in the sewer being re-laid at your expense.
4. All excavation works near to YWS apparatus should be by hand digging only.
5. Backfilling with a suitable material to a minimum 300mm above YW apparatus is required.
6. To enable future repair works to be carried out, a minimum clearance of 1000mm must be maintained where any works or services are installed adjacent to YWS apparatus and a minimum clearance of 150mm where any works or services cross the apparatus.
7. Adequate support must be provided where any works pass under existing YWS apparatus.
8. Jointing chambers, lighting columns and other structures must not be installed in such a way that future repairs to YWS apparatus are hindered.
9. YWS surface boxes must not be covered or buried. Any adjustment, alteration or replacement of manhole covers must be agreed on site prior to the commencement of the works with a YWS Inspector who may be contacted via our Call Centre on 0845 120 8482.
10. Explosives must not be used within 100 metres of YWS apparatus or installations and vibrating equipment should not be used directly over any apparatus.
11. Ground levels over existing YWS apparatus are to be maintained.
12. Movement or operation by vehicles or heavy plant is not to be permitted in the immediate vicinity of YWS plant or apparatus unless there has been prior consultation and, if necessary, adequate protection provided without cost to YWS.
13. You will be held responsible for any damage or loss to YWS apparatus during and after completion of work, caused by yourselves, your servant or agent. Any damage caused or observed to YWS plant or apparatus should be immediately reported to YWS.
14. You should ensure that nothing is done on the site to prejudice the safety or operation of YWS employees, plant or apparatus.

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Sewer Legend

	Combined Sewer		S24 Combined Sewer
	Surface Water Sewer		S24 Surface Water Sewer
	Foul Sewer		S24 Foul Sewer
	Section 104 Sewer		Public Rising Main
	Pumping Station		Abandoned Sewer
	Public Sewage Treatment Works		Syphon Sewer & Vacuum Sewer
			Manhole

Water Legend

	Water Main 4" and below
	Water Main 4" and above
	Raw Water Main
	Private Water Main
	Fire Hydrant
	Pumping Station

Appendix C Trial Pit Log





Contract: BE4 BD21 Bridges		Client: Jacobs Engineering		Trialpit: HBR3/123 TP01
Contract Ref: 761999	Date: 24.08.11	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: Grass over TOPSOIL.	0.24	
						MADE GROUND: Compact brown friable CLAY with siltstone cobbles.	0.41	
						MADE GROUND: Bitumen seal.	0.46	
						MADE GROUND: Weakly cemented CONCRETE.	0.62	
						MADE GROUND: Dense CONCRETE.	0.69	
						Trial pit terminated at 0.69m depth on red brick arch crown.		

GINT LIBRARY v8.04.GLB\TRIAL PIT LOG - STANDARD | 761999 BE4 BD21 BRIDGES.GPJ - v8.04 | 08/09/11 - 13:28 | MP. Structural Soils Ltd, Branch Office - Castleford, The Potteries, Pottery Street, Castleford, West Yorkshire, WF10 1NJ. Tel: 01977-552255, Fax: 01977-552299, Web: www.soils.co.uk, Email:north@soils.co.uk.

Plan (Not to Scale)		<h3>General Remarks</h3> <ol style="list-style-type: none"> 1. Trial hole carried out in verge. 2. Service plans checked and position CAT scanned prior to excavation. 3. No groundwater encountered during excavation. 4. Trial hole backfilled and reinstated to local authority specification. 		
All dimensions in metres		Scale: 1:25		
Method Used: Hand dug	Plant Used: Hand tools	Logged By:	Checked By:	

Appendix D Form AA

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

ELR/ Bridge No HBR3/123

Appendix: 4

Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT**Bridge/Line Name: Stubbs Road, Walden Stubbs /
Hull and Barnsley line****ELR/Bridge No. HBR3/123****Brief Description of Existing Bridge:****(a) Span Arrangement**

The bridge is a single span skew overbridge with 7.92m (26') clear skew span and a square span of 7.75m (25' 5") giving a skew angle of 11°

(b) Superstructure Type

The bridge comprises seven longitudinally spanning cast iron girders spaced at 1.37m (4' 6") centres. The bottom flanges of the five internal girders are 457mm (18") wide and 50mm (2") thick, whereas the top flanges are 152mm (6") wide and 40mm (1½") thick. The edge girders have an eccentric web, located 75mm (3") from the outer edge of flanges. Bottom flanges are 387mm (15") wide and 50mm (2") thick.

The beams are linked together by three transverse steel ties at 2.29m (7' 6") spacing from the central tie. Two courses thick brick jack arches span between the bottom flanges of beams. The rise of the jack arches is 159mm (6").

The parapets are brick with bull nosed blue brick copings.

(c) Substructure Type

The abutments and wingwalls are brick gravity type structures.

(d) Planned highway works/modifications at this site

None

(e) Road designation class and whether classed as a heavy load route

The bridge carries an unclassified rural road serving several nearby villages and farms. The road is a single carriageway 4.14m wide at the centre of the span. There are verges of 1.78m and 1.63m width on the west and east sides respectively. Traffic is sparse. Occasional heavy farm vehicles and HGV's are likely to pass over the structure. It is unlikely to be a heavy load route.

(f) Any other requirements

None

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

ELR/ Bridge No HBR3/123

Appendix: 4

Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT**Assessment Criteria**

(a) Loadings and Speed

Section sizes used to calculate dead loads obtained from site measurements. (See Jacobs report "VAR9-3299 Assessment Programme – Assessment and Inspection Report – Bridge Ref.: HBR3/123 – December 2011). 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 Highway Bridges for Construction and Use Vehicles" Ministry of Transport, 1967 (with amendments to 1969)

(c) Proposed Method of Structural Analysis

The deck loading is amenable to analysis by the quick assessment method outlined in Part 2 of BE4. The edge girders will be unaffected by live loads applied in accordance with BE4 as internal girders are positioned between them and the near-side line of wheels (Clause 302). The edge girders will be checked under dead and superimposed dead load only. Capacities will be calculated using measurements of reduced section sizes where corrosion is present, as identified in the Inspection Report. Consequently, a general condition factor is not applied.

The infill material above the top flange of the girders is clay with siltstone cobbles. Due to the substantial clay content, the material is considered not fully compliant with BE4 Clause 305 b ii 1 therefore D/d enhancement of the live load section modulus will not be used in the initial assessment. Should the required capacity not be reached by this conservative approach, a sensitivity analysis will be carried out to examine the degree of enhancement that would be required.

Review of the adequacy of the jack arches and tie-rods will be based upon the empirical method described in Bridgeguard 3 Current Information Sheet No 22 (Pro-forma for the empirical assessment of brick, masonry and concrete jack arches and associated ties.)

The substructure will be assessed qualitatively.

FORM 'AA' (BRIDGES)

GC/TP0356

ELR/ Bridge No HBR3/123

Appendix: 4

Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Senior Civil Engineer's Comments

None

Proposed Category for Independent Check 1

Superstructure 1

Substructure 1

Name of Checker suggested if Cat 2 or 3 Not Applicable

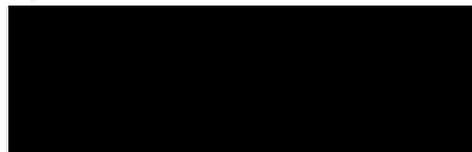
Category 1

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

Signed

Title

Date



Category 2 and 3

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

Signed

Title

Date

Signed

Title

Date

Appendix E Form BA

FORM 'BA' (BRIDGES)

GC/TP0356

ELR/ Bridge No HBR3/123

Appendix: 4

Issue: 1

Revision: A (Dec 2005)

CERTIFICATION FOR ASSESSMENT CHECK

Assessment Group: Jacobs Engineering UK Ltd

Bridge/Line Name: Stubbs Road/ Hull and Barnsley Railway

Category of Check: 1

ELR/ Bridge No: HBR3/123

We 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 as recorded on Form AA approved on 5th January 2012
- (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 Highway Bridges for 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.

