

HRE Assessment Programme

Highways England - Historical Railways Estate

AYH/1, Limekiln Road, South Ayrshire

BD21/01 Assessment and Inspection Report

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Executive Summary

Structure Type: Single span overbridge

Superstructure Form: Six longitudinal cast iron girders with cast iron hogging plates

Substructure Form: Gravity type with stone abutments and wingwalls

Span: 8.04m

Assessment Code: BD21

Live load capacity: 7.5 tonnes ALL Group 2 FE

Critical member: Internal girders under carriageway in bending

Capacity factor: 0.39

Restriction: 7.5 tonne GVW

Condition: Fair

Local Authority: South Ayrshire Council

OS Reference: NS 339 231

This report presents the load carrying capacity for the bridge and identifies the data derived for the assessment. It has been prepared by Jacobs for the exclusive use by HRE and should not be relied on by third parties. It has been based on site measurements and investigation by Jacobs or from historical information provided by HRE, as appropriate.

The description of condition does not represent a principal inspection; nor should it be relied on for the development of maintenance works. Close inspection of the structure was limited by the constraints of safe access possible within a single site visit.

Identification of defects is principally based on ground level survey and select elevated inspection of visible elements.

 Edge Girders - The parapet walls supported by the edge girder restricted the inspection of the top flange. The internal face of the web and internal outstands of both flanges were considered as built-in parts and therefore not amenable to inspection. Unexposed surfaces were assumed to be competent owing to their protection by the deck construction or the wall. The exposed section of the top flange could not be safely measured with the available access equipment.



1. General Description and Structural Details

1.1 Introduction

Jacobs was appointed by Highways England – Historical Railways Estate (HRE) to undertake a BD21/01 assessment of overbridge AYH/1.

Structural Soils Ltd. excavated two trials pits within the carriageway of bridge. The first located at midspan to expose the top sides of the internal girder and hogging plate. A second pit was excavated at the eastern support to confirm the level of the internal girder.

1.2 Location and General Description

Bridge AYH/1, carries Limekiln Road over the track bed of the former Ayr Harbour Branch (Goods Branch), in Ayr.

The road is a single carriageway and is 5.42m wide at the centre of the span. Footways line both sides of the road and were measured as 0.50m wide on both the north and south sides. The overall width between parapets is 6.42m. Refer to the plan at road level in Appendix G for carriageway dimensions.

The bridge carries Limekiln Road an unclassified road which serves as access to an industrial area. Traffic use is light, with a 30mph speed limit applying over the bridge.

The OS grid reference is NS 339 231.

Bridge was constructed in 1882 according to a previous assessment dated 1935 by LM&SR (Scottish division).

1.3 Construction type

The bridge comprises four cast iron internal girders and two cast iron edge girders. Cast iron hogging plates span transversely between the girders. The bridge has span of 8.03m.

The four internal girders have total depth of 483mm at midspan. The web is 51mm wide and 381mm deep, with the top flange measured as 76mm wide and a thickness of 51mm. The bottom flange has a width of 457mm and thickness of 51mm. As confirmed on site, the girders feature a hog backed design with a total depth of 356mm at the support giving a corresponding web depth of 254mm.





Figure 1: Internal girders dimensions at midspan (left) and support (right).

The edge girders have a total depth of 559 mm throughout their length, with the bottom flange 279 mm wide and 51mm thick. The outer face of the web is located 64mm from the outside edge of the bottom flange. The top flange of the edge girder could not be measured, therefore based on historical drawings, it has been assumed to have the same profile as the internal girders. This gives a web depth of 457mm.

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Figure 2: Edge girder dimensions.

The spacing between the internal girders is 1295mm, with the edge girders having a reduced spacing of 1206mm. The hogging plates are reported as 12.7mm thick and have a rise of 127mm with clear span of 838mm between all girders. The hogging plates are 914mm long with total width of 990mm, they feature ribs located at the joints and the longitudinal midspan with a rib running along the crown of the plate. These ribs are 20mm thick and 76mm deep. Historical information used for dimensions have been included in Appendix F.



Figure 3: Girder arrangement and hogging plate dimensions

The bridge is supported by gravity type abutments formed from coursed stonework. The wingwalls are of similar construction. The parapets are formed from cast iron plates which are fixed to the edge girders.

Sketches of the plan at road level, the bridge in section and of the elevations are included in Appendix G.



2. Information Search

2.1 Services Search

A service search was carried out by Jacobs. Information is supplied in Appendix D.

2.2 Site Investigation Description and Results

Two trial pits were excavated in the north side of the carriageway. The trial pit at midspan, exposed the topside of the internal girder and hogging plate. The second was opened at the support of the internal girder to allow a level to be recorded as the girder is hog backed. The trial pit logs are included in Appendix E.

2.3 Existing Drawings

A historical drawing has been taken from a previous assessment dated 1935 by LM&SR (Scottish division). The drawing is included in Appendix F.



3. Structure Condition

3.1 General

The survey and inspection for BD21/01 assessment was undertaken on Tuesday 17th July 2018; weather conditions were sunny with occasional cloud and an average temperature of 18°C.

Parking was available in on Limekiln Road to the east of the bridge. Access to the formation was gained through two gates located on Weir Road. The key was obtained from the local authority, the current landowner. Palisade fencing located across the southern face of the structure, secured with a combination lock gate, allowed access to the underside of the structure.

3.2 Structure Condition

3.2.1 Cast Iron Internal Girders

The internal girders are in fair condition. Up to 2mm of section loss was recorded across all the exposed parts of the girders. (Photograph 5 and 12)



Figure 4: Section loss observed on internal girder.

3.2.2 Cast Iron Edge Girders

The edge girders are in a fair condition with section loss of up to 2mm observed along the underside of the exposed section of the girder. On the southern edge girder, a section 25mm by 75mm area near to the support has also experienced up to 13mm of section loss. (Photograph 13)



Figure 5: Section loss observed on edge girders at support (left) and midspan (right).



3.2.3 Cast Iron Hogging Plates

The hogging plates are in fair condition with section loss occurring to the lower 100mm on both springers with a depth of loss up to 3mm. (Photograph 12)

3.2.4 Abutments

The abutments are in fair condition. There is extensive damp staining across both abutments indicating water ingress which has caused the observed spalling of the stone work. (Photographs 10 and 11).

3.2.5 Wingwalls

The wingwalls are in good condition. Minor weathering of the stonework and mortar loss in the joints was noted on all the wingwalls, especially on the south face (Photographs 6 to 9).

The northeast wingwall has a hairline stepped fracture across its face (Photograph 15). The southwest wingwall features a 2mm wide full height steeped fracture passing through a broken mortar tab dated from 2014 (Photographs 16). A number of other hairline cracks are also present in the central section of this wingwall.

3.2.6 Parapets

The parapets are in fair condition. The paint system is 50% lost across both parapets which has initiated minor pitting corrosion. (Photographs 18 and 19). A section of approach fencing is missing near to the north west pilaster.

3.2.7 Formation

The formation to the south of the bridge is vacant, with signs of trespass and fire evident. To the north is an active railway separated from the site by palisade fencing. Fly tipping is present on both sides of the bridge as well as in the formation (Photographs 20 and 21).

The boundary wall to the north east on the adjacent property has suffered significant damage resulting in partially collapse and currently supported by the timber fencing (Photograph 17).

3.2.8 Road Surface and traffic

The road surface above the structure is in fair condition with no signs of settlement or tracking. There was evidence of previous inspection pits at midspan and at each of supports. (Photographs 2, 3 and 4). Road surface category for assessment is taken as "poor". There was occasional use of the bridge by HGVs during the inspection. The AAHHGVF for this assessment is taken as 'low'.



4. BD21 Assessment

4.1 Methodology

Capacities of the girders were calculated using reduced section sizes where corrosion was present. A general condition factor was not applied.

The internal girders were checked for full 40/44 tonne loading as described in BD21, distributed by simplified method described in BA16/97.

The edge girders were assessed using the accidental vehicle loading described in BD21/01 Annex D applied using simple statics.

Resistance capacities were determined in accordance with BD21 clauses 4.10 and 4.11. The capacity of the internal girder was enhanced using D/d factor, as the girders are encased in well compacted fill and no large services were present within the deck.

As the cast iron hogging plates gain substantial stiffness and capacity from their ribs, it was necessary to analyse them using finite element analysis software. The hogging plates were represented in the model using thick shell quadrilateral elements to represent the plate and thick beam three dimensional elements to represent the stiffeners. Loading of the plates was based on a single wheel load from BD21. The maximum stresses induced in the plate was compared with the limits indicated in BD21/01 clause 4.10.

The substructure was checked qualitatively based on visual inspection.

