Jacobs

Great Musgrave Bridge (EDE/25) CS454 Assessment Certification

Document no: 0451648
Version: 0

National Highways - Historical Railways Estate
EDE/25

EDE/25 Infill Removal and Refurbishment
20 September 2023

Great Musgrave Bridge (EDE/25)
CS454 Assessment Certification

Client name:	National Highways - Historical Railways Estate		
Project name:	EDE/25 Infill Removal and Refurbishment		
Client reference:	EDE/25	**Project no:**	B38380SS
Document no:	0451648	**Project manager:**	[redacted]
Version:	0	**Prepared by:**	[redacted]
Date:	20 September 2023	**File name:**	0451648_EDE_25 CS454 Assessment Certification

Document status: For Issue

Document history and status

Version	Date	Description	Author	Checked	Reviewed	Approved
0	20/09/23	First Issue	[redacted]	[redacted]	[redacted]	[redacted]

Distribution of copies

Version	Issue approved	Date issued	Issued to	Comments

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Contents

Appendices

1. Introduction

General Overview

Structure Type: Single span overbridge

Superstructure Form: Semi-elliptical masonry stone arch (skewed).

Substructure Form: Gravity type stone abutments and wingwalls.

Span: Skew: 8.45m

Assessment Code: CS 454

Live Load Capacity: Normal Traffic Loading (subject to satisfactory completion of masonry repairs)

Minimum Adequacy Factor: 3.43

Restriction: None

Condition: The assessment is based upon the anticipated condition of the bridge following completion of the refurbishment works in October 2023. An inspection following completion of the works is required to confirm the condition of the structure meets with the assumptions made within this assessment.

Local Authority: Westmorland and Furness Council

OS Reference: NY 765 136

This report presents the load carrying capacity for the bridge and has been assessed based on assumed condition data in anticipation of completion of a refurbishment scheme at the bridge. 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 historical information provided by HRE, as appropriate.

At the time of survey, the bridge structure was partially buried and only the north elevation down to springing level was visible.

The assessment assumes the refurbishment works will address any previous concerns regarding the condition of the bridge therefore no structural defects have been accounted for in the analysis model.

The arch barrel extrados and the soil faces of the spandrel walls were considered to be built-in parts not amenable to inspection except in localised areas where investigation trenches were excavated. Assessment followed standard methods based on appraisal of the visible parts of the bridge.

A MEXE assessment to BD21/97 was done by Cumbria County Council (CCC) in 1998. This returned a live load rating of 17T GVW with the proviso that if repairs were carried out to the pointing in the arch barrel, then a 40T rating might be achieved. Pointing repairs were subsequently carried out but, a few years later, they had failed thus theoretically returning the bridge to the 17T GVW capacity assessed in 1998. The CCC assessment had assumed a uniform arch barrel thickness throughout the elliptical arch profile which complies with the MEXE method. When Jacobs initially did an assessment based on the CCC data but using a LimitState RING analysis, the result was similar, if not somewhat worse than the MEXE analysis. Elliptical arches are often problematical in assessment when the assumptions about the internal construction are not necessarily correct. The recent closure of the bridge afforded the opportunity to further investigate the arch barrel thickness and the extrados profile and this data has made possible an updated, more refined analysis.

List and Description of Appendices

The following documents are provided as Certification of the load capacity of structure EDE/25 (Great Musgrave Bridge) in accordance with CS454. These documents rely upon completion of a satisfactory refurbishment scheme in October 2023 and final validation by the Jacobs assessment engineer upon completion of the works otherwise the certification is not valid.

Appendix Reference	Appendix Name	Revision/Issue Date
A	Form AA	September 2023
B	Form BA	September 2023
C	Calculations	September 2023

Appendix A: Form AA

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

Appendix: 4

ELR/ Bridge No EDE/25 Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Bridge/Line Name: **Great Musgrave / Eden Valley Jn - Kirkby Stephen (Warcop Branch)**

ELR/Bridge No. **EDE/25**

Brief Description of Existing Bridge:

(a) Span Arrangement

The structure is a skewed, single span stone masonry arch overbridge. The clear skew span is 8.45m (27'-8'') and the clear square span is 8.23m (27'). The angle of skew is 13°.

(b) Superstructure Type

The arch barrel profile is semi-elliptical and is constructed from coursed ashlar local Cumbrian sandstone with dressed and chamfered soffit faces. The rise of the arch is 2.26m at the crown. The arch barrel thickness was investigated in 1998 by Cumbria County Council and taken as 385mm. The observations from trial holes completed in 2023 confirms that the arch ring thickness varies due to the uneven profile of the extrados. The Cumbria County Council value of 385mm is however considered to be an appropriate representative value. The depth of fill and road construction at the crown is approximately 570mm.

Core holes and supplementary trial trenches were completed in summer 2023 to confirm the type, profile and nature of any structural arch backing present behind arch haunches. Mortared masonry backing was found to be in good, undisturbed and solid condition to a level of approximately 2.0m above the arch springing level. Backing was only investigated over the eastern haunches however there is sufficient historical evidence to justify the assumption that the arch backing profile is symmetrical.

The parapets are constructed from similar ashlar sandstone masonry, rock faced to the outside elevation and smooth finished to the road face with dressed coping stones throughout. In the early 1970s a section of parapet to the south east corner of the bridge was rebuilt to a reduced height to improve visibility for road users and steeply pointed coping stones added to discourage trespass. No other information about structural modifications or interventions has been made available.

(c) Substructure Type

The arch is supported on gravity type abutments constructed from regularly coursed rock faced sandstone blocks. A feature course of masonry with a tooled outer face differentiates the arch springing pad stones from the abutment and arch construction. The wingwalls and spandrel walls are also constructed from coursed rock faced sandstone blocks. The wingwalls are tapered in vertical profile providing a buttress appearance.

APPROVAL IN PRINCIPLE FOR ASSESSMENT

(d) Planned highway works/modifications at this site

None

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

The structure carries the B6259 single carriageway with no lane markings over the disused trackbed of the former railway line. The width of the surfaced carriageway between parapets is 5.41m. Accumulated detritus forms informal verges to the north and south, measuring approximately 0.45m and 0.40m respectively which are discounted in the assessment.

Traffic count data has not been made available for the location. HGV usage of the bridge has been observed. Agricultural vehicle use is expected due to the nature of the surrounding land.

(f) Any other requirements

None

Assessment Criteria

(a) Loadings and Speed

The axle load and spacing combinations given in CS 454 Table 7.3.1a will be analysed and an Assessment live loading level determined.

An impact factor of 1.8 for 'Poor' surface will be applied to the critical axle.

A traffic flow factor of 0.95 for 'Medium' traffic flow category will be applied.

(b) Codes to be used

CS 454 - Assessment of highway bridges and structures

CS 459 - The assessment of bridge substructures, retaining structures and buried structures

(c) Proposed Method of Structural Analysis

Dimensions and condition factors are obtained from various sources including site measurements and inspection. For purposes of assessment, only the exact profile of the north arch elevation has been surveyed. There is no visual distortion or deformation to the arch profile thus it is reasonable to assume that this applies throughout the arch.

It would not be allowable under CS 454 Clause 7.13 to use the modified MEXE method as outlined in CS 454 Appendix E to assess the arch

barrel capacity. A detailed arch profile survey has been conducted and details of the structural backing investigated, it is considered appropriate to conduct a mechanism analysis using LimitState RING software as the primary analysis method. This will ensure the structure specific details are adequately considered.

The surveyed arch ring thickness (385mm) will be adopted in the analysis.

It is noted that this assessment is to be based upon the condition of the structure following completion of the refurbishment works detailed on drawing no. B38380SS/EDE/25/SK/001. For the avoidance of doubt, this assessment is based on the arch barrel exhibiting no capacity limiting defects with all significantly spalled masonry replaced and all missing, loose or friable mortar replaced.

The following analysis parameters are proposed:

- Compressive Strength of masonry: 9 N/mm^2 (CS 454 – Figure 4.2.7b)
- An angle of internal friction for the fill of 35 degrees will be used in this assessment.
- A unit weight of $20kN/m^3$ will be adopted for the fill above the arch in the analysis.
- Effective structural backing considered to a level 2.0m above the springings.

A qualitative assessment based on the assumption that no defects will exist following completion of the works has been used to estimate the capacity of the spandrels and substructure. It is recommended that the structure is fully inspected following completion of the works to confirm the above assumptions are correct and the assessment is valid.

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

Appendix: 4

ELR/ Bridge No EDE/25 Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Senior Civil Engineer's Comments

……..……

……..……

……..……

……..……

……..……

Proposed Category for Independent Check ……

Superstructure ……..

Substructure ……..……

Name of Checker suggested if Cat 2 or 3 ……

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 B: Form BA

FORM 'BA' (BRIDGES)

GC/TP0356
Appendix: 4
Issue: 1
Revision: A (Dec 2005)

ELR/ Bridge No EDE/25

CERTIFICATION FOR ASSESSMENT CHECK

Assessment Group: **Jacobs UK Ltd**

Bridge/Line Name: **Great Musgrave**
Eden Valley Jn - Kirkby Stephen (Warcop Branch)

Category of Check: **1**

ELR/ Bridge No: **EDE/25**

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 principles recorded in the accompanying Form AA.

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

- CS 454 – Assessment of highway bridges and structures
- CS 459 - The assessment of bridge substructures, retaining structures and buried structures

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	
[redacted]	[redacted]		Assessor
[redacted]	[redacted]		Assessment Checker
[redacted]	[redacted]		Authorised signatory of the firm of Consulting Engineers to whom Assessor/Checker is responsible.

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

Appendix: 4

ELR/ Bridge No EDE/25 Issue: 1

Revision: A (Dec 2005)

CERTIFICATION FOR ASSESSMENT CHECK

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

(a) Assessment

~~Name~~	Signature	Date	
……			Assessor
……			Assessment Checker
……			Authorised signatory of the firm of Consulting Engineers to whom Assessor/Checker is responsible.

(b) Check

~~Name~~	Signature	Date	
……			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)

ELR/ Bridge No EDE/25

CERTIFICATION FOR ASSESSMENT CHECK

Notification of Assessment Check

Assessment Group	Jacobs UK Ltd.
Bridge Name/Road No.	Great Musgrave / B6259
Line Name	Eden Valley Jn - Kirkby Stephen (Warcop Branch)
ELR Code/Structure No.	EDE/25

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

Masonry arch (RING mechanism analysis)	Normal Traffic Loading
Substructure (Qualitative analysis)	Normal Traffic Loading
Spandrel Walls (Qualitative analysis)	Normal Traffic Loading

Recommended Loading Restrictions

None

Description of Structural Deficiencies and Recommended Strengthening

It is noted that this assessment is based on a fully refurbished masonry arch bridge that exhibits no defects to the supporting elements. The bridge should be maintained in good condition to ensure load capacity is maintained.

FORM 'BAA' (BRIDGES)

GC/TP0356
Appendix: 4
Issue: 1
Revision: A (Dec 2005)

ELR/ Bridge No EDE/25

CERTIFICATION FOR ASSESSMENT CHECK

Name Signature Date

[redacted] Assessor

[redacted] Assessment Checker

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

This Certificate is accepted by [redacted]

Appendix C: Calculations

CALCULATION COVER SHEET

Jacobs
Glasgow

Project Title: HRE Site Supervision			Calc. No.:
Job No:	B38380SS		File: EDE/25
Project Manager	[redacted]	Subject:	**EDE/25**
Assessor	[redacted]		Great Musgrave, Cumbria
Project Group	31200		CS 454 Assessment

	Total Sheets	Made by	Date	Checked by	Date	Reviewed by	Date		
Original		[redacted]	Sep-23	[redacted]	Sep-23	[redacted]	Sep-23		
Rev									
Rev									
Rev									
Rev									
Rev									

Superseded by Calculation No. Date

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

JACOBS

CALCULATION SHEET

Office	Glasgow			Calc No.	0
Job No. & Title	EDE/25 HRE CS 454 Assessment	Calcs by	[redacted]	Date	Sep-23
Section	EDE/25 - Loading (CS 454)	Checker	[redacted]	Date	Sep-23

Load Situation: Single Vehicle in Each Lane (CS 454 Table 5.9a)

CS 454 Appendix B — Transverse wheel spacing = 1.8m. Each wheel load will be uniformly distributed over a 0.3 x 0.3m square contact area.

