PUNCH consulting engineers

Residential Development, Fortfield Road, Terenure

Existing Pedestrian Bridge Inspection and Assessment Report

222102-PUNCH-XX-XX-RP-C-0010

November 2024

Document Control

Document Number: **222102-PUNCH-XX-XX-RP-C-0010**

Status	Rev	Description	Date	Prepared	Checked	Approved
A0	C01	Stage 2 LRD Submission	07/03/2024	JP. Murray	MC. Daly	P. Casey
A0	C02	Stage 2 LRD Submission	11/03/2024	JP. Murray	MC. Daly	P. Casey
A0	C03	Stage 3 LRD Submission	01/11/2024	JP. Murray	MC. Daly	P. Casey

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1 Introduction

PUNCH Consulting Engineers undertook a structural inspection and load capacity assessment of the existing 3-span masonry arch bridge located on the eastern extents of the site's lake walk. The purpose of the bridge inspection/assessment is to determine its load carrying capacity in order to demonstrate its ability to function for the intended pedestrian and cyclist loading.

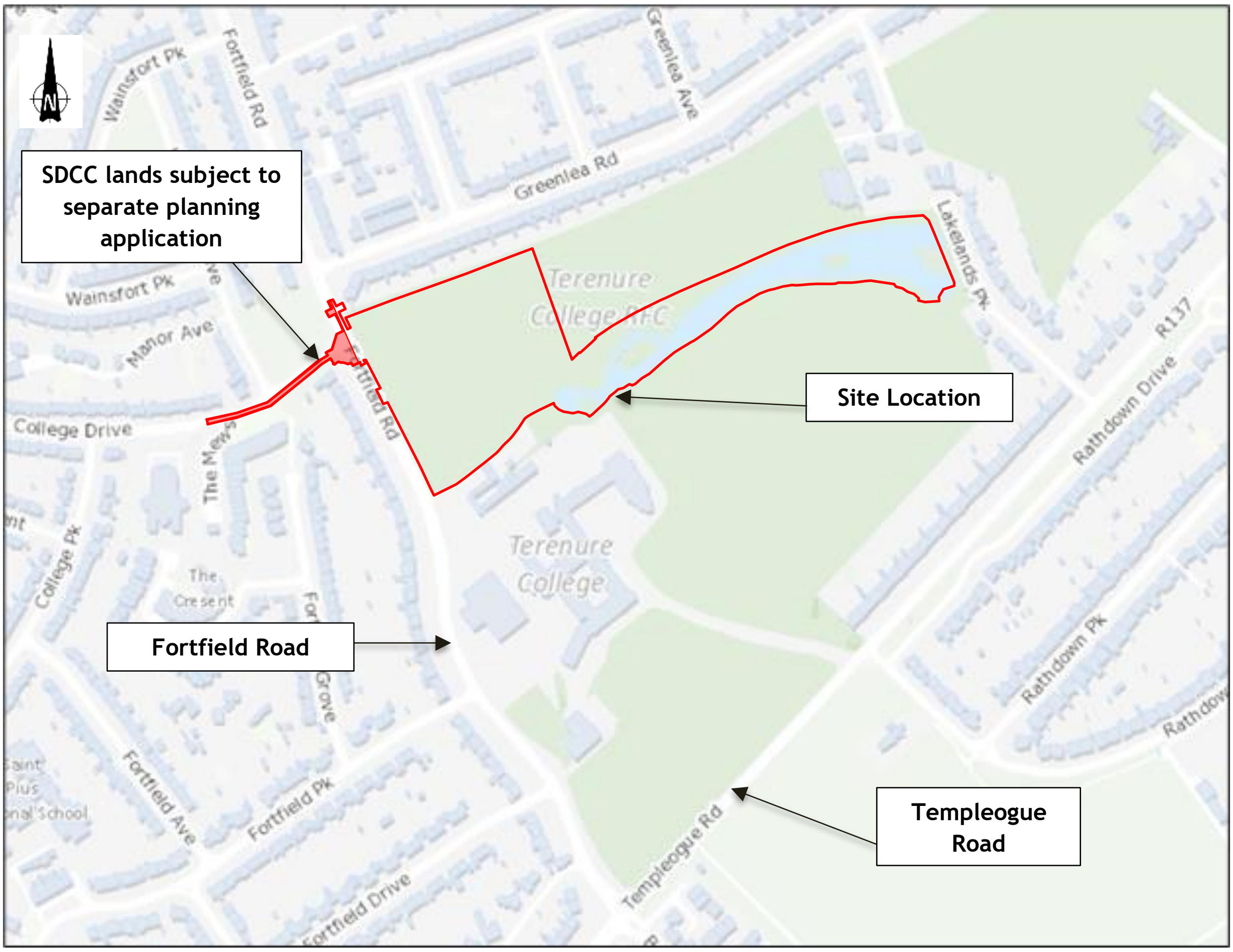


Figure 1: Location Map.

2 Bridge Description

The bridge is a 3 no. masonry arch pedestrian bridge over the local watercourse. The bridge spans consists of irregular arches, varying between round and segmental and of varying spans and heights.

The bridge structure consists of rubble limestone walls with render finish and rubble limestone parapet walls with angled masonry cappings.

3 Visual Inspections (16/05/2022 and 22/02/2024)

A visual walkover survey of the bridge was undertaken on Monday 16th 2022 by Stephen Maher and Karl Mullins (PUNCH Consulting Engineers). This bridge inspection incorporated field measurements and visual inspection only. No material testing was undertaken on the bridge given the status of the on-going initial capacity assessment.

A follow-up visual walkover survey of the bridge was conducted on Thursday 22nd February 2024 to assess any potential changes in the interim period. No appreciable changes to the bridge condition was observed.