4.2 Results

Elements: Internal Girders under carriageway

Action	Location	DL and SDL effect	Adjusted HA Loading	Total Load Effect	Assessed Resistance	Capacity Factor	Live Load Capacity
Bending	Midspan	160.8 kNm	304.4 kNm	465.3 kNm	280.9 kNm	0.39	7.5 tonnes ALL Group 2FE

Elements: Edge Girders

Action	Location	DL and SDL effect	Annex D Loading	Total Load Effect	Assessed Resistance	Live Load Capacity
Bending (44 tonnes)	Midspan	99 kNm	213.9 kNm	213.9 kNm	210.9 kNm	Failure
Bending (7.5 tonnes)	Midspan	99 kNm	81.9 kNm	181.0 kNm	210.9 kNm	7.5 tonnes AVL



Elements: Hogging Plates

Action	Location	Wheel Loading Effect	Total Load Effect	Assessed Live Load Capacity	Live Load Capacity
Bending	Plate	18.785 N/mm ²	19.189 N/mm ²	24.42 N/mm ²	40/44 tonnes

Element: Substructure

The abutments show minor signs of structural distress. By qualitative assessment, the substructure appears to be satisfactory for vehicles conforming to the Road Vehicles (Authorised Weight) Regulations (BD 21 (DMRB 3.4.3)).



5. Conclusion

The assessment demonstrates that the internal girders have sufficient capacity to support 7.5 tonnes assessment live loading and Group 2 FE loading, applied to the carriageway. The edge girders are capable of supporting accidental vehicle loading of 7.5 tonnes GVW on the verges. It is therefore, recommended the bridge is restricted to vehicles with a gross weight of 7.5 tonnes unless measures are taken improve the capacity.

The finite element analysis of the arched hogging plates shows that they are capable of withstanding 82.5kN wheel load effects and are therefore considered satisfactory for ALL vehicles to 40/44 tonnes.

By qualitative assessment, the substructure appears to be satisfactory for vehicles conforming to the Road Vehicles (Authorised Weight) Regulations (BD 21 (DMRB 3.4.3)).

Due to the lack of capacity of the girders, it is recommended the bridge be infilled to guarantee the long-term support of the road. Alternatively, a propping system could be considered.



Appendix A. Photographs

1) South elevation



2) View of carriageway approach looking west



3) View of carriageway approach looking east



4) View of carriageway on the bridge



5) Underside of bridge deck (north)



6) Southeast wingwall



7) Southwest wingwall



8) Northeast wingwall



9) Northwest wingwall



10) East Abutment

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11) West Abutment



12) Underside corrosion of the internal girder



13) Corrosion of the external girder



14) Corrosion of the underside of the southern edge girder at support



15) Degraded wall next to northeast wingwall on adjacent property



16) Stepped fracture on southwest wingwall

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17) Degraded wall next to northeast wingwall on adjacent property.



18) North parapet



19) South parapet



20) Formation looking North

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21) Formation looking South



22) Trial pit at midspan showing top side of hogging plate



23) Trial pit at midspan showing top side internal girder



24) Approach fencing damaged at north-western pilaster.



Appendix B. Form AA

Group Standard

FORM 'AA' (BRIDGES)

ELR/ Bridge No AYH/1

GC/TP0356

Appendix: 4 Issue: 1 Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Bridge/Line Name: Limekiln Street/ Ayr Harbour Branch

ELR/Bridge No. AYH/1

Brief Description of Existing Bridge:

(a) Span Arrangement

The structure is single span overbridge with a span of 8.04m.

(b) Superstructure Type

The bridge comprises four cast iron internal girders and two cast iron edge girders. Cast iron hogging plates span transversely between the girders. The bridge is square to the formation and has a span of 8.03m.

The four internal girders have total depth of 483mm at midspan. The web is 51mm wide and 381mm deep, with the top flange measures 76mm wide with a thickness of 51mm. The bottom flange has a width of 457mm and thickness of 51mm. As confirmed on site the girders feature a hog backed design with a total depth of 356mm at support giving a corresponding web depth of 254mm.

The edge girders have a total depth of 559 mm throughout their length, with the bottom flange 279 mm wide and 51mm thick. The web is located 64mm from the outside edge of the bottom flange. The top flange of the edge girder was unable to be measured, therefore based on historical drawings it has been determined to have the same profile as the internal girders. This therefore gives a web depth of 457mm.

The spacing between the internal girders is 1295mm, with the edge girders having a reduced spacing of 1206mm. The hogging plates are reported as 12.7mm thick and have a rise of 127mm with clear span of 838mm between all girders. the Hogging plate are 914mm long with total width of 990mm, they feature ribs located at the joints and midspan longitudinally with one also running along the crown of the plate. These ribs are 20mm wide and 76mm deep. The parapets are formed from cast iron plates which are fixed to the edge girders.

(c) Substructure Type

The bridge is supported by gravity type abutment formed from coursed stone work with wingwalls of similar construction.

(d) Planned highway works/modifications at this site

(b) Codes to be used BD21/01 "The Assessment of Highway Bridges and Structures"

Dimensions and condition are obtained from site measurements and inspection. (See Jacobs report "VAR9/5606 Assessment Programme -Assessment and Inspection Report – Bridge Ref.: AYH 1 March 2019"). The bridge is to be assessed for up to 40/44 tonne live loading, with reduced loading being determined where this capacity is not reached.

BA16/97 "The Assessment of Highway Bridges and Structures" (Incorporating amendment No 1 dated November 1997 and Amendment No 2 dated November 2001)

BD56/10 "The Assessment of Steel Highways Bridges and Structures"

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ELR/ Bridge No AYH/1

Assessment Criteria

(a) Loadings and Speed

FORM 'AA' (BRIDGES)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

None.

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

The road is a single carriageway and is 5.42m wide at the centre of the span. Footways line both sides of the road and are 0.50m wide on both the north and south sides respectively. The overall width between parapets is 6.42m.

The bridge carries Limekiln road an unclassified road which serves as an Industry area. The road is subject to a low flow of traffic with a 30mph speed limit applying over the bridge. A low number HGVs were observed using the bridge during the inspection, with the AAHHGVF for this assessment taken as 'low'.

Group Standard

Revision: B (Nov 2000)

GC/TP0356

Appendix: 4

Issue: 1

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FORM 'AA' (BRIDGES)

ELR/ Bridge No AYH/1

APPROVAL IN PRINCIPLE FOR ASSESSMENT

(c) Proposed Method of Structural Analysis

Capacities of the girders will be calculated using reduced section sizes where corrosion is present. A general condition factor will not be applied.

The internal girders will be checked for full 40/44 tonne loading as described in BD21 distributed by simplified method described in BA16/97.

The edge girders will be assessed using the distributed accidental vehicle loading described in BD21/01 Annex D applied using simple statics.

Resistance capacities will be determined in accordance with BD21 clauses 4.10 and 4.11. The capacity of the internal girder will be enhanced using D/d factor, as the girders are encased in well compacted fill and no large services are present within the deck.

As the cast iron hogging plates gain substantial stiffness and capacity from their ribs, it will be necessary to analyse them using finite element analysis software. The hogging plates are to be represented in the model using thick shell quadrilateral elements to represent the plate and thick beam three dimensional elements to represent the stiffeners. Loading of the plates is to be based on a single wheel load from BD21. The maximum stresses induced in the plate will be compared with the limits indicated in BD21/01 clause 4.10.

The substructure will be checked qualitatively based on visual inspection.

GC/TP0356

Appendix: 4 Issue: 1 Revision: B (Nov 2000)

Highways England Historical Railways Estate	Group Standard
FORM 'AA' (BRIDGES)	GC/TP0356
ELR/ Bridge No AYH/1	Appendix: 4 Issue: 1 Revision: R (New 2000)
APPROVAL IN PRINCIPLE FOR ASSESSME	NT
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	plicable

Category 1

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

Signed	
Title	Civil Engineer
Date	20th March 2019

Category 2 and 3

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

Signed	·····/
Title	
Date	
Signed	
Title	
Date	



Appendix C. Form BA

Highways England Historical Railways Estate **Group Standard**

FORM 'BA' (BRIDGES)

ELR/ Bridge No AYH/1

Revision: A (Dec 2005) CERTIFICATION FOR ASSESSMENT CHECK

Assessment Group:	Jacobs UK Ltd
Bridge/Line Name:	Limekiln Road / Ayr Harbour Branch (Goods Branch)
Category of Check:	1
ELR/ Bridge No:	AYH/1

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 20th March 2019.
- (2) It has been checked for compliance with the following principal British Standards, Codes of Practice, BRB (Residuary) Limited technical notes and Assessment standards:
 - BD21/01 "The Assessment of Highway Bridges and Structures" •
 - BA16/97 "The Assessment of Highway Bridges and Structures" .
 - BD56/10 "The Assessment of Steel Highway Bridges and Structures" •

List any departures from the above and additional methods or criteria adopted, with reference and justification for their acceptance.

