traffico
ROAD SAFETY ENGINEERING

Kilsaran Bellewstown Access & Road Improvements

Stage 1 Road Safety Audit

Kilsaran

October 2021

traffico

Kilsaran Bellewstown Access & Road Improvements

Stage 1 Road Safety Audit

September 2021

Notice

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Document History

JOB NUMBER: 210061			DOCUMENT REF: 210061RPT001_RSA1_Rev_1			
1	Final Issue	JW	MD	MD	MD	28 Oct 2021
0	Draft Issue	JW	MD	MD	MD	21 Sept 2021
Revision	Purpose Description	Originated	Checked	Reviewed	Authorised	Date

Contents

List of Tables

List of Figures

Appendices

1. Introduction

1.1 Report Context

This report describes the findings of a Stage 1 Road Safety Audit associated with the Kilsaran Bellewstown Access & Road Improvements project.

The Audit has been completed by Traffico Ltd. on behalf of Kilsaran.

1.2 Details of Site Inspection

Date	Daylight / Darkness	Weather & Road Conditions
Tuesday 14th September 2021	Daylight	Sunny with clouds, dry roads.

Table 1.1 – Site Inspection Details

1.3 The Road Safety Audit Team

The members of the Road Safety Audit Team have been listed following:

Status	Name / Qualifications	TII Auditor Reference No:
Audit Team Leader (ATL)	**Martin Deegan** BEng(Hons) MSc CEng MIEI	MD101312
Audit Team Member (ATM)	**Jason Walsh** BEng (Hons) PCert (RSA) CEng MIEI	JW3362499
Audit Trainee (AT)	-	-

Table 1.2 – Audit Team Details

1.4 Design Drawings Examined as Part of the Audit Process

The following drawing(s) were examined as part of the Road Safety Audit (RSA) process:

Drawing No.	Drawing Title	Revision
03138-20-P-00 to 03138-20-P-08 (9 sheets)	Proposed New Access Road (L56172 to L1615) and Road Improvements to L1615	-
03138-20-P-09 (1 sheet)	Proposed Link Road Vertical Profile – Long Section	-

Table 1.3 – Designers Drawing List

1.5 Road Safety Audit Compliance

Procedure and Scope

This Road Safety Audit has been carried out in accordance with the procedures and scope set out in TII publication number GE-STY-01024 - Road Safety Audit.

As part of the road safety audit process, the Audit Team have examined only those issues within the design which relate directly to road safety.

Compliance with Design Standards

The road safety audit process is not a design check, therefore verification or compliance with design standards has not formed part of the audit process.

Minimizing Risk of Collision Occurrence

All problems described in this report are considered by the Audit Team to require action in order to improve the safety of the scheme and minimise the risk of collision occurrence.

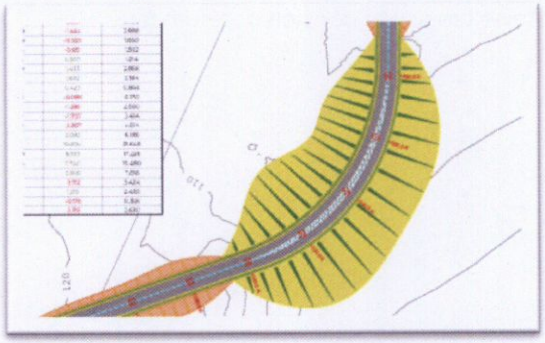
2. Road Safety Issues Identified

2.1 Problem: Errant Vehicles at Embankments

Location: Where Horizontal Curves are Combined with Embankments

The risk of injury to an errant vehicle's occupants is increased at locations where horizontal curves are combined with significant earth embankments.

Figure 2.1 – Example Where Horizontal Curve is Combined with Embankment



Recommendation

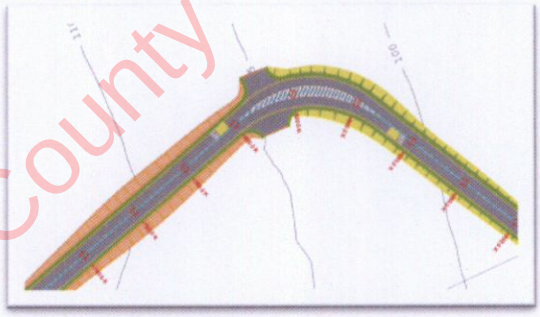
Appropriate vehicle restraint systems should be specified to contain errant vehicles at the locations described.

2.2 Problem: Loss of Control at Horizontal Curve

Location: Horizontal Curve at Link Road Chainage 800.0 K to Chainage 850.0 K

The long straight approaches to the (relatively) low radius curve could result in inappropriate entry speeds, leading to loss of control type collisions.

Figure 2.2 – Straight Approaches to Horizontal Curve



Recommendation

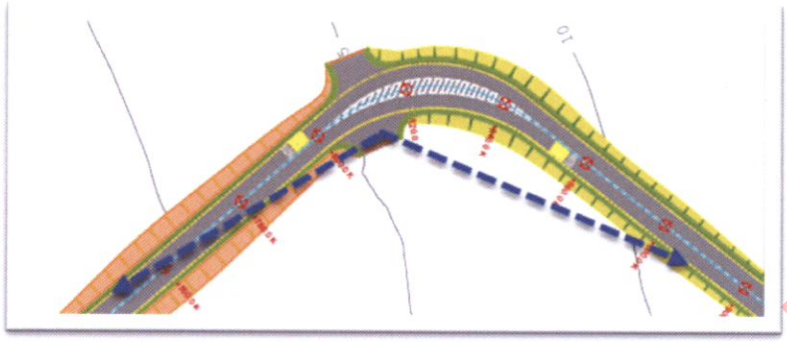
Warning signage should be provided for drivers on both approaches to (and also around) the horizontal curve.

2.3 Problem: Field Access on Horizontal Curve

Location: **Horizontal Curve at Link Road Chainage 810.0 K**

The envelope of visibility could be restricted by the geometry of the horizontal curve and boundary treatments. This could lead to conflicts between farm traffic and mainline traffic.

Figure 2.3 – Field Access Proximity to Curve



Recommendation

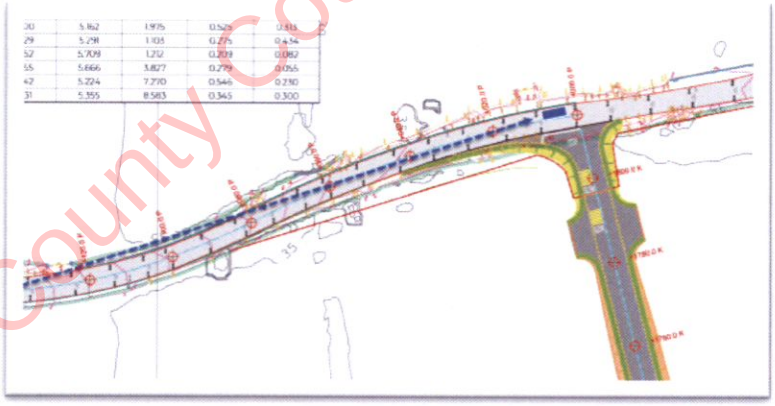
The field access should be moved to a point where an appropriate envelope of visibility can be provided.

2.4 Problem: Stopping Sight Distance to Right Turning Vehicle

Location: **New Link Road T-Junction with Local Road. Link Road Chainage 1,815.0 K**

The constraints of the existing local road may impede the Stopping Sight Distance to a stationary right turning vehicle. This could lead to rear end shunt type collisions.

Figure 2.4 – Stopping Sight Distance to Stationary Right Turning Vehicle



Recommendation

Appropriate Stopping Sight Distance should be provided along the Local Road to a stationary right turning vehicle.

2.5 Problem: Drivers Not Aware of Quarry

Location: **Improved Quarry Access onto Local Road. Link Road Chainage 0.070 K**

Drivers may not be aware of the quarry access. This could lead to conflicts with slow moving HGV's and / or vehicles turning into the quarry access in error.

Recommendation

Suitable signage should be provided on the local road approaches to warn road users that slow moving HGV's will be crossing the local road.

3. Audit Team Statement

3.1 Certification & Purpose

We certify that we have examined the drawing(s) listed in Chapter 1 of this Report.

Sole Purpose of the Road Safety Audit

The Road Safety Audit has been carried out with the sole purpose of identifying any features of the design which could be removed or modified to improve the road safety aspects of the scheme.

3.2 Implementation of RSA Recommendations

The problems identified herein have been noted in the Report together with their associated recommendations for road safety improvements.

We (the Audit Team) propose that these recommendations should be studied with a view to implementation.

Audit Team's Independence to the Design Process

No member of the Audit Team has been otherwise involved with the design of the measures audited.

3.3 Road Safety Audit Team Sign-Off

Martin Deegan
Audit Team Leader
Road Safety Engineering Team
traffico

Signed:
Date: 21st September 2021

Jason Walsh
Audit Team Member
Road Safety Engineering Team
traffico

Signed:
Date: 21st September 2021

4. Designers Response

4.1 How the Designer Should Respond to the Road Safety Audit

The Designer should prepare an Audit Response for each of the recommendations using the Road Safety Audit Feedback Form attached in Appendix A.

When completed, this form should be signed by the Designer and returned to the Audit Team for consideration. See flow-chart following for further description.

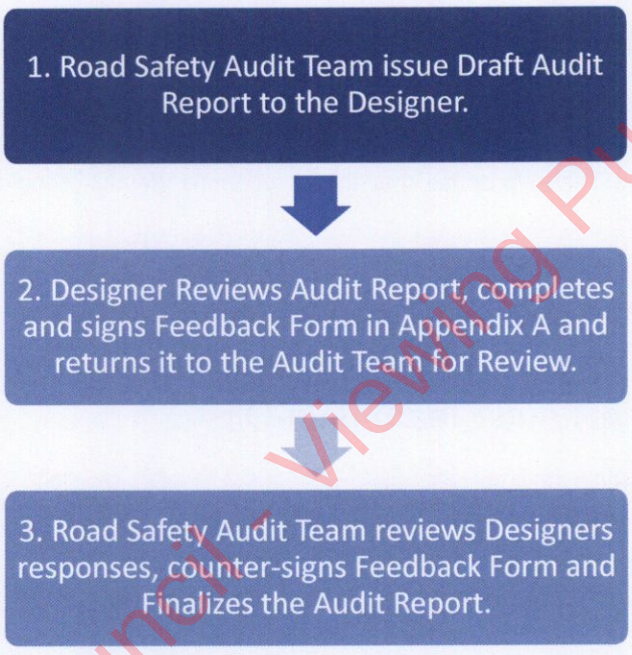


Figure 4.1 – Road Safety Audit Sign-Off and Completion Process

4.2 Returning the Completed Feedback Form

The Designer should return the completed Road Safety Audit Feedback Form attached in Appendix A of this report to the following email address:

- Email address: martin@traffico.ie

The Audit Team will consider the Designer's response and reply indicating acceptance or otherwise of the Designers response to each recommendation.

Triggering the Need for an Exception Report

Where the Designer and the Audit Team cannot agree on an appropriate means of addressing an underlying safety issue identified as part of the audit process, an Exception Report must be prepared by the Designer on each disputed item listed in the audit report.

Appendix A

A.1 Road Safety Audit Feedback Form

Road Safety Audit Feedback Form

Scheme: Kilsaran Bellewstown Access & Road Improvements

Audit Stage: Stage 1 Road Safety Audit | **Audit Date:** 21st September 2021

Problem Reference (Section 2)	Designer Response Section			Audit Team Response Section
	Problem Accepted (yes / no)	Recommended Measure Accepted (yes / no)	Alternative Measures or Comments	Alternative Measures Accepted (yes / no)
2.1	Y	Y	Appropriate vehicle restraint systems will be specified at the detailed design stages in accordance with current guidance and best practice. Sufficient verge space is included in the road cross-section to accommodate proprietary barrier systems.	Noted with thanks
2.2	Y	Y	The current layout drawings include 'SLOW' road markings in advance of bends and at junctions. At chainage 800-850 these road markings will be complemented by appropriate signing indicating the bend ahead and the need to reduce speed. The layout and design of signs and road markings will be finalised at the detailed design stage.	Noted with thanks
2.3	Y	Y	The road design has been updated. The proposed crossing point has been relocated to Chainage 940 which is a straight section of road approximately 100m east of the bend.	Noted with thanks
2.4	Y	Y	Visibility at the proposed access accords with the national roads design standards for the Design Speed of the receiving road. Forward visibility to a right turning vehicle is one step below the desirable distance. These matters are addressed in EIAR Section 12.4.4. It is proposed to mitigate this shortfall by providing advance warning signs of turning traffic and through the provision of high friction wearing course along the 120 m section of the southbound approach lane to the proposed new junction.	Noted with thanks
2.5	Y	Y	Advance warning signing and road markings will be incorporated on the approaches to the site access on L56172 Mullagh Road and at both ends of the proposed new link road between L1615 and L56172. The layout position and design of the signing on the public road will be finalised at the detailed design stage. The detailed design of the signage and road marking works will be agreed with Meath County Council and the works will be carried out by Meath County Council or an appointed and authorised agent of Meath County Council.	Noted with thanks

Designer's Name:	Julian Keenan	Designer's Signature:	Julian M Keenan	Date:	28/10/2021
Audit Team's Name:	Martin Deegan	Audit Team's Signature:	Martin Deegan	Date:	28th October 2021

APPENDIX 12.4: BEAUMONT BRIDGE STRUCTURAL ASSESSMENT

WS Atkins Stage 1 Structural Assessment Report
WS Atkins Stage 2 Structural Assessment Report

ATKINS

Member of the SNC-Lavalin Group

Beaumont Bridge Structural Assessment

Stage 2 Structural Assessment Report

Kilsaran

February 2022

ATKINS
Member of the SNC-Lavalin Group

Notice

This document and its contents have been prepared and are intended solely as information for Kilsaran and use in relation to Beaumont Bridge Structural Assessment

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Document history

Revision	Purpose description	Origin-ated	Checked	Reviewed	Authorised	Date
Rev 1.0	Issue for Review	RMcS	MG	MJ	MJ	25/02/2022

Client signoff

Client	Kilsaran
Project	Beaumont Bridge Structural Assessment
Job number	5210920
Client signature / date	

ATKINS
Member of the SNC-Lavalin Group

Contents

Tables

Executive Summary

MH-L1615-001.00 Beaumont Bridge is a seven span masonry arch structure carrying the L1615 local road over the River Nanny in the townland of Beaumont, Co. Meath. The structure has span widths varying between 2.31m and 4.51m with a total length of 44.65m and a width out to out of 7.5m. The structure shows evidence of historical widening works using masonry construction, with varying arch profiles and open joints evident below the structure.

The structure is a protected structure and is listed in the Record of Protected Structures within the Meath County Development Plan 2021-2027.

The structure is in an overall fair condition with minor areas of masonry and pointing loss found to the arch barrels, piers and abutments. Repointing works should be undertaken in order to restore these key structural elements to a good condition.

The depression noted to the carriageway surfacing and the scour damage to the riverbed are the defects of most concern. Repairs are recommended to be undertaken to the areas of scour damage below the structure with the mainline carriageway surfacing previously only extended to arch 3 over the structure now extended to beyond the south abutment. The grass verges over the structure should be replaced by either concrete verges or the extension of the carriageway surfacing to prevent further water ingress through the arch barrels.

The Stage 1 Structural Assessment (Report reference 5210920DG0001) found the structure to have a low load capacity of <3t and 3t for the lowerbound and upperbound conditions respectively. A Stage 2 Assessment was recommended to be undertaken to the structure in order to confirm the load capacity of the structure. Structural Investigation works were subsequently undertaken to the structure to determine the exact depth of fill above each arch barrel and the thickness of each arch barrel. The investigation works also confirmed the existing arch backing to be a silty clay material with minor cobble and boulder content.

The Stage 2 Structural assessment of the structure was undertaken in accordance with TII Publication *AM-STR-06057 Stage 2 Structural Assessment of Road Structures*. The structural assessment found the existing structure to have a reduced load capacity of less than 3t due to the shallow depth of fill above the structure and the reduced arch thicknesses of certain arch barrels. Despite the assessed low load capacity of the structure Beaumont Bridge is behaving satisfactorily under current loading with no load restriction currently in place.

The results from the Archie-M analysis shows that the presence of concrete backing to the arch barrels increases the load capacity of the structure to the required 46t capacity. The installation of low strength concrete backing is therefore recommended to the areas between the piers and above the abutments of the structure. Construction details for the concrete backing and subsequent resurfacing works are to be determined at detailed design stage of the proposed repair and strengthening works.

The recommended repair and strengthening works for the structure to be agreed in liaison with Meath County Council are as follows:

- Masonry repointing to the arch barrels, piers and abutments
- Installation of low strength concrete backing to the arch barrels
- Resurfacing of the carriageway over the structure
- Repairs to areas of undermining to the north abutment and northern piers
- Infilling of scour holes at the west elevation
- Removal of debris trapped at the west elevation of arch barrel 7
- Replacement of the grass verges with new concrete verges or extension of the carriageway pavement
- Vegetation removal and repointing to the parapets, spandrel walls and wing walls
- Vegetation clearance to the embankments

1. Introduction

Kilsaran engaged Atkins to undertake the structural assessment of MH-L1615-001.00 Beaumont Bridge in accordance with TII Publication *AM-STR-06056 Stage 1 Structural Assessment of Road Structures* to determine the current condition and load capacity of the existing structure. The structural assessment of the structure was undertaken in accordance with TII Publication *AM-STR-06026 The Assessment of Road Bridges and Structures*. The Stage 1 Structural Assessment (Report reference 5210920DG0001) found the structure to have a low load capacity of <3t and 3t for the lowerbound and upperbound conditions respectively. A Stage 2 Assessment was recommended to be undertaken to the structure in accordance with *AM-STR-06057 Stage 2 Structural Assessment of Road Structures* in order to confirm the load capacity of the structure.

2. Description of the Structure

MH-L1615-001.00 Beaumont Bridge is a seven span masonry arch structure carrying the L1615 local road over the River Nanny in the townland of Beaumont, Co. Meath. The structure has span widths varying between 2.31m and 4.51m with a total length of 44.65m and a width out to out of 7.5m. The structure shows evidence of historical widening works using masonry construction, with varying arch profiles and open joints evident below the structure.

The structure is a protected structure and is listed in the Record of Protected Structures within the Meath County Development Plan 2021-2027.

The location of the structure is shown on the location map in Appendix A of this report.

3. Visual Inspection

The Principal Inspection of the structure was undertaken in December 2021. The condition of each component of the structure is outlined below with photographs from the inspection provided in Appendix C of this report. For the purposes of inspection the arch barrels and piers and have been numbered in a north to south direction.

Bridge Surface

The carriageway surfacing over the structure is split into 2no. distinct sections, the local road surfacing and the newer tie in surfacing from the mainline R150 local road.

The newer tie in surfacing is in a good condition overall, with the local road surfacing showing a loss of skid resistance throughout with areas of surfacing loss and potholes forming. There is also an area of depression noted to the carriageway surface above pier 3. See Photograph B-1 to B-3 for details of the bridge surface.

Verges

Raised grass verges are present along the base of both parapets over the structure, with areas of water ingress noted to the arch barrels below. See Photograph B-4 and B-5 for both verges.

Parapets

The masonry parapets are in a good overall condition with minor vegetation removal and repointing required. See Photograph B-4 and B-5 for both parapets.

Embankments

The embankments at both elevations are in a fair overall condition with areas of vegetation clearance required to maintain access to the structure. See Photograph B-6 to B-9. There is large debris restricting access to arch 7, see Photograph B-29.

Wing/Spandrel walls

The wing and spandrel walls are in a fair condition overall with areas of vegetation growth and minor pointing loss evident. See Photograph B-10 and B-11 for the spandrel walls.

Abutments

The abutments are in a good overall condition apart from pointing loss and undermining to the north abutment below the waterline. The south abutment is mostly hidden below the mudline, see Photograph B-12 and B-13 for both abutments.

Piers

The piers are in a fair overall condition with minor areas of pointing loss to the pier faces and vegetation growth to the cutwaters. There is also 400mm deep undermining noted to pier 1 and 200mm deep undermining noted to pier 2 with masonry and pointing loss noted below the waterline, see Photograph B-14 to B-21 for the piers.

Arch Barrels

The masonry arch barrels are in a fair condition overall with minor masonry and pointing loss evident to localised areas throughout. Water ingress is evident to all arch barrels most likely due to the soft verges over the structure with a transverse crack also evident to the arch barrel of span 1 above the north abutment.

See Photograph B-22 to B-29 for the arch barrels.

Riverbed

The riverbed below the structure is in a poor condition due the extensive scour noted at the upstream elevation of spans 1 to 4, with scour depths of up to 500mm recorded. Undermining is evident to the piers in spans 1 and 2 as a result of the scour to the adjacent riverbed. Both the upstream and downstream watercourse are impacted by overgrown vegetation with the watercourse mainly channelled through arches 3 and 4 as a result.

See Photograph B-30 and B-31 for the riverbed.

Overall Structure

The structure is in an overall fair condition with minor areas of masonry and pointing loss found to the arch barrels, piers and abutments. The depression noted to the carriageway surfacing and the scour damage to the riverbed are the defects of most concern.

See Photograph B-32 and B-33 for both elevations of the structure.

4. Summary of Stage 1 Structural Assessment

The Stage 1 Structural Assessment of the structure was undertaken in January 2021 in accordance with TII Publication *AM-STR-06056 Stage 1 Structural Assessment of Road Structures*. The structural assessment found the existing structure to have a reduced load capacity of >3t and 3t for the lowerbound and upperbound conditions respectively, mainly due to the shallow depth of fill above the structure, estimated to be less than 100mm in places. Investigation works were therefore recommended to determine the exact depth of fill above each barrel and the thickness of each arch in order to undertake a Stage 2 Structural Assessment. The results of the Stage 1 Assessment are as outlined in Table 4-1 and 4-2 below.

Table 4-1 Results of Stage 1 Modified MEXE Analysis

	Max Gross Vehicle Weight (tonnes)	
	Upper Bound	**Lower Bound**
Arch Barrel 1	40t	18t
Arch Barrel 2	40t	40t

	Max Gross Vehicle Weight (tonnes)	
	Upper Bound	Lower Bound
Arch Barrel 3	18t	18t
Arch Barrel 4	18t	18t
Arch Barrel 5	40t	40t
Arch Barrel 6	40t	40t
Arch Barrel 7	40t	40t

Table 4-2 Results of the Stage 1 Archie-M Analysis

		Present Condition	Good Condition	Backing Present
HA Loading	Lowerbound	Fails 3t	Fails 3t	44t
	Upperbound	3t	3t	44t
SV Loading	Lowerbound	Fails SV80	Fails SV80	SV80
	Upperbound	Fails SV80	Fails SV80	SV100

For further detail on the Stage 1 Assessment please refer to the Stage 1 Structural Assessment Report (ref. 5210920DG0001).

5. Structural Investigation Results

Jons Civil Engineering Co. Ltd. were engaged to undertake structural investigations at Beaumont Bridge in order to determine each arch barrel thickness and the depth of fill above each arch, and also to confirm the backing material behind each pier. The structural investigation works were undertaken on 10th & 11th February with the key findings outlined in Table 5-1 below.

Table 5-1 Results of the Structural Investigation

	Dimension (m)						
	Arch 1	Arch 2	Arch 3	Arch 4	Arch 5	Arch 6	Arch 7
Arch Thickness	0.380	0.270	0.350	0.370	0.500	0.400	0.250
Depth of Fill	0.080	0.200	0.110	0.050	0.400	0.450	0.290

The pier backing material was found to be a silty clay material with minor cobble and boulder content. The investigation works also identified that the exposed crowns of the northern arch barrels in the east verge are above the adjacent road surfacing, possibly due to planing of the arch barrels at this location as part of surfacing works over the structure. Any planing works would have reduced the arch barrel thicknesses which would be a cause of concern for the structure.

For further details on the investigation results refer to the factual report in Appendix C of this document.

6. Stage 2 Structural Assessment

In accordance with the recommendations of the Stage 1 Assessment Report a Stage 2 Structural Assessment was undertaken to the arch barrels of Beaumont Bridge in accordance with *AM-STR-06057 Stage 2 Structural*

Assessment of Road Structures in order to confirm the load carrying capacity of the structure. As the piers and abutments had passed the Stage 1 Assessment they were not considered in the Stage 2 Assessment.

Arch Barrels

A structural assessment of the masonry arch barrels was undertaken using the modified MEXE method outlined in *AM-STR-06002 The Assessment of Road Bridges and Structures*. The structure dimensions surveyed on site by Atkins and the arch dimensions confirmed by the structural investigations are listed below in Table 6-1.

Table 6-1 Structure dimensions used in the Stage 2 Assessment

	Dimension (m)						
	Arch 1	Arch 2	Arch 3	Arch 4	Arch 5	Arch 6	Arch 7
Span	2.360	2.890	4.220	4.510	2.310	2.570	2.720
Rise at Crown	1.170	1.280	1.930	2.010	1.150	1.190	1.350
Rise at Quarter Point	1.050	1.020	1.560	1.660	0.960	1.030	1.100
Ring Thickness	0.380	0.270	0.350	0.370	0.500	0.400	0.250
Depth of Fill	0.080	0.200	0.110	0.050	0.400	0.450	0.290

Based on a visual inspection and the recommendations of *AM-STR-06002* Annex D, the condition factors used in the arch assessment are summarised in Table 6-2 below.

Table 6-2 Condition factors used in the Stage 2 Assessment

Condition Factor		Reasoning
Barrel Factor, F_b	1.0	Limestone in good overall condition
Fill Factor, F_f	0.7	Well compacted material
Joint Width Factor, F_w	0.9	Joint widths between 6mm and 12.5mm
Joint Depth factor, F_d	0.8	Loss of pointing evident, average depths 20mm
Joint Mortar factor, F_{mo}	1.0	Mortar in good condition
Condition Factor, F_{cM}	0.9	Good overall condition with pointing loss evident

The Modified MEXE analysis gives a live load capacity varying between 12.5 and 46 tonnes Gross Vehicle Weight (GVW) for all arch barrels, see Table 6-3 below.

Table 6-3 Results of the Stage 2 Modified MEXE Analysis

	Max Gross Vehicle Weight (tonnes)
Arch Barrel 1	46t
Arch Barrel 2	46t
Arch Barrel 3	18t
Arch Barrel 4	12.5t
Arch Barrel 5	46t
Arch Barrel 6	46t
Arch Barrel 7	46t

As the structure is a multi-span arch structure the guidance given in *AM-STR-06026* was followed with the results from the MEXE analysis corroborated with the results of the three-hinge limit analysis method using Archie-M software. Archie-M analysis was carried out on the structure for both HA and SV assessment loading.

The Archie-M analysis carried out on the structure determined that the existing structure has a less than 3t load capacity. See Table 6-4 below for a summary of the Archie-M analysis results.

Table 6-4 Results of the Stage 2 Archie-M Analysis

	Present Condition	Good Condition	Backing Present
HA Loading	Fails 3t	Fails 3t	46t
SV Loading	Fails SV80	Fails SV80	SV100

The results from the Archie-M analysis shows that the third condition comprising the presence of backing to the arch barrels greatly increases the load capacity of the structure to 46t. The installation of a low strength concrete backing is therefore recommended to the structure.

See Appendix D of this report for the calculations and outputs from both the MEXE and Archie-M analysis.

7. Conclusions

The structure is in an overall fair condition with minor areas of masonry and pointing loss found to the arch barrels, piers and abutments. Repointing works should be undertaken in order to restore these key structural elements to a good condition.

The depression noted to the carriageway surfacing and the scour damage to the riverbed are the defects of most concern. Repairs are recommended to be undertaken to the areas of scour damage below the structure with the mainline carriageway surfacing previously only extended to arch 3 over the structure now extended to beyond the south abutment. The grass verges over the structure should be replaced by concrete verges to prevent further water ingress through the arch barrels.

The low <3t load capacity found for the existing structure is due to the shallow depths of fill over the structure, measured less than 100mm in places by the structural investigation works. Despite the assessed low load capacity of the structure Beaumont Bridge is behaving satisfactorily under current loading with no load restriction currently in place.

The results from the Archie-M analysis shows that the presence of concrete backing to the arch barrels increases the load capacity of the structure to the required 46t capacity. The installation of low strength concrete backing is therefore recommended to the areas between the piers and above the abutments of the structure. Construction details for the concrete backing and subsequent resurfacing works are to be determined at detailed design stage of the proposed repair and strengthening works.

8. Recommendations

The recommended repair and strengthening works for the structure to be agreed in liaison with Meath County Council are as follows:

- Masonry repointing to the arch barrels, piers and abutments
- Installation of low strength concrete backing to the arch barrels
- Resurfacing of the carriageway over the structure
- Repairs to areas of undermining to the north abutment and northern piers
- Infilling of scour holes at the west elevation
- Removal of debris trapped at the west elevation of arch barrel 7
- Replacement of the grass verges with new concrete verges or extension of the carriageway pavement
- Vegetation removal and repointing to the parapets, spandrel walls and wing walls
- Vegetation clearance to the embankments

Appendices

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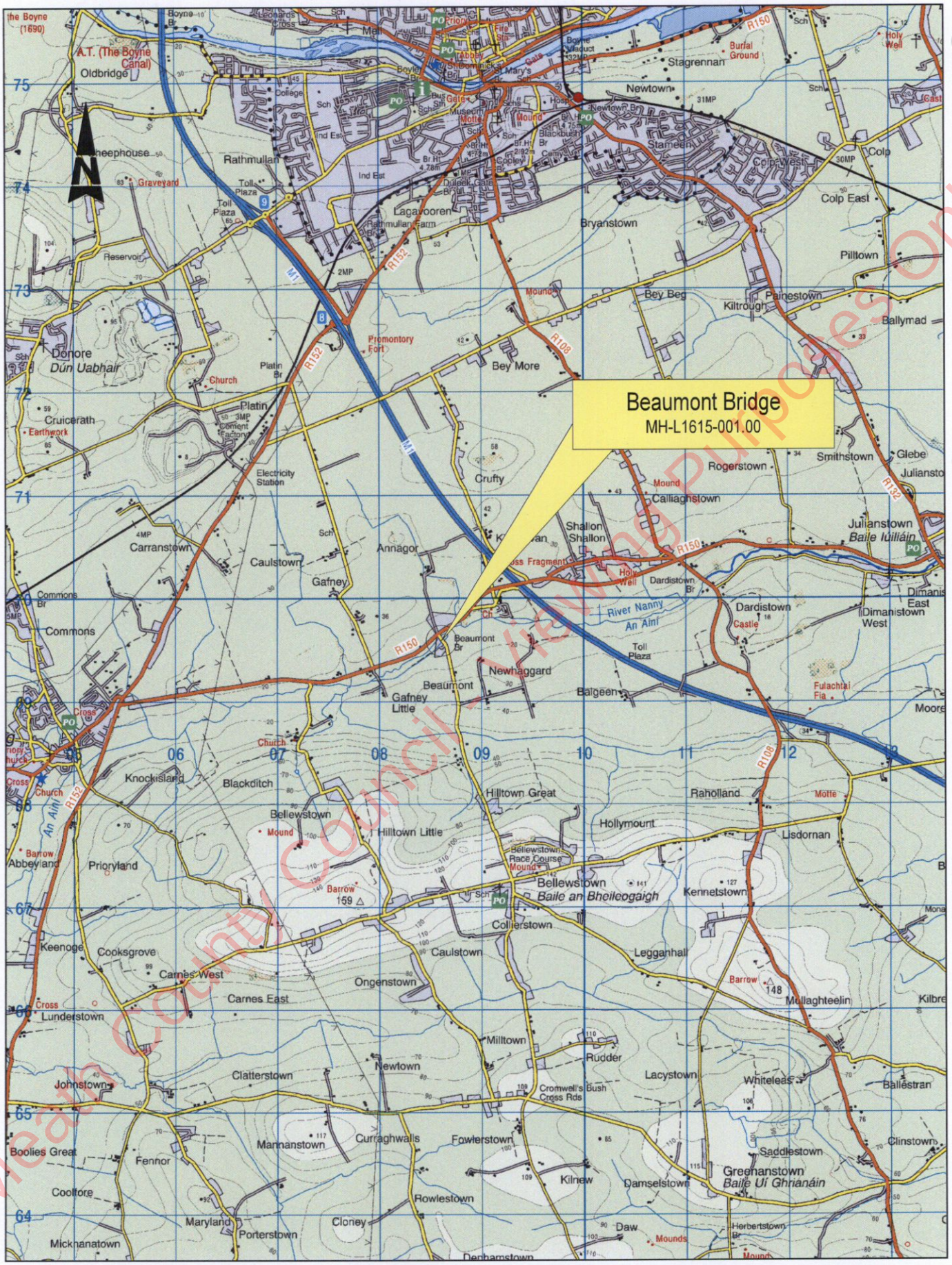
Appendix A. Structure Location Map



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Beaumont Bridge Assessment

Appendix B. Inspection Photographs

Photograph B-1 – Bridge surface looking south

Photograph B-2 – Bridge surface looking north

Photograph B-3 – Area of depression to carriageway surface above pier 3. Note tie into R150 road surfacing above arch 3.