None

Category 1

Name	Signature	Date

Assessor

Assessment Checker

Authorised signatory of the
Firm of Consulting
Engineers to whom
Assessor/Checker is
responsible.

FORM 'BA' (BRIDGES)

GC/TP0356

ELR/ Bridge No HBR3/123

Appendix: 4

Issue: 1

Revision: A (Dec 2005)

CERTIFICATION FOR ASSESSMENT CHECK

Category 2 and 3 (Note: Category 1 check must also be signed)

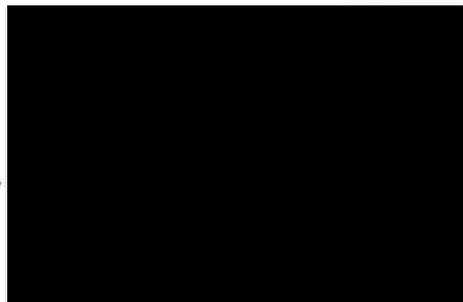
(a) Assessment

<u>Name</u>	<u>Signature</u>	<u>Date</u>	
.....	Assessor
.....	Assessment Checker
.....	Authorised signatory of the firm of Consulting Engineers to whom Assessor/Checker is responsible.

(b) Check

<u>Name</u>	<u>Signature</u>	<u>Date</u>	
.....	Assessor
.....	Assessment Checker
.....	Authorised signatory of the firm of Consulting Engineers to whom Assessor/Checker is responsible.

This Certificate is accepted by.



FORM 'BAA' (BRIDGES)

GC/TP0356

ELR/ Bridge No HBR3/123

Appendix: 4

Issue: 1

Revision: A (Dec 2005)

CERTIFICATION FOR ASSESSMENT CHECK**Notification of Assessment Check**

Assessment Group	Jacobs Engineering UK Ltd
Bridge Name/Road No.	Stubbs Road/ Unclassified Road
Line Name	Hull and Barnsley Railway
ELR Code/Structure No.	HBR3/123

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

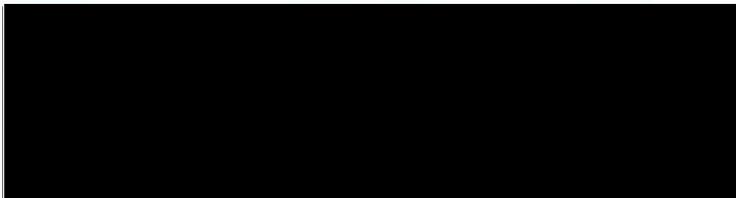
Main Girders carrying carriageway	Full C&U loading: 24 ton vehicle train
Edge Girders (no live loading)	Pass
Jack Arches and ties	Not Compliant*
Substructure:	Full C&U loading by qualitative assessment.

Recommended Loading Restrictions

*The tie bars in the external jack arch bays are non-compliant with the specific area requirements of Construction Information Sheet No.22. There is no applied BE4 live load on these arches therefore the deficiency does not directly affect the load rating for the bridge, but structural stability needs to be preserved.

Description of Structural Deficiencies and Recommended Strengthening

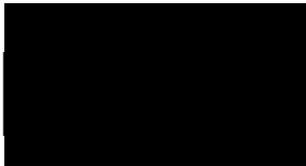
Install additional ties straps in outer bays to meet specific area requirements in order to ensure stability of the edge girders and edge jack arches.

NameSignatureDate


Assessor

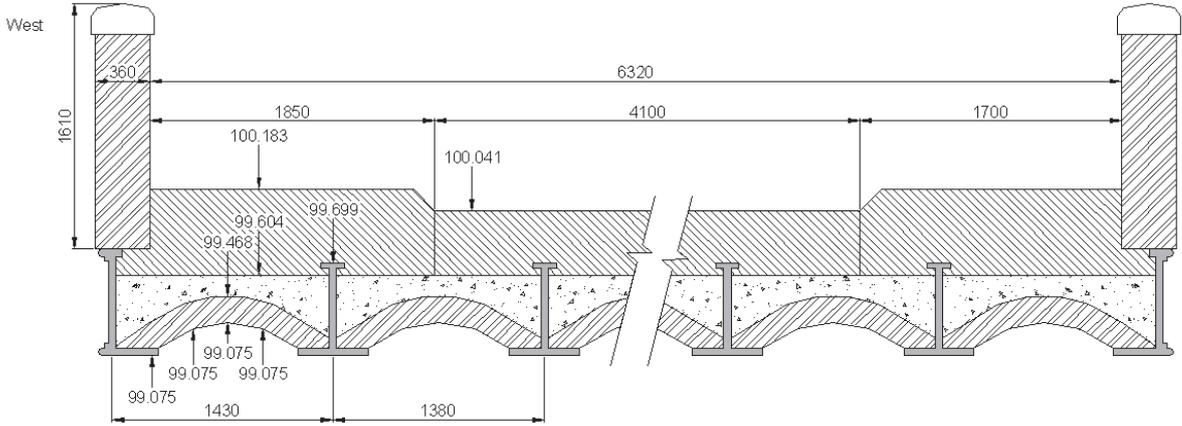
Assessment Checker

Authorised signatory of the
firm of Consulting
Engineers to whom
Assessor/Checker is
responsible.

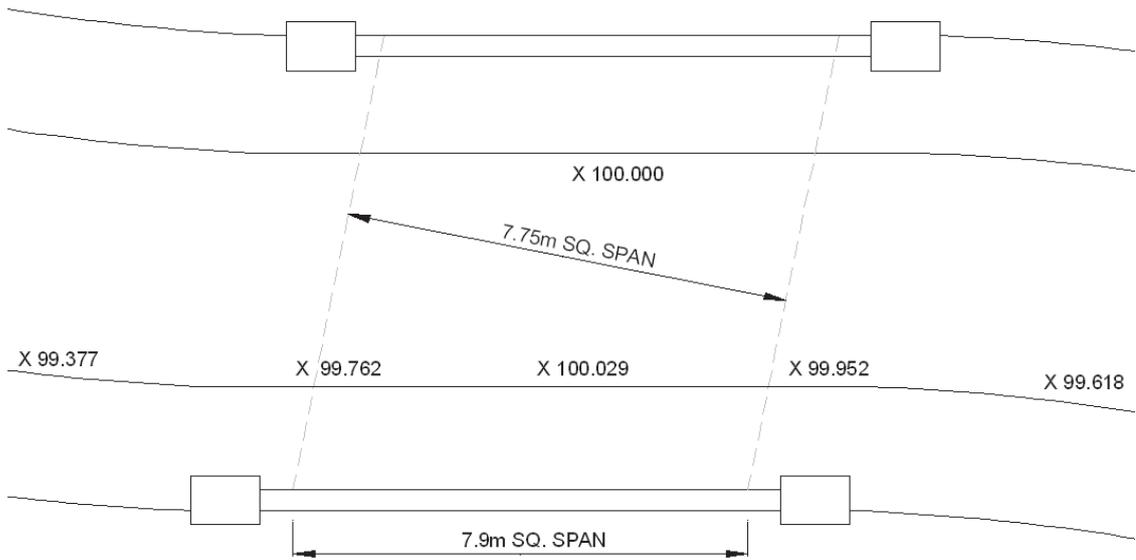


This Certificate is accepted by....