None

Category 1

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

GC/TP0356

Issue: 1

Appendix: 4

FORM 'BA'	(BRIDGES)		GC/TP03
ELR/ Bridge No AYH/1		Appendix Issue	
CERTIFICA	TION FOR ASSES	SMENT CH	Revision: A (Dec 200 ECK
Category 2 and	13 (Note: Category 1 che	eck must also be	e signed)
(a) <u>Assessmen</u>	<u>it</u>		/
<u>Name</u>	<u>Signature</u>	Date	
			Assessor
			Assessment Checker
			Authorised signatory of irm of Consulting
			Engineers to whom Assessor/Checker is
		_ /	responsible.
(b) Check			
<u>Name</u>	<u>Signature</u>	Date	
••••••	/		Assessor
			Assessment Checker
			Authorised signatory of firm of Consulting
			Engineers to whom Assessor/Checker is
			responsible.
This Certificate	is accepted by		19th July 2019

Highways England Historical Railways Estate Group Standard

FORM 'BAA' (BRIDGES)

ELR/ Bridge No AYH/1

GC/TP0356

Appendix: 4 Issue: 1 Revision: A (Dec 2005)

CERTIFICATION FOR ASSESSMENT CHECK

Notification of Assessment Check

Assessment Group	Jacobs UK Ltd
Bridge Name/Road No.	Limekiln Road
Line Name	Ayr Harbour Branch (Goods Branch)

ELR Code/Structure No. AYH/1

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

Internal Girders under carriageway: Edge Girders: Buckle Plates:

7.5 tonnes ALL / Group 2FE 7.5 tonnes accidental vehicle loading 40/44 tonnes loading

Substructure:

40/44 tonnes loading by qualitative assessment

Recommended Loading Restrictions

7.5 tonnes GVW and Group 2 fire engines

Description of Structural Deficiencies and Recommended Strengthening

The longitudinal girders are deficient under live loading conditions. Therefore, it is recommended the bridge be infilled to guarantee the long-term support of the road. Alternatively, a propping system could be considered.

<u>Name</u>	<u>Signature</u>	Date		
				Assessor
*****			••	
				Assessment Checker
			••	Authorised signatory of the firm of Consulting Engineers to whom Assessor/Checker is
*******				responsible.
This Certi	ificate is accepted by		19	oth July 2019



Appendix D. Services Information

Archdale, Karon

From: Sent: To: Subject: National One Call <retriever@national-one-call.co.uk> 17 April 2018 09:51

[EXTERNAL] Core Certificate EQ/KMNYM142

Certi	ficate of Regi	stered E	nquiry	
This Certificate Acting on the list of o Please refer to ea	has a Best Before Date of contacts or their Responses not recommended. ach response for specific val and/or instructions.	21/04/2018. after this date is id-until dates	PlanToE	ig
Issued to:	Highways			
Contificate No		Comico	Dateinur	
Certificate No.	EQ/KMINYM142	Service	Complete	
	vilp Pd Wair Pd Avr. South	Status West Sectland		
Liner	Accet Owner	Affected	AO ODD	Status
	Asset Owner	Allected	Received	Status
	Electrici	h.,		
Scottich Power	Electrici	Ly Voc	Voc	Closed
		l Inknown	Not Expected ⁶	Closed
Scottish & Southern End		No	Not Expected	Closed
	Gas	110		Closed
Scotland Gas Networks	(Distribution)	Ves	Ves	Closed
Scotland Gas Networks (Distribution)		No	Ves	Closed
National Grid Transmission (Gas)		No	Yes	Closed
	Group Member	s Search	100	Clobba
Linesearch (Pipeline sea	arch service)	Yes	Yes	Closed
	Multi-util	itv	100	Clobed
Brookfield Utilities UK (w	vas GTC & Independent Pipelines)	No	Yes	Closed
E S Pipelines Ltd		No	Yes	Closed
Energetics		No	Yes	Closed
	Telecom	S.		
BT Openreach		Yes	Yes	Closed
Virgin Media		Yes	Yes	Closed
Mobile Broadband Netw	ork Ltd	Unknown	Not Expected ⁶	Closed
BSkyB Telecommunicat	ions Services Ltd	No	Yes	Closed
CityFibre		No	Yes	Closed
Instalcom		No	Yes	Closed
Interoute		No	Yes	Closed
KPN International		No	Yes	Closed
Trafficmaster Ltd		No	Yes	Closed
Verizon Business		No	Yes	Closed

Vodafone Limited (formerly C&W UK)	No	Yes	Closed		
Water / Drainage					
Scottish Water Plant Protection	Yes	Yes	Closed		
Note 1: Where Affected is designated 'Unknown' this means either that a) we are still pursuing the Asset Owner for a Response in which case the status is 'Awaiting Response', or b) the contact cannot supply a plan in which case status is 'Closed'. Note 2: Where Affected is designated 'Failed' this means that the Asset Owner made no response to the Enquiry within the available time. Although marked as 'Closed', any late Response will be forwarded to you. Note 3: Where Affected is designated 'Refused' this means that the Asset Owner refused to evaluate the Enquiry or supply a Plan. Note 4: Where Affected is designated 'Consultation' this means that the Asset Owner wishes to have a meeting with you regarding your Enquiry. Instructions for this will be contained in the 'Comments from Asset Owners'. Note 5: Where Affected is designated 'Declined' this means that the Enquirer declined to pay the price that the Asset Owner quoted for supplying a response. Note 6: Where Received is designated 'Not Expected' this generally means that the Asset Owner has no services at all anywhere near the Enquiry site and will not be making a response of any kind.					
Validity of Certificate: This Certificate is issued by National One Call as an accurate record of the Enquiry as detailed above and warrants that the information contained is a true and accurate record of the Enquiry details as entered and Responses received against that Enquiry.					
This certificate in no way constitutes any permission, licence, permit, agreement, acknowled by any party to the Enquirer or their Agent undertaking any works or any other subsequent a All and any information in whatever format that was provided in Response to this Enquiry rer contextual solely to the details of this Enquiry. The purposes that the information provided in	gement or other ctions. nains the intellec response to this	form of active or passiv ctual property of the pro Enquiry shall be restric	e consent vider and is cted entirely		
to the stated intentions of the Enquirer and shall not be made available in any format or summary for other purposes without permission of the owner of the IPR.					

©National One Call 2018
Comments from Asset Owners

Enquiry Ref: EQ/KMNYM142 (Limekiln Rd,Weir Rd, Ayr, South West Scotland, KA8 8BD)

When responding to Enquiries, some asset owners add comments to their Response. These are often as important as plans; please ensure you read them carefully.



IMPORTANT: Please ensure these Comments accompany the plans given to operators going on-site.

WARNING: THIS ENQUIRY IS NOT YET COMPLETE - OTHER RESPONSES MAY APPLY

	Status: Affected											
Asset Owner	Comment											
Scottish Power	WARNING Should any proposed works appear to be within 5 metres of any 132kV network and a clear print is unobtainable, then more detailed information concerning this network must be obtained from the Plans Department. Furthermore, if proposed works appear to be within 3 metres of underground 132kV network then the Plans Department must be notified prior to carrying out any works within the vicinity: Telephone: 0141 614 5666 Email: requestforplansmanweb@spenergynetworks.co.uk											
Virgin Media	The Plant Enquiries Team has now completed your search, and the results are attached. Please note that we try to provide maps where ever available. On occasions where our records show the area is not affected, you may receive a map showing apparatus in the close proximity.											
	Status: Unknown											
Asset Owner	Comment											
Mobile Broadband Network Ltd	Many thanks for your email. Turner & Townsend would like to assure you that all plant enquiries we receive are reviewed thoroughly before making a decision on how to progress. Unfortunately, due to the sheer volume of enquiries we receive, we are unable to reply to every individual enquiry. We endeavour to reply to all relevant enquiries within a period of 14 working days. Kindly note that if you do not receive a reply to your enquiry within 14 working days, you are able to assume that your proposal will NOT impact upon one of our sites. Kind Regards MBNL SHQE Team Turner & Townsend											
UTILITY ASSETS LIMITED	I hank you for recently contacting Utility Assets plant record department. We will check whether we have any plant present at your site and contact you within 5 - 7 working days ONLY if we own any plant in the vicinity. If we do not reply, we do not have any apparatus in the area of your works. However, PLEASE TAKE CARE when excavating around electricity cables in the event that not all cables present may be accurately shown. We recommend you use detecting equipment to map the site before excavating and fully comply with HSG47. DO NOT assume that a cable is dead if you don't have a record of its presence. The cable must be treated as live unless PROVEN DEAD by the cable owner. In case of emergency please contact your local electricity distribution company.											
	Status: Not Affected											
Asset Owner	Comment											
Brookfield Utilities UK (was GTC & Independent Pipelines)	GTC Apparatus Not Found In Search Area Our Plant Enquiry Service Ref: 646236 Your Enquiry Ref: EQ/KMNYM142 Thank you for your enquiry concerning apparatus in the vicinity of your proposed work. GTC can confirm that we have no apparatus in the vicinity but please note that other asset owners may have and ensure all utility owners have been consulted.											
BSkyB Telecommunications Services Ltd	Please be advised that Sky Telecommunications Services Ltd will not be affected by your proposal.											
CityFibre	You recently requested information pertaining to the above location and in relation to CityFibre Holdings Ltd plant. Reference 99h0szdt824jxs3 Title: EQ/KMNYM142 Comment: Limekiln Rd, Ayr Please find attached a plan of the area of your interest that may contain plant which may be affected by your proposed works. The validity of this response is 6 weeks, after such time a new enquiry would need to be made.											
Energetics	Based on the information provided, I can confirm that Energetics does not have any plant within the area(s) specified in your request.											
Instalcom	Dear Sir or Madam, Thank you for your plant enquiry below. We can confirm that CenturyLink Communications UK Limited (formerly Level 3), Global Crossing (Uk) Ltd, Global Crossing PEC, Fibernet UK Ltd and Fibrespan Ltd do not have any apparatus within the indicated works area. Instalcom responds to plant enquiries for all of the											

