ARCADIS Design & Consultancy for natural and built assets

C/028 RIVERHILL ESTATE ACCESS BRIDGE

Inspection and Assessment Report

NOVEMBER 2020

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C/028 Riverhill Estate Access Bridge

Inspection and Assessment Report

Author	Avishek Pal
Checker	Anastasios Karakolios
Reviewer	Andrew Branch
Approver	Jaydip Dasgupta

Report No	10044965-ARC-XX-XX-RP-CB-0002
Date	NOVEMBER 2020

VERSION CONTROL

Version	Date	Author	Changes
01	23/11/2020	AP	First Issue
02	25/11/2020	AP	Certificate signatures added

CONTENTS

1 EXECUTIVE SUMMARY

Caneparo Associates have commissioned Arcadis to undertake an inspection for assessment and assessment for the Riverhill Estate Access Bridge. The bridge carries vehicular and pedestrian traffic over the Hogsmill River.

The inspection for assessment was carried out on the 14th October 2020 by Sebastian Springer and Avishek Pal.

The inspection noted varying degrees of general spalling, mortar loss and parapet damage. Furthermore, there are areas of vegetation growth adjacent to the abutments and cracks have been observed at the arch springing. The main defects were signs of settlement behind the south abutment and damage/deterioration to the parapets.

The structure is in a fair condition but in need of maintenance. The structure would also benefit from a general review of its maintenance regime, this is outside of the scope of this document.

There is no evidence of any structural record or as-built drawings which exist for the structure, therefore information from the visual inspection, prior inspections and engineering judgement have been used to determine any missing parameters and any assumptions have been stated. No destructive testing or material testing have been commissioned for this assessment. The assessment check is CAT II as per DMRB CG300 and has been undertaken by an independent team within Arcadis.

The assessment was carried out in accordance with DMRB CS 454 using the ARCHIE-M arch analysis software. **The Assessment Live Load (ALL) capacity was found to be 40T.**

The parapets do not comply with modern standards. A safety audit is recommended.

Key Recommendations:

- Repair the cracks to the arch springing and spandrel wall.
- Resurface the road where there is cracking and settlement (note the surfacing level should not be increased.
- Monitor the bridge for ongoing signs of settlement behind the abutments.
- Undertake a risk assessment to determine the level of restraint required for the parapets.
- Repair/replace the parapet following the recommendations of the risk assessment.
- Repair minor spalling to the concrete as required.
- Remove corrosion and paint the service duct brackets.
- Remove vegetation from the spandrels and river training walls and repair/repoint as required.

2 INTRODUCTION

The inspection for assessment was carried out on the 14th October 2020 by Sebastian Springer and Avishek Pal.

The weather was moderate with a shade temperature of 12°C.

The 1997 and 2005 Principal Inspections, 1994 AIP for Assessment and Strength Assessment report were available for reference. The 1994 assessment reported a capacity of 40T ALL + 45 HB.

Hogsmill Brook was subject to normal flow conditions and all visible parts of the bridge could be inspected.

3 DESCRIPTION OF STRUCTURE

Bridge Name	**Riverhill Estate Access Bridge**
Bridge No.	C/028
Grid Reference	E520865, N165485
Weight restriction signs	None
Access	Accessed from B284 Old Malden Lane
Location	Residential access
Skew	0°

The structure comprises a single span reinforced concrete arch with a clear span of 9.20m which is continuous with reinforced concrete abutments. There are river training walls of stone and concrete at both ends of the structure. Brick and masonry parapets and architectural wrought iron railings protect the public from the open water course. The height of the crown above the arches is approximately 1.0m. The barrel thickness is 0.29m at the crown and varies at the arch springing positions. The date of construction of the bridge is not known

The depth of fill above the arches appears to be approximately 0.34m. The overall width of the bridge is 5.24m.

The remaining design life of the structure is unknown.

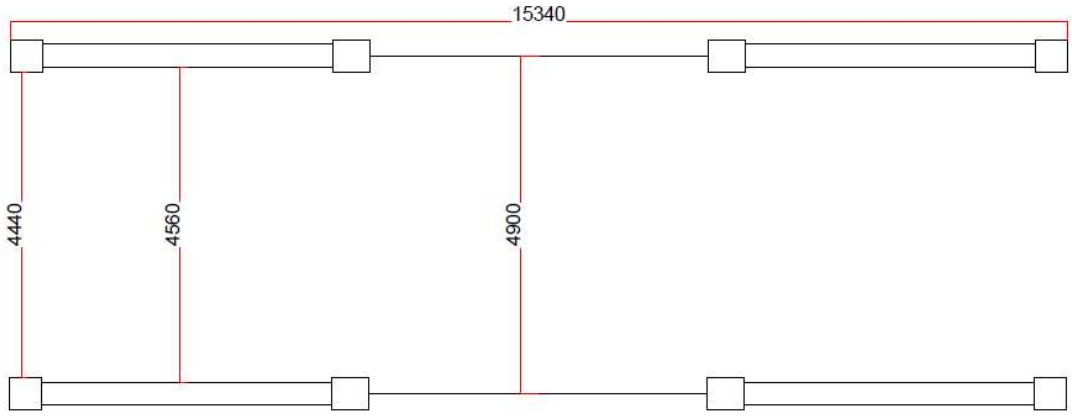

Figure 1 Plan View

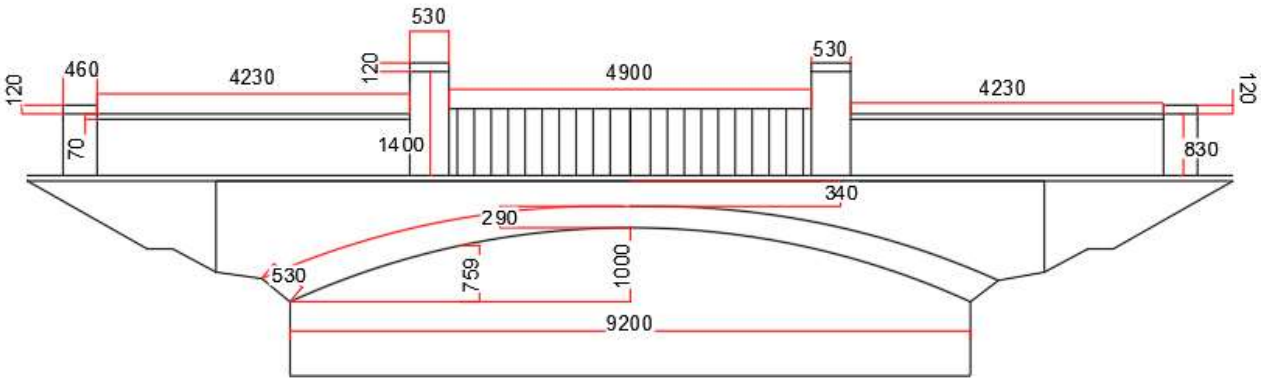

Figure 2 Elevation view

4 DISCUSSION OF BRIDGE CONDITION

4.1 Superstructure

4.1.1 Arch

The reinforced concrete arch is in fair condition. Noticeable cracking has been observed to the concrete behind the arch springing at the south abutment (figure 9). This was noted at the 2005 Principal Inspection and appears to be stable, but it should be formally monitored as it may indicate potential settlement to the fill to the south of the bridge. At the crown of the arch, there is minor staining and spalling (figure 10).

4.1.2 Spandrel Walls and Parapets

The spandrel walls are generally poor condition, with extensive vegetation growth (figure 8 and 12). The crack observed to the arch at south abutment continues through the spandrel at the south east end (figure 9). The masonry parapets are in poor condition with dense vegetation growth. They have exhibited cracking of varying degrees. Some portions of the masonry parapets are longitudinally displaced from their original position. There are steel railings at the central portion of the structure connected with the masonry parapet. The railings are mostly in a fair condition however the collapse of an adjoining masonry parapet portion on the western end may have affected the structural stability of the railing at that position (figure 7).

4.1.3 Carriageway Surfacing

There are signs of settlement in the carriageway to the south of the south abutment, which is consistent with cracking observed behind the arch springing (figure 13). The carriageway should be resurfaced and monitored.

4.2 Substructure

4.2.1 Foundations

The foundations were not visible during the inspection. There are signs of settlement behind the south abutment as described in section 4.1 above.

4.2.2 Abutments

The abutments appeared to be in good condition. Drainage through the abutments appeared to be functioning (figure 10).

4.3 Other Elements

4.3.1 Approach/River Training Walls

The river training wall were generally overgrown with vegetation but appeared to be stable and in a fair condition (figures 3, 8 and 10).

4.3.2 River Invert

The depth of water did not allow for a visual inspection of the invert, but no obvious signs of silting or other defects were noted.

4.3.3 Services

There are a number of service ducts attached to both elevations. The brackets holding the ducts are corroding (figures 11 and 12).

5 ASSESSMENT

Following agreement of the Approval in Principle (AIP), 10044965-ARC-XX-XX-RP-CB-001, Arcadis carried out an assessment of Riverhill Estate Access Bridge for single, double and triple axles as per guidance in Table 7.3.1a of CS 454 for current AW vehicles up to 40/44 tonnes gross vehicle weight.

The condition of structure has been based on the Inspection for Assessment. Although a number of defects were observed, these are not deemed to currently impact the load capacity of the bridge. In particular it should be noted that the crack observed at the south abutment is in a position that will not impact the load path of the arch. As a result, a condition factor of 1.0 was used for the assessment of the superstructure.

The bridge was found to be capable of sustaining loads from single, double and triple axles given in Table 7.3.1a of CS 454 for current AW vehicles up to 40/44 tonnes gross vehicle weight. The Assessment rating of the structure is 40T ALL. A copy of the Assessment and CATII Assessment Check certificate can be found in Appendix E.

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5.1 Assessment Criteria

5.1.1 Superstructure

The bridge was assessed for single, double and triple axles given in Table 7.3.1a of CS 454 up to 40/44 tonnes gross vehicle weight. The structure has been assessed using Archie-M software.

Archie-M software is based on the mechanism method and uses basic assumptions for the plastic analysis method. The analysis produces a thrust line along the arch. If the line of thrust remains within the arch cross section at all points, this demonstrates that a collapse mechanism is unlikely to form.

Following loads have been applied in the Archie M model

- Self-weight of arch barrel
- Superimposed dead loads (fill and surfacing)
- Single, double and triple axle loading as per Table 7.3.1a of CS 454. The nominal values of the axle weights have been determined by multiplying the axle weight by appropriate factors. The lift off condition of axles has been considered for this assessment.

Longitudinal traction loads were not considered as part of this assessment.

5.1.2 Substructure

The quantitative assessment of the sub-structure was not part of the scope of these works. There is no sign of distress to the abutments and are deemed satisfactory on a qualitative basis.

5.1.3 Material Properties

The material unit weights used are as follows:

- Concrete – 2400 kg/m3
- Surfacing – 2300 kg/m3
- Fill – 1800 kg/m^3

5.1.5 Assumptions

The following assumptions have been made for the use of Archie-M software on a concrete arch, which are deemed to be conservative:

- The concrete has zero tensile strength
- The compression is limited to capacity of concrete and no tensile stresses are allowed on the concrete surface. Any tension on the surface of the barrel to be evaluated manually.
- Rebar present in the Reinforced Concrete sections provides sagging/hogging moment capacity, therefore formation of plastic hinge may not be at the same location as a corresponding masonry arch with zero tensile strength. However, in this assessment, masonry arch hinge locations have been adopted.
- The reinforcement also provides additional shear capacity which masonry does not offer. In this assessment shear capacity has been ignored.
- Due to absence of as built drawings, reinforcement details are not known. The assessment has been carried out assuming an unreinforced concrete section.

5.2 Assessment Results

The results of the assessment demonstrate that the bridge can withstand single, double and triple axle loading as per Table 7.3.1a of CS 454.

Two load case combinations were analysed for each type of load, factored and unfactored. The factors used are shown in Table 2 in Appendix D.

The live loads have been positioned at the most onerous position so as to produce the most adverse effects on the structure.

	Unfactored load case combination (refer Archie-M output for factors)	**Factored load case combination (refer Archie-M output for factors)**
Single Axle	Single Axle 11.5t (PASS) (See Figure 14,15)	Single Axle 11.5t (PASS) (See Figure 24,25)
Double Axle	Double Axle (>1.0m) (PASS) (See Figure 16,17)	Double Axle (>1.0m) (PASS) (See Figure 26,27)
	Double Axle (1.3m) (PASS) (See Figure 18,19)	Double Axle (1.3m) (PASS) (See Figure 28,29)
Triple Axle	Triple Axle(<2.6m) (PASS) (See Figure 20,21)	Triple Axle(<2.6m) (PASS) (See Figure 30,31)
	Triple Axle(>2.6m) (PASS) (See Figure 22,23)	Triple Axle(>2.6m) (PASS) (See Figure 32,33)

Table 1 Results Summary

6 CONCLUSIONS

The inspection found the main load carrying elements of the structure to be in fair condition, with no defects that are currently reducing the load carrying capacity of the bridge. There were however a number of defects noted that will need to be monitored or addressed.

There are signs that the fill behind the south abutment has settled. Cracking to back of the arch at the springing point, continuing up though the spandrel wall and parapet as well as cracking and dipping of the road surfacing were all noted. These have also been noted in previous inspections, and may have been historic after the bridge was constructed. Cracks should be repaired and then formally monitored. The dipping of the road surface will be causing additional dynamic loading to the arch and it should be resurfaced to eliminate this. The resurfacing should not increase the level of surfacing over the bridge as this will in turn increase the loading on the bridge.

The parapets are in poor condition, with cracking and areas of collapse. Visual inspection suggests that they not be providing any vehicle restraint. It is recommended that a risk assessment be undertaken into the required level of restraint needed and that the parapets are repaired and strengthened if required.

Other general maintenance should be carried out to avoid deterioration to the structure, including vegetation removal and corrosion protection to the service duct brackets.

The assessment concludes that the superstructure is capable of sustaining single, double and triple axle loads for current vehicles up to 40/44 tonnes gross vehicle weight. The assessment rating of the structure is 40T ALL.

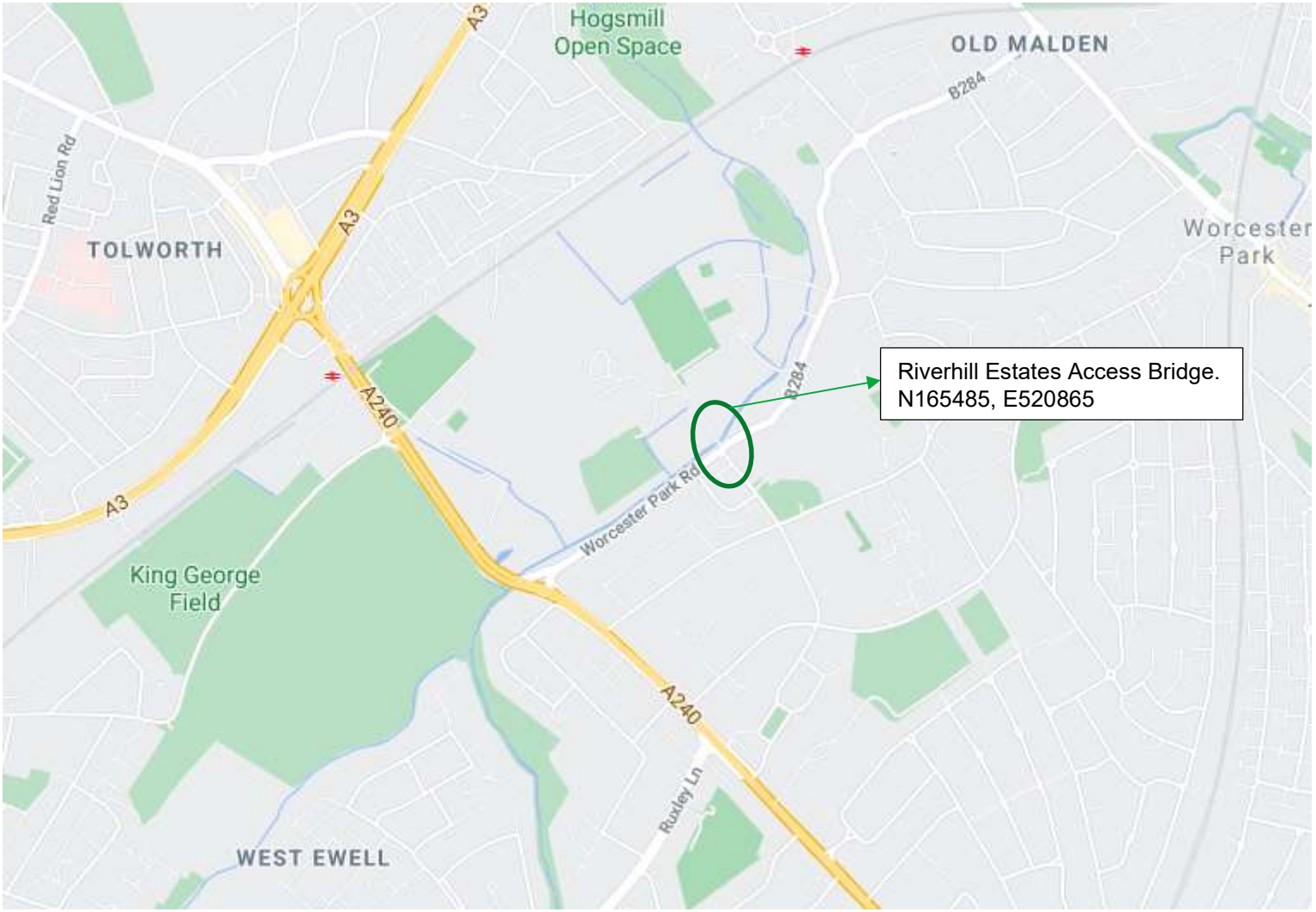
7 RECOMMENDATIONS

Overall, the structure is in fair condition. The recommendations are as follows:

- Repair the cracks to the arch springing and spandrel wall.
- Resurface the road where there is cracking and settlement (note the surfacing level should not be increased.
- Monitor the bridge for ongoing signs of settlement behind the abutments.
- Undertake a risk assessment to determine the level of restraint required for the parapets.
- Repair/replace the parapet following the recommendations of the risk assessment.
- Repair minor spalling to the concrete as required.
- Remove corrosion and paint the service duct brackets.
- Remove vegetation from the spandrels and river training walls and repair/repoint as required.