Photograph B-4 – West parapet and grass verge

Photograph B-5 – East parapet and grass verge

Photograph B-6 – NW embankment with overgrown vegetation evident

Photograph B-7 – NE embankment with overgrown vegetation evident

Photograph B-8 – SW embankment with overgrown vegetation evident

Photograph B-9 – SE embankment with overgrown vegetation evident

Photograph B-10 – West spandrel wall with minor vegetation growth evident

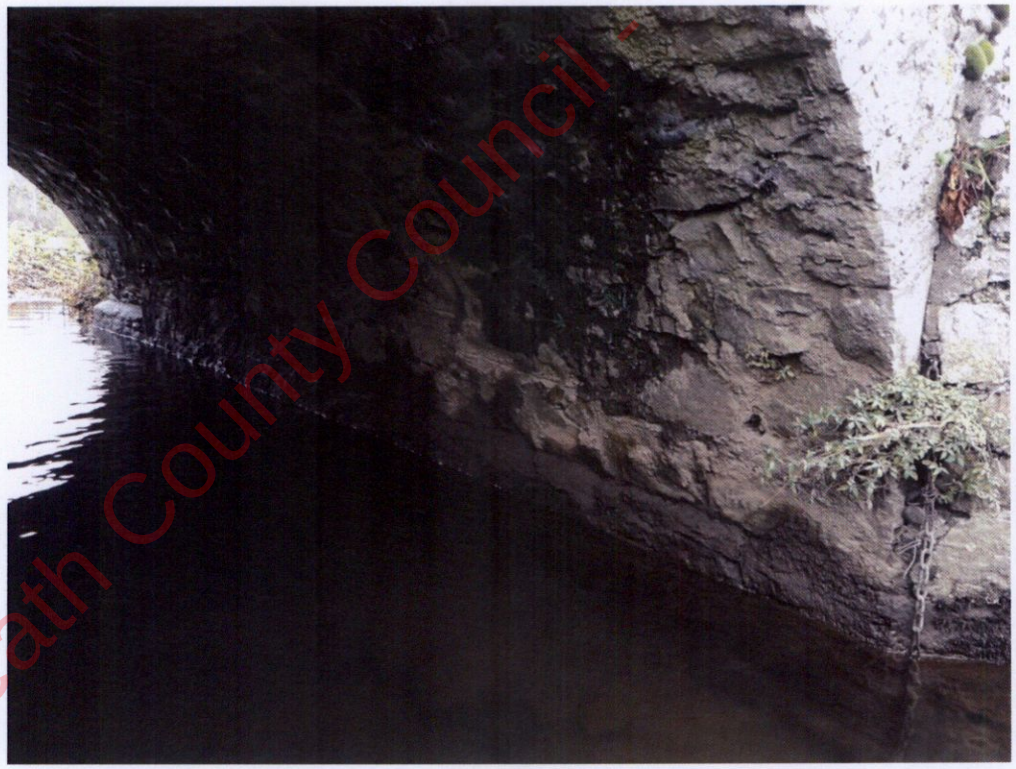
Photograph B-11 – East spandrel wall with minor vegetation growth evident

Photograph B-12 – North abutment with pointing loss and undermining evident below waterline

Photograph B-13 – South abutment

Photograph B-14 – North face of pier 1 with undermining evident

Photograph B-15 – West cutwater of pier 1 with vegetation growth evident



Photograph B-16 – North face of pier 2 with vegetation growth evident

Photograph B-17 – West cutwater of pier 3 with vegetation growth evident

Photograph B-18 – South face of pier 3

Photograph B-19 – West cutwater of pier 4 with vegetation growth evident

Photograph B-20 – South face of pier 4

Photograph B-21 – South face of pier 5

Photograph B-22 – Transverse crack to the bottom of arch barrel 1 above the north abutment

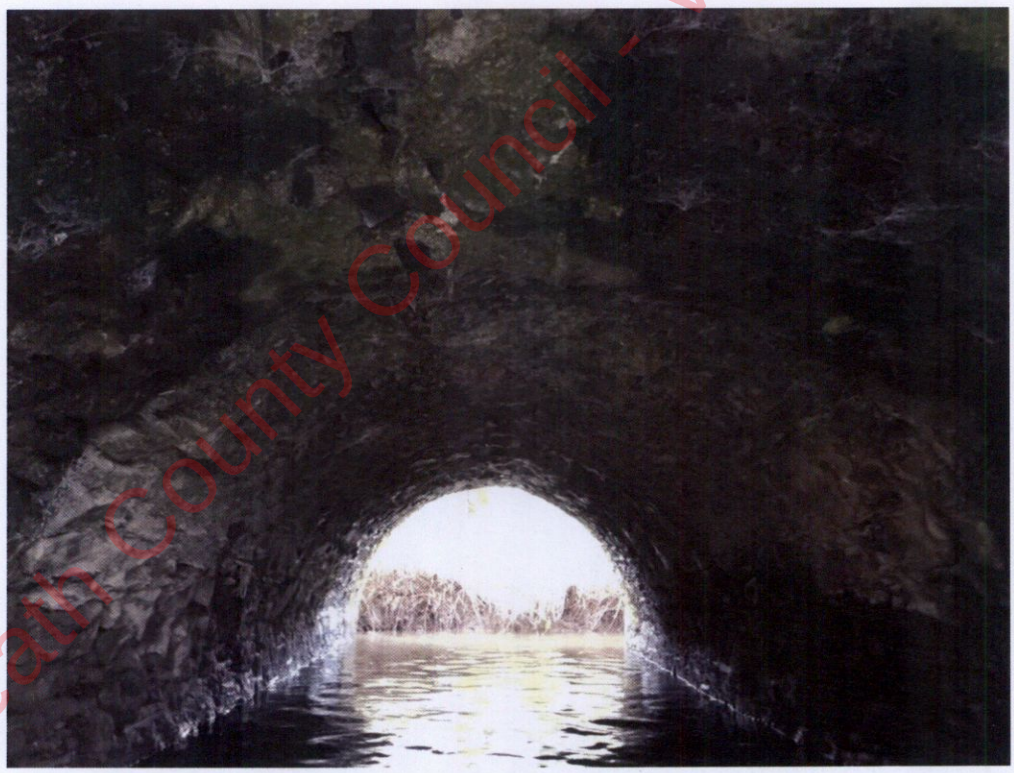
Photograph B-23 – Arch barrel 1 with pointing loss and water ingress evident

Photograph B-24 – Arch barrel 2 with pointing loss, minor masonry loss and water ingress evident

Photograph B-25 – Arch barrel 3 with dropped stones, minor masonry loss and pointing loss evident

Photograph B-26 – Arch barrel 4 with minor pointing loss evident and recent repointing works visible

Photograph B-27 – Arch barrel 5 with water ingress and minor pointing loss evident with a change in the arch profile evident



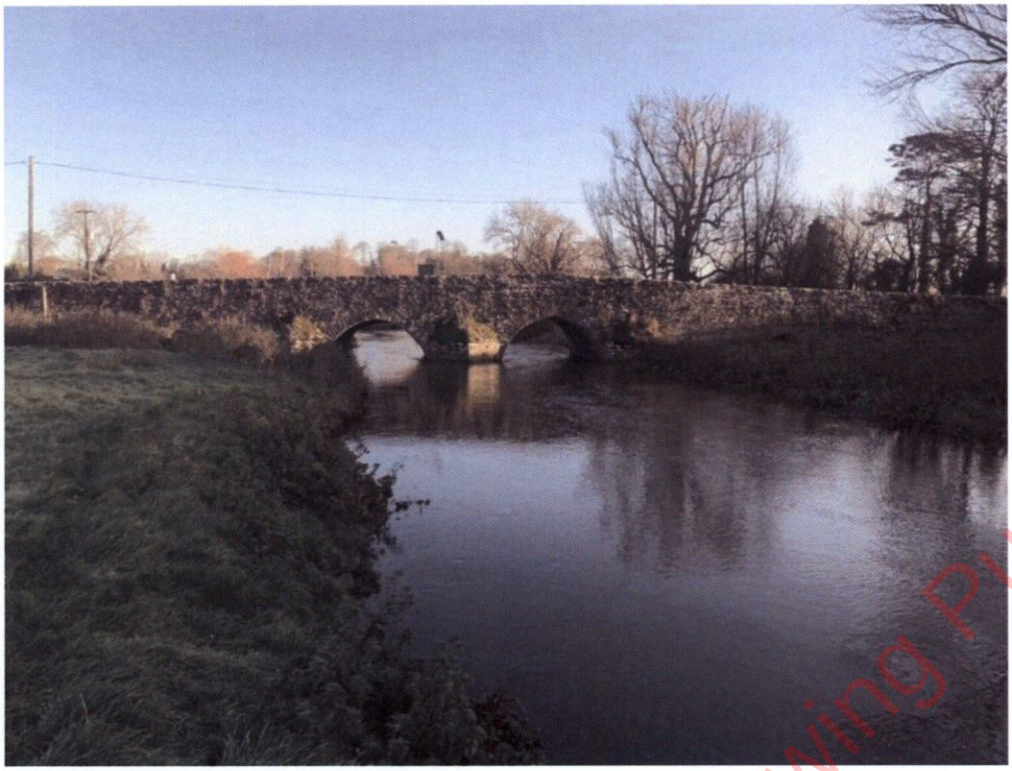
Photograph B-28 – Arch barrel 6 with water ingress and minor pointing loss evident

Photograph B-29 – Arch barrel 7 with water ingress and minor pointing loss evident and debris located at the west elevation with a change in the arch profile evident

Photograph B-30 – View of downstream riverbed

Photograph B-31 – View of upstream riverbed with watercourse main channel through arches 3 and 4

Photograph B-32 – View of east elevation



Photograph B-33 – View of west elevation

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Appendix C. Structural Investigation Report

Jons Civil Engineering Co. Ltd.

Investigation Works atMH-L16615-001.00

Brief

- *7no. slit trenches in the west soft verge to confirm the arch thickness and depth of fill of each arch (to include presence of any services)*
- *6no. trial excavations in the east soft verge above each pier to confirm the presence of any backing material , maximum expected depth of 1.5m be. low carriageway level (to include presence of any services)*
- *CAT scans to both verges prior to works commencing in order to determine the presence of any services*

INTRODUCTION

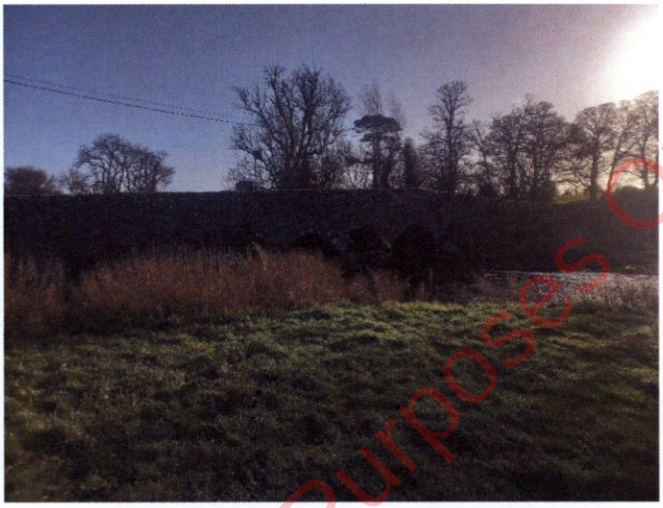
Jons Civil Engineering Limited (JCEL) were employed by Kilsaran to carry out site investigations to facilitate a Stage 2 Structural Assessment by Atkins.

JCEL submitted a T1 License Request to Meath County Council for the works which was issued on the 10/02/2022. JCEL commenced the works on 10/02/2022 and completed on 11/02/2022.

AS part of the investigation JCEL carried out the following;

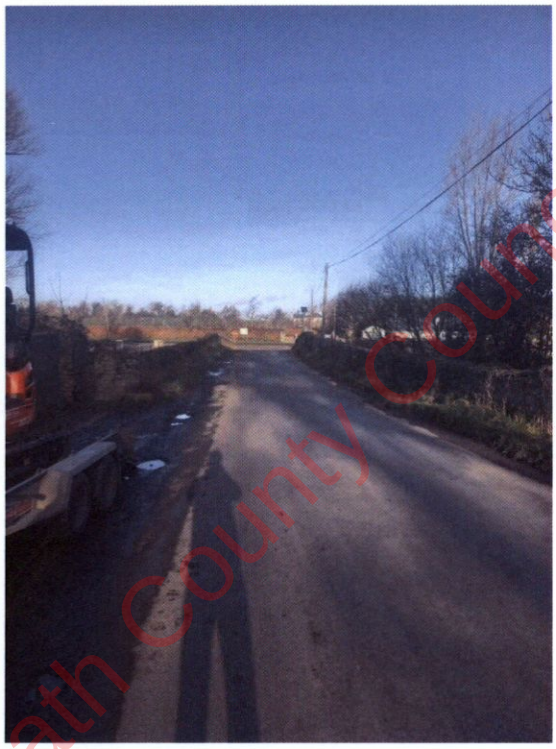
- Desktop survey of services in area (see attached service drawings in Appendix A)
- Precondition photographic survey of the road and verge condition
- Temporary Traffic Management (TTM) for the works
- 7no. Slit trenches carried out in west soft verge to determine arch thickness
- 2 no. trial excavations carried out in East soft verge at main pier locations to confirm presence of any backing material
- 7no. Slit trenches carried out in East soft verge to determine arch thickness
- 6 no. trial excavations carried out in west soft verge at main pier locations to confirm presence of any backing material
- 1 no. trail excavation carried out on MH-L1615-002.00 (Beaumond Bridge) to determine depth to soffit
- De-Vegetation on East parapet wall.

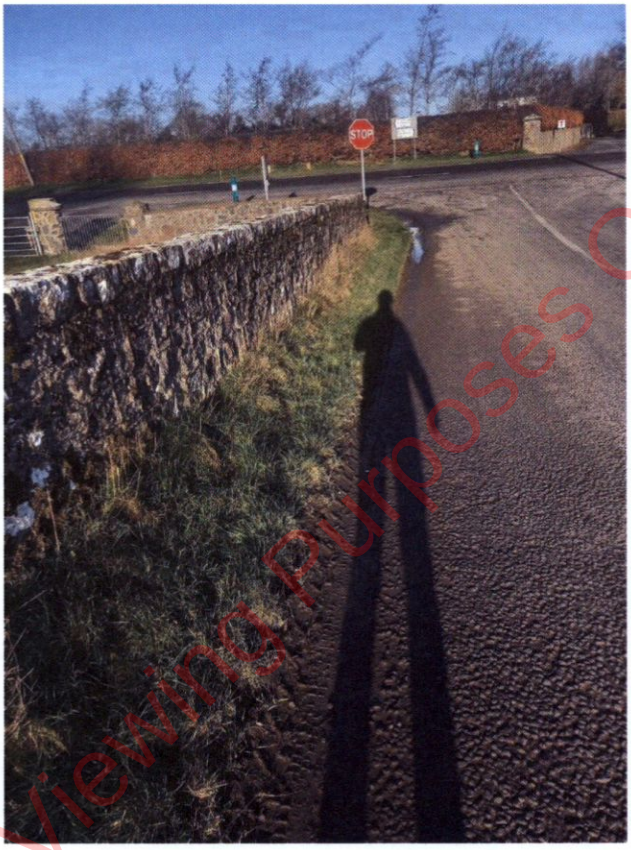
West Elevation



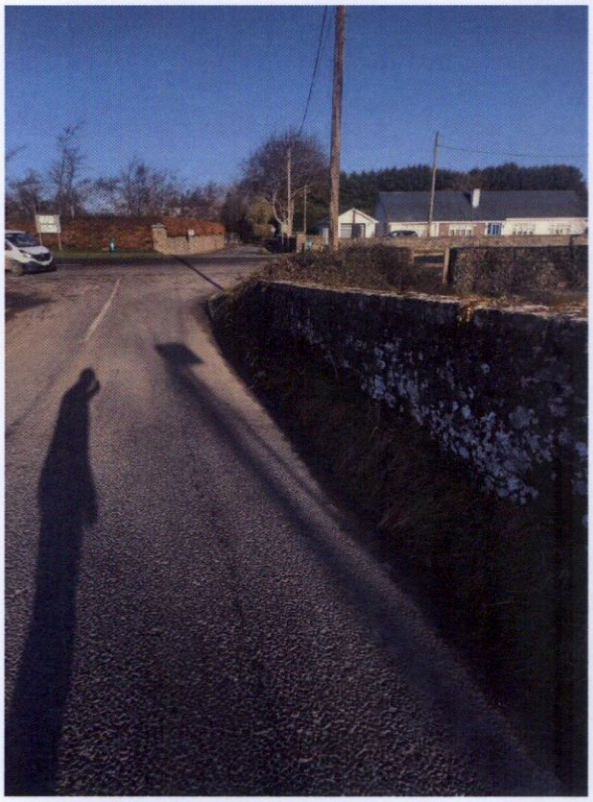
East Elevation

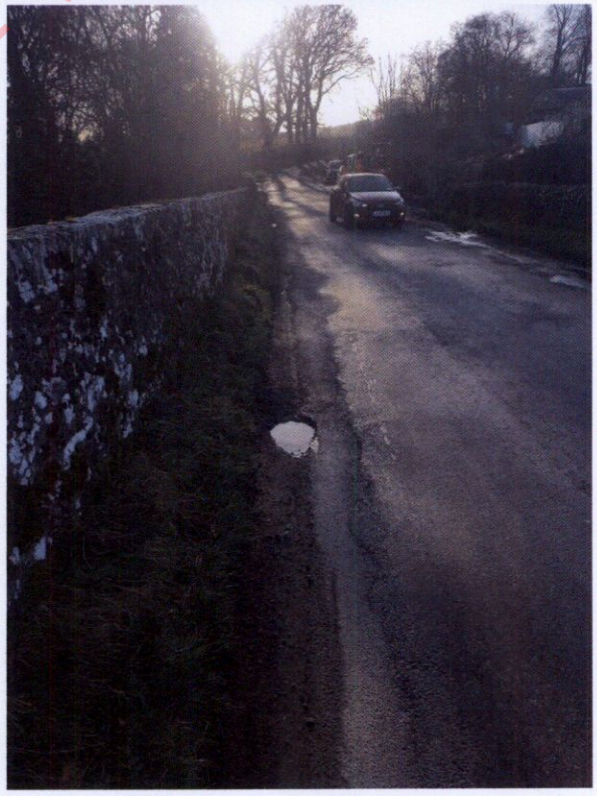
East Verge





West Verge





Beaumond Bridge

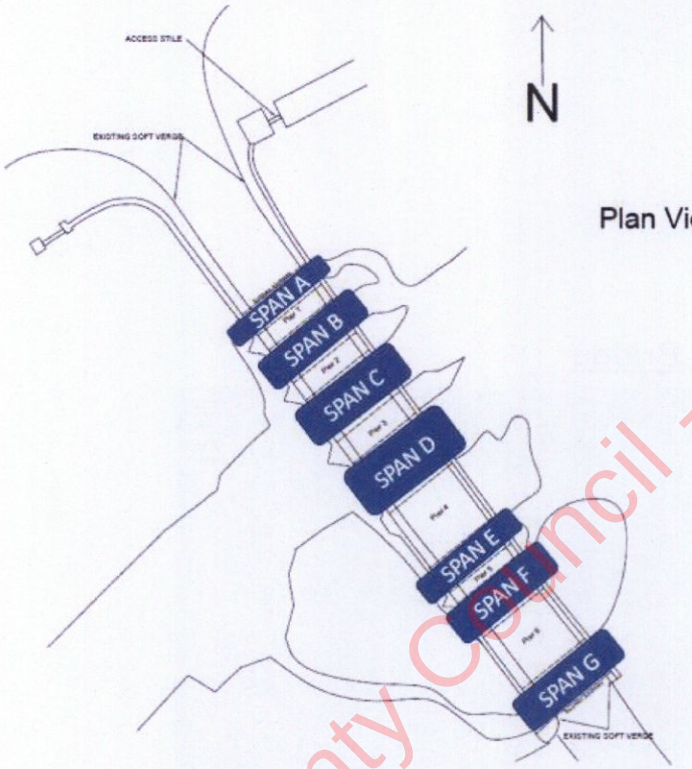
Service Location

JCEL requested service drawings from all the major utility providers. EIR, ESB and GNI drawings are included in appendix A.

No ESB or GNI service is located on the structure, EIR service drawings show an overhead service (visual confirmation on site) and buried service on the East Verge.

CAT scan survey was carried out on both verges and carriageway using an RD7000 and signal generator. No buried services were detected. After completing trial holes we can confirm that there are no buried services within the verge. Upon inspection of the overhead service, it appears that the cable being identified as buried is actually overhead (two cables present overhead).

Top of Arch Trail Holes

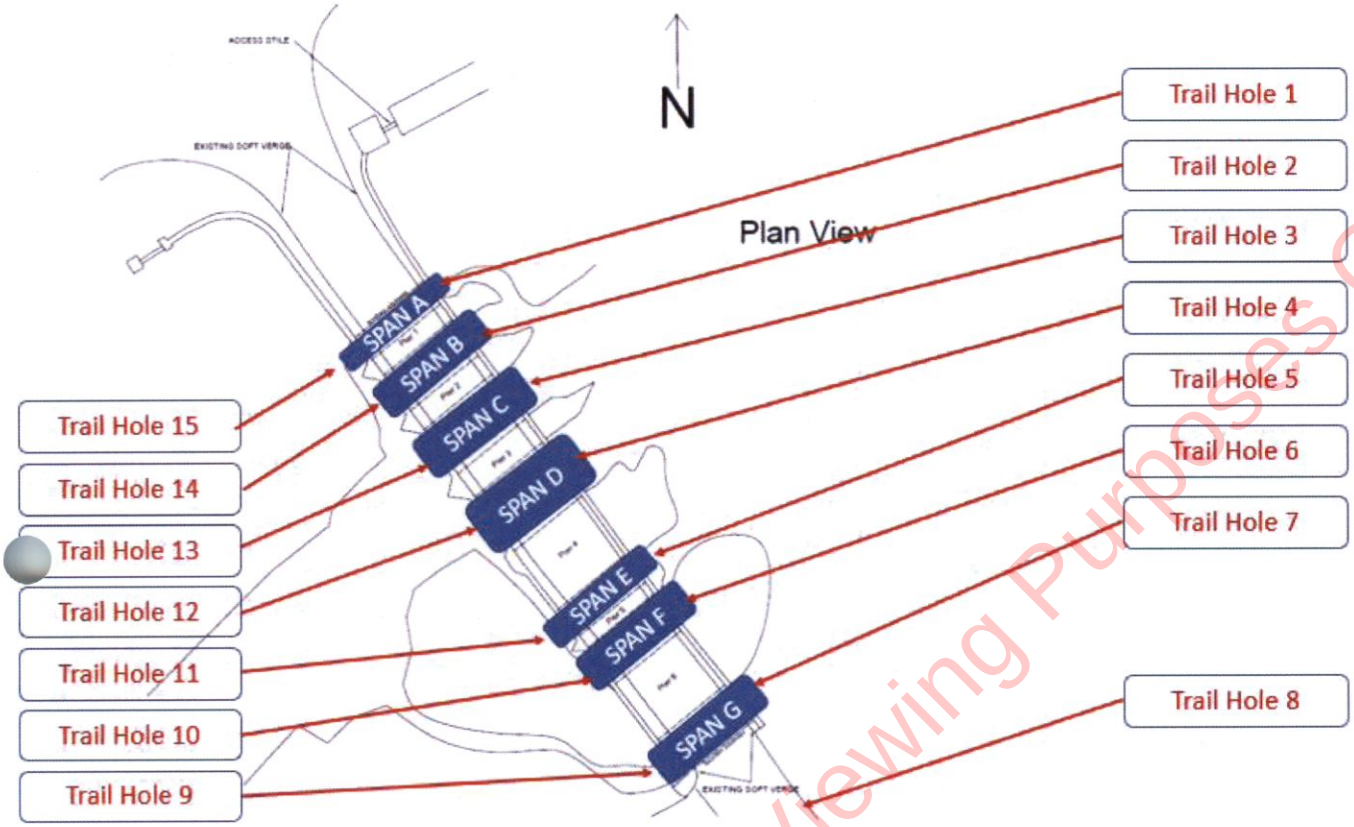


N

Plan View

Span Ref	West	East
A	0.38	0.35
B	0.27	0.4
C	0.35	0.42
D	0.37	0.32
E	0.5	0.525
F	0.4	0.42
G	0.25	0.45

Table A 1 Arch Thickness



SPAN A

East (Trail Hole 1)

1.7 to bottom of key stone

1.35m to top of arch (measured from parapet)

West (Trial Hole 15)

1.78 to bottom of key stone

1.4m to top of arch (measured from parapet)

80mm below road

SPAN B

East (Trial Hole 2)

1.8 to bottom of key stone

1.4m to top of arch (measured from parapet)

West (Trial Hole 14)

1.8 to bottom of key stone

1.53m to top of arch (measured from parapet)

200mm below road

SPAN C

East (Trial Hole 3)

1.85 to bottom of key stone

1.43m to top of arch (measured from parapet)

West (Trial Hole 13)

1.8 to bottom of key stone

1.45m to top of arch (measured from parapet)

110mm below road

SPAN D

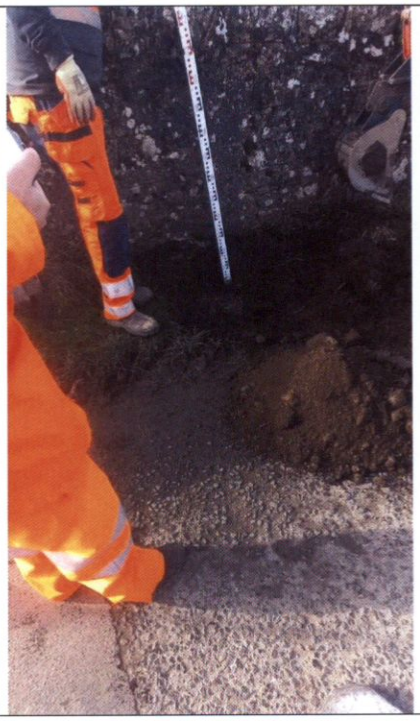
East (Trial Hole 4)

1.57 to bottom of key stone

1.25m to top of arch (measured from parapet)

Top of arch is above road level

West (Trial Hole 12)

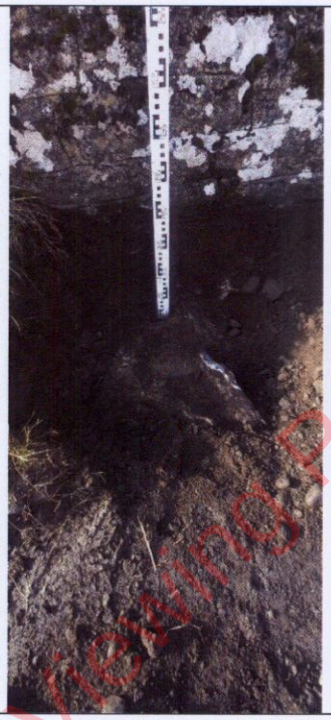


1.8 to bottom of key stone

1.43m to top of arch (measured from parapet)

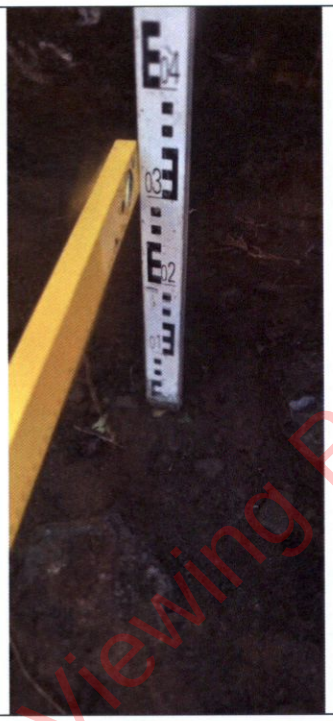
50mm below road

SPAN E

East (Trial Hole 5)	West (Trial Hole 11)
2.385 to bottom of key stone 1.86m to top of arch (measured from parapet) **100mm below road**	 1.95 to bottom of key stone 1.45m to top of arch (measured from parapet) (Back of key stone) 0.4m below road. (measures 1.55m nearer to road) arch thickness taken as 0.4m.

SPAN F

East (Trial Hole 6)	West (Trial Hole 10)
 **2.35 to bottom of key stone** 2.08m to top of arch (measured from parapet) **650mm below road**	 1.95 to bottom of key stone 1.55m to top of arch (measured from parapet) 0.45m below road.