	above and therefore you only need send one plant enquiry to cover all of these companies. Please note that this response is only valid for 3 months. If your works do not commence within this time period, please resubmit your plant enquiry for assessment before any works commence. Regards Plant Enquiries Dept Instalcom Limited
Interoute	This response does not include Vtesse or Easynet plant, please continue to use Vtesse or Easynet details for their enquiries To whom it may concern 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. All responses are only vaild for 28 days Yours faithfully PLANCAST Plant Enquiry Department
KPN International	With reference to your plant enquiry below, we can confirm that KPN do not have any apparatus within the immediate proximity of your proposed works. If you require any further information, please do not hesitate to contact us. Please note that this response is only valid for 3 months. If your works do not commence within this time period, please resubmit your plant enquiry for assessment before any works commence. Regards Plant Enquiries Dept Instalcom Limited
Trafficmaster Ltd	New Roads and Street Works Act 1991- Sections 83, 84,142 and 143 Codes of Practice Appendix C2 In response to your notice regarding works which you, are proposing to undertake. I can confirm that Trafficmaster does not have equipment installed within the boundary of the works. If you have any further queries regarding this or any other programme, please do not hesitate to contact me on my details below. Yours sincerely For & on Behalf of Trafficmaster Ltd
Verizon Business	Verizon is a licensed Statutory Undertaker. We have reviewed your plans and have determined that Verizon (Formally known as MCI WorldCom, MFS) has no apparatus in the areas concerned. If you have any further queries please do not hesitate to get in touch. Yours faithfully Plant Protection Officer (GB) Email osp-team@uk.verizon.com
Vodafone Limited (formerly C&W UK)	Please accept this email as confirmation that Vodafone: Fixed does not have apparatus within the vicinity of your proposed works detailed below. Many thanks. Plant Enquiries Team
	©2018 National One Call



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.



openreach

CLICK BEFORE YOU DIG

FOR PROFESSIONAL FREE ON SITE ASSISTANCE PRIOR TO COMMENCEMENT OF EXCAVATION WORKS INCLUDING LOCATE AND MARKING SERVICE

email cbyd@openreach.co.uk

ADVANCE NOTICE REQUIRED (Office hours: Monday - Friday 08.00 to 17.00) www.openreach.co.uk/cbyd

Reproduced from the Ordnance Survey map by BT by permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office (C) Crown Copyright British Telecommunications plc 100028040

KEY TO BT SYMBOLS	Pole	0
DP O	Planned Pole	0
Planned DP	Joint Box	
PCP 🔯	Change Of State	+
Planned PCP	Split Coupling	×
Built	/ Duct Tee	
Planned	Planned Box	
Inferred	Manhole	
Building	Planned Manhole	
Kiosk 🛞	Cabinet	Û
Hatchings	Planned Cabinet	Û
	Other proposed plant is shown usi BT Symbols not listed above may Existing BT Plant may not be	ng dashed lines. De disregarded. recorded.

Information valid at time of preparation

BT Ref : ZWQ10375R Map Reference : (centre) NS3395123135 Easting/Northing : (centre) 233951,623135 Issued : 23/03/2018 10:37:25

WARNING: IF PLANNED WORKS FALL INSIDE HATCHED AREA IT IS ESSENTIAL BEFORE PROCEEDING THAT YOU CONTACT THE NATIONAL NOTICE HANDLING CENTRE. PLEASE SEND E-MAIL TO: nnhc@openreach.co.uk









Our Ref: 12489364 Your Ref: EQ/KMNYM142



1|1

Friday, 23 March 2018

1 Mill Place Mill Road Ind Est Linlithgow Bridge Linlithgow West Lothian EH49 7TL

Dear

Smell gas? Call 0800 111 999

Thank you for your enquiry dated Friday, 23 March 2018

Please find an extract from our mains records for your proposed work area, any SGN assets are described in the map legend. On some occasions blank maps may be sent to you, this is due to your proposed work being in a no gas area but within our operational boundaries.

This mains record only shows the pipes owned by SGN in our role as a Licensed Gas Transporter (GT). Please note that privately owned gas pipes or pipes owned by other GTs may be present in this area and information regarding those pipes needs to be requested from the owners. If we know of any other pipes in the area we will note them on the plans as a shaded area and/or a series of x's.

The information shown on this plan is given without obligation or warranty and the accuracy 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 plan is only valid for 28 days.

On the mains record you may see the low/medium/intermediate pressure gas main near your site. There should be no mechanical excavations taking place above or within 0.5m of a low/medium pressure system or above or within 3.0m of an intermediate pressure system. You should, where required confirm the position using hand dug trial holes.

A colour copy of these plans and the gas safety advice booklet enclosed should be passed to the senior person on site in order to prevent damage to our 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 the 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 relevant people (direct labour or contractors) working for you on or near gas pipes.

It must be stressed that both direct and consequential damage to gas plant can be dangerous for your employees and the general public and repairs to any such damage will incur a charge to you or the organisation carrying out work on your behalf. 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.

If you require any further information please do not hesitate to contact us.

Yours sincerely, The Safety Admin Team For more information, visit our Dig Safely pages on sgn.co.uk Tel: 0800 912 1722

> SGN is a brand name of Scotia Gas Networks Limited Registered in England & Wales No. 04958135 Registered Office: St Lawrence House | Station Approach | Horley | Surrey RH6 9HJ

> > Authorised and regulated by the Financial Conduct Authority







Contact Us Mapping Enquiries: All areas

General Enquiries: All areas

Date Requested: 23/03/2018 Job Reference: 12489364 Site Location: 233951 623135 Requested by: Mr Brian McMaster Your Scheme/Reference: EQ/KMNYM142 Exact Scales: 1:1000 Area or Circle dig site 1:1000 Line dig site

This plan shows the location of those pipes owned by Scotia Gas Networks (SGN) by virtue of being a licensed Gas Transporter (GT). Gas pipes owned by other GTs or third parties may also be present in this area but are not shown on this plan. Information with regard to such pipes should be obtained from the relevant owners. No warranties are given with regard to the accuracy of the information shown on this plan. Service pipes, valves, siphons, sub-connections etc. are not shown but their presence should be anticipated. You should be aware that a small percentage of our pipes/assets may be undergoing review and will temporarily be highlighted in yellow. If your proposed works are close to one of these pipes, you should contact the SGN Safety Admin Team on 0800 912 1722 for advice. No liability of any kind whatsoever is accepted by SGN or its agents, servants or sub-contractors for any error or omission contained herein. 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 plant location information is provided to all persons (whether direct labour or sub-contractors) working for you on or near gas apparatus. Information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

Report damage immediately – KEEP EVERYONE AWAY FROM THE AREA 0800 111 999

Low Pressure Mains	
Medium Pressure Mains	
Intermediate Pressure Mains	
High Pressure Mains	
LAs	
GTs S	SSSIs
Some Examples Of Plant Items Valve Syphon O Cover C Digsite: Line:	Diameter Material Change
Linese before	earch Mdig
This plan is reproduced from or based Gas Networks plc, with the sanction Stationery Office. Crown Copyright R 100044373 and Scotland Ga	l on the OS map by Scotia of the controller of HM Reserved. Southern Gas – as – 100044366.



Virgin Media Field Services Units 1-12 Broad Lane Mayfair Business Park Bradford Yorkshire BD4 8PW

Tel: 0870 888 3116 Opt 2 Fax: 01268 468557

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

 Plant Enquiry Ref:
 VM.1101839

 Your Letter Date
 22.03.2018

 Your Ref
 :
 EQ/KMNYM142

 Date
 :
 28.03.2018

Hello,

Enquiry Location: Limekiln Rd, Weir Rd, Ayr, South West Scotland, KA8 8BD

Thank you for your enquiry regarding work at the above location.

I enclose a copy of our above referenced drawing, marked to show the approximate position of plant owned and operated by Virgin Media.

You will be aware that you have a duty to ensure that no damage results to this equipment as a result of your proposed works. Please note that this apparatus may contain Fibre Optic, Coaxial and/or 240v Power Cables and as such, special care must be taken when excavating this area.

Should you require Virgin Media apparatus to be diverted we must agree a specification of works and provide a detailed estimate of costs. The costs are £720 (Business) or £240 (Residential) Inc VAT and the charge applies to each individual scheme requested.

Both the estimate and specification will be sent to you within 25 working days of when the payment was received.

This initial payment will cover the following: -

- Detailed site visit by an experienced planning engineer. (Up to 10 hours planning time)
- Detailed specification of works.
- Detailed breakdown of costs.

Payment is required in advance for the estimated cost of detailed design work and the charge applies whether or not your works proceed. Please supply us with your payment and a copy of your plans or drawings and quote 'Our Ref' as above.