Appendix F Calculations



Cross Section



Plan

CALCULATION COVER SHEET

Jacobs
York

Project Title: BRB (Residuary) Ltd - Major Works 2009/2012		Calc. No.: 0447929
Job No: B12360BN		File: VAR9/3299
Project Manager	[REDACTED]	Subject: HBR3/123 Stubbs Road, North Yorkshire BE4 Assessment
Assessor		
Project Group 31200		

	Total Sheets	Made by	Date	Checked by	Date	Reviewed by	Date		
Original	19	[REDACTED]	Feb-12	[REDACTED]	Feb-12				
Rev									
Rev									
Rev									
Rev									
Rev									

Superseded by Calculation No.	Date
-------------------------------	------

For assessment criteria, refer to Approval in Principle (Form AA) document

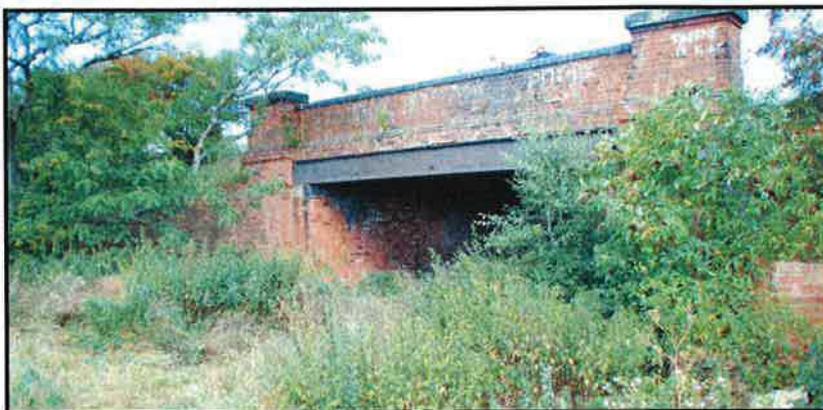
CALCULATION SHEET	BRB (Residuary) Ltd - Major Works Programme 2009-2012		
	BE4 Assessment of Cast Iron Girders and Transverse Jack Arches		
Section: 1. Assessment Info	Job No:	B12360BN	
Made by: DT Date: Feb-12 Checked by: ██████ Date: Feb-12	Ref:	HBR3/123	

Sheet No: 1

1. Assessment Information

1.1. Structure Details

Overbridge: HBR3/123 - Stubbs Road



1.2. Assessment Criteria - Cast Iron Girders

- The deck loading is amenable to analysis by the quick assessment method outlined in Part 2 of BE4.
- The edge girders will be unaffected by live loads applied in accordance with BE4 as internal girders are positioned between them and the near-side line of wheels (Clause 302).
- Due to the substantial clay content of the material above the girder top flanges, the material is considered not fully compliant with BE4 Clause 305 b ii 1 therefore D/d enhancement of the live load section modulus will not be used in the initial assessment.
- Shear stress not critical in assessment of cast iron girders, therefore not considered within the assessment

1.3. Assessment Criteria - Jack Arches

- Review of the adequacy of the jack arches and tie-rods will be based upon the empirical method described in Bridgeguard 3 Current Information Sheet No 22 (Pro-forma for the empirical assessment of brick, masonry and concrete jack arches and associated ties.)

1.4. Calculation Key

Input	=	Number taken from external references (Reference noted in margin)
Previous	=	Number referenced earlier in assessment (Original source noted in margin)
Output	=	Number calculated from numbers referenced earlier in calculations
*Assumption	=	Statement of assumption affecting the assessment

CALCULATION SHEET	BRB (Residuary) Ltd - Major Works Programme 2009-2012		
	BE4 Assessment of Cast Iron Girders and Transverse Jack Arches		
Section: 2. Assessment Assumptions	Job No:	B12360BN	
Made by: DT Date: Feb-12 Checked by: ████ Date: Feb-12	Ref:	HBR3/123	

Sheet No: 2

2. Assessment Assumptions

BE4 pg 4

2.1. Material Densities/ Unit Weights

Cast Iron	$\rho_{ci} =$	450	lbs/ft ³	=	65.60	kN/m ³
Miscellaneous Fill	$\rho_f =$	135	lbs/ft ³	=	19.68	kN/m ³
Macadam	$\rho_m =$	144	lbs/ft ³	=	20.99	kN/m ³
Concrete	$\rho_c =$	150	lbs/ft ³	=	21.87	kN/m ³
Brickwork	$\rho_b =$	140	lbs/ft ³	=	20.41	kN/m ³

CALCULATION SHEET	BRB (Residuary) Ltd - Major Works Programme 2009-2012		
	BE4 Assessment of Cast Iron Girders and Transverse Jack Arches		
Section: 3. Level Survey	Job No:	B12360BN	
Made by: DT Date: Feb-12 Checked by: ██████ Date: Feb-12	Ref:	HBR3/123	

Sheet No: 3

3. Level Survey

Ref.	Back Sight	Inter-Sight	Fore Sight	Collimation or H.P.C	Reduced Level	Remarks
1	1.083	-	-	101.083	100.000	BM1
2		2.240			98.843	20N (West side)
3		1.991			99.092	15N (West side)
4		1.706			99.377	10N (West side)
5		1.320			99.763	5N (West side)
6		1.053			100.030	0 (c/c West side)
7		1.130			99.953	5S (West side)
8		1.464			99.619	10S (West side)
9		1.724			99.359	15S (West side)
10		1.946			99.137	20S (West side)
11	0.478		3.646	97.915	97.437	CP
12		-1.172			99.087	US of Beam 1, N
13		-1.141			99.056	US of Beam 1, Mid
14		-1.185			99.100	US of Beam 1, S
15		-1.147			99.062	US of Beam 2, N
16		-1.171			99.086	US of Beam 2, Mid
17		-1.193			99.108	US of Beam 2, S
18		-1.155			99.070	US of Beam 3, N
19		-1.177			99.092	US of Beam 3, Mid
20		-1.930			99.845	US of Beam 3, S
21		-1.156			99.071	US of Beam 4, N
22		-1.190			99.105	US of Beam 4, Mid
23		-1.199			99.114	US of Beam 4, S
24		-1.168			99.083	US of Beam 5, N
25		-1.198			99.113	US of Beam 5, Mid
26		-1.201			99.116	US of Beam 5, S
27		-1.171			99.086	US of Beam 6, N
28		-1.344			99.259	W QP of Arch 1-2
29		-1.383			99.298	Crown of Arch 1-2
30		-1.336			99.251	E QP of Arch 1-2
31		-1.340			99.255	W QP of Arch 2-3
32		-1.385			99.300	Crown of Arch 2-3
33		-1.346			99.261	E QP of Arch 2-3
33	3.542		0.476	100.981	97.439	CP
34		0.935			100.046	Road Adjacent to TP
35		0.793			100.188	Verge Adjacent to TP
36		1.276			99.705	TS of Beam 1
37		1.371			99.610	Top of Conc Backing, Arch 1-2
38		1.507			99.474	Top of Arch 1-2
40		0.975			100.006	BM1

CALCULATION SHEET

BRB (Residuary) Ltd - Major Works Programme 2009-2012

BE4 Assessment of Cast Iron Girders and Transverse Jack Arches

Section: 4. Section Properties

Job No: B12360BN

Made by: DT Date: Feb-12 Checked by: ████ Date: Feb-12

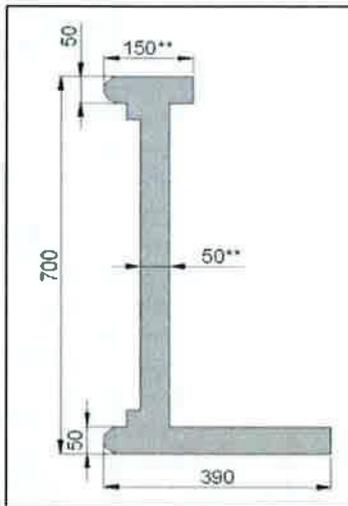
Ref: HBR3/123

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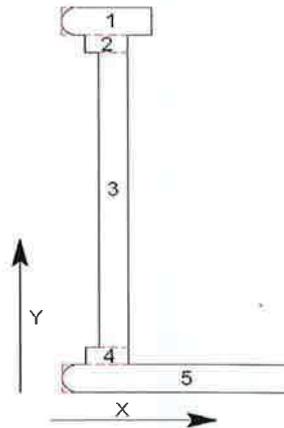
4. Section Properties

4.1. Edge Girder Section Properties

4.1.1. Section Arrangement



Section capacity values calculated from the simplified section breakdown as shown below.