APPENDIX A LOCATION PLAN

Location plan



Source: Google Maps

APPENDIX B PHOTOS

Figure 3 Dense vegetation growth, view from South-eastern side of the bridge

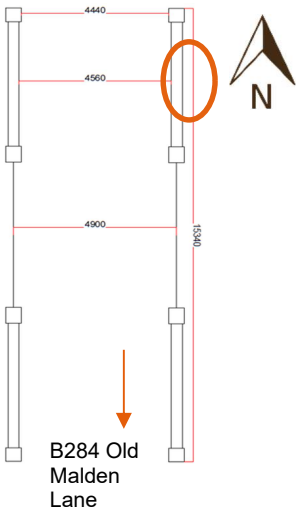


Figure 4 Approximately 35mm cracking on the eastern face of the parapet, north of the bridge

Figure 5 Loss of masonry at eastern face of parapet, south of the bridge

Figure 6 Longitudinal displacement of parapet on the western face, south of the bridge

Figure 7 Vegetation overgrowth along the west side of the bridge

Figure 8 View from the river showing staining, water seepage and vegetation growth along arch, east of the bridge

Figure 9 Cracking at arch springing at the south abutment on the east face

Figure 10 Soffit of arch *on the east face* showing minor spalling and staining

Figure 11 Corrosion at the steel brackets supporting ducts, west face of the bridge

Figure 12 Water seepage at the arch-masonry interface, west face of the bridge

Figure 13 View of the carriageway, south of the bridge

APPENDIX C SIGNED APPROVAL IN PRINCIPLE

ARCADIS Design & Consultancy for natural and built assets

ASSESSMENT OF RIVERHILL ESTATE ACCESS BRIDGE

Approval in Principle

OCTOBER 2020

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Assessment of Riverhill Estate Access Bridge

Approval in Principle

Author	Avishek Pal
Checker	Anastasios Karakolios
Approver	Andrew Branch
Report No	10044965-ARC-XX-XX-RP-CB-0001
Date	OCTOBER 2020

VERSION CONTROL

Version	Date	Author	Changes
01	30/10/2020	AP	First Issue

CONTENTS

APPENDICES

Name of Project:	Approval in Principle for Assessment of Riverhill Estate Access Bridge
Structure Name:	Riverhill Estate Access Bridge
Structure Key No:	C/028

1 HIGHWAY DETAILS

1.1 Type of highway

Over the structure	Single carriageway road providing access to Riverhill Estate properties
Under the structure	Not applicable

1.2 Permitted traffic speed

Over the structure	30mph
Under the structure	Not applicable

1.3 Existing restrictions

None.

2 SITE DETAILS

2.1 Obstacles crossed

The bridge crosses over the Hogsmill River.

3 PROPOSED STRUCTURE

3.1 Description of structure and design working life

Riverhill Estate Access Bridge carries vehicular and pedestrian access over the Hogsmill River. The structure comprises a single span reinforced concrete arch with a clear span of 9.12m built onto reinforced concrete abutments. There are river training walls of stone and concrete at both ends of the structure. Brick and masonry parapets and architectural wrought iron railings protect the public from the open water course.

Design working life of the structure is unknown.

3.2 Structural type

Single span reinforced concrete arch spanning onto concrete abutments

3.3 Foundation type

Foundation type is unknown

3.4 Span arrangements

The structure has a clear span of 9.12m and the overall length of the structure is 16.30m. The structure is built square to the Hogsmill River. The arch is built continuous with the abutments.

3.5 Articulation arrangements

The arch is continuous with the abutments.

3.6 Road restraint systems requirements

Brick and masonry parapets and architectural wrought iron railings protect the public from the open water course.

3.7 Proposals for water management

Not Applicable

3.8 Propose arrangements for future maintenance and inspection

3.8.1 Traffic management

Not Applicable

3.8.2 Access arrangements to structure.

The top of the deck is accessed by road. Access to the underside of the deck is via shallow embankments, no special access arrangement are needed. When the water depth is shallow, access to the underside of the deck can be undertaken using waders.

3.8.3 Intrusive investigations proposed

None.

3.9 Environment and sustainability

Not applicable to this assessment.

3.10 Durability - materials strengths assumed and basis of assumptions

Factors for the assessment shall be determined in accordance with CS 454 following an inspection for assessment.

3.11 Risks and hazards considered

Hazards and associated risks for the inspection for assessment are:

- Working over or near water - drowning, leptospirosis.
- Slips trips and falls - Injury
- Infection (including needle prick – Hep A, Hep B, HIV etc.) - Damage to nervous / immune system.
- Falls from height - Injury to any body part,
- Working adjacent to live traffic – Injury / death
- Working around the public – Confrontation, public injury

3.12 Resilience and security

Not applicable

3.13 Year of construction

Unknown.

3.14 Reason for assessment

To determine the current capacity of the bridge so that its suitability as an access route for a proposed park and ride facility can be determined.

3.15 Part of structure to be assessed

Quantitative assessment of the structural arch.

Qualitative assessment of the abutments, spandrels, wing walls and parapets.

All structural measurements will be recorded during the inspection for assessment.

4 ASSESSMENT CRITERIA

4.1 Actions

4.1.1 Permanent actions

Fill and self-weight of arch, spandrels and parapets.

4.1.2 Snow, Wind and Thermal actions

Not applicable.

4.1.3 Loading relating to normal traffic under AW regulations and C&U regulations

Highway loading in accordance with CS 454

4.1.4 Loading relating to General Order traffic under STGO regulations

Not applicable.

4.1.5 Footway or footbridge variable actions

Not applicable, there are no footways on the bridge.

4.1.6 Actions relating to Special Order traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross-section

Not applicable.

4.1.7 Accidental actions

Not applicable.

4.1.8 Actions during construction

Not applicable.

4.1.9 Any special action not covered above

None

4.2 Heavy or high load route requirements and arrangements being made to preserve the route, including any provision for future heavy loads or future widening

Not applicable.

4.3 Minimum headroom provided

River is non navigable hence not required

4.4 Authorities consulted and any special conditions required

Records including any existing drawings and principal inspection reports were made available.

4.5 Standards and documents listed in the Technical Approval Schedule

Refer to Appendix A.

4.6 Proposed Departures relating to departures from standards given in 4.5

None.

4.7 Proposed Departures relating to methods for dealing with aspects not covered by standards in 4.5

None.

5 STRUCTURAL ANALYSIS

5.1 Methods of analysis proposed for superstructure, substructure and foundations

The arch will be assessed using Archie-M software, which uses the mechanism method of arch analysis.

Factors will be derived in accordance with CS 454

The current load capacity will be provided in terms of allowable vehicle loading.

5.2 Description and diagram of idealised structure to be used for analysis.

Figures 1 and 2 show the plan and elevation view of the structure. Dimensions are based on the measurements taken at the most recent inspection.

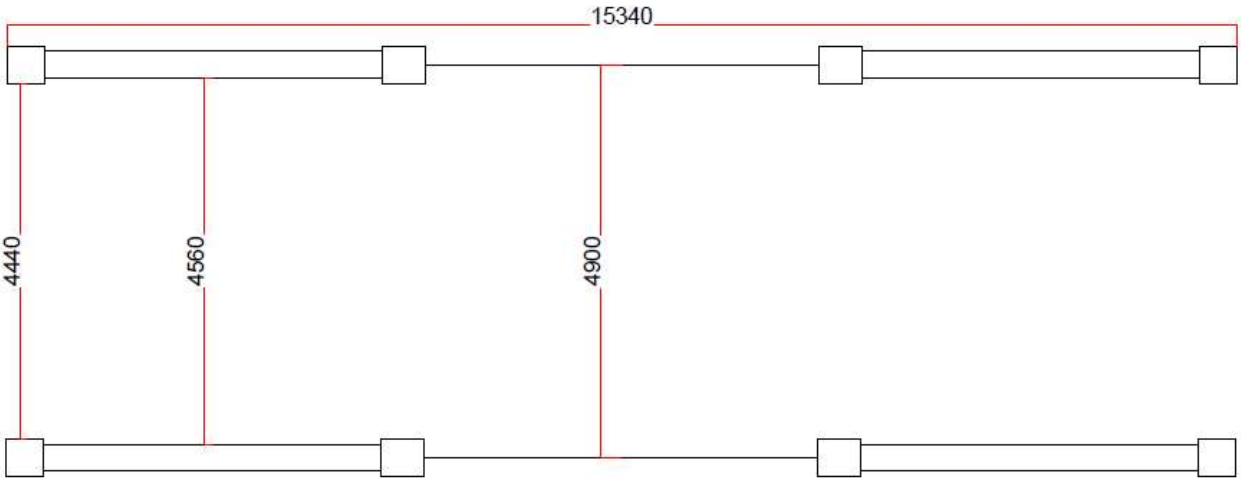


Figure 1 Plan View

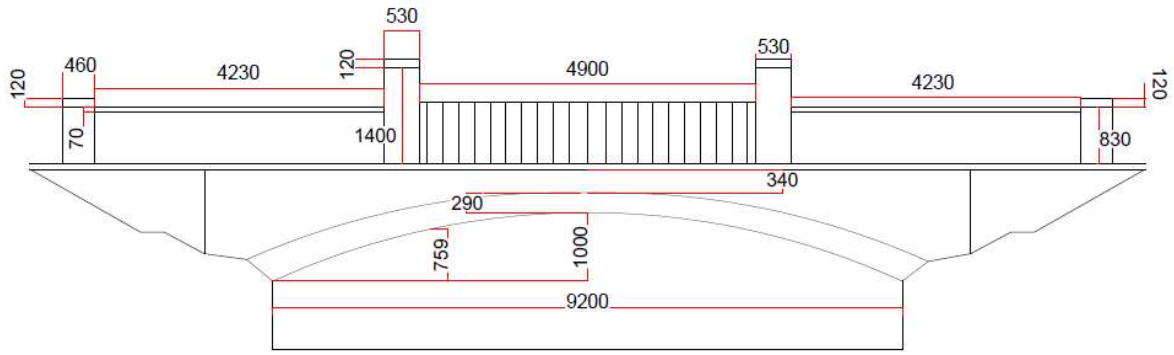


Figure 2 Elevation View

5.3 Assumptions intended for calculation of structural element stiffness.

Not applicable.

5.4 Proposed range of soil parameters to be used in the assessment of earth retaining elements.

Not applicable.

6 GEOTECHNICAL CONDITIONS

6.1 Acceptance of recommendations of the Geotechnical Design Report to be used in the assessment and reasons for any proposed changes

Not applicable.

6.2 Summary of design for highway structure in Geotechnical Design Report.

Not applicable.

6.3 Differential settlement to be allowed for in the assessment of the structure.

Not considered in the assessment.

7 CHECK

7.1 Proposed Category

Category 2.

7.2 If Category III, name of proposed independent Checker

Not applicable.

8 DRAWINGS AND DOCUMENTS

8.1 List of drawings (including numbers) and documents accompanying the submission

Appendix A Schedule TAS

8.2 List of construction and record drawings (including numbers) to be used in the assessment

None available.

8.3 List of pile driving or other construction records

None available.

8.4 List of previous inspection and assessment reports

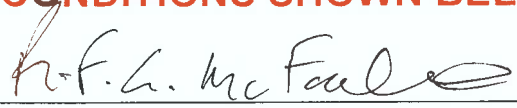
Principal Inspection Report 1994 and 2005.

Assessment report 1994

9 THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed	
Name	Andrew Branch Assessment Team Leader
Engineering Qualifications	BEng (Hons) CEng MICE
Name of the Organisation	Arcadis Consulting Ltd
Date	30/10/2020

10 THE ABOVE IS REJECTED/AGREED SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW

Signed	
Name	Richard McFarlane
Position Held	Structures Asset Manager RBK
Engineering Qualifications	Our Ing Bsc MICE
TAA	Royal Borough of Kingston upon Thames
Date	11 November 2020

APPENDIX A Technical Approval Schedule (TAS)

Appendix A

Technical Approval Schedule (TAS)

Schedule of Documents Relating to Design of Highway Bridges and Structures

(All documents are taken to include revisions current as of 13 October 2020)

The standards listed are typically required for a highway structure.

Additional standards needed for a particular design should be added to the section at the bottom of the TAS.

The Designer is responsible for ensuring that the standards and references given in the schedule are correct and up to date.

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
~~**Eurocode 0**~~	~~**Basis of structural design**~~		
~~BS EN 1990:2002 +A1:2005~~	~~Eurocode 0: Basis of structural design~~	~~+A1:2005 Incorporating corrigenda December 2008 and April 2010~~	~~See CD 350 section 7 for additional guidance.~~
~~NA to BS EN 1990:2002 + A1:2005~~	~~UK National Annex to Eurocode 0 Basis of structural design~~	~~National Amendment No.1~~	~~See CD 350 section 7 for additional guidance.~~
~~**Eurocode 1**~~	~~**Actions on structures**~~		
~~BS EN 1991-1-1:2002~~	~~Eurocode 1: Actions on structures. General Actions. Densities, self-weight, imposed load for buildings~~	~~Corrigenda December 2004 and March 2009~~	
~~NA to BS EN 1991-1-1:2002~~	~~UK National Annex to Eurocode 1: Actions on structures. General Actions. Densities, self-weight, imposed load for buildings~~	~~Corrigenda July 2019~~	
~~BS EN 1991-1-3:2003 +A1:2015~~	~~Eurocode 1: Actions on structures. General Actions. Snow loads~~	~~+A1:2015 Incorporating corrigenda December 2004 and March 2009~~	
~~NA + A2:18 to BS EN 1991-1-3:2003+A1:2015~~	~~UK National Annex to Eurocode 1: Actions on structures. General Actions. Snow loads~~	~~+A2:2018 Incorporating corrigenda June 2007, December 2015 and October 2018~~	

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
~~BS EN 1991-1-4:2005 +A1:2010~~	~~Eurocode 1: Actions on structures. General Actions. Wind actions~~	~~+A1:2010 Corrigenda July 2009 and January 2010~~	
~~NA to BS EN 1991-1-4:2005 + A1:2010~~	~~UK National Annex to Eurocode 1: Actions on structures. General Actions. Wind actions~~	~~National Amendment No.1~~	
~~BS EN 1991-1-5:2003~~	~~Eurocode 1: Actions on structures. General Actions. Thermal actions~~	~~Corrigenda December 2004 and March 2009~~	
~~NA to BS EN 1991-1-5:2003~~	~~UK National Annex to Eurocode 1: Actions on structures. General Actions. Thermal actions~~	~~-~~	
~~BS EN 1991-1-6:2005~~	~~Eurocode 1: Actions on structures. General Actions. Actions during execution~~	~~Corrigenda July 2008, November 2012 and February 2013~~	
~~NA to BS EN 1991-1-6:2005~~	~~UK National Annex to Eurocode 1: Actions on structures. General Actions. Actions during execution~~	~~-~~	
~~BS EN 1991-1-7:2006 +A1:2014~~	~~Eurocode 1: Actions on structures. General Actions. Accidental actions~~	~~+A1: 2014 Corrigendum February 2010~~	
~~NA+A1 to BS EN 1991-1-7:2006+A1:2014~~	~~UK National Annex to Eurocode 1: Actions on structures. Part 1-7 : Accidental actions~~	~~+A1:2014 Incorporating corrigenda August 2014 and November 2015~~	~~See CD 350 for additional guidance.~~
~~BS EN 1991-2:2003~~	~~Eurocode 1: Actions on structures. Traffic loads on bridges~~	~~Corrigenda December 2004 and February 2010~~	~~See CD 350 section 7 for additional guidance.~~
~~**NA +A1:2020 to BS EN 1991-2:2003**~~	~~**UK National Annex to Eurocode 1: Actions on structures. Traffic loads on bridges**~~	~~**Corrigendum No.1 Amendment June 2020**~~	~~**See CD 350 section 7 for additional guidance.**~~
~~**Eurocode 2**~~	~~**Design of concrete structures**~~		
~~BS EN 1992-1-1:2004 + A1:2014~~	~~Eurocode 2: Design of concrete structures– Part 1-1: General rules and rules for buildings~~	~~Incorporating corrigendum January 2008, November 2010 and January 2014~~	
~~NA + A2:2014 to BS EN 1992-1-1:2004 + A1:2014~~	~~UK National Annex to Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings~~		

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
~~BS EN 1992-2:2005~~	~~Eurocode 2: Design of concrete structures – Part 2: Concrete bridges – Design and detailing rules~~	~~Corrigendum July 2008~~	
~~NA to BS EN 1992-2:2005~~	~~UK National Annex to Eurocode 2: Design of concrete structure – Part 2: Concrete bridges – Design and detailing rules~~	~~-~~	
~~BS EN 1992-3:2006~~	~~Eurocode 2: Design of concrete structures – Part 3: Liquid retaining and containment structures~~	~~-~~	
~~NA to BS EN 1992-3:2006~~	~~UK National Annex to Eurocode 2: Design of concrete structures – Part 3: Liquid retaining and containment structures~~	~~-~~	
~~BS EN 1992-4:2018~~	~~Eurocode 2: Design of concrete structures – Part 4: Design of fastenings for use in concrete~~		
~~NA to BS EN 1992-4:2018~~	~~UK National Annex to Eurocode 2: Design of concrete structures – Part 4: Design of fastenings for use in concrete~~		
~~**Eurocode 3**~~	~~**Design of steel structures**~~		
~~BS EN 1993-1-1:2005 + A1:2014~~	~~Eurocode 3: Design of steel structures – Part 1-1 General rules and rules for buildings~~	~~Corrigenda February 2006 and April 2009~~	
~~NA + A1:2014 to BS EN 1993-1-1:2005 + A1:2014~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-1 General rules and rules for buildings~~	~~-~~	
~~BS EN 1993-1-3:2006~~	~~Eurocode 3: Design of steel structures – Part 1-3 General rules – Supplementary rules for cold-formed members and sheeting~~	~~Corrigendum November 2009~~	
~~NA to BS EN 1993-1-3:2006~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-3 Supplementary rules for cold-formed members and sheeting~~	~~-~~	
~~BS EN 1993-1-4:2006 + A1:2015~~	~~Eurocode 3: Design of steel structures – Part 1-4 General rules – Supplementary rules for stainless steels~~	~~+ A1:2015 Amendment No. 1~~	
~~NA+A1:15 to BS EN 1993-1-4:2006+A1:2015~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-4 Supplementary rules for stainless steels~~	~~+ A1:2015 Amendment No. 1~~	
~~BS EN 1993-1-5:2006+A2:2019~~	~~Eurocode 3: Design of steel structures – Part 1-5 Plated structural elements~~	~~Corrigendum April 2009, +A1:2017 Amendment No. 2, +A2:2019~~	