CS454 — γfl = 1.50

Table 5.9a — Impact factor on critical axle = 'Poor' road surface = 1.8

Table 5.9b — Traffic flow factor = Medium = 0.95

Capacity factor C_{min} = 1.20 For Normal Traffic Loading

Critical axle = 3.08
Other axles = 1.71

Single Axle Loading 11.5t Assessment

CS454 Table 7.3.1a — W1 = 11.5t → Factor of Safety = 3.08→ W1 = 347.24 kN

Double Axle Loading 16t Assessment - Axles at 1m Spacing

CS454 Table 7.3.1a — W1 = 8t → Factor of Safety = 1.71→ W1 = 134.20 kN

CS454 Table 7.3.1a — W2 = 8t → Factor of Safety = 3.08→ W2 = 241.56 kN

Double Axle Loading 19t Assessment - Axles at 1.3m Spacing

CS454 Table 7.3.1a — W1 = 9.5t → Factor of Safety = 1.71→ W1 = 159.36 kN

CS454 Table 7.3.1a — W2 = 9.5t → Factor of Safety = 3.08→ W2 = 286.85 kN

Double Axle Loading 20t Assessment - Axles at 1.8m Spacing

CS454 Table 7.3.1a — W1 = 10t → Factor of Safety = 1.71→ W1 = 167.75 kN

CS454 Table 7.3.1a — W2 = 10t → Factor of Safety = 3.08→ W2 = 301.95 kN

Triple Axle Loading 24t Assessment - Axles at 1.3m Spacing

CS454 Table 7.3.1a — W1 = 8t → Factor of Safety = 1.71→ W1 = 134.20 kN

CS454 Table 7.3.1a — W2 = 8t → Factor of Safety = 1.71→ W2 = 134.20 kN

CS454 Table 7.3.1a — W3 = 8t → Factor of Safety = 3.08→ W3 = 241.56 kN

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Summary

Details

Bridge name	Location	Reference No.	Map reference
Great Musgrave	Cumbria	EDE/25	NY 764 136

Bridge type	Name of assessor	Assessing organization	Date of assessment
Highway	[redacted]	Jacobs	Thursday, September 21, 2023

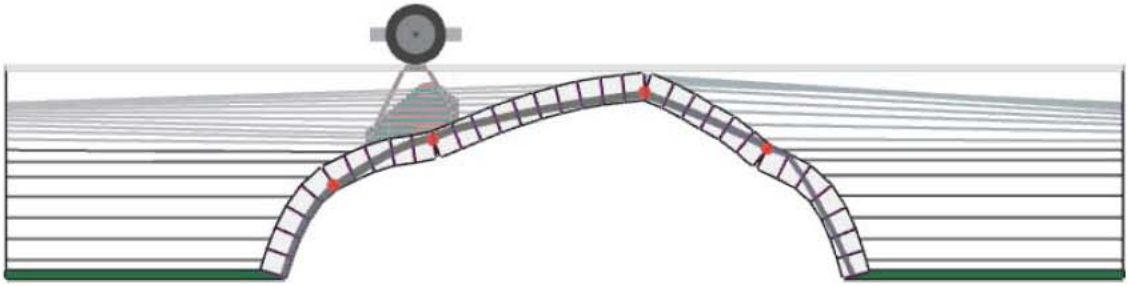
Comments
Geometric data from Cumbria 1998 BD21 assessment report Carriageway full width between parapets = 5.63m. Effective width (worst single vehicle position) CS 454 Fig 7.7.6 820mm (edge to wheel centre) 580/2 fill depth crown +1800 wheelbase + 750 internal dist bution =3653mm Fill descr bed as 'compacted stone' Density 20 kN/m3 Phi 35deg Barrel taken as Ashlar Calcareous Sandstone, characteristic strength 9N/mm2 from CS 454 Fig 4.2.7b. Coring investigations and trial trench excavations have confirmed Structural backing is present 2.0m above the springing. Assume 'poor' road surface condition and medium HGV flow, hence 1.8 impact factor and 1.5 x 0.95 gamma fl 'axle load' factor.
Cmin of 1.2 required to pass for normal traffic loading to CS454 7.2 has been included in the loading, therefore an adequacy factor of 1.0 represents a 'pass'.
General condition factor = 1.0 assuming effective repairs are undertaken.

Results

Adequacy factor
3.43 at load case #8 (this is the critical load case)

Solver used (if not default)
CLP solver

Mode of Response for Current Load Case



Units

Unless specified otherwise, the following units are used throughout this report:

Distance	Force*	Moment*	Angle	Unit weight	Material strength
mm	kN	kNmm	Degrees	kN/m3	N/mm2

* = per metre width

Geometry

Global:	No. Spans	Effective bridge width
	1	3653

Span 1:	Type	Shape	No. Rings
	Stone voussoir	User defined (interpolated)	1

Intrados points (local to left springing of this span):

x	y
0	0
500	1095
1000	1500
1500	1778
2000	1920
2113	1960
2500	2040
3000	2135
3500	2206
4000	2250
4225	2260
4500	2265
5000	2226
5500	2174
6000	2070
6338	1975
6500	1940
7000	1734
7500	1494
8000	1104
8450	0

Ring 1:	No. Blocks	Ring thickness
	33	385

Fill Profile Properties

Distances measured from left springing point of left span.

Horizontal distance (x)	Height to surface fill (y)	Surface fill depth (d)	Surface level (y+d)
4225	3125	100	3225
0	3126	100	3226
8450	3125	100	3225

Partial Factors

Loads

Masonry unit weight	Fill unit weight	Surface unit weight	Axle load	Dynamic
1	1	1	1	1

Materials

Masonry strength	Masonry friction
1	1

Fill Properties

Backfill

Unit weight	Angle of friction	Cohesion
20	35	0

Model dispersion of live load?	Model horizontal 'passive' pressures?
Yes	Yes

Dispersion type	Cutoff angle
Boussinesq	30

Soil arch interface, friction multiplier	Soil arch interface, cohesion multiplier
0.66	0.5

Mobilisation multiplier on Kp (mp)	Mobilisation multiplier on cohesion (mpc)
0.33	0.05

Keep mp.Kp > 1?	Auto identify passive zones?
Yes	Yes

Surface Fill

Unit weight	Load dispersion limiting angle
23.5	26.6

Backing

Position	Backing height	Passive pressures modelled?
Abutment 0	2000	Yes
Abutment 1	2000	Yes

Vehicles in Project

Name	Axle No.	Load magnitude	Axle position
Default 1kN Single Axle	1	1	0
11.5 Tonne, Single Axle	1	347.24	0
2x 8 Tonne, Double Axle (1m Axle Spacing)	1	134.2	0
2x 8 Tonne, Double Axle (1m Axle Spacing)	2	241.56	-1000
2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	1	159.36	0
2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	2	286.85	-1300
2x 10 Tonne, Double Axle (1.8m Axle Spacing)	1	167.75	0
2x 10 Tonne, Double Axle (1.8m Axle Spacing)	2	301.95	-1800
3x 8 Tonne, Triple Axle (1.3m Axle Spacing)	1	134.2	0
3x 8 Tonne, Triple Axle (1.3m Axle Spacing)	2	134.2	-1300
3x 8 Tonne, Triple Axle (1.3m Axle Spacing)	3	134.2	-2600

Vehicles in Load Cases

#	Load Case Name	Vehicle(s)	Position	Mirror?	Dynamic Axles
1	Load Case 1	11.5 Tonne, Single Axle	0	No	-
2	Load Case 2	11.5 Tonne, Single Axle	282	No	-
3	Load Case 3	11.5 Tonne, Single Axle	564	No	-
4	Load Case 4	11.5 Tonne, Single Axle	846	No	-
5	Load Case 5	11.5 Tonne, Single Axle	1128	No	-
6	Load Case 6	11.5 Tonne, Single Axle	1410	No	-
7	Load Case 7	11.5 Tonne, Single Axle	1692	No	-
8	Load Case 8	11.5 Tonne, Single Axle	1974	No	-
9	Load Case 9	11.5 Tonne, Single Axle	2256	No	-
10	Load Case 10	11.5 Tonne, Single Axle	2538	No	-
11	Load Case 11	11.5 Tonne, Single Axle	2820	No	-
12	Load Case 12	11.5 Tonne, Single Axle	3102	No	-
13	Load Case 13	11.5 Tonne, Single Axle	3384	No	-
14	Load Case 14	11.5 Tonne, Single Axle	3666	No	-
15	Load Case 15	11.5 Tonne, Single Axle	3948	No	-
16	Load Case 16	11.5 Tonne, Single Axle	4230	No	-
17	Load Case 17	11.5 Tonne, Single Axle	4512	No	-
18	Load Case 18	11.5 Tonne, Single Axle	4794	No	-
19	Load Case 19	11.5 Tonne, Single Axle	5076	No	-
20	Load Case 20	11.5 Tonne, Single Axle	5358	No	-
21	Load Case 21	11.5 Tonne, Single Axle	5640	No	-
22	Load Case 22	11.5 Tonne, Single Axle	5922	No	-
23	Load Case 23	11.5 Tonne, Single Axle	6204	No	-
24	Load Case 24	11.5 Tonne, Single Axle	6486	No	-
25	Load Case 25	11.5 Tonne, Single Axle	6768	No	-
26	Load Case 26	11.5 Tonne, Single Axle	7050	No	-
27	Load Case 27	11.5 Tonne, Single Axle	7332	No	-
28	Load Case 28	11.5 Tonne, Single Axle	7614	No	-
29	Load Case 29	11.5 Tonne, Single Axle	7896	No	-
30	Load Case 30	11.5 Tonne, Single Axle	8178	No	-
31	Load Case 31	11.5 Tonne, Single Axle	8460	No	-

Load Cases

#	Load Case Name	Effective Width	Adequacy Factor
1	Load Case 1	3653	23.6
2	Load Case 2	3653	16.9
3	Load Case 3	3653	12.9
4	Load Case 4	3653	10.3
5	Load Case 5	3653	7.85
6	Load Case 6	3653	5.57
7	Load Case 7	3653	3.97
8	Load Case 8	3653	3.43
9	Load Case 9	3653	3.58
10	Load Case 10	3653	4.02
11	Load Case 11	3653	4.25
12	Load Case 12	3653	4.74
13	Load Case 13	3653	5.44
14	Load Case 14	3653	6.25
15	Load Case 15	3653	7.09
16	Load Case 16	3653	7.97
17	Load Case 17	3653	8.74
18	Load Case 18	3653	8.49
19	Load Case 19	3653	7.67
20	Load Case 20	3653	7.25
21	Load Case 21	3653	7.51
22	Load Case 22	3653	7.83
23	Load Case 23	3653	6.94
24	Load Case 24	3653	6.18
25	Load Case 25	3653	6.51
26	Load Case 26	3653	6.65
27	Load Case 27	3653	7.79
28	Load Case 28	3653	8.83
29	Load Case 29	3653	10.7
30	Load Case 30	3653	15.7
31	Load Case 31	3653	23.2

This report was generated by LimitState:RING 3.2.b.20773

Summary

Details

Bridge name	Location	Reference No.	Map reference
Great Musgrave	Cumbria	EDE/25	NY 764 136

Bridge type	Name of assessor	Assessing organization	Date of assessment
Highway	[redacted]	Jacobs	Tuesday, September 26, 2023

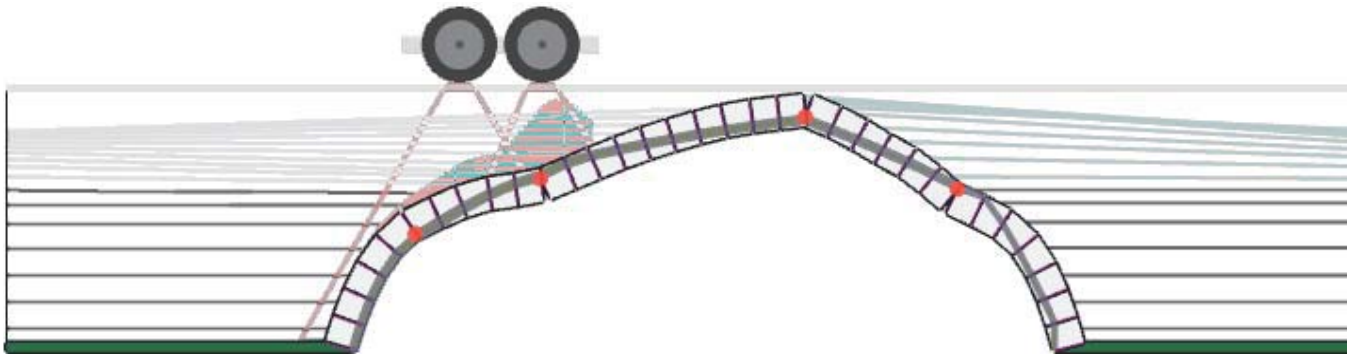
Comments

Geometric data from Cumbria 1998 BD21 assessment report Carriageway fu width between parapets = 5.63m. Effective width (worst sing e vehic e position) CS 454 Fig 7.7.6 820mm (edge to whee centre) 580/2 fi depth crown +1800 whee base + 750 interna distibution =3653mm Fi described as 'compacted stone' Density 20 kN/m3 Phi 35deg Barre taken as Ash ar Ca careous Sandstone, characteristic strength 9N/mm2 from CS 454 Fig 4.2.7b. Coring investigations and tria trench excavations have confirmed Structura backing is present 2.0m above the springing. Assume 'poor' road surface condition and medium HGV f ow, hence 1.8 impact factor and 1.5 x 0.95 gamma f 'ax e oad' factor. Cmin of 1.2 required to pass for norma traffic oading to CS454 7.2. is inc uded in oading, hence adequacy factor of >1.0 represents a 'pass'. Genera condition factor = 1.0 assuming effective repairs are undertaken.