4.1.2. Edge Girder Properties (About x-x Axis)

No.	Section	b	d	A	y	A.y	A(y-y _i) ²	I _x
		(mm)	(mm)	(mm ²)	(mm)	(mm ³)	(mm ⁴)	(mm ⁴)
1	Top Flange (i)	150	50	7500	675.0	5.06E+06	1.15E+09	1.56E+06
2	Top Flange (ii)	70	30	2100	635.0	1.33E+06	2.60E+08	1.58E+05
3	Web	50	540	27000	350.0	9.45E+06	1.21E+08	6.56E+08
4	Bot Flange (ii)	70	30	2100	65.0	1.37E+05	9.98E+07	1.58E+05
5	Bot Flange (i)	390	50	19500	25.0	4.88E+05	1.30E+09	4.06E+06
Sum				58200		1.65E+07	2.93E+09	6.62E+08

Site Survey

Depth of Full Section

D = 700 mm

Distance to N/A from soffit of section

y_t = 283.0 mm

2nd moment of area of beam section

I_{xx} = 3.59E+09 mm⁴

Elastic Section Modulus (Compression Flange)

Z_{xc} = 8.62E+06 mm³

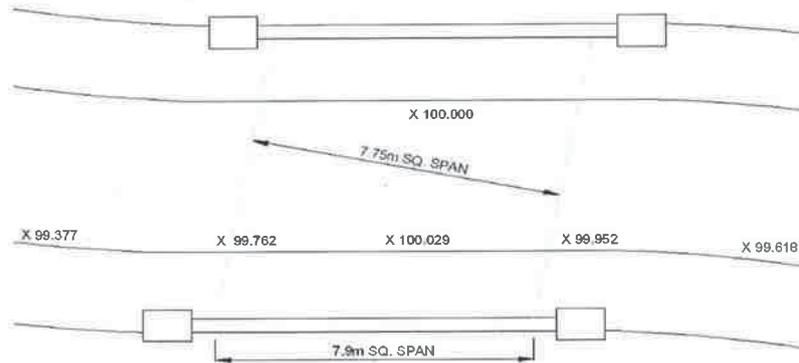
Elastic Section Modulus (Tension Flange)

Z_{xt} = 1.27E+07 mm³

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4.1.3. Effective Span of Edge Girder



Site Survey
Refer to 4.1.2

Clear Skew Span
Depth of Edge Girder

L = 7900 mm
D = 700 mm

BE4 303 (a)iv

The effective span (L_{eff}) should be taken as the distance between the centroids of the bearing pressure diagrams.

**The deck girders bear onto individual sandstone pad blocks built flush into the abutments. Where the slab rests directly on masonry, the reaction shall be assumed to be distributed linearly from a maximum at the front edge of the support to zero at the back of the bearing area.*

BE4 303 (a)iv

** Due to sandstone pad blocks, assume bearing area = 0.5 x girder depth. Centroid of bearing is therefore (D/2) x (1/3) from front edge of support.*

» $L_{eff} = L + 2[(D/2) \times (1/3)]$

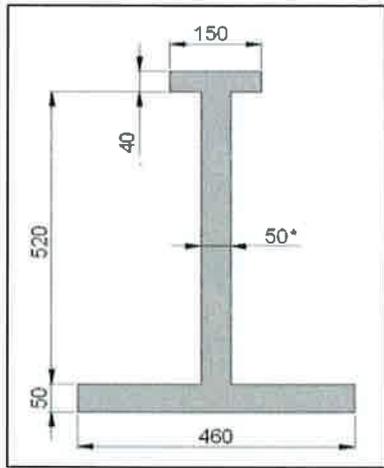
$L_{eff} =$ 8133 mm

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	BE4 Assessment of Cast Iron Girders and Transverse Jack Arches		
Section: 4. Section Properties	Job No:	B12360BN	
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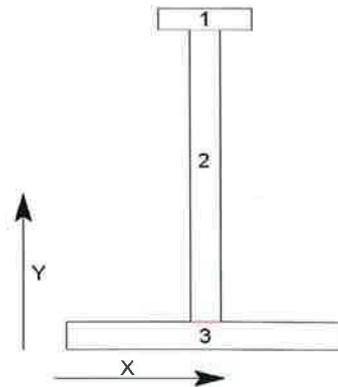
Sheet No: 6

4.2. Internal Girder Section Properties

4.2.1. Section Arrangement



Section capacity values calculated from the simplified section breakdown as shown below.



4.2.2. Internal Girder Properties (About x-x Axis)

No.	Section	b	d	A	y	A.y	A(y-y _i) ²	I _x
		(mm)	(mm)	(mm ²)	(mm)	(mm ³)	(mm ⁴)	(mm ⁴)
1	Top Flange	150	40	6000	590.0	3.54E+06	8.15E+08	8.00E+05
2	Web	50	520	26000	310.0	8.06E+06	2.04E+08	5.86E+08
3	Bot Flange	460	50	23000	25.0	5.75E+05	8.87E+08	4.79E+06
Sum				55000		1.22E+07	1.91E+09	5.91E+08

Site Survey

Depth of Full Section
 Distance to N/A from soffit of section
 2nd moment of area of beam section
 Elastic Section Modulus (Compression Flange)
 Elastic Section Modulus (Tension Flange)

D =	610	mm
y _i =	221.4	mm
I _{xx} =	2.50E+09	mm ⁴
Z _{xc} =	6.43E+06	mm ³
Z _{xt} =	1.13E+07	mm ³

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Site Survey
Refer to 4.2.2

4.2.3. Effective Span of Internal Girder

Clear Skew Span
Depth of Internal Girder

L = 7900 mm
D = 610 mm

BE4 303 (ajiv)

The effective span (L_{eff}) should be taken as the distance between the centroids of the bearing pressure diagrams.

**The deck girders bear onto individual sandstone pad blocks built flush into the abutments.*

BE4 303 (ajiv)

Where the slab rests directly on masonry, the reaction shall be assumed to be distributed linearly from a maximum at the front edge of the support to zero at the back of the bearing area.

** Due to sandstone pad blocks, assume bearing area = 0.5 x girder depth. Centroid of bearing is therefore (D/2) x (1/3) from front edge of support.*

» $L_{eff} = L + 2[(D/2) \times (1/3)]$

$L_{eff} =$ 8002 mm

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5. Dead & Super Imposed Dead Loads

5.1. Edge Girder - Dead Loads

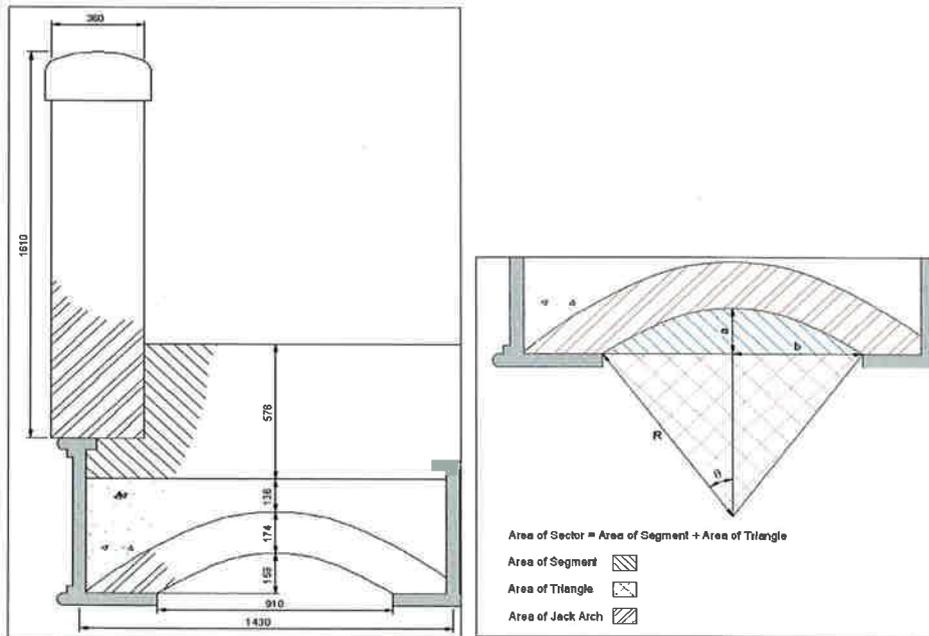
5.1.1. Edge Girder Self Weight

Refer to 2.1.
Refer to 4.1.2.