The address to send the cheque is:

Diversionary Works, Virgin Media, 1 Dove Wynd, Strathclyde Business Park Bellshill ML4 3AL

Or if you prefer to talk, please call the Diversionary Team on: 0800 408 0088 Option 1

Yours faithfully

National Plant Enquiries Team

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(c) Crown copyright and	database rights 2018 Ordnance Survey 100019209	Date: 28/03/18	Scale: 1:2357	Map Centre: 233977,623114	Data updated: 04/03/1	3	Telecoms Plan A4
Important Information - p tried to make it as accur within Virgin Media appa inside green, rather thar which can be downloade carrying out any excava	blease read The purpose of this plan is to identify Virgin ate as possible but we cannot warrant its accuracy. In a rratus there may be instances where mains voltage pow black ducting. Further details can be found using the "/ ad from this website. Therefore, you must not rely solely ion or other works in the vicinity of Virgin Media apparat purports the wrified hus plantation of the provider of the purport he wrified hus plantations.	Media apparatus. We have ddition, we caution that er cables have been placed Mfected Postcodes.pdf", on this plan if you are tus. The actual position of	Duct, Trench	Chamber	Cabinet	ruthi.basavaraj@virginmedia.co.uk /.1101839	Virgin media

which can be downloaded from this website. Therefore, you must not rely solely on this plan if you are carrying out any excavation or other works in the vicinity of Virgin Media aparatus. The actual position of any mechanical plant is used. Accordingly, unless it is due to the negligence of Virgin Media, its employees or agents, Virgin Media will not have any liability for any omissions or inaccuracies in the plan or for any loss or damage caused or arising from the use of and/or any reliance on this plan. This plan is produced by Virgin Media Limited (c) Crown copyright and database rights 2018 Ordnance Survey 100019209.



Appendix E. Trial Pit Logs



HRE Bridges 2018

BRIDGE: AYH/1

Factual Report on Bridge Assessment

Project No: 764649

Client: Jacobs (UK) Limited



AUGUST 2018



DOCUMENT ISSUE RECORD

Project No	.:	764649									
Project Na	me:	HRE BRIDGES 2018									
Document	Title	Factual Report on Bridge Assessment									
Client:		JACOBS (UK) Limited									
Engineer: JACOBS (UK) Limited											
Status:		FINAL									
Author											
Technical Reviewer											
Approved	by										
Report Iss	ue Date	13 th August 2018									
REVISION	RECORD										
Revision	Date	Description of revisions Prepare									
00	13/08/2018	Final Factual Report									

STRUCTURAL SOILS LIMITED The Potteries Pottery Street CASTLEFORD West Yorkshire WF10 1NJ

> Tel: 01977 552255 Email: ask@soils.co.uk www.soils.co.uk



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	(ii) Exploratory Hole Location Plan	
AF	PPENDIX B - EXPLORATORY HOLE RECORDS	
	(i) Key to Exploratory Hole Logs	
	(ii) Trial Pit Logs	
AF	PPENDIX C - GEOTECHNICAL LABORATORY TESTING ERROR	!
	BOOKMARK NOT DEFINED.	
	(i) Loborotory Toot Doculto	

(i) Laboratory Test Results



1 INTRODUCTION

This investigation was carried out by Structural Soils Limited (SSL) on the instructions of Jacobs (UK) Limited (the Client). The work was carried out as part of a term contract to investigate a number of bridges around the United Kingdom.

This report relates to bridge AYH/1 located in South Ayrshire, Scotland at British National Grid Reference NS 339231 (see Site Location Map in Appendix A). The bridge comprises a single span cast iron girders, parapets and jack arch plates with masonry abutments and wing walls. This investigation was carried out to provide information for the structural assessment of the bridge.

The investigation has been carried out in accordance with the contract specification, and the general requirements of BS 5930:2015, BS 10175:2011+A1:2013, BS EN 1997-2 (2007), BS EN ISO 22475-1 (2006) and other relevant standards as identified below.

This report presents the factual records of the fieldwork carried out and laboratory testing. Whilst every attempt is made to record full details of the strata encountered in the exploratory holes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks. All information given in this report is based on the ground conditions encountered during the site work, and on the results of laboratory and field tests performed during the investigation. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes.

This report was prepared by SSL for the sole and exclusive use of Jacobs (UK) Limited in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded. No liability will be accepted after a period of 6 years from the date of the report.



2 FIELDWORK

2.1 General

The fieldwork was commenced and completed on 17 July 2018 and comprised the excavation of two hand dug trial pits (AYH/1 TP1 and AYH/1 TP2) at the locations shown on the Exploratory Hole Location Plan in Appendix A.

The trial pits were excavated on the northern side of the bridge deck. The pits were excavated to determine the thickness of the fill over the bridge deck and to take a level on the crown of the arch/bridge deck. Levelling was carried out by Jacobs (UK) Limited. The trial pits were terminated on the top of the concrete backing.

On completion the trial pits were backfilled with arisings and the road surface reinstated.

The investigation was supervised by an engineer from SSL. The scope of works and positions were selected and set out by Jacobs (UK) Ltd and adjusted where necessary to take account of buried or overhead services, or other restrictions. The exploratory hole and in-situ test locations are shown on the Exploratory Hole Location Plan presented in Appendix A.

The exploratory hole logs are presented in Appendix B. These provide information including the equipment and methods used, samples taken, tests carried out, water observations and descriptions of the strata encountered. Explanation of the terms and abbreviations used on the logs is given in the Key to Exploratory Hole Records in Appendix B, together with other explanatory information.

The holes were logged by an engineer in general accordance with the recommendations of BS 5930:2015 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1), together with relevant comments, are given on the logs.



3 REFERENCES

- **3.1** BS 5930:2015 Code of practice for ground investigations
- **3.2** BS EN 1997-1:2004 *Eurocode* 7 *Geotechnical Design Part 1 General Rules* incorporating corrigendum Feb 2009 and Amemdment A1 2013
- **3.3** BS EN 1997-2:2007 Eurocode 7 Geotechnical design Part 2: Ground Investigation and testing
- **3.4** BS 10175:2011 Investigation of potentially contaminated sites: Code of practice, including amendment A1 2013
- **3.5** BS EN ISO 14688-1:2002 Geotechnical investigation and testing Identification and classification of soil: Part 1: Identification and description, including Amendment A1 2013
- **3.6** BS EN ISO 14688-2:2004 Geotechnical investigation and testing Identification and classification of soil: Part 2: Principles for a classification, including Amendment A1 2013



APPENDIX A -PLANS AND DRAWINGS

- (i) Site Location Map
- (ii) Exploratory Hole Location Plan



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APPENDIX B -EXPLORATORY HOLE RECORDS

- (i) Key to Exploratory Hole Logs
- (ii) Trial Pit Logs





KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF ABBREVIATIONS

ADDITIONAL NOTES

1. All soil and rock descriptions and legends in general accordance with BS EN ISO 14688-1, 14688-2, 14689-1, and BS5930:2015.

Material types divided by a broken line (- - -) indicates an unclear boundary.
 The data on any sheet within the report showing the AGS icon is available in the AGS format.



KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF GRAPHIC SYMBOLS

MATERIAL GRAPHIC LEGENDS



MADE GROUND

INSTRUMENTATION SYMBOLS



Backfill



Bentonite cement grout



Bentonite seal



Concrete



Contract:						Client:						Trial	Trial Pit:			
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Appendix F. Historical Information



Taken from a previous assessment dated 1935 by LM&SR (Scottish division).



Appendix G. Survey Sketches

All dimensions are in mm, with heights in m from TBM.











South Elevation



Appendix H. Calculations

CALCULATION COVER SHEET

Jacobs York

Project Title: HRE Assessment Programme				Calc. No.: 450627				
Job No:	B28280B	T					File:	VAR9/5606
Project M	anager							
					Limekiln Ro	oad, Ayr, So	uth Ayrshire	9
Project G	Project Group 31200			BD21 Assessment				
	Total	Made	Date	Checked	Date	Reviewed	Date	
	Sheets	by	Dale	by	Date	by	Dale	
Original	25		May-19		May-19	JR	May-19	
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For asses	sment crit	teria, refer	to Approva	l in Principle	e (Form AA)	document		


JACOBS **CALCULATION SHEET** Office York Page No. 1 Calcs by Job No. & Title VAR9/5606 - AYH/1 BD21 Assessment

Section	Internal Girders - Section Properties	Checker	Date
Section	Properties		
Internal G	irders		





Calc No.