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
~~NA+A1:2016 to BS EN 1993-1-5:2006~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-5 Plated structural elements~~	~~+ A1:2016 Amendment No. 1~~	
~~BS EN 1993-1-6:2007+ A1:2017~~	~~Eurocode 3: Design of steel structures – Part 1-6 Strength and stability of shell structures~~	~~+ A1:2017 Amendment No. 1~~	
~~BS EN 1993-1-7:2007~~	~~Eurocode 3: Design of steel structures – Part 1-7 Plated structures subject to out of plane loading~~	~~Corrigendum April 2009~~	
~~BS EN 1993-1-8:2005~~	~~Eurocode 3: Design of steel structures – Part 1-8 Design of joints~~	~~Corrigenda December 2005, September 2006, July 2009 and August 2010~~	
~~NA to BS EN 1993-1-8:2005~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-8 Design of joints~~	~~-~~	
~~BS EN 1993-1-9:2005~~	~~Eurocode 3: Design of steel structures – Part 1-9 Fatigue~~	~~Corrigenda December 2005, September 2006 and April 2009~~	
~~NA to BS EN 1993-1-9:2005~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-9 Fatigue~~	~~-~~	
~~BS EN 1993-1-10:2005~~	~~Eurocode 3: Design of steel structures – Part 1-10 Material toughness and through-thickness properties~~	~~Corrigenda December 2005, September 2006 and March 2009~~	
~~NA to BS EN 1993-1-10:2005~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-10 Material toughness and through thickness properties~~	~~-~~	
~~BS EN 1993-1-11:2006~~	~~Eurocode 3: Design of steel structures – Part 1-11 Design of structures with tension components~~	~~Corrigendum April 2009~~	
~~NA to BS EN 1993-1-11:2006~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-11 Design of structures with tension components~~	~~-~~	
~~BS EN 1993-1-12:2007~~	~~Eurocode 3: Design of steel structures – Part 1-12 Additional rules for the extension of EN 1993 up to steel grades S 700~~	~~Corrigendum April 2009~~	

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
~~NA to BS EN 1993-1-12:2007~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 1-12 Additional rules for the extension of EN 1993 up to steel grades S 700~~	~~-~~	
~~BS EN 1993-2:2006~~	~~Eurocode 3: Design of steel structures – Part 2 Steel bridges~~	~~Corrigendum July 2009~~	
~~NA + A1:2012 to BS EN 1993-2:2006~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 2 Steel bridges~~	~~+ A1:2012~~	
~~BS EN 1993-5:2007~~	~~Eurocode 3: Design of steel structures – Part 5 Piling~~	~~Corrigendum May 2009~~	
~~NA + A1:2012 to BS EN 1993-5:2007~~	~~UK National Annex to Eurocode 3: Design of steel structures – Part 5 Piling~~	~~+ A1:2012~~	
~~**Eurocode 4**~~	~~**Design of composite steel and concrete structures**~~		
~~BS EN 1994-1-1:2004~~	~~Eurocode 4: Design of composite steel and concrete structures – Part 1-1 General rules and rules for buildings~~	~~Corrigendum April 2009~~	
~~NA to BS EN 1994-1-1:2004~~	~~UK National Annex to Eurocode 4: Design of composite steel and concrete structures – Part 1-1 General rules and rules for buildings~~	~~-~~	
~~BS EN 1994-2:2005~~	~~Eurocode 4: Design of composite steel and concrete structures – Part 2 General rules and rules for bridges~~	~~Corrigendum July 2008~~	
~~NA to BS EN 1994-2:2005~~	~~UK National Annex to Eurocode 4: Design of composite steel and concrete structures – Part 2 General rules and rules for bridges~~	~~-~~	
~~**Eurocode 5**~~	~~**Design of timber structures**~~		
~~BS EN 1995-1-1:2004 + A2:2014~~	~~Eurocode 5: Design of timber structures – Part 1-1 General – common rules and rules for buildings~~	~~+ A2:2014 Incorporating corrigendum June 2006~~	
~~NA to BS EN 1995-1-1:2004 + A2:2014~~	~~UK National Annex to Eurocode 5: Design of timber structures – Part 1-1 General – common rules and rules for buildings~~	~~+ A2:2014~~	
~~BS EN 1995-2:2004~~	~~Eurocode 5: Design of timber structures – Part 2 Bridges~~	~~-~~	
~~NA to BS EN 1995-2:2004~~	~~UK National Annex to Eurocode 5: Design of timber structures – Part 2 Bridges~~	~~-~~	

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
Eurocode 6	**Design of masonry structures**		
~~BS EN 1996-1-1:2005+A1:2012~~	~~Eurocode 6: Design of masonry structures – Part 1-1 General rules for reinforced and unreinforced masonry structures~~	~~+A1:2012 Corrigenda February 2006 and July 2009~~	
~~NA to BS EN 1996-1-1:2005 +A1:2012~~	~~UK National Annex to Eurocode 6: Design of masonry structures – Part 1-1 General rules for reinforced and unreinforced masonry structures~~	~~+A1:2012~~	
~~BS EN 1996-2:2006~~	~~Eurocode 6: Design of masonry structures – Part 2 Design considerations, selection of materials and execution of masonry~~	~~Corrigendum September 2009~~	
~~NA to BS EN 1996-2:2006~~	~~UK National Annex to Eurocode 6: Design of masonry structures – Part 2 Design considerations, selection of materials and execution of masonry~~	~~Corrigendum No.1~~	
~~BS EN 1996-3:2006~~	~~Eurocode 6: Design of masonry structures – Part 3 Simplified calculation methods for unreinforced masonry structures~~	~~Corrigendum October 2009~~	
~~NA +A1:2014 to BS EN 1996-3:2006~~	~~UK National Annex to Eurocode 6: Design of masonry structures – Part 3 Simplified calculation methods for unreinforced masonry structures~~	~~+A1:2014~~	
~~**Eurocode 7**~~	~~**Geotechnical design**~~		
~~BS EN 1997-1:2004+A1:2013~~	~~Eurocode 7: Geotechnical design – Part 1 General rules~~	~~+A1:2013 Corrigendum February 2009~~	
~~NA+A1:2014 to BS EN 1997-1:2004+A1:2013~~	~~UK National Annex to Eurocode 7: Geotechnical design – Part 1 General rules~~	~~+A1:2013 Incorporating Corrigendum No.1~~	
~~BS EN 1997-2:2007~~	~~Eurocode 7: Geotechnical design – Part 2 Ground investigation and testing~~	~~Corrigendum June 2010~~	
~~NA to BS EN 1997-2:2007~~	~~UK National Annex to Eurocode 7: Geotechnical design – Part 2 Ground investigation and testing~~	~~-~~	
~~**Eurocode 8**~~	~~**Design of structures for earthquake resistance**~~		
~~BS EN 1998-1:2004 + A1:2013~~	~~Eurocode 8: Design of structures for earthquake resistance – Part 1 General rules, seismic actions and rules for buildings~~	~~Corrigendum June 2009, January 2011 and March 2013~~	

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
~~NA to BS EN 1998-1:2004~~	~~UK National Annex to Eurocode 8: Design of structures for earthquake resistance – Part 1 General rules, seismic actions and rules for buildings~~	~~-~~	
~~BS EN 1998-2:2005+A2:2011~~	~~Eurocode 8: Design of structures for earthquake resistance – Part 2 Bridges~~	~~Corrigenda February 2010 and February 2012~~	
~~NA to BS EN 1998-2:2005~~	~~UK National Annex to Eurocode 8: Design of structures for earthquake resistance – Part 2 Bridges~~	~~-~~	
~~BS EN 1998-5:2004~~	~~Eurocode 8: Design of structures for earthquake resistance – Part 5 Foundations, retaining structures and geotechnical aspects~~	~~-~~	
~~NA to BS EN 1998-5:2004~~	~~UK National Annex to Eurocode 8: Design of structures for earthquake resistance – Part 5 Foundations, retaining structures and geotechnical aspects~~	~~-~~	
~~**Eurocode 9**~~	~~**Design of aluminium structures**~~		
~~BS EN 1999-1-1:2007 + A2:2013~~	~~Eurocode 9: Design of aluminium structures– Part 1-1 General structural rules~~	~~+ A2:2013 Incorporating corrigendum March 2014~~	
~~NA to BS EN 1999-1-1:2007 + A1:2009~~	~~UK National Annex to Eurocode 9: Design of aluminium structures – Part 1-1 General structural rules~~	~~National Amendment No.1 Corrigendum No.1~~	
~~BS EN 1999-1-3:2007 + A1:2011~~	~~Eurocode 9: Design of aluminium structures – Part 1-3 Structures susceptible to fatigue~~	~~+ A1:2011~~	
~~NA to BS EN 1999-1-3:2007 + A1:2011~~	~~UK National Annex to Eurocode 9: Design of aluminium structures – Part 1-3 Structures susceptible to fatigue~~	~~+ A1:2011~~	
~~BS EN 1999-1-4:2007 +A1:2011~~	~~Eurocode 9: Design of aluminium structures – Part 1-4 Cold formed structural sheeting~~	~~+ A1:2011 Corrigendum November 2009~~	
~~NA to BS EN 1999-1-4:2007~~	~~UK National Annex to Eurocode 9: Design of aluminium structures – Part 1-4 Cold formed structural sheeting~~	~~-~~	
Bsi Published Documents ***For guidance only unless clauses are otherwise specified in CD 350 Appendix A.***			

Eurocodes and associated UK National Annexes			
Eurocode part	**Title**	**Amendment / Corrigenda**	***Notes***
Published Document reference	**Title**	**Notes**	
~~PD 6687-1:2010~~	~~Background paper to the UK National Annexes to BS EN 1992-1 and BS EN 1992-3~~	~~See CD 350 clauses 3.6, 4.1 and Appendix A for additional guidance.~~	
~~PD 6687-2:2008~~	~~Recommendations for the design of structures to BS EN 1992-2:2005~~	~~See CD 350 clauses 4.1, 4.2 and Appendix A for additional guidance.~~	
~~PD 6688-1-1:2011~~	~~Recommendations for the design of structures to BS EN 1991-1-1~~	~~See CD 350 Appendix A for additional guidance.~~	
~~PD 6688-1-4:2015~~	~~Background paper to the UK National Annex to BS EN 1991-1-4~~	~~See CD 350 Appendix A for additional guidance.~~	
~~PD 6688-1-7:2009 +A1:2014~~	~~Recommendations for the design of structures to BS EN 1991-1-7~~	~~See CD350 clause 3.7 and Appendix B for additional guidance.~~	
~~PD 6688-2:2011~~	~~Recommendations for the design of structures to BS EN 1991-2~~	~~See CD 350 Appendix A for additional guidance.~~	
~~**PD 6694-1:2011 + A1:2020**~~	~~**Recommendations for the design of structures subject to traffic loading to BS EN 1997-1**~~	~~**See CD 350 Appendix A for additional guidance.**~~ ~~**Amended 27 May 2020**~~ ~~**(Temporarily withdrawn due to technical errors)**~~	
~~PD 6695-1-9:2008~~	~~Recommendations for the design of structures to BS EN 1993-1-9~~	~~See CD 350 Appendix A for additional guidance.~~	
~~PD 6695-1-10:2009~~	~~Recommendations for the design of structures to BS EN 1993-1-10~~	~~See CD 350 Appendix A for additional guidance.~~	
~~PD 6695-2:2008 + A1:2012 Incorporating Corrigendum No.1~~	~~Recommendation for the design of bridges to BS EN 1993~~	~~See CD 350 Appendix A for additional guidance.~~	
~~PD 6696-2:2007 + A1:2012~~	~~Background paper to BS EN 1994-2 and the UK National Annex to BS EN 1994-2~~	~~See CD 350 Appendix A for additional guidance.~~	
~~PD 6698:2009~~	~~Recommendations for the design of structures for earthquake resistance to BS EN 1998~~	~~See CD 350 section 7 for additional guidance.~~	
~~PD 6702-1:2009+A1:2019~~	~~Structural use of aluminium. Recommendations for the design of aluminium structures to BS EN 1999~~	~~Amended 31 May 2019~~	
~~PD 6703:2009~~	~~Structural bearings – Guidance on the use of structural bearings~~		
~~PD 6705-2:2020~~	~~Structural use of steel and aluminium. Execution of steel bridges conforming to BS EN 1090-2. Guide~~	~~Replaces PD 6705-2:2010 + A1:2013~~	
~~PD 6705-3:2009~~	~~Recommendations on the execution of aluminium structures to BS EN 1090-3~~		

Execution Standards referenced in British Standards or Eurocodes		
Execution Standard reference	**Title**	**Notes**
~~BS EN 1090-1:2009+A1:2011~~	~~Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components~~	
~~BS EN 1090-2:2018~~	~~Execution of steel structures and aluminium structures. Technical requirements for the execution of steel structures~~	~~Supersedes BS EN 1090-2:2008+A1:2011~~
~~BS EN 1090-3:2019~~	~~Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures~~	~~Supersedes BS EN 1090-3:2008~~
~~BS EN 13670:2009 Incorporating corrigenda October 2015 and November 2015~~	~~Execution of concrete structures~~	

Product Standards referenced in British Standards or Eurocodes		
Product Standard reference	**Title**	**Notes**
~~BS EN 206:2013+A1:2016~~	~~Concrete – Specification, performance, production and conformity~~	~~+A1:2016~~
~~BS EN 1317-1:2010~~	~~Road Restraint Systems – Part 1 – Terminology and general criteria for test methods~~	
~~BS EN 1317-2:2010~~	~~Road Restraint Systems – Part 2 – Performance classes, impact test acceptance criteria and test methods for safety barriers.~~	
~~BS EN 1317-3:2010~~	~~Road Restraint Systems – Part 3 – Performance classes, impact test acceptance criteria and test methods for crash cushions.~~	
~~DD ENV 1317-4:2002~~	~~Road Restraint Systems – Part 4 – Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers.~~	~~*Draft BS EN 1317-4 for public comment published in June 2012*~~
~~BS EN 1317-5:2007+A2:2012~~	~~Road Restraint Systems – Part 5 - Product requirements and evaluation of conformity for vehicle restraint systems~~	~~Incorporating corrigendum August 2012~~ ~~*Draft prEN 1317-5 for public comment published in December 2013*~~

Product Standards referenced in British Standards or Eurocodes		
Product Standard reference	**Title**	**Notes**
~~PD CEN/TR 16949:2016~~	~~Road Restraint System – Pedestrian restraint system - Pedestrian parapets~~	~~*Bsi Published Document / CEN Technical Report published in July 2016*~~ ~~*(This document should not be used. The requirements of BS 7818:1995 apply.)*~~
~~Draft prEN 1317-7~~	~~Road restraint systems - Part 7: Performance classes, impact test acceptance criteria and test methods for terminals of safety barriers~~	~~*Draft prEN 1317-7 for public comment published in June 2012*~~ ~~*(This document should not be used. All terminals should continue to be in accordance with ENV1317-4.)*~~
~~PD CEN/TS 17342:2019~~	~~Road restraint systems - Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers~~	~~*Replaces* PD CEN/TS 1317-8:2012~~ ~~*(This document should not be used.)*~~
~~PD CEN/TR 17081:2018~~	~~Design of fastenings for use in concrete – Plastic design of fastenings with headed and post-installed fasteners~~	
~~BS EN 1337-1:2000~~	~~Structural bearings – Part 1: General Design Rules~~	
~~BS EN 1337-2:2004~~	~~Structural bearings – Part 2: Sliding elements~~	
~~BS EN 1337-3:2005~~	~~Structural bearings – Part 3: Elastomeric bearings~~	
~~BS EN 1337-4:2004~~	~~Structural bearings – Part 4: Roller bearings~~	~~Corrigendum No.1 March 2007~~
~~BS EN 1337-5:2005~~	~~Structural bearings – Part 5: Pot bearings~~	
~~BS EN 1337-6:2004~~	~~Structural bearings – Part 6: Rocker bearings~~	
~~BS EN 1337-7:2004~~	~~Structural bearings – Part 7: Spherical and cylindrical PTFE bearings~~	
~~BS EN 1337-8:2007~~	~~Structural bearings – Part 8: Guide bearings and restraint bearings~~	
~~BS EN 1337-9:1998~~	~~Structural bearings – Part 9: Protection~~	
~~BS EN 1337-10:2003~~	~~Structural bearings – Part 10: Inspection and maintenance~~	~~Corrigendum No.1 November 2003~~
~~BS EN 1337-11:1998~~	~~Structural bearings – Part 11: Transport, Storage and Installation.~~	
~~BS EN 10025-1:2004~~	~~Hot rolled products of structural steels Part 1: General technical delivery conditions.~~	

Product Standards referenced in British Standards or Eurocodes		
Product Standard reference	**Title**	**Notes**
~~BS EN 10025-2:2019~~	~~Hot rolled products of structural steels Part 2: Technical delivery conditions for non-alloy structural steels.~~	~~Supersedes BS EN 10025-1:2004~~
~~BS EN 10025-3:2019~~	~~Hot rolled products of structural steels Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels.~~	~~Supersedes BS EN 10025-3:2004~~
~~BS EN 10025-4:2019~~	~~Hot rolled products of structural steels Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels.~~	~~Supersedes BS EN 10025-4:2004~~
~~BS EN 10025-5:2019~~	~~Hot rolled products of structural steels – Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance~~	~~Supersedes BS EN 10025-5:2004~~
~~BS EN 10025-6:2019~~	~~Hot rolled products of structural steels – Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition.~~	~~Supersedes BS EN 10025-6:2004+A1:2009~~
~~BS EN 10080:2005~~	~~Steel for the reinforcement of concrete – Weldable reinforcing steel - General~~	
~~BS EN 10210-1:2006~~	~~Hot finished structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery conditions~~	
~~BS EN 10210-2:2019~~	~~Hot finished structural hollow sections – Part 2: Tolerances, dimensions and sectional properties~~	~~Supersedes BS EN 10210-2:2006~~
~~BS EN 10248-1:1996~~	~~Hot rolled sheet piling of non alloy steels. Technical delivery conditions~~	
~~BS EN 10248-2:1996~~	~~Hot rolled sheet piling of non alloy steels. Tolerances on shape and dimensions~~	
~~BS EN 12063:1999~~	~~Execution of special geotechnical work. Sheet pile walls.~~	
~~BS EN 14388:2005~~	~~Road traffic noise reducing devices~~	~~There is a 2015 version, however the 2015 version is not harmonised.~~
~~BS EN 15050:2007 + A1:2012~~	~~Precast concrete products – Bridge elements~~	~~See CD 350 clause 3.8.1 for additional guidance.~~