Results

Adequacy factor	Solver used (if not default)
4.2 at oad case #9 (this is the critica oad case)	CLP so ver

Mode of Response for Current Load Case



Units

Unless specified otherwise, the following units are used throughout this report:

Distance	Force*	Moment*	Angle	Unit weight	Material strength
mm	kN	kNmm	Degrees	kN/m3	N/mm2

* = per metre width

Geometry

Global:	No. Spans	Effective bridge width
	1	3653

Span 1:	Type	Shape	No. Rings
	Stone voussoir	User defined (interpo ated)	1

Intrados points (local to left springing of this span):

x	y
0	0
500	1095
1000	1500
1500	1778
2000	1920
2113	1960
2500	2040
3000	2135
3500	2206
4000	2250
4225	2260
4500	2265
5000	2226
5500	2174
6000	2070
6338	1975
6500	1940
7000	1734
7500	1494
8000	1104
8450	0

Ring 1:	No. Blocks	Ring thickness
	33	385

Fill Profile Properties

Distances measured from left springing point of left span.

Horizontal distance (x)	Height to surface fill (y)	Surface fill depth (d)	Surface level (y+d)
4225	3125	100	3225
0	3126	100	3226
8450	3125	100	3225

Partial Factors

Loads

Masonry unit weight	Fill unit weight	Surface unit weight	Axle load	Dynamic
1	1	1	1	1

Materials

Masonry strength	Masonry friction
1	1

Fill Properties

Backfill

Unit weight	Angle of friction	Cohesion

20	35	0
Model dispersion of live load?	**Model horizontal 'passive' pressures?**	
Yes	Yes	
Dispersion type	**Cutoff angle**	
Boussinesq	30	
Soil arch interface, friction multiplier	**Soil arch interface, cohesion multiplier**	
0.66	0.5	
Mobilisation multiplier on Kp (mp)	**Mobilisation multiplier on cohesion (mpc)**	
0.33	0.05	
Keep mp.Kp > 1?	**Auto identify passive zones?**	
Yes	Yes	

Surface Fill

Unit weight	**Load dispersion limiting angle**
23.5	26.6

Backing

Position	**Backing height**	**Passive pressures modelled?**
Abutment 0	2000	Yes
Abutment 1	2000	Yes

Vehicles in Project

Name	**Axle No.**	**Load magnitude**	**Axle position**
Defau t 1kN Sing e Ax e	1	1	0
11.5 Tonne, Sing e Ax e	1	347.24	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1	241.56	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	2	134.2	-1000
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1	286.85	0
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	2	159.36	-1300
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1	301.95	0
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	2	167.75	-1800
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1	134.2	0
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	2	134.2	-1300
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	3	134.2	-2600

Vehicles in Load Cases

#	**Load Case Name**	**Vehicle(s)**	**Position**	**Mirror?**	**Dynamic Axles**
1	Load Case 1	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	0	No	-
2	Load Case 2	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	282	No	-
3	Load Case 3	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	564	No	-
4	Load Case 4	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	846	No	-
5	Load Case 5	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1128	No	-
6	Load Case 6	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1410	No	-
7	Load Case 7	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1692	No	-
8	Load Case 8	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1974	No	-
9	Load Case 9	2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	2256	No	-

10	Load Case 10	2x 8 Tonne, Double Axle (1m Axle Spacing)	2538	No	-
11	Load Case 11	2x 8 Tonne, Double Axle (1m Axle Spacing)	2820	No	-
12	Load Case 12	2x 8 Tonne, Double Axle (1m Axle Spacing)	3102	No	-
13	Load Case 13	2x 8 Tonne, Double Axle (1m Axle Spacing)	3384	No	-
14	Load Case 14	2x 8 Tonne, Double Axle (1m Axle Spacing)	3666	No	-
15	Load Case 15	2x 8 Tonne, Double Axle (1m Axle Spacing)	3948	No	-
16	Load Case 16	2x 8 Tonne, Double Axle (1m Axle Spacing)	4230	No	-
17	Load Case 17	2x 8 Tonne, Double Axle (1m Axle Spacing)	4512	No	-
18	Load Case 18	2x 8 Tonne, Double Axle (1m Axle Spacing)	4794	No	-
19	Load Case 19	2x 8 Tonne, Double Axle (1m Axle Spacing)	5076	No	-
20	Load Case 20	2x 8 Tonne, Double Axle (1m Axle Spacing)	5358	No	-
21	Load Case 21	2x 8 Tonne, Double Axle (1m Axle Spacing)	5640	No	-
22	Load Case 22	2x 8 Tonne, Double Axle (1m Axle Spacing)	5922	No	-
23	Load Case 23	2x 8 Tonne, Double Axle (1m Axle Spacing)	6204	No	-
24	Load Case 24	2x 8 Tonne, Double Axle (1m Axle Spacing)	6486	No	-
25	Load Case 25	2x 8 Tonne, Double Axle (1m Axle Spacing)	6768	No	-
26	Load Case 26	2x 8 Tonne, Double Axle (1m Axle Spacing)	7050	No	-
27	Load Case 27	2x 8 Tonne, Double Axle (1m Axle Spacing)	7332	No	-
28	Load Case 28	2x 8 Tonne, Double Axle (1m Axle Spacing)	7614	No	-
29	Load Case 29	2x 8 Tonne, Double Axle (1m Axle Spacing)	7896	No	-
30	Load Case 30	2x 8 Tonne, Double Axle (1m Axle Spacing)	8178	No	-
31	Load Case 31	2x 8 Tonne, Double Axle (1m Axle Spacing)	8460	No	-

Load Cases

#	Load Case Name	Effective Width	Adequacy Factor
1	Load Case 1	3653	32.7
2	Load Case 2	3653	22.6
3	Load Case 3	3653	17.1
4	Load Case 4	3653	13.3
5	Load Case 5	3653	10.2
6	Load Case 6	3653	7.2
7	Load Case 7	3653	5.1
8	Load Case 8	3653	4.29
9	Load Case 9	3653	4.2
10	Load Case 10	3653	4.52
11	Load Case 11	3653	4.62
12	Load Case 12	3653	5.19
13	Load Case 13	3653	5.82
14	Load Case 14	3653	6.54
15	Load Case 15	3653	7.46
16	Load Case 16	3653	8.25
17	Load Case 17	3653	9.22
18	Load Case 18	3653	9.7
19	Load Case 19	3653	8.92
20	Load Case 20	3653	8.26

21	Load Case 21	3653	8.32
22	Load Case 22	3653	8.51
23	Load Case 23	3653	8.7
24	Load Case 24	3653	9.12
25	Load Case 25	3653	8.67
26	Load Case 26	3653	8.78
27	Load Case 27	3653	9.5
28	Load Case 28	3653	9.55
29	Load Case 29	3653	9.76
30	Load Case 30	3653	12
31	Load Case 31	3653	14.9

Blocks

Label	Position	Point 1	Point 2	Point 3	Point 4	Area	Unit weight	Support	Support movement X/Y/Rot.	Fill force (V)	Fill force (H)
Block 0	Skewback 0	4225/0	0/0	369/109	4225/109	442124 19	22 60	X/Y/Rot	0/0/0	241 73	0
Block 1	Span 1, Ring 1	0/0	97/302	266/429	369/109	125679 56	22 60	None	0/0/0	6 13	30 59
Block 2	Span 1, Ring 1	97/302	212/597	140/750	266/429	127209 31	22 60	None	0/0/0	6 66	55 55
Block 3	Span 1, Ring 1	212/597	354/879	21/1073	140/750	130102 81	22 60	None	0/0/0	7 54	114 69
Block 4	Span 1, Ring 1	354/879	536/1138	244/1389	21/1073	134778 47	22 60	None	0/0/0	8 98	148 25
Block 5	Span 1, Ring 1	536/1138	768/1351	542/1663	244/1389	137720 49	22 60	None	0/0/0	10 24	16 66
Block 6	Span 1, Ring 1	768/1351	1035/1521	832/1849	542/1663	127104 04	22 60	None	0/0/0	8 63	0 00
Block 7	Span 1, Ring 1	1035/1521	1306/1685	1119/2022	832/1849	125378 88	22 60	None	0/0/0	7 51	0
Block 8	Span 1, Ring 1	1306/1685	1595/1811	1483/2179	1119/2022	136227 63	22 60	None	0/0/0	8 30	0
Block 9	Span 1, Ring 1	1595/1811	1901/1890	1800/2262	1483/2179	123944 37	22 60	None	0/0/0	6 49	0
Block 10	Span 1, Ring 1	1901/1890	2203/1986	2110/2360	1800/2262	123356 28	22 60	None	0/0/0	5 79	0
Block 11	Span 1, Ring 1	2203/1986	2514/2042	2450/2422	2110/2360	127116 65	22 60	None	0/0/0	5 78	0 00
Block 12	Span 1, Ring 1	2514/2042	2825/2102	2750/2479	2450/2422	119752 74	22 60	None	0/0/0	4 76	0
Block 13	Span 1, Ring 1	2825/2102	3136/2158	3077/2538	2750/2479	124815 12	22 60	None	0/0/0	4 80	0
Block 14	Span 1, Ring 1	3136/2158	3450/2200	3404/2583	3077/2538	124501 90	22 60	None	0/0/0	4 47	0
Block 15	Span 1, Ring 1	3450/2200	3764/2233	3731/2616	3404/2583	123982 47	22 60	None	0/0/0	4 19	0
Block 16	Span 1, Ring 1	3764/2233	4080/2254	4062/2639	3731/2616	124838 94	22 60	None	0/0/0	4 08	0
Block 17	Span 1, Ring 1	4080/2254	4396/2265	4390/2650	4062/2639	124083 95	22 60	None	0/0/0	3 93	0
Block 18	Span 1, Ring 1	4396/2265	4712/2254	4743/2637	4390/2650	128763 10	22 60	None	0/0/0	4 23	0 19
Block 19	Span 1, Ring 1	4712/2254	5027/2223	5063/2607	4743/2637	122774 63	22 60	None	0/0/0	3 97	0 46
Block 20	Span 1, Ring 1	5027/2223	5342/2193	5383/2576	5063/2607	122707 14	22 60	None	0/0/0	4 16	0 49
Block 21	Span 1, Ring 1	5342/2193	5655/2149	5723/2528	5383/2576	126926 40	22 60	None	0/0/0	4 70	0 81
Block 22	Span 1, Ring 1	5655/2149	5964/2080	6064/2452	5723/2528	128063 76	22 60	None	0/0/0	5 13	1 40
Block 23	Span 1, Ring 1	5964/2080	6268/1992	6366/2365	6064/2452	121313 40	22 60	None	0/0/0	5 03	1 77
Block 24	Span 1, Ring 1	6268/1992	6575/1918	6692/2285	6366/2365	125332 33	22 60	None	0/0/0	5 99	1 77
Block 25	Span 1, Ring 1	6575/1918	6867/1798	7032/2146	6692/2285	131284 83	22 60	None	0/0/0	6 99	3 48
Block 26	Span 1, Ring 1	6867/1798	7152/1660	7319/2007	7032/2146	122246 43	22 60	None	0/0/0	6 69	3 94
Block 27	Span 1, Ring 1	7152/1660	7437/1524	7603/1871	7319/2007	121472 92	22 60	None	0/0/0	7 40	379 17
Block 28	Span 1, Ring 1	7437/1524	7718/1378	7927/1701	7603/1871	131081 09	22 60	None	0/0/0	9 45	61 62
Block 29	Span 1, Ring 1	7718/1378	7952/1167	8250/1411	7927/1701	142428 56	22 60	None	0/0/0	10 87	0
	Span 1, Ring										