Date

450627

May/19

May/19

Gross Elastic Section Properties (About x-x axis)

Section

	b	d	Α	У	A.y	A(y-y _t) ²	l _x
Section	(mm)	(mm)	(mm²)	(mm)	(mm³)	(mm⁴)	(mm⁴)
Top Flange	76	51	3876	25.5	98.8 E+3	363.0 E+6	840.1 E+3
Web	51	381	19431	241.5	4.7 E+6	157.5 E+6	235.1 E+6
Bottom Flange	457	51	23307	457.5	10.7 E+6	369.8 E+6	5.1 E+6
	Gr	oss Area	46614	Σ	15.5 E+6	890.3 E+6	240.9 E+6

						_
Depth of Full Section	D			=	483.0	mm
Distance to N/A from top of section	y _t	=	ΣΑ.y / ΣΑ	=	331.5	mm
2nd moment of area of beam section	l _{xx}	=	$\Sigma A(y-y_t)^2 + \Sigma I_x$	=	1.13 E+9	mm ⁴
Elastic Section Modulus (Compression Flange)	Z_{xc}	=	I _{xx} / y _t	=	3.41 E+6	mm ³
Elastic Section Modulus (Tension Flange)	Z _{xt}	=	I _{xx} / (D - y _t)	=	7.47 E+6	mm ³

Corroded Elastic Section Properties (About x-x axis)

	b	d	Α	У	A.y	A(y-y _t) ²	2 I _x	
Section	(mm)	(mm)	(mm²)	(mm)	(mm³)	(mm⁴)	(mm	⁴)
Top Flange	76	51	3876	25.5	98.8 E+3	354.6 E+	-6 840.1	E+3
Web	51	381	19431	241.5	4.7 E+6	145.3 E+	6 235.1	E+6
Bottom Flange	453	49	22197	456.5	10.1 E+6	366.6 E+	-6 4.4 E	+6
		Net Area	45504	Σ	14.9 E+6	866.6 E+	-6 240.3	E+6
				-				
Depth of Full Section				D		=	481.0	mm
Distance to N/A from top of section				y _t =	ΣΑ.y / ΣΑ	=	328.0	mm
2nd moment of area of beam sectio	n			I _{xx} =	$\Sigma A(y-y_t)^2 + \Sigma I_x$	=	1.11 E+9	mm ⁴
Elastic Section Modulus (Compress	ion Flange)			Z _{xc} =	I _{xx} / y _t	=	3.37 E+6	mm ³
Elastic Section Modulus (Tension F	lange)			Z _{xt} =	I _{xx} / (D - y _t)	=	7.23 E+6	mm ³

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Job No. & Title	VAR9/5606 - AYH/1 BD	21 Assessn	nent			Calc	s by		Date	May/19
Section	Edge Girders - Section	Properties				Che	cker		Date	May/19
Section Edge Gird	Properties ers	76 64 - 279	51 = 51 = 51 = 51			2mm section los	s]		
		h	-			A 14	A()	(-)() ²		
	Section	(mm)	(mm)	(mm²)	y (mm)	A.y (mm ³)	(y (m	nm ⁴)	'× (mm⁴))
	Top Flange Web	76 51	51 457	3876 23307	25.5 279.5	98.8 E+3 6.5 E+6	390. 94.0	7 E+6 0 E+6	840.1 E- 405.6 E-	+3 +6

			-		
Depth of Full Section	D		=	559.0	mm
Distance to N/A from top of section	y _t =	ΣΑ.y / ΣΑ	=	343.0	mm
2nd moment of area of beam section	I _{xx} =	$\Sigma A(y-y_t)^2 + \Sigma I_x$	=	1.41 E+9	mm⁴
Elastic Section Modulus (Compression Flange)	Z _{xc} =	I _{xx} / y _t	=	4.11 E+6	mm ³
Elastic Section Modulus (Tension Flange)	Z _{xt} =	I _{xx} / (D-y _t)	=	6.53 E+6	mm ³
			-		_

14229

41412

533.5

Σ

7.6 E+6

14.2 E+6

516.4 E+6

1.0 E+9

3.1 E+6

409.6 E+6

Corroded Elastic Section Properties (About x-x axis)

Bottom Flange

279

51

Gross Area

Section	b (mm)	d (mm)	A (mm²)	y (mm)	A.y (mm ³)	A(y-y _t) ² (mm⁴)	l _x	⁴)
Top Flange	76	51	3876	25.5	98.8 E+3	381.3 E+	-6 840.1	E+3
Web	51	457	23307	279.5	6.5 E+6	82.9 E+	6 405.6	E+6
Bottom Flange	275	49	13475	532.5	7.2 E+6	503.8 E+	-6 2.7 E	+6
		Net Area	40658	Σ	13.8 E+6	968.0 E+	-6 409.2	E+6
				-		_		_
Depth of Full Section				D		=	557.0	mm
Distance to N/A from top of section				y _t =	ΣΑ.γ / ΣΑ	=	339.1	mm
2nd moment of area of beam section	n			I _{xx} =	$\Sigma A(y-y_t)^2 + \Sigma I_x$	=	1.38 E+9	mm⁴
Elastic Section Modulus (Compress	ion Flange)			Z _{xc} =	I _{xx} / y _t	=	4.06 E+6	mm ³
Elastic Section Modulus (Tension F	lange)			Z _{xt} =	$I_{xx} / (D-y_t)$	= [6.32 E+6	mm ³

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Office	York Office	Page No. 3	Calc No.	450627
Job No. & Title	VAR9/5606 - AYH/1 BD21 Assessment	Calcs by	Date	May/19
Section	Effective Girder Spans	Checker	Date	May/19
	Effective Span			
BD21/01 Cl. 6.5	Where there are no bearing stiffeners and the beam rests directly on mas the effective span should be taken between the centroids of the bearing p	onry, concrete or brick, ressure diagrams.		
	In this case, the pressure diagrams shall be determined by assuming that linearly from a maximum at the front edge of the support to zero at the bac	the reaction is distributed ck of the bearing area.	d	
	The length of the bearing area shall not be taken as greater than the depth support is of soft brick, or one-quarter of the depth of the beam where the such as concrete.	n of the beam where the support is of hard mater	ial	
	Bearing details = Girder bears directly upon sandsto	ne pad stones]
	» Length of bearing = ½ Depth of Gir Internal Girder	der		
Form AA	Clear skew span=8.040Depth of Girder=483 <i>» Length of bearing</i> =0.242m1/2 depth of girder			
	<i>»</i> Effective Span = Clear Span (8.040m) + 2 [Length of beau = <u>8.201</u> m	ring(0.242m) ÷ 3]		
	Effective Span Diagram			
	$ \underbrace{0.242}_{m} \xrightarrow{m} $		< <u>0.242</u>	∍m
	L = 8.040 m L _{eff} = 8.201 m		→	1
	Edge Girder			
	Clear skew span=8.040Depth of Girder=559 <i>» Length of bearing</i> =0.280m1/2 depth of g	iirder		
	» Effective Span = Clear Span (8.040m) + 2 [Length of beau = 8.226 m	ring(0.242m) ÷ 3]		
	Effective Span Diagram			
	$ \xrightarrow{0.280} ^{m} $		< 0.280 ≥	∍ ^m
	L = 8.040 m		$\rightarrow \wedge$	
		0		



Office	York Office	Page N	o. 5	Calc No.	450627
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Section	Internal Girders - Dead Loads	Checke	er 🔳	Date	May/19
3D21/01		3			
Table 4.1	Plate unit weight $\rho = 71.0$ k	xN/m³			
Table 3.1	Partial load factor $\gamma_{fl} = 1.00$				
	» Hogging Plate UDL = 0.011 x 71.0	x 1.00 =	0.80 kN/r	n	
Table 4 1	Backing Fill unit weight o - 21.58 k	N/m ³			
Table 3.1	Partial load factor $v_{-} = 1.00$	XI V/ 11 /			
	» Backing Fill UDL = 0.097 x 21.6	x 1.00 =	2.10 kN/r	n	
	Fill Material Load				
Table 3.1	Unit weight $\rho = 21.58$	xN/m ³			
	Depth of Fill = 299.3 r	nm			
	Cross sectional area A = 0.388 r	n ²			
	Partial load factor $\gamma_{fl} = 1.00$				
	» Fill UDL = 21.6 x 0.388	x 1.00 =	8.36 kN/r	n	
	Surfacing	N1/m ³			
able 3.1	Unit weight $\rho = 23.54$ k	(N/M)			
		nm "Assume top 100mm "2	1		
	Cross sectional area $A = 0.130$	ri			
	Partial load factor $\gamma_{\rm fl} = 1.30$				
	» Surfacing UDL = 23.5 x 0.130	x 1.50 =	4.57 kN/r	n	
	Total UDL				
	Surfacing 4.57				
	Fill Material 8.36				
	Hogging plate 0.80				
	Arch backing fill 2.10				
	Girder 3.29				
	Total Dead UDL = 19.1 k	:N/m			
	Dead Load Effect				
	Effective Span = 8.201 m				
	$M_{DL} = WL^2 / 8 = 19.1 \times 8.201^2 / 8$	=	160.8	kNm	
	$V_{01} - wl/2 - 191 x 8201/2$	_	78.5	kN	



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Section	Edge Girder - Dead Loads		Checker		Date	May/19
BD21/01						
Table 4.1	Plate unit weight	$\rho = 70.63 \text{ kN/m}^3$				
Table 3.1	Partial load factor	γ _{fl} = 1.00				
	» Hogging Plate UDL	= (70.6 x 0.006 x 1.00)	=	0.4	kN/m	
Table 4 1	Backing Fill unit weight	$0 = 21.58 \text{ kN/m}^3$				
Table 3.1	Partial load factor	$\gamma_{fl} = 1.00$				
		••••	_		_	
	» Backing Fill UDL	= (21.6 x 0.049 x 1.00)	=	1.1	kN/m	
	Fill Material Load					
Table 4.1	Unit weight	$\rho = 21.58 \text{ kN/m}^3$				
	Cross sectional area	$A = 0.336 m^2$				
Table 3.1	Partial load factor	γ _{fl} = 1.00				
	» Fill UDL	= (21.6 x 0.336 x 1.00)	=	7.3	kN/m	
	Total Dead UDL					
	Girder	3.07 kN/m				
	Hogging plate	0.40 kN/m				
	Arch Backing Fill Material	1.05 kN/m				
	Fill Material above Girders	7.26 kN/m				
	Total Dead UDL	= 11.8 kN/m				
	Dead load effects					
	L _e = 8.201 m					
	Bending Moment at Midspan					
	$M_{DL} = WL^2/8 =$	11.8 x 8.201² / 8	=	99.0	kNm	
	Shear Force at Support					
	$V_{DL} = wL/2 =$	11.8 x 8.201 / 2	=	48.3	kN	