British Standards		
British Standard reference	**Title**	**Notes**
~~BS 4449:2005+A3:2016~~	~~Steel for the reinforcement of concrete~~	~~No longer covers plain round bar. (See BS4482 up to 12mm dia, see BS EN 10025-1 for larger sizes and dowels. See BS EN 13877-3 for dowel bars in concrete pavements.)~~
~~BS 5896:2012~~	~~Specification for high tensile steel wire and strand for the prestressing of concrete~~	
~~BS 7818:1995~~	~~Specification for pedestrian restraint systems in metal~~	~~Incorporating Corrigendum No.1 May 2004 and Corrigendum No.2 September 2006~~ ~~Currently the requirements of BS 7818:1995 are to be used instead of PD CEN/TR 16949:2016~~
~~BS 8002:2015~~	~~Code of practice for earth retaining structures~~	
~~BS 8004:2015 +A1 2020~~	~~Code of practice for foundations~~	~~Amendment +A1:2020~~
~~BS 8006-1:2010+A1:2016~~	~~Code of practice for strengthened/reinforced soils and other fills~~	
~~BS 8500-1:2015+A2:2019~~	~~Concrete – Complementary British Standard to BS EN 206: Method of specifying and guidance for the specifier.~~	~~Incorporating Corrigendum No.1 and Corrigendum No.2 June 2020~~ ~~Amendment +A2:2019~~
~~BS 8500-2:2015+A2:2019~~	~~Concrete – Complementary British Standard to BS EN 206 : Specification for constituent materials and concrete.~~	~~Amendment +A2:2019~~
~~BS 8666:2005~~	~~Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete~~	~~Incorporating Amendment No.1~~

The Manual Contract Document for Highway Works (MCHW)		
MCHW reference	**Title**	***Notes***
~~MCHW Volume 1: March 2020~~	~~Specification for Highway Works~~	~~*Specification compliant with the execution standards must be used. A Departure is necessary for the parts where a compliant revision has not been published. Amendments March 2020*~~
~~MCHW Volume 2: March 2020~~	~~Notes for guidance on the Specification for Highway Works~~	~~*Notes for guidance compliant with the execution standards must be used. A Departure is necessary for*~~

		~~*the parts where a compliant revision has not been published. Amendments March 2020*~~
~~MCHW Volume 3: February 2017~~	~~Highway Construction Details~~	

The Design Manual for Roads and Bridges (DMRB)		
DMRB reference	**Title**	**Notes**
~~GG 101 Revision 0~~	~~Introduction to the Design Manual for Roads and Bridges~~	~~Replaces GD 01/16~~
~~GG 102 Revision 0~~	~~Quality Management Systems for Highway Design~~	~~Replaces GD 02/16~~
~~GG 103 Revision 0~~	~~Introduction and general requirements for sustainable development and design~~	
~~GG 104 Revision 0~~	~~Requirements for Safety Risk Assessment~~	~~Replaces GD04/12 and IAN 191/16~~
~~GG 184~~	~~Specification for the use of Computer Aided Design~~	~~Replaces IAN 184/16~~
CG 300 Revision 0	Technical approval of highway structures	Supersedes BD 2/12
~~CG 302 Revision 0~~	~~As-built, operational and maintenance records for highway structures~~	~~Supersedes BD 62/07~~
~~CG 303 Revision 0~~	~~Quality assurance scheme for paints and similar protective coatings~~	~~Supersedes BD 35/14~~
~~CG 305 Revision 0~~	~~Identification marking of highway structures~~	~~Supersedes BD 45/93~~
~~CG 501 Revision 2~~	~~Design of highway drainage systems~~	~~Supersedes HD 33/16, TA 80/99~~
~~CD 127 Revision 1~~	~~Cross-sections and headrooms~~	~~Replaces TD 27/05 and TD 70/08~~
~~CD 350 Revision 0~~	~~The design of highway structures~~	~~Supersedes BD 100/16, BA 57/01, BD 57/01 and IAN 124/11~~
~~CD 351 Revision 0~~	~~The design and appearance of highway structures~~	~~Supersedes BA 41/98~~
~~CD 352 Revision 0~~	~~Design of road tunnels~~	~~Supersedes BD 78/99~~
~~CD 353 Revision 0~~	~~Design criteria for footbridges~~	~~Supersedes BD 29/17~~
~~CD 354 Revision 1~~	~~Design of minor structures~~	~~Supersedes BD 94/17~~
~~CD 355 Revision 0~~	~~Application of whole-life costs for design and maintenance of highway structures~~	~~Replaces BD 36/92 and BA 28/92~~
~~CD 356 Revision 1~~	~~Design of highway structures for hydraulic action~~	~~Supersedes BA 59/94~~
~~CD 357 Revision 1~~	~~Bridge expansion joints~~	~~Replaces BD 33/94, BA 26/94, IAN 168/12 and IAN 169/12~~
~~CD 358 Revision 1~~	~~Waterproofing and surfacing of concrete bridge decks~~	~~Replaces BD 47/99, BA 47/99 and IAN 96/07~~
~~CD 359 Revision 0~~	~~Design requirements for permanent soffit formwork~~	~~Supersedes BA 36/90 and IAN 131/11~~

The Design Manual for Roads and Bridges (DMRB)

DMRB reference	Title	Notes
~~CD 361 Revision 0~~	~~Weathering steel for highway structures~~	~~Supersedes BD 7/01~~
~~CD 362 Revision 1~~	~~Enclosure of bridges~~	~~Replaces BD 67/96 and BA 67/96~~
~~CD 363 Revision 0~~	~~Design rules for aerodynamic effects on bridges~~	~~Replaces BD 49/01~~
~~CD 364 Revision 0~~	~~Formation of continuity joints in bridge decks~~	~~Replaces BA 82/00~~
~~CD 365 Revision 1~~	~~Portal and cantilever signs/signals gantries~~	~~Replaces BD 51/14, IAN 193/16, BE 7/04~~
~~CD 366 Revision 0~~	~~Design criteria for collision protection beams~~	~~Replaces BD 65/14~~
~~CD 368 Revision 0~~	~~Design of fibre reinforced polymer bridges and highway structures~~	~~Replaces BD 90/05~~
~~CD 369 Revision 0~~	~~Surface protection for concrete highway structures~~	~~Replaces BA 85/04~~
~~CD 372 Revision 0~~	~~Design of post-installed anchors and reinforcing bar connections in concrete~~	~~Supersedes IAN 104/15~~
~~CD 373 Revision 0~~	~~Impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants~~	~~Supersedes BD 43/03~~
~~CD 374 Revision 0~~	~~The use of recycled aggregates in structural concrete~~	~~Supersedes BA 92/07~~
~~CD 375 Revision 1~~	~~Design of corrugated steel buried structures~~	~~Supersedes BD 12/01~~
~~CD 377 Revision 2~~	~~Requirements for road restraint systems~~	~~Supersedes TD 19/06~~
~~CD 622 Revision 1~~	~~Managing geotechnical risk~~	~~Replaces HD 22/08, BD 10/97 and HA 120/08~~
~~CS 461 Revision 0~~	~~Assessment and upgrading of in-service parapets~~	~~Supersedes BA 37/92 and IAN 97/07~~
~~GD 304 Revision 2~~	~~Designing health and safety into maintenance~~	~~Replaces IAN 69/15~~
~~LA 104 Revision 1~~	~~Environmental assessment and monitoring~~	~~Supersedes HA 205/08, HD 48/08, IAN 125/15, and IAN 133/10~~
~~LA 106 Revision 1~~	~~Cultural heritage assessment~~	~~Supersedes HA 208/07, HA 60/92, HA 75/01~~
~~LA 110 Revision 0~~	~~Material assets and waste~~	~~Supersedes IAN 153/11~~
~~LA 113 Revision 1~~	~~Road drainage and the water environment~~	~~Supersedes HD 45/09~~
~~LD 119 Revision 0~~	~~Roadside environmental mitigation and enhancement~~	~~Formerly LA 119, which superseded HA 65/94 and HA 66/95~~

Interim Advice Notes

IAN reference	Title	Notes
~~IAN 105/08~~	~~Implementation of construction (design and management) 2007 and the withdrawal of SD 10 and SD 11~~	

Miscellaneous		
Standard reference	**Title**	**Notes**
~~CIRIA C543~~	~~Bridge Detailing Guide~~	
~~CIRIA C766~~	~~Control of cracking caused by restrained deformation in concrete~~	~~Supersedes C660~~
~~CIRIA C686~~	~~Safe Access for Maintenance and Repair~~	
~~CIRIA C760~~	~~Guidance on embedded retaining wall design~~	

Additional Standards **Additional standards needed for a particular design should be listed here.**		
Reference	**Title**	**Notes**
CS454	Assessment of highway bridges and structures	

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APPENDIX D ARCHIE-M RESULTS

		Dead load	Superimposed dead load	Surfacing	Live Load	Load effect	Material strength
Safety Factors	Factored Load case	1.15	1.2	1.75	1.9	1	1
	Unfactored Load case	1	1	1	1.9	1	1

Table 2 Safety Factors used

APPLIED LOAD CASES

1.	Single Axle	Total weight:	112.82	[kN]	Position:	-220	[mm]				
	11.50	1	1.00	11.50	1.00	1.80	2.50				
	Effective lane width:		4447	[mm]	Distribution length:		1448	[mm]			
2.	Double Axle (>1.0 m)	Total weight:	156.96	[kN]	Position:	-220	[mm]				
	16.00	2	1.00	8.00	1.02	8.00	1.00	1.80	2.50		
	Effective lane width:		4447	[mm]	Distribution length:		1448	[mm]			
3.	Double Axle (1.3 m)	Total weight:	176.58	[kN]	Position:	-220	[mm]				
	18.00	2	1.00	9.00	1.30	9.00	1.00	1.80	2.50		
	Effective lane width:		4447	[mm]	Distribution length:		1448	[mm]			
4.	Triple Axle (<2.6 m)	Total weight:	206.01	[kN]	Position:	-220	[mm]				
	21.00	3	1.00	7.00	0.70	7.00	1.40	7.00	1.00	1.80	2.50
	Effective lane width:		4447	[mm]	Distribution length:		1448	[mm]			
5.	Triple Axle (>2.6 m)	Total weight:	235.44	[kN]	Position:	-220	[mm]				
	24.00	3	1.00	8.00	1.32	8.00	2.64	8.00	1.00	1.80	2.50
	Effective lane width:		4447	[mm]	Distribution length:		1448	[mm]			

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

STRUCTURE PROPERTIES

Road shape:	Flat line (1-point method)					
Road points:	(0, 1630)					
Depth of surfacing:	75	Depth 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	

Fill unit weight:	18.00	[kN/m3]	Fill phi:	30	degree						
Shape:	Circular										
Span:	9200	[mm]	Rise:	1000	[mm]	Q-rise:	760	[mm]			
Ring thickness at crown:			290	[mm]	Ring thickness at springing:			530	[mm]	Mortar loss: 0	[mm]
Concrete unit weight	24.00	[kN/m3]	Masonry strength:		9.00	[MPa]					

Factored Loadcase

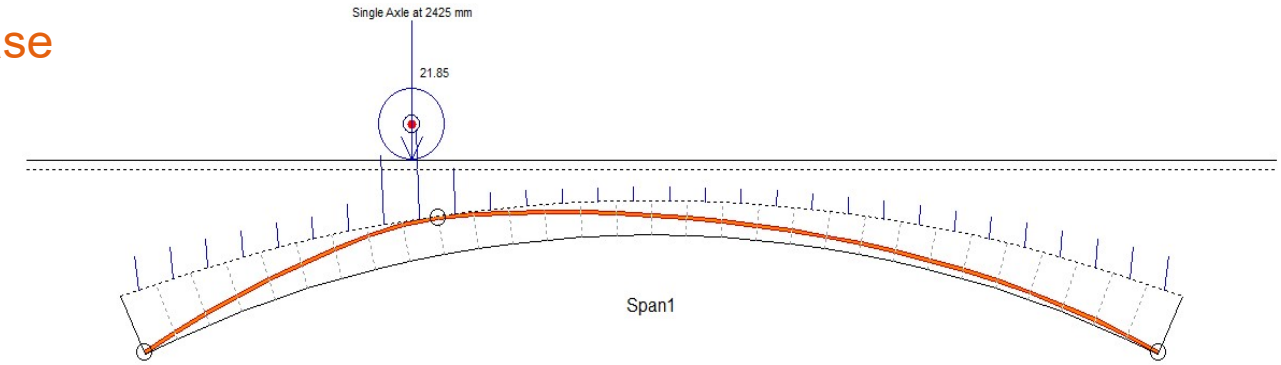

Figure 14 Single axle at quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-244.40	-160.40	-4.64	-0	32	498	
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-245.72	-147.91	-16.58	43	74	425	
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-246.83	-136.34	-27.72	84	115	356	
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-247.77	-125.64	-38.21	123	154	290	
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-248.56	-115.75	-48.23	162	192	227	
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-249.21	-106.59	-57.93	200	230	167	
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-249.74	-98.12	-67.47	238	268	109	
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.16	-2.58	0.48	0.00	-250.34	-87.66	-76.65	276	305	53	
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	1.02	-18.35	2.33	0.00	-251.71	-61.98	-82.04	302	331	11	
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	1.20	-25.04	2.60	0.00	-253.19	-30.09	-80.04	300	328	-0	**
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.41	-10.16	0.71	0.00	-253.82	-13.49	-73.23	275	303	13	
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.01	-0.23	-0.00	0.00	-253.99	-7.15	-66.00	247	275	32	
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	-0.00	0.00	0.00	0.00	-254.12	-1.32	-59.21	220	248	52	
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	-0.00	0.00	0.00	0.00	-254.20	4.30	-52.94	195	223	71	
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	-0.00	0.00	0.00	0.00	-254.25	9.79	-47.23	172	200	91	
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	-0.00	0.00	0.00	0.00	-254.26	15.21	-42.12	152	180	110	
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	0.00	0.00	0.00	0.00	-254.25	20.62	-37.62	134	162	129	
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	0.00	0.00	0.00	0.00	-254.20	26.11	-33.72	118	146	148	
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	0.00	0.00	0.00	0.00	-254.12	31.73	-30.40	105	133	167	
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	0.00	0.00	0.00	0.00	-253.99	37.56	-27.61	93	122	185	
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	0.00	0.00	0.00	0.00	-253.83	43.66	-25.31	84	113	204	
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	0.00	0.00	0.00	0.00	-253.61	50.10	-23.40	76	105	224	
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	0.00	0.00	0.00	0.00	-253.33	56.96	-21.80	70	98	244	
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	0.00	0.00	0.00	0.00	-252.98	64.28	-20.40	64	93	266	
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	0.00	0.00	0.00	0.00	-252.54	72.15	-19.08	58	87	289	
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	0.00	0.00	0.00	0.00	-252.01	80.63	-17.69	52	82	315	
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	0.00	0.00	0.00	0.00	-251.36	89.78	-16.09	45	75	344	
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-250.57	99.68	-14.13	37	67	376	
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-249.63	110.37	-11.64	28	58	413	
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-248.52	121.94	-8.45	15	46	453	
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-247.21	134.44	-4.38	-0	31	499	

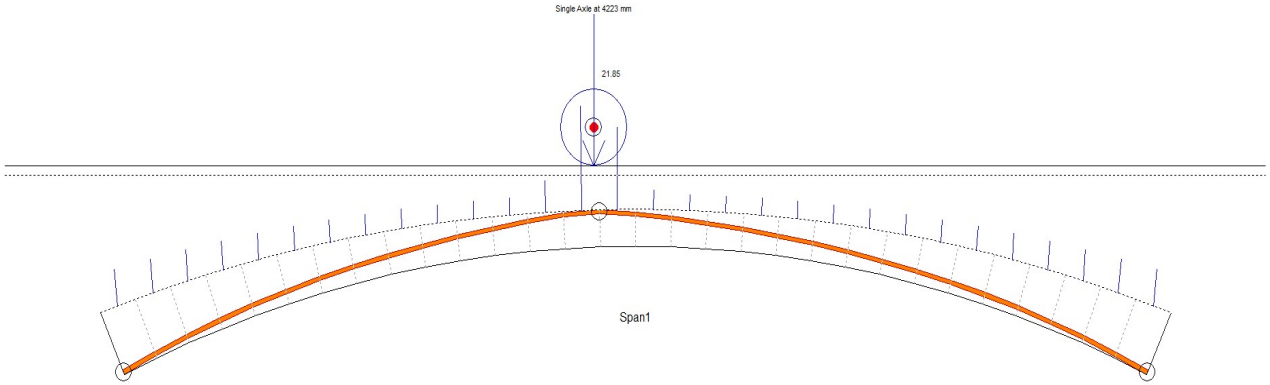

Figure 15 Single Axle at crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-272.85	-151.02	-5.37	-0	35	495
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-274.16	-138.52	-10.98	19	53	446
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-275.27	-126.95	-15.98	36	70	401
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-276.21	-116.25	-20.56	52	85	358
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-277.00	-106.36	-24.86	67	100	319
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-277.65	-97.21	-29.07	83	115	282
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-278.18	-88.73	-33.34	98	131	246
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-278.62	-80.86	-37.81	114	147	212
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-278.97	-73.53	-42.61	132	164	178
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-279.25	-66.68	-47.86	151	183	146
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.00	-0.00	0.00	0.00	-279.47	-60.24	-53.68	172	204	113
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.00	-0.00	0.00	0.00	-279.63	-54.14	-60.15	196	228	80
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.00	-0.00	0.00	0.00	-279.76	-48.31	-67.34	222	254	46
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.11	-5.75	1.33	0.00	-279.94	-36.94	-74.83	250	281	13
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.33	-30.14	4.94	0.00	-280.32	-1.31	-77.21	260	291	-0
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.08	-21.77	2.59	0.00	-280.42	25.88	-71.19	238	269	21
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.00	-1.14	0.04	0.00	-280.40	32.43	-63.12	209	240	51
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	0.00	0.00	0.00	0.00	-280.35	37.92	-55.84	182	214	81
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	0.00	0.00	0.00	0.00	-280.27	43.54	-49.38	159	190	109
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	0.00	0.00	0.00	0.00	-280.15	49.37	-43.71	138	170	137
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	0.00	0.00	0.00	0.00	-279.98	55.47	-38.76	120	152	165
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	0.00	0.00	0.00	0.00	-279.76	61.91	-34.46	104	136	192
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	0.00	0.00	0.00	0.00	-279.48	68.77	-30.71	91	123	220
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	0.00	0.00	0.00	0.00	-279.13	76.09	-27.42	79	111	247
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	0.00	0.00	0.00	0.00	-278.70	83.96	-24.45	68	100	276
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	0.00	0.00	0.00	0.00	-278.16	92.44	-21.68	58	90	307
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	0.00	0.00	0.00	0.00	-277.51	101.59	-18.96	48	81	339
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-276.72	111.49	-16.13	38	71	373
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-275.79	122.18	-13.03	26	60	410
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-274.67	133.75	-9.48	14	48	451
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-273.36	146.25	-5.32	-0	34	496