The inspections of the bridge was undertaken in line with standards BD 21/14 (Volume 3, Section 4, Part 1 'The Assessment of Road Bridges and Structures') and TII Publication AM-STR-06002 (Volume 3, Section 4, Part 2 'The Assessment of Road Bridges and Structures'). Sufficient detailed information was derived from the survey to allow subsequent assessment of the masonry arches by the modified MEXE method, should it be required by Council at a later stage. The required dimensional details and factors affecting the various modifying factors (e.g. material type used for the arch barrel, type of construction of the barrel, width of mortar joints, etc.) have been determined.

The results of the detailed structural inspection are described in terms of key bridge components similar to the standard Eirspan template.

3.1 Bridge Surface

The bridge surface is in poor condition. The wearing course is deteriorating or non-existent in places with the arch barrel exposed in places, representing a tripping hazard. It is recommended that replacement of the bridge surfacing is undertaken in accordance with the landscape architectural recommendations, with the provision of a 100mm thick wearing surface build-up throughout the bridge extents.

Figure 2 – Bridge Surface

3.2 Footways/Median

The masonry arch structure serves to carry a narrow (1.2m wide between parapets) pedestrian pathway over the local watercourse at this location.

Figure 3 – Narrow Width of Bridge

3.3 Parapet

The parapet wall is typically in the order of 400mm high relative to the existing bridge surface. The introduction of 100mm depth of new surfacing will further reduce the height of the parapet to 300mm relative to the walking surface.

Iron posts are cast into the parapet at regular 3m intervals. It is presumed that a chain previously ran between these posts to offer additional restraint to pedestrians.

The parapet wall is in reasonably good condition. Some localised masonry loss and damage observed to coping.

Figure 4 – Short Parapet Height

Figure 5 – Historic Iron Posts

3.4 Spandrel Walls

The western spandrel walls appear in good condition with no significant cracking or bulging observed on this upstream bridge elevation.

Figure 6 – Western/Upstream Spandrel Wall

The eastern spandrel walls appear in good condition generally with no significant cracking or bulging observed on this elevation for the Spans 2 and 3 extents. However, there is a significant diagonal crack observed over the Span 1 arch. This longitudinal crack has been previously patched with mortar, obscuring the width and depth of the cracking in the previous mortar joints.