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Office	York Office	9							Page No.	8	Calc No	. 450627
lob No. & Title	VAR9/560	6 - AYH/1 B	8D21 A	ssessmen	t				Calcs by		Date	May/19
Section	Hogging P	late - Dead	Loads						Checker		Date	May/19
	<u>Dea</u>	ad Loads	: & SI	uperimp	osed De	ad Loads						
	Surface	100 mm	<u>}</u>			100.530			Girder Spac Arch span	bing = =	1295 838	mm mm
	Fill Rise	299 mm 127 mm	¥ L						Plate thickn	ess =	12.7	mm
			θ	R		99.940			Bottom flan	ge thickr =	ness 51	mm
		R θ Arc length	= = 1 =	(127² + 4 sin⁻¹ (419 1.18 x 75	9 (2 x 9 / 755) 9 - 755	127)	= 75 = 33 = 88	4.7 3.7 8.4	mm deg mm	=	0.59 rad	lians
		Area unde	er Arch	= = =	Area of ((2 x 33) 0.335 0.072	Sector 7) ÷ 360) x (π x m ² m ²	(0.755²)	- -	Area Triang (0.419 x (0. 0.263	le 755 - 0.1 m ²	27))	
		Area of Ar	rch and	Fill = = =	1.295 x 0.181 0.109	(0.013 + 0.127 m ² m ²)	-	0.072 0.072	m²		
		Area of Ar	rch	= =	Arc leng 0.888 x	th x Arch Thick 0.013	ness	=	0.011	m²		
		Area of Fi	II	=	0.109 - (0.011		=	0.097	m²		

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Job No. & Title	VAR9/5606 - AYH/1 BD21 Assessment			Calcs by		Date	May/19
Section	Hogging Plate - Dead Loads			Checker		Date	May/19
BD21/01							
Table 4.1	Plate unit weight	ρ =	70.63 kN/m ³				
Table 3.1	Partial load factor	Y _{fl} =	1.00				
	» Arch UDL	=	(70.6 x 0.011 x 1.00)	= 0.	<mark>80</mark> kN/n	n	
Table 4.1	Backing Fill unit weight	0 =	21.58 kN/m ³				
Table 3.1	Partial load factor	P - V ₁ =	1.00				
	» Backing Fill UDL	=	(21.6 x 0.097 x 1.00)	= 2.	10 kN/n	n	
	Fill Material Load						
Table 3.1	Unit weight	ρ =	21.58 kN/m ³				
	Cross sectional area	A =	0.388 m ²	(Girder spacing x	fill depth)		
	Partial load factor	Y _{fl} =	1.00				
	» Fill UDL	=	(21.6 x 0.388 x 1.00)	= 8.	<mark>36</mark> kN/n	n	
	Surfacing_						
Table 3.1	Unit weight	ρ =	23.54 kN/m ³				
	Depth of Surfacing	=	100.0 mm	*Assume top 100	mm to be s	urfacing	
	Cross sectional area	A =	0.130 m ²	(Girder spacing x	surfacing c	lepth)	
	Partial load factor	Y _{fl} =	1.50				
	» Fill UDL	=	(23.5 x 0.130 x 1.50)	= 4.	<mark>57</mark> kN/n	n	
	Total UDL						
	Surfacing		4.57 kN/m				
			0.30 KN/M				
	Hogging Plate		0.80 KN/M				
	Backing fill		2.10 kN/m				
	Total Dead UDL =		15.84 kN/m ²	= 0.0	158 N/mi	m2	
I	l						

Office Job No. & Title Section	York Office VAR9/5606 - AYH/1 BD21 Assessment Internal Girders - Live Loading (HA Loading)	Page No. Calcs by	10	Calc No.	450397
Job No. & Title Section	VAR9/5606 - AYH/1 BD21 Assessment Internal Girders - Live Loading (HA Loading)	Calcs by			
Section	Internal Girders - Live Loading (HA Loading)			Date	May/19
		Checker	43608	Date	May/19
	<u>Live Loading</u> Internal Girders - Live Load (Type HA Loading UDL and KEL)				
BD21/01 Cl. 5.18	*Assume HA Loading to occur as UDL and KEL along main beams. For loaded lengths between 2m and 50m, W = $336(1/L)^{0.67}$, where W i width 2.5m. Span W (m) (kN/m) W = $336(1/L)^{0.67}$	s the UDL in	kN/m of lan	e	
BD21/01	8.201 82.0				
Cl. 5.18 BD21/01	To be applied in conjunction with KEL of 120 kN, unifor	mly distribute	d across the	e lane width.	
Table 3.1	Y_{fl} = Partial Factor for Live Loading	Yfl	= 1	.0	
	» UDL » (82.0 x 1.00) » KEL » (120.0 x 1.00)	w P	= 82 = 12	2.0 kN/m 0.0 kN	
	Adjustment Factor (A _f)				
BD21/01	HA UDL and KEL adjusted in order to eliminate lateral bunching using	A _f			
Cl. 5.23	For; $0 < L \le 20$ » $A_f = \underline{a_L}$ » $A_f = \boxed{1}$	/ 2.5 .46	(a _L =	= 3.65m)	
	Adjusted UDL » (82.04 / 1.46) Adjusted KEL » (120.0 / 1.46)	w _a P _a	= 50 = 82	6.2 kN/m 2.2 kN	
BA16/97 Cl. 2.6	Proportion Factor The nominal live load bending moment applied to an internal girder und obtained by multiplying the gross moment due to the effects of the live of width 2.5m by the appropriate factor from figure Figure 2/2.	der a traffic la load from one	ne can be e notional la	ne	
	Effective span of Girder		= 8.2	201 m	
	Girder spacing *Average spacing taken		= 1.2	2 95 m	
BA16/97 Fig. 2/2b	0.8 0.7 y 100 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0				
	oportion	Factor	= 0.4	475	





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Section	VAR9/5606	6 - AYH	/1 BD21	Asses	smen	t						Calc	s by			Date	May/1
	Edge Girde	er - Live	Load (Annex [D)							Che	cker			Date	May/1
3D21 Annex D	Anne L _{eff} Vehic Gros Weigl (tonne	ex D Ve = [No. of Axles	01 (m)	oading 6 m W1 (tonnes)	A1 (m)	W2 (tonnes)	AX	W3 (tonnes)	A3 (m)	D SPACE W4 (tonnes)	NG A4 (m)	W5 (tonnes)	A5 (m)	W6 (tonnes)	02 (m)		
	321	4	1.0	6.50	1.20	6.50	3.90	11.50	1.30	7.50					1.0		
	38=	4	1.0	6.50	3.00	11.50	5.10	10.00	1.80	10.00					1.0		
	403	5	1.0	6.00	3.00	11.50	4.20	7.50	1.35	7.50	1.35	7.50			1.0		
	40*	5	1.0	5.00	2.80	10.50	1.30	4.50	4.80	10.00	1.80	10.00			1.0	-	
	41°	6	1.0	5.00	2.80	10.50	1.30	5.00	4.18	6.83	1.35	6.83	1.35	6.83	1.0		
	44 ⁷	6	1.0	6.00 7.00	2.80	10.50	1.30	5.00	4.70	7.50	1.35	7.50	1.35	7.50	1.0		
			1.0	7.00	2.00	11.50	1.50	7.50	7.00	5.00	1.55	2.00			1.0		
	Ass	essment Live	Vehicle Ref.	Vehic Gros	le s	No. of		AXLE WEIGHTS AND SPAC			SPACING						
		ading Level		(tonne	ht s)	Axles	01 (m)	W1 (tonnes)		A1 (m)	W2 (tonnes)	A2 (m)	(to)	W3 nnes)	02 (m)		
		26	RA	20.3	2	3	1.0	4.32	2		8.00	1.02	8	.00	1.00	-	
		26	RB	26.0	D	3	1.0	7.00	3	.42	9.50	1.30	9	.50	1.00		
		26 26	RC	26.0		3	1.0	7.00	3	.42	11.50 +	1.30	7.	50 + 00 +	1.00		
		18	RE	18.0	Ď	2	1.0	6.50	3	.00	11.50	5.50	a.		1.00		
		7.5	RF	7.50		2	1.0	6.00	2	.00	1.50				1.00	4	
iD21 01 XI D4 (a)	*An lı	npact fai	ctor of 1. I tonne	8 shall b <u>s</u>	e impli	ed to the	e most c	ritical axle	of the	vehicle.							
				Ref				w1		w2		w3	v	v4	w5	i v	/6
		No	ninal A		ad (to	nnes)		7 68	,	11.5	_	7.5	9	9	9	3 0)
		N	Imp	act Fac	tor*	KN)		00.1	+	1.8	,	0	0	0	00.	5 0)
		Nomina	al Axle	Loads	(inc. Im	pact fac	tor)	68.7	,	203.1		73.6	8	8.3	88.	3 0	.0
			Sp	acing ((m)				2.8	0	1.30	7	60	1.3	5	0.00	