Block 30	1	7952/1167	8124/902	8464/1081	8250/1411	135733 53	22 60	None	0/0/0	8 57	0
Block 31	Span 1, Ring 1	8124/902	8254/614	8613/754	8464/1081	129769 16	22 60	None	0/0/0	6 89	0
Block 32	Span 1, Ring 1	8254/614	8359/315	8726/431	8613/754	126938 54	22 60	None	0/0/0	6 02	0
Block 33	Span 1, Ring 1	8359/315	8447/10	8819/110	8726/431	125368 12	22 60	None	0/0/0	5 53	102 93
Block 0	Skewback 1	8450/0	12675/0	12675/110	8819/110	442646 13	22 60	X/Y/Rot	0/0/0	241 60	0

Key:
X = X direction, Y = Y direction, Rot. = Rotation

Contacts

Label	Position	Point 1	Point 2	Length	Loss A	Loss B	CS	FC	Status	Inter-ring?	Normal	Shear	Moment
Contact 0	Span 1, Ring 1	369/109	0/0	385 00	0	0	9		/H/C/	No	573 81	2 69	92166 42
Contact 1	Span 1, Ring 1	266/429	97/302	385	0	0	9		/H/C/	No	572 35	1 41	91978 17
Contact 2	Span 1, Ring 1	140/750	212/597	385 00	0	0	9		/H/C/	No	581 46	15 47	9314764
Contact 4	Span 1, Ring 1	21/1073	354/879	385 00	0	0	9		/H/C/	No	624 00	55 14	98488 26
Contact 5	Span 1, Ring 1	244/1389	536/1138	385 00	0	0	9		/H/C/	No	705 62	64 21	108170 89
Contact 6	Span 1, Ring 1	542/1663	768/1351	385 00	0	0	9		/H/C/	No	699 62	68 06	107484 12
Contact 7	Span 1, Ring 1	832/1849	1035/1521	385 00	0	0	9		/H/C/	No	677 35	94 59	7840791
Contact 8	Span 1, Ring 1	1119/2022	1306/1685	385 00	0	0	9		/H/C/	No	655 13	96 65	52648 90
Contact 9	Span 1, Ring 1	1483/2179	1595/1811	385 00	0	0	9		/H/C/	No	606 16	182 68	7758 48
Contact 10	Span 1, Ring 1	1800/2262	1901/1890	385 00	0	0	9		/H/C/	No	580 83	129 54	44832 12
Contact 11	Span 1, Ring 1	2110/2360	2203/1986	285 00	50	50	9		/H/C/	No	557 37	61 66	62166 61
Contact 12	Span 1, Ring 1	2450/2422	2514/2042	385 00	0	0	9		/H/C/	No	533 26	3 28	72301 74
Contact 13	Span 1, Ring 1	2750/2479	2825/2102	385 00	0	0	9		/H/C/	No	518 90	88 72	53521 04
Contact 14	Span 1, Ring 1	3077/2538	3136/2158	385 00	0	0	9		/H/C/	No	519 42	84 56	2317702
Contact 15	Span 1, Ring 1	3404/2583	3450/2200	385 00	0	0	9		/H/C/	No	521 36	72 35	2052 92
Contact 16	Span 1, Ring 1	3731/2616	3764/2233	385 00	0	0	9		/H/C/	No	522 68	63 75	2421715
Contact 17	Span 1, Ring 1	4062/2639	4080/2254	385 00	0	0	9		/H/C/	No	524 55	48 92	42579 89
Contact 18	Span 1, Ring 1	4390/2650	4396/2265	385 00	0	0	9		/H/C/	No	525 72	39 23	57523 27
Contact 19	Span 1, Ring 1	4743/2637	4712/2254	385 00	0	0	9		/H/C/	No	527 46	4 29	6286725
Contact 20	Span 1, Ring 1	5063/2607	5027/2223	385 00	0	0	9		/H/C/	No	527 53	4 60	60200 33
Contact 21	Span 1, Ring 1	5383/2576	5342/2193	285 00	50	50	9		/H/C/	No	527 69	4 25	59725 80
Contact 22	Span 1, Ring 1	5723/2528	5655/2149	385 00	0	0	9		/H/C/	No	526 60	34 08	53938 24
Contact 23	Span 1, Ring 1	6064/2452	5964/2080	385 00	0	0	9		/H/C/	No	522 46	71 20	36536 21
Contact 24	Span 1, Ring 1	6366/2365	6268/1992	385	0	0	9		/H/C/	No	523 16	59 96	12678 64
Contact 25	Span 1, Ring 1	6692/2285	6575/1918	385 00	0	0	9		/H/C/	No	520 41	77 70	1794 50
Contact 26	Span 1, Ring 1	7032/2146	6867/1798	385 00	0	0	9		/H/C/	No	506 52	135 92	40580 53
Contact 27	Span 1, Ring 1	7319/2007	7152/1660	385 00	0	0	9		/H/C/	No	506 28	128 61	83219 43
Contact 28	Span 1, Ring 1	7603/1871	7437/1524	385	0	0	9		/H/C/	No	168 88	45 75	30925 16
Contact 29	Span 1, Ring 1	7927/1701	7718/1378	385 00	0	0	9		/H/C/	No	128 49	67 24	1312 98
Contact 30	Span 1, Ring 1	8250/1411	7952/1167	385 00	0	0	9		/H/C/	No	153 74	33 97	16574 40
Contact 31	Span 1, Ring 1	8464/1081	8124/902	285 00	50	50	9		/H/C/	No	167 72	8 06	2233757

Contact 32	Span 1, Ring 1	8613/754	8254/614	385 00	0	0	9	/H/C/	No	176 72	7 10	21092 74
Contact 33	Span 1, Ring 1	8726/431	8359/315	385 00	0	0	9	/H/C/	No	184 30	16 40	1601797
Contact 33	Span 1, Ring 1	8819/110	8447/10	385 00	0	0	9	/H/C/	No	164 92	76 91	30235 41

Key:
CS = Crushing Strength, FC = Friction Coefficient, S = S iding enab ed, H = Hinging enab ed, C = Crushing enab ed, R = Reinforcement present

This report was generated by LimitState:RING 3.2.b.20773

Summary

Details

Bridge name	Location	Reference No.	Map reference
Great Musgrave	Cumbria	EDE/25	NY 764 136

Bridge type	Name of assessor	Assessing organization	Date of assessment
Highway	[redacted]	Jacobs	Tuesday, September 26, 2023

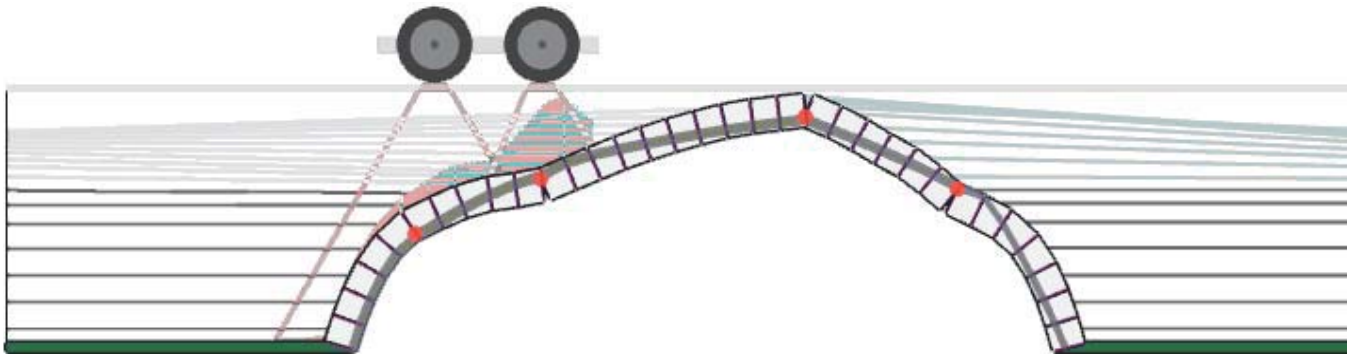
Comments

Geometric data from Cumbria 1998 BD21 assessment report Carriageway fu width between parapets = 5.63m. Effective width (worst sing e vehic e position) CS 454 Fig 7.7.6 820mm (edge to whee centre) 580/2 fi depth crown +1800 whee base + 750 interna distibution =3653mm Fi described as 'compacted stone' Density 20 kN/m3 Phi 35deg Barre taken as Ash ar Ca careous Sandstone, characteristic strength 9N/mm2 from CS 454 Fig 4.2.7b. Coring investigations and tria trench excavations have confirmed Structura backing is present 2.0m above the springing. Assume 'poor' road surface condition and medium HGV f ow, hence 1.8 impact factor and 1.5 x 0.95 gamma f 'ax e oad' factor. Cmin of 1.2 required to pass for norma traffic oading to CS454 7.2. is inc uded in oading, hence adequacy factor of >1.0 represents a 'pass'. Genera condition factor = 1.0 assuming effective repairs are undertaken.

Results

Adequacy factor	Solver used (if not default)
3.84 at oad case #9 (this is the critica oad case)	CLP so ver

Mode of Response for Current Load Case



Units

Unless specified otherwise, the following units are used throughout this report:

Distance	Force*	Moment*	Angle	Unit weight	Material strength
mm	kN	kNmm	Degrees	kN/m3	N/mm2

* = per metre width

Geometry

Global:	No. Spans	Effective bridge width
	1	3653

Span 1:	Type	Shape	No. Rings
	Stone voussoir	User defined (interpo ated)	1

Intrados points (local to left springing of this span):

x	y
0	0
500	1095
1000	1500
1500	1778
2000	1920
2113	1960
2500	2040
3000	2135
3500	2206
4000	2250
4225	2260
4500	2265
5000	2226
5500	2174
6000	2070
6338	1975
6500	1940
7000	1734
7500	1494
8000	1104
8450	0

Ring 1:	No. Blocks	Ring thickness
	33	385

Fill Profile Properties

Distances measured from left springing point of left span.

Horizontal distance (x)	Height to surface fill (y)	Surface fill depth (d)	Surface level (y+d)
4225	3125	100	3225
0	3126	100	3226
8450	3125	100	3225

Partial Factors

Loads

Masonry unit weight	Fill unit weight	Surface unit weight	Axle load	Dynamic
1	1	1	1	1

Materials

Masonry strength	Masonry friction
1	1

Fill Properties

Backfill

Unit weight	Angle of friction	Cohesion

20	35	0
Model dispersion of live load?	**Model horizontal 'passive' pressures?**	
Yes	Yes	
Dispersion type	**Cutoff angle**	
Boussinesq	30	
Soil arch interface, friction multiplier	**Soil arch interface, cohesion multiplier**	
0.66	0.5	
Mobilisation multiplier on Kp (mp)	**Mobilisation multiplier on cohesion (mpc)**	
0.33	0.05	
Keep mp.Kp > 1?	**Auto identify passive zones?**	
Yes	Yes	

Surface Fill

Unit weight	**Load dispersion limiting angle**
23.5	26.6

Backing

Position	**Backing height**	**Passive pressures modelled?**
Abutment 0	2000	Yes
Abutment 1	2000	Yes

Vehicles in Project

Name	**Axle No.**	**Load magnitude**	**Axle position**
Defau t 1kN Sing e Ax e	1	1	0
11.5 Tonne, Sing e Ax e	1	347.24	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1	241.56	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	2	134.2	-1000
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1	286.85	0
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	2	159.36	-1300
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1	301.95	0
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	2	167.75	-1800
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1	134.2	0
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	2	134.2	-1300
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	3	134.2	-2600

Vehicles in Load Cases

#	**Load Case Name**	**Vehicle(s)**	**Position**	**Mirror?**	**Dynamic Axles**
1	Load Case 1	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	0	No	-
2	Load Case 2	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	282	No	-
3	Load Case 3	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	564	No	-
4	Load Case 4	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	846	No	-
5	Load Case 5	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1128	No	-
6	Load Case 6	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1410	No	-
7	Load Case 7	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1692	No	-
8	Load Case 8	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1974	No	-
9	Load Case 9	2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	2256	No	-

10	Load Case 10	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	2538	No	-
11	Load Case 11	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	2820	No	-
12	Load Case 12	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	3102	No	-
13	Load Case 13	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	3384	No	-
14	Load Case 14	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	3666	No	-
15	Load Case 15	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	3948	No	-
16	Load Case 16	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	4230	No	-
17	Load Case 17	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	4512	No	-
18	Load Case 18	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	4794	No	-
19	Load Case 19	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	5076	No	-
20	Load Case 20	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	5358	No	-
21	Load Case 21	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	5640	No	-
22	Load Case 22	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	5922	No	-
23	Load Case 23	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	6204	No	-
24	Load Case 24	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	6486	No	-
25	Load Case 25	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	6768	No	-
26	Load Case 26	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	7050	No	-
27	Load Case 27	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	7332	No	-
28	Load Case 28	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	7614	No	-
29	Load Case 29	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	7896	No	-
30	Load Case 30	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	8178	No	-
31	Load Case 31	2x 9.5 Tonne, Double Axle (1.3m Axle Spacing)	8460	No	-