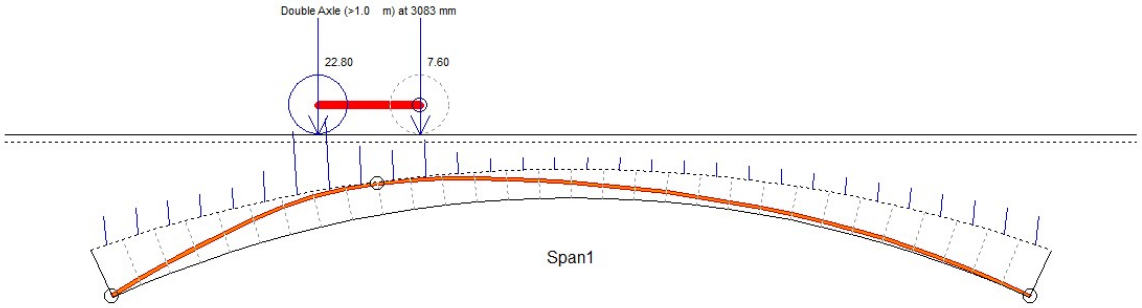

Figure 16 Double axle (>1.0m spacing) at quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-266.45	-176.98	-5.54	-0	35	495
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-267.77	-164.48	-19.48	45	80	419
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-268.88	-152.92	-32.86	90	124	346
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-269.82	-142.22	-45.83	135	169	275
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-270.60	-132.32	-58.56	180	213	206
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-271.26	-123.17	-71.21	225	258	139
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.33	-4.70	0.70	0.00	-272.12	-109.99	-83.17	270	302	75
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	1.26	-19.95	2.17	0.00	-273.82	-82.17	-90.58	302	333	25
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	1.31	-23.55	2.17	0.00	-275.48	-51.29	-90.90	309	340	2
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.47	-9.85	0.69	0.00	-276.23	-34.59	-87.05	298	328	-0
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.26	-6.50	0.96	0.00	-276.71	-21.65	-81.92	280	311	6
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.33	-9.93	1.20	0.00	-277.20	-5.62	-74.47	254	285	22
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.09	-3.50	0.26	0.00	-277.42	3.71	-65.63	222	253	47
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.00	-0.02	-0.00	0.00	-277.50	9.35	-57.24	192	222	72
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	-0.00	0.00	0.00	0.00	-277.55	14.84	-49.62	164	195	97
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	-0.00	0.00	0.00	0.00	-277.56	20.25	-42.81	139	170	120
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	0.00	0.00	0.00	0.00	-277.55	25.67	-36.81	117	148	143
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	0.00	0.00	0.00	0.00	-277.50	31.16	-31.63	98	129	165
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	0.00	0.00	0.00	0.00	-277.42	36.78	-27.24	82	113	187
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	0.00	0.00	0.00	0.00	-277.29	42.61	-23.61	69	100	207
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	0.00	0.00	0.00	0.00	-277.13	48.71	-20.66	58	89	228
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	0.00	0.00	0.00	0.00	-276.91	55.15	-18.33	49	81	248
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	0.00	0.00	0.00	0.00	-276.63	62.00	-16.52	43	74	268
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	0.00	0.00	0.00	0.00	-276.28	69.33	-15.12	37	69	289
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	0.00	0.00	0.00	0.00	-275.84	77.20	-14.02	33	65	312
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	0.00	0.00	0.00	0.00	-275.31	85.68	-13.06	29	61	335
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	0.00	0.00	0.00	0.00	-274.66	94.83	-12.12	26	58	361
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-273.87	104.73	-11.02	21	54	390
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-272.93	115.42	-9.61	16	49	421
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-271.82	126.99	-7.70	9	42	457
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-270.51	139.49	-5.13	-0	34	496

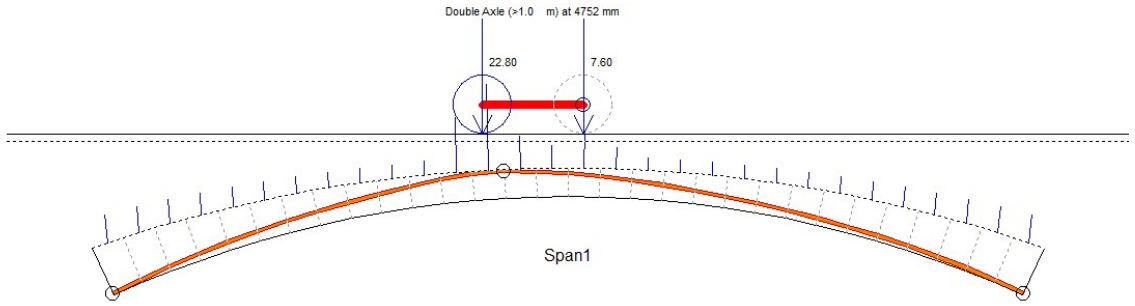

Figure 17 Double axle (>1.0m spacing) at crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-324.91	-175.47	-7.54	-0	41	489
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-326.23	-162.97	-13.61	17	58	442
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-327.34	-151.40	-19.59	34	74	396
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-328.28	-140.70	-25.65	52	92	352
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-329.06	-130.81	-31.97	71	110	309
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-329.71	-121.66	-38.71	91	130	267
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-330.25	-113.18	-46.02	113	152	225
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-330.69	-105.31	-54.03	137	175	183
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-331.04	-97.98	-62.89	164	202	140
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-331.32	-91.13	-72.71	194	232	97
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.02	-0.38	0.10	0.00	-331.55	-84.31	-83.57	227	265	52
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.59	-17.87	3.14	0.00	-332.31	-60.35	-92.98	257	295	12
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.94	-36.56	4.86	0.00	-333.37	-17.96	-93.79	263	300	-0
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.27	-14.62	1.25	0.00	-333.72	2.28	-87.62	245	282	13
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.00	-0.16	0.01	0.00	-333.77	7.92	-81.43	226	263	28
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.02	-6.50	1.37	0.00	-333.81	19.84	-75.87	209	246	44
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.05	-14.99	2.38	0.00	-333.73	40.25	-67.90	184	221	70
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	-0.06	-5.33	0.55	0.00	-333.63	51.07	-57.74	153	191	104
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	-0.00	-0.01	0.00	0.00	-333.55	56.70	-48.33	125	162	138
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	0.00	0.00	0.00	0.00	-333.42	62.53	-40.20	100	138	170
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	0.00	0.00	0.00	0.00	-333.26	68.63	-33.28	79	117	200
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	0.00	0.00	0.00	0.00	-333.04	75.07	-27.50	62	100	229
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	0.00	0.00	0.00	0.00	-332.76	81.92	-22.78	48	86	257
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	0.00	0.00	0.00	0.00	-332.41	89.25	-19.00	36	74	284
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	0.00	0.00	0.00	0.00	-331.97	97.12	-16.04	27	66	311
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	0.00	0.00	0.00	0.00	-331.44	105.59	-13.78	20	59	338
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	0.00	0.00	0.00	0.00	-330.79	114.75	-12.05	15	54	365
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-330.00	124.64	-10.72	11	50	394
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-329.06	135.34	-9.60	7	47	424
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-327.95	146.91	-8.53	4	44	455
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-326.64	159.41	-7.33	-0	40	490

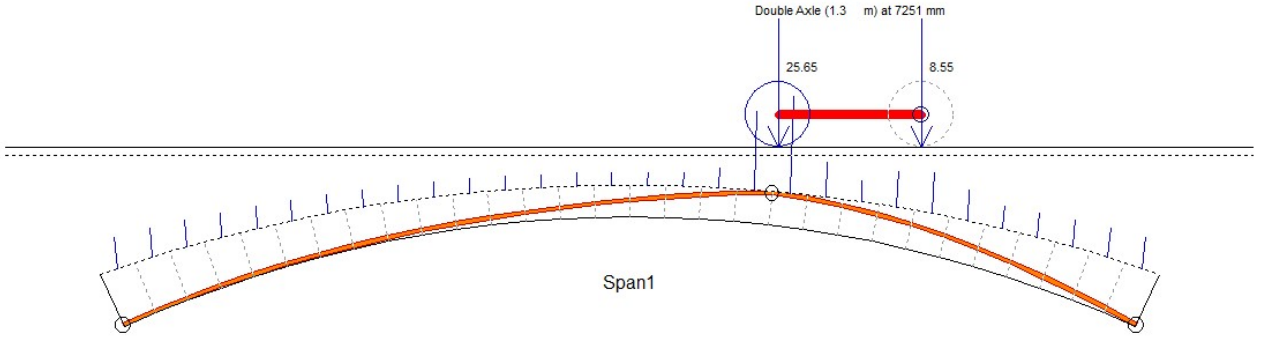

Figure 18 Double Axle Loading (1.3m spacing) at quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-306.59	-148.32	-6.44	-0	38	492	
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-307.90	-135.83	-6.98	2	39	460	
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-309.02	-124.26	-7.18	3	40	430	
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-309.96	-113.56	-7.23	4	40	404	
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-310.74	-103.67	-7.29	4	40	379	
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-311.39	-94.51	-7.54	5	41	356	
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-311.93	-86.04	-8.13	7	43	333	
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-312.37	-78.17	-9.20	11	46	312	
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-312.72	-70.84	-10.91	16	52	291	
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-313.00	-63.99	-13.36	24	60	269	
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.00	-0.00	0.00	0.00	-313.21	-57.55	-16.66	35	70	247	
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.00	-0.00	0.00	0.00	-313.38	-51.45	-20.92	48	84	224	
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.00	-0.00	0.00	0.00	-313.50	-45.62	-26.20	65	100	199	
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.00	-0.00	0.00	0.00	-313.58	-39.99	-32.56	86	121	174	
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.00	-0.00	0.00	0.00	-313.63	-34.51	-40.04	110	145	146	
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.00	-0.00	0.00	0.00	-313.65	-29.09	-48.67	138	173	117	
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.00	-0.00	0.00	0.00	-313.63	-23.67	-58.44	169	204	87	
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	-0.00	-0.00	0.00	0.00	-313.58	-18.18	-69.34	205	240	55	
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	-0.05	-2.57	0.72	0.00	-313.45	-9.99	-81.24	244	278	21	
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	-0.66	-25.71	5.36	0.00	-312.67	21.55	-90.71	272	307	-0	***
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	-1.07	-32.23	5.58	0.00	-311.44	59.88	-91.23	270	306	11	
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	-0.30	-7.46	0.86	0.00	-310.92	73.78	-85.63	251	286	42	
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	-0.09	-1.81	0.49	0.00	-310.55	82.45	-79.93	231	267	75	
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	-0.41	-7.31	1.68	0.00	-309.80	97.08	-73.90	210	246	112	
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	-0.55	-8.64	1.85	0.00	-308.82	113.59	-65.97	183	220	157	
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	-0.26	-3.70	0.70	0.00	-308.02	125.77	-56.27	152	188	208	
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	-0.01	-0.16	0.02	0.00	-307.35	135.08	-46.24	120	157	262	
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-306.57	144.97	-36.43	89	127	317	
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-305.63	155.67	-26.70	59	97	373	
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-304.52	167.24	-16.89	30	68	431	
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-303.20	179.74	-6.82	-0	39	491	

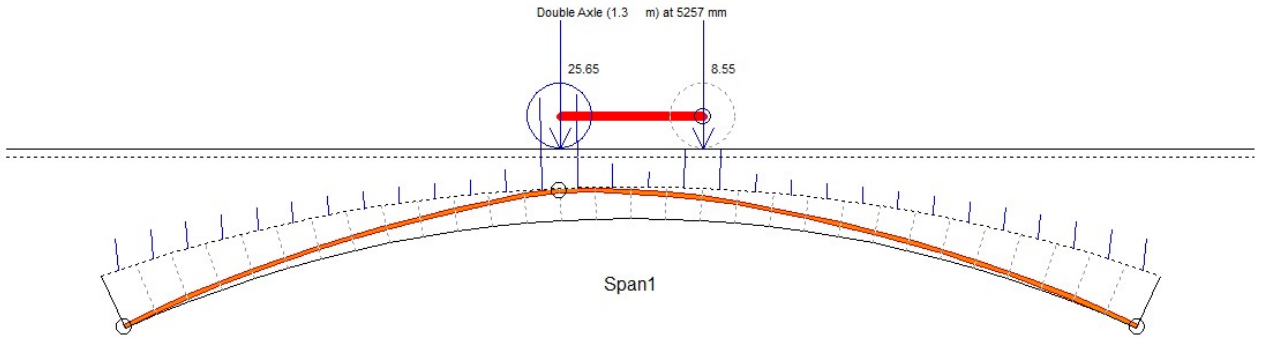

Figure 19 Double Axle Loading (1.3m spacing) near the crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-322.16	-168.21	-7.32	-0	40	490
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-323.48	-155.71	-11.63	13	52	447
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-324.59	-144.14	-15.81	25	64	406
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-325.53	-133.44	-20.03	37	77	367
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-326.32	-123.55	-24.46	51	90	330
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-326.97	-114.39	-29.26	65	104	293
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-327.50	-105.92	-34.58	82	120	257
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-327.94	-98.05	-40.58	100	138	221
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-328.29	-90.72	-47.38	121	158	184
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-328.57	-83.87	-55.10	144	182	147
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.00	-0.00	0.00	0.00	-328.79	-77.43	-63.85	171	208	108
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.00	-0.00	0.00	0.00	-328.95	-71.33	-73.71	201	239	68
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.08	-3.29	0.79	0.00	-329.16	-62.21	-84.51	235	272	28
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.55	-30.27	5.07	0.00	-329.79	-26.31	-91.26	258	294	-0
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.34	-31.39	3.94	0.00	-330.19	10.57	-88.22	249	286	5
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.01	-3.91	0.21	0.00	-330.22	19.89	-81.49	228	265	25
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.00	-1.07	0.29	0.00	-330.20	26.38	-75.79	211	247	44
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	-0.11	-10.03	1.94	0.00	-330.04	41.89	-69.87	192	229	65
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	-0.19	-10.51	1.59	0.00	-329.77	58.02	-61.55	166	203	97
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	-0.03	-1.35	0.11	0.00	-329.61	65.20	-52.56	138	176	132
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	0.00	0.00	0.00	0.00	-329.44	71.30	-44.65	114	151	165
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	0.00	0.00	0.00	0.00	-329.23	77.74	-37.85	93	131	198
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	0.00	0.00	0.00	0.00	-328.95	84.59	-32.07	76	113	229
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	0.00	0.00	0.00	0.00	-328.60	91.92	-27.21	61	99	260
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	0.00	0.00	0.00	0.00	-328.16	99.79	-23.14	48	87	290
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	0.00	0.00	0.00	0.00	-327.62	108.27	-19.74	38	76	320
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	0.00	0.00	0.00	0.00	-326.97	117.42	-16.85	29	68	351
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-326.19	127.31	-14.33	21	60	383
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-325.25	138.01	-12.00	14	54	417
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-324.13	149.58	-9.70	7	47	452
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-322.82	162.08	-7.24	-0	40	490

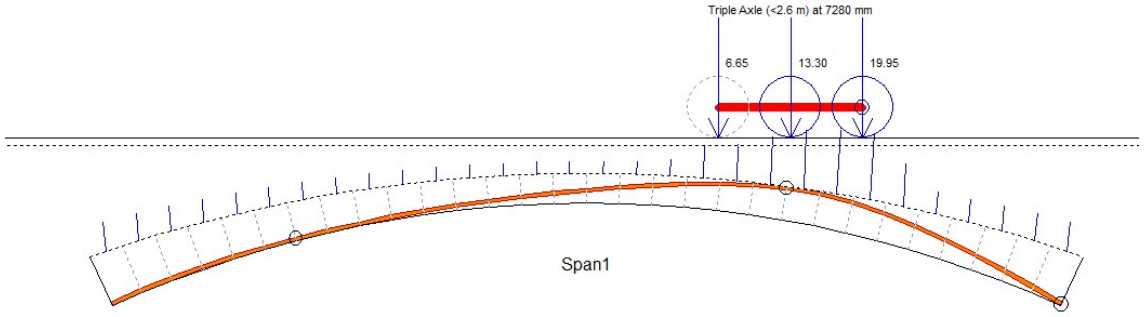

Figure 20 Triple Axle Loading (<2.6m) around quarter length

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-317.71	-149.62	-9.40	7	46	484
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-319.02	-137.12	-8.90	6	45	454
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-320.13	-125.55	-8.16	5	43	428
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-321.07	-114.86	-7.37	3	41	403
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-321.86	-104.96	-6.68	1	39	381
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-322.51	-95.81	-6.28	-0	37	359
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-323.04	-87.33	-6.32	0	37	339
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-323.48	-79.46	-6.95	2	39	319
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-323.83	-72.14	-8.31	7	43	299
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-324.11	-65.28	-10.52	13	50	278
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.00	-0.00	0.00	0.00	-324.33	-58.84	-13.68	23	60	257
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.00	-0.00	0.00	0.00	-324.50	-52.74	-17.89	36	73	234
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.00	-0.00	0.00	0.00	-324.62	-46.91	-23.23	53	89	211
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.00	-0.00	0.00	0.00	-324.70	-41.29	-29.75	73	109	185
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.00	-0.00	0.00	0.00	-324.75	-35.80	-37.49	97	133	158
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.00	-0.00	0.00	0.00	-324.76	-30.38	-46.47	125	161	129
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.00	-0.00	0.00	0.00	-324.75	-24.97	-56.70	157	193	98
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	-0.00	-0.00	0.00	0.00	-324.70	-19.48	-68.16	193	229	65
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	-0.07	-3.89	0.99	0.00	-324.54	-9.96	-80.57	232	268	32
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	-0.44	-17.04	3.31	0.00	-323.99	12.90	-91.06	264	300	8
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	-0.54	-16.38	2.92	0.00	-323.28	35.39	-97.08	281	317	-0
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	-0.62	-15.40	3.11	0.00	-322.44	57.22	-99.47	286	322	7
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	-0.82	-17.03	3.41	0.00	-321.34	81.11	-97.74	277	314	29
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	-0.81	-14.59	3.05	0.00	-320.18	103.02	-91.93	256	293	66
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	-0.85	-13.40	2.86	0.00	-318.90	124.29	-82.50	224	262	115
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	-0.40	-5.64	1.06	0.00	-317.96	138.40	-70.16	185	223	174
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	-0.02	-0.23	0.03	0.00	-317.29	147.79	-57.22	145	184	235
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-316.51	157.68	-44.62	108	147	297
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-315.57	168.38	-32.22	71	110	360
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-314.46	179.95	-19.87	35	75	424
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-313.14	192.44	-7.39	-0	41	489