Figure 7 – Eastern/Downstream Spandrel Wall

Figure 8 – Crack in Parapet and Spandrel Wall over Span 1 (Eastern Elevation)

3.5 Abutments

The abutments are in good condition generally, but some mortar loss was observed in the abutment masonry.

3.6 Piers

The piers are in good condition generally, but some mortar loss was observed in the masonry throughout.

3.7 Arch Barrels

The arch barrels do not exhibit any significant transverse or longitudinal cracking with the exception of a longitudinal crack in Span 2 coinciding with the western parapet. There is widespread mortar loss throughout the arch barrels. The joints between barrel stones are insufficiently filled to depths in the range of 10-20mm. The remaining mortar is generally loose and friable.

Figure 9 – Span 2 Arch Barrel

Figure 10 – Span 2 Arch Barrel

3.8 Structure in General

The structure is generally in good condition. The principal defects associated with the bridge are as follows:

1) Inadequate depth of fill/surface cover over masonry barrel arches.
2) Inadequate height of parapet/restraint system for pedestrians and cyclists.
3) Longitudinal crack in Span 2 coincident with western parapet/spandrel wall.
4) Longitudinal crack in parapet/spandrel wall above Span 1 on eastern bridge elevation.
5) Some loss of mortar throughout the barrel arches.

The defects do not represent a concern for the on-going function of the pedestrian bridge. However, remedial works to improve the bridge should be considered in light of proposals to improve the lakeside walks as part of the proposed Fortfield Road LRD proposals.

4 Load Capacity Assessment

4.1 Assessment of Typical Masonry Arch (Modified MEXE Method)

Following completion of the structural inspection, an assessment of the strength of the arch barrels was undertaken for the bridge using the Modified MEXE Method outlined in TII Publication AM-STR-06002 '*The Assessment of Road Bridges and Structures*' Section 3. The assessment was based on recorded measurements, observed type and condition of materials and joints.

4.1.1 Span 1

Recorded Geometry for Span 1:

L = 1.28m *(Span)*

r_c = 0.46m *(Rise of the arch barrel at the crown)*

r_q = 0.38m *(Rise of the arch barrel at the quarter point)*

d = 0.24m *(Thickness of the arch barrel adjacent to the keystone)*

h = 0.10m *(Average depth of fill)*

The provisional axle loading (PAL) is obtained by reference to expression below derived from Figure 3.1 of AM-STR-06002 below.

$$PAL = \frac{740(d+h)^2}{L^{1.3}}$$

- PAL = 62 Tonnes
- F_{sr} = 1.0 *(AM-STR-06002, Figure 3.3)*
- F_p = 0.81 *(AM-STR-06002, Figure 3.4)*
- F_m = 0.91 *(assuming F_b = 1.0 and F_f = 0.7. AM-STR-06002 Tables 3.1 & 3.2)*
- F_j = 0.58 *(assuming F_w = 0.8, F_d = 0.8 and F_{mo} = 0.9. AM-STR-06002 Tables 3.3-3.5)*
- F_{cm} = 0.6 (based on observed cracking at arch barrel)
- Modified Axle Load = $F_{sr}\cdot F_p\cdot F_m\cdot F_j\cdot F_{cm}\cdot PAL$
  = 15.75 Tonnes
- Axle Factors (No Axle Lift-Off) from AM-STR-06002 Figure 3.5a:
  - Single Axle = 1.0
  - 2 Axle Bogey = 1.0
  - 3 Axle Bogey = 1.0
- Allowable Axle Loads (No Axle Lift-Off):
  - Single Axle = **16 Tonnes** *(refer to AM-STR-06002 Section 3.30)*
  - 2 Axle Bogey = **16 Tonnes** *(refer to AM-STR-06002 Section 3.30)*
  - 3 Axle Bogey = **16 Tonnes** *(refer to AM-STR-06002 Section 3.30)*

Taking these Allowable Axle Loads, the capacity of the arch is determined in terms of gross weights from Table 3.6 of AM-STR-06002 below.