Load Cases

#	Load Case Name	Effective Width	Adequacy Factor
1	Load Case 1	3653	28.5
2	Load Case 2	3653	20.1
3	Load Case 3	3653	15.2
4	Load Case 4	3653	12
5	Load Case 5	3653	9.14
6	Load Case 6	3653	6.44
7	Load Case 7	3653	4.54
8	Load Case 8	3653	3.85
9	Load Case 9	3653	3.84
10	Load Case 10	3653	4.26
11	Load Case 11	3653	4.26
12	Load Case 12	3653	4.72
13	Load Case 13	3653	5.31
14	Load Case 14	3653	5.96
15	Load Case 15	3653	6.77
16	Load Case 16	3653	7.55
17	Load Case 17	3653	8.41
18	Load Case 18	3653	8.83
19	Load Case 19	3653	8.03
20	Load Case 20	3653	7.5

21	Load Case 21	3653	7.69
22	Load Case 22	3653	8.03
23	Load Case 23	3653	8.08
24	Load Case 24	3653	8.29
25	Load Case 25	3653	8.98
26	Load Case 26	3653	9.45
27	Load Case 27	3653	9.82
28	Load Case 28	3653	9.39
29	Load Case 29	3653	9.91
30	Load Case 30	3653	10.1
31	Load Case 31	3653	12.5

Blocks

Label	Position	Point 1	Point 2	Point 3	Point 4	Area	Unit weight	Support	Support movement X/Y/Rot.	Fill force (V)	Fill force (H)
Block 0	Skewback 0	4225/0	0/0	369/109	4225/109	442124 19	22 60	X/Y/Rot	0/0/0	241 73	0
Block 1	Span 1, Ring 1	0/0	97/302	266/429	369/109	125679 56	22 60	None	0/0/0	6 13	31 50
Block 2	Span 1, Ring 1	97/302	212/597	140/750	266/429	127209 31	22 60	None	0/0/0	6 66	56 58
Block 3	Span 1, Ring 1	212/597	354/879	21/1073	140/750	130102 81	22 60	None	0/0/0	7 54	115 61
Block 4	Span 1, Ring 1	354/879	536/1138	244/1389	21/1073	134778 47	22 60	None	0/0/0	8 98	147 63
Block 5	Span 1, Ring 1	536/1138	768/1351	542/1663	244/1389	137720 49	22 60	None	0/0/0	10 24	13 92
Block 6	Span 1, Ring 1	768/1351	1035/1521	832/1849	542/1663	127104 04	22 60	None	0/0/0	8 63	0 00
Block 7	Span 1, Ring 1	1035/1521	1306/1685	1119/2022	832/1849	125378 88	22 60	None	0/0/0	7 51	0
Block 8	Span 1, Ring 1	1306/1685	1595/1811	1483/2179	1119/2022	136227 63	22 60	None	0/0/0	8 30	0
Block 9	Span 1, Ring 1	1595/1811	1901/1890	1800/2262	1483/2179	123944 37	22 60	None	0/0/0	6 49	0
Block 10	Span 1, Ring 1	1901/1890	2203/1986	2110/2360	1800/2262	123356 28	22 60	None	0/0/0	5 79	0
Block 11	Span 1, Ring 1	2203/1986	2514/2042	2450/2422	2110/2360	127116 65	22 60	None	0/0/0	5 78	0 00
Block 12	Span 1, Ring 1	2514/2042	2825/2102	2750/2479	2450/2422	119752 74	22 60	None	0/0/0	4 76	0
Block 13	Span 1, Ring 1	2825/2102	3136/2158	3077/2538	2750/2479	124815 12	22 60	None	0/0/0	4 80	0
Block 14	Span 1, Ring 1	3136/2158	3450/2200	3404/2583	3077/2538	124501 90	22 60	None	0/0/0	4 47	0 00
Block 15	Span 1, Ring 1	3450/2200	3764/2233	3731/2616	3404/2583	123982 47	22 60	None	0/0/0	4 19	0
Block 16	Span 1, Ring 1	3764/2233	4080/2254	4062/2639	3731/2616	124838 94	22 60	None	0/0/0	4 08	0 00
Block 17	Span 1, Ring 1	4080/2254	4396/2265	4390/2650	4062/2639	124083 95	22 60	None	0/0/0	3 93	0
Block 18	Span 1, Ring 1	4396/2265	4712/2254	4743/2637	4390/2650	128763 10	22 60	None	0/0/0	4 23	0 19
Block 19	Span 1, Ring 1	4712/2254	5027/2223	5063/2607	4743/2637	122774 63	22 60	None	0/0/0	3 97	0 46
Block 20	Span 1, Ring 1	5027/2223	5342/2193	5383/2576	5063/2607	122707 14	22 60	None	0/0/0	4 16	0 49
Block 21	Span 1, Ring 1	5342/2193	5655/2149	5723/2528	5383/2576	126926 40	22 60	None	0/0/0	4 70	0 81
Block 22	Span 1, Ring 1	5655/2149	5964/2080	6064/2452	5723/2528	128063 76	22 60	None	0/0/0	5 13	1 40
Block 23	Span 1, Ring 1	5964/2080	6268/1992	6366/2365	6064/2452	121313 40	22 60	None	0/0/0	5 03	1 77
Block 24	Span 1, Ring 1	6268/1992	6575/1918	6692/2285	6366/2365	125332 33	22 60	None	0/0/0	5 99	1 77
Block 25	Span 1, Ring 1	6575/1918	6867/1798	7032/2146	6692/2285	131284 83	22 60	None	0/0/0	6 99	3 48
Block 26	Span 1, Ring 1	6867/1798	7152/1660	7319/2007	7032/2146	122246 43	22 60	None	0/0/0	6 69	3 94
Block 27	Span 1, Ring 1	7152/1660	7437/1524	7603/1871	7319/2007	121472 92	22 60	None	0/0/0	7 40	383 05
Block 28	Span 1, Ring 1	7437/1524	7718/1378	7927/1701	7603/1871	131081 09	22 60	None	0/0/0	9 45	63 94
Block 29	Span 1, Ring 1	7718/1378	7952/1167	8250/1411	7927/1701	142428 56	22 60	None	0/0/0	10 87	0
	Span 1, Ring										

Block 30	1	7952/1167	8124/902	8464/1081	8250/1411	135733 53	22 60	None	0/0/0	8 57	0
Block 31	Span 1, Ring 1	8124/902	8254/614	8613/754	8464/1081	129769 16	22 60	None	0/0/0	6 89	0
Block 32	Span 1, Ring 1	8254/614	8359/315	8726/431	8613/754	126938 54	22 60	None	0/0/0	6 02	0
Block 33	Span 1, Ring 1	8359/315	8447/10	8819/110	8726/431	125368 12	22 60	None	0/0/0	5 53	0
Block 0	Skewback 1	8450/0	12675/0	12675/110	8819/110	442646 13	22 60	X/Y/Rot	0/0/0	241 60	0

Key:
X = X direction, Y = Y direction, Rot. = Rotation

Contacts

Label	Position	Point 1	Point 2	Length	Loss A	Loss B	CS	FC	Status	Inter-ring?	Normal	Shear	Moment
Contact 0	Span 1, Ring 1	369/109	0/0	385 00	0	0	9		/H/C/	No	601 05	3 16	95632 65
Contact 1	Span 1, Ring 1	266/429	97/302	385	0	0	9		/H/C/	No	599 01	0 74	95375 15
Contact 2	Span 1, Ring 1	140/750	212/597	385 00	0	0	9		/H/C/	No	607 24	14 30	96408 81
Contact 4	Span 1, Ring 1	21/1073	354/879	385 00	0	0	9		/H/C/	No	648 21	52 81	10143724
Contact 5	Span 1, Ring 1	244/1389	536/1138	385 00	0	0	9		/H/C/	No	725 85	59 35	110456 72
Contact 6	Span 1, Ring 1	542/1663	768/1351	385 00	0	0	9		/H/C/	No	712 11	73 70	108909 26
Contact 7	Span 1, Ring 1	832/1849	1035/1521	385 00	0	0	9		/H/C/	No	685 23	94 40	79671 25
Contact 8	Span 1, Ring 1	1119/2022	1306/1685	385 00	0	0	9		/H/C/	No	659 87	91 18	55566 51
Contact 9	Span 1, Ring 1	1483/2179	1595/1811	385 00	0	0	9		/H/C/	No	612 51	180 23	12393 33
Contact 10	Span 1, Ring 1	1800/2262	1901/1890	385 00	0	0	9		/H/C/	No	590 44	138 95	41515 62
Contact 11	Span 1, Ring 1	2110/2360	2203/1986	285 00	50	50	9		/H/C/	No	567 26	73 29	6295728
Contact 12	Span 1, Ring 1	2450/2422	2514/2042	385 00	0	0	9		/H/C/	No	540 83	0 69	75423 47
Contact 13	Span 1, Ring 1	2750/2479	2825/2102	385 00	0	0	9		/H/C/	No	525 49	90 42	56704 84
Contact 14	Span 1, Ring 1	3077/2538	3136/2158	385 00	0	0	9		/H/C/	No	525 95	86 80	25581 41
Contact 15	Span 1, Ring 1	3404/2583	3450/2200	385 00	0	0	9		/H/C/	No	527 97	74 34	331 30
Contact 16	Span 1, Ring 1	3731/2616	3764/2233	385 00	0	0	9		/H/C/	No	529 34	65 55	23109 40
Contact 17	Span 1, Ring 1	4062/2639	4080/2254	385 00	0	0	9		/H/C/	No	531 29	50 44	42011 57
Contact 18	Span 1, Ring 1	4390/2650	4396/2265	385 00	0	0	9		/H/C/	No	532 50	40 54	57420 87
Contact 19	Span 1, Ring 1	4743/2637	4712/2254	385 00	0	0	9		/H/C/	No	534 33	3 63	6308753
Contact 20	Span 1, Ring 1	5063/2607	5027/2223	385 00	0	0	9		/H/C/	No	534 41	4 04	6059799
Contact 21	Span 1, Ring 1	5383/2576	5342/2193	285 00	50	50	9		/H/C/	No	534 58	3 77	60300 93
Contact 22	Span 1, Ring 1	5723/2528	5655/2149	385 00	0	0	9		/H/C/	No	533 51	34 10	54596 35
Contact 23	Span 1, Ring 1	6064/2452	5964/2080	385 00	0	0	9		/H/C/	No	529 33	71 81	37091 80
Contact 24	Span 1, Ring 1	6366/2365	6268/1992	385	0	0	9		/H/C/	No	530 05	60 53	13006 15
Contact 25	Span 1, Ring 1	6692/2285	6575/1918	385 00	0	0	9		/H/C/	No	527 25	78 62	1603 99
Contact 26	Span 1, Ring 1	7032/2146	6867/1798	385 00	0	0	9		/H/C/	No	513 18	137 74	40889 66
Contact 27	Span 1, Ring 1	7319/2007	7152/1660	385 00	0	0	9		/H/C/	No	512 93	130 47	84123 14
Contact 28	Span 1, Ring 1	7603/1871	7437/1524	385	0	0	9		/H/C/	No	172 04	45 58	31473 14
Contact 29	Span 1, Ring 1	7927/1701	7718/1378	385 00	0	0	9		/H/C/	No	129 65	67 93	1385 84
Contact 30	Span 1, Ring 1	8250/1411	7952/1167	385 00	0	0	9		/H/C/	No	155 06	34 27	166870 0
Contact 31	Span 1, Ring 1	8464/1081	8124/902	285 00	50	50	9		/H/C/	No	169 07	8 09	22504 91

Contact 32	Span 1, Ring 1	8613/754	8254/614	385 00	0	0	9	/H/C/	No	178 06	7 22	21242 91
Contact 33	Span 1, Ring 1	8726/431	8359/315	385 00	0	0	9	/H/C/	No	185 64	16 61	16112 49
Contact 33	Span 1, Ring 1	8819/110	8447/10	385 00	0	0	9	/H/C/	No	192 79	22 81	8611 40

Key:
CS = Crushing Strength, FC = Friction Coefficient, S = S iding enab ed, H = Hinging enab ed, C = Crushing enab ed, R = Reinforcement present

This report was generated by LimitState:RING 3.2.b.20773

Summary

Details

Bridge name	Location	Reference No.	Map reference
Great Musgrave	Cumbria	EDE/25	NY 764 136

Bridge type	Name of assessor	Assessing organization	Date of assessment
Highway	[redacted]	Jacobs	Tuesday, September 26, 2023