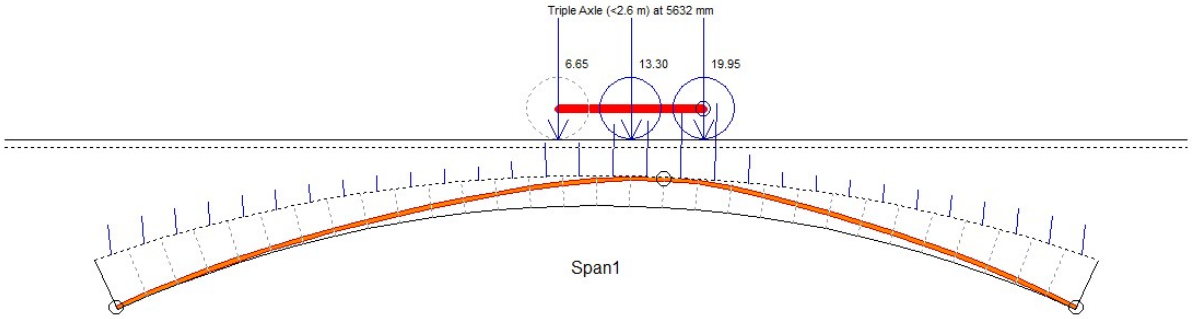

Figure 21 Triple Axle Loading (<2.6m) around crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-346.73	-166.39	-8.21	-0	43	487	
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-348.05	-153.90	-8.88	2	44	455	
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-349.16	-142.33	-9.61	5	46	424	
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-350.10	-131.63	-10.58	8	49	395	
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-350.88	-121.74	-11.96	12	53	366	
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-351.53	-112.58	-13.92	17	58	339	
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-352.07	-104.11	-16.61	25	66	311	
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-352.51	-96.24	-20.18	35	76	283	
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-352.86	-88.91	-24.77	48	88	254	
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-353.14	-82.06	-30.50	64	104	224	
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.00	-0.00	0.00	0.00	-353.36	-75.62	-37.46	84	124	193	
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.00	-0.00	0.00	0.00	-353.52	-69.52	-45.76	107	147	160	
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.00	-0.00	0.00	0.00	-353.64	-63.69	-55.46	135	175	125	
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.03	-1.52	0.36	0.00	-353.75	-56.55	-66.50	167	206	88	
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.10	-8.96	1.49	0.00	-353.90	-42.10	-77.32	198	238	54	
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.03	-8.63	1.28	0.00	-353.95	-28.06	-86.72	225	265	25	
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.06	-16.40	3.00	0.00	-353.87	-6.24	-94.16	247	286	5	
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	-0.20	-17.86	2.77	0.00	-353.63	17.11	-97.22	255	294	-0	***
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	-0.40	-21.77	4.22	0.00	-353.14	44.50	-96.32	251	291	9	
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	-0.67	-26.18	4.35	0.00	-352.35	76.52	-88.73	227	267	40	
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	-0.19	-5.62	0.58	0.00	-352.00	88.24	-77.00	193	233	83	
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	0.00	0.00	0.00	0.00	-351.78	94.68	-66.03	162	202	126	
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	0.00	0.00	0.00	0.00	-351.50	101.53	-56.30	134	175	168	
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	0.00	0.00	0.00	0.00	-351.15	108.86	-47.72	110	151	208	
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	0.00	0.00	0.00	0.00	-350.72	116.72	-40.17	88	129	247	
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	0.00	0.00	0.00	0.00	-350.18	125.20	-33.52	70	111	286	
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	0.00	0.00	0.00	0.00	-349.53	134.36	-27.62	53	95	325	
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-348.74	144.25	-22.32	38	80	364	
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-347.80	154.95	-17.47	25	67	403	
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-346.69	166.52	-12.88	12	55	444	
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-345.38	179.01	-8.39	-0	43	487	

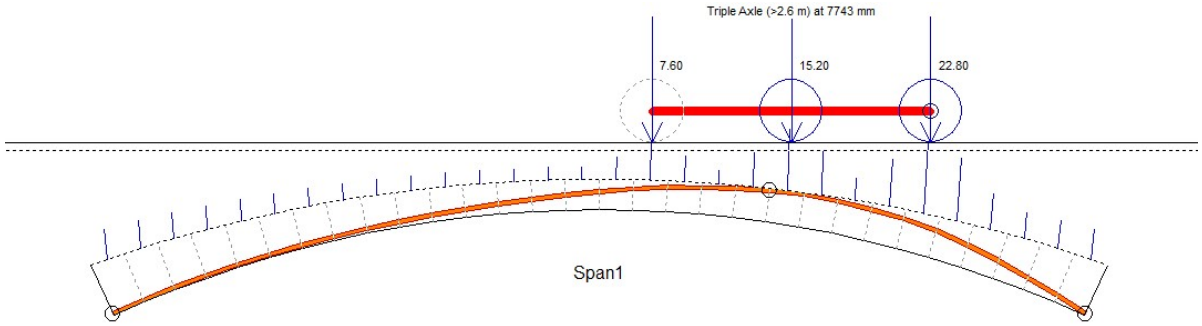

Figure 22Triple Axle Loading (>2.6m) around quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-306.78	-149.46	-6.47	-0	38	492
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-308.10	-136.97	-7.31	3	40	459
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-309.21	-125.40	-7.82	5	42	428
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-310.15	-114.70	-8.19	6	43	401
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-310.94	-104.81	-8.57	8	44	375
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-311.59	-95.65	-9.14	10	46	351
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-312.12	-87.17	-10.06	13	49	327
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-312.56	-79.31	-11.47	18	54	305
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-312.91	-71.98	-13.52	24	60	282
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-313.19	-65.13	-16.31	33	69	260
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.00	-0.00	0.00	0.00	-313.41	-58.69	-19.96	45	80	236
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.00	-0.00	0.00	0.00	-313.57	-52.59	-24.57	60	95	212
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.00	-0.00	0.00	0.00	-313.69	-46.76	-30.20	78	113	187
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.00	-0.00	0.00	0.00	-313.78	-41.13	-36.92	99	135	160
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.00	-0.00	0.00	0.00	-313.82	-35.65	-44.76	125	160	131
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.00	-0.00	0.00	0.00	-313.84	-30.23	-53.74	154	189	101
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.01	-3.12	0.73	0.00	-313.81	-21.70	-63.62	186	221	70
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	-0.12	-11.03	1.93	0.00	-313.64	-5.18	-72.34	214	249	46
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	-0.11	-6.13	0.78	0.00	-313.45	6.57	-79.08	235	270	29
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	-0.01	-0.20	0.02	0.00	-313.32	12.60	-86.04	258	293	15
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	-0.22	-6.51	1.59	0.00	-312.94	25.21	-93.51	281	316	1
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	-0.75	-18.45	3.74	0.00	-311.98	50.10	-98.24	293	328	-0
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	-0.63	-13.23	2.30	0.00	-311.06	70.18	-98.20	290	326	17
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	-0.14	-2.50	0.49	0.00	-310.57	80.00	-96.30	283	318	40
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	-0.65	-10.28	2.62	0.00	-309.49	98.14	-93.95	272	308	69
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	-1.43	-20.19	4.84	0.00	-307.52	126.81	-88.03	248	284	112
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	-1.41	-17.90	4.14	0.00	-305.47	153.87	-76.25	207	244	175
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	-0.56	-6.47	1.36	0.00	-304.12	170.23	-59.99	155	194	250
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	-0.02	-0.21	0.03	0.00	-303.16	181.14	-42.47	103	141	329
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-302.05	192.71	-24.90	51	90	409
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-300.74	205.21	-7.15	-0	40	490

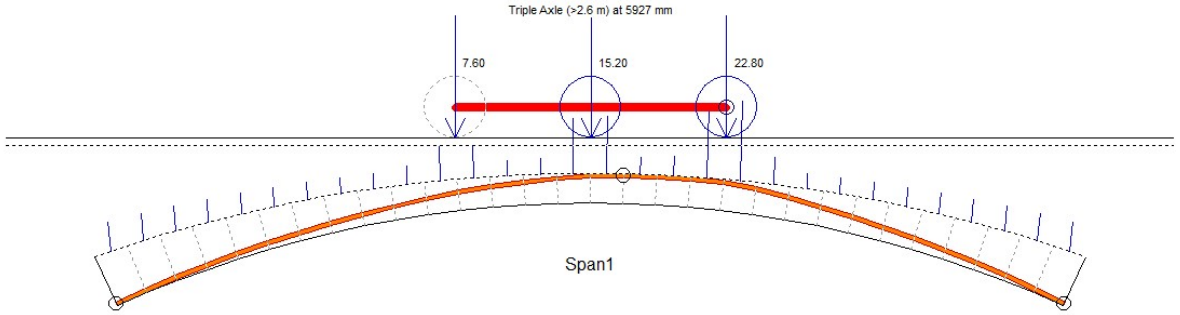

Figure 23 Triple Axle Loading (>2.6m) around crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-352.17	-174.41	-8.57	-0	44	486	
1	290	127	95	587	1630	1.31	-12.50	0.37	0.00	-0.00	0.00	0.00	-353.48	-161.91	-10.87	6	50	450	
2	583	246	412	684	1630	1.11	-11.57	0.52	0.00	-0.00	0.00	0.00	-354.60	-150.34	-13.30	13	56	414	
3	879	356	730	774	1630	0.94	-10.70	0.63	0.00	-0.00	0.00	0.00	-355.54	-139.64	-16.04	21	63	381	
4	1178	458	1049	857	1630	0.79	-9.89	0.71	0.00	-0.00	0.00	0.00	-356.32	-129.75	-19.26	30	72	347	
5	1480	552	1369	933	1630	0.65	-9.15	0.76	0.00	-0.00	0.00	0.00	-356.97	-120.60	-23.13	41	82	314	
6	1785	636	1689	1001	1630	0.54	-8.48	0.79	0.00	-0.00	0.00	0.00	-357.51	-112.12	-27.81	54	95	281	
7	2092	712	2011	1062	1630	0.44	-7.87	0.81	0.00	-0.00	0.00	0.00	-357.94	-104.25	-33.43	69	110	248	
8	2401	780	2333	1115	1630	0.35	-7.33	0.82	0.00	-0.00	0.00	0.00	-358.30	-96.92	-40.13	88	129	213	
9	2712	838	2656	1162	1630	0.28	-6.85	0.82	0.00	-0.00	0.00	0.00	-358.57	-90.07	-48.03	110	151	178	
10	3024	887	2979	1201	1630	0.22	-6.44	0.82	0.07	-1.70	0.35	0.00	-358.86	-81.93	-57.04	135	176	141	
11	3338	928	3303	1233	1630	0.17	-6.10	0.81	0.30	-9.13	1.33	0.00	-359.33	-66.70	-65.55	160	200	107	
12	3652	959	3627	1258	1630	0.12	-5.83	0.81	0.21	-8.27	0.92	0.00	-359.66	-52.61	-72.49	180	220	80	
13	3968	982	3951	1276	1630	0.08	-5.62	0.82	0.02	-1.06	0.04	0.00	-359.76	-45.92	-79.73	200	240	54	
14	4284	995	4275	1286	1630	0.05	-5.49	0.83	0.02	-1.92	0.49	0.00	-359.83	-38.51	-88.35	225	265	26	
15	4600	1000	4600	1290	1630	0.02	-5.42	0.84	0.07	-18.49	3.34	0.00	-359.92	-14.61	-95.52	245	285	5	
16	4916	995	4925	1286	1630	-0.02	-5.42	0.87	-0.07	-18.59	2.53	0.00	-359.83	9.39	-97.57	251	291	-0	***
17	5232	982	5249	1276	1630	-0.05	-5.49	0.91	-0.02	-1.97	0.12	0.00	-359.76	16.85	-98.15	253	293	2	
18	5548	959	5573	1258	1630	-0.08	-5.62	0.96	-0.06	-3.12	0.85	0.00	-359.62	25.59	-100.00	257	297	2	
19	5862	928	5897	1233	1630	-0.12	-5.83	1.02	-0.63	-24.67	5.05	0.00	-358.87	56.09	-99.74	255	295	12	
20	6176	887	6221	1201	1630	-0.17	-6.10	1.11	-0.91	-27.48	4.66	0.00	-357.79	89.68	-91.88	230	271	46	
21	6488	838	6544	1162	1630	-0.22	-6.44	1.21	-0.21	-5.19	0.56	0.00	-357.37	101.31	-79.67	195	236	92	
22	6799	780	6867	1115	1630	-0.28	-6.85	1.33	0.00	0.00	0.00	0.00	-357.09	108.16	-68.21	163	204	138	
23	7108	712	7189	1062	1630	-0.35	-7.33	1.47	0.00	0.00	0.00	0.00	-356.74	115.49	-57.95	134	176	183	
24	7415	636	7511	1001	1630	-0.44	-7.87	1.64	0.00	0.00	0.00	0.00	-356.30	123.35	-48.79	109	151	226	
25	7720	552	7831	933	1630	-0.54	-8.48	1.83	0.00	0.00	0.00	0.00	-355.76	131.83	-40.59	86	128	269	
26	8022	458	8151	857	1630	-0.65	-9.15	2.07	0.00	0.00	0.00	0.00	-355.11	140.99	-33.21	66	108	311	
27	8321	356	8470	774	1630	-0.79	-9.89	2.33	0.00	0.00	0.00	0.00	-354.33	150.88	-26.50	48	90	353	
28	8617	246	8788	684	1630	-0.94	-10.70	2.64	0.00	0.00	0.00	0.00	-353.39	161.58	-20.30	31	74	397	
29	8910	127	9105	587	1630	-1.11	-11.57	3.00	0.00	0.00	0.00	0.00	-352.27	173.14	-14.43	15	59	441	
30	9200	0	9420	482	1630	-1.31	-12.50	3.42	0.00	0.00	0.00	0.00	-350.96	185.64	-8.73	-0	44	486	

Unfactored Load case

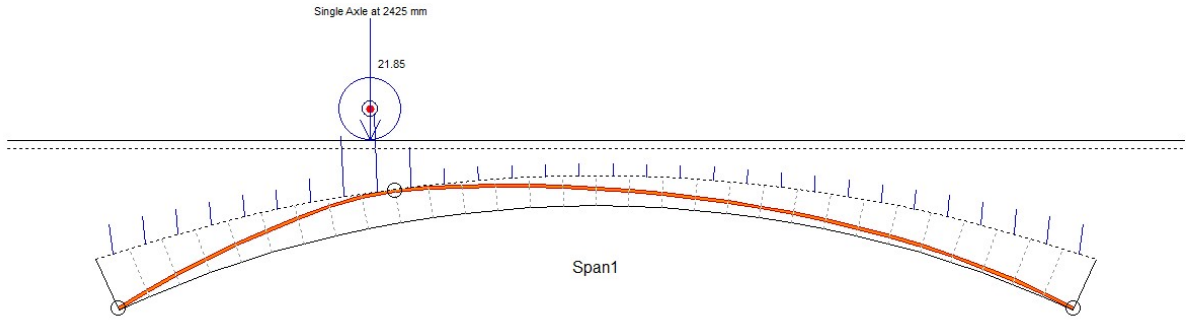

Figure 24 Single Axle Loading quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-215.35	-138.23	-3.56	-0	28	502	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-216.41	-127.89	-13.38	40	68	432	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-217.30	-118.35	-22.67	79	106	364	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-218.04	-109.54	-31.56	117	144	300	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-218.67	-101.41	-40.21	155	181	238	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-219.18	-93.90	-48.74	193	219	178	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-219.60	-86.96	-57.29	231	257	119	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.07	-1.07	0.22	0.00	-220.00	-79.47	-65.85	271	296	62	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.82	-14.84	2.02	0.00	-221.10	-58.67	-71.82	302	327	15	
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	1.25	-26.07	2.86	0.00	-222.56	-27.03	-70.77	304	328	-0	***
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.56	-13.75	1.11	0.00	-223.29	-8.07	-64.02	276	301	16	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.03	-0.78	0.01	0.00	-223.44	-2.36	-56.38	241	266	41	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	-0.00	0.00	0.00	0.00	-223.53	2.34	-49.25	209	234	66	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	-0.00	0.00	0.00	0.00	-223.59	6.86	-42.70	179	204	90	
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	-0.00	0.00	0.00	0.00	-223.63	11.27	-36.77	152	177	114	
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	-0.00	0.00	0.00	0.00	-223.64	15.62	-31.50	128	153	137	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	0.00	0.00	0.00	0.00	-223.63	19.98	-26.89	108	132	159	
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	0.00	0.00	0.00	0.00	-223.59	24.38	-22.95	90	115	180	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	0.00	0.00	0.00	0.00	-223.53	28.91	-19.64	75	100	200	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	0.00	0.00	0.00	0.00	-223.44	33.61	-16.94	62	88	220	
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	0.00	0.00	0.00	0.00	-223.31	38.54	-14.79	53	78	239	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	0.00	0.00	0.00	0.00	-223.15	43.75	-13.13	45	70	258	
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	0.00	0.00	0.00	0.00	-222.93	49.31	-11.88	39	65	278	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	0.00	0.00	0.00	0.00	-222.66	55.28	-10.95	35	60	298	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	0.00	0.00	0.00	0.00	-222.32	61.70	-10.23	32	57	319	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	0.00	0.00	0.00	0.00	-221.90	68.63	-9.62	29	54	343	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	0.00	0.00	0.00	0.00	-221.39	76.14	-8.97	25	51	368	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-220.77	84.27	-8.16	21	48	396	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-220.02	93.08	-7.05	16	43	428	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-219.13	102.63	-5.50	9	36	463	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-218.08	112.96	-3.34	-0	27	503	