Allowable Axle Load (tonnes) per axle			**Max Gross Vehicle Weight (gvw) (tonnes)**	**Weight Restriction (tonnes)**	**Type of Vehicle**
Single	Double	Triple			
11.5	10	8*	40/44	N/A	HGV-5 or 6 axles
11.5	9.5	-	32	33	HGV-4 axles
11.5	9.5	-	26	26	HGV-3 axles
11.5 9 7	- - -	- - -	18 12.5 10	18 13 10	HGV-2 axles
5.5 2	- -	- -	7.5 3	7.5 3	LGV Car/Van

In the case of this bridge span, the Max Gross Vehicle Weight (gvw) is **40/44 Tonnes**.

Therefore, weight restrictions are not applicable to this particular arch only.

4.1.2 Span 2

Recorded Geometry for Span 2:

L = 1.96m	(Span)
r_c = 0.91m	(Rise of the arch barrel at the crown)
r_q = 0.78m	(Rise of the arch barrel at the quarter point)
d = 0.24m	(Thickness of the arch barrel adjacent to the keystone)
h = 0.10m	(Average depth of fill)

The provisional axle loading (PAL) is obtained by reference to expression below derived from Figure 3.1 of AM-STR-06002 below.

$$PAL = \frac{740(d+h)^2}{L^{1.3}}$$

- PAL = 36 Tonnes
- F_{sr} = 1.0 *(AM-STR-06002, Figure 3.3)*
- F_p = 0.72 *(AM-STR-06002, Figure 3.4)*
- F_m = 0.91 *(assuming F_b = 1.0 and F_f = 0.7. AM-STR-06002 Tables 3.1 & 3.2)*
- F_j = 0.58 *(assuming F_w = 0.8, F_d = 0.8 and F_{mo} = 0.9. AM-STR-06002 Tables 3.3-3.5)*
- F_{cm} = 0.70 (based on observed cracking at arch barrel)
- Modified Axle Load = $F_{sr} \cdot F_p \cdot F_m \cdot F_j \cdot F_{cm} \cdot PAL$
  = 9.38 Tonnes
- Axle Factors (No Axle Lift-Off) from AM-STR-06002 Figure 3.5a:
  - Single Axle = 1.0
  - 2 Axle Bogey = 1.0
  - 3 Axle Bogey = 1.0

- Allowable Axle Loads (No Axle Lift-Off):
  - Single Axle = **9 Tonnes** *(refer to AM-STR-06002 Section 3.30)*
  - 2 Axle Bogey = **9 Tonnes** *(refer to AM-STR-06002 Section 3.30)*
  - 3 Axle Bogey = **9 Tonnes** *(refer to AM-STR-06002 Section 3.30)*

Taking these Allowable Axle Loads, the capacity of the arch is determined in terms of gross weights from Table 3.6 of AM-STR-06002 below.

Allowable Axle Load (tonnes) per axle			**Max Gross Vehicle Weight (gvw) (tonnes)**	**Weight Restriction (tonnes)**	**Type of Vehicle**
Single	Double	Triple			
11.5	10	8*	40/44	N/A	HGV-5 or 6 axles
11.5	9.5	-	32	33	HGV-4 axles
11.5	9.5	-	26	26	HGV-3 axles
11.5	-	-	18	18	HGV-2 axles
9	-	-	12.5	13	
7	-	-	10	10	
5.5	-	-	7.5	7.5	LGV
2	-	-	3	3	Car/Van

In the case of this bridge span, the Max Gross Vehicle Weight (gvw) is **12.5 Tonnes**.

According to the Modified MEXE Method analysis, this will necessitate a **Weight Restriction of 13 tonnes (HGV – 2 axles)** on this particular arch and therefore the bridge in its entirety.