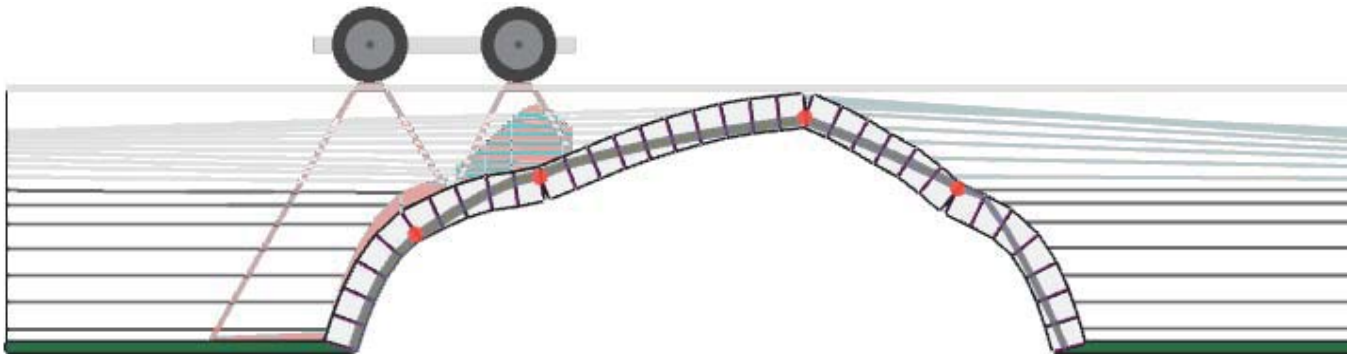
Comments

Geometric data from Cumbria 1998 BD21 assessment report Carriageway fu width between parapets = 5.63m. Effective width (worst sing e vehic e position) CS 454 Fig 7.7.6 820mm (edge to whee centre) 580/2 fi depth crown +1800 whee base + 750 interna distibution =3653mm Fi described as 'compacted stone' Density 20 kN/m3 Phi 35deg Barre taken as Ash ar Ca careous Sandstone, characteristic strength 9N/mm2 from CS 454 Fig 4.2.7b. Coring investigations and tria trench excavations have confirmed Structura backing is present 2.0m above the springing. Assume 'poor' road surface condition and medium HGV f ow, hence 1.8 impact factor and 1.5 x 0.95 gamma f 'ax e oad' factor. Cmin (adequacy factor) of 1.2 required to pass for norma traffic oading to CS454 7.2 is inc uded in the oading, hence an adequacy factor of 1.0 represents a 'pass'. Genera condition factor = 1.0 assuming effective repairs are undertaken.

Results

Adequacy factor	Solver used (if not default)
3.93 at oad case #8 (this is the critica oad case)	CLP so ver

Mode of Response for Current Load Case



Units

Unless specified otherwise, the following units are used throughout this report:

Distance	Force*	Moment*	Angle	Unit weight	Material strength
mm	kN	kNmm	Degrees	kN/m3	N/mm2

* = per metre width

Geometry

Global:	No. Spans	Effective bridge width
	1	3653

Span 1:	Type	Shape	No. Rings
	Stone voussoir	User defined (interpo ated)	1

Intrados points (local to left springing of this span):

x	y
0	0
500	1095
1000	1500
1500	1778
2000	1920
2113	1960
2500	2040
3000	2135
3500	2206
4000	2250
4225	2260
4500	2265
5000	2226
5500	2174
6000	2070
6338	1975
6500	1940
7000	1734
7500	1494
8000	1104
8450	0

Ring 1:	No. Blocks	Ring thickness
	33	385

Fill Profile Properties

Distances measured from left springing point of left span.

Horizontal distance (x)	Height to surface fill (y)	Surface fill depth (d)	Surface level (y+d)
4225	3125	100	3225
0	3126	100	3226
8450	3125	100	3225

Partial Factors

Loads

Masonry unit weight	Fill unit weight	Surface unit weight	Axle load	Dynamic
1	1	1	1	1

Materials

Masonry strength	Masonry friction
1	1

Fill Properties

Backfill

Unit weight	Angle of friction	Cohesion

20	35	0

Model dispersion of live load?	**Model horizontal 'passive' pressures?**
Yes	Yes
Dispersion type	**Cutoff angle**
Boussinesq	30
Soil arch interface, friction multiplier	**Soil arch interface, cohesion multiplier**
0.66	0.5
Mobilisation multiplier on Kp (mp)	**Mobilisation multiplier on cohesion (mpc)**
0.33	0.05
Keep mp.Kp > 1?	**Auto identify passive zones?**
Yes	Yes

Surface Fill

Unit weight	**Load dispersion limiting angle**
23.5	26.6

Backing

Position	Backing height	Passive pressures modelled?
Abutment 0	2000	Yes
Abutment 1	2000	Yes

Vehicles in Project

Name	Axle No.	Load magnitude	Axle position
Defau t 1kN Sing e Ax e	1	1	0
11.5 Tonne, Sing e Ax e	1	347.24	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1	134.2	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	2	241.56	-1000
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1	159.36	0
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	2	286.85	-1300
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1	301.95	0
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	2	167.75	-1800
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1	134.2	0
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	2	134.2	-1300
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	3	134.2	-2600

Vehicles in Load Cases

#	Load Case Name	Vehicle(s)	Position	Mirror?	Dynamic Axles
1	Load Case 1	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	0	No	-
2	Load Case 2	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	282	No	-
3	Load Case 3	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	564	No	-
4	Load Case 4	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	846	No	-
5	Load Case 5	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1128	No	-
6	Load Case 6	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1410	No	-
7	Load Case 7	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1692	No	-
8	Load Case 8	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1974	No	-
9	Load Case 9	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	2256	No	-

10	Load Case 10	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	2538	No	-
11	Load Case 11	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	2820	No	-
12	Load Case 12	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	3102	No	-
13	Load Case 13	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	3384	No	-
14	Load Case 14	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	3666	No	-
15	Load Case 15	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	3948	No	-
16	Load Case 16	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	4230	No	-
17	Load Case 17	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	4512	No	-
18	Load Case 18	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	4794	No	-
19	Load Case 19	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	5076	No	-
20	Load Case 20	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	5358	No	-
21	Load Case 21	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	5640	No	-
22	Load Case 22	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	5922	No	-
23	Load Case 23	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	6204	No	-
24	Load Case 24	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	6486	No	-
25	Load Case 25	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	6768	No	-
26	Load Case 26	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	7050	No	-
27	Load Case 27	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	7332	No	-
28	Load Case 28	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	7614	No	-
29	Load Case 29	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	7896	No	-
30	Load Case 30	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	8178	No	-
31	Load Case 31	2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	8460	No	-

Load Cases

#	Load Case Name	Effective Width	Adequacy Factor
1	Load Case 1	3653	27.4
2	Load Case 2	3653	19.6
3	Load Case 3	3653	14.9
4	Load Case 4	3653	11.9
5	Load Case 5	3653	9.09
6	Load Case 6	3653	6.44
7	Load Case 7	3653	4.54
8	Load Case 8	3653	3.93
9	Load Case 9	3653	3.99
10	Load Case 10	3653	4.42
11	Load Case 11	3653	4.62
12	Load Case 12	3653	5.15
13	Load Case 13	3653	5.72
14	Load Case 14	3653	6.53
15	Load Case 15	3653	7.26
16	Load Case 16	3653	8.16
17	Load Case 17	3653	9.05
18	Load Case 18	3653	9.55
19	Load Case 19	3653	8.46
20	Load Case 20	3653	8.02

21	Load Case 21	3653	8.48
22	Load Case 22	3653	9.16
23	Load Case 23	3653	9.44
24	Load Case 24	3653	9.65
25	Load Case 25	3653	9.8
26	Load Case 26	3653	10.3
27	Load Case 27	3653	11.7
28	Load Case 28	3653	12.9
29	Load Case 29	3653	12.3
30	Load Case 30	3653	11.3
31	Load Case 31	3653	11.9

Blocks

Label	Position	Point 1	Point 2	Point 3	Point 4	Area	Unit weight	Support	Support movement X/Y/Rot.	Fill force (V)	Fill force (H)
Block 0	Skewback 0	4225/0	0/0	369/109	4225/109	442124 19	22 60	X/Y/Rot	0/0/0	241 73	0
Block 1	Span 1, Ring 1	0/0	97/302	266/429	369/109	125679 56	22 60	None	0/0/0	6 13	29 44
Block 2	Span 1, Ring 1	97/302	212/597	140/750	266/429	127209 31	22 60	None	0/0/0	6 66	51 89
Block 3	Span 1, Ring 1	212/597	354/879	21/1073	140/750	130102 81	22 60	None	0/0/0	7 54	102 75
Block 4	Span 1, Ring 1	354/879	536/1138	244/1389	21/1073	134778 47	22 60	None	0/0/0	8 98	124 31
Block 5	Span 1, Ring 1	536/1138	768/1351	542/1663	244/1389	137720 49	22 60	None	0/0/0	10 24	0 08
Block 6	Span 1, Ring 1	768/1351	1035/1521	832/1849	542/1663	127104 04	22 60	None	0/0/0	8 63	0 00
Block 7	Span 1, Ring 1	1035/1521	1306/1685	1119/2022	832/1849	125378 88	22 60	None	0/0/0	7 51	0
Block 8	Span 1, Ring 1	1306/1685	1595/1811	1483/2179	1119/2022	136227 63	22 60	None	0/0/0	8 30	0
Block 9	Span 1, Ring 1	1595/1811	1901/1890	1800/2262	1483/2179	123944 37	22 60	None	0/0/0	6 49	0
Block 10	Span 1, Ring 1	1901/1890	2203/1986	2110/2360	1800/2262	123356 28	22 60	None	0/0/0	5 79	0
Block 11	Span 1, Ring 1	2203/1986	2514/2042	2450/2422	2110/2360	127116 65	22 60	None	0/0/0	5 78	0 00
Block 12	Span 1, Ring 1	2514/2042	2825/2102	2750/2479	2450/2422	119752 74	22 60	None	0/0/0	4 76	0
Block 13	Span 1, Ring 1	2825/2102	3136/2158	3077/2538	2750/2479	124815 12	22 60	None	0/0/0	4 80	0
Block 14	Span 1, Ring 1	3136/2158	3450/2200	3404/2583	3077/2538	124501 90	22 60	None	0/0/0	4 47	0
Block 15	Span 1, Ring 1	3450/2200	3764/2233	3731/2616	3404/2583	123982 47	22 60	None	0/0/0	4 19	0
Block 16	Span 1, Ring 1	3764/2233	4080/2254	4062/2639	3731/2616	124838 94	22 60	None	0/0/0	4 08	0 00
Block 17	Span 1, Ring 1	4080/2254	4396/2265	4390/2650	4062/2639	124083 95	22 60	None	0/0/0	3 93	0
Block 18	Span 1, Ring 1	4396/2265	4712/2254	4743/2637	4390/2650	128763 10	22 60	None	0/0/0	4 23	0 19
Block 19	Span 1, Ring 1	4712/2254	5027/2223	5063/2607	4743/2637	122774 63	22 60	None	0/0/0	3 97	0 46
Block 20	Span 1, Ring 1	5027/2223	5342/2193	5383/2576	5063/2607	122707 14	22 60	None	0/0/0	4 16	0 49
Block 21	Span 1, Ring 1	5342/2193	5655/2149	5723/2528	5383/2576	126926 40	22 60	None	0/0/0	4 70	0 81
Block 22	Span 1, Ring 1	5655/2149	5964/2080	6064/2452	5723/2528	128063 76	22 60	None	0/0/0	5 13	1 40
Block 23	Span 1, Ring 1	5964/2080	6268/1992	6366/2365	6064/2452	121313 40	22 60	None	0/0/0	5 03	1 77
Block 24	Span 1, Ring 1	6268/1992	6575/1918	6692/2285	6366/2365	125332 33	22 60	None	0/0/0	5 99	1 77
Block 25	Span 1, Ring 1	6575/1918	6867/1798	7032/2146	6692/2285	131284 83	22 60	None	0/0/0	6 99	3 48
Block 26	Span 1, Ring 1	6867/1798	7152/1660	7319/2007	7032/2146	122246 43	22 60	None	0/0/0	6 69	3 94
Block 27	Span 1, Ring 1	7152/1660	7437/1524	7603/1871	7319/2007	121472 92	22 60	None	0/0/0	7 40	347 70
Block 28	Span 1, Ring 1	7437/1524	7718/1378	7927/1701	7603/1871	131081 09	22 60	None	0/0/0	9 45	46 20
Block 29	Span 1, Ring 1	7718/1378	7952/1167	8250/1411	7927/1701	142428 56	22 60	None	0/0/0	10 87	0
	Span 1, Ring										