Unit weight of Cast Iron
Cross sectional Area of Edge Beam
» Edge Girder Self Weight UDL

$$\begin{aligned} \rho_{ci} &= 65.60 \text{ kN/m}^3 \\ A &= 0.058 \text{ m}^2 \\ &= 3.82 \text{ kN/m} \\ \text{Total Dead Load UDL} &= 3.82 \text{ kN/m} \end{aligned}$$

5.2. Edge Girder - Super Imposed Dead Loads



*Assume parapet overhangs edge girder by 20mm

5.2.1. Jack Arch Load

Refer to 2.2.
Level survey
Level survey

Unit weight of Brickwork
Arch Barrel Thickness
Arch Barrel Rise
Jack Arch Span = 910.0 mm
Jack Arch Radius » $R_{(Intrados)} = (a^2 + b^2) / 2a$
» $R_{(Extrados)} = R_{(Intrados)} + d_{arch}$
 $\sin \theta = (b / R_{Intrados})$ » $\theta = \sin^{-1} (b / R_{Intrados})$

$$\begin{aligned} \rho_b &= 20.41 \text{ kN/m}^3 \\ d_{arch} &= 174 \text{ mm} \\ r_c = a &= 159.0 \text{ mm} \\ \text{» } b &= 455.0 \text{ mm} \\ &= 730.5 \text{ mm} \\ &= 904.5 \text{ mm} \\ \theta &= 38.52^\circ \end{aligned}$$

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Area of Sector	» $((2 \times \theta)/360) \times \pi R_{Intrados}^2$		A _{sec} =	0.359 m ²
Area of Triangle	» $b \times (R_{Intrados} - a)$		A _{tri} =	0.260 m ²
Area of Segment	» $A_{sec} - A_{tri}$		A _{seg} =	0.099 m ²
Area of Jack Arch	» $((2 \times \theta)/360) \times \pi (R_{Extrados}^2 - R_{Intrados}^2)$		A _{arch} =	0.191 m ²
*Edge girder supports 50% of jack arch				
» Jack Arch UDL			=	1.95 kN/m

5.2.2. Concrete Backing Material

Refer to 2.1.	Unit weight of Concrete		ρ _c =	21.87 kN/m ³
	Max. depth of conc.(Between Girders)	» (159+174+136)	d _{c,btwn} =	469.0 mm
	Max. width of conc.(Between Girders)	» (1430-50)	b _{c,btwn} =	1380.0 mm
	Area of Concrete between Girders	» (d _{c,btwn} × b _{c,btwn}) - A _{arch} - A _{seg}	=	0.456 m ²
	*Edge girder supports 50% of concrete area			
	» Concrete UDL		=	4.98 kN/m

5.2.3. Fill Material

Refer to 2.1.	Unit weight of Miscellaneous Fill		ρ _f =	19.68 kN/m ³
	Depth of Fill (Between Girders)	» (700-50-159-174-136)	d _{f,btwn} =	181 mm
	Width of Fill (Between Girders)	» (1430-50)	b _{f,btwn} =	1380 mm
	Area of Fill (Between Girders)	» 181 × 1380	=	0.250 m ²
	*Edge girder supports 50% of fill material between girders			
	» Fill Material (Between Girders) UDL		=	2.46 kN/m

Depth of Fill (Above Girders)	» 578 - 181		d _{f,abv} =	397 mm
Width of Fill (Above Girders)	» ((1430/2)+110)-360		b _{f,abv} =	465 mm
*Edge girder supports area of fill above girders, up to midspan of jack arch				
Area of Fill (Above Girders)	» 397 × 465	=	A _{f,abv} =	0.185 m ²
» Fill Material (Above Girders) UDL			=	3.63 kN/m

5.2.4. Parapet

Refer to 2.1.	Unit weight of Brickwork		ρ _b =	20.41 kN/m ³
	Cross Section Area of Parapet	» 360 × 1610	=	0.580 m ²
	» Parapet UDL		=	11.83 kN/m

Total Super Imposed Dead Load UDL				24.86 kN/m
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5.3. Internal Girder - Dead Loads

5.3.1. Internal Girder Self Weight

Refer to 2.1.

Unit weight of Cast Iron

$$P_{ci} = \boxed{65.60} \text{ kN/m}^3$$

Refer to 4.2.2.

Cross sectional Area of Internal Beam

$$A = \boxed{0.055} \text{ m}^2$$

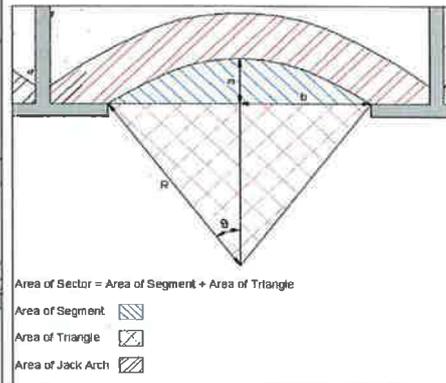
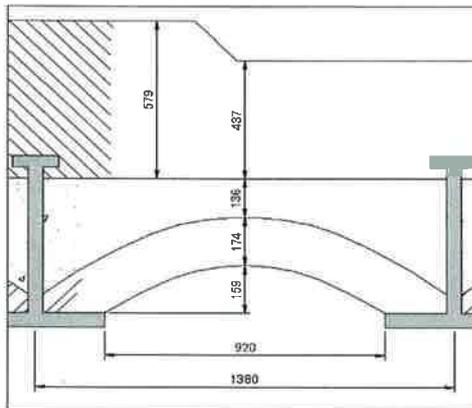
» Internal Girder Self Weight UDL

$$= \boxed{3.61} \text{ kN/m}$$

Total Dead Load UDL

$$= \boxed{3.61} \text{ kN/m}$$

5.4. Internal Girder - Super Imposed Dead Loads



5.4.1. Jack Arch Load

Refer to 2.1.

Unit weight of Brickwork

$$P_b = \boxed{20.41} \text{ kN/m}^3$$

Level survey

Arch Barrel Thickness

$$d_{arch} = \boxed{174.0} \text{ mm}$$

Level survey

Arch Barrel Rise

$$r_c = a = \boxed{159.0} \text{ mm}$$

Jack Arch Span = $\boxed{920.0}$ mm

$$» b = \boxed{460.0} \text{ mm}$$

Jack Arch Radius » $R_{(Intrados)} = (a^2 + b^2) / 2a$

$$= \boxed{744.9} \text{ mm}$$

» $R_{(Extrados)} = R_{(Intrados)} + d_{arch}$

$$= \boxed{918.9} \text{ mm}$$

$\sin \theta = (b / R_{(Intrados)})$ » $\theta = \sin^{-1}(b / R_{(Intrados)})$

$$\theta = \boxed{38.14}^\circ$$

Area of Sector » $((2 \times \theta) / 360) \times \pi R_{(Intrados)}^2$

$$A_{sec} = \boxed{0.369} \text{ m}^2$$

Area of Triangle » $b \times (R_{(Intrados)} - a)$

$$A_{tri} = \boxed{0.270} \text{ m}^2$$

Area of Segment » $A_{sec} - A_{tri}$

$$A_{seg} = \boxed{0.100} \text{ m}^2$$

Area of Jack Arch » $((2 \times \theta) / 360) \times \pi (R_{(Extrados)}^2 - R_{(Intrados)}^2)$

$$A_{arch} = \boxed{0.193} \text{ m}^2$$

*Internal girder supports 50% of both adjacent jack arches » 100% of a single jack arch UDL