SPAN G	
East (Trial Hole 7)	West (Trial Hole 9)
1.9 to bottom of key stone 1.45m to top of arch (measured from parapet) 350mm below road	 1.53 to bottom of key stone 1.28m to top of arch (measured from parapet) 0.29m below road.

Beaumond Bridge (Trial Hole 8)

Concrete slab 2.35 from top of parapet to underside of deck, 2.08m to top of deck, depth of fill 850mm. Fill is a Gravely SILT with cobble content. No water proofing evident.

Pier Surveys - East Side

Pier 1

660mm depth below road, fill is a gravely SILT. Both arches meet (very narrow pier). Dip to ground level = 3.65m, refusal at 1.95m.

Pier 2

Dip to ground level from parapet 4m. Bottom of trail hole = 2.28. Refusal was stone + mortar.

Depth below road 1.03m

Pier 3

Dip to ground level = 4.35m, refusal at 2.63m. Depth below road at 1.2m.

SILT Backfill, with some cobble content (50-80mm) and some boulder content (max 200mm)

Pier 4

1.4m below road to solid. Fill is stoney, SILT cobbles and some boulders up to 200mm.

Dip from top of parapet to ground level 4.35m. Parapet to bottom of trial hole 2.7m.

Pier 5

1.2m below road to solid. Fill is brown silty sandy CLAY with small cobbles. Trail hole terminated once solid material encountered at 1.2m depth, lime mortar evident at bottom of hole.

Dip from top of parapet to ground level 4.1m. Parapet to bottom of trial hole 2.5m.

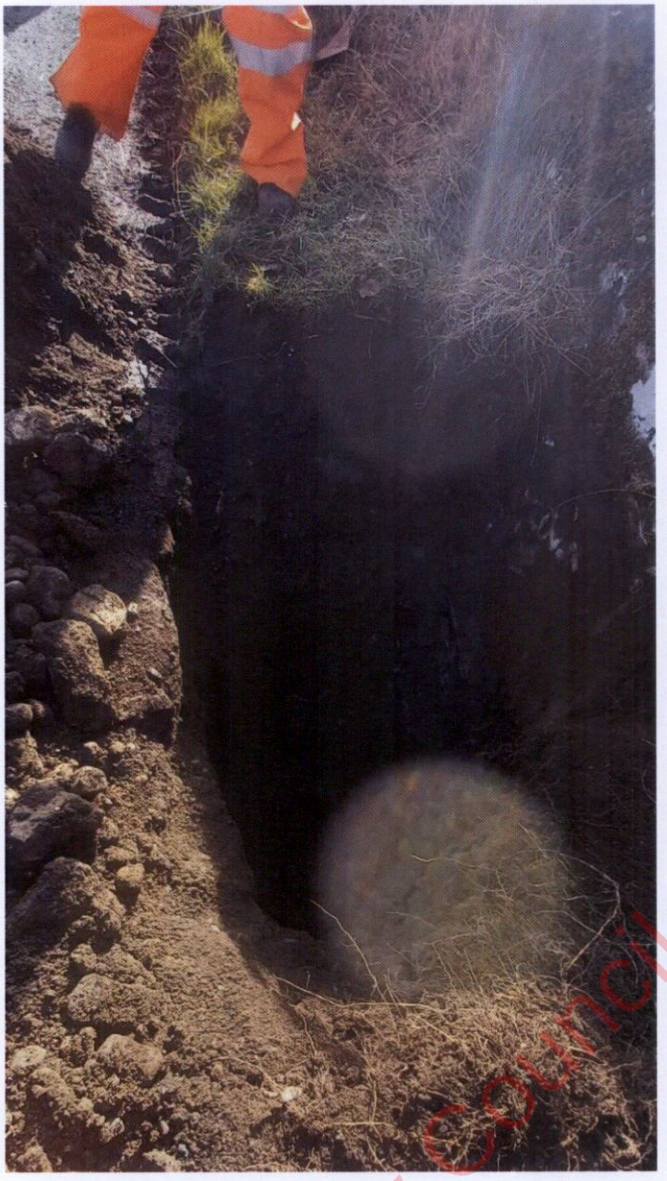
Pier 6

1.5m below road to solid. Fill is silty CLAY with small cobble content.

Dip from top of parapet to ground level 3.8m. Parapet to bottom of trial hole 2.7m.

Pier 2 (West)

Dip to ground level = 4.2m, dip to refusal =1.93m, 600mm below road level. Fill has a high cobble content and is a GRAVELy Silt.



Pier 4 (West)

Dip to ground level = 4.48m, dip to refusal =2.4m, 1.08m below road level. Fill has a high cobble content and is a GRAVELy Silt.

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Appendix D. Stage 2 Structural Assessment

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations		Output
TII AM-STR-06002	**Modified MEXE Method - Span 1**		
	Span	L in m	2.360
	Rise at Crown	r_c in m	1.170
	Rise at Quarter point	r_q in m	1.050
	Ring Thickness	d in m	0.380
	Depth of fill	h in m	0.080
	Barrel Factor	F_b	1.000
	Fill Factor	F_f	0.700
	Joint Width Factor	F_w	0.900
	Joint Mortar Factor	F_{mo}	1.000
	Horizontal Curve Radius	r in m	>600
	$v^2 = \frac{1000\,r}{r + 150}$ Centrifugal Effect Factor	$F_A = 1 + \frac{0.20\,v^2}{r}$	1.000
	Joint Depth Factor	F_d	
	Average depth of missing mortar,	in m	0.020
Annex G	=>	F_d	0.800
	Condition Factor	F_{cM}	0.900
		h + d in m	0.460
		L / r_c	2.017
	From Fig. 3.2 Nonogram Provisional Axle Loading	P.A.L. or $740 \times \frac{(d + h)^2}{L^{1.3}}$ = P.A.L.	51.28
From Fig. 3.3	Span/Rise Factor	F_{sr}	1.000
From Fig. 3.4	Profile Factor	$F_p = 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.587
	Material Factor	$F_m = \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.948
	Joint Factor	$F_j = F_w \times F_{mo} \times F_d$	0.720
	MODIFIED AXLE LOAD FOR 2-AXLE BOGIE (M.A.L)	M.A.L = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	18.475
	AXLE FACTOR (A_f - see Fig 3.5a & 3.5b	Axle lift-off (Y/N)	Y
	Single axle -	1.00 Allowable A.L	18.5
	2-Axle bogie	0.66 Allowable A.L	12.2
	3-Axle bogie	1.00 Allowable A.L	18.5
	LOAD CAPACITY	**Max G.V.W in tonnes =**	**46**

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations		Output
TII AM-STR-06002	**Modified MEXE Method - Span 2**		
	Span	L in m	2.890
	Rise at Crown	r_c in m	1.280
	Rise at Quarter point	r_q in m	1.020
	Ring Thickness	d in m	0.270
	Depth of fill	h in m	0.200
	Barrel Factor	F_b	1.000
	Fill Factor	F_f	0.700
	Joint Width Factor	F_w	0.900
	Joint Mortar Factor	F_{mo}	1.000
	Horizontal Curve Radius	r in m	>600
	$v^2 = \frac{1000\,r}{r + 150}$ Centrifugal Effect Factor	$F_A = 1 + \frac{0.20\,v^2}{r}$	1.000
	Joint Depth Factor	F_d	
	Average depth of missing mortar,	in m	0.020
Annex G	=>	F_d	0.800
	Condition Factor	F_{cM}	0.900
		h + d in m	0.470
		L / r_c	2.258
	From Fig. 3.2 Nonogram Provisional Axle Loading	P.A.L. or $740 \times \frac{(d + h)^2}{L^{1.3}}$ = P.A.L.	41.14
From Fig. 3.3	Span/Rise Factor	F_{sr}	1.000
From Fig. 3.4	Profile Factor	$F_p = 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.884
	Material Factor	$F_m = \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.872
	Joint Factor	$F_j = F_w \times F_{mo} \times F_d$	0.720
	MODIFIED AXLE LOAD FOR 2-AXLE BOGIE (M.A.L)	M.A.L = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	20.555
	AXLE FACTOR (A_f - see Fig 3.5a & 3.5b	Axle lift-off (Y/N)	Y
	Single axle -	1.00 Allowable A.L	20.6
	2-Axle bogie	0.66 Allowable A.L	13.6
	3-Axle bogie	1.00 Allowable A.L	20.6
	LOAD CAPACITY	**Max G.V.W in tonnes =**	**46**

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations		Output
TII AM-STR-06002	**Modified MEXE Method - Span 3**		
	Span	L in m	4.220
	Rise at Crown	r_c in m	1.930
	Rise at Quarter point	r_q in m	1.560
	Ring Thickness	d in m	0.350
	Depth of fill	h in m	0.110
	Barrel Factor	F_b	1.000
	Fill Factor	F_f	0.700
	Joint Width Factor	F_w	0.900
	Joint Mortar Factor	F_{mo}	1.000
	Horizontal Curve Radius	r in m	>600
	$v^2 = \frac{1000\,r}{r + 150}$	Centrifugal Effect Factor $F_A = 1 + \frac{0.20\,v^2}{r}$	1.000
	Joint Depth Factor	F_d	
	Average depth of missing mortar,	in m	0.020
Annex G	=>	F_d	0.800
	Condition Factor	F_{cM}	0.900
		h + d in m	0.460
		L / r_c	2.187
	From Fig. 3.2 Nonogram Provisional Axle Loading	P.A.L. or $740 \times \frac{(d + h)^2}{L^{1.3}}$ = P.A.L.	24.09
From Fig. 3.3	Span/Rise Factor	F_{sr}	1.000
From Fig. 3.4	Profile Factor	$F_p = 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.854
	Material Factor	$F_m = \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.928
	Joint Factor	$F_j = F_w \times F_{mo} \times F_d$	0.720
	MODIFIED AXLE LOAD FOR 2-AXLE BOGIE (M.A.L)	M.A.L = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	12.371
	AXLE FACTOR (A_f - see Fig 3.5a & 3.5b	Axle lift-off (Y/N)	Y
	Single axle -	1.03 Allowable A.L	12.8
	2-Axle bogie	0.66 Allowable A.L	8.2
	3-Axle bogie	1.00 Allowable A.L	12.4
	LOAD CAPACITY	**Max G.V.W in tonnes =**	**18**

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations		Output
TII AM-STR-06002	**Modified MEXE Method - Span 4**		
	Span	L in m	4.510
	Rise at Crown	r_c in m	2.010
	Rise at Quarter point	r_q in m	1.660
	Ring Thickness	d in m	0.370
	Depth of fill	h in m	0.050
	Barrel Factor	F_b	1.000
	Fill Factor	F_f	0.700
	Joint Width Factor	F_w	0.900
	Joint Mortar Factor	F_{mo}	1.000
	Horizontal Curve Radius	r in m	>600
	$v^2 = \frac{1000\,r}{r + 150}$ Centrifugal Effect Factor	$F_A = 1 + \frac{0.20\,v^2}{r}$	1.000
	Joint Depth Factor	F_d	
	Average depth of missing mortar,	in m	0.020
Annex G	=>	F_d	0.800
	Condition Factor	F_{cM}	0.900
		h + d in m	0.420
		L / r_c	2.244
	From Fig. 3.2 Nonogram Provisional Axle Loading	P.A.L. or $740 \times \frac{(d + h)^2}{L^{1.3}}$ = P.A.L.	18.42
From Fig. 3.3	Span/Rise Factor	F_{sr}	1.000
From Fig. 3.4	Profile Factor	$F_p = 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.806
	Material Factor	$F_m = \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.964
	Joint Factor	$F_j = F_w \times F_{mo} \times F_d$	0.720
	MODIFIED AXLE LOAD FOR 2-AXLE BOGIE (M.A.L)	M.A.L $= F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	9.275
	AXLE FACTOR (A_f - see Fig 3.5a & 3.5b	Axle lift-off (Y/N)	Y
	Single axle -	1.07 Allowable A.L	10.0
	2-Axle bogie	0.67 Allowable A.L	6.2
	3-Axle bogie	1.00 Allowable A.L	9.3
	LOAD CAPACITY	**Max G.V.W in tonnes =**	**12.5**

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations		Output
TII AM-STR-06002	**Modified MEXE Method - Span 5**		
	Span	L in m	2.310
	Rise at Crown	r_c in m	1.150
	Rise at Quarter point	r_q in m	0.960
	Ring Thickness	d in m	0.500
	Depth of fill	h in m	0.400
	Barrel Factor	F_b	1.000
	Fill Factor	F_f	0.700
	Joint Width Factor	F_w	0.900
	Joint Mortar Factor	F_{mo}	1.000
	Horizontal Curve Radius	r in m	>600
	$v^2 = \frac{1000\,r}{r + 150}$ Centrifugal Effect Factor	$F_A = 1 + \frac{0.20\,v^2}{r}$	1.000
	Joint Depth Factor	F_d	
	Average depth of missing mortar,	in m	0.020
Annex G	=>	F_d	0.800
	Condition Factor	F_{cM}	0.900
		h + d in m	0.900
		L / r_c	2.009
	From Fig. 3.2 Nonogram Provisional Axle Loading	P.A.L. or $740 \times \frac{(d + h)^2}{L^{1.3}}$ = P.A.L.	70.00
From Fig. 3.3	Span/Rise Factor	F_{sr}	1.000
From Fig. 3.4	Profile Factor	$F_p = 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.781
	Material Factor	$F_m = \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.867
	Joint Factor	$F_j = F_w \times F_{mo} \times F_d$	0.720
	MODIFIED AXLE LOAD FOR 2-AXLE BOGIE (M.A.L)	M.A.L = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	30.696
	AXLE FACTOR (A_f - see Fig 3.5a & 3.5b	Axle lift-off (Y/N)	Y
	Single axle -	1.00 Allowable A.L	30.7
	2-Axle bogie	0.66 Allowable A.L	20.3
	3-Axle bogie	1.00 Allowable A.L	30.7
	LOAD CAPACITY	**Max G.V.W in tonnes =**	**46**

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations		Output
TII AM-STR-06002	**Modified MEXE Method - Span 6**		
	Span	L in m	2.570
	Rise at Crown	r_c in m	1.190
	Rise at Quarter point	r_q in m	1.030
	Ring Thickness	d in m	0.250
	Depth of fill	h in m	0.290
	Barrel Factor	F_b	1.000
	Fill Factor	F_f	0.700
	Joint Width Factor	F_w	0.900
	Joint Mortar Factor	F_{mo}	1.000
	Horizontal Curve Radius	r in m	>600
	$v^2 = \frac{1000\,r}{r + 150}$	Centrifugal Effect Factor $F_A = 1 + \frac{0.20\,v^2}{r}$	1.000
	Joint Depth Factor	F_d	
	Average depth of missing mortar,	in m	0.020
Annex G	=>	F_d	0.800
	Condition Factor	F_{cM}	0.900
		h + d in m	0.540
		L / r_c	2.160
	From Fig. 3.2 Nonogram Provisional Axle Loading	P.A.L. or $740 \times \frac{(d + h)^2}{L^{1.3}}$ = P.A.L.	63.26
From Fig. 3.3	Span/Rise Factor	F_{sr}	1.000
From Fig. 3.4	Profile Factor	$F_p = 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.690
	Material Factor	$F_m = \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.839
	Joint Factor	$F_j = F_w \times F_{mo} \times F_d$	0.720
	MODIFIED AXLE LOAD FOR 2-AXLE BOGIE (M.A.L)	M.A.L = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	23.728
	AXLE FACTOR (A_f - see Fig 3.5a & 3.5b	Axle lift-off (Y/N)	Y
	Single axle -	1.00 Allowable A.L	23.7
	2-Axle bogie	0.66 Allowable A.L	15.7
	3-Axle bogie	1.00 Allowable A.L	23.7
	LOAD CAPACITY	**Max G.V.W in tonnes =**	**46**

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations		Output
TII AM-STR-06002	**Modified MEXE Method - Span 7**		
	Span	L in m	2.720
	Rise at Crown	r_c in m	1.350
	Rise at Quarter point	r_q in m	1.100
	Ring Thickness	d in m	0.250
	Depth of fill	h in m	0.290
	Barrel Factor	F_b	1.000
	Fill Factor	F_f	0.700
	Joint Width Factor	F_w	0.900
	Joint Mortar Factor	F_{mo}	1.000
	Horizontal Curve Radius	r in m	>600
	$v^2 = \frac{1000\,r}{r + 150}$ Centrifugal Effect Factor	$F_A = 1 + \frac{0.20\,v^2}{r}$	1.000
	Joint Depth Factor	F_d	
	Average depth of missing mortar,	in m	0.020
Annex G	=>	F_d	0.800
	Condition Factor	F_{cM}	0.900
		h + d in m	0.540
		L / r_c	2.015
	From Fig. 3.2 Nonogram Provisional Axle Loading	P.A.L. or $740 \times \frac{(d+h)^2}{L^{1.3}}$ = P.A.L.	58.76
From Fig. 3.3	Span/Rise Factor	F_{sr}	1.000
From Fig. 3.4	Profile Factor	$F_p = 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.836
	Material Factor	$F_m = \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.839
	Joint Factor	$F_j = F_w \times F_{mo} \times F_d$	0.720
	MODIFIED AXLE LOAD FOR 2-AXLE BOGIE (M.A.L)	M.A.L = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	26.709
	AXLE FACTOR (A_f - see Fig 3.5a & 3.5b	Axle lift-off (Y/N)	Y
	Single axle -	1.00 Allowable A.L	26.7
	2-Axle bogie	0.66 Allowable A.L	17.6
	3-Axle bogie	1.00 Allowable A.L	26.7
	LOAD CAPACITY	**Max G.V.W in tonnes =**	**46**

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Structure No. MH-L1615-001.00	Assessment using TII AM-STR-06002 MEXE Method		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations	Output

TII
AM-STR-06002

Modified MEXE Method - Summary

	Max Gross Vehicle Weight (tonnes)
MEXE Span 1	46
MEXE Span 2	46
MEXE Span 3	18
MEXE Span 4	12.5
MEXE Span 5	46
MEXE Span 6	46
MEXE Span 7	46

Summary of Load Cases (Highlighted in bold) Considered in ArchieM Analysis

Axle Lift Off: Yes/No? **Yes**

Case 1: Most onerous AWR vehicle
1A : In present condition
1B : In perfect condition
1C : If backing is also present

Case 2: SV Loading
2A : In present condition
2B : In perfect condition
2C : If backing is also present

Summary of Results

1A	1B	1C
Fails 3t	Fails 3t	46t
2A	**2B**	**2C**
Fails SV80	Fails SV80	SV100

ATKINS	Project	Beaumont Bridge Stage 2 Assessment		Job ref 5210920	
	Part of Structure MH-L1615-001.00	Archie M analysis		Calc sheet no. rev 0	
	Drawing Ref -	Calc By MG	Date 22-Feb-22	Check by MJ	Date 23-Feb-22

Ref	Calculations	Output

Arch Assessment using ArchieM

Remarks

TII AM-STR-06026

General Archie Input

Table 3.1	Thickness of road surfacing	=	0.1	m	road surfacing only	
Table 4.1	Unit weight of road surfacing	=	23	kN/m3		
Fig 4.3	Masonry comp. strength	=	7	N/mm2		Material: Limestone
Table 4.1	Density	=	22	kN/m^3		Ashlar/Random?: Random Rubble
	Unit weight of fill	=	18	kN/m3	(default in Archie)	with lime mortar
	phi	=	30		(default in Archie)	

Arch Dimensions

Refer to MEXE Analysis for dimensions of each span

Lane & Load details

TII AM-STR-06026

Load assessment 40t vehicle

	Structure loaded with		46	t vehicle	
	Load per axle	=	11.5	t	
	Lane width	=	2.5	m	(this is the most conservative lane width)
6.22	Distributed width of wheel load	=	1.5 +h		

6.23 As per Cl.6.23 TII AM-STR-06026 Axles have 1.8m track with 0.7m minimum spacing between the track width of adjacent vehicles

TII AM-STR-06048

Load assessment SV100 vehicle

Archie M does not allow load assessment of SV100 vehicle on lanes less than 3.5m
Use the more critical of 3.5m lanewidth or actual lane width in analysis

	Structure loaded with		100	t vehicle
	Load per axle	=	16.5	t
	Lane width	=	3.5	m
	Distributed width of wheel load	=	1.5 +h	

Axles assumed to have 3.0m track with 0.5m minimum spacing between the track width of adjacent vehicles

Ref	Calculations	Output

TII AM-STR-06026

Details for Archie analysis

Condition factors, in present condition

Cl.6.2 γ_{F3} = 1

Cl.6.2 γ_m = 1 no other recorded defects which might reduce strength of masonry

Joint width factor Fw = 0.9

Mortar factor Fmo = 1

Average mortar loss = 0.02 mm (conservative as hidden by gunnite layer)

Fd = 1.00 taken as 1.0 as mortar loss is modelled directly in Archie

Fj = (Fw*Fmo*Fd) = 0.90

- TII AM-STR-06026 Cl.6.2 gives a combined gFL factor of 3.4 which is made up a load factor of 1.9 and an impact factor of 1.8. Archie includes the 1.8 impact factor in the load definitions so γ_{FL} is taken as 1.9 in the analysis

– γ_{FL} factor is 2.0 for SV load assessment

		HA	SV
	γ_{FL} =	1.9	2
Centrifugal effect	F_A =	1.00	1.00
Condition factor	F_{cm} =	0.9	0.9

	HA	SV
Effective γ_{FL} = $\frac{\gamma_{FL}}{Fj*Fcm}$ xFa =	**2.35**	**2.47**

Condition factors, if repair works are carried out

Fw = 0.9 *joint width does not change*

Fmo = 1

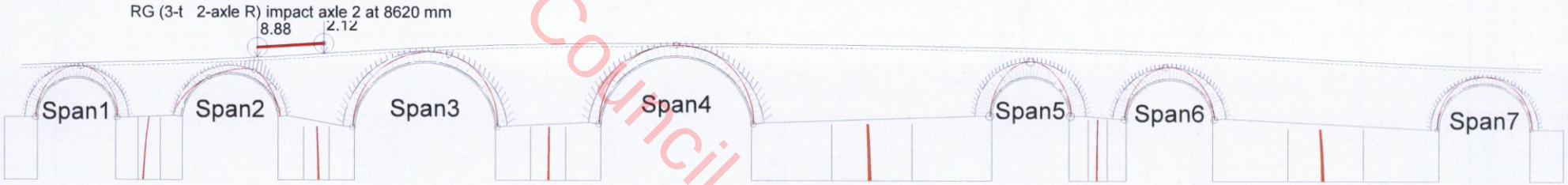
Fd = 1

Fj = (Fw*Fmo*Fd) = 0.9

best condition γ_{FL} factor

	HA	SV
γ_{FL} =	1.9	2
F_A =	1.00	1.00
F_{cm} =	1	1
Effective γ_{FL} =	**2.11**	**2.22**

Beaumont Bridge



3t HA loading in Current Condition

gammaFl dead load: 1.00 RG (3-t 2-axle R) impact axle 2 @ 8620 [mm]
gammaFl superimposed: 1.00
gammaFl live load: 2.35
gammaF3 load effect: 1.00
gammaM material: 1.00
File path: V:\5210920\7 Calcs\72 Model\Stage 2 Assessment\Beaumont Bridge.brg

NAME: Beaumont Bridge
LOCATION: Beaumont, Meath
NUMBER: MH-L1615-001.00
Atkins
DATE: 22 February 2022
Printed on: Thursday, February 24, 2022 16:00:29

Bridge Name: Beaumont Bridge Bridge Location: Beaumont, Meath
Bridge Number: MH-L1615-001.00
Number of spans: 7

SAFETY FACTORS
Factor for deadload: 1.00 Factor for superimposed deadload: 1.00 Factor for surfacing: 1.00
Factor for live load: 2.35 Factor for load effect: 1.00 Factor for material strength: 1.00

APPLIED LOAD CASES
1.RG (3-t 2-axle R) impact axle 2 Total weight: 29.43 [kN] Position: 8620 [mm]
3.00 2 1.00 0.90 2.00 3.78 0.75 1.80 2.50
Effective lane width: 3350 [mm] Distribution length: 2418 [mm]

Applied distribution mode: Archie-M, BD21/97
Applied live load pressure: Active pressure

STRUCTURE PROPERTIES
Road shape: True shape (multi-point method)
Road points: (-500, 1950) (1180, 2010) (5805, 2150) (11660, 2490) (19175, 2630) (29755, 2500) (33895, 2390) (43290, 1960) (45000, 1910)
Depth of surfacing: 100Depth of overlay: 0
Surface unit weight: 23.00 [kN/m3] Overlay unit weight: 23.00 [kN/m3]
Lane width: 0

Fill unit weight: 18.00 [kN/m3] Fill phi: 30 degree

Left abutment Base level:-1500 [mm] Height: 380 [mm] Width: 1000 [mm]
Right abutment Base level:-1500 [mm] Height: 70 [mm] Width: 1000 [mm]

Right abutment Base level:-1500 [mm] Height: 70 [mm] Width: 1000 [mm]
Shape: Circular
Span: 2360 [mm] Rise: 1170 [mm] Q-rise: 1050 [mm]
Ring thickness at crown:380 [mm] Ring thickness at springing: 380 [mm] Mortar loss: 50 [mm]
Masonry unit weight:22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	0	380	-380	3831	954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.55	-29.97	-0.06	-0	4	326
1	4	472	-374	5051	954	1.68	-1.05	-0.12	0.00	-0.00	0.00	0.00	0.86	-28.92	-0.16	3	8	322
2	16	563	-359	6261	954	1.54	-1.28	-0.16	0.00	-0.00	0.00	0.00	-0.68	-27.64	-0.26	8	12	318
3	35	654	-334	7451	955	1.39	-1.47	-0.19	0.00	-0.00	0.00	0.00	-2.07	-26.17	-0.39	13	17	313
4	60	742	-300	8621	956	1.24	-1.61	-0.21	0.00	-0.00	0.00	0.00	-3.31	-24.55	-0.53	20	24	306
5	93	828	-257	9761	958	1.09	-1.72	-0.22	0.00	-0.00	0.00	0.00	-4.41	-22.84	-0.69	29	32	298
6	132	912	-206	1086	1960	0.95	-1.78	-0.22	0.00	-0.00	0.00	0.00	-5.36	-21.05	-0.87	39	42	288
7	177	992	-146	1192	1962	0.81	-1.81	-0.21	0.00	-0.00	0.00	0.00	-6.17	-19.24	-1.05	52	55	275
8	229	1068	-77	1293	1965	0.68	-1.81	-0.20	0.00	-0.00	0.00	0.00	-6.85	-17.43	-1.24	67	70	260
9	286	1141	-2	1389	1967	0.56	-1.79	-0.18	0.00	-0.00	0.00	0.00	-7.41	-15.64	-1.44	85	88	242
10	349	1208	82	1478	1970	0.45	-1.74	-0.16	0.00	-0.00	0.00	0.00	-7.86	-13.91	-1.64	106	108	222
11	417	1270	171	1560	1974	0.36	-1.67	-0.14	0.00	-0.00	0.00	0.00	-8.21	-12.23	-1.83	128	130	200
12	490	1327	267	1635	1977	0.27	-1.59	-0.11	0.00	-0.00	0.00	0.00	-8.49	-10.64	-2.02	153	155	175
13	566	1378	369	1703	1981	0.20	-1.51	-0.09	0.00	-0.00	0.00	0.00	-8.69	-9.13	-2.20	180	182	148
14	647	1423	475	1762	1985	0.15	-1.43	-0.07	0.00	-0.00	0.00	0.00	-8.84	-7.70	-2.36	207	209	121
15	731	1461	586	1813	1989	0.10	-1.35	-0.05	0.00	-0.00	0.00	0.00	-8.95	-6.35	-2.52	234	236	94
16	817	1493	700	1854	1993	0.07	-1.28	-0.03	0.00	-0.00	0.00	0.00	-9.02	-5.08	-2.65	260	262	68
17	906	1518	818	1887	1998	0.05	-1.22	-0.01	0.00	-0.00	0.00	0.00	-9.06	-3.86	-2.76	284	285	45
18	996	1536	937	1911	2001	0.03	-1.17	0.01	0.00	-0.00	0.00	0.00	-9.09	-2.69	-2.86	303	305	25
19	1088	1546	1058	1925	2006	0.01	-1.14	0.03	0.00	-0.00	0.00	0.00	-9.10	-1.55	-2.93	318	319	11
20	1180	1550	1180	1930	2010	0.00	-1.13	0.04	0.00	-0.00	0.00	0.00	-9.11	-0.42	-2.98	327	328	2
21	1272	1546	1302	1925	2013	-0.00	-1.14	0.06	-0.00	-0.00	0.00	0.00	-9.10	0.72	-3.01	329	330	-0 ***

22	1364	1536	1423	1911	2017	-0.02	-1.17	0.08	-0.00	-0.00	0.00	0.00	-9.09	1.88	-3.01	3243255	
23	1454	1518	1542	1887	2021	-0.03	-1.21	0.10	-0.00	-0.00	0.00	0.00	-9.06	3.09	-2.99	31331416	
24	1543	1493	1660	1854	2024	-0.05	-1.27	0.12	-0.00	-0.00	0.00	0.00	-9.00	4.37	-2.94	29629832	
25	1629	1461	1774	1813	2028	-0.08	-1.35	0.15	-0.00	-0.00	0.00	0.00	-8.92	5.71	-2.87	27527654	
26	1713	1423	1885	1762	2031	-0.12	-1.43	0.18	-0.00	-0.00	0.00	0.00	-8.80	7.15	-2.77	25025179	
27	1794	1378	1991	1703	2034	-0.17	-1.52	0.20	-0.00	-0.00	0.00	0.00	-8.62	8.67	-2.65	223224106	
28	1870	1327	2093	1635	2037	-0.24	-1.61	0.23	-0.00	-0.00	0.00	0.00	-8.38	10.28	-2.51	195197133	
29	1943	1270	2189	1560	2039	-0.32	-1.70	0.27	-0.00	-0.00	0.00	0.00	-8.07	11.98	-2.35	168170160	
30	2011	1208	2278	1478	2041	-0.41	-1.78	0.30	-0.00	-0.00	0.00	0.00	-7.66	13.76	-2.16	142144186	
31	2074	1141	2362	1389	2043	-0.51	-1.85	0.32	-0.00	-0.00	0.00	0.00	-7.15	15.61	-1.97	118120210	
32	2131	1068	2437	1293	2045	-0.63	-1.89	0.35	-0.00	-0.00	0.00	0.00	-6.52	17.50	-1.76	97	99 231
33	2183	992	2506	1192	2047	-0.76	-1.91	0.37	-0.00	-0.00	0.00	0.00	-5.77	19.42	-1.54	77	80 250
34	2228	912	2566	1086	2049	-0.89	-1.91	0.38	-0.00	-0.00	0.00	0.00	-4.87	21.33	-1.32	61	64 266
35	2267	828	2617	976	2051	-1.04	-1.87	0.39	-0.00	-0.00	0.00	0.00	-3.83	23.19	-1.10	46	50 280
36	2300	742	2660	862	2052	-1.19	-1.79	0.39	-0.00	-0.00	0.00	0.00	-2.64	24.98	-0.88	34	38 292
37	2325	654	2694	745	2053	-1.34	-1.67	0.38	-0.00	-0.00	0.00	0.00	-1.30	26.66	-0.67	24	27 303
38	2344	563	2719	626	2053	-1.50	-1.51	0.36	-0.00	-0.00	0.00	0.00	0.20	28.17	-0.46	15	19 311
39	2356	472	2734	505	2054	-1.65	-1.31	0.33	-0.00	-0.00	0.00	0.00	1.85	29.48	-0.26	7	11 319
40	2360	380	2740	383	2054	-1.79	-1.06	0.30	-0.00	-0.00	0.00	0.00	3.64	30.54	-0.07	0	4 326