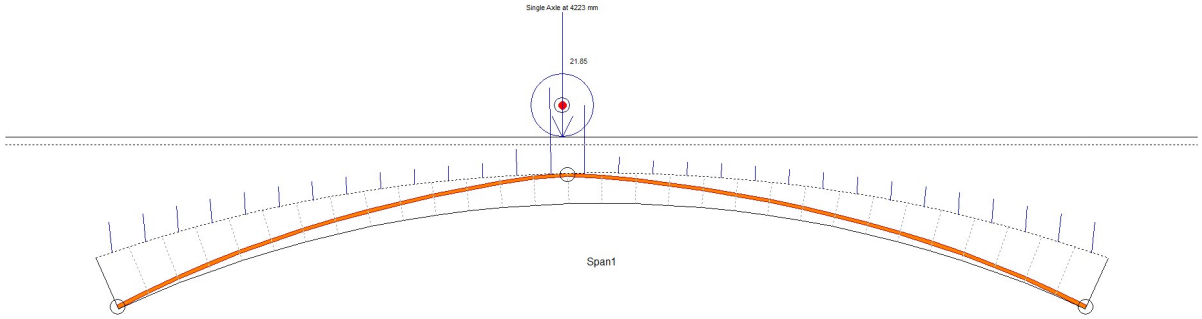

Figure 25 Single Axle Loading crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-240.20	-128.93	-4.11	-0	30	500	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-241.25	-118.60	-8.08	15	45	454	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-242.14	-109.05	-11.69	29	59	412	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-242.89	-100.24	-15.08	43	72	372	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-243.51	-92.11	-18.42	56	85	334	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-244.02	-84.60	-21.82	70	99	298	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-244.44	-77.67	-25.43	85	114	263	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.00	-0.00	0.00	0.00	-244.78	-71.25	-29.37	101	130	229	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.00	-0.00	0.00	0.00	-245.05	-65.28	-33.75	119	147	195	
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.00	-0.00	0.00	0.00	-245.27	-59.72	-38.67	140	168	161	
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.00	-0.00	0.00	0.00	-245.43	-54.51	-44.22	162	190	126	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.00	-0.00	0.00	0.00	-245.56	-49.58	-50.48	188	216	91	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.00	-0.00	0.00	0.00	-245.65	-44.88	-57.51	218	245	54	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.07	-4.08	0.98	0.00	-245.79	-36.27	-65.05	249	277	18	
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.31	-28.41	4.80	0.00	-246.13	-3.45	-68.28	264	291	-0	***
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.09	-24.39	3.05	0.00	-246.24	25.29	-62.89	242	269	21	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.01	-1.93	0.09	0.00	-246.22	31.57	-54.81	208	236	55	
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	0.00	0.00	0.00	0.00	-246.18	35.98	-47.50	178	205	89	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	0.00	0.00	0.00	0.00	-246.12	40.51	-41.05	151	179	121	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	0.00	0.00	0.00	0.00	-246.03	45.20	-35.41	128	156	151	
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	0.00	0.00	0.00	0.00	-245.90	50.13	-30.54	108	136	181	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	0.00	0.00	0.00	0.00	-245.74	55.35	-26.38	91	119	210	
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	0.00	0.00	0.00	0.00	-245.52	60.91	-22.84	76	104	238	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	0.00	0.00	0.00	0.00	-245.25	66.87	-19.85	64	92	266	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	0.00	0.00	0.00	0.00	-244.91	73.29	-17.29	53	82	295	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	0.00	0.00	0.00	0.00	-244.49	80.23	-15.05	44	73	324	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	0.00	0.00	0.00	0.00	-243.98	87.74	-13.01	36	65	355	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-243.36	95.87	-11.03	28	57	387	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-242.61	104.68	-8.98	19	49	422	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-241.72	114.23	-6.71	10	40	459	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-240.67	124.56	-4.07	-0	30	500	

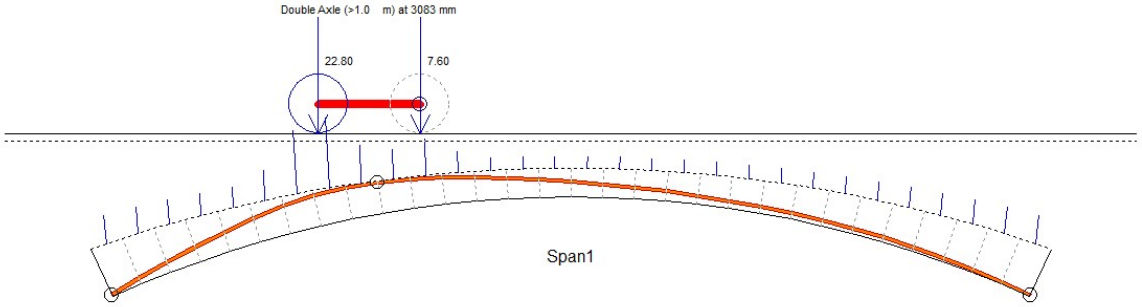

Figure 26 Double Axle Loading (>1m spacing) quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-235.30	-155.13	-4.30	-0	31	499	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-236.36	-144.80	-16.48	45	75	424	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-237.25	-135.26	-28.35	90	120	350	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-237.99	-126.44	-40.05	135	165	279	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-238.61	-118.31	-51.72	182	211	208	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-239.13	-110.80	-63.50	229	258	139	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.35	-4.98	0.73	0.00	-239.90	-98.88	-74.70	276	305	72	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	1.28	-20.22	2.18	0.00	-241.52	-72.24	-81.37	309	337	21	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	1.30	-23.35	2.13	0.00	-243.08	-42.93	-81.11	315	342	-0	***
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.46	-9.56	0.67	0.00	-243.76	-27.80	-76.86	300	327	1	
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.27	-6.63	0.98	0.00	-244.19	-15.96	-71.42	279	306	10	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.33	-9.87	1.19	0.00	-244.64	-1.16	-63.72	249	276	32	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.09	-3.35	0.25	0.00	-244.82	6.89	-54.73	211	238	61	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.00	-0.01	-0.00	0.00	-244.88	11.42	-46.26	176	203	91	
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	-0.00	0.00	0.00	0.00	-244.92	15.83	-38.61	144	172	119	
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	-0.00	0.00	0.00	0.00	-244.93	20.19	-31.80	116	143	147	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	0.00	0.00	0.00	0.00	-244.92	24.54	-25.84	92	119	172	
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	0.00	0.00	0.00	0.00	-244.88	28.95	-20.74	71	98	196	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	0.00	0.00	0.00	0.00	-244.82	33.47	-16.48	53	80	219	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	0.00	0.00	0.00	0.00	-244.73	38.17	-13.01	39	66	241	
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	0.00	0.00	0.00	0.00	-244.60	43.10	-10.29	28	55	261	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	0.00	0.00	0.00	0.00	-244.44	48.31	-8.26	19	47	281	
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	0.00	0.00	0.00	0.00	-244.22	53.88	-6.84	13	41	301	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	0.00	0.00	0.00	0.00	-243.95	59.84	-5.93	10	38	321	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	0.00	0.00	0.00	0.00	-243.61	66.26	-5.43	7	36	341	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	0.00	0.00	0.00	0.00	-243.19	73.20	-5.22	6	35	362	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	0.00	0.00	0.00	0.00	-242.68	80.70	-5.19	6	34	385	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-242.06	88.83	-5.18	6	34	409	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-241.31	97.65	-5.08	5	34	436	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-240.42	107.19	-4.71	3	33	467	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-239.37	117.52	-3.94	-0	30	500	

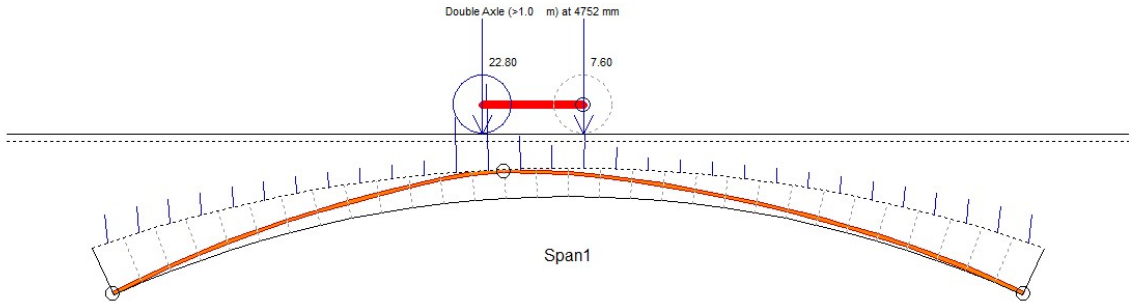

Figure 27 Double Axle Loading (>1m spacing) crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-271.80	-143.43	-5.23	-0	34	496
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-272.85	-133.09	-9.37	14	48	451
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-273.74	-123.55	-13.47	28	62	409
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-274.49	-114.74	-17.68	43	76	368
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-275.11	-106.60	-22.13	59	91	328
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-275.62	-99.10	-26.96	76	108	288
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-276.04	-92.16	-32.31	95	127	249
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.00	-0.00	0.00	0.00	-276.38	-85.74	-38.30	117	149	210
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.00	-0.00	0.00	0.00	-276.65	-79.78	-45.03	141	173	170
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.00	-0.00	0.00	0.00	-276.87	-74.22	-52.62	168	200	128
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.00	-0.00	0.00	0.00	-277.03	-69.00	-61.14	199	231	86
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.03	-0.81	0.21	0.00	-277.19	-63.26	-70.61	234	266	42
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.51	-19.77	3.46	0.00	-277.78	-38.79	-78.17	264	295	5
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.58	-31.82	4.22	0.00	-278.43	-2.44	-77.55	263	294	-0
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.09	-8.63	0.65	0.00	-278.56	10.60	-71.74	242	273	18
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.02	-5.16	1.08	0.00	-278.59	20.11	-65.88	221	252	38
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.04	-11.40	1.80	0.00	-278.54	35.86	-58.30	193	224	67
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	-0.04	-3.87	0.39	0.00	-278.46	44.14	-49.24	160	191	103
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	-0.00	-0.00	0.00	0.00	-278.40	48.67	-40.93	130	161	139
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	0.00	0.00	0.00	0.00	-278.31	53.37	-33.74	104	135	172
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	0.00	0.00	0.00	0.00	-278.18	58.29	-27.62	82	113	204
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	0.00	0.00	0.00	0.00	-278.01	63.51	-22.51	63	95	234
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	0.00	0.00	0.00	0.00	-277.80	69.07	-18.32	48	80	262
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	0.00	0.00	0.00	0.00	-277.53	75.03	-14.97	36	68	290
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	0.00	0.00	0.00	0.00	-277.19	81.46	-12.35	27	59	318
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	0.00	0.00	0.00	0.00	-276.77	88.39	-10.36	20	52	345
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	0.00	0.00	0.00	0.00	-276.26	95.90	-8.87	14	47	373
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-275.63	104.03	-7.74	10	43	401
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-274.89	112.84	-6.84	7	40	431
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-274.00	122.39	-6.01	3	37	462
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-272.94	132.72	-5.11	-0	34	496

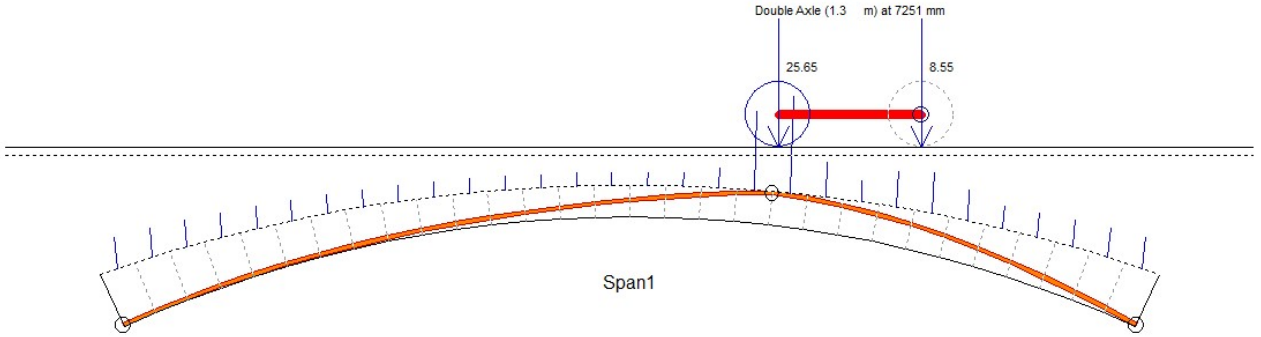

Figure 28 Double Axle Loading (1.3m spacing) at quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-275.29	-125.32	-12.11	23	57	473	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-276.34	-114.99	-10.56	19	52	447	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-277.23	-105.44	-8.94	14	47	424	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-277.98	-96.63	-7.39	9	41	402	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-278.60	-88.50	-6.07	5	37	382	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-279.11	-80.99	-5.11	1	34	363	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-279.53	-74.06	-4.64	-0	32	344	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.00	-0.00	0.00	0.00	-279.87	-67.63	-4.81	1	33	326	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.00	-0.00	0.00	0.00	-280.15	-61.67	-5.71	4	36	307	
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.00	-0.00	0.00	0.00	-280.36	-56.11	-7.47	10	42	286	
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.00	-0.00	0.00	0.00	-280.53	-50.89	-10.15	20	51	265	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.00	-0.00	0.00	0.00	-280.65	-45.97	-13.86	33	65	243	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.00	-0.00	0.00	0.00	-280.74	-41.27	-18.65	50	82	218	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.00	-0.00	0.00	0.00	-280.80	-36.74	-24.56	71	103	192	
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.00	-0.00	0.00	0.00	-280.84	-32.33	-31.64	97	128	163	
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.00	-0.00	0.00	0.00	-280.85	-27.98	-39.90	126	158	132	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.00	-0.00	0.00	0.00	-280.84	-23.63	-49.34	161	192	99	
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	-0.00	-0.00	0.00	0.00	-280.80	-19.22	-59.94	199	230	64	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	-0.03	-1.64	0.47	0.00	-280.71	-13.05	-71.63	242	273	27	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	-0.59	-22.98	4.91	0.00	-280.03	14.62	-81.60	276	307	-0	***
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	-1.11	-33.48	5.94	0.00	-278.80	53.03	-83.10	277	309	8	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	-0.40	-9.81	1.24	0.00	-278.24	68.05	-77.81	256	288	40	
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	-0.07	-1.43	0.40	0.00	-277.95	75.04	-72.17	235	267	75	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	-0.38	-6.77	1.58	0.00	-277.31	87.77	-66.45	213	245	113	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	-0.55	-8.79	1.90	0.00	-276.41	102.98	-59.07	185	218	159	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	-0.31	-4.31	0.84	0.00	-275.69	114.23	-49.96	152	185	212	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	-0.02	-0.30	0.04	0.00	-275.15	122.03	-40.50	119	152	267	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-274.53	130.16	-31.44	87	121	323	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-273.78	138.97	-22.67	57	91	379	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-272.89	148.52	-14.06	28	63	437	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-271.84	158.85	-5.45	-0	35	495	

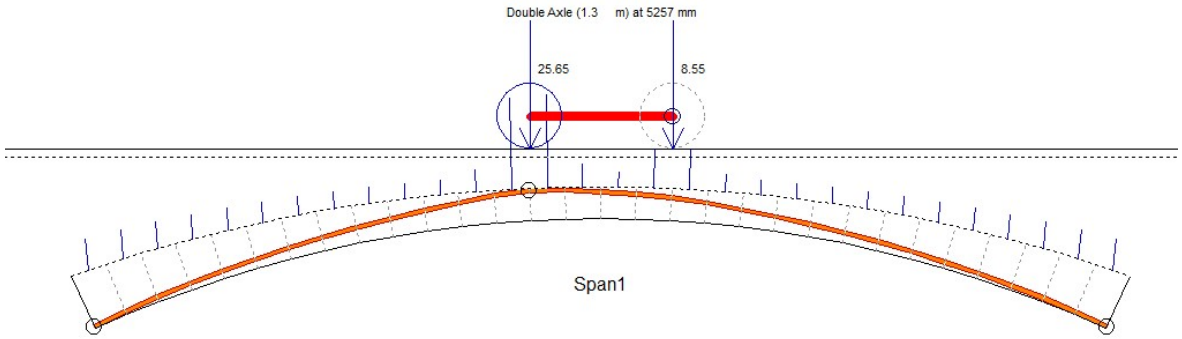

Figure 29 Double Axle Loading (1.3m spacing) near the crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-289.02	-146.19	-5.82	-0	36	494	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-290.07	-135.85	-8.57	9	45	455	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-290.96	-126.31	-11.43	18	54	417	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-291.71	-117.50	-14.55	29	64	380	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-292.33	-109.37	-18.08	41	75	344	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-292.84	-101.86	-22.14	54	89	308	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-293.26	-94.92	-26.87	70	104	272	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.00	-0.00	0.00	0.00	-293.60	-88.50	-32.40	89	123	236	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.00	-0.00	0.00	0.00	-293.87	-82.54	-38.83	111	144	198	
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.00	-0.00	0.00	0.00	-294.08	-76.98	-46.27	136	170	159	
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.00	-0.00	0.00	0.00	-294.25	-71.76	-54.79	165	199	118	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.00	-0.00	0.00	0.00	-294.38	-66.83	-64.49	198	232	76	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.07	-2.75	0.67	0.00	-294.54	-59.38	-75.21	235	269	31	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.53	-29.19	4.95	0.00	-295.13	-25.67	-82.27	261	294	-0	***
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.36	-32.38	4.14	0.00	-295.53	11.12	-79.55	253	286	5	
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.02	-4.55	0.25	0.00	-295.55	20.02	-72.82	230	263	27	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.00	-0.90	0.24	0.00	-295.54	25.27	-67.11	210	243	48	
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	-0.11	-9.65	1.88	0.00	-295.40	39.34	-61.29	190	223	72	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	-0.20	-10.82	1.66	0.00	-295.14	54.68	-53.13	161	194	105	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	-0.04	-1.57	0.13	0.00	-295.01	60.95	-44.21	131	164	143	
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	0.00	0.00	0.00	0.00	-294.88	65.88	-36.38	104	138	179	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	0.00	0.00	0.00	0.00	-294.71	71.10	-29.72	81	115	213	
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	0.00	0.00	0.00	0.00	-294.50	76.66	-24.15	63	96	246	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	0.00	0.00	0.00	0.00	-294.23	82.62	-19.58	47	81	277	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	0.00	0.00	0.00	0.00	-293.89	89.04	-15.90	35	69	308	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	0.00	0.00	0.00	0.00	-293.47	95.98	-13.02	25	59	338	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	0.00	0.00	0.00	0.00	-292.96	103.48	-10.79	17	52	367	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-292.34	111.62	-9.09	12	46	397	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-291.59	120.43	-7.79	7	42	428	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-290.70	129.97	-6.72	3	39	460	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-289.65	140.31	-5.75	-0	36	494	