» Jack Arch UDL

$$= \boxed{3.93} \text{ kN/m}$$

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Refer to 2.1.	<p>5.4.2. Concrete Backing Material</p> <p>Unit weight of Concrete $\rho_c = 21.87$ kN/m³</p> <p>Max. depth of conc.(Between Girders) » (159+174+136) $d_{c,btwn} = 469$ mm</p> <p>Max. width of conc.(Between Girders) » (1380-50) $b_{c,btwn} = 1330$ mm</p> <p>Area of conc. between Girders » $(d_{c,btwn} \times b_{c,btwn}) - A_{arch} - A_{seg} = 0.331$ m²</p> <p><i>*Internal girder supports 50% of both adjacent backing sections » 100% of a single backing UDL</i></p> <p>» Concrete Backing UDL = 7.24 kN/m</p>
Refer to 2.1.	<p>5.4.3. Fill Material</p> <p>Unit weight of Miscellaneous Fill $\rho_f = 19.68$ kN/m³</p> <p>Depth of Fill (Between Girders) » (610-50-159-174-136) $d_{f,btwn} = 91$ mm</p> <p>Width of Fill (Between Girders) » (1380-50) $b_{f,btwn} = 1330$ mm</p> <p>Area of Fill (Between Girders) » 91 x 1330 = $A_{f,btwn} = 0.121$ m²</p> <p><i>*Internal girder supports 50% of both adjacent areas of fill » 100% of a single area of fill UDL</i></p> <p>» Fill Material (Between Girders) UDL = 2.38 kN/m</p> <p>Depth of Fill (Above Girders) » 437 - 91 - 100 $d_{f,abv} = 246$ mm</p> <p><i>*Assume 100mm deep carriageway construction</i></p> <p><i>*Internal girder considered not to support any of the carriageway verge fill</i></p> <p>Width of Fill (Above Girders) » 1380 $b_{f,abv} = 1380$ mm</p> <p><i>*Each internal girder supports 1380mm width of fill material</i></p> <p>Area of Fill (Above Girders) » 246 x 1380 = $A_{f,abv} = 0.339$ m²</p> <p>» Fill Material (Above Girders) UDL = 6.68 kN/m</p>
Refer to 2.1.	<p>5.4.3. Carriageway Surfacing Material</p> <p>Unit weight of Macadam Surfacing $\rho_m = 20.99$ kN/m³</p> <p>Depth of Carriageway Surfacing $d_c = 100$ mm</p> <p><i>*Assume 100mm deep carriageway construction</i></p> <p>Width of Carriageway Surfacing $b_c = 1380$ mm</p> <p><i>*Each internal girder supports 1380mm width of carriageway construction</i></p> <p>Cross sectional Area of Carriageway $A = 0.138$ m²</p> <p>» Carriageway Surfacing UDL = 2.90 kN/m</p>
	<p style="text-align: right;">Total Super Imposed Dead Load UDL = 23.13 kN/m</p>

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6. Live Loading

6.1. Edge Girder - Live Loading

Refer to 1.2

** No requirement to check live load effects on edge girders due to internal girder between edge girder and carriageway.*

6.2. Internal Girder - Live Loading

6.2.1. Bending Moment - Internal Girder

Refer to 4.2.4.

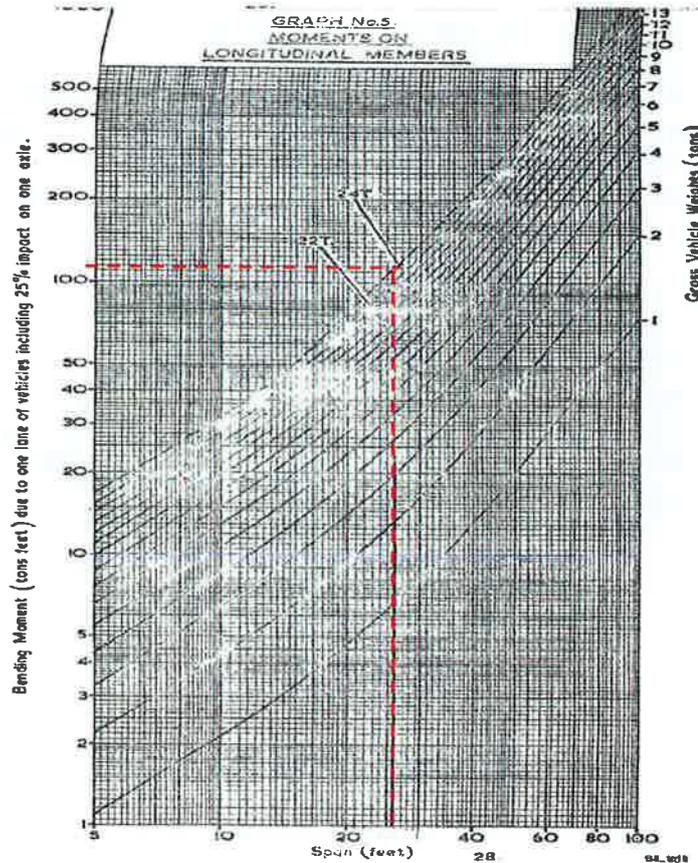
Effective Span » $L_{eff} =$ 8002 mm
 = 26.25 ft

For longitudinal members, use BE4 Graph 5 to obtain bending moments due to LL

BE4 Graph 5

Bending Moment due to one lane of vehicles including 25% impact on one axle (M_{LL})

M_{LL} (midspan) » = 114 ton.ft



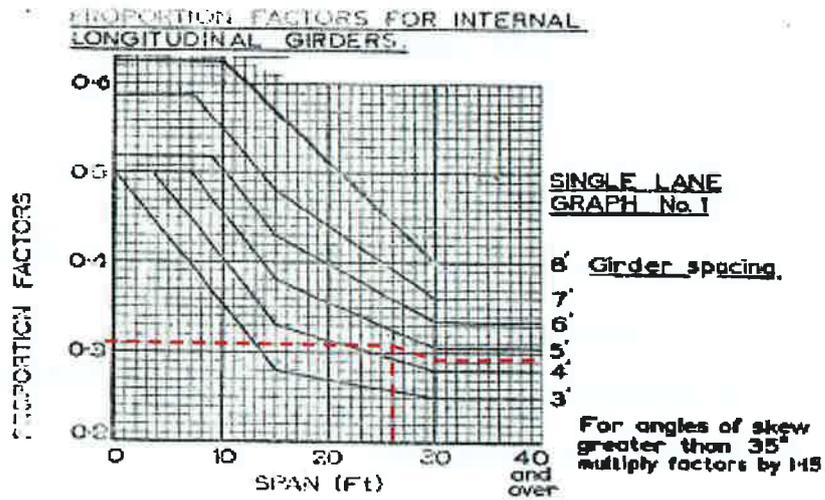
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6.2.2. Proportion Factor - Internal Girder
 Girder Spacing » = 1380 mm
 = 4.53 ft

For longitudinal Girders subject to single lane traffic, use BE4 Graph 1 to obtain appropriate proportion factor.