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 380 [mm] Thickness at top: 2000 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	2360	4360	380	-109.21	-18.33	-109.21	-1.30	3340	3356	-0.06	-0.05	980.26	1004.14
1	2360	4360	-247	-27.57	-18.33	-136.79	-12.79	3257	3276	-0.09	-0.05	896.74	1083.72
2	2360	4360	-873	-27.57	-18.33	-164.36	-24.27	3201	3224	-0.12	-0.05	840.57	1135.95
3	2360	4360	-1500	-27.57	-18.33	-191.93	-35.76	3160	3187	-0.15	-0.04	799.98	1172.60

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2890 [mm] Rise: 1280 [mm] Q-rise: 1020 [mm]
Ring thickness at crown: 270 [mm] Ring thickness at springing: 270 [mm] Mortar loss: 50 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	4360	4004	092	4332	089	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-14.69	-36.46	-9.64	251	257	-37 ***
1	4377	5044	112	5562	090	1.80	-1.26	-0.05	0.00	-0.00	0.00	0.00	-16.49	-35.21	-8.42	220	226	-6 ***
2	4401	6074	140	6782	091	1.65	-1.45	-0.07	0.00	-0.00	0.00	0.00	-18.14	-33.75	-7.26	192	197	23
3	4432	7084	177	7972	092	1.48	-1.61	-0.09	0.00	-0.00	0.00	0.00	-19.62	-32.14	-6.17	165	170	50
4	4471	8064	223	9142	093	1.33	-1.73	-0.10	0.00	-0.00	0.00	0.00	-20.95	-30.42	-5.16	140	145	75
5	4516	9014	277	1026	2095	1.17	-1.81	-0.10	0.00	-0.00	0.00	0.00	-22.11	-28.61	-4.24	117	122	98
6	4569	9934	339	1135	2097	1.02	-1.85	-0.10	0.00	-0.00	0.00	0.00	-23.13	-26.76	-3.40	95	100	120
7	4627	1080	4409	1239	2099	0.88	-1.86	-0.09	0.00	-0.00	0.00	0.00	-24.01	-24.90	-2.65	75	80	140
8	4693	1163	4486	1337	2101	0.74	-1.85	-0.08	0.00	-0.00	0.00	0.00	-24.75	-23.05	-1.99	57	62	158
9	4763	1241	4570	1430	2104	0.62	-1.81	-0.07	0.00	-0.00	0.00	0.00	-25.38	-21.23	-1.43	41	46	174
10	4840	1314	4661	1516	2107	0.51	-1.76	-0.06	0.00	-0.00	0.00	0.00	-25.89	-19.47	-0.96	27	32	188
11	4921	1381	4757	1596	2110	0.42	-1.69	-0.05	0.00	-0.00	0.00	0.00	-26.30	-17.78	-0.58	16	21	199
12	5007	1442	4859	1668	2113	0.33	-1.62	-0.03	0.00	-0.00	0.00	0.00	-26.63	-16.16	-0.31	8	12	208
13	5098	1497	4966	1733	2117	0.26	-1.54	-0.02	0.00	-0.00	0.00	0.00	-26.89	-14.62	-0.13	2	7	213
14	5192	1544	5078	1789	2121	0.20	-1.46	-0.01	0.00	-0.00	0.00	0.00	-27.09	-13.17	-0.06	-0	4	216
15	5289	1585	5193	1838	2125	0.15	-1.38	0.00	0.00	-0.00	0.00	0.00	-27.24	-11.78	-0.10	1	5	215
16	5389	1619	5312	1878	2130	0.11	-1.32	0.02	0.00	-0.00	0.00	0.00	-27.34	-10.46	-0.24	6	10	210
17	5491	1646	5433	1909	2134	0.08	-1.26	0.03	0.00	-0.00	0.00	0.00	-27.42	-9.20	-0.49	15	19	201
18	5595	1665	5556	1932	2139	0.05	-1.22	0.04	0.00	-0.00	0.00	0.00	-27.47	-7.98	-0.84	28	32	188

19 5700 1676 5680 1945 2144 0.03 -1.20 0.05 0.00 -0.00 0.00 0.00 -27.50 -6.78 -1.30 44 48 172
20 5805 1680 5805 1950 2150 0.01 -1.19 0.06 0.00 -0.00 0.00 0.00 -27.51 -5.58 -1.85 65 69 151
21 5910 1676 5930 1945 2155 -0.01 -1.21 0.07 -0.00 -0.00 0.00 0.00 -27.50 -4.37 -2.51 91 95 125
22 6015 1665 6054 1932 2161 -0.03 -1.24 0.08 -0.00 -0.02 0.00 0.00 -27.47 -3.12 -3.26 12012496
23 6119 1646 6177 1909 2167 -0.05 -1.28 0.10 -0.03 -0.50 0.05 0.00 -27.38 -1.34 -4.09 15315763
24 6221 1619 6298 1878 2173 -0.09 -1.35 0.11 -0.14 -1.67 0.17 0.00 -27.15 1.69 -4.94 18418832
25 6321 1585 6417 1838 2179 -0.12 -1.42 0.13 -0.35 -3.07 0.32 0.00 -26.68 6.18 -5.69 2082119
26 6418 1544 6532 1789 2184 -0.17 -1.51 0.15 -0.58 -4.15 0.47 0.00 -25.92 11.84-6.21 216220-0 ***
27 6512 1497 6644 1733 2191 -0.23 -1.60 0.17 -0.78 -4.57 0.55 0.00 -24.91 18.00-6.41 2082128
28 6603 1442 6751 1668 2196 -0.30 -1.69 0.19 -0.86 -4.26 0.54 0.00 -23.75 23.94-6.25 18719228
29 6689 1381 6853 1596 2201 -0.39 -1.78 0.22 -0.80 -3.40 0.46 0.00 -22.56 29.12-5.76 15916456
30 6770 1314 6949 1516 2207 -0.48 -1.86 0.24 -0.64 -2.33 0.33 0.00 -21.44 33.31-5.00 12813486
31 6847 1241 7040 1430 2212 -0.59 -1.93 0.26 -0.42 -1.33 0.19 0.00 -20.43 36.57-4.11 99 104116
32 6917 1163 7124 1337 2217 -0.72 -1.98 0.28 -0.22 -0.59 0.09 0.00 -19.50 39.14-3.18 72 78 142
33 6983 1080 7201 1239 2222 -0.85 -2.02 0.30 -0.07 -0.17 0.03 0.00 -18.57 41.33-2.31 49 55 165
34 7041 9937271 1135 2225 -0.99 -2.02 0.31 -0.02 -0.04 0.01 0.00 -17.56 43.39-1.57 31 37 183
35 7094 9017333 1026 2229 -1.15 -2.00 0.32 -0.02 -0.04 0.01 0.00 -16.39 45.43-0.99 17 24 196
36 7139 8067387 9142232 -1.31 -1.94 0.32 -0.03 -0.04 0.01 0.00 -15.05 47.41-0.56 8 15 205
37 7178 7087433 7972235 -1.47 -1.84 0.32 -0.03 -0.04 0.01 0.00 -13.55 49.29-0.30 2 9 211
38 7209 6077470 6782237 -1.64 -1.71 0.31 -0.04 -0.04 0.01 0.00 -11.87 51.03-0.20 -0 7 213
39 7233 5047498 5562239 -1.81 -1.53 0.30 -0.04 -0.03 0.01 0.00 -10.02 52.59-0.26 1 9 211
40 7250 4007518 4332240 -1.97 -1.31 0.28 -0.05 -0.02 0.01 0.00 -8.00 53.92-0.49 5 13 207

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 100 [mm] Thickness at top: 2300 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
0 7250 9550 100-188.90 8.97 -188.90 1.71 8396 8423 -0.08 -0.08 1145.55 1127.47
1 7250 9550 -433 -26.99 8.97 -215.88 6.49 8415 8445 -0.09 -0.10 1164.65 1104.51
2 7250 9550 -967 -26.99 8.97 -242.87 11.278429 8464 -0.09 -0.12 1179.07 1086.23
3 7250 9550 -1500 -26.99 8.97 -269.86 16.068440 8479 -0.10 -0.14 1190.23 1071.22

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 4220 [mm] Rise: 1930 [mm] Q-rise: 1560 [mm]
Ring thickness at crown: 350 [mm] Ring thickness at springing: 350 [mm] Mortar loss: 50 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
0 9550 1009201 1312346 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.53 -55.11 -0.21 -0 8 292
1 9570 2569224 3132347 3.51 -2.20 -0.07 0.15 -0.06 0.00 0.00 -2.13 -52.86 -0.88 13 20 280
2 9601 4099261 4922350 3.18 -2.60 -0.13 0.14 -0.09 -0.00 0.00 -5.45 -50.17 -1.48 26 33 267
3 9643 5609310 6682353 2.85 -2.91 -0.18 0.13 -0.11 -0.01 0.00 -8.44 -47.15 -2.04 40 46 254
4 9697 7089373 8402357 2.52 -3.14 -0.21 0.12 -0.14 -0.01 0.00 -11.08 -43.88 -2.55 54 60 240
5 9761 8519448 1006 2361 2.20 -3.28 -0.22 0.11 -0.15 -0.01 0.00 -13.39 -40.44 -3.02 69 75 225
6 9836 9899535 1167 2367 1.89 -3.35 -0.22 0.10 -0.16 -0.02 0.00 -15.38 -36.93 -3.44 84 90 210
7 9921 1121 9633 1321 2373 1.60 -3.36 -0.21 0.09 -0.16 -0.02 0.00 -17.06 -33.40 -3.81 100105195
8 10015 1247 9743 1467 2380 1.33 -3.31 -0.19 0.07 -0.16 -0.01 0.00 -18.46 -29.94 -4.12 116121179
9 10118 1365 9864 1605 2388 1.08 -3.21 -0.16 0.05 -0.14 -0.01 0.00 -19.60 -26.60 -4.40 132136164
10 10230 1475 9994 1733 2396 0.87 -3.07 -0.13 0.04 -0.12 -0.01 0.00 -20.50 -23.41 -4.62 147152148
11 10350 1576 10133 1851 2404 0.68 -2.90 -0.10 0.03 -0.09 -0.01 0.00 -21.21 -20.42 -4.81 162166134
12 10477 1669 10281 1959 2413 0.51 -2.72 -0.07 0.01 -0.06 -0.00 0.00 -21.74 -17.64 -4.98 177180120
13 10610 1751 10436 2055 2422 0.38 -2.53 -0.04 0.01 -0.03 -0.00 0.00 -22.12 -15.08 -5.12 190194106
14 10749 1824 10599 2140 2432 0.27 -2.35 -0.01 0.00 -0.01 -0.00 0.00 -22.40 -12.72 -5.26 20320694
15 10893 1886 10766 2213 2442 0.19 -2.18 0.02 0.00 -0.00 -0.00 0.00 -22.59 -10.54 -5.39 21521882

16	11041	1938	10939	2272	2452	0.12	-2.03	0.04	-0.00	0.00	0.00	0.00	-22.71	-8.51	-5.53	22723070		
17	11193	1978	11116	2319	2461	0.08	-1.91	0.06	-0.00	0.00	0.00	0.00	-22.79	-6.60	-5.68	23824159		
18	11347	2007	11296	2353	2471	0.05	-1.82	0.08	-0.00	0.00	0.00	0.00	-22.84	-4.79	-5.84	24925248		
19	11503	2024	11477	2373	2480	0.03	-1.77	0.10	-0.00	0.00	0.00	0.00	-22.86	-3.02	-6.02	26026337		
20	11660	2030	11660	2380	2490	0.01	-1.75	0.13	-0.00	0.00	0.00	0.00	-22.87	-1.27	-6.21	27027327		
21	11817	2024	11843	2373	2499	-0.01	-1.79	0.15	0.00	0.00	0.00	0.00	-22.86	0.52	-6.42	27928317		
22	11973	2007	12024	2353	2507	-0.03	-1.85	0.18	0.00	0.00	0.00	0.00	-22.83	2.37	-6.63	2882919		
23	12127	1978	12204	2319	2514	-0.06	-1.96	0.22	0.00	0.00	0.00	0.00	-22.77	4.33	-6.84	2932973		
24	12279	1938	12381	2272	2522	-0.11	-2.10	0.26	0.00	0.00	0.00	0.00	-22.67	6.44	-7.03	297300-0	***	
25	12427	1886	12554	2213	2529	-0.17	-2.27	0.30	0.00	0.00	0.00	0.00	-22.50	8.71	-7.19	2963000		
26	12571	1824	12721	2140	2536	-0.25	-2.47	0.35	0.00	0.00	0.00	0.00	-22.25	11.18	-7.31	2922955		
27	12710	1751	12884	2055	2542	-0.36	-2.68	0.41	0.00	0.00	0.00	0.00	-21.89	13.85	-7.38	28328713		
28	12843	1669	13039	1959	2548	-0.49	-2.89	0.47	0.00	0.00	0.00	0.00	-21.40	16.74	-7.37	27027426		
29	12970	1576	13187	1851	2552	-0.65	-3.10	0.53	0.00	0.00	0.00	0.00	-20.75	19.84	-7.29	25325743		
30	13090	1475	13326	1733	2557	-0.84	-3.29	0.59	0.00	0.00	0.00	0.00	-19.91	23.13	-7.12	23323763		
31	13202	1365	13456	1605	2561	-1.06	-3.46	0.65	0.00	0.00	0.00	0.00	-18.84	26.59	-6.86	21021585		
32	13305	1247	13577	1467	2565	-1.31	-3.59	0.71	0.00	0.00	0.00	0.00	-17.54	30.18	-6.49	186191109		
33	13399	1121	13687	1321	2569	-1.58	-3.68	0.75	0.00	0.00	0.00	0.00	-15.96	33.86	-6.02	161166134		
34	13484	98913785	1167	2572	-1.87	-3.71	0.79	0.00	0.00	0.00	0.00	-14.08	37.58	-5.46	135141159			
35	13559	85113872	1006	2574	-2.19	-3.68	0.82	0.00	0.00	0.00	0.00	-11.89	41.26	-4.80	111117183			
36	13623	70813947	8402576	-2.52	-3.57	0.83	0.00	0.00	0.00	0.00	-9.37	44.83	-4.05	87	93	207		
37	13677	56014010	6682577	-2.86	-3.39	0.83	0.00	0.00	0.00	0.00	-6.51	48.22	-3.22	64	71	229		
38	13719	40914059	4922578	-3.21	-3.11	0.81	0.00	0.00	0.00	0.00	-3.30	51.33	-2.30	42	49	251		
39	13750	25614096	3132579	-3.56	-2.75	0.77	0.00	0.00	0.00	0.00	0.25	54.08	-1.30	21	28	272		
40	13770	10014119	1312580	-3.89	-2.29	0.72	0.00	0.00	0.00	0.00	4.15	56.37	-0.22	-0	8	292		

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 100 [mm] Thickness at top: 3150 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right

0	13770	16920	100	-228.03	-1.43	-228.03	4.87	15350	15383	-0.07	-0.08	1580.07	1537.35
1	13770	16920	-433	-36.96	-1.43	-264.99	4.11	15342	15379	-0.08	-0.09	1571.58	1540.57
2	13770	16920	-967	-36.96	-1.43	-301.95	3.35	15335	15378	-0.09	-0.10	1564.51	1542.35
3	13770	16920	-1500	-36.96	-1.43	-338.91	2.58	15328	15377	-0.11	-0.11	1558.42	1543.17

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 4510 [mm] Rise: 2010 [mm] Q-rise: 1660 [mm]
Ring thickness at crown: 370 [mm] Ring thickness at springing: 370 [mm] Mortar loss: 50 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust

0	16920	20016552	2422621	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.72	-58.85	-0.24	-0	8	312		
1	16945	36316581	4322621	3.95	-2.66	-0.10	-0.00	0.00	0.00	0.00	-1.23	-56.19	-1.36	21	28	292		
2	16982	52416624	6202622	3.58	-3.08	-0.18	-0.00	0.00	0.00	0.00	-4.81	-53.11	-2.38	42	49	271		
3	17030	68216680	8032622	3.21	-3.41	-0.23	-0.00	0.00	0.00	0.00	-8.02	-49.69	-3.31	63	70	250		
4	17090	83616750	9832623	2.83	-3.65	-0.26	-0.00	0.00	0.00	0.00	-10.85	-46.04	-4.16	86	93	227		
5	17160	98616832	1156	2624	2.47	-3.80	-0.27	-0.00	0.00	0.00	0.00	-13.33	-42.25	-4.91	109	116	204	
6	17242	1130	16927	1323	2624	2.12	-3.86	-0.26	-0.00	0.00	0.00	0.00	-15.45	-38.39	-5.57	134	139	181
7	17333	1267	17033	1483	2625	1.80	-3.85	-0.25	-0.00	0.00	0.00	0.00	-17.25	-34.54	-6.13	158	164	156
8	17435	1397	17151	1635	2626	1.49	-3.78	-0.22	-0.00	0.00	0.00	0.00	-18.74	-30.76	-6.60	183	188	132
9	17545	1520	17280	1778	2626	1.22	-3.65	-0.19	-0.00	0.00	0.00	0.00	-19.96	-27.12	-6.97	207	211	109
10	17665	1635	17418	1911	2627	0.97	-3.48	-0.15	-0.00	0.00	0.00	0.00	-20.93	-23.64	-7.25	22923486		
11	17792	1740	17566	2033	2628	0.75	-3.27	-0.12	-0.00	0.00	0.00	0.00	-21.68	-20.37	-7.45	25025466		
12	17926	1836	17723	2145	2628	0.57	-3.05	-0.08	-0.00	0.00	0.00	0.00	-22.25	-17.32	-7.58	26827248		

13	18068	1922	17887	2245	2629	0.41	-2.82	-0.04	-0.00	0.00	0.00	0.00	-22.66	-14.50	-7.64	28328634	
14	18215	1997	18058	2332	2629	0.29	-2.59	-0.01	-0.00	0.00	0.00	0.00	-22.96	-11.91	-7.65	29429822	
15	18367	2061	18235	2407	2629	0.19	-2.37	0.02	-0.00	0.00	0.00	0.00	-23.15	-9.54	-7.63	30330713	
16	18523	2114	18417	2469	2630	0.12	-2.17	0.05	-0.00	0.00	0.00	0.00	-23.27	-7.37	-7.59	3093137	
17	18683	2156	18603	2517	2630	0.07	-2.00	0.07	-0.00	0.00	0.00	0.00	-23.34	-5.36	-7.54	3133173	
18	18846	2186	18792	2552	2630	0.04	-1.87	0.09	-0.00	0.00	0.00	0.00	-23.38	-3.49	-7.50	3163191	
19	19010	2204	18983	2573	2630	0.02	-1.78	0.11	-0.00	0.00	0.00	0.00	-23.40	-1.71	-7.47	3173200	
20	19175	2210	19175	2580	2630	0.01	-1.73	0.13	-0.00	0.00	0.00	0.00	-23.40	0.02	-7.45	317320-0	***
21	19340	2204	19367	2573	2629	-0.01	-1.73	0.16	0.00	0.00	0.00	0.00	-23.40	1.76	-7.45	3163191	
22	19504	2186	19558	2552	2629	-0.02	-1.78	0.18	0.00	0.00	0.00	0.00	-23.38	3.53	-7.47	3143182	
23	19667	2156	19747	2517	2628	-0.04	-1.87	0.22	0.00	0.00	0.00	0.00	-23.34	5.40	-7.51	3123155	
24	19827	2114	19933	2469	2628	-0.07	-2.00	0.26	0.00	0.00	0.00	0.00	-23.27	7.40	-7.55	3073119	
25	19983	2061	20115	2407	2627	-0.12	-2.17	0.30	0.00	0.00	0.00	0.00	-23.15	9.57	-7.58	30130416	
26	20135	1997	20292	2332	2626	-0.19	-2.36	0.36	0.00	0.00	0.00	0.00	-22.96	11.93	-7.59	29229525	
27	20282	1922	20463	2245	2626	-0.29	-2.58	0.41	0.00	0.00	0.00	0.00	-22.67	14.50	-7.57	28028436	
28	20424	1836	20627	2145	2625	-0.41	-2.81	0.48	0.00	0.00	0.00	0.00	-22.26	17.31	-7.50	26526951	
29	20558	1740	20784	2033	2624	-0.57	-3.04	0.55	0.00	0.00	0.00	0.00	-21.69	20.35	-7.37	24725169	
30	20685	1635	20932	1911	2623	-0.75	-3.26	0.62	0.00	0.00	0.00	0.00	-20.95	23.62	-7.17	22723189	
31	20805	1520	21070	1778	2622	-0.96	-3.47	0.68	0.00	0.00	0.00	0.00	-19.98	27.08	-6.89	204209111	
32	20915	1397	21199	1635	2621	-1.21	-3.64	0.75	0.00	0.00	0.00	0.00	-18.77	30.72	-6.52	181186134	
33	21017	1267	21317	1483	2621	-1.49	-3.77	0.81	0.00	0.00	0.00	0.00	-17.28	34.49	-6.06	156162158	
34	21108	1130	21423	1323	2620	-1.79	-3.84	0.86	0.00	0.00	0.00	0.00	-15.49	38.33	-5.50	132138182	
35	21190	98621518	1156	2620	-2.12	-3.85	0.89	0.00	0.00	0.00	0.00	-13.37	42.18	-4.85	108114206		
36	21260	83621600	9832619	-2.47	-3.79	0.92	0.00	0.00	0.00	0.00	-10.91	45.97	-4.11	85	92	228	
37	21320	68221670	8032619	-2.83	-3.64	0.92	0.00	0.00	0.00	0.00	-8.08	49.61	-3.28	63	70	250	
38	21368	52421726	6202618	-3.20	-3.41	0.91	0.00	0.00	0.00	0.00	-4.88	53.03	-2.36	41	49	271	
39	21405	36321769	4322618	-3.57	-3.08	0.88	0.00	0.00	0.00	0.00	-1.30	56.11	-1.35	20	28	292	
40	21430	20021798	2422618	-3.95	-2.66	0.83	0.00	0.00	0.00	0.00	2.64	58.76	-0.24	-0	8	312	

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 200 [mm] Thickness at top: 7170 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	21430	28600	200	-386.20	2.56	-386.20	-50.01	24858	24913	-0.06	-0.05	3427.92	3686.91
1	21430	28600	-367	-89.39	2.56	-475.58	-48.56	24879	24947	-0.07	-0.06	3448.93	3653.13
2	21430	28600	-933	-89.39	2.56	-564.97	-47.10	24891	24972	-0.08	-0.07	3461.27	3628.02
3	21430	28600	-1500	-89.39	2.56	-654.36	-45.65	24898	24992	-0.10	-0.09	3468.50	3608.02

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2310 [mm] Rise: 1150 [mm] Q-rise: 960 [mm]
Ring thickness at crown: 500 [mm] Ring thickness at springing: 500 [mm] Mortar loss: 50 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust

0	28600	45028100	4522532	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.21	-47.77	-0.16	0	7	443	
1	28604	54028106	5822532	2.38	-1.42	-0.25	-0.00	0.00	0.00	0.00	2.83	-46.36	-0.37	5	11	439	
2	28615	63028121	7102532	2.22	-1.75	-0.33	-0.00	0.00	0.00	0.00	0.61	-44.61	-0.61	11	17	433	
3	28633	71928147	8372531	2.04	-2.04	-0.38	-0.00	0.00	0.00	0.00	-1.43	-42.57	-0.89	18	24	426	
4	28658	80628183	9622530	1.86	-2.27	-0.43	-0.00	0.00	0.00	0.00	-3.29	-40.30	-1.21	28	34	416	
5	28689	89028228	1083	2530	1.68	-2.46	-0.45	-0.00	0.00	0.00	0.00	-4.97	-37.84	-1.57	40	45	405
6	28727	97228283	1201	2529	1.50	-2.60	-0.46	-0.00	0.00	0.00	0.00	-6.47	-35.24	-1.95	55	59	391
7	28772	1051	28346	1314	2527	1.32	-2.70	-0.46	-0.00	0.00	0.00	0.00	-7.78	-32.54	-2.37	72	77	373
8	28822	1126	28419	1421	2526	1.15	-2.75	-0.44	-0.00	0.00	0.00	0.00	-8.93	-29.78	-2.79	93	97	353
9	28879	1197	28499	1523	2525	0.99	-2.78	-0.41	-0.00	0.00	0.00	0.00	-9.92	-27.01	-3.23	118	122	328

10	28940	1263	28587	1618	2523	0.84	-2.77	-0.38	-0.00	0.00	0.00	0.00	-10.76	-24.24	-3.67	147150300
11	29007	1325	28683	1706	2521	0.70	-2.73	-0.34	-0.00	0.00	0.00	0.00	-11.46	-21.51	-4.09	179182268
12	29078	1381	28785	1786	2519	0.58	-2.68	-0.29	-0.00	0.00	0.00	0.00	-12.04	-18.83	-4.50	215218232
13	29153	1431	28892	1857	2516	0.47	-2.62	-0.24	-0.00	0.00	0.00	0.00	-12.51	-16.21	-4.88	254256194
14	29232	1475	29006	1921	2514	0.37	-2.54	-0.19	-0.00	0.00	0.00	0.00	-12.88	-13.67	-5.22	294297153
15	29314	1513	29123	1975	2512	0.29	-2.47	-0.14	-0.00	0.00	0.00	0.00	-13.17	-11.20	-5.52	334337113
16	29399	1544	29245	2019	2510	0.22	-2.40	-0.10	-0.00	0.00	0.00	0.00	-13.39	-8.81	-5.76	37237476
17	29486	1568	29370	2055	2508	0.16	-2.33	-0.05	-0.00	0.00	0.00	0.00	-13.55	-6.48	-5.96	40540743
18	29575	1586	29497	2080	2505	0.11	-2.28	-0.01	-0.00	0.00	0.00	0.00	-13.65	-4.20	-6.09	43043218
19	29665	1596	29626	2095	2502	0.06	-2.24	0.04	-0.00	0.00	0.00	0.00	-13.71	-1.96	-6.16	4454473
20	29755	1600	29755	2100	2499	0.02	-2.21	0.08	-0.00	0.00	0.00	0.00	-13.73	0.25	-6.17	448450-0 ***
21	29845	1596	29884	2095	2497	-0.02	-2.21	0.12	0.00	0.00	0.00	0.00	-13.71	2.46	-6.11	4404428
22	29935	1586	30013	2080	2494	-0.06	-2.22	0.17	0.00	0.00	0.00	0.00	-13.65	4.68	-5.99	42042228
23	30024	1568	30140	2055	2491	-0.10	-2.25	0.21	0.00	0.00	0.00	0.00	-13.55	6.92	-5.81	39139456
24	30111	1544	30265	2019	2489	-0.15	-2.29	0.26	0.00	0.00	0.00	0.00	-13.40	9.21	-5.57	35635892
25	30196	1513	30387	1975	2487	-0.21	-2.34	0.30	0.00	0.00	0.00	0.00	-13.19	11.56	-5.28	317319131
26	30278	1475	30504	1921	2484	-0.28	-2.41	0.35	0.00	0.00	0.00	0.00	-12.91	13.97	-4.94	276278172
27	30357	1431	30618	1857	2481	-0.35	-2.47	0.40	0.00	0.00	0.00	0.00	-12.56	16.44	-4.57	236238212
28	30432	1381	30725	1786	2479	-0.44	-2.54	0.45	0.00	0.00	0.00	0.00	-12.12	18.98	-4.17	197200250
29	30503	1325	30827	1706	2477	-0.55	-2.60	0.50	0.00	0.00	0.00	0.00	-11.57	21.58	-3.74	163166284
30	30570	1263	30923	1618	2475	-0.66	-2.65	0.55	0.00	0.00	0.00	0.00	-10.90	24.24	-3.31	131135315
31	30631	1197	31011	1523	2472	-0.80	-2.69	0.59	0.00	0.00	0.00	0.00	-10.11	26.92	-2.87	104108342
32	30688	1126	31091	1421	2470	-0.94	-2.70	0.63	0.00	0.00	0.00	0.00	-9.17	29.62	-2.44	81 85 365
33	30738	1051	31164	1314	2469	-1.09	-2.68	0.65	0.00	0.00	0.00	0.00	-8.08	32.30	-2.03	62 66 384
34	30783	97231227	1201	2467	-1.26	-2.63	0.67	0.00	0.00	0.00	0.00	-6.82	34.93	-1.64	45 50 400	
35	30821	89031282	1083	2466	-1.43	-2.54	0.67	0.00	0.00	0.00	0.00	-5.39	37.47	-1.28	32 38 412	
36	30852	80631327	9622465	-1.61	-2.41	0.66	0.00	0.00	0.00	0.00	-3.78	39.88	-0.97	22 27 423		
37	30877	71931363	8372465	-1.79	-2.23	0.64	0.00	0.00	0.00	0.00	-1.99	42.11	-0.69	14 20 430		
38	30895	63031389	7102464	-1.96	-2.01	0.60	0.00	0.00	0.00	0.00	-0.03	44.11	-0.47	8 14 436		
39	30906	54031404	5822464	-2.14	-1.73	0.55	0.00	0.00	0.00	0.00	2.11	45.85	-0.29	3 10 440		
40	30910	45031410	4522464	-2.30	-1.41	0.48	0.00	0.00	0.00	0.00	4.41	47.26	-0.16	-0 7 443		

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 350 [mm] Thickness at top: 1700 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	30910	32610	350	-124.75	-2.79	-124.75	-1.15	31742	31760	-0.08	-0.07	831.90	850.28
1	30910	32610	-267	-23.06	-2.79	-147.81	-2.87	31730	31751	-0.09	-0.08	820.05	858.84
2	30910	32610	-883	-23.06	-2.79	-170.87	-4.59	31721	31745	-0.11	-0.09	810.95	864.64
3	30910	32610	-1500	-23.06	-2.79	-193.94	-6.31	31714	31741	-0.13	-0.10	803.62	868.68