Block 30	1	7952/1167	8124/902	8464/1081	8250/1411	135733 53	22 60	None	0/0/0	8 57	0
Block 31	Span 1, Ring 1	8124/902	8254/614	8613/754	8464/1081	129769 16	22 60	None	0/0/0	6 89	0
Block 32	Span 1, Ring 1	8254/614	8359/315	8726/431	8613/754	126938 54	22 60	None	0/0/0	6 02	0
Block 33	Span 1, Ring 1	8359/315	8447/10	8819/110	8726/431	125368 12	22 60	None	0/0/0	5 53	0
Block 0	Skewback 1	8450/0	12675/0	12675/110	8819/110	442646 13	22 60	X/Y/Rot	0/0/0	241 60	0

Key:
X = X direction, Y = Y direction, Rot. = Rotation

Contacts

Label	Position	Point 1	Point 2	Length	Loss A	Loss B	CS	FC	Status	Inter-ring?	Normal	Shear	Moment
Contact 0	Span 1, Ring 1	369/109	0/0	385 00	0	0	9		/H/C/	No	604 09	5 61	96013 43
Contact 1	Span 1, Ring 1	266/429	97/302	385	0	0	9		/H/C/	No	598 76	2 93	95343 57
Contact 2	Span 1, Ring 1	140/750	212/597	385 00	0	0	9		/H/C/	No	601 38	787	95673 69
Contact 4	Span 1, Ring 1	21/1073	354/879	385 00	0	0	9		/H/C/	No	630 12	38 92	99240 04
Contact 5	Span 1, Ring 1	244/1389	536/1138	385 00	0	0	9		/H/C/	No	683 18	3749	105582 14
Contact 6	Span 1, Ring 1	542/1663	768/1351	385 00	0	0	9		/H/C/	No	64769	84 12	101374 25
Contact 7	Span 1, Ring 1	832/1849	1035/1521	385 00	0	0	9		/H/C/	No	618 90	9793	70828 98
Contact 8	Span 1, Ring 1	1119/2022	1306/1685	385 00	0	0	9		/H/C/	No	600 96	105 08	42950 80
Contact 9	Span 1, Ring 1	1483/2179	1595/1811	385 00	0	0	9		/H/C/	No	549 23	172 51	2449 50
Contact 10	Span 1, Ring 1	1800/2262	1901/1890	385 00	0	0	9		/H/C/	No	522 02	109 52	49340 08
Contact 11	Span 1, Ring 1	2110/2360	2203/1986	285 00	50	50	9		/H/C/	No	493 81	19 03	56820 73
Contact 12	Span 1, Ring 1	2450/2422	2514/2042	385 00	0	0	9		/H/C/	No	474 68	40 73	5226705
Contact 13	Span 1, Ring 1	2750/2479	2825/2102	385 00	0	0	9		/H/C/	No	468 29	79 34	3001776
Contact 14	Span 1, Ring 1	3077/2538	3136/2158	385 00	0	0	9		/H/C/	No	469 96	6774	5529 02
Contact 15	Span 1, Ring 1	3404/2583	3450/2200	385 00	0	0	9		/H/C/	No	471 31	5739	14586 93
Contact 16	Span 1, Ring 1	3731/2616	3764/2233	385 00	0	0	9		/H/C/	No	472 20	50 29	32158 74
Contact 17	Span 1, Ring 1	4062/2639	4080/2254	385 00	0	0	9		/H/C/	No	473 56	3756	46493 07
Contact 18	Span 1, Ring 1	4390/2650	4396/2265	385 00	0	0	9		/H/C/	No	474 40	29 47	57964 29
Contact 19	Span 1, Ring 1	4743/2637	4712/2254	385 00	0	0	9		/H/C/	No	475 43	9 07	60922 51
Contact 20	Span 1, Ring 1	5063/2607	5027/2223	385 00	0	0	9		/H/C/	No	475 44	8 69	56966 81
Contact 21	Span 1, Ring 1	5383/2576	5342/2193	285 00	50	50	9		/H/C/	No	475 56	7 68	55202 72
Contact 22	Span 1, Ring 1	5723/2528	5655/2149	385 00	0	0	9		/H/C/	No	474 36	33 81	48842 57
Contact 23	Span 1, Ring 1	6064/2452	5964/2080	385 00	0	0	9		/H/C/	No	470 43	66 43	32271 80
Contact 24	Span 1, Ring 1	6366/2365	6268/1992	385	0	0	9		/H/C/	No	471 11	55 52	10192 22
Contact 25	Span 1, Ring 1	6692/2285	6575/1918	385 00	0	0	9		/H/C/	No	468 65	70 60	3190 05
Contact 26	Span 1, Ring 1	7032/2146	6867/1798	385 00	0	0	9		/H/C/	No	456 17	121 98	38140 13
Contact 27	Span 1, Ring 1	7319/2007	7152/1660	385 00	0	0	9		/H/C/	No	456 01	114 38	76229 60
Contact 28	Span 1, Ring 1	7603/1871	7437/1524	385	0	0	9		/H/C/	No	146 96	46 23	27090 06
Contact 29	Span 1, Ring 1	7927/1701	7718/1378	385 00	0	0	9		/H/C/	No	119 75	62 19	834 42
Contact 30	Span 1, Ring 1	8250/1411	7952/1167	385 00	0	0	9		/H/C/	No	143 89	31 82	15698 43
Contact 31	Span 1, Ring 1	8464/1081	8124/902	285 00	50	50	9		/H/C/	No	15764	791	21082 56

Contact 32	Span 1, Ring 1	8613/754	8254/614	385 00	0	0	9	/H/C/	No	166 68	6 13	19993 84
Contact 33	Span 1, Ring 1	8726/431	8359/315	385 00	0	0	9	/H/C/	No	174 35	14 74	15361 48
Contact 33	Span 1, Ring 1	8819/110	8447/10	385 00	0	0	9	/H/C/	No	181 59	20 43	8555 99

Key:
CS = Crushing Strength, FC = Friction Coefficient, S = Siding enabled, H = Hinging enabled, C = Crushing enabled, R = Reinforcement present

This report was generated by LimitState:RING 3.2.b.20773

Summary

Details

Bridge name	Location	Reference No.	Map reference
Great Musgrave	Cumbria	EDE/25	NY 764 136

Bridge type	Name of assessor	Assessing organization	Date of assessment
Highway	[redacted]	Jacobs	Tuesday, September 26, 2023

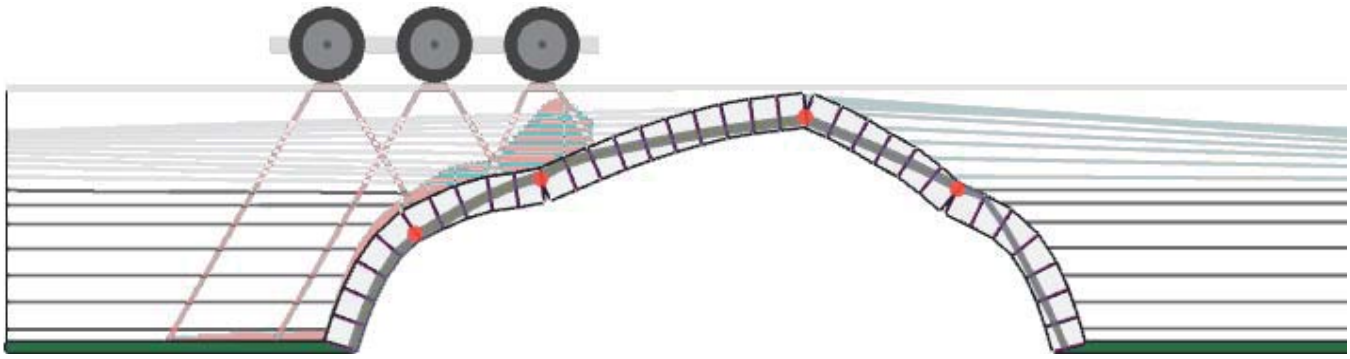
Comments

Geometric data from Cumbria 1998 BD21 assessment report Carriageway fu width between parapets = 5.63m. Effective width (worst sing e vehic e position) CS 454 Fig 7.7.6 820mm (edge to whee centre) 580/2 fi depth crown +1800 whee base + 750 interna distibution =3653mm Fi described as 'compacted stone' Density 20 kN/m3 Phi 35deg Barre taken as Ash ar Ca careous Sandstone, characteristic strength 9N/mm2 from CS 454 Fig 4.2.7b. Coring investigations and tria trench excavations have confirmed Structura backing is present 2.0m above the springing. Assume 'poor' road surface condition and medium HGV f ow, hence 1.8 impact factor and 1.5 x 0.95 gamma f 'ax e oad' factor. Cmin of 1.2 required to pass for norma traffic oading to CS454 7.2. is inc uded in oading, hence adequacy factor of >1.0 represents a 'pass'. Genera condition factor = 1.0 assuming effective repairs are undertaken.

Results

Adequacy factor	Solver used (if not default)
4.57 at oad case #9 (this is the critica oad case)	CLP so ver

Mode of Response for Current Load Case



Units

Unless specified otherwise, the following units are used throughout this report:

Distance	Force*	Moment*	Angle	Unit weight	Material strength
mm	kN	kNmm	Degrees	kN/m3	N/mm2

* = per metre width

Geometry

Global:	No. Spans	Effective bridge width
	1	3653

Span 1:	Type	Shape	No. Rings
	Stone voussoir	User defined (interpo ated)	1

Intrados points (local to left springing of this span):

x	y
0	0
500	1095
1000	1500
1500	1778
2000	1920
2113	1960
2500	2040
3000	2135
3500	2206
4000	2250
4225	2260
4500	2265
5000	2226
5500	2174
6000	2070
6338	1975
6500	1940
7000	1734
7500	1494
8000	1104
8450	0

Ring 1:	No. Blocks	Ring thickness
	33	385

Fill Profile Properties

Distances measured from left springing point of left span.

Horizontal distance (x)	Height to surface fill (y)	Surface fill depth (d)	Surface level (y+d)
4225	3125	100	3225
0	3126	100	3226
8450	3125	100	3225

Partial Factors

Loads

Masonry unit weight	Fill unit weight	Surface unit weight	Axle load	Dynamic
1	1	1	1	1

Materials

Masonry strength	Masonry friction
1	1

Fill Properties

Backfill

Unit weight	Angle of friction	Cohesion

20	35	0

Model dispersion of live load?	**Model horizontal 'passive' pressures?**
Yes	Yes
Dispersion type	**Cutoff angle**
Boussinesq	30
Soil arch interface, friction multiplier	**Soil arch interface, cohesion multiplier**
0.66	0.5
Mobilisation multiplier on Kp (mp)	**Mobilisation multiplier on cohesion (mpc)**
0.33	0.05
Keep mp.Kp > 1?	**Auto identify passive zones?**
Yes	Yes

Surface Fill

Unit weight	**Load dispersion limiting angle**
23.5	26.6

Backing

Position	Backing height	Passive pressures modelled?
Abutment 0	2000	Yes
Abutment 1	2000	Yes

Vehicles in Project

Name	Axle No.	Load magnitude	Axle position
Defau t 1kN Sing e Ax e	1	1	0
11.5 Tonne, Sing e Ax e	1	347.24	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	1	241.56	0
2x 8 Tonne, Doub e Ax e (1m Ax e Spacing)	2	134.2	-1000
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	1	286.85	0
2x 9.5 Tonne, Doub e Ax e (1.3m Ax e Spacing)	2	159.36	-1300
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	1	301.95	0
2x 10 Tonne, Doub e Ax e (1.8m Ax e Spacing)	2	167.75	-1800
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1	241.56	0
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	2	134.2	-1300
3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	3	134.2	-2600

Vehicles in Load Cases

#	Load Case Name	Vehicle(s)	Position	Mirror?	Dynamic Axles
1	Load Case 1	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	0	No	-
2	Load Case 2	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	282	No	-
3	Load Case 3	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	564	No	-
4	Load Case 4	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	846	No	-
5	Load Case 5	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1128	No	-
6	Load Case 6	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1410	No	-
7	Load Case 7	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1692	No	-
8	Load Case 8	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	1974	No	-
9	Load Case 9	3x 8 Tonne, Trip e Ax e (1.3m Ax e Spacing)	2256	No	-