Proportion Factor = 0.31



6.2.3. Bending Effect - Internal Girder
 Bending Effect = Proportion Factor x Bending Moment (midspan)
 = 0.31 x 114 ton.ft
 = 35.34 ton.ft
 = 107.3 kNm

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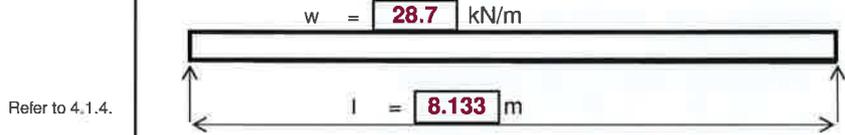
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7. Loading Effects

7.1. Edge Girder Loading Effects

Refer to 5.1.	7.1.1. DL and SDL Loading Effects		
	Total Dead Load UDL	=	3.82 kN/m
Refer to 5.2.	Total Super Imposed Dead Load UDL	=	24.86 kN/m
	Combined DL & SDL UDL	=	28.67 kN/m

Loading Diagram



	Maximum Bending (Midspan) »	M_D	$\frac{wl^2}{8}$	=	237.09 kNm
				=	78.07 ton.ft
	Bending Stress (tension flange) »	M_D/Z_{xt}		=	18.67 N/mm ²
				=	1.354 tons/in ²

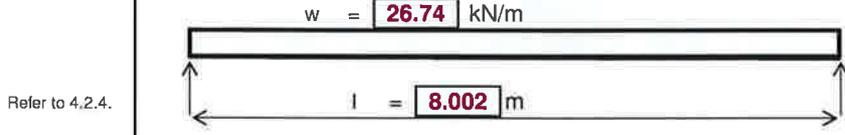
7.1.2. LL Loading Effects

**No requirement to check live load effects on edge girders due to internal girder between edge girder and carriageway.*

7.2. Internal Girder Loading Effects

Refer to 5.3.	7.2.1. DL and SDL Loading Effects		
	Total Dead Load UDL	=	3.61 kN/m
Refer to 5.4.	Total Super Imposed Dead Load UDL	=	23.13 kN/m
	Combined DL, SDL & LL UDL	=	26.74 kN/m

Loading Diagram



	Maximum Bending (Midspan) »	M_D	$\frac{wl^2}{8}$	=	214.03 kNm
				=	70.47 ton.ft
	Bending Stress (tension flange) »	M_D/Z_{xt}		=	18.97 N/mm ²
				=	1.38 tons/in ²

7.2.2. LL Loading Effects

Refer to 6.2.3.	Maximum Bending (Midspan)	=	107.33 kNm	
		=	35.34 ton.ft	
	Bending Stress (tension flange) »	M_L/Z_{xt}	=	9.51 N/mm ²
		=	0.69 tons/in ²	

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	BE4 Assessment of Cast Iron Girders and Transverse Jack Arches		
Section: 8. Girder Capacity	Job No:	B12360BN	
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BE4 CI 304 (c)

8. Girder Capacity

The actual permissible tensile stresses for assessment of cast iron girders should be based on the following ratio of dead to live load.

$$5f_L + 2.2f_D = 8 \quad (\text{but no higher than } 3\text{ton/in}^2)$$

Where;

f_L = Tensile bending stress due to live loading

f_D = Tensile bending stress due to dead loading

8.1. Edge Girder Capacity

Refer to 7.1.1.

$$f_D = \begin{matrix} 18.67 \\ 2708 \\ 1.354 \end{matrix} \begin{matrix} \text{Mpa} \\ \text{lbs/in}^2 \\ \text{tons/in}^2 \end{matrix} \quad (\text{Imposed tensile bending stress, due to DL \& SDL})$$

BE4 CI 304 (c)

Permissible stress in tension should not exceed = **3.00** tons/in²
 » Max. permissible stress in tension > Imposed tensile bending stress » OK

$$f_D = \begin{matrix} 1.35 \\ 0.00 \end{matrix} \text{tons/in}^2$$

$$f_L = \begin{matrix} 0.00 \end{matrix} \text{tons/in}^2$$

» $5f_L + 2.2f_D < 8$ » OK

Girders have capacity for DL and SDL

Girder Capacity = Max permissible tensile stress x Z_{xt}

Refer to 4.1.2.

$$Z_{xt} = \begin{matrix} 1.27E+07 \\ 774.9 \end{matrix} \begin{matrix} \text{mm}^3 \\ \text{in}^3 \end{matrix}$$

$$\text{Girder Capacity} = \begin{matrix} 2324.8 \\ 193.7 \end{matrix} \begin{matrix} \text{ton.in} \\ \text{ton.ft} \end{matrix}$$

8.1.2. Tensile bending stress due to live loading

**No requirement to check live load effects on edge girders due to internal girder between edge girder and carriageway.*

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8.2. Internal Girder Capacity

Refer to 7.2.1. $f_D = 1.38 \text{ tons/in}^2$ (Imposed tensile bending stress, due to DL & SDL)

$f_L = (8 - 2.2f_D) / 5$ (but no higher than 3ton/in²)

$= 0.99 \text{ tons/in}^2$ (Max. allowable tensile bending stress due to LL)

Refer to 7.2.2. Imposed tensile bending stress, due to LL = 0.69 tons/in²

» Allowable LL tensile bending stress > Imposed LL tensile bending stress » OK

Total Imposed Tensile Bending Stress = $f_D + f_L$

$= 1.38 + 0.69$

$= 2.07 \text{ tons/in}^2$

BE4 CI 304 (c) Permissible stress in tension should not exceed = 3.00 tons/in²

» Max. permissible stress in tension > Imposed tensile bending stress » OK

Girders have capacity for 24t C+U vehicle

Girder Capacity = Max permissible tensile stress x Z_{xt}

Refer to 4.2.2. $Z_{xt} = 1.13E+07 \text{ mm}^3$

$= 688.6 \text{ in}^3$

Girder Capacity = 2065.8 ton.in

$= 172.2 \text{ ton.ft}$

or

Girder Capacity = $M_D + (f_L \times Z_{xt})$

Refer to 7.2.1. $M_D = 70.47 \text{ ton.ft}$

$= 845.67 \text{ ton.in}$

Girder Capacity = 1530.7 ton.in

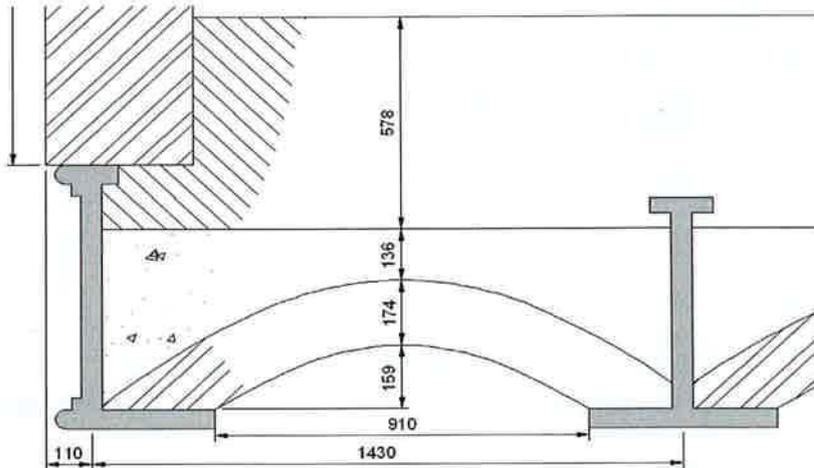
$= 127.6 \text{ ton.ft}$

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9. Jack Arch Assessment

**Consider Jack arch between edge girder and adjacent internal girder due to larger span*



**Review of the adequacy of the jack arches and tie-rods will be based upon the empirical method described in Bridgeguard 3 Current Information Sheet No 22 (Pro-forma for the empirical assessment of brick, masonry and concrete jack arches and associated ties.)*

Section 1

SECTION 1 Check for Compliance with 40T Configuration Requirements

Refer to 5.2.1

Refer to 3.1

		Compliant Yes/No
What is the maximum span of the arch?	<input type="text" value="0.910"/> m	Yes
<i>*Non-compliant if greater than 2.0m</i>		
Do jack arches spring from bottom flanges of beams?	<input type="text" value="Yes"/>	Yes
<i>*If not, non-compliant</i>		
What is the beam spacing?	b = <input type="text" value="1.430"/> m	Yes
What is the rise of the arch?	r _c = <input type="text" value="0.159"/> m	
Gross aspect ratio?	b/r _c = <input type="text" value="8.9937"/> m	
<i>*Non-compliant if b/r_c greater than 10</i>		
What is the arch barrel thickness?	d = <input type="text" value="310"/> mm	Yes
(include concrete fill above)		
How is thickness derived?	<input type="text" value="Site Investigation"/>	Yes
<i>*Non-compliant if thickness is less than 220mm</i>		