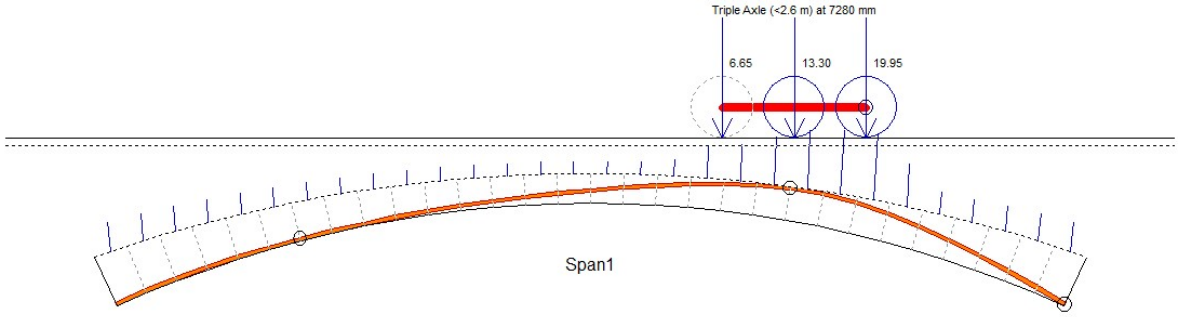

Figure 30 Triple Axle Loading (<2.6m) around quarter length

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-282.68	-123.62	-21.03	51	85	445	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-283.73	-113.28	-18.05	42	76	423	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-284.62	-103.74	-15.05	33	67	404	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-285.37	-94.93	-12.19	24	57	387	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-285.99	-86.80	-9.60	16	49	371	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-286.50	-79.29	-7.43	8	42	355	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-286.92	-72.35	-5.82	3	36	340	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.00	-0.00	0.00	0.00	-287.26	-65.93	-4.90	0	33	325	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.00	-0.00	0.00	0.00	-287.53	-59.97	-4.79	-0	33	310	
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.00	-0.00	0.00	0.00	-287.75	-54.41	-5.58	3	35	293	
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.00	-0.00	0.00	0.00	-287.91	-49.19	-7.37	9	41	275	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.00	-0.00	0.00	0.00	-288.04	-44.26	-10.25	19	51	256	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.00	-0.00	0.00	0.00	-288.13	-39.57	-14.26	33	65	234	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.00	-0.00	0.00	0.00	-288.19	-35.04	-19.48	51	83	211	
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.00	-0.00	0.00	0.00	-288.23	-30.63	-25.92	74	106	185	
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.00	-0.00	0.00	0.00	-288.24	-26.28	-33.60	101	133	157	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.00	-0.00	0.00	0.00	-288.23	-21.93	-42.53	132	164	127	
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	-0.00	-0.00	0.00	0.00	-288.19	-17.52	-52.70	168	200	95	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	-0.04	-2.15	0.54	0.00	-288.09	-10.84	-63.92	208	239	60	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	-0.22	-8.67	1.67	0.00	-287.78	2.53	-74.70	245	277	30	
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	-0.33	-9.83	1.90	0.00	-287.33	17.29	-83.71	276	308	9	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	-0.61	-15.05	3.11	0.00	-286.55	37.56	-90.23	296	329	-0	**
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	-0.89	-18.54	3.81	0.00	-285.45	61.66	-92.60	301	333	9	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	-1.13	-20.44	4.40	0.00	-284.04	88.06	-90.06	287	320	38	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	-1.26	-19.91	4.23	0.00	-282.44	114.40	-81.96	254	288	89	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	-0.56	-7.94	1.48	0.00	-281.46	129.27	-69.39	209	243	153	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	-0.02	-0.26	0.03	0.00	-280.93	137.03	-55.93	164	198	221	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-280.31	145.16	-42.97	120	155	289	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-279.56	153.98	-30.39	78	114	357	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-278.67	163.52	-18.07	39	74	425	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-277.62	173.85	-5.85	-0	36	494	

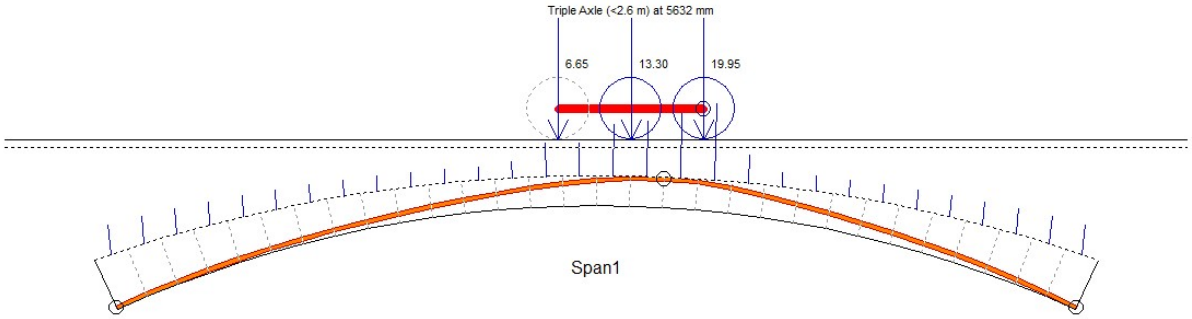

Figure 31 Triple Axle Loading (<2.6m) around crown

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-Thrus
0	0	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-314.20	-146.32	-6.96	1	39	491
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-315.25	-135.99	-6.55	-0	38	461
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-316.14	-126.44	-6.46	0	38	433
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-316.89	-117.63	-6.83	1	39	405
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-317.51	-109.50	-7.83	5	42	377
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-318.03	-101.99	-9.58	10	47	350
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-318.45	-95.06	-12.22	18	55	321
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.00	-0.00	0.00	0.00	-318.79	-88.64	-15.88	30	66	292
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.00	-0.00	0.00	0.00	-319.06	-82.67	-20.66	44	81	261
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.00	-0.00	0.00	0.00	-319.27	-77.11	-26.67	63	100	229
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.00	-0.00	0.00	0.00	-319.44	-71.90	-33.99	86	122	194
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.00	-0.00	0.00	0.00	-319.56	-66.97	-42.71	113	149	158
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.00	-0.10	0.03	0.00	-319.66	-62.17	-52.87	145	181	118
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.09	-5.12	0.97	0.00	-319.81	-52.52	-63.86	180	216	78
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.11	-9.74	1.39	0.00	-319.95	-38.37	-73.71	212	247	44
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.04	-10.46	1.88	0.00	-320.00	-23.56	-82.27	239	275	15
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.07	-20.01	3.25	0.00	-319.92	0.80	-87.41	256	291	-0
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	-0.18	-16.41	2.85	0.00	-319.70	21.62	-88.48	258	294	0
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	-0.52	-28.20	5.12	0.00	-319.13	54.34	-84.42	244	280	20
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	-0.42	-16.48	2.27	0.00	-318.61	75.52	-73.81	209	245	62
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	-0.02	-0.56	0.03	0.00	-318.47	81.01	-62.23	172	209	108
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	0.00	0.00	0.00	0.00	-318.30	86.22	-52.01	140	177	152
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	0.00	0.00	0.00	0.00	-318.09	91.78	-43.11	112	149	193
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	0.00	0.00	0.00	0.00	-317.82	97.75	-35.45	88	125	233
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	0.00	0.00	0.00	0.00	-317.48	104.17	-28.93	68	105	271
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	0.00	0.00	0.00	0.00	-317.06	111.10	-23.43	51	88	308
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	0.00	0.00	0.00	0.00	-316.54	118.61	-18.83	37	75	345
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-315.92	126.74	-15.01	25	63	381
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-315.18	135.55	-11.83	15	54	417
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-314.29	145.10	-9.14	7	46	454
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-313.23	155.43	-6.79	-0	39	491

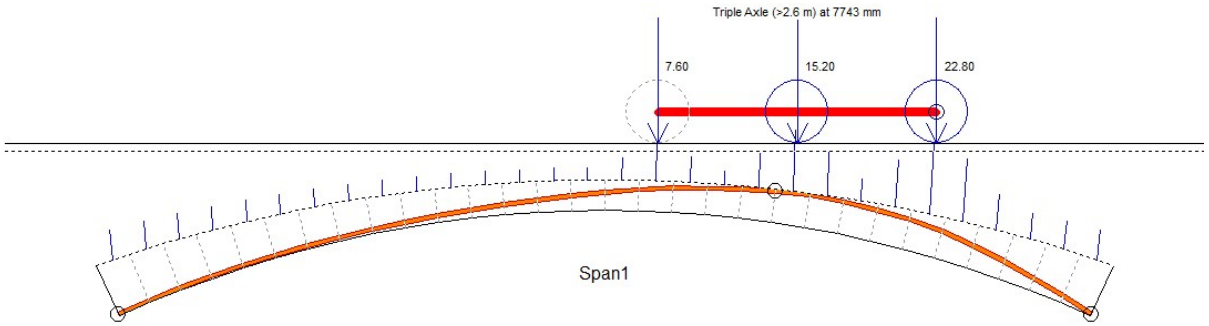

Figure 32 Triple Axle Loading (>2.6m) around quarter span

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-276.65	-127.04	-9.95	16	50	480	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-277.70	-116.71	-8.73	12	46	453	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-278.59	-107.16	-7.45	8	42	429	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-279.34	-98.35	-6.27	5	38	406	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-279.96	-90.22	-5.32	2	34	385	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-280.47	-82.71	-4.75	-0	32	364	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-280.89	-75.78	-4.70	-0	32	344	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.00	-0.00	0.00	0.00	-281.23	-69.35	-5.28	2	34	324	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.00	-0.00	0.00	0.00	-281.50	-63.39	-6.63	7	39	303	
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.00	-0.00	0.00	0.00	-281.71	-57.83	-8.84	15	47	282	
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.00	-0.00	0.00	0.00	-281.88	-52.61	-12.00	26	58	259	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.00	-0.00	0.00	0.00	-282.01	-47.68	-16.19	41	73	235	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.00	-0.00	0.00	0.00	-282.10	-42.99	-21.47	60	91	208	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.00	-0.00	0.00	0.00	-282.16	-38.46	-27.90	83	114	180	
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.00	-0.00	0.00	0.00	-282.19	-34.05	-35.50	110	141	150	
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.00	-0.00	0.00	0.00	-282.21	-29.70	-44.30	141	173	117	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.01	-3.12	0.73	0.00	-282.18	-22.23	-54.03	176	208	83	
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	-0.12	-11.03	1.93	0.00	-282.03	-6.79	-62.66	207	238	56	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	-0.11	-6.13	0.78	0.00	-281.85	3.86	-69.35	231	262	37	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	-0.01	-0.20	0.02	0.00	-281.76	8.76	-76.33	256	287	20	
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	-0.22	-6.51	1.59	0.00	-281.42	20.19	-83.88	282	314	3	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	-0.75	-18.45	3.74	0.00	-280.50	43.85	-88.77	297	328	-0	***
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	-0.63	-13.23	2.30	0.00	-279.65	62.64	-88.99	295	327	16	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	-0.14	-2.50	0.49	0.00	-279.24	71.10	-87.46	288	320	39	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	-0.65	-10.28	2.62	0.00	-278.26	87.80	-85.61	278	310	67	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	-1.43	-20.19	4.84	0.00	-276.41	114.93	-80.33	253	286	110	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	-1.41	-17.90	4.14	0.00	-274.49	140.34	-69.39	211	245	174	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	-0.56	-6.47	1.36	0.00	-273.31	154.94	-54.14	158	192	252	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	-0.02	-0.21	0.03	0.00	-272.54	163.96	-37.86	103	138	332	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-271.65	173.51	-21.77	51	86	413	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-270.60	183.84	-5.78	-0	36	494	

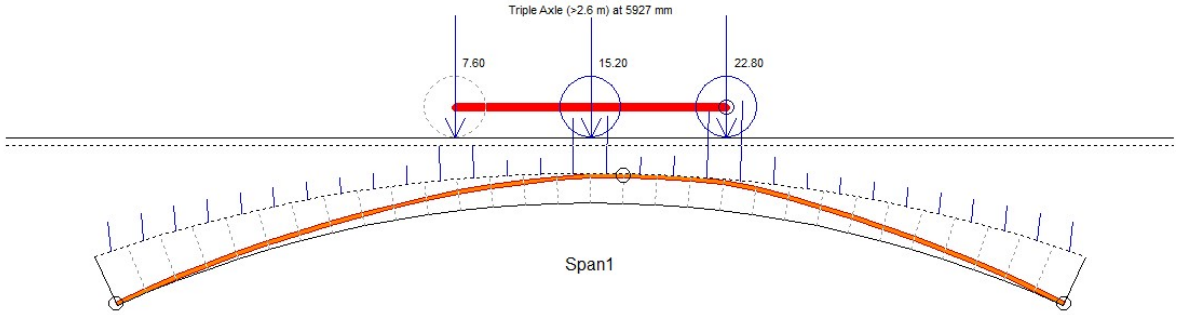

Figure 33 Triple Axle Loading (>2.6m) around crown

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	0	-220	482	1630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-319.53	-163.33	-7.14	-0	40	490	
1	290	127	95	587	1630	1.05	-10.33	0.31	0.00	-0.00	0.00	0.00	-320.58	-153.00	-10.98	11	51	448	
2	583	246	412	684	1630	0.89	-9.55	0.43	0.00	-0.00	0.00	0.00	-321.47	-143.45	-15.24	24	63	408	
3	879	356	730	774	1630	0.75	-8.81	0.52	0.00	-0.00	0.00	0.00	-322.22	-134.64	-20.06	38	77	367	
4	1178	458	1049	857	1630	0.62	-8.13	0.58	0.00	-0.00	0.00	0.00	-322.84	-126.51	-25.61	55	93	326	
5	1480	552	1369	933	1630	0.51	-7.51	0.63	0.00	-0.00	0.00	0.00	-323.36	-119.00	-32.00	74	112	285	
6	1785	636	1689	1001	1630	0.42	-6.94	0.65	0.00	-0.00	0.00	0.00	-323.77	-112.07	-39.37	96	134	242	
7	2092	712	2011	1062	1630	0.34	-6.42	0.66	0.06	-0.88	0.16	0.00	-324.17	-104.77	-47.73	122	159	199	
8	2401	780	2333	1115	1630	0.27	-5.96	0.67	0.35	-6.35	0.81	0.00	-324.79	-92.45	-55.96	147	185	157	
9	2712	838	2656	1162	1630	0.21	-5.56	0.67	0.42	-8.73	0.91	0.00	-325.43	-78.17	-62.84	170	207	122	
10	3024	887	2979	1201	1630	0.17	-5.22	0.66	0.14	-3.57	0.25	0.00	-325.74	-69.38	-69.32	190	227	90	
11	3338	928	3303	1233	1630	0.13	-4.93	0.66	0.01	-0.40	0.08	0.00	-325.88	-64.05	-76.95	214	251	56	
12	3652	959	3627	1258	1630	0.09	-4.70	0.66	0.30	-11.87	2.14	0.00	-326.27	-47.48	-84.39	238	275	25	
13	3968	982	3951	1276	1630	0.06	-4.52	0.66	0.40	-21.67	2.94	0.00	-326.73	-21.28	-87.34	249	285	9	
14	4284	995	4275	1286	1630	0.04	-4.41	0.66	0.07	-6.81	0.55	0.00	-326.84	-10.06	-87.31	249	285	6	
15	4600	1000	4600	1290	1630	0.01	-4.35	0.68	0.00	-0.17	0.05	0.00	-326.85	-5.54	-88.31	252	288	2	
16	4916	995	4925	1286	1630	-0.01	-4.35	0.70	-0.06	-15.70	3.37	0.00	-326.78	14.52	-89.26	255	291	-0	***
17	5232	982	5249	1276	1630	-0.04	-4.41	0.73	-0.37	-33.82	5.55	0.00	-326.38	52.75	-83.28	235	272	23	
18	5548	959	5573	1258	1630	-0.06	-4.52	0.77	-0.21	-11.61	1.25	0.00	-326.10	68.88	-70.93	196	233	67	
19	5862	928	5897	1233	1630	-0.09	-4.70	0.83	-0.00	-0.01	0.00	0.00	-326.01	73.59	-58.88	159	196	111	
20	6176	887	6221	1201	1630	-0.13	-4.93	0.89	0.00	0.00	0.00	0.00	-325.89	78.52	-48.35	126	163	153	
21	6488	838	6544	1162	1630	-0.17	-5.22	0.98	0.00	0.00	0.00	0.00	-325.72	83.74	-39.28	99	136	193	
22	6799	780	6867	1115	1630	-0.21	-5.56	1.07	0.00	0.00	0.00	0.00	-325.51	89.30	-31.58	75	112	230	
23	7108	712	7189	1062	1630	-0.27	-5.96	1.19	0.00	0.00	0.00	0.00	-325.23	95.26	-25.19	56	93	265	
24	7415	636	7511	1001	1630	-0.34	-6.42	1.33	0.00	0.00	0.00	0.00	-324.89	101.68	-19.99	40	78	299	
25	7720	552	7831	933	1630	-0.42	-6.94	1.50	0.00	0.00	0.00	0.00	-324.47	108.62	-15.88	27	65	331	
26	8022	458	8151	857	1630	-0.51	-7.51	1.69	0.00	0.00	0.00	0.00	-323.96	116.12	-12.73	18	56	363	
27	8321	356	8470	774	1630	-0.62	-8.13	1.91	0.00	0.00	0.00	0.00	-323.34	124.25	-10.41	11	49	394	
28	8617	246	8788	684	1630	-0.75	-8.81	2.17	0.00	0.00	0.00	0.00	-322.59	133.07	-8.78	6	45	426	
29	8910	127	9105	587	1630	-0.89	-9.55	2.47	0.00	0.00	0.00	0.00	-321.70	142.61	-7.70	2	41	458	
30	9200	0	9420	482	1630	-1.05	-10.33	2.82	0.00	0.00	0.00	0.00	-320.65	152.94	-7.01	-0	39	491	

APPENDIX E CERTIFICATES

Part 1 - Design Certificate

Name of Project: Riverhill Estate Access Bridge Assessment

Name of Structure: Riverhill Estate Access Bridge

Structure Ref. No.: C/028

1. We certify that reasonable professional skill and care has been used in the preparation of the assessment of Riverhill Estate Access Bridge with a view to securing that:
    i. It has been assessed in accordance with the Approval in Principle ref. 10044965-ARC-XX-XX-RP-CB-0001 dated 11 November 2020.
    ii. The assessed capacity of the structure is 40T Assessment Live Loading (ALL).

Signed	 ……
Name	Andrew Branch……Assessment Team Leader
Engineering Qualifications	BEng, CEng, MICE……..
Signed	 ……
Name	Leon Sullivan ……..……...…
Position Held	Business Unit Director – Bridges and Civil Structures……
Name of Organisation	Arcadis Consulting (UK) Ltd……
Date	25/11/2020……..…….

2. The certificate is accepted by the TAA

Signed	……
Name	……
Position Held	……
Engineering Qualifications	……
TAA	Royal Borough of Kingston upon Thames …….....
Date	……

Part 2 - Check Certificate

Name of Project: Riverhill Estate Access Bridge Assessment

Name of Structure: Riverhill Estate Access Bridge

Structure Ref. No.: C/028

1. We certify that reasonable professional skill and care has been used in the check of Riverhill Estate Access Bridge with a view to securing that:
    i. It has been checked in accordance with the Approval in Principle ref. 10044965-ARC-XX-XX-RP-CB-0001 dated 11 November 2020.
    ii. The assessed capacity of the structure is 40T Assessment Live Loading (ALL).

Signed	……
Name	Jaydip Dasgupta……Check Team Leader
Engineering Qualifications	BEng, MSc, CEng, FIStructE ……
Signed	……
Name	Leon Sullivan……
Position Held	Business Unit Director – Bridges and Civil Structures ……
Name of Organisation	Arcadis Consulting (UK) Ltd ……
Date	25/11/2020……

2. The certificate is accepted by the TAA

Signed	……
Name	……
Position Held	……
Engineering Qualifications	……
TAA	Royal Borough of Kingston upon Thames ……....
Date	……

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