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2570 [mm] Rise: 1190 [mm] Q-rise: 1030 [mm]
Ring thickness at crown: 400 [mm] Ring thickness at springing: 400 [mm] Mortar loss: 50 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	32610	35032211	3812443	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	-45.30	-0.14	0	6	344		
1	32621	44632226	5062442	2.29	-1.50	-0.17	-0.00	0.00	0.00	0.00	-0.67	-43.80	-0.40	6	12	338		
2	32639	54032249	6302442	2.12	-1.79	-0.22	-0.00	0.00	0.00	0.00	-2.79	-42.01	-0.70	14	20	330		
3	32664	63332282	7522441	1.95	-2.03	-0.26	-0.00	0.00	0.00	0.00	-4.74	-39.98	-1.02	23	29	321		
4	32696	72432324	8712440	1.77	-2.23	-0.28	-0.00	0.00	0.00	0.00	-6.51	-37.75	-1.38	34	40	310		
5	32735	81232375	9862438	1.60	-2.38	-0.29	-0.00	0.00	0.00	0.00	-8.11	-35.37	-1.77	47	52	298		
6	32780	89732434	1098	2437	1.43	-2.49	-0.30	-0.00	0.00	0.00	0.00	-9.54	-32.88	-2.17	63	68	282	

7	32831	97932501	1204	2435	1.26	-2.57	-0.29	-0.00	0.00	0.00	0.00	-10.80	-30.32	-2.58	81	85	265		
8	32888	1056	32576	1306	2432	1.10	-2.61	-0.27	-0.00	0.00	0.00	0.00	-11.90	-27.71	-3.00	101	105	245	
9	32951	1129	32658	1401	2430	0.95	-2.62	-0.25	-0.00	0.00	0.00	0.00	-12.85	-25.09	-3.41	124	128	222	
10	33019	1197	32748	1490	2427	0.81	-2.60	-0.23	-0.00	0.00	0.00	0.00	-13.66	-22.49	-3.81	149	152	198	
11	33092	1260	32843	1572	2424	0.68	-2.57	-0.20	-0.00	0.00	0.00	0.00	-14.34	-19.93	-4.19	176	179	171	
12	33170	1317	32945	1647	2421	0.57	-2.51	-0.17	-0.00	0.00	0.00	0.00	-14.91	-17.41	-4.54	204	207	143	
13	33251	1368	33052	1714	2418	0.46	-2.45	-0.13	-0.00	0.00	0.00	0.00	-15.37	-14.96	-4.86	232	235	115	
14	33336	1413	33163	1773	2414	0.37	-2.38	-0.10	-0.00	0.00	0.00	0.00	-15.74	-12.58	-5.14	26	026	387	
15	33425	1451	33279	1824	2411	0.29	-2.31	-0.07	-0.00	0.00	0.00	0.00	-16.03	-10.26	-5.37	28	628	961	
16	33516	1483	33398	1865	2407	0.22	-2.25	-0.03	-0.00	0.00	0.00	0.00	-16.26	-8.02	-5.56	30	931	238	
17	33609	1508	33520	1898	2403	0.16	-2.19	-0.00	-0.00	0.00	0.00	0.00	-16.42	-5.83	-5.70	32	833	119	
18	33703	1526	33644	1921	2398	0.11	-2.14	0.03	-0.00	0.00	0.00	0.00	-16.53	-3.69	-5.78	34	13	437	
19	33799	1536	33769	1935	2394	0.06	-2.10	0.06	-0.00	0.00	0.00	0.00	-16.59	-1.60	-5.81	348	350	-0	***
20	33895	1540	33895	1940	2389	0.02	-2.07	0.09	-0.00	0.00	0.00	0.00	-16.61	0.47	-5.79	34	735	00	
21	33991	1536	34021	1935	2384	-0.02	-2.06	0.12	0.00	0.00	0.00	0.00	-16.59	2.53	-5.71	34	03	437	
22	34087	1526	34146	1921	2380	-0.06	-2.06	0.15	0.00	0.00	0.00	0.00	-16.53	4.60	-5.59	32	732	921	
23	34181	1508	34270	1898	2375	-0.10	-2.08	0.18	0.00	0.00	0.00	0.00	-16.42	6.68	-5.41	30	831	139	
24	34274	1483	34392	1865	2371	-0.15	-2.12	0.21	0.00	0.00	0.00	0.00	-16.27	8.80	-5.19	28	528	763	
25	34365	1451	34511	1824	2366	-0.21	-2.16	0.24	0.00	0.00	0.00	0.00	-16.07	10.96	-4.93	25	926	189	
26	34454	1413	34627	1773	2361	-0.27	-2.21	0.27	0.00	0.00	0.00	0.00	-15.80	13.17	-4.62	230	233	117	
27	34539	1368	34738	1714	2356	-0.34	-2.27	0.31	0.00	0.00	0.00	0.00	-15.46	15.44	-4.29	202	205	145	
28	34620	1317	34845	1647	2352	-0.42	-2.33	0.34	0.00	0.00	0.00	0.00	-15.03	17.76	-3.93	174	177	173	
29	34698	1260	34947	1572	2348	-0.52	-2.38	0.38	0.00	0.00	0.00	0.00	-14.52	20.14	-3.54	147	150	200	
30	34771	1197	35042	1490	2344	-0.62	-2.43	0.41	0.00	0.00	0.00	0.00	-13.89	22.57	-3.15	121	125	225	
31	34839	1129	35132	1401	2340	-0.74	-2.46	0.44	0.00	0.00	0.00	0.00	-13.15	25.03	-2.75	99	103	247	
32	34902	1056	35214	1306	2336	-0.87	-2.48	0.47	0.00	0.00	0.00	0.00	-12.28	27.51	-2.35	78	83	267	
33	34959	97935289	1204	2332	-1.01	-2.47	0.49	0.00	0.00	0.00	0.00	-11.27	29.99	-1.96	61	65	285		
34	35010	89735356	1098	2329	-1.16	-2.44	0.50	0.00	0.00	0.00	0.00	-10.11	32.42	-1.59	46	50	300		
35	35055	81235415	9862327	-1.32	-2.38	0.51	0.00	0.00	0.00	0.00	-8.79	34.80	-1.25	33	38	312			
36	35094	72435466	8712325	-1.48	-2.28	0.51	0.00	0.00	0.00	0.00	-7.31	37.08	-0.94	23	28	322			
37	35126	63335508	7522323	-1.65	-2.14	0.50	0.00	0.00	0.00	0.00	-5.66	39.21	-0.67	14	20	330			
38	35151	54035541	6302321	-1.82	-1.96	0.48	0.00	0.00	0.00	0.00	-3.84	41.17	-0.45	8	14	336			
39	35169	44635564	5062320	-1.99	-1.74	0.45	0.00	0.00	0.00	0.00	-1.86	42.91	-0.27	3	9	341			
40	35180	35035579	3812320	-2.15	-1.47	0.40	0.00	0.00	0.00	0.00	0.29	44.38	-0.14	-0	6	344			

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 70 [mm] Thickness at top: 6750 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	35180	41930	70	-316.75	2.26	-316.75	-51.54	38370	38415	-0.05	-0.04	3189.65	3515.10
1	35180	41930	-453	-77.71	2.26	-394.46	-50.36	38399	38456	-0.07	-0.05	3219.16	3474.49
2	35180	41930	-977	-77.71	2.26	-472.18	-49.18	38417	38485	-0.08	-0.06	3237.12	3445.43
3	35180	41930	-1500	-77.71	2.26	-549.89	-48.00	38428	38507	-0.09	-0.08	3248.43	3423.01

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2720 [mm] Rise: 1350 [mm] Q-rise: 1100 [mm]
Ring thickness at crown: 250 [mm] Ring thickness at springing: 250 [mm] Mortar loss: 50 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust

0	41930	70	41680	72	2021	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.54	-32.39	-0.07	0	5	195	
1	41935	17641686	1982021	2.17	-0.84	0.02	-0.00	0.00	0.00	0.00	0.38	-31.55	-0.30	7	12	188			
2	41948	28241701	3222020	2.01	-1.14	-0.02	-0.00	0.00	0.00	0.00	-1.63	-30.41	-0.52	15	19	181			
3	41970	38641727	4462019	1.84	-1.40	-0.04	-0.00	0.00	0.00	0.00	-3.47	-29.01	-0.75	24	28	172			

4	41999	48841762	5672017	1.68	-1.60	-0.06	-0.00	0.00	0.00	0.00	0.00	-5.15	-27.41	-0.98	33	37	163		
5	42036	58741806	6842016	1.50	-1.77	-0.07	-0.00	0.00	0.00	0.00	0.00	-6.65	-25.64	-1.21	44	48	152		
6	42081	68441859	7982013	1.33	-1.89	-0.08	-0.00	0.00	0.00	0.00	0.00	-7.99	-23.75	-1.45	57	60	140		
7	42134	77641921	9082011	1.17	-1.96	-0.08	-0.00	0.00	0.00	0.00	0.00	-9.16	-21.79	-1.67	70	73	127		
8	42193	86441992	1012	2008	1.01	-2.00	-0.08	-0.00	0.00	0.00	0.00	-10.17	-19.79	-1.89	84	87	113		
9	42259	94742070	1111	2004	0.86	-2.01	-0.07	-0.00	0.00	0.00	0.00	-11.03	-17.78	-2.09	99	10298			
10	42332	1025	42156	1203	2001	0.72	-1.99	-0.06	-0.00	0.00	0.00	0.00	-11.75	-15.79	-2.27	115	118	82	
11	42410	1097	42248	1288	1998	0.60	-1.94	-0.04	-0.00	0.00	0.00	0.00	-12.35	-13.85	-2.43	131	133	67	
12	42494	1163	42347	1365	1993	0.49	-1.88	-0.03	-0.00	0.00	0.00	0.00	-12.84	-11.97	-2.56	146	148	52	
13	42582	1221	42452	1435	1989	0.39	-1.81	-0.02	-0.00	0.00	0.00	0.00	-13.23	-10.16	-2.67	160	162	38	
14	42675	1273	42562	1496	1985	0.30	-1.72	-0.00	-0.00	0.00	0.00	0.00	-13.53	-8.44	-2.75	172	174	26	
15	42772	1317	42677	1549	1981	0.23	-1.64	0.01	-0.00	0.00	0.00	0.00	-13.76	-6.80	-2.81	183	185	15	
16	42872	1354	42795	1592	1976	0.17	-1.57	0.02	-0.00	0.00	0.00	0.00	-13.93	-5.23	-2.85	190	192	8	
17	42974	1383	42916	1626	1972	0.12	-1.50	0.03	-0.00	0.00	0.00	0.00	-14.05	-3.74	-2.86	196	198	2	
18	43078	1403	43039	1650	1968	0.08	-1.44	0.05	-0.00	0.00	0.00	0.00	-14.13	-2.30	-2.85	198	200	-0	***
19	43184	1416	43164	1665	1964	0.04	-1.39	0.06	-0.00	0.00	0.00	0.00	-14.18	-0.91	-2.82	198	200	0	
20	43290	1420	43290	1670	1960	0.01	-1.37	0.07	-0.00	0.00	0.00	0.00	-14.19	0.46	-2.78	195	197	3	
21	43396	1416	43416	1665	1956	-0.01	-1.36	0.08	0.00	0.00	0.00	0.00	-14.18	1.82	-2.72	189	191	9	
22	43502	1403	43541	1650	1952	-0.04	-1.37	0.09	0.00	0.00	0.00	0.00	-14.13	3.18	-2.64	182	184	16	
23	43606	1383	43664	1626	1948	-0.07	-1.39	0.11	0.00	0.00	0.00	0.00	-14.06	4.58	-2.56	172	174	26	
24	43708	1354	43785	1592	1944	-0.11	-1.43	0.12	0.00	0.00	0.00	0.00	-13.95	6.01	-2.45	161	163	37	
25	43808	1317	43903	1549	1941	-0.16	-1.49	0.14	0.00	0.00	0.00	0.00	-13.79	7.50	-2.34	149	151	49	
26	43905	1273	44018	1496	1937	-0.21	-1.55	0.15	0.00	0.00	0.00	0.00	-13.58	9.05	-2.21	135	138	62	
27	43998	1221	44128	1435	1934	-0.27	-1.62	0.17	0.00	0.00	0.00	0.00	-13.31	10.68	-2.07	121	124	76	
28	44086	1163	44233	1365	1932	-0.35	-1.70	0.19	0.00	0.00	0.00	0.00	-12.95	12.37	-1.92	107	109	91	
29	44170	1097	44332	1288	1929	-0.44	-1.76	0.21	0.00	0.00	0.00	0.00	-12.51	14.14	-1.75	92	95	105	
30	44248	1025	44424	1203	1926	-0.54	-1.82	0.23	0.00	0.00	0.00	0.00	-11.97	15.96	-1.58	79	81	119	
31	44321	94744510	1111	1923	-0.66	-1.87	0.25	0.00	0.00	0.00	0.00	-11.31	17.82	-1.40	65	68	132		
32	44387	86444588	1012	1921	-0.79	-1.89	0.26	0.00	0.00	0.00	0.00	-10.52	19.71	-1.22	53	57	143		
33	44446	77644659	9081919	-0.93	-1.89	0.27	0.00	0.00	0.00	0.00	-9.60	21.60	-1.03	42	46	154			
34	44499	68444721	7981918	-1.08	-1.86	0.28	0.00	0.00	0.00	0.00	-8.52	23.46	-0.86	33	36	164			
35	44544	58744774	6841916	-1.23	-1.79	0.28	0.00	0.00	0.00	0.00	-7.28	25.25	-0.69	24	28	172			
36	44581	48844818	5671915	-1.40	-1.69	0.28	0.00	0.00	0.00	0.00	-5.89	26.94	-0.53	17	21	179			
37	44610	38644853	4461914	-1.56	-1.54	0.27	0.00	0.00	0.00	0.00	-4.33	28.48	-0.39	12	16	184			
38	44632	28244879	3221913	-1.73	-1.35	0.26	0.00	0.00	0.00	0.00	-2.60	29.83	-0.27	7	11	189			
39	44645	17644894	1981913	-1.89	-1.11	0.24	0.00	0.00	0.00	0.00	-0.71	30.94	-0.16	3	8	192			
40	44650	70	44900	72	1912	-2.04	-0.83	0.22	0.00	0.00	0.00	0.00	1.33	31.77	-0.07	-0	5	195	

Beaumont Bridge

46t HA loading in Good Condition with Backing

gammaFl dead load: 1.00
gammaFl superimposed: 1.00
gammaFl live load: 2.11
gammaF3 load effect: 1.00
gammaM material: 1.00
File path: V:\5210920\7 Calcs\72 Model\Stage 2 Assessment\Beaumont Bridge w backing.brg

10 (46t 6-axle 10.5t*) impact axle 3 @ 24383 [mm]

NAME: Beaumont Bridge
LOCATION: Beaumont, Meath
NUMBER: MH-L1615-001.00
Atkins
DATE: 22 February 2022
Printed on: Thursday, February 24, 2022 15:57:17

Bridge Name: Beaumont Bridge Bridge Location: Beaumont, Meath
Bridge Number: MH-L1615-001.00
Number of spans: 7

SAFETY FACTORS
Factor for deadload: 1.00 Factor for superimposed deadload: 1.00 Factor for surfacing: 1.00
Factor for live load: 2.11 Factor for load effect: 1.00 Factor for material strength: 1.00

APPLIED LOAD CASES
1.10 (46t 6-axle 10.5t*) impact axle 3 Total weight: 451.26 [kN] Position: 24383 [mm]
46.00 6 1.00 6.00 2.80 5.00 4.10 18.90 9.30 8.16 10.60 8.16 11.90 8.16 1.00 1.80 2.50
Effective lane width: 3350 [mm] Distribution length: 2755 [mm]

Applied distribution mode: Archie-M, BD21/97
Applied live load pressure: Active pressure

STRUCTURE PROPERTIES
Road shape: True shape (multi-point method)
Road points: (-500, 1950) (1180, 2010) (5805, 2150) (11660, 2490) (19175, 2630) (29755, 2500) (33895, 2390) (43290, 1960) (45000, 1900)
Depth of surfacing: 150Depth of overlay: 0
Surface unit weight: 23.00 [kN/m3] Overlay unit weight: 23.00 [kN/m3]
Lane width: 0

Fill unit weight: 18.00 [kN/m3] Fill phi: 30 degree

Left abutment Base level:-1500 [mm] Height: 380 [mm] Width: 1000 [mm]
Right abutment Base level:-1500 [mm] Height: 70 [mm] Width: 1000 [mm]

Right abutment Base level:-1500 [mm] Height: 70 [mm] Width: 1000 [mm]
Shape: Circular
Span: 2360 [mm] Rise: 1170 [mm] Q-rise: 1050 [mm]
Ring thickness at crown:380 [mm] Ring thickness at springing: 380 [mm] Mortar loss: 20 [mm]
Masonry unit weight:22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust	
0	0	380	-380	3831	954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-5.63	-30.87	-2.13	67	71	289	
1	4	472	-374	5051	954	0.00	-1.08	-0.24	0.00	-0.00	0.00	0.00	-5.63	-29.78	-1.50	47	52	308	
2	16	563	-359	6261	954	0.00	-1.35	-0.33	0.00	-0.00	0.00	0.00	-5.63	-28.44	-0.98	32	36	324	
3	35	654	-334	7451	955	0.00	-1.56	-0.39	0.00	-0.00	0.00	0.00	-5.63	-26.88	-0.58	19	23	337	
4	60	742	-300	8621	956	0.00	-1.72	-0.44	0.00	-0.00	0.00	0.00	-5.63	-25.15	-0.29	9	13	347	
5	93	828	-257	9761	958	0.00	-1.84	-0.45	0.00	-0.00	0.00	0.00	-5.63	-23.32	-0.11	3	6	354	
6	132	912	-206	1086	1960	0.00	-1.90	-0.45	0.00	-0.00	0.00	0.00	-5.63	-21.41	-0.03	-0	3	357	
7	177	992	-146	1192	1962	0.00	-1.93	-0.43	0.00	-0.00	0.00	0.00	-5.63	-19.49	-0.04	1	4	356	
8	229	1068	-77	1293	1965	0.00	-1.91	-0.40	0.00	-0.00	0.00	0.00	-5.63	-17.57	-0.12	6	8	352	
9	286	1141	-2	1389	1967	0.00	-1.87	-0.36	0.00	-0.00	0.00	0.00	-5.63	-15.71	-0.27	16	18	342	
10	349	1208	82	1478	1970	0.00	-1.80	-0.31	0.00	-0.00	0.00	0.00	-5.63	-13.91	-0.46	32	34	326	
11	417	1270	171	1560	1974	0.00	-1.71	-0.26	0.00	-0.00	0.00	0.00	-5.63	-12.20	-0.69	56	57	303	
12	490	1327	267	1635	1977	0.28	-1.62	-0.12	0.00	-0.00	0.00	0.00	-5.91	-10.58	-1.00	90	92	268	
13	566	1378	369	1703	1981	0.21	-1.54	-0.10	0.00	-0.00	0.00	0.00	-6.13	-9.05	-1.29	129	131	229	
14	647	1423	475	1762	1985	0.16	-1.45	-0.07	0.00	-0.00	0.00	0.00	-6.28	-7.59	-1.56	171	173	187	
15	731	1461	586	1813	1989	0.11	-1.38	-0.05	0.00	-0.00	0.00	0.00	-6.39	-6.22	-1.78	215	216	144	
16	817	1493	700	1854	1993	0.08	-1.30	-0.03	0.00	-0.00	0.00	0.00	-6.47	-4.91	-1.98	258	259	101	
17	906	1518	818	1887	1998	0.05	-1.24	-0.01	0.00	-0.00	0.00	0.00	-6.52	-3.67	-2.14	29	629	763	
18	996	1536	937	1911	2001	0.03	-1.20	0.01	0.00	-0.00	0.00	0.00	-6.55	-2.47	-2.25	32	832	931	
19	1088	1546	1058	1925	2006	0.02	-1.17	0.03	0.00	-0.00	0.00	0.00	-6.56	-1.30	-2.33	3503	519		
20	1180	1550	1180	1930	2010	0.01	-1.16	0.04	0.00	-0.00	0.00	0.00	-6.57	-0.14	-2.36	359	360	-0	***
21	1272	1546	1302	1925	2013	-0.01	-1.17	0.06	-0.00	-0.00	0.00	0.00	-6.56	1.03	-2.35	3553	564		

22	1364	1536	1423	1911	2017	-0.02	-1.20	0.08	-0.00	-0.00	0.00	0.00	-6.55	2.23	-2.30	33733822	
23	1454	1518	1542	1887	2021	-0.03	-1.24	0.10	-0.00	-0.00	0.00	0.00	-6.51	3.47	-2.20	30830951	
24	1543	1493	1660	1854	2024	-0.06	-1.30	0.13	-0.00	-0.00	0.00	0.00	-6.45	4.77	-2.06	27127288	
25	1629	1461	1774	1813	2028	-0.09	-1.38	0.15	-0.00	-0.00	0.00	0.00	-6.37	6.15	-1.88	228229131	
26	1713	1423	1885	1762	2031	-0.13	-1.46	0.18	-0.00	-0.00	0.00	0.00	-6.24	7.61	-1.66	184185175	
27	1794	1378	1991	1703	2034	-0.18	-1.55	0.21	-0.00	-0.00	0.00	0.00	-6.05	9.15	-1.40	140141219	
28	1870	1327	2093	1635	2037	-0.25	-1.64	0.24	-0.00	-0.00	0.00	0.00	-5.81	10.79	-1.10	99	100260
29	1943	1270	2189	1560	2039	-0.33	-1.73	0.28	-0.00	-0.00	0.00	0.00	-5.48	12.52	-0.77	62	63 297
30	2011	1208	2278	1478	2041	0.00	-1.82	0.41	0.00	-0.00	0.00	0.00	-5.48	14.34	-0.53	37	39 321
31	2074	1141	2362	1389	2043	0.00	-1.91	0.46	0.00	-0.00	0.00	0.00	-5.48	16.24	-0.33	19	22 338
32	2131	1068	2437	1293	2045	0.00	-1.98	0.50	0.00	-0.00	0.00	0.00	-5.48	18.22	-0.17	8	11 349
33	2183	9922506	1192	2047	0.00	-2.02	0.53	0.00	-0.00	0.00	0.00	-5.48	20.23	-0.06	2	5 355	
34	2228	9122566	1086	2049	0.00	-2.02	0.55	0.00	-0.00	0.00	0.00	-5.48	22.26	-0.04	0	3 357	
35	2267	8282617	9762051	0.00	-1.99	0.56	0.00	-0.00	0.00	0.00	-5.48	24.24	-0.09	2	6 354		
36	2300	7422660	8622052	0.00	-1.91	0.54	0.00	-0.00	0.00	0.00	-5.48	26.15	-0.25	8	11 349		
37	2325	6542694	7452053	0.00	-1.78	0.50	0.00	-0.00	0.00	0.00	-5.48	27.93	-0.52	16	20 340		
38	2344	5632719	6262053	0.00	-1.60	0.44	0.00	-0.00	0.00	0.00	-5.48	29.54	-0.90	28	32 328		
39	2356	4722734	5052054	0.00	-1.37	0.36	0.00	-0.00	0.00	0.00	-5.48	30.91	-1.40	43	47 313		
40	2360	3802740	3832054	0.00	-1.09	0.25	0.00	-0.00	0.00	0.00	-5.48	32.00	-2.02	61	65 295		

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 380 [mm] Thickness at top: 2000 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right

0	2360	4360	380	-113.98	-3.99	-113.98	3.75	3385	3401	-0.05	-0.06	1024.74	958.97
1	2360	4360	-247	-27.57	-3.99	-141.55	1.25	3359	3379	-0.07	-0.07	998.71	981.06
2	2360	4360	-873	-27.57	-3.99	-169.13	-1.25	3341	3365	-0.09	-0.08	980.53	995.31
3	2360	4360	-1500	-27.57	-3.99	-196.70	-3.75	3327	3355	-0.10	-0.09	966.89	1005.01

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2890 [mm] Rise: 1280 [mm] Q-rise: 1020 [mm]
Ring thickness at crown: 270 [mm] Ring thickness at springing: 270 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust

0	4360	4004092	4332089	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.47	-32.87	-2.08	59	64 186	
1	4377	5044112	5562090	0.00	-1.35	-0.25	0.00	-0.00	0.00	0.00	-9.47	-31.52	-1.36	39	44 206		
2	4401	6074140	6782091	0.00	-1.58	-0.29	0.00	-0.00	0.00	0.00	-9.47	-29.94	-0.81	24	28 222		
3	4432	7084177	7972092	0.00	-1.76	-0.32	0.00	-0.00	0.00	0.00	-9.47	-28.18	-0.42	12	16 234		
4	4471	8064223	9142093	0.00	-1.89	-0.33	0.00	-0.00	0.00	0.00	-9.47	-26.29	-0.17	4	8 242		
5	4516	9014277	1026	2095	0.00	-1.97	-0.33	0.00	-0.00	0.00	0.00	-9.47	-24.32	-0.05	0	4 246	
6	4569	9934339	1135	2097	0.00	-2.01	-0.32	0.00	-0.00	0.00	0.00	-9.47	-22.30	-0.04	-0	3 247	
7	4627	1080	4409	1239	2099	0.00	-2.02	-0.30	0.00	-0.00	0.00	0.00	-9.47	-20.28	-0.12	4	7 243
8	4693	1163	4486	1337	2101	0.00	-1.99	-0.27	0.00	-0.00	0.00	0.00	-9.47	-18.29	-0.26	11	14 236
9	4763	1241	4570	1430	2104	0.00	-1.94	-0.23	0.00	-0.00	0.00	0.00	-9.47	-16.36	-0.45	23	26 224
10	4840	1314	4661	1516	2107	0.00	-1.86	-0.20	0.00	-0.00	0.00	0.00	-9.47	-14.50	-0.68	39	42 208
11	4921	1381	4757	1596	2110	0.00	-1.76	-0.16	0.00	-0.00	0.00	0.00	-9.47	-12.73	-0.92	59	62 188
12	5007	1442	4859	1668	2113	0.00	-1.66	-0.13	0.00	-0.00	0.00	0.00	-9.47	-11.07	-1.18	83	85 165
13	5098	1497	4966	1733	2117	0.27	-1.57	-0.03	0.00	-0.00	0.00	0.00	-9.74	-9.51	-1.48	112	114 136
14	5192	1544	5078	1789	2121	0.20	-1.49	-0.01	0.00	-0.00	0.00	0.00	-9.94	-8.02	-1.75	140	142 108
15	5289	1585	5193	1838	2125	0.15	-1.41	-0.00	0.00	-0.00	0.00	0.00	-10.09	-6.61	-1.98	167	169 81
16	5389	1619	5312	1878	2130	0.11	-1.35	0.01	0.00	-0.00	0.00	0.00	-10.21	-5.26	-2.18	192	194 56
17	5491	1646	5433	1909	2134	0.08	-1.29	0.02	0.00	-0.00	0.00	0.00	-10.28	-3.97	-2.33	213	215 35
18	5595	1665	5556	1932	2139	0.05	-1.25	0.04	0.00	-0.00	0.00	0.00	-10.34	-2.71	-2.46	231	232 18

19	5700	1676	5680	1945	2144	0.03	-1.23	0.05	0.00	-0.00	0.00	0.00	-10.37	-1.48	-2.54	2422446			
20	5805	1680	5805	1950	2150	0.01	-1.23	0.06	0.00	-0.00	0.00	0.00	-10.38	-0.25	-2.59	249250	-0	***	
21	5910	1676	5930	1945	2155	-0.01	-1.24	0.07	-0.00	-0.00	0.00	0.00	-10.37	0.98	-2.59	2482500			
22	6015	1665	6054	1932	2161	-0.03	-1.27	0.09	-0.00	-0.00	0.00	0.00	-10.33	2.25	-2.56	2422437			
23	6119	1646	6177	1909	2167	-0.06	-1.31	0.10	-0.00	-0.00	0.00	0.00	-10.28	3.57	-2.48	22923119			
24	6221	1619	6298	1878	2173	-0.09	-1.38	0.12	-0.00	-0.00	0.00	0.00	-10.19	4.94	-2.36	21121238			
25	6321	1585	6417	1838	2179	-0.13	-1.45	0.14	-0.00	-0.00	0.00	0.00	-10.06	6.39	-2.20	18718961			
26	6418	1544	6532	1789	2184	-0.18	-1.53	0.16	-0.00	-0.00	0.00	0.00	-9.88	7.93	-1.98	16016288			
27	6512	1497	6644	1733	2191	-0.24	-1.62	0.18	-0.00	-0.00	0.00	0.00	-9.64	9.55	-1.72	131133117			
28	6603	1442	6751	1668	2196	-0.31	-1.72	0.20	-0.00	-0.00	0.00	0.00	-9.33	11.27	-1.41	100102148			
29	6689	1381	6853	1596	2201	0.00	-1.82	0.30	0.00	-0.00	0.00	0.00	-9.33	13.09	-1.15	73	76	174	
30	6770	1314	6949	1516	2207	0.00	-1.93	0.34	0.00	-0.00	0.00	0.00	-9.33	15.02	-0.88	51	53	197	
31	6847	1241	7040	1430	2212	0.00	-2.03	0.38	0.00	-0.00	0.00	0.00	-9.33	17.05	-0.62	32	35	215	
32	6917	1163	7124	1337	2217	0.00	-2.10	0.41	0.00	-0.00	0.00	0.00	-9.33	19.15	-0.39	18	20	230	
33	6983	1080	7201	1239	2222	0.00	-2.16	0.44	0.00	-0.00	0.00	0.00	-9.33	21.31	-0.21	8	11	239	
34	7041	9937271	1135	2225	0.00	-2.18	0.45	0.00	-0.00	0.00	0.00	-9.33	23.49	-0.09	2	5	245		
35	7094	9017333	1026	2229	0.00	-2.16	0.46	0.00	-0.00	0.00	0.00	-9.33	25.65	-0.05	-0	4	246		
36	7139	8067387	9142232	0.00	-2.11	0.45	0.00	-0.00	0.00	0.00	-9.33	27.76	-0.12	2	6	244			
37	7178	7087433	7972235	0.00	-2.01	0.43	0.00	-0.00	0.00	0.00	-9.33	29.76	-0.32	8	13	237			
38	7209	6077470	6782237	0.00	-1.86	0.40	0.00	-0.00	0.00	0.00	-9.33	31.62	-0.67	18	23	227			
39	7233	5047498	5562239	0.00	-1.66	0.35	0.00	-0.00	0.00	0.00	-9.33	33.27	-1.18	32	37	213			
40	7250	4007518	4332240	0.00	-1.41	0.28	0.00	-0.00	0.00	0.00	-9.33	34.68	-1.87	50	55	195			