4.1.3 Span 3

Recorded Geometry for Span 3:

L = 1.28m	(Span)
r_c = 0.31m	(Rise of the arch barrel at the crown)
r_q = 0.38m	(Rise of the arch barrel at the quarter point)
d = 0.24m	(Thickness of the arch barrel adjacent to the keystone)
h = 0.10m	(Average depth of fill)

The provisional axle loading (PAL) is obtained by reference to expression below derived from Figure 3.1 of AM-STR-06002 below.

$$PAL = \frac{740(d+h)^2}{L^{1.3}}$$

- PAL = 62 Tonnes
- F_{sr} = 1.0 *(AM-STR-06002, Figure 3.3)*
- F_p = 0.81 *(AM-STR-06002, Figure 3.4)*
- F_m = 0.91 *(assuming F_b = 1.0 and F_f = 0.7. AM-STR-06002 Tables 3.1 & 3.2)*
- F_j = 0.58 *(assuming F_w = 0.8, F_d = 0.8 and F_{mo} = 0.9. AM-STR-06002 Tables 3.3-3.5)*
- F_{cm} = 0.75 (based on observed condition of arch)
- Modified Axle Load = $F_{sr} \cdot F_p \cdot F_m \cdot F_j \cdot F_{cm} \cdot PAL$
  = 19.68 Tonnes
- Axle Factors (No Axle Lift-Off) from AM-STR-06002 Figure 3.5a:
  - Single Axle = 1.0
  - 2 Axle Bogey = 1.0
  - 3 Axle Bogey = 1.0

- Allowable Axle Loads (No Axle Lift-Off):
  - Single Axle = **20 Tonnes** *(refer to AM-STR-06002 Section 3.30)*
  - 2 Axle Bogey = **20 Tonnes** *(refer to AM-STR-06002 Section 3.30)*
  - 3 Axle Bogey = **20 Tonnes** *(refer to AM-STR-06002 Section 3.30)*

Taking these Allowable Axle Loads, the capacity of the arch is determined in terms of gross weights from Table 3.6 of AM-STR-06002 below.

Allowable Axle Load (tonnes) per axle			Max Gross Vehicle Weight (gvw) (tonnes)	Weight Restriction (tonnes)	Type of Vehicle
Single	Double	Triple			
11.5	10	8*	40/44	N/A	HGV-5 or 6 axles
11.5	9.5	-	32	33	HGV-4 axles
11.5	9.5	-	26	26	HGV-3 axles
11.5 9 7	- - -	- - -	18 12.5 10	18 13 10	HGV-2 axles
5.5 2	- -	- -	7.5 3	7.5 3	LGV Car/Van

In the case of this bridge span, the Max Gross Vehicle Weight (gvw) is **40/44 Tonnes**.

Therefore, weight restrictions are not applicable to this particular arch only.

Refer to Appendix B for all of Modified MEXE Method calculation spreadsheets.

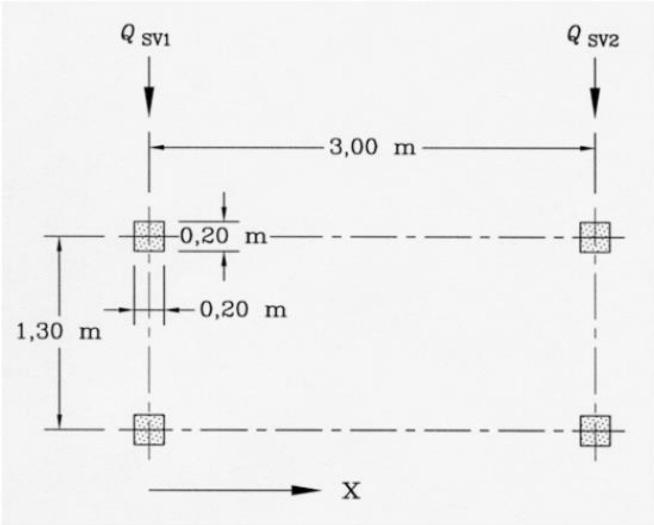
The summary of the Modified MEXE Method analyses is provided below:

Span	*Max Gross Vehicle Weight (gvw)*	*Restrictions*
1	40/44 Tonnes	None
2	12.5 tonnes	HGV – 2 axles only with Weight Restriction = 13 tonnes
3	40/44 Tonnes	None

Span 2 presents the limiting capacity of the bridge and the magnitude and effects of the associated limiting vehicle are then compared to the magnitude and effects of pedestrian and cyclist load case.

4.2 Assessment of pedestrian and cyclist load capacity

The effect of the 12.5 tonnes gross vehicle weight 2 axle HGV can be assessed using the Service Vehicle load model as presented in clause 5.3.2.3 of I.S. EN 1991-2+NA:2009 Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges (Including Irish National Annex). The graphical representation of this Service Vehicle is included below, it is noted the 120 kN of force represents 12.2 tonnes of mass which is closely comparable to the 12.5 tonnes limiting HGV of Span 2.



Key
x : Bridge axis direction
Q_{sv1} = 80 kN
Q_{sv2} = 40 kN

The referred Eurocode in clause 5.3.2.1 also specifies pedestrian and cyclist loading which equates to 5kN/m^2. The deck contributary area of span two can be conservatively approximated as (1.5m)(2m) = 3m^2, resulting in design value of 15kN of force transferred to the arch. As this is considerably less than the magnitude of force transferred to the arch from even a single wheel of the Service Vehicle, it is concluded that required capacity to accommodate pedestrian and cyclist loading is less than required capacity to accommodate a 12.5 tonne gross vehicle weight 2 axle HGC. It is further concluded that the bridge in its entirety has sufficient capacity to accommodate pedestrian and cyclist loading.

5 Conclusions

1) The masonry arch bridge is generally in good condition. However a number of defects are noted:
    i. Inadequate depth of fill/surface cover over masonry barrel arches.
    ii. Inadequate height of parapet/restraint system for pedestrians and cyclists.
    iii. Longitudinal crack in Span 2 coincident with western parapet/spandrel wall.
    iv. Longitudinal crack in parapet/spandrel wall above Span 1 on eastern bridge elevation.
    v. Some loss of mortar throughout the barrel arches.
2) Following a structural analysis of the bridge structure, it is concluded that the bridge (in its existing condition) has sufficient load carrying capacity to accommodate the pedestrian/cyclist traffic.
3) Repointing is recommended throughout the bridge at multiple locations, particularly to the arch barrels on all three spans. The loss of mortar throughout the arch barrels leads to a loss of strength to the bridge arches in the analyses. The loss of mortar also accelerates the deterioration of the arch over time, increasing the risk of arch separation and stone displacement in the barrel. A lime-based mortar is recommended.
4) Provision of a 100mm thick wearing surface build-up throughout the bridge extents is recommended. This should be specified in consultation with landscape architectural recommendations.
5) An assessment of pedestrian safety in the context of low height parapet walls is recommended. This would benefit from consultations with a conservation architect.
6) Detailed record photographs of the bridge should be taken in advance of any remedial works for record purposes.
7) It is recommended that periodic inspections of the bridge are undertaken to monitor for any signs of distress or deterioration of the bridge.