10	Load Case 10	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	2538	No	-
11	Load Case 11	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	2820	No	-
12	Load Case 12	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	3102	No	-
13	Load Case 13	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	3384	No	-
14	Load Case 14	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	3666	No	-
15	Load Case 15	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	3948	No	-
16	Load Case 16	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	4230	No	-
17	Load Case 17	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	4512	No	-
18	Load Case 18	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	4794	No	-
19	Load Case 19	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	5076	No	-
20	Load Case 20	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	5358	No	-
21	Load Case 21	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	5640	No	-
22	Load Case 22	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	5922	No	-
23	Load Case 23	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	6204	No	-
24	Load Case 24	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	6486	No	-
25	Load Case 25	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	6768	No	-
26	Load Case 26	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	7050	No	-
27	Load Case 27	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	7332	No	-
28	Load Case 28	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	7614	No	-
29	Load Case 29	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	7896	No	-
30	Load Case 30	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	8178	No	-
31	Load Case 31	3x 8 Tonne, Tripe Axe (1.3m Axe Spacing)	8460	No	-

Load Cases

#	Load Case Name	Effective Width	Adequacy Factor
1	Load Case 1	3653	33.9
2	Load Case 2	3653	23.8
3	Load Case 3	3653	18.1
4	Load Case 4	3653	14.3
5	Load Case 5	3653	10.9
6	Load Case 6	3653	7.67
7	Load Case 7	3653	5.4
8	Load Case 8	3653	4.59
9	Load Case 9	3653	4.57
10	Load Case 10	3653	5.07
11	Load Case 11	3653	5.03
12	Load Case 12	3653	5.51
13	Load Case 13	3653	6.24
14	Load Case 14	3653	6.96
15	Load Case 15	3653	7.79
16	Load Case 16	3653	8.73
17	Load Case 17	3653	9.89
18	Load Case 18	3653	10.5
19	Load Case 19	3653	9.51
20	Load Case 20	3653	8.94

21	Load Case 21	3653	9.11
22	Load Case 22	3653	9.73
23	Load Case 23	3653	9.95
24	Load Case 24	3653	9.75
25	Load Case 25	3653	9.85
26	Load Case 26	3653	10.5
27	Load Case 27	3653	11.3
28	Load Case 28	3653	11.6
29	Load Case 29	3653	12.2
30	Load Case 30	3653	13.2
31	Load Case 31	3653	14.9

Blocks

Label	Position	Point 1	Point 2	Point 3	Point 4	Area	Unit weight	Support	Support movement X/Y/Rot.	Fill force (V)	Fill force (H)
Block 0	Skewback 0	4225/0	0/0	369/109	4225/109	442124 19	22 60	X/Y/Rot	0/0/0	241 73	0
Block 1	Span 1, Ring 1	0/0	97/302	266/429	369/109	125679 56	22 60	None	0/0/0	6 13	31 34
Block 2	Span 1, Ring 1	97/302	212/597	140/750	266/429	127209 31	22 60	None	0/0/0	6 66	54 26
Block 3	Span 1, Ring 1	212/597	354/879	21/1073	140/750	130102 81	22 60	None	0/0/0	7 54	109 15
Block 4	Span 1, Ring 1	354/879	536/1138	244/1389	21/1073	134778 47	22 60	None	0/0/0	8 98	139 06
Block 5	Span 1, Ring 1	536/1138	768/1351	542/1663	244/1389	137720 49	22 60	None	0/0/0	10 24	13 86
Block 6	Span 1, Ring 1	768/1351	1035/1521	832/1849	542/1663	127104 04	22 60	None	0/0/0	8 63	0
Block 7	Span 1, Ring 1	1035/1521	1306/1685	1119/2022	832/1849	125378 88	22 60	None	0/0/0	7 51	0
Block 8	Span 1, Ring 1	1306/1685	1595/1811	1483/2179	1119/2022	136227 63	22 60	None	0/0/0	8 30	0
Block 9	Span 1, Ring 1	1595/1811	1901/1890	1800/2262	1483/2179	123944 37	22 60	None	0/0/0	6 49	0
Block 10	Span 1, Ring 1	1901/1890	2203/1986	2110/2360	1800/2262	123356 28	22 60	None	0/0/0	5 79	0
Block 11	Span 1, Ring 1	2203/1986	2514/2042	2450/2422	2110/2360	127116 65	22 60	None	0/0/0	5 78	0 00
Block 12	Span 1, Ring 1	2514/2042	2825/2102	2750/2479	2450/2422	119752 74	22 60	None	0/0/0	4 76	0
Block 13	Span 1, Ring 1	2825/2102	3136/2158	3077/2538	2750/2479	124815 12	22 60	None	0/0/0	4 80	0
Block 14	Span 1, Ring 1	3136/2158	3450/2200	3404/2583	3077/2538	124501 90	22 60	None	0/0/0	4 47	0
Block 15	Span 1, Ring 1	3450/2200	3764/2233	3731/2616	3404/2583	123982 47	22 60	None	0/0/0	4 19	0
Block 16	Span 1, Ring 1	3764/2233	4080/2254	4062/2639	3731/2616	124838 94	22 60	None	0/0/0	4 08	0
Block 17	Span 1, Ring 1	4080/2254	4396/2265	4390/2650	4062/2639	124083 95	22 60	None	0/0/0	3 93	0 00
Block 18	Span 1, Ring 1	4396/2265	4712/2254	4743/2637	4390/2650	128763 10	22 60	None	0/0/0	4 23	0 19
Block 19	Span 1, Ring 1	4712/2254	5027/2223	5063/2607	4743/2637	122774 63	22 60	None	0/0/0	3 97	0 46
Block 20	Span 1, Ring 1	5027/2223	5342/2193	5383/2576	5063/2607	122707 14	22 60	None	0/0/0	4 16	0 49
Block 21	Span 1, Ring 1	5342/2193	5655/2149	5723/2528	5383/2576	126926 40	22 60	None	0/0/0	4 70	0 81
Block 22	Span 1, Ring 1	5655/2149	5964/2080	6064/2452	5723/2528	128063 76	22 60	None	0/0/0	5 13	1 40
Block 23	Span 1, Ring 1	5964/2080	6268/1992	6366/2365	6064/2452	121313 40	22 60	None	0/0/0	5 03	1 77
Block 24	Span 1, Ring 1	6268/1992	6575/1918	6692/2285	6366/2365	125332 33	22 60	None	0/0/0	5 99	1 77
Block 25	Span 1, Ring 1	6575/1918	6867/1798	7032/2146	6692/2285	131284 83	22 60	None	0/0/0	6 99	3 48
Block 26	Span 1, Ring 1	6867/1798	7152/1660	7319/2007	7032/2146	122246 43	22 60	None	0/0/0	6 69	3 94
Block 27	Span 1, Ring 1	7152/1660	7437/1524	7603/1871	7319/2007	121472 92	22 60	None	0/0/0	7 40	383 17
Block 28	Span 1, Ring 1	7437/1524	7718/1378	7927/1701	7603/1871	131081 09	22 60	None	0/0/0	9 45	64 01
Block 29	Span 1, Ring 1	7718/1378	7952/1167	8250/1411	7927/1701	142428 56	22 60	None	0/0/0	10 87	0
	Span 1, Ring										

Block 30	1	7952/1167	8124/902	8464/1081	8250/1411	135733 53	22 60	None	0/0/0	8 57	0
Block 31	Span 1, Ring 1	8124/902	8254/614	8613/754	8464/1081	129769 16	22 60	None	0/0/0	6 89	0
Block 32	Span 1, Ring 1	8254/614	8359/315	8726/431	8613/754	126938 54	22 60	None	0/0/0	6 02	0
Block 33	Span 1, Ring 1	8359/315	8447/10	8819/110	8726/431	125368 12	22 60	None	0/0/0	5 53	0
Block 0	Skewback 1	8450/0	12675/0	12675/110	8819/110	442646 13	22 60	X/Y/Rot	0/0/0	241 60	0

Key:
X = X direction, Y = Y direction, Rot. = Rotation

Contacts

Label	Position	Point 1	Point 2	Length	Loss A	Loss B	CS	FC	Status	Inter-ring?	Normal	Shear	Moment
Contact 0	Span 1, Ring 1	369/109	0/0	385 00	0	0	9		/H/C/	No	680 62	8 17	105283 44
Contact 1	Span 1, Ring 1	266/429	97/302	385	0	0	9		/H/C/	No	672 03	6 23	104275 21
Contact 2	Span 1, Ring 1	140/750	212/597	385 00	0	0	9		/H/C/	No	670 51	3 42	104095 99
Contact 4	Span 1, Ring 1	21/1073	354/879	385 00	0	0	9		/H/C/	No	695 56	35 53	107016 96
Contact 5	Span 1, Ring 1	244/1389	536/1138	385 00	0	0	9		/H/C/	No	749 46	39 35	113066 14
Contact 6	Span 1, Ring 1	542/1663	768/1351	385 00	0	0	9		/H/C/	No	71708	80 16	109470 57
Contact 7	Span 1, Ring 1	832/1849	1035/1521	385 00	0	0	9		/H/C/	No	685 91	95 09	80411 33
Contact 8	Span 1, Ring 1	1119/2022	1306/1685	385 00	0	0	9		/H/C/	No	660 48	91 83	56099 00
Contact 9	Span 1, Ring 1	1483/2179	1595/1811	385 00	0	0	9		/H/C/	No	612 95	180 90	12698 70
Contact 10	Span 1, Ring 1	1800/2262	1901/1890	385 00	0	0	9		/H/C/	No	590 82	139 50	41404 35
Contact 11	Span 1, Ring 1	2110/2360	2203/1986	285 00	50	50	9		/H/C/	No	56758	73 67	62982 76
Contact 12	Span 1, Ring 1	2450/2422	2514/2042	385 00	0	0	9		/H/C/	No	541 08	0 82	75524 87
Contact 13	Span 1, Ring 1	2750/2479	2825/2102	385 00	0	0	9		/H/C/	No	525 71	90 47	56808 33
Contact 14	Span 1, Ring 1	3077/2538	3136/2158	385 00	0	0	9		/H/C/	No	526 17	86 87	25659 62
Contact 15	Span 1, Ring 1	3404/2583	3450/2200	385 00	0	0	9		/H/C/	No	528 19	74 41	275 25
Contact 16	Span 1, Ring 1	3731/2616	3764/2233	385 00	0	0	9		/H/C/	No	529 56	65 61	23073 27
Contact 17	Span 1, Ring 1	4062/2639	4080/2254	385 00	0	0	9		/H/C/	No	531 50	50 49	41992 95
Contact 18	Span 1, Ring 1	4390/2650	4396/2265	385 00	0	0	9		/H/C/	No	532 72	40 58	5741738
Contact 19	Span 1, Ring 1	4743/2637	4712/2254	385 00	0	0	9		/H/C/	No	534 55	3 61	63094 53
Contact 20	Span 1, Ring 1	5063/2607	5027/2223	385 00	0	0	9		/H/C/	No	534 63	4 02	60610 76
Contact 21	Span 1, Ring 1	5383/2576	5342/2193	285 00	50	50	9		/H/C/	No	534 80	3 76	60319 48
Contact 22	Span 1, Ring 1	5723/2528	5655/2149	385 00	0	0	9		/H/C/	No	533 73	34 10	5461762
Contact 23	Span 1, Ring 1	6064/2452	5964/2080	385 00	0	0	9		/H/C/	No	529 56	71 83	37109 78
Contact 24	Span 1, Ring 1	6366/2365	6268/1992	385	0	0	9		/H/C/	No	530 27	60 55	13016 76
Contact 25	Span 1, Ring 1	6692/2285	6575/1918	385 00	0	0	9		/H/C/	No	52748	78 65	159 79
Contact 26	Span 1, Ring 1	7032/2146	6867/1798	385 00	0	0	9		/H/C/	No	513 40	13780	40899 63
Contact 27	Span 1, Ring 1	7319/2007	7152/1660	385 00	0	0	9		/H/C/	No	513 15	130 53	84152 35
Contact 28	Span 1, Ring 1	7603/1871	7437/1524	385	0	0	9		/H/C/	No	172 14	45 58	31491 05
Contact 29	Span 1, Ring 1	7927/1701	7718/1378	385 00	0	0	9		/H/C/	No	129 69	6795	1388 23
Contact 30	Span 1, Ring 1	8250/1411	7952/1167	385 00	0	0	9		/H/C/	No	155 10	34 28	16690 64
Contact 31	Span 1, Ring 1	8464/1081	8124/902	285 00	50	50	9		/H/C/	No	169 12	8 09	22510 34

Contact 32	Span 1, Ring 1	8613/754	8254/614	385 00	0	0	9	/H/C/	No	178 11	723	2124780
Contact 33	Span 1, Ring 1	8726/431	8359/315	385 00	0	0	9	/H/C/	No	185 68	16 61	16115 58
Contact 33	Span 1, Ring 1	8819/110	8447/10	385 00	0	0	9	/H/C/	No	192 83	22 82	8611 94

Key:
CS = Crushing Strength, FC = Friction Coefficient, S = S iding enab ed, H = Hinging enab ed, C = Crushing enab ed, R = Reinforcement present