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx total Fz total My total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 100 [mm] Thickness at top: 2300 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	7250	9550	100	-185.50	-42.51	-185.50	-9.73	8334	8361	-0.09	-0.07	1084.30	1189.20
1	7250	9550	-433	-26.99	-42.51	-212.49	-32.40	8232	8263	-0.13	-0.06	982.34	1287.30
2	7250	9550	-967	-26.99	-42.51	-239.48	-55.07	8153	8187	-0.17	-0.04	902.92	1362.86
3	7250	9550	-1500	-26.99	-42.51	-266.46	-77.74	8089	8127	-0.20	-0.03	839.20	1422.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 4220 [mm] Rise: 1930 [mm] Q-rise: 1560 [mm]
Ring thickness at crown: 350 [mm] Ring thickness at springing: 350 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	9550	1009201	1312346	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-51.84	-69.38	-50.26	677687	-357	***		
1	9570	2569224	3132347	0.00	-2.37	-0.56	0.00	-0.00	0.00	0.00	-51.84	-67.01	-42.89	570581	-251	***		
2	9601	4099261	4922350	0.00	-2.84	-0.68	0.00	-0.00	0.00	0.00	-51.84	-64.17	-36.18	480491	-161	***		
3	9643	5609310	6682353	0.00	-3.21	-0.76	0.00	-0.00	0.00	0.00	-51.84	-60.96	-30.13	402413	-83	***		
4	9697	7089373	8402357	0.00	-3.47	-0.80	0.00	-0.00	0.00	0.00	-51.84	-57.48	-24.72	335345	-15	***		
5	9761	8519448	1006	2361	0.00	-3.63	-0.80	0.00	-0.00	0.00	0.00	-51.84	-53.85	-19.94	27528545			
6	9836	9899535	1167	2367	0.00	-3.70	-0.76	0.00	-0.00	0.00	0.00	-51.84	-50.15	-15.74	22123199			
7	9921	1121	9633	1321	2373	0.00	-3.69	-0.70	0.00	-0.00	0.00	0.00	-51.84	-46.46	-12.10	174183147		
8	10015	1247	9743	1467	2380	0.00	-3.61	-0.63	0.00	-0.00	0.00	0.00	-51.84	-42.84	-8.99	132141189		
9	10118	1365	9864	1605	2388	0.00	-3.47	-0.54	0.00	-0.00	0.00	0.00	-51.84	-39.37	-6.38	95	104226	
10	10230	1475	9994	1733	2396	0.00	-3.29	-0.44	0.00	-0.00	0.00	0.00	-51.84	-36.08	-4.24	63	72	258
11	10350	1576	10133	1851	2404	0.00	-3.07	-0.35	0.00	-0.00	0.00	0.00	-51.84	-33.01	-2.57	38	46	284
12	10477	1669	10281	1959	2413	0.00	-2.83	-0.26	0.00	-0.00	0.00	0.00	-51.84	-30.18	-1.34	18	27	303
13	10610	1751	10436	2055	2422	0.00	-2.59	-0.18	0.00	-0.00	0.00	0.00	-51.84	-27.59	-0.54	5	13	317
14	10749	1824	10599	2140	2432	0.28	-2.39	-0.02	0.00	-0.00	0.00	0.00	-52.12	-25.20	-0.24	-0	8	322
15	10893	1886	10766	2213	2442	0.20	-2.22	0.01	0.00	-0.00	0.00	0.00	-52.32	-22.98	-0.31	1	9	321

16	11041	1938	10939	2272	2452	0.13	-2.07	0.04	0.00	-0.00	0.00	0.00	-52.45	-20.91	-0.76	9	17	313	
17	11193	1978	11116	2319	2461	0.09	-1.95	0.06	0.00	-0.00	0.00	0.00	-52.53	-18.96	-1.59	25	33	297	
18	11347	2007	11296	2353	2471	0.05	-1.86	0.08	0.00	-0.00	0.00	0.00	-52.59	-17.09	-2.80	47	55	275	
19	11503	2024	11477	2373	2480	0.03	-1.81	0.11	0.00	-0.00	0.00	0.00	-52.61	-15.28	-4.38	78	86	244	
20	11660	2030	11660	2380	2490	0.01	-1.80	0.13	0.00	-0.00	0.00	0.00	-52.62	-13.48	-6.34	117	124	206	
21	11817	2024	11843	2373	2499	-0.01	-1.83	0.16	-0.00	-0.00	0.00	0.00	-52.61	-11.65	-8.65	164	171	159	
22	11973	2007	12024	2353	2507	-0.03	-1.90	0.19	-0.00	-0.02	0.00	0.00	-52.58	-9.73	-11.29	220	227	103	
23	12127	1978	12204	2319	2514	-0.07	-2.01	0.22	-0.20	-3.13	0.48	0.00	-52.32	-4.59	-14.24	28	128	842	
24	12279	1938	12381	2272	2522	-0.11	-2.15	0.26	-1.06	-12.02	1.76	0.00	-51.14	9.57	-16.87	323	330	-0	***
25	12427	1886	12554	2213	2529	-0.17	-2.32	0.31	-1.99	-17.22	2.60	0.00	-48.98	29.11	-17.97	3	163	246	
26	12571	1824	12721	2140	2536	-0.26	-2.51	0.36	-1.96	-13.65	2.14	0.00	-46.76	45.26	-16.83	26	827	753	
27	12710	1751	12884	2055	2542	-0.37	-2.72	0.42	-1.06	-6.08	0.99	0.00	-45.33	54.06	-13.98	206	216	114	
28	12843	1669	13039	1959	2548	0.00	-2.95	0.61	0.00	-2.46	0.59	0.00	-45.33	59.46	-10.96	150	160	170	
29	12970	1576	13187	1851	2552	0.00	-3.21	0.72	0.00	-3.04	0.80	0.00	-45.33	65.72	-8.29	103	114	216	
30	13090	1475	13326	1733	2557	0.00	-3.46	0.82	0.00	-3.78	1.04	0.00	-45.33	72.95	-6.00	67	78	252	
31	13202	1365	13456	1605	2561	0.00	-3.68	0.92	0.00	-4.28	1.24	0.00	-45.33	80.91	-4.07	39	52	278	
32	13305	1247	13577	1467	2565	0.00	-3.86	1.01	0.00	-4.52	1.36	0.00	-45.33	89.29	-2.54	19	33	297	
33	13399	1121	13687	1321	2569	0.00	-3.99	1.09	0.00	-4.50	1.40	0.00	-45.33	97.78	-1.46	6	21	309	
34	13484	98	913785	1167	2572	0.00	-4.05	1.13	0.00	-4.28	1.37	0.00	-45.33	106.11	-0.93	-0	16	314	
35	13559	85	113872	1006	2574	0.00	-4.03	1.15	0.00	-3.89	1.28	0.00	-45.33	114.03	-1.07	-0	17	313	
36	13623	70	813947	840	2576	0.00	-3.92	1.13	0.00	-3.39	1.13	0.00	-45.33	121.35	-2.00	6	25	305	
37	13677	56	014010	668	2577	0.00	-3.72	1.07	0.00	-2.83	0.95	0.00	-45.33	127.90	-3.85	19	38	292	
38	13719	40	914059	492	2578	0.00	-3.41	0.97	0.00	-2.24	0.76	0.00	-45.33	133.55	-6.76	38	58	272	
39	13750	25	614096	313	2579	0.00	-3.00	0.82	0.00	-1.63	0.55	0.00	-45.33	138.17	-10.82	65	86	244	
40	13770	10	014119	131	2580	0.00	-2.47	0.64	0.00	-1.02	0.35	0.00	-45.33	141.66	-16.11	101	121	209	

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 100 [mm] Thickness at top: 3150 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	13770	16920	100	-436.90	-46.86	-436.90	-184.53	14891	14954	-0.25	-0.03	1121.43	1966.16
1	13770	16920	-433	-36.96	-46.86	-473.86	-209.53	14869	14937	-0.28	-0.02	1098.99	1983.32
2	13770	16920	-967	-36.96	-46.86	-510.82	-234.52	14849	14922	-0.30	-0.02	1079.41	1997.61
3	13770	16920	-1500	-36.96	-46.86	-547.78	-259.51	14832	14910	-0.33	-0.02	1062.12	2009.62

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 4510 [mm] Rise: 2010 [mm] Q-rise: 1660 [mm]
Ring thickness at crown: 370 [mm] Ring thickness at springing: 370 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust	
0	16920	20016	552	2422	621	0.00	0.00	0.00	0.00	0.00	0.00	-93.43	-81.98	-122.20	1320	1333	-983	***	
1	16945	36316	581	4322	621	0.00	-2.88	-0.73	0.00	-0.17	-0.06	0.00	-93.43	-78.93	-108.00	1130	1144	-794	***
2	16982	52416	624	6202	622	0.00	-3.38	-0.86	0.00	-0.22	-0.07	0.00	-93.43	-75.33	-94.67	971	984	-634	***
3	17030	68216	680	8032	622	0.00	-3.76	-0.95	0.00	-0.26	-0.08	0.00	-93.43	-71.31	-82.22	833	847	-497	***
4	17090	83616	750	9832	623	0.00	-4.03	-0.98	0.00	-0.27	-0.08	0.00	-93.43	-67.01	-70.68	711	725	-375	***
5	17160	98616	832	1156	2624	0.00	-4.19	-0.97	0.00	-0.24	-0.07	0.00	-93.43	-62.57	-60.03	602	616	-266	***
6	17242	1130	16927	1323	2624	0.00	-4.25	-0.92	0.00	-0.20	-0.05	0.00	-93.43	-58.13	-50.28	504	518	-168	***
7	17333	1267	17033	1483	2625	0.00	-4.22	-0.84	0.00	-0.13	-0.03	0.00	-93.43	-53.77	-41.42	415	429	-79	***
8	17435	1397	17151	1635	2626	0.00	-4.11	-0.75	0.00	-0.07	-0.02	0.00	-93.43	-49.59	-33.44	334	348	2	
9	17545	1520	17280	1778	2626	0.00	-3.94	-0.64	0.00	-0.02	-0.00	0.00	-93.43	-45.64	-26.32	262	276	74	
10	17665	1635	17418	1911	2627	0.00	-3.71	-0.52	0.00	-0.00	-0.00	0.00	-93.43	-41.92	-20.07	199	213	137	
11	17792	1740	17566	2033	2628	0.00	-3.45	-0.41	0.00	-0.00	0.00	0.00	-93.43	-38.47	-14.67	143	157	193	
12	17926	1836	17723	2145	2628	0.00	-3.17	-0.30	0.00	-0.00	0.00	0.00	-93.43	-35.30	-10.13	97	111	239	

13	18068	1922	17887	2245	2629	0.00	-2.88	-0.20	0.00	-0.00	0.00	0.00	-93.43	-32.42	-6.46	59	73	277	
14	18215	1997	18058	2332	2629	0.30	-2.63	-0.02	0.00	-0.00	0.00	0.00	-93.73	-29.79	-3.74	31	45	305	
15	18367	2061	18235	2407	2629	0.20	-2.41	0.01	0.00	-0.00	0.00	0.00	-93.93	-27.38	-1.86	12	26	324	
16	18523	2114	18417	2469	2630	0.13	-2.22	0.04	0.00	-0.00	0.00	0.00	-94.06	-25.16	-0.83	2	15	335	
17	18683	2156	18603	2517	2630	0.08	-2.05	0.07	0.00	-0.00	0.00	0.00	-94.14	-23.11	-0.67	-0	14	336	
18	18846	2186	18792	2552	2630	0.04	-1.92	0.09	0.00	-0.00	0.00	0.00	-94.18	-21.19	-1.39	8	21	329	
19	19010	2204	18983	2573	2630	0.02	-1.83	0.11	0.00	-0.00	0.00	0.00	-94.21	-19.36	-3.00	25	38	312	
20	19175	2210	19175	2580	2630	0.01	-1.78	0.13	0.00	-0.00	0.00	0.00	-94.21	-17.58	-5.49	52	65	285	
21	19340	2204	19367	2573	2629	-0.01	-1.78	0.16	-0.00	-0.00	0.00	0.00	-94.21	-15.80	-8.85	89	102	248	
22	19504	2186	19558	2552	2629	-0.02	-1.83	0.19	-0.00	-0.00	0.00	0.00	-94.18	-13.97	-13.07	137	150	200	
23	19667	2156	19747	2517	2628	-0.04	-1.92	0.22	-0.00	-0.00	0.00	0.00	-94.14	-12.06	-18.11	196	209	141	
24	19827	2114	19933	2469	2628	-0.08	-2.05	0.26	-0.20	-2.35	0.47	0.00	-93.86	-7.67	-24.02	26	82	80	70
25	19983	2061	20115	2407	2627	-0.13	-2.21	0.31	-2.27	-20.01	3.52	0.00	-91.47	14.55	-30.45	32	93	42	8
26	20135	1997	20292	2332	2626	-0.20	-2.40	0.37	-5.40	-38.28	6.77	0.00	-85.86	55.24	-34.69	33	63	50	-0 ***
27	20282	1922	20463	2245	2626	-0.30	-2.62	0.43	-6.22	-36.44	6.63	0.00	-79.34	94.31	-33.78	28	53	01	49
28	20424	1836	20627	2145	2625	0.00	-2.87	0.61	0.00	-18.57	4.44	0.00	-79.34	115.75	-29.21	21	62	34	116
29	20558	1740	20784	2033	2624	0.00	-3.16	0.72	0.00	-3.92	0.96	0.00	-79.34	122.83	-21.89	14	91	69	181
30	20685	1635	20932	1911	2623	0.00	-3.44	0.84	0.00	-1.64	0.47	0.00	-79.34	127.90	-15.22	95	116	23	4
31	20805	1520	21070	1778	2622	0.00	-3.70	0.96	0.00	-1.89	0.58	0.00	-79.34	133.50	-9.85	54	76	27	4
32	20915	1397	21199	1635	2621	0.00	-3.93	1.07	0.00	-2.03	0.64	0.00	-79.34	139.46	-5.83	26	48	30	2
33	21017	1267	21317	1483	2621	0.00	-4.10	1.16	0.00	-2.05	0.67	0.00	-79.34	145.62	-3.21	8	31	31	9
34	21108	1130	21423	1323	2620	0.00	-4.21	1.23	0.00	-1.97	0.67	0.00	-79.34	151.80	-2.07	-0	24	32	6
35	21190	98	621518	1156	2620	0.00	-4.24	1.27	0.00	-1.81	0.62	0.00	-79.34	157.86	-2.51	2	27	32	3
36	21260	83	621600	983	2619	0.00	-4.19	1.26	0.00	-1.59	0.56	0.00	-79.34	163.63	-4.61	12	38	31	2
37	21320	68	221670	803	2619	0.00	-4.03	1.22	0.00	-1.34	0.48	0.00	-79.34	169.00	-8.46	32	59	29	1
38	21368	52	421726	620	2618	0.00	-3.76	1.13	0.00	-1.07	0.38	0.00	-79.34	173.83	-14.15	62	89	26	1
39	21405	36	321769	432	2618	0.00	-3.38	0.99	0.00	-0.80	0.29	0.00	-79.34	178.01	-21.73	101	128	22	2
40	21430	20	021798	242	2618	0.00	-2.88	0.80	0.00	-0.54	0.19	0.00	-79.34	181.43	-31.25	152	179	17	1

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx total Fz total My total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 200 [mm] Thickness at top: 7170 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	21430	28600	200	-623.12	72.67	-623.12	-388.05	24348	24437	-0.13	-0.04	2917.74	4163.24
1	21430	28600	-367	-89.39	72.67	-712.51	-346.87	24477	24579	-0.14	-0.06	3047.28	4020.94
2	21430	28600	-933	-89.39	72.67	-801.90	-305.69	24577	24691	-0.15	-0.08	3146.51	3908.93
3	21430	28600	-1500	-89.39	72.67	-891.28	-264.51	24655	24782	-0.16	-0.09	3224.56	3818.11

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2310 [mm] Rise: 1150 [mm] Q-rise: 960 [mm]
Ring thickness at crown: 500 [mm] Ring thickness at springing: 500 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	28600	45028	100	4522532	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7.45	-49.41	-3.21	61	68	412	
1	28604	54028	106	5822532	0.00	-1.45	-0.43	0.00	0.00	0.00	0.00	-7.45	-47.96	-2.29	44	51	429	
2	28615	63028	121	7102532	0.00	-1.83	-0.60	0.00	0.00	0.00	0.00	-7.45	-46.14	-1.52	29	36	444	
3	28633	71928	147	8372531	0.00	-2.14	-0.73	0.00	0.00	0.00	0.00	-7.45	-43.99	-0.92	18	24	456	
4	28658	80628	183	9622530	0.00	-2.40	-0.83	0.00	0.00	0.00	0.00	-7.45	-41.59	-0.49	9	15	465	
5	28689	89028	228	1083 2530	0.00	-2.60	-0.89	0.00	0.00	0.00	0.00	-7.45	-38.99	-0.21	3	8	472	
6	28727	97228	283	1201 2529	0.00	-2.75	-0.91	0.00	0.00	0.00	0.00	-7.45	-36.24	-0.09	-0	5	475	
7	28772	1051	28346	1314 2527	0.00	-2.84	-0.90	0.00	0.00	0.00	0.00	-7.45	-33.40	-0.11	1	6	474	
8	28822	1126	28419	1421 2526	0.00	-2.88	-0.86	0.00	0.00	0.00	0.00	-7.45	-30.52	-0.25	6	11	469	
9	28879	1197	28499	1523 2525	0.00	-2.89	-0.80	0.00	0.00	0.00	0.00	-7.45	-27.63	-0.49	17	21	459	

10	28940	1263	28587	1618	2523	0.00	-2.85	-0.72	0.00	0.00	0.00	0.00	-7.45	-24.78	-0.81	34	37	443	
11	29007	1325	28683	1706	2521	0.00	-2.79	-0.64	0.00	0.00	0.00	0.00	-7.45	-21.99	-1.20	59	62	418	
12	29078	1381	28785	1786	2519	0.00	-2.72	-0.55	0.00	0.00	0.00	0.00	-7.45	-19.27	-1.62	92	95	385	
13	29153	1431	28892	1857	2517	0.48	-2.64	-0.26	-0.00	0.00	0.00	0.00	-7.92	-16.63	-2.23	144	146	334	
14	29232	1475	29006	1921	2515	0.38	-2.57	-0.21	-0.00	0.00	0.00	0.00	-8.30	-14.06	-2.79	201	203	277	
15	29314	1513	29123	1975	2512	0.30	-2.50	-0.15	-0.00	0.00	0.00	0.00	-8.60	-11.56	-3.27	263	265	215	
16	29399	1544	29245	2019	2510	0.22	-2.43	-0.10	-0.00	0.00	0.00	0.00	-8.82	-9.14	-3.67	327	328	152	
17	29486	1568	29370	2055	2508	0.16	-2.36	-0.06	-0.00	0.00	0.00	0.00	-8.99	-6.77	-3.99	386	387	93	
18	29575	1586	29497	2080	2505	0.11	-2.31	-0.01	-0.00	0.00	0.00	0.00	-9.10	-4.47	-4.22	435	437	43	
19	29665	1596	29626	2095	2502	0.06	-2.27	0.04	-0.00	0.00	0.00	0.00	-9.16	-2.20	-4.36	468	469	11	
20	29755	1600	29755	2100	2499	0.02	-2.25	0.08	-0.00	0.00	0.00	0.00	-9.18	0.05	-4.40	479	480	-0	***
21	29845	1596	29884	2095	2497	-0.02	-2.24	0.12	0.00	0.00	0.00	0.00	-9.16	2.29	-4.35	466	468	12	
22	29935	1586	30013	2080	2494	-0.06	-2.25	0.17	0.00	0.00	0.00	0.00	-9.10	4.54	-4.20	432	434	46	
23	30024	1568	30140	2055	2491	-0.11	-2.28	0.22	0.00	0.00	0.00	0.00	-8.99	6.82	-3.96	383	385	96	
24	30111	1544	30265	2019	2489	-0.16	-2.32	0.26	0.00	0.00	0.00	0.00	-8.83	9.14	-3.63	323	325	155	
25	30196	1513	30387	1975	2486	-0.21	-2.37	0.31	0.00	0.00	0.00	0.00	-8.62	11.51	-3.23	260	262	218	
26	30278	1475	30504	1921	2484	-0.28	-2.44	0.36	0.00	0.00	0.00	0.00	-8.34	13.95	-2.74	199	201	279	
27	30357	1431	30618	1857	2481	-0.36	-2.50	0.42	0.00	0.00	0.00	0.00	-7.98	16.45	-2.20	142	144	336	
28	30432	1381	30725	1786	2478	-0.45	-2.57	0.47	0.00	0.00	0.00	0.00	-7.53	19.02	-1.59	91	94	386	
29	30503	1325	30827	1706	2476	0.00	-2.64	0.72	0.00	0.00	0.00	0.00	-7.53	21.66	-1.17	58	61	419	
30	30570	1263	30923	1618	2474	0.00	-2.71	0.80	0.00	0.00	0.00	0.00	-7.53	24.37	-0.79	33	36	444	
31	30631	1197	31011	1523	2472	0.00	-2.77	0.87	0.00	0.00	0.00	0.00	-7.53	27.14	-0.46	16	20	460	
32	30688	1126	31091	1421	2470	0.00	-2.81	0.93	0.00	0.00	0.00	0.00	-7.53	29.95	-0.23	6	10	470	
33	30738	1051	31164	1314	2469	0.00	-2.81	0.97	0.00	0.00	0.00	0.00	-7.53	32.75	-0.10	1	5	475	
34	30783	97231227	1201	2467	0.00	-2.77	0.99	0.00	0.00	0.00	0.00	-7.53	35.52	-0.09	-0	5	475		
35	30821	89031282	1083	2466	0.00	-2.69	0.98	0.00	0.00	0.00	0.00	-7.53	38.21	-0.22	3	8	472		
36	30852	80631327	9622465	0.00	-2.55	0.94	0.00	0.00	0.00	0.00	-7.53	40.76	-0.50	9	15	465			
37	30877	71931363	8372464	0.00	-2.36	0.87	0.00	0.00	0.00	0.00	-7.53	43.12	-0.94	19	25	455			
38	30895	63031389	7102463	0.00	-2.11	0.76	0.00	0.00	0.00	0.00	-7.53	45.23	-1.55	31	37	443			
39	30906	54031404	5822463	0.00	-1.81	0.61	0.00	0.00	0.00	0.00	-7.53	47.04	-2.33	46	52	428			
40	30910	45031410	4522463	0.00	-1.44	0.43	0.00	0.00	0.00	0.00	-7.53	48.48	-3.26	64	71	409			

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 350 [mm] Thickness at top: 1700 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right

0	30910	32610	350	-132.21	-2.73	-132.21	1.40	31761	31780	-0.07	-0.08	851.18	829.93
1	30910	32610	-267	-23.06	-2.73	-155.27	-0.28	31747	31769	-0.09	-0.09	837.12	840.69
2	30910	32610	-883	-23.06	-2.73	-178.33	-1.96	31736	31762	-0.11	-0.10	826.28	848.25
3	30910	32610	-1500	-23.06	-2.73	-201.40	-3.64	31728	31756	-0.13	-0.11	817.54	853.69

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2570 [mm] Rise: 1190 [mm] Q-rise: 1030 [mm]
Ring thickness at crown: 400 [mm] Ring thickness at springing: 400 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust

0	32610	35032211	3812442	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-10.25	-47.26	-2.71	53	60	320			
1	32621	44632226	5062441	0.00	-1.57	-0.42	0.00	0.00	0.00	0.00	-10.25	-45.68	-1.81	35	42	338			
2	32639	54032249	6302441	0.00	-1.90	-0.53	0.00	0.00	0.00	0.00	-10.25	-43.79	-1.10	21	28	352			
3	32664	63332282	7522440	0.00	-2.16	-0.60	0.00	0.00	0.00	0.00	-10.25	-41.63	-0.59	11	17	363			
4	32696	72432324	8712439	0.00	-2.38	-0.66	0.00	0.00	0.00	0.00	-10.25	-39.25	-0.26	4	9	371			
5	32735	81232375	9862437	0.00	-2.54	-0.68	0.00	0.00	0.00	0.00	-10.25	-36.71	-0.10	-0	5	375			
6	32780	89732434	1098	2436	0.00	-2.65	-0.68	0.00	0.00	0.00	0.00	-10.25	-34.06	-0.09	0	5	375		

7 32831 97932501 1204 2434 0.00 -2.72 -0.66 0.00 0.00 0.00 0.00 -10.25 -31.35 -0.22 5 9 371
8 32888 1056 32576 1306 2432 0.00 -2.74 -0.62 0.00 0.00 0.00 0.00 -10.25 -28.60 -0.45 14 18 362
9 32951 1129 32658 1401 2430 0.00 -2.73 -0.57 0.00 0.00 0.00 0.00 -10.25 -25.87 -0.77 28 31 349
10 33019 1197 32748 1490 2427 0.00 -2.70 -0.51 0.00 0.00 0.00 0.00 -10.25 -23.17 -1.15 48 51 329
11 33092 1260 32843 1572 2424 0.00 -2.63 -0.45 0.00 0.00 0.00 0.00 -10.25 -20.54 -1.57 74 77 303
12 33170 1317 32945 1647 2421 0.00 -2.56 -0.38 0.00 0.00 0.00 0.00 -10.25 -17.98 -2.02 107110270
13 33251 1368 33052 1714 2418 0.47 -2.48 -0.15 -0.00 0.00 0.00 0.00 -10.72 -15.50 -2.59 151154226
14 33336 1413 33163 1773 2414 0.38 -2.41 -0.11 -0.00 0.00 0.00 0.00 -11.10 -13.09 -3.11 197199181
15 33425 1451 33279 1824 2411 0.30 -2.34 -0.08 -0.00 0.00 0.00 0.00 -11.40 -10.75 -3.55 243245135
16 33516 1483 33398 1865 2406 0.23 -2.28 -0.04 -0.00 0.00 0.00 0.00 -11.63 -8.47 -3.92 28728991
17 33609 1508 33520 1898 2402 0.17 -2.22 -0.01 -0.00 0.00 0.00 0.00 -11.79 -6.26 -4.20 32532753
18 33703 1526 33644 1921 2398 0.11 -2.17 0.02 -0.00 0.00 0.00 0.00 -11.90 -4.09 -4.40 35535624
19 33799 1536 33769 1935 2394 0.06 -2.13 0.06 -0.00 0.00 0.00 0.00 -11.97 -1.96 -4.52 3733755
20 33895 1540 33895 1940 2390 0.02 -2.10 0.09 -0.00 0.00 0.00 0.00 -11.99 0.14 -4.55 378380-0 ***
21 33991 1536 34021 1935 2385 -0.02 -2.09 0.12 0.00 0.00 0.00 0.00 -11.97 2.23 -4.49 3703728
22 34087 1526 34146 1921 2381 -0.06 -2.10 0.15 0.00 0.00 0.00 0.00 -11.90 4.33 -4.35 34935129
23 34181 1508 34270 1898 2376 -0.11 -2.12 0.18 0.00 0.00 0.00 0.00 -11.80 6.45 -4.12 31832060
24 34274 1483 34392 1865 2371 -0.16 -2.15 0.21 0.00 0.00 0.00 0.00 -11.64 8.59 -3.82 27928199
25 34365 1451 34511 1824 2366 -0.21 -2.19 0.25 0.00 0.00 0.00 0.00 -11.43 10.79-3.44 235237143
26 34454 1413 34627 1773 2362 -0.28 -2.24 0.28 0.00 0.00 0.00 0.00 -11.15 13.03-2.99 189192188
27 34539 1368 34738 1714 2357 -0.35 -2.30 0.32 0.00 0.00 0.00 0.00 -10.81 15.33-2.48 144147233
28 34620 1317 34845 1647 2353 -0.43 -2.36 0.36 0.00 0.00 0.00 0.00 -10.37 17.68-1.91 102104276
29 34698 1260 34947 1572 2349 0.00 -2.42 0.54 0.00 0.00 0.00 0.00 -10.37 20.11-1.47 70 73 307
30 34771 1197 35042 1490 2345 0.00 -2.50 0.60 0.00 0.00 0.00 0.00 -10.37 22.60-1.06 45 48 332
31 34839 1129 35132 1401 2341 0.00 -2.56 0.66 0.00 0.00 0.00 0.00 -10.37 25.16-0.69 25 29 351
32 34902 1056 35214 1306 2338 0.00 -2.60 0.70 0.00 0.00 0.00 0.00 -10.37 27.76-0.39 12 16 364
33 34959 97935289 1204 2334 0.00 -2.61 0.74 0.00 0.00 0.00 0.00 -10.37 30.38-0.18 4 8 372
34 35010 89735356 1098 2331 0.00 -2.59 0.76 0.00 0.00 0.00 0.00 -10.37 32.97-0.08 -0 5 375
35 35055 81235415 9862329 0.00 -2.54 0.76 0.00 0.00 0.00 0.00 -10.37 35.51-0.11 0 6 374
36 35094 72435466 8712327 0.00 -2.44 0.74 0.00 0.00 0.00 0.00 -10.37 37.94-0.30 5 10 370
37 35126 63335508 7522325 0.00 -2.29 0.70 0.00 0.00 0.00 0.00 -10.37 40.23-0.65 13 19 361
38 35151 54035541 6302323 0.00 -2.09 0.63 0.00 0.00 0.00 0.00 -10.37 42.33-1.18 24 30 350
39 35169 44635564 5062322 0.00 -1.85 0.54 0.00 0.00 0.00 0.00 -10.37 44.17-1.91 39 45 335
40 35180 35035579 3812322 0.00 -1.54 0.42 0.00 0.00 0.00 0.00 -10.37 45.72-2.83 58 64 316

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 70 [mm] Thickness at top: 6750 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

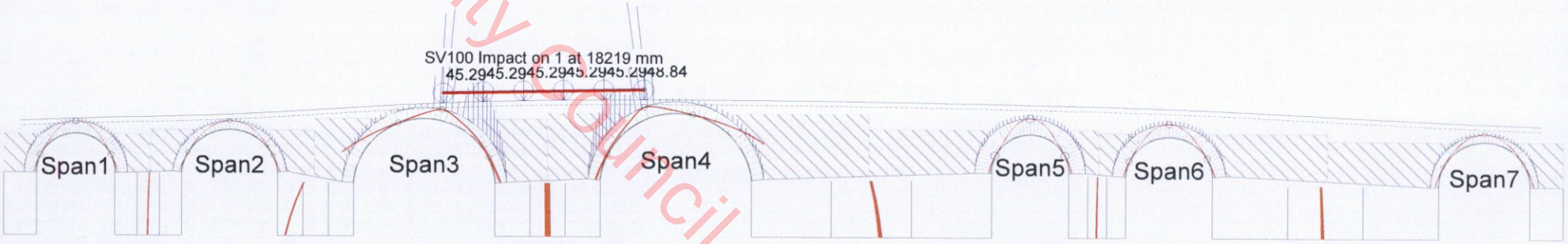
Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
0 35180 41930 70 -354.06 0.76 -354.06 -44.57 38404 38454 -0.06 -0.05 3223.82 3475.60
1 35180 41930 -453 -77.71 0.76 -431.78 -44.17 38422 38484 -0.07 -0.06 3241.85 3446.47
2 35180 41930 -977 -77.71 0.76 -509.49 -43.78 38433 38505 -0.08 -0.07 3252.68 3424.53
3 35180 41930 -1500 -77.71 0.76 -587.21 -43.38 38439 38523 -0.09 -0.08 3259.18 3406.94