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Section	Hogging Plate - Live Loading	Checker		Date	May-19			
	Hogging Plate							
BD21 Table 5.3.1	Maximum single axle loading taken as 165 kN, for road with low traffic and go	od surface						
Table 3.1	Nominal single wheel load = $165/2$ = 82 Y _{fL} = 1.00	2.5 kN						
	Single wheel load to be applied = 82.5×1.0 = 8	2.5 kN						
BD21 CI.5.33	Effective pressure = 1.1 N/mm ²							
	Therefore, wheel contact area = $\frac{Load}{\Gamma f f entire} = 2$	74 mm						
	Depth between road and top plate $\sqrt{Effective Pressure} = 0.3$	399 m						
CI 6.7	Loads to be dispersed at ratio of 2 vertical to 1 horizontally through general fil and 1 to 1 through structural concrete to (i) highest part of the plate	I						
	Width of dispersal = 0.	6 73 m						
	Therefore UDL is applied to beam (1m section) = $82.5 / 0.673^2$	= 18 = 0.1	<mark>2.2</mark> kN/m 82 N/mn	2 n ²				

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Section	Internal Girder - Capacity	Checker		Date	May-19
Form AA	Capacity Internal Girder - Cast Iron Girder Capacity Girder resistance will be determined in accordance with BD21 clauses 4.10 Elastic Section Modulus (Tension Flange) Elastic Section Modulus (Compression Flange) -Tensile effects assumed to be critical	and 4.11.	Z _{xt} = Z _{xc} =	7.2E+6 3.4E+6	mm ³ mm ³
	Stresses due to DL & SDL Bending effects (f_d) DL and SDL Loading EffectsTensile Bending stress $f_d = M_{DL}/Z_{xt} = 160$ Stresses due to LL Bending effects (f_L) Live Loading EffectsTensile Bending stress $f_L = M_{DL}/Z_{xt} = 304$	8 / 7.23E+6 4 / 7.23E+6	M _{DL} = = M _{LL} = =	160.8 22.2 304.4 42.1	kNm N/mm ² kNm N/mm ²
CI.7.13	The section modulus of cast iron girders may be increased for live loading by D = Overall depth of deck less 75mm for surfacing d = Depth of bare girder at midspan D/d enhancement factor (max value of 2) 1.121	y the factor D	$f_L = f_L = $	539.0 481.0 37.6	mm mm N/mm ²
3D21-01 Cl.4.10	The tensile stress in cast iron shall not exceed $\label{eq:fd} f_d + f_L \qquad = \qquad$	22.2 + 37.6	= 6 =	46.0 59.8 » Girder N	N/mm ² N/mm ² ot OK
Cl.4.10 Cl.4.10(i)	In tension, f _L shall not exceed the greater of the values given by either » 24.6 or -19. Resulting max live load stress in tension Max.f _L	5 - 0.44f _d 6 - 0.76f _d	= = =	14.8 2.7 14.8 » Girder N	N/mm ² N/mm ² N/mm ² ot OK
	Max. Applied Bending Moment>> $M_{DL} + M_{LL}$ Girder Capacity>> $M_{DL} + (Z_{xt})$ Girder Capacity M_R >>Live Load Capacity	x Max.f _L) x Max.f _L x D/	= = d) =	465.3 268.0 280.9	kNm kNm kNm
	C factor = $(M_R - M_{DL})$ = $(280.9 - 160.85)$ = M_{LL} = 304.4 Loading K Factor boundaries for assessment live load restrictions under -	0.39]	Low Traffi	c flow
BD21 Fig.	40 tonnes = 0.88 7.5 tonnes = 26 tonnes = 0.84 Group 2 FE = 18 tonnes = 0.67 3 tonnes = Group 1 FE = 0.47	0.33 0.25 0.20			
	» Allowable live load rating = 7.5 tonnes AW				

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Job No. & Title	VAR9/5606 - AYH/1 BD21 Assessment		Calcs by		Date	May-19
Section	Edge Girder - Capacity		Checker		Date	May-19
Form AA	Capacity Internal Girder - Cast Iron Girder Capacity Girder resistance will be determined in accordance wit Elastic Section Modulus (Tension Flange) Elastic Section Modulus (Compression Flange)	h BD21 clauses 4.1	0 and 4.11. Z _{xt} Z	=	6.3E+6	mm ³
	-Tensile effects assumed to be critical Stresses due to DL & SDL Bending effects (f_d) DL and SDL Loading Effects Tensile Bending stress $f_d = 1$	M _{DL} / Z _{xt} = 99	 M _D .0 / 6.32E+6	L = =	99.0 15.7	kNm N/mm ²
BD21-01 Cl.4.10	Stresses due to LL Bending effects (f_) for 44 tonn Live Loading Effects Tensile Bending stress $f_L = I$ The tensile stress in cast iron shall not exceed	es $M_{DL}/Z_{xt} = 21$ $f_d + f_L =$	M _{LI} 3.9 / 6.32E+6 15.7 + 33.8	- = = = =	213.9 33.8 46.0 49.5 » Girder No	kNm N/mm ² N/mm ² N/mm ² ot OK
Cl.4.10 Cl.4.10(i)	In tension, f _L shall not exceed the greater of the values e Resulting max live load stress in tension	given by bither » 24 or -19 Max.f _L	9.6 - 0.44f _d 9.6 - 0.76f _d	= = =	17.7 7.7 17.7 » Girder No	N/mm ² N/mm ² N/mm ² ot OK
	Stresses due to LL Bending effects (f_L) for 18 tonn Live Loading Effects Tensile Bending stress $f_L = f_L$	es $M_{DL}/Z_{xt} = 16$	M _{LI} 0.4 / 6.32E+6	_ =	160.4 25.4	kNm N/mm²
BD21-01 Cl.4.10	The tensile stress in cast iron shall not exceed	$f_d + f_L =$	15.7 + 25.4	=	46.0 41.0 » Girder Ol	N/mm² N/mm² K
Cl.4.10 Cl.4.10(i)	In tension, ${\rm f_L}$ shall not exceed the greater of the values e	⊢given by uither × 24 or -1: Max.f∟	1.6 - 0.44f _d 9.6 - 0.76f _d	= =	17.7 7.7 17.7 » Girder No	N/mm ² N/mm ² N/mm ² ot OK

JACOBS CALCULATION SHEET							
Office	York Office	Pa	ge No. 18	Calc No.	450627		
Job No. & Title	VAR9/5606 - AYH/1 BD21 Assessment	Ca	alcs by	Date	May-19		
Section	Edge Girder - Capacity	Cł	necker	Date	May-19		
	Stresses due to LL Bending effects (f_L) for 7.5 tonnes		•				
	Live Loading Effects Tensile Bending stress $f_L = M_{DL} / Z_{xt}$	= 81.9 / 6.3	M _{LL} = 2E+6 =	81.9 13.0	kNm N/mm ²		
BD21-01 Cl.4.10	The tensile stress in cast iron shall not exceed ${\rm f_d} + $	f _L = 15.7	= 7 + 13.0 =	46.0 28.6 » Girder Of	N/mm ² N/mm ² (
Cl.4.10 Cl.4.10(i)	In tension, f_L shall not exceed the greater of the values given by either or Resulting max live load stress in tension Max.f_L	» 24.6 - 0.4 -19.6 - 0.1	14f _d = 76f _d = =	17.7 7.7 17.7 » Girder Of	N/mm ² N/mm ² N/mm ² (
	Max. Applied Bending Moment » Girder Capacity » Allowable live load rating = 7.5 tonne	M _{DL} + M _{LL} M _{DL} + (Z _{xt} x Max es AVL	M = x.f _L) =	181.0 210.9	kNm kNm		

JAC	OBS	CAL	CUL	ATIC	ON SH	EET				
Office	York Office	Pag	e No.	19	Calc No.	450627				
Job No. & Title	VAR9/5606 - AYH/1 BD21 Assessment	Calo	cs by		Date	May-19				
Section	Hogging Plate - Capacity	Che	ecker			May-19				
	Combined Stress considerations									
	Case 1 DL + LL Max Compression stress = Max Tensile stress =	-10.399 19.189	N/mm² N/mm²							
	Case 2 LL Max Compression stress = Max Tensile stress =	-9.523 18.785	N/mm² N/mm²							
	f_d = Case 1 - Case 2 = 18.785 - 19.189 =	0.404	N/mm ²							
CI.4.10	In tension, \boldsymbol{f}_L shall not exceed the greater of the values given by									
ы.4.1U(I)	» 24.6 - 0.44f _d = 24.6 - 0. 19.6 - 0.76f _d = 19.6 - 0.7 Resulting maximum live load stress capacity in tension	.44 x 0.40 76 x 0.40 Max.	= = f =	= 24 = 19 24 » Ho	I.42 N/mr J.29 N/mr I.42 N/mr gging Plate	р ² р ² ОК				