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Section 2

SECTION 2 Check for Deficiency

Type No.	Deficiency	Pass/Fail
1	<p>What is the backing material? Is it structural? » Structural Concrete</p> <p>Does the structural backing extend to at least the crown level of the arch extrados? Yes</p> <p><i>*If not, fail</i></p> <p>What is effective shear depth of deck? $D_s =$ 469 mm » arch rise 159 mm + barrel thickness 174 mm + height of structural fill above crown of extrados 136 mm</p> <p>Is $D_s \geq$ minimum requirement Fig1. Fig1. Min = 311 mm <i>*Fail if $D_s <$ Fig 1 » 469 > 311</i></p>	Pass
2	<p>Do jack arches span longitudinally or transversely between longitudinal girders? Transversely</p> <p><i>For Longitunal spanning jack arches, ignore following questions on ties/lateral restraint and state N/A.</i></p> <p>Are ties provided in edge bays of transverse spanning jack arches? <i>*If yes, go to 3a/3b</i> <i>*If not, fail, unless edge bay is 'hard' (see 5)</i></p>	Pass
3a	<p>What is the cross sectional area of one tie? $A =$ 253.3 mm² <i>(Allowing for coorsion losses)</i> (1" Dia, 50% SL)</p> <p>What is the number of ties per beam length? $n =$ 3</p> <p>What is the clear skew span? $L =$ 7.75 m</p> <p>Specific area of tie ($A_s = ((n+1) \times A) / L$) $A_s =$ 130.74 mm²/m</p> <p><i>*Non-compliant if less than 260mm²/m</i></p> <p>What is the maximum tie spacing? $S =$ 2.29 m <i>*Non compliant if greater than 3.0m for wrought iron/steel</i></p>	Fail
3b	<p>What is the cross sectional area of one tie? $A =$ mm² <i>(Allowing for coorsion losses)</i></p> <p>What is the number of ties per beam length? $n =$ </p> <p>What is the clear skew span? $L =$ m</p> <p>Specific area of tie ($A_s = ((n+1) \times A) / L$) $A_s =$ mm²/m</p> <p><i>*Non-compliant if less than 260mm²/m</i></p> <p>What is the maximum tie spacing? $S =$ m <i>*Non compliant if greater than 3.0m for wrought iron/steel</i></p>	Pass
4	<p>Are ties located within crown of external arch? No</p> <p><i>*If so, then fail CI or possible fail for wrought iron/steel</i></p>	Pass
5	<p>Does external bay construction provide alternative lateral restraint? <i>(ie not soft edge)</i> No</p> <p><i>*If so, pass</i> <i>*If not, are ties provided in first Jack Arch bay?</i> Yes</p> <p><i>*If yes, treat as 3a (or 3b) Otherwise fail.</i></p>	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

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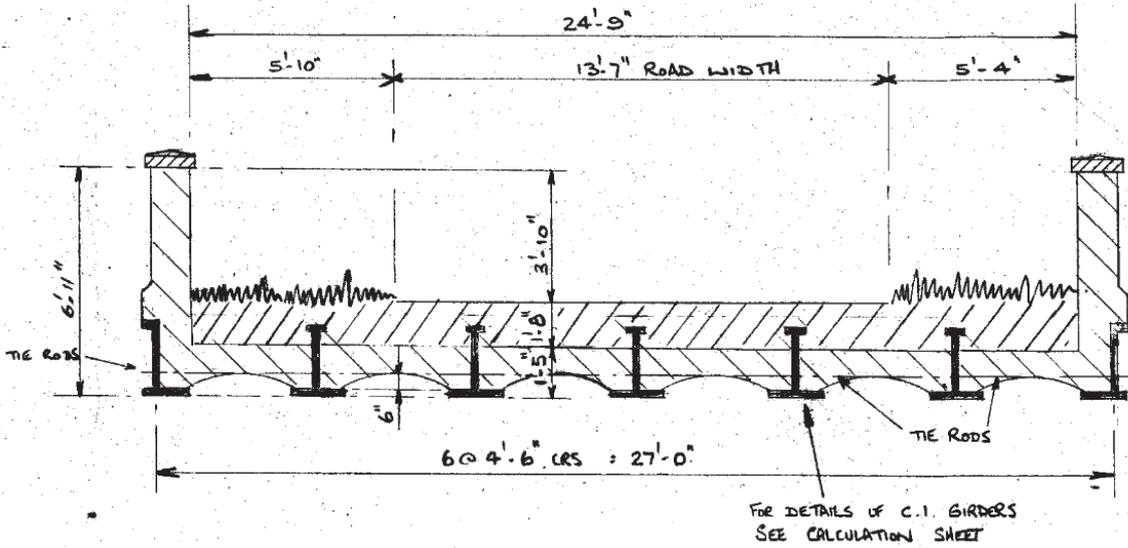
SECTION 3 Checks for Defects

Type No.	Defect	Empirical Assessment		Pass/ Fail
		CI Decks	WI/Steel Decks	
6	Rotation of supporting beam	Fail	Fail	Pass
7	Horizontal Displacement of supporting beam	Fail	Fail	Pass
8	Inadequate support to springings eg. Corrosion of bottom flange of supporting beam over a significant length, missing bedding mortar	Possible fail	Possible Fail	Pass
9	Transversely bowed bottom flange of supporting beam	Fail	Fail	Pass
10	Cracking at crown of arch owing to spreading of springings (other than 12, 13)	Fail	Fail	Pass
11	Distortion and any associated cracking of jack arch barrel	Fail	Fail	Pass
12	Arch crack resulting in substructure crack	Fail	Fail ⁽⁵⁾	Pass
13	Substructure crack or other distress resulting in crack to jack arch	Possible fail ⁽³⁾	Possible Fail ⁽³⁾ ₍₅₎	Pass

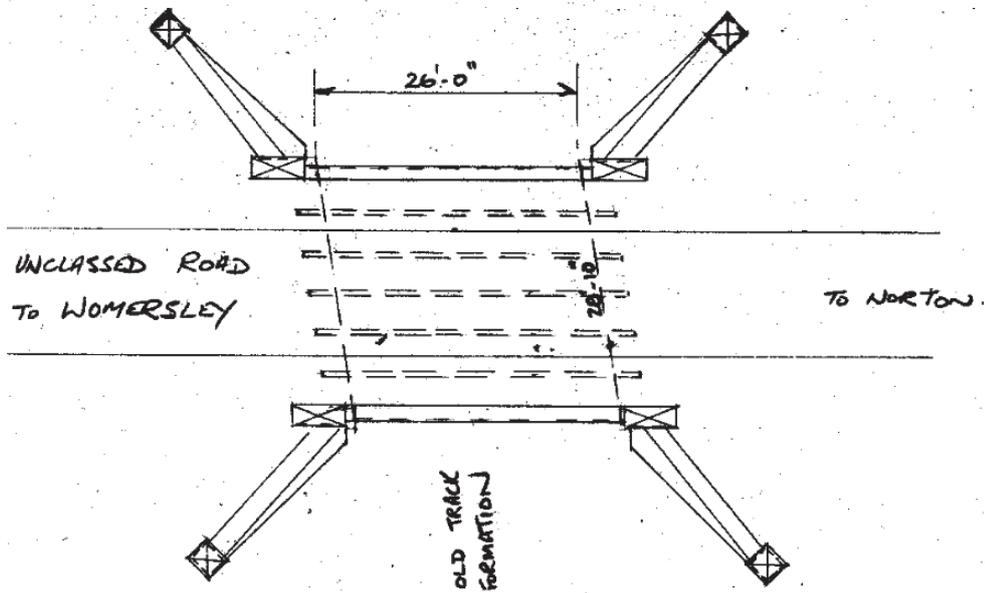
Notes

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

Appendix G Historical Information



Cross Section



Plan