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2720 [mm] Rise: 1350 [mm] Q-rise: 1100 [mm]
Ring thickness at crown: 250 [mm] Ring thickness at springing: 250 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
0 41930 70 41680 72 2026 0.00 0.00 0.00 0.00 0.00 0.00 0.00 -9.62 -34.38 -3.26 92 97 133
1 41935 17641686 1982026 0.00 -0.87 -0.13 0.00 0.00 0.00 0.00 -9.62 -33.51 -2.26 64 69 161
2 41948 28241701 3222025 0.00 -1.22 -0.21 0.00 0.00 0.00 0.00 -9.62 -32.29 -1.46 41 46 184
3 41970 38641727 4462024 0.00 -1.51 -0.26 0.00 0.00 0.00 0.00 -9.62 -30.78 -0.85 24 29 201

4	41999	48841762	5672022	0.00	-1.74	-0.30	0.00	0.00	0.00	0.00	0.00	-9.62	-29.03	-0.43	12	16	214		
5	42036	58741806	6842021	0.00	-1.92	-0.32	0.00	0.00	0.00	0.00	0.00	-9.62	-27.11	-0.17	4	8	222		
6	42081	68441859	7982018	0.00	-2.05	-0.32	0.00	0.00	0.00	0.00	0.00	-9.62	-25.06	-0.05	-0	4	226		
7	42134	77641921	9082016	0.00	-2.12	-0.31	0.00	0.00	0.00	0.00	0.00	-9.62	-22.94	-0.05	0	4	226		
8	42193	86441992	1012	2013	0.00	-2.16	-0.29	0.00	0.00	0.00	0.00	0.00	-9.62	-20.78	-0.16	5	9	221	
9	42259	94742070	1111	2009	0.00	-2.15	-0.27	0.00	0.00	0.00	0.00	0.00	-9.62	-18.63	-0.33	15	18	212	
10	42332	1025	42156	1203	2006	0.00	-2.11	-0.23	0.00	0.00	0.00	0.00	0.00	-9.62	-16.53	-0.56	29	31	199
11	42410	1097	42248	1288	2002	0.00	-2.04	-0.19	0.00	0.00	0.00	0.00	0.00	-9.62	-14.49	-0.81	47	50	180
12	42494	1163	42347	1365	1997	0.00	-1.95	-0.16	0.00	0.00	0.00	0.00	0.00	-9.62	-12.54	-1.08	70	73	157
13	42582	1221	42452	1435	1993	0.00	-1.85	-0.12	0.00	0.00	0.00	0.00	0.00	-9.62	-10.69	-1.35	97	99	131
14	42675	1273	42562	1496	1988	0.31	-1.76	-0.01	-0.00	0.00	0.00	0.00	0.00	-9.93	-8.93	-1.66	128	130	100
15	42772	1317	42677	1549	1984	0.24	-1.68	0.00	-0.00	0.00	0.00	0.00	0.00	-10.17	-7.26	-1.91	156	158	72
16	42872	1354	42795	1592	1979	0.18	-1.60	0.02	-0.00	0.00	0.00	0.00	0.00	-10.34	-5.65	-2.12	182	184	46
17	42974	1383	42916	1626	1974	0.13	-1.53	0.03	-0.00	0.00	0.00	0.00	0.00	-10.47	-4.12	-2.27	203	205	25
18	43078	1403	43039	1650	1969	0.08	-1.47	0.04	-0.00	0.00	0.00	0.00	0.00	-10.55	-2.65	-2.37	218	220	10
19	43184	1416	43164	1665	1964	0.05	-1.43	0.06	-0.00	0.00	0.00	0.00	0.00	-10.60	-1.23	-2.43	227	229	1
20	43290	1420	43290	1670	1959	0.01	-1.40	0.07	-0.00	0.00	0.00	0.00	0.00	-10.61	0.17	-2.43	228	230	-0 ***
21	43396	1416	43416	1665	1954	-0.01	-1.39	0.08	0.00	0.00	0.00	0.00	0.00	-10.60	1.56	-2.39	223	224	6
22	43502	1403	43541	1650	1950	-0.04	-1.39	0.09	0.00	0.00	0.00	0.00	0.00	-10.55	2.95	-2.30	211	212	18
23	43606	1383	43664	1626	1946	-0.08	-1.42	0.11	0.00	0.00	0.00	0.00	0.00	-10.48	4.37	-2.17	193	194	36
24	43708	1354	43785	1592	1942	-0.12	-1.46	0.13	0.00	0.00	0.00	0.00	0.00	-10.36	5.83	-1.99	170	172	58
25	43808	1317	43903	1549	1937	-0.16	-1.51	0.14	0.00	0.00	0.00	0.00	0.00	-10.20	7.34	-1.77	144	145	85
26	43905	1273	44018	1496	1933	-0.21	-1.57	0.16	0.00	0.00	0.00	0.00	0.00	-9.99	8.92	-1.50	115	117	113
27	43998	1221	44128	1435	1930	-0.28	-1.64	0.18	0.00	0.00	0.00	0.00	0.00	-9.71	10.56	-1.20	86	88	142
28	44086	1163	44233	1365	1926	0.00	-1.72	0.26	0.00	0.00	0.00	0.00	0.00	-9.71	12.28	-0.94	61	63	167
29	44170	1097	44332	1288	1923	0.00	-1.82	0.30	0.00	0.00	0.00	0.00	0.00	-9.71	14.10	-0.68	40	42	188
30	44248	1025	44424	1203	1919	0.00	-1.90	0.33	0.00	0.00	0.00	0.00	0.00	-9.71	16.00	-0.45	23	26	204
31	44321	94744510	1111	1916	0.00	-1.97	0.36	0.00	0.00	0.00	0.00	0.00	-9.71	17.96	-0.25	11	14	216	
32	44387	86444588	1012	1914	0.00	-2.01	0.38	0.00	0.00	0.00	0.00	0.00	-9.71	19.98	-0.11	3	6	224	
33	44446	77644659	9081912	0.00	-2.03	0.39	0.00	0.00	0.00	0.00	0.00	-9.71	22.00	-0.04	-0	3	227		
34	44499	68444721	7981909	0.00	-2.01	0.40	0.00	0.00	0.00	0.00	0.00	-9.71	24.01	-0.07	1	5	225		
35	44544	58744774	6841907	0.00	-1.94	0.39	0.00	0.00	0.00	0.00	0.00	-9.71	25.95	-0.23	6	10	220		
36	44581	48844818	5671906	0.00	-1.83	0.37	0.00	0.00	0.00	0.00	0.00	-9.71	27.78	-0.52	16	20	210		
37	44610	38644853	4461905	0.00	-1.67	0.33	0.00	0.00	0.00	0.00	0.00	-9.71	29.45	-0.98	29	34	196		
38	44632	28244879	3221904	0.00	-1.46	0.28	0.00	0.00	0.00	0.00	0.00	-9.71	30.91	-1.61	48	53	177		
39	44645	17644894	1981903	0.00	-1.18	0.21	0.00	0.00	0.00	0.00	0.00	-9.71	32.09	-2.43	72	77	153		
40	44650	70	44900	72	1903	0.00	-0.86	0.13	0.00	0.00	0.00	0.00	0.00	-9.71	32.95	-3.45	102	107	123

Beaumont Bridge



SV100 loading in Good Condition with Backing

gammaFl dead load: 1.00 SV100 Impact on 1 @ 18219 [mm]
gammaFl superimposed: 1.00
gammaFl live load: 2.22
gammaF3 load effect: 1.00
gammaM material: 1.00
File path: V:\5210920\7 Calcs\72 Model\Stage 2 Assessment\Beaumont Bridge w backing.brg

NAME: Beaumont Bridge
LOCATION: Beaumont, Meath
NUMBER: MH-L1615-001.00
Atkins
DATE: 22 February 2022
Printed on: Thursday, February 24, 2022 16:19:09

Bridge Name: Beaumont Bridge Bridge Location: Beaumont, Meath
Bridge Number: MH-L1615-001.00
Number of spans: 7

SAFETY FACTORS
Factor for deadload: 1.00 Factor for superimposed deadload: 1.00 Factor for surfacing: 1.00
Factor for live load: 2.22 Factor for load effect: 1.00 Factor for material strength: 1.00

APPLIED LOAD CASES
1.SV100 Impact on 1 Total weight: 1216.44 [kN] Position: 18219 [mm]
124.00 6 1.00 22.00 1.20 20.40 2.40 20.40 3.60 20.40 4.80 20.40 6.00 20.40 1.00 2.65 3.00
Effective lane width: 3350 [mm] Distribution length: 2743 [mm]

Applied distribution mode: Archie-M, BD21/97
Applied live load pressure: Active pressure

STRUCTURE PROPERTIES
Road shape: True shape (multi-point method)
Road points: (-500, 1950) (1180, 2010) (5805, 2150) (11660, 2490) (19175, 2630) (29755, 2500) (33895, 2390) (43290, 1960) (45000, 1900)
Depth of surfacing: 150Depth of overlay: 0
Surface unit weight: 23.00 [kN/m3] Overlay unit weight: 23.00 [kN/m3]
Lane width: 0

Fill unit weight: 18.00 [kN/m3] Fill phi: 30 degree

Left abutment Base level:-1500 [mm] Height: 380 [mm] Width: 1000 [mm]
Right abutment Base level:-1500 [mm] Height: 70 [mm] Width: 1000 [mm]

Right abutment Base level:-1500 [mm] Height: 70 [mm] Width: 1000 [mm]
Shape: Circular
Span: 2360 [mm] Rise: 1170 [mm] Q-rise: 1050 [mm]
Ring thickness at crown:380 [mm] Ring thickness at springing: 380 [mm] Mortar loss: 20 [mm]
Masonry unit weight:22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	0	380	-380	3831	954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-5.63	-30.87	-2.13	67	71	289
1	4	472	-374	5051	954	0.00	-1.08	-0.24	0.00	-0.00	0.00	0.00	-5.63	-29.78	-1.50	47	52	308
2	16	563	-359	6261	954	0.00	-1.35	-0.33	0.00	-0.00	0.00	0.00	-5.63	-28.44	-0.98	32	36	324
3	35	654	-334	7451	955	0.00	-1.56	-0.39	0.00	-0.00	0.00	0.00	-5.63	-26.88	-0.58	19	23	337
4	60	742	-300	8621	956	0.00	-1.72	-0.44	0.00	-0.00	0.00	0.00	-5.63	-25.15	-0.29	9	13	347
5	93	828	-257	9761	958	0.00	-1.84	-0.45	0.00	-0.00	0.00	0.00	-5.63	-23.32	-0.11	3	6	354
6	132	912	-206	1086	1960	0.00	-1.90	-0.45	0.00	-0.00	0.00	0.00	-5.63	-21.41	-0.03	-0	3	357
7	177	992	-146	1192	1962	0.00	-1.93	-0.43	0.00	-0.00	0.00	0.00	-5.63	-19.49	-0.04	1	4	356
8	229	1068	-77	1293	1965	0.00	-1.91	-0.40	0.00	-0.00	0.00	0.00	-5.63	-17.57	-0.12	6	8	352
9	286	1141	-2	1389	1967	0.00	-1.87	-0.36	0.00	-0.00	0.00	0.00	-5.63	-15.71	-0.27	16	18	342
10	349	1208	82	1478	1970	0.00	-1.80	-0.31	0.00	-0.00	0.00	0.00	-5.63	-13.91	-0.46	32	34	326
11	417	1270	171	1560	1974	0.00	-1.71	-0.26	0.00	-0.00	0.00	0.00	-5.63	-12.20	-0.69	56	57	303
12	490	1327	267	1635	1977	0.28	-1.62	-0.12	0.00	-0.00	0.00	0.00	-5.91	-10.58	-1.00	90	92	268
13	566	1378	369	1703	1981	0.21	-1.54	-0.10	0.00	-0.00	0.00	0.00	-6.13	-9.05	-1.29	129	131	229
14	647	1423	475	1762	1985	0.16	-1.45	-0.07	0.00	-0.00	0.00	0.00	-6.28	-7.59	-1.56	171	173	187
15	731	1461	586	1813	1989	0.11	-1.38	-0.05	0.00	-0.00	0.00	0.00	-6.39	-6.22	-1.78	215	216	144
16	817	1493	700	1854	1993	0.08	-1.30	-0.03	0.00	-0.00	0.00	0.00	-6.47	-4.91	-1.98	258	259	101
17	906	1518	818	1887	1998	0.05	-1.24	-0.01	0.00	-0.00	0.00	0.00	-6.52	-3.67	-2.14	296	297	63
18	996	1536	937	1911	2001	0.03	-1.20	0.01	0.00	-0.00	0.00	0.00	-6.55	-2.47	-2.25	328	329	31
19	1088	1546	1058	1925	2006	0.02	-1.17	0.03	0.00	-0.00	0.00	0.00	-6.56	-1.30	-2.33	350	351	9
20	1180	1550	1180	1930	2010	0.01	-1.16	0.04	0.00	-0.00	0.00	0.00	-6.57	-0.14	-2.36	359	360	-0 ***
21	1272	1546	1302	1925	2013	-0.01	-1.17	0.06	-0.00	-0.00	0.00	0.00	-6.56	1.03	-2.35	355	356	4

22 1364 1536 1423 1911 2017 -0.02 -1.20 0.08 -0.00 -0.00 0.00 0.00 -6.55 2.23 -2.30 33733822
23 1454 1518 1542 1887 2021 -0.03 -1.24 0.10 -0.00 -0.00 0.00 0.00 -6.51 3.47 -2.20 30830951
24 1543 1493 1660 1854 2024 -0.06 -1.30 0.13 -0.00 -0.00 0.00 0.00 -6.45 4.77 -2.06 27127288
25 1629 1461 1774 1813 2028 -0.09 -1.38 0.15 -0.00 -0.00 0.00 0.00 -6.37 6.15 -1.88 228229131
26 1713 1423 1885 1762 2031 -0.13 -1.46 0.18 -0.00 -0.00 0.00 0.00 -6.24 7.61 -1.66 184185175
27 1794 1378 1991 1703 2034 -0.18 -1.55 0.21 -0.00 -0.00 0.00 0.00 -6.05 9.15 -1.40 140141219
28 1870 1327 2093 1635 2037 -0.25 -1.64 0.24 -0.00 -0.00 0.00 0.00 -5.81 10.79-1.10 99 100260
29 1943 1270 2189 1560 2039 -0.33 -1.73 0.28 -0.00 -0.00 0.00 0.00 -5.48 12.52-0.77 62 63 297
30 2011 1208 2278 1478 2041 0.00 -1.82 0.41 0.00 -0.00 0.00 0.00 -5.48 14.34-0.53 37 39 321
31 2074 1141 2362 1389 2043 0.00 -1.91 0.46 0.00 -0.00 0.00 0.00 -5.48 16.24-0.33 19 22 338
32 2131 1068 2437 1293 2045 0.00 -1.98 0.50 0.00 -0.00 0.00 0.00 -5.48 18.22-0.17 8 11 349
33 2183 9922506 1192 2047 0.00 -2.02 0.53 0.00 -0.00 0.00 0.00 -5.48 20.23-0.06 2 5 355
34 2228 9122566 1086 2049 0.00 -2.02 0.55 0.00 -0.00 0.00 0.00 -5.48 22.26-0.04 0 3 357
35 2267 8282617 9762051 0.00 -1.99 0.56 0.00 -0.00 0.00 0.00 -5.48 24.24-0.09 2 6 354
36 2300 7422660 8622052 0.00 -1.91 0.54 0.00 -0.00 0.00 0.00 -5.48 26.15-0.25 8 11 349
37 2325 6542694 7452053 0.00 -1.78 0.50 0.00 -0.00 0.00 0.00 -5.48 27.93-0.52 16 20 340
38 2344 5632719 6262053 0.00 -1.60 0.44 0.00 -0.00 0.00 0.00 -5.48 29.54-0.90 28 32 328
39 2356 4722734 5052054 0.00 -1.37 0.36 0.00 -0.00 0.00 0.00 -5.48 30.91-1.40 43 47 313
40 2360 3802740 3832054 0.00 -1.09 0.25 0.00 -0.00 0.00 0.00 -5.48 32.00-2.02 61 65 295

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 380 [mm] Thickness at top: 2000 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
0 2360 4360 380-113.98-3.99 -113.983.75 3385 3401 -0.05 -0.06 1024.74 958.97
1 2360 4360 -247 -27.57 -3.99 -141.55 1.25 3359 3379 -0.07 -0.07 998.71 981.06
2 2360 4360 -873 -27.57 -3.99 -169.13 -1.25 3341 3365 -0.09 -0.08 980.53 995.31
3 2360 4360 -1500 -27.57 -3.99 -196.70 -3.75 3327 3355 -0.10 -0.09 966.89 1005.01

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2890 [mm] Rise: 1280 [mm] Q-rise: 1020 [mm]
Ring thickness at crown: 270 [mm] Ring thickness at springing: 270 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
0 4360 4004092 4332089 0.00 0.00 0.00 0.00 0.00 0.00 0.00 -9.47 -32.87 -2.08 59 64 186
1 4377 5044112 5562090 0.00 -1.35 -0.25 0.00 -0.00 0.00 0.00 -9.47 -31.52 -1.36 39 44 206
2 4401 6074140 6782091 0.00 -1.58 -0.29 0.00 -0.00 0.00 0.00 -9.47 -29.94 -0.81 24 28 222
3 4432 7084177 7972092 0.00 -1.76 -0.32 0.00 -0.00 0.00 0.00 -9.47 -28.18 -0.42 12 16 234
4 4471 8064223 9142093 0.00 -1.89 -0.33 0.00 -0.00 0.00 0.00 -9.47 -26.29 -0.17 4 8 242
5 4516 9014277 1026 2095 0.00 -1.97 -0.33 0.00 -0.00 0.00 0.00 -9.47 -24.32 -0.05 0 4 246
6 4569 9934339 1135 2097 0.00 -2.01 -0.32 0.00 -0.00 0.00 0.00 -9.47 -22.30 -0.04 -0 3 247
7 4627 1080 4409 1239 2099 0.00 -2.02 -0.30 0.00 -0.00 0.00 0.00 -9.47 -20.28 -0.12 4 7 243
8 4693 1163 4486 1337 2101 0.00 -1.99 -0.27 0.00 -0.00 0.00 0.00 -9.47 -18.29 -0.26 11 14 236
9 4763 1241 4570 1430 2104 0.00 -1.94 -0.23 0.00 -0.00 0.00 0.00 -9.47 -16.36 -0.45 23 26 224
10 4840 1314 4661 1516 2107 0.00 -1.86 -0.20 0.00 -0.00 0.00 0.00 -9.47 -14.50 -0.68 39 42 208
11 4921 1381 4757 1596 2110 0.00 -1.76 -0.16 0.00 -0.00 0.00 0.00 -9.47 -12.73 -0.92 59 62 188
12 5007 1442 4859 1668 2113 0.00 -1.66 -0.13 0.00 -0.00 0.00 0.00 -9.47 -11.07 -1.18 83 85 165
13 5098 1497 4966 1733 2117 0.27 -1.57 -0.03 0.00 -0.00 0.00 0.00 -9.74 -9.51 -1.48 112 114 136
14 5192 1544 5078 1789 2121 0.20 -1.49 -0.01 0.00 -0.00 0.00 0.00 -9.94 -8.02 -1.75 140142108
15 5289 1585 5193 1838 2125 0.15 -1.41 -0.00 0.00 -0.00 0.00 0.00 -10.09 -6.61 -1.98 16716981
16 5389 1619 5312 1878 2130 0.11 -1.35 0.01 0.00 -0.00 0.00 0.00 -10.21 -5.26 -2.18 19219456
17 5491 1646 5433 1909 2134 0.08 -1.29 0.02 0.00 -0.00 0.00 0.00 -10.28 -3.97 -2.33 21321535
18 5595 1665 5556 1932 2139 0.05 -1.25 0.04 0.00 -0.00 0.00 0.00 -10.34 -2.71 -2.46 23123218

19	5700	1676	5680	1945	2144	0.03	-1.23	0.05	0.00	-0.00	0.00	0.00	-10.37	-1.48	-2.54	2422446		
20	5805	1680	5805	1950	2150	0.01	-1.23	0.06	0.00	-0.00	0.00	0.00	-10.38	-0.25	-2.59	249250	-0	***
21	5910	1676	5930	1945	2155	-0.01	-1.24	0.07	-0.00	-0.00	0.00	0.00	-10.37	0.98	-2.59	2482500		
22	6015	1665	6054	1932	2161	-0.03	-1.27	0.09	-0.00	-0.00	0.00	0.00	-10.33	2.25	-2.56	2422437		
23	6119	1646	6177	1909	2167	-0.06	-1.31	0.10	-0.00	-0.00	0.00	0.00	-10.28	3.57	-2.48	22923119		
24	6221	1619	6298	1878	2173	-0.09	-1.38	0.12	-0.00	-0.00	0.00	0.00	-10.19	4.94	-2.36	21121238		
25	6321	1585	6417	1838	2179	-0.13	-1.45	0.14	-0.00	-0.00	0.00	0.00	-10.06	6.39	-2.20	18718961		
26	6418	1544	6532	1789	2184	-0.18	-1.53	0.16	-0.00	-0.00	0.00	0.00	-9.88	7.93	-1.98	16016288		
27	6512	1497	6644	1733	2191	-0.24	-1.62	0.18	-0.00	-0.00	0.00	0.00	-9.64	9.55	-1.72	131133117		
28	6603	1442	6751	1668	2196	-0.31	-1.72	0.20	-0.00	-0.00	0.00	0.00	-9.33	11.27	-1.41	100102148		
29	6689	1381	6853	1596	2201	0.00	-1.82	0.30	0.00	-0.00	0.00	0.00	-9.33	13.09	-1.15	73	76	174
30	6770	1314	6949	1516	2207	0.00	-1.93	0.34	0.00	-0.00	0.00	0.00	-9.33	15.02	-0.88	51	53	197
31	6847	1241	7040	1430	2212	0.00	-2.03	0.38	0.00	-0.00	0.00	0.00	-9.33	17.05	-0.62	32	35	215
32	6917	1163	7124	1337	2217	0.00	-2.10	0.41	0.00	-0.00	0.00	0.00	-9.33	19.15	-0.39	18	20	230
33	6983	1080	7201	1239	2222	0.00	-2.16	0.44	0.00	-0.00	0.00	0.00	-9.33	21.31	-0.21	8	11	239
34	7041	9937271	1135	2225	0.00	-2.18	0.45	0.00	-0.00	0.00	0.00	-9.33	23.49	-0.09	2	5	245	
35	7094	9017333	1026	2229	0.00	-2.16	0.46	0.00	-0.00	0.00	0.00	-9.33	25.65	-0.05	-0	4	246	
36	7139	8067387	9142232	0.00	-2.11	0.45	0.00	-0.00	0.00	0.00	-9.33	27.76	-0.12	2	6	244		
37	7178	7087433	7972235	0.00	-2.01	0.43	0.00	-0.00	0.00	0.00	-9.33	29.76	-0.32	8	13	237		
38	7209	6077470	6782237	0.00	-1.86	0.40	0.00	-0.00	0.00	0.00	-9.33	31.62	-0.67	18	23	227		
39	7233	5047498	5562239	0.00	-1.66	0.35	0.00	-0.00	0.00	0.00	-9.33	33.27	-1.18	32	37	213		
40	7250	4007518	4332240	0.00	-1.41	0.28	0.00	-0.00	0.00	0.00	-9.33	34.68	-1.87	50	55	195		

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 100 [mm] Thickness at top: 2300 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	7250	9550	100	-215.92	-122.04	-215.92	-78.07	8023	8054	-0.18	-0.01	773.01	1496.14
1	7250	9550	-433	-26.99	-122.04	-242.90	-143.16	7793	7828	-0.27	0.06	543.29	1722.01
2	7250	9550	-967	-26.99	-122.04	-269.89	-208.25	7609	7648	-0.35	0.12	359.13	1902.32
3	7250	9550	-1500	-26.99	-122.04	-296.88	-273.34	7458	7501	-0.44	0.18	208.09	2049.50

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 4220 [mm] Rise: 1930 [mm] Q-rise: 1560 [mm]
Ring thickness at crown: 350 [mm] Ring thickness at springing: 350 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust

0	9550	1009201	1312346	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-131.37	-99.79	-153.57	1375	1390	-1060	***	
1	9570	2569224	3132347	0.00	-2.37	-0.56	0.00	-0.00	0.00	0.00	-131.37	-97.42	-134.31	1135	1152	-822	***	
2	9601	4099261	4922350	0.00	-2.84	-0.68	0.00	-0.00	0.00	0.00	-131.37	-94.58	-116.22	938	955	-625	***	
3	9643	5609310	6682353	0.00	-3.21	-0.76	0.00	-0.00	0.00	0.00	-131.37	-91.37	-99.34	772	790	-460	***	
4	9697	7089373	8402357	0.00	-3.47	-0.80	0.00	-0.00	0.00	0.00	-131.37	-87.90	-83.74	631	649	-319	***	
5	9761	8519448	1006	2361	0.00	-3.63	-0.80	0.00	-0.00	0.00	0.00	-131.37	-84.26	-69.44	509	529	-199	***
6	9836	9899535	1167	2367	0.00	-3.70	-0.76	0.00	-0.00	0.00	0.00	-131.37	-80.56	-56.46	405	424	-94	***
7	9921	1121	9633	1321	2373	0.00	-3.69	-0.70	0.00	-0.00	0.00	0.00	-131.37	-76.87	-44.82	315	334	-4 ***
8	10015	1247	9743	1467	2380	0.00	-3.61	-0.63	0.00	-0.00	0.00	0.00	-131.37	-73.25	-34.53	237	257	73
9	10118	1365	9864	1605	2388	0.00	-3.47	-0.54	0.00	-0.00	0.00	0.00	-131.37	-69.78	-25.61	172	192	138
10	10230	1475	9994	1733	2396	0.00	-3.29	-0.44	0.00	-0.00	0.00	0.00	-131.37	-66.49	-18.07	117	138	192
11	10350	1576	10133	1851	2404	0.00	-3.07	-0.35	0.00	-0.00	0.00	0.00	-131.37	-63.42	-11.92	73	94	236
12	10477	1669	10281	1959	2413	0.00	-2.83	-0.26	0.00	-0.00	0.00	0.00	-131.37	-60.59	-7.16	40	60	270
13	10610	1751	10436	2055	2422	0.00	-2.59	-0.18	0.00	-0.00	0.00	0.00	-131.37	-58.00	-3.81	16	37	293
14	10749	1824	10599	2140	2432	0.28	-2.39	-0.02	0.00	-0.00	0.00	0.00	-131.65	-55.61	-1.94	3	24	306
15	10893	1886	10766	2213	2442	0.20	-2.22	0.01	0.00	-0.00	0.00	0.00	-131.85	-53.39	-1.44	-0	20	310

16	11041	1938	10939	2272	2452	0.13	-2.07	0.04	0.00	-0.00	0.00	0.00	-131.98	-51.32	-2.32	6	27	303	
17	11193	1978	11116	2319	2461	0.09	-1.95	0.06	0.00	-0.00	0.00	0.00	-132.07	-49.37	-4.57	23	43	287	
18	11347	2007	11296	2353	2471	0.05	-1.86	0.08	0.00	-0.00	0.00	0.00	-132.12	-47.51	-8.20	50	69	261	
19	11503	2024	11477	2373	2480	0.03	-1.81	0.11	0.00	-0.00	0.00	0.00	-132.15	-45.69	-13.18	88	107	223	
20	11660	2030	11660	2380	2490	0.01	-1.80	0.13	0.00	-0.00	0.00	0.00	-132.16	-43.89	-19.48	138	157	173	
21	11817	2024	11843	2373	2499	-0.01	-1.83	0.16	-0.00	-0.12	0.02	0.00	-132.14	-41.94	-27.07	201	220	110	
22	11973	2007	12024	2353	2507	-0.03	-1.90	0.19	-0.54	-14.51	1.98	0.00	-131.57	-25.53	-35.57	272	290	40	
23	12127	1978	12204	2319	2514	-0.07	-2.01	0.22	-2.93	-46.99	5.99	0.00	-128.57	23.46	-41.88	311	330	-0	***
24	12279	1938	12381	2272	2522	-0.11	-2.15	0.26	-4.42	-49.99	6.46	0.00	-124.04	75.60	-42.06	289	309	21	
25	12427	1886	12554	2213	2529	-0.17	-2.32	0.31	-2.38	-20.66	2.63	0.00	-121.48	98.57	-36.55	235	256	74	
26	12571	1824	12721	2140	2536	-0.26	-2.51	0.36	-0.63	-4.37	0.72	0.00	-120.59	105.45	-29.87	183	205	125	
27	12710	1751	12884	2055	2542	-0.37	-2.72	0.42	-1.44	-8.27	1.56	0.00	-118.78	116.44	-24.22	139	162	168	
28	12843	1669	13039	1959	2548	0.00	-2.95	0.61	0.00	-13.38	3.30	0.00	-118.78	132.76	-20.19	105	129	201	
29	12970	1576	13187	1851	2552	0.00	-3.21	0.72	0.00	-17.48	4.56	0.00	-118.78	153.45	-16.91	76	103	227	
30	13090	1475	13326	1733	2557	0.00	-3.46	0.82	0.00	-19.78	5.45	0.00	-118.78	176.69	-14.02	53	83	247	
31	13202	1365	13456	1605	2561	0.00	-3.68	0.92	0.00	-20.15	5.81	0.00	-118.78	200.52	-11.33	34	66	264	
32	13305	1247	13577	1467	2565	0.00	-3.86	1.01	0.00	-18.91	5.68	0.00	-118.78	223.29	-8.89	18	54	276	
33	13399	1121	13687	1321	2569	0.00	-3.99	1.09	0.00	-16.67	5.18	0.00	-118.78	243.94	-6.98	7	45	285	
34	13484	98	913785	1167	2572	0.00	-4.05	1.13	0.00	-14.00	4.47	0.00	-118.78	261.99	-6.00	1	41	289	
35	13559	85	113872	1006	2574	0.00	-4.03	1.15	0.00	-11.32	3.70	0.00	-118.78	277.34	-6.47	-0	43	287	
36	13623	70	813947	840	2576	0.00	-3.92	1.13	0.00	-8.88	2.95	0.00	-118.78	290.14	-8.87	6	51	279	
37	13677	56	014010	668	2577	0.00	-3.72	1.07	0.00	-6.77	2.28	0.00	-118.78	300.64	-13.65	19	65	265	
38	13719	40	914059	492	2578	0.00	-3.41	0.97	0.00	-4.99	1.69	0.00	-118.78	309.04	-21.16	41	88	242	
39	13750	25	614096	313	2579	0.00	-3.00	0.82	0.00	-3.46	1.17	0.00	-118.78	315.49	-31.66	72	119	211	
40	13770	10	014119	131	2580	0.00	-2.47	0.64	0.00	-2.10	0.71	0.00	-118.78	320.06	-45.30	114	161	169	

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx total Fz total My total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 100 [mm] Thickness at top: 3150 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	13770	16920	100	-1037.45	13.60	-1037.45	-7.70	15263	15412	-0.33	-0.32	1493.47	1508.32
1	13770	16920	-433	-36.96	13.60	-1074.41	-0.44	15268	15421	-0.34	-0.34	1497.84	1498.67
2	13770	16920	-967	-36.96	13.60	-1111.37	6.81	15272	15431	-0.35	-0.36	1501.74	1489.49
3	13770	16920	-1500	-36.96	13.60	-1148.33	14.07	15275	15439	-0.36	-0.37	1505.23	1480.73

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 4510 [mm] Rise: 2010 [mm] Q-rise: 1660 [mm]
Ring thickness at crown: 370 [mm] Ring thickness at springing: 370 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	16920	20016	552	2422	621	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-109.27	-316.39	-39.29	97	144	206
1	16945	36316	581	4322	621	0.00	-2.88	-0.73	0.00	-3.54	-1.18	0.00	-109.27	-309.97	-27.15	60	107	243
2	16982	52416	624	6202	622	0.00	-3.38	-0.86	0.00	-5.33	-1.72	0.00	-109.27	-301.25	-17.96	33	79	271
3	17030	68216	680	8032	622	0.00	-3.76	-0.95	0.00	-7.20	-2.23	0.00	-109.27	-290.29	-11.52	15	59	291
4	17090	83616	750	9832	623	0.00	-4.03	-0.98	0.00	-9.13	-2.70	0.00	-109.27	-277.12	-7.53	4	47	303
5	17160	98616	832	1156	2624	0.00	-4.19	-0.97	0.00	-11.08	-3.11	0.00	-109.27	-261.85	-5.68	-0	40	310
6	17242	1130	16927	1323	2624	0.00	-4.25	-0.92	0.00	-12.92	-3.40	0.00	-109.27	-244.68	-5.61	2	40	310
7	17333	1267	17033	1483	2625	0.00	-4.22	-0.84	0.00	-14.43	-3.54	0.00	-109.27	-226.03	-6.97	11	46	304
8	17435	1397	17151	1635	2626	0.00	-4.11	-0.75	0.00	-15.34	-3.46	0.00	-109.27	-206.58	-9.52	25	58	292
9	17545	1520	17280	1778	2626	0.00	-3.94	-0.64	0.00	-15.38	-3.16	0.00	-109.27	-187.27	-13.09	47	77	273
10	17665	1635	17418	1911	2627	0.00	-3.71	-0.52	0.00	-14.32	-2.63	0.00	-109.27	-169.24	-17.69	77	105	245
11	17792	1740	17566	2033	2628	0.00	-3.45	-0.41	0.00	-12.12	-1.97	0.00	-109.27	-153.67	-23.43	117	143	207
12	17926	1836	17723	2145	2628	0.00	-3.17	-0.30	0.00	-8.99	-1.26	0.00	-109.27	-141.52	-30.52	168	193	157

13	18068	1922	17887	2245	2629	0.00	-2.88	-0.20	0.00	-7.31	-0.76	0.00	-109.27	-131.32	-38.80	23225595			
14	18215	1997	18058	2332	2629	0.30	-2.63	-0.02	4.34	-25.44	-0.20	0.00	-113.92	-103.25	-45.25	29831832			
15	18367	2061	18235	2407	2629	0.20	-2.41	0.01	7.35	-52.09	-0.25	0.00	-121.47	-48.75	-44.60	331350	-0	***	
16	18523	2114	18417	2469	2630	0.13	-2.22	0.04	5.56	-49.10	-0.05	0.00	-127.16	2.58	-37.36	30031733			
17	18683	2156	18603	2517	2630	0.08	-2.05	0.07	1.47	-16.93	-0.13	0.00	-128.71	21.56	-28.42	226244106			
18	18846	2186	18792	2552	2630	0.04	-1.92	0.09	0.02	-0.30	-0.01	0.00	-128.77	23.78	-20.71	158176174			
19	19010	2204	18983	2573	2630	0.02	-1.83	0.11	-0.00	0.00	0.00	0.00	-128.79	25.60	-14.25	103122228			
20	19175	2210	19175	2580	2630	0.01	-1.78	0.13	-0.00	0.00	0.00	0.00	-128.80	27.39	-9.04	61	79	271	
21	19340	2204	19367	2573	2629	-0.01	-1.78	0.16	0.00	0.00	0.00	0.00	-128.79	29.17	-5.12	30	49	301	
22	19504	2186	19558	2552	2629	-0.02	-1.83	0.19	0.00	0.00	0.00	0.00	-128.77	30.99	-2.51	10	28	322	
23	19667	2156	19747	2517	2628	-0.04	-1.92	0.22	0.00	0.00	0.00	0.00	-128.73	32.91	-1.23	-0	19	331	
24	19827	2114	19933	2469	2628	-0.08	-2.05	0.26	0.00	0.00	0.00	0.00	-128.65	34.95	-1.26	-0	19	331	
25	19983	2061	20115	2407	2627	-0.13	-2.21	0.31	0.00	0.00	0.00	0.00	-128.52	37.16	-2.60	10	29	321	
26	20135	1997	20292	2332	2626	-0.20	-2.40	0.37	0.00	0.00	0.00	0.00	-128.32	39.57	-5.23	30	49	301	
27	20282	1922	20463	2245	2626	-0.30	-2.62	0.43	0.00	0.00	0.00	0.00	-128.02	42.19	-9.12	59	78	272	
28	20424	1836	20627	2145	2625	0.00	-2.87	0.61	0.00	0.00	0.00	0.00	-128.02	45.06	-14.39	100119231			
29	20558	1740	20784	2033	2624	0.00	-3.16	0.72	0.00	0.00	0.00	0.00	-128.02	48.22	-20.94	151169181			
30	20685	1635	20932	1911	2623	0.00	-3.44	0.84	0.00	0.00	0.00	0.00	-128.02	51.66	-28.77	212231119			
31	20805	1520	21070	1778	2622	0.00	-3.70	0.96	0.00	0.00	0.00	0.00	-128.02	55.36	-37.84	28430347			
32	20915	1397	21199	1635	2621	0.00	-3.93	1.07	0.00	0.00	0.00	0.00	-128.02	59.29	-48.14	368386	-36	***	
33	21017	1267	21317	1483	2621	0.00	-4.10	1.16	0.00	0.00	0.00	0.00	-128.02	63.39	-59.66	463482	-132	***	
34	21108	1130	21423	1323	2620	0.00	-4.21	1.23	0.00	0.00	0.00	0.00	-128.02	67.61	-72.40	572590	-240	***	
35	21190	98621518	1156	2620	0.00	-4.24	1.27	0.00	0.00	0.00	0.00	-128.02	71.85	-86.33	695712	-362	***		
36	21260	83621600	9832	619	0.00	-4.19	1.26	0.00	0.00	0.00	0.00	-128.02	76.03	-101.46	834851	-501	***		
37	21320	68221670	8032	619	0.00	-4.03	1.22	0.00	0.00	0.00	0.00	-128.02	80.06	-117.75	994101	0	-660	***	
38	21368	52421726	6202	618	0.00	-3.76	1.13	0.00	0.00	0.00	0.00	-128.02	83.82	-135.20	1178	1195	-845	***	
39	21405	36321769	4322	618	0.00	-3.38	0.99	0.00	0.00	0.00	0.00	-128.02	87.20	-153.77	1396	1411	-1061	***	
40	21430	20021798	2422	618	0.00	-2.88	0.80	0.00	0.00	0.00	0.00	-128.02	90.08	-173.40	1657	1672	-1322	***	

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx total Fz total My total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 200 [mm] Thickness at top: 7170 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	21430	28600	200	-462.07	120.58	-462.07	-4.25	24973	25039	-0.06	-0.06	3542.79	3561.20
1	21430	28600	-367	-89.39	120.58	-551.46	64.07	25092	25171	-0.07	-0.08	3661.80	3429.42
2	21430	28600	-933	-89.39	120.58	-640.84	132.40	25176	25267	-0.07	-0.10	3745.83	3332.62
3	21430	28600	-1500	-89.39	120.58	-730.23	200.73	25238	25342	-0.08	-0.13	3807.72	3257.96

Segment Left x Right x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2310 [mm] Rise: 1150 [mm] Q-rise: 960 [mm]
Ring thickness at crown: 500 [mm] Ring thickness at springing: 500 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx total Fz total My total Thrust in Thrust out Extra-Thrust

0	28600	45028100	4522532	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7.45	-49.41	-3.21	61	68	412			
1	28604	54028106	5822532	0.00	-1.45	-0.43	0.00	0.00	0.00	0.00	-7.45	-47.96	-2.29	44	51	429			
2	28615	63028121	7102532	0.00	-1.83	-0.60	0.00	0.00	0.00	0.00	-7.45	-46.14	-1.52	29	36	444			
3	28633	71928147	8372531	0.00	-2.14	-0.73	0.00	0.00	0.00	0.00	-7.45	-43.99	-0.92	18	24	456			
4	28658	80628183	9622530	0.00	-2.40	-0.83	0.00	0.00	0.00	0.00	-7.45	-41.59	-0.49	9	15	465			
5	28689	89028228	1083	2530	0.00	-2.60	-0.89	0.00	0.00	0.00	0.00	-7.45	-38.99	-0.21	3	8	472		
6	28727	97228283	1201	2529	0.00	-2.75	-0.91	0.00	0.00	0.00	0.00	-7.45	-36.24	-0.09	-0	5	475		
7	28772	1051	28346	1314	2527	0.00	-2.84	-0.90	0.00	0.00	0.00	0.00	-7.45	-33.40	-0.11	1	6	474	
8	28822	1126	28419	1421	2526	0.00	-2.88	-0.86	0.00	0.00	0.00	0.00	-7.45	-30.52	-0.25	6	11	469	
9	28879	1197	28499	1523	2525	0.00	-2.89	-0.80	0.00	0.00	0.00	0.00	-7.45	-27.63	-0.49	17	21	459	

10	28940	1263	28587	1618	2523	0.00	-2.85	-0.72	0.00	0.00	0.00	0.00	-7.45	-24.78	-0.81	34	37	443	
11	29007	1325	28683	1706	2521	0.00	-2.79	-0.64	0.00	0.00	0.00	0.00	-7.45	-21.99	-1.20	59	62	418	
12	29078	1381	28785	1786	2519	0.00	-2.72	-0.55	0.00	0.00	0.00	0.00	-7.45	-19.27	-1.62	92	95	385	
13	29153	1431	28892	1857	2517	0.48	-2.64	-0.26	-0.00	0.00	0.00	0.00	-7.92	-16.63	-2.23	144	146	334	
14	29232	1475	29006	1921	2515	0.38	-2.57	-0.21	-0.00	0.00	0.00	0.00	-8.30	-14.06	-2.79	201	203	277	
15	29314	1513	29123	1975	2512	0.30	-2.50	-0.15	-0.00	0.00	0.00	0.00	-8.60	-11.56	-3.27	263	265	215	
16	29399	1544	29245	2019	2510	0.22	-2.43	-0.10	-0.00	0.00	0.00	0.00	-8.82	-9.14	-3.67	327	328	152	
17	29486	1568	29370	2055	2508	0.16	-2.36	-0.06	-0.00	0.00	0.00	0.00	-8.99	-6.77	-3.99	38	638	793	
18	29575	1586	29497	2080	2505	0.11	-2.31	-0.01	-0.00	0.00	0.00	0.00	-9.10	-4.47	-4.22	43	543	743	
19	29665	1596	29626	2095	2502	0.06	-2.27	0.04	-0.00	0.00	0.00	0.00	-9.16	-2.20	-4.36	46	846	911	
20	29755	1600	29755	2100	2499	0.02	-2.25	0.08	-0.00	0.00	0.00	0.00	-9.18	0.05	-4.40	479	480	-0	***
21	29845	1596	29884	2095	2497	-0.02	-2.24	0.12	0.00	0.00	0.00	0.00	-9.16	2.29	-4.35	46	646	812	
22	29935	1586	30013	2080	2494	-0.06	-2.25	0.17	0.00	0.00	0.00	0.00	-9.10	4.54	-4.20	43	243	446	
23	30024	1568	30140	2055	2491	-0.11	-2.28	0.22	0.00	0.00	0.00	0.00	-8.99	6.82	-3.96	38	338	496	
24	30111	1544	30265	2019	2489	-0.16	-2.32	0.26	0.00	0.00	0.00	0.00	-8.83	9.14	-3.63	323	325	155	
25	30196	1513	30387	1975	2486	-0.21	-2.37	0.31	0.00	0.00	0.00	0.00	-8.62	11.51	-3.23	260	262	218	
26	30278	1475	30504	1921	2484	-0.28	-2.44	0.36	0.00	0.00	0.00	0.00	-8.34	13.95	-2.74	199	201	279	
27	30357	1431	30618	1857	2481	-0.36	-2.50	0.42	0.00	0.00	0.00	0.00	-7.98	16.45	-2.20	142	144	336	
28	30432	1381	30725	1786	2478	-0.45	-2.57	0.47	0.00	0.00	0.00	0.00	-7.53	19.02	-1.59	91	94	386	
29	30503	1325	30827	1706	2476	0.00	-2.64	0.72	0.00	0.00	0.00	0.00	-7.53	21.66	-1.17	58	61	419	
30	30570	1263	30923	1618	2474	0.00	-2.71	0.80	0.00	0.00	0.00	0.00	-7.53	24.37	-0.79	33	36	444	
31	30631	1197	31011	1523	2472	0.00	-2.77	0.87	0.00	0.00	0.00	0.00	-7.53	27.14	-0.46	16	20	460	
32	30688	1126	31091	1421	2470	0.00	-2.81	0.93	0.00	0.00	0.00	0.00	-7.53	29.95	-0.23	6	10	470	
33	30738	1051	31164	1314	2469	0.00	-2.81	0.97	0.00	0.00	0.00	0.00	-7.53	32.75	-0.10	1	5	475	
34	30783	97	231227	1201	2467	0.00	-2.77	0.99	0.00	0.00	0.00	0.00	-7.53	35.52	-0.09	-0	5	475	
35	30821	89	031282	1083	2466	0.00	-2.69	0.98	0.00	0.00	0.00	0.00	-7.53	38.21	-0.22	3	8	472	
36	30852	80	631327	962	2465	0.00	-2.55	0.94	0.00	0.00	0.00	0.00	-7.53	40.76	-0.50	9	15	465	
37	30877	71	931363	837	2464	0.00	-2.36	0.87	0.00	0.00	0.00	0.00	-7.53	43.12	-0.94	19	25	455	
38	30895	63	031389	710	2463	0.00	-2.11	0.76	0.00	0.00	0.00	0.00	-7.53	45.23	-1.55	31	37	443	
39	30906	54	031404	582	2463	0.00	-1.81	0.61	0.00	0.00	0.00	0.00	-7.53	47.04	-2.33	46	52	428	
40	30910	45	031410	452	2463	0.00	-1.44	0.43	0.00	0.00	0.00	0.00	-7.53	48.48	-3.26	64	71	409	

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 350 [mm] Thickness at top: 1700 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	30910	32610	350	-132.21	-2.73	-132.21	1.40	31761	31780	-0.07	-0.08	851.18	829.93
1	30910	32610	-267	-23.06	-2.73	-155.27	-0.28	31747	31769	-0.09	-0.09	837.12	840.69
2	30910	32610	-883	-23.06	-2.73	-178.33	-1.96	31736	31762	-0.11	-0.10	826.28	848.25
3	30910	32610	-1500	-23.06	-2.73	-201.40	-3.64	31728	31756	-0.13	-0.11	817.54	853.69

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2570 [mm] Rise: 1190 [mm] Q-rise: 1030 [mm]
Ring thickness at crown: 400 [mm] Ring thickness at springing: 400 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Intrados.x	Intrados.z	Extrados.x	Extrados.z	Road.z	Fx dead	Fz dead	My dead	Fx live	Fz live	My live	Fx passive	Fx total	Fz total	My total	Thrust in	Thrust out	Extra-Thrust
0	32610	35032211	3812442	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-10.25	-47.26	-2.71	53	60	320		
1	32621	44632226	5062441	0.00	-1.57	-0.42	0.00	0.00	0.00	0.00	-10.25	-45.68	-1.81	35	42	338		
2	32639	54032249	6302441	0.00	-1.90	-0.53	0.00	0.00	0.00	0.00	-10.25	-43.79	-1.10	21	28	352		
3	32664	63332282	7522440	0.00	-2.16	-0.60	0.00	0.00	0.00	0.00	-10.25	-41.63	-0.59	11	17	363		
4	32696	72432324	8712439	0.00	-2.38	-0.66	0.00	0.00	0.00	0.00	-10.25	-39.25	-0.26	4	9	371		
5	32735	81232375	9862437	0.00	-2.54	-0.68	0.00	0.00	0.00	0.00	-10.25	-36.71	-0.10	-0	5	375		
6	32780	89732434	1098	2436	0.00	-2.65	-0.68	0.00	0.00	0.00	0.00	-10.25	-34.06	-0.09	0	5	375	

7	32831	97932501	1204	2434	0.00	-2.72	-0.66	0.00	0.00	0.00	0.00	-10.25	-31.35	-0.22	5	9	371		
8	32888	1056	32576	1306	2432	0.00	-2.74	-0.62	0.00	0.00	0.00	0.00	-10.25	-28.60	-0.45	14	18	362	
9	32951	1129	32658	1401	2430	0.00	-2.73	-0.57	0.00	0.00	0.00	0.00	-10.25	-25.87	-0.77	28	31	349	
10	33019	1197	32748	1490	2427	0.00	-2.70	-0.51	0.00	0.00	0.00	0.00	-10.25	-23.17	-1.15	48	51	329	
11	33092	1260	32843	1572	2424	0.00	-2.63	-0.45	0.00	0.00	0.00	0.00	-10.25	-20.54	-1.57	74	77	303	
12	33170	1317	32945	1647	2421	0.00	-2.56	-0.38	0.00	0.00	0.00	0.00	-10.25	-17.98	-2.02	107	110	270	
13	33251	1368	33052	1714	2418	0.47	-2.48	-0.15	-0.00	0.00	0.00	0.00	-10.72	-15.50	-2.59	151	154	226	
14	33336	1413	33163	1773	2414	0.38	-2.41	-0.11	-0.00	0.00	0.00	0.00	-11.10	-13.09	-3.11	197	199	181	
15	33425	1451	33279	1824	2411	0.30	-2.34	-0.08	-0.00	0.00	0.00	0.00	-11.40	-10.75	-3.55	243	245	135	
16	33516	1483	33398	1865	2406	0.23	-2.28	-0.04	-0.00	0.00	0.00	0.00	-11.63	-8.47	-3.92	28	72	8991	
17	33609	1508	33520	1898	2402	0.17	-2.22	-0.01	-0.00	0.00	0.00	0.00	-11.79	-6.26	-4.20	32	53	2753	
18	33703	1526	33644	1921	2398	0.11	-2.17	0.02	-0.00	0.00	0.00	0.00	-11.90	-4.09	-4.40	35	53	5624	
19	33799	1536	33769	1935	2394	0.06	-2.13	0.06	-0.00	0.00	0.00	0.00	-11.97	-1.96	-4.52	37	33	755	
20	33895	1540	33895	1940	2390	0.02	-2.10	0.09	-0.00	0.00	0.00	0.00	-11.99	0.14	-4.55	37	83	80-0	***
21	33991	1536	34021	1935	2385	-0.02	-2.09	0.12	0.00	0.00	0.00	0.00	-11.97	2.23	-4.49	37	03	728	
22	34087	1526	34146	1921	2381	-0.06	-2.10	0.15	0.00	0.00	0.00	0.00	-11.90	4.33	-4.35	34	93	5129	
23	34181	1508	34270	1898	2376	-0.11	-2.12	0.18	0.00	0.00	0.00	0.00	-11.80	6.45	-4.12	31	83	2060	
24	34274	1483	34392	1865	2371	-0.16	-2.15	0.21	0.00	0.00	0.00	0.00	-11.64	8.59	-3.82	27	92	8199	
25	34365	1451	34511	1824	2366	-0.21	-2.19	0.25	0.00	0.00	0.00	0.00	-11.43	10.79	-3.44	235	237	143	
26	34454	1413	34627	1773	2362	-0.28	-2.24	0.28	0.00	0.00	0.00	0.00	-11.15	13.03	-2.99	189	192	188	
27	34539	1368	34738	1714	2357	-0.35	-2.30	0.32	0.00	0.00	0.00	0.00	-10.81	15.33	-2.48	144	147	233	
28	34620	1317	34845	1647	2353	-0.43	-2.36	0.36	0.00	0.00	0.00	0.00	-10.37	17.68	-1.91	102	104	276	
29	34698	1260	34947	1572	2349	0.00	-2.42	0.54	0.00	0.00	0.00	0.00	-10.37	20.11	-1.47	70	73	307	
30	34771	1197	35042	1490	2345	0.00	-2.50	0.60	0.00	0.00	0.00	0.00	-10.37	22.60	-1.06	45	48	332	
31	34839	1129	35132	1401	2341	0.00	-2.56	0.66	0.00	0.00	0.00	0.00	-10.37	25.16	-0.69	25	29	351	
32	34902	1056	35214	1306	2338	0.00	-2.60	0.70	0.00	0.00	0.00	0.00	-10.37	27.76	-0.39	12	16	364	
33	34959	97935289	1204	2334	0.00	-2.61	0.74	0.00	0.00	0.00	0.00	-10.37	30.38	-0.18	4	8	372		
34	35010	89735356	1098	2331	0.00	-2.59	0.76	0.00	0.00	0.00	0.00	-10.37	32.97	-0.08	-0	5	375		
35	35055	81235415	9862329	0.00	-2.54	0.76	0.00	0.00	0.00	0.00	-10.37	35.51	-0.11	0	6	374			
36	35094	72435466	8712327	0.00	-2.44	0.74	0.00	0.00	0.00	0.00	-10.37	37.94	-0.30	5	10	370			
37	35126	63335508	7522325	0.00	-2.29	0.70	0.00	0.00	0.00	0.00	-10.37	40.23	-0.65	13	19	361			
38	35151	54035541	6302323	0.00	-2.09	0.63	0.00	0.00	0.00	0.00	-10.37	42.33	-1.18	24	30	350			
39	35169	44635564	5062322	0.00	-1.85	0.54	0.00	0.00	0.00	0.00	-10.37	44.17	-1.91	39	45	335			
40	35180	35035579	3812322	0.00	-1.54	0.42	0.00	0.00	0.00	0.00	-10.37	45.72	-2.83	58	64	316			

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust
Base level: -1500 [mm] Top level: 70 [mm] Thickness at top: 6750 [mm]
Batter: 1:0
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment	Left x	Right x	z	Weight	Fx	Fz	My	Thrust left	Thrust right	Stress left	Stress right	Dist. left	Dist. right
0	35180	41930	70	-354.06	0.76	-354.06	-44.57	38404	38454	-0.06	-0.05	3223.82	3475.60
1	35180	41930	-453	-77.71	0.76	-431.78	-44.17	38422	38484	-0.07	-0.06	3241.85	3446.47
2	35180	41930	-977	-77.71	0.76	-509.49	-43.78	38433	38505	-0.08	-0.07	3252.68	3424.53
3	35180	41930	-1500	-77.71	0.76	-587.21	-43.38	38439	38523	-0.09	-0.08	3259.18	3406.94

Segment Left xRight x z Weight Fx Fz My Thrust left Thrust right Stress left Stress right Dist. left Dist. right
Shape: Circular
Span: 2720 [mm] Rise: 1350 [mm] Q-rise: 1100 [mm]
Ring thickness at crown: 250 [mm] Ring thickness at springing: 250 [mm] Mortar loss: 20 [mm]
Masonry unit weight: 22.00 [kN/m3] Masonry strength: 7.00 [MPa]

Segment Intrados.x Intrados.z Extrados.x Extrados.z Road.z Fx dead Fz dead My dead Fx live Fz live My live Fx passive Fx totalFz totalMy total Thrust in Thrust out Extra-Thrust

0	41930	70	41680	72	2026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.62	-34.38	-3.26	92	97	133	
1	41935	17641686	1982026	0.00	-0.87	-0.13	0.00	0.00	0.00	0.00	-9.62	-33.51	-2.26	64	69	161			
2	41948	28241701	3222025	0.00	-1.22	-0.21	0.00	0.00	0.00	0.00	-9.62	-32.29	-1.46	41	46	184			
3	41970	38641727	4462024	0.00	-1.51	-0.26	0.00	0.00	0.00	0.00	-9.62	-30.78	-0.85	24	29	201			

4	41999	48841762	5672022	0.00	-1.74	-0.30	0.00	0.00	0.00	0.00	0.00	-9.62	-29.03	-0.43	12	16	214		
5	42036	58741806	6842021	0.00	-1.92	-0.32	0.00	0.00	0.00	0.00	0.00	-9.62	-27.11	-0.17	4	8	222		
6	42081	68441859	7982018	0.00	-2.05	-0.32	0.00	0.00	0.00	0.00	0.00	-9.62	-25.06	-0.05	-0	4	226		
7	42134	77641921	9082016	0.00	-2.12	-0.31	0.00	0.00	0.00	0.00	0.00	-9.62	-22.94	-0.05	0	4	226		
8	42193	86441992	1012	2013	0.00	-2.16	-0.29	0.00	0.00	0.00	0.00	-9.62	-20.78	-0.16	5	9	221		
9	42259	94742070	1111	2009	0.00	-2.15	-0.27	0.00	0.00	0.00	0.00	-9.62	-18.63	-0.33	15	18	212		
10	42332	1025	42156	1203	2006	0.00	-2.11	-0.23	0.00	0.00	0.00	0.00	-9.62	-16.53	-0.56	29	31	199	
11	42410	1097	42248	1288	2002	0.00	-2.04	-0.19	0.00	0.00	0.00	0.00	-9.62	-14.49	-0.81	47	50	180	
12	42494	1163	42347	1365	1997	0.00	-1.95	-0.16	0.00	0.00	0.00	0.00	-9.62	-12.54	-1.08	70	73	157	
13	42582	1221	42452	1435	1993	0.00	-1.85	-0.12	0.00	0.00	0.00	0.00	-9.62	-10.69	-1.35	97	99	131	
14	42675	1273	42562	1496	1988	0.31	-1.76	-0.01	-0.00	0.00	0.00	0.00	-9.93	-8.93	-1.66	128	130	100	
15	42772	1317	42677	1549	1984	0.24	-1.68	0.00	-0.00	0.00	0.00	0.00	-10.17	-7.26	-1.91	156	158	72	
16	42872	1354	42795	1592	1979	0.18	-1.60	0.02	-0.00	0.00	0.00	0.00	-10.34	-5.65	-2.12	182	184	46	
17	42974	1383	42916	1626	1974	0.13	-1.53	0.03	-0.00	0.00	0.00	0.00	-10.47	-4.12	-2.27	203	205	25	
18	43078	1403	43039	1650	1969	0.08	-1.47	0.04	-0.00	0.00	0.00	0.00	-10.55	-2.65	-2.37	218	220	10	
19	43184	1416	43164	1665	1964	0.05	-1.43	0.06	-0.00	0.00	0.00	0.00	-10.60	-1.23	-2.43	227	229	1	
20	43290	1420	43290	1670	1959	0.01	-1.40	0.07	-0.00	0.00	0.00	0.00	-10.61	0.17	-2.43	228	230	-0	***
21	43396	1416	43416	1665	1954	-0.01	-1.39	0.08	0.00	0.00	0.00	0.00	-10.60	1.56	-2.39	223	224	6	
22	43502	1403	43541	1650	1950	-0.04	-1.39	0.09	0.00	0.00	0.00	0.00	-10.55	2.95	-2.30	211	212	18	
23	43606	1383	43664	1626	1946	-0.08	-1.42	0.11	0.00	0.00	0.00	0.00	-10.48	4.37	-2.17	193	194	36	
24	43708	1354	43785	1592	1942	-0.12	-1.46	0.13	0.00	0.00	0.00	0.00	-10.36	5.83	-1.99	170	172	58	
25	43808	1317	43903	1549	1937	-0.16	-1.51	0.14	0.00	0.00	0.00	0.00	-10.20	7.34	-1.77	144	145	85	
26	43905	1273	44018	1496	1933	-0.21	-1.57	0.16	0.00	0.00	0.00	0.00	-9.99	8.92	-1.50	115	117	113	
27	43998	1221	44128	1435	1930	-0.28	-1.64	0.18	0.00	0.00	0.00	0.00	-9.71	10.56	-1.20	86	88	142	
28	44086	1163	44233	1365	1926	0.00	-1.72	0.26	0.00	0.00	0.00	0.00	-9.71	12.28	-0.94	61	63	167	
29	44170	1097	44332	1288	1923	0.00	-1.82	0.30	0.00	0.00	0.00	0.00	-9.71	14.10	-0.68	40	42	188	
30	44248	1025	44424	1203	1919	0.00	-1.90	0.33	0.00	0.00	0.00	0.00	-9.71	16.00	-0.45	23	26	204	
31	44321	94744510	1111	1916	0.00	-1.97	0.36	0.00	0.00	0.00	0.00	-9.71	17.96	-0.25	11	14	216		
32	44387	86444588	1012	1914	0.00	-2.01	0.38	0.00	0.00	0.00	0.00	-9.71	19.98	-0.11	3	6	224		
33	44446	77644659	9081912	0.00	-2.03	0.39	0.00	0.00	0.00	0.00	-9.71	22.00	-0.04	-0	3	227			
34	44499	68444721	7981909	0.00	-2.01	0.40	0.00	0.00	0.00	0.00	-9.71	24.01	-0.07	1	5	225			
35	44544	58744774	6841907	0.00	-1.94	0.39	0.00	0.00	0.00	0.00	-9.71	25.95	-0.23	6	10	220			
36	44581	48844818	5671906	0.00	-1.83	0.37	0.00	0.00	0.00	0.00	-9.71	27.78	-0.52	16	20	210			
37	44610	38644853	4461905	0.00	-1.67	0.33	0.00	0.00	0.00	0.00	-9.71	29.45	-0.98	29	34	196			
38	44632	28244879	3221904	0.00	-1.46	0.28	0.00	0.00	0.00	0.00	-9.71	30.91	-1.61	48	53	177			
39	44645	17644894	1981903	0.00	-1.18	0.21	0.00	0.00	0.00	0.00	-9.71	32.09	-2.43	72	77	153			
40	44650	70	44900	72	1903	0.00	-0.86	0.13	0.00	0.00	0.00	0.00	-9.71	32.95	-3.45	102	107	123	

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