Appendix A Site Inspection Photographs (16/05/2022)

Site Photo 1

Site Photo 2

Site Photo 3

Site Photo 4

Site Photo 5

Site Photo 6

Site Photo 7

Site Photo 8

Site Photo 9

Site Photo 10

Site Photo 11

Site Photo 12

Site Photo 13

Site Photo 14

Site Photo 15

Site Photo 16

Site Photo 17

Site Photo 18

Site Photo 19

Site Photo 20

Site Photo 21

Site Photo 22

Site Photo 23

Site Photo 24

Site Photo 25

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Site Photo 29

Site Photo 30

Appendix B Modified MEXE Methd Analysis

PUNCH consulting engineers	Fortfield Road - Pedestrian Bridge - Span 1		Job No: 222102	
	Assessment using BA16/14 MEXE Method		Sheet No: 1	Rev: R0
	Pedestrian Bridge	Calc by: DW	Check by: KOR	Date: 18/05/2022
		Date: 17-05-2022		

Ref	Calculations			Output
BA 16/14	**Modified MEXE Method**			
3.5	Arch Dimensions			
	Span	L (m)		1.28
	Rise at Crown	r_c (m)		0.46
	Rise at Quarter Point	r_q (m)		0.38
	Ring Thickness	d (m)		0.24
	Depth of Fill	h (m)		0.10
3.10	Provisional Assessment			
	Provisional Axle Loading (P.A.L.)			
	From Fig. 3/1 Nonogram, or	$\frac{740 \times (d+h)^2}{L^{1.3}}$, or 70		62.06
	Modifying Factors			
3.11	Span/Rise Factor	F_{sr}	Fig. 3.3	1.00
		L/r_c		2.78
3.12	Profile Factor	F_p	$= 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.81
3.13	Material Factor	F_m	$= \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.91
3.16	Joint Factor	F_j	$= F_w \times F_{mo} \times F_d$	0.58
3.17	Condition Factor	F_{cM}		0.60
Table 3.1	Barrel Factor	F_b		1.00
Table 3.2	Fill Factor	F_f		0.70
Table 3.3	Joint Width Factor	F_w		0.80
Table 3.4	Joint Mortar Factor	F_{mo}		0.90
Table 3.5	Depth factor	F_d (m)		0.80
Annex G				
	Horizontal Curve Radius, r (m)			> 600
	$v2 = \frac{1000r}{r + 150}$		Centrifugal Effect Factor $F_A = 1 + (0.2v^2/r) =$	N/A
3.24	Modified Axle Load		M.A.L. = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	15.75
	For 2-Axle Bogie (M.A.L)			
3.27	Axle Lift Off (Y/N)	N/A		
	Axle Factor	A_f	see Fig. 3/5a & 3/5b	
	Singe Axle	1.00	Allowable A.L.	16
	2-Axle Bogie	1.00	Allowable A.L.	16
	3-Axle Bogie	1.00	Allowable A.L.	16
Table 3/6	**LOAD CAPACITY**		**Max G.V.W. (tonnes)**	**40/44**

PUNCH consulting engineers	Fortfield Road - Pedestrian Bridge - Span 2		Job No: 222102	
	Assessment using BA16/14 MEXE Method		Sheet No: 1	Rev: R0
	Pedestrian Bridge	Calc by: DW Date: 17/05/2022	Check by: KOR	Date: 18/05/2022

Ref	Calculations			Output
BA 16/14	**Modified MEXE Method**			
3.5	Arch Dimensions			
	Span	L (m)		1.96
	Rise at Crown	r_c (m)		0.91
	Rise at Quarter Point	r_q (m)		0.78
	Ring Thickness	d (m)		0.24
	Depth of Fill	h (m)		0.10
3.10	Provisional Assessment			
	Provisional Axle Loading (P.A.L.)			
	From Fig. 3/1 Nonogram, or	$\frac{740 \times (d+h)^2}{L^{1.3}}$,	or 70	35.67
	Modifying Factors			
3.11	Span/Rise Factor	F_{sr}	Fig. 3.3	1.00
		L/r_c		2.15
3.12	Profile Factor	F_p	$= 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.72
3.13	Material Factor	F_m	$= \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.91
3.16	Joint Factor	F_j	$= F_w \times F_{mo} \times F_d$	0.58
3.17	Condition Factor	F_{cM}		0.70
Table 3.1	Barrel Factor	F_b		1.00
Table 3.2	Fill Factor	F_f		0.70
Table 3.3	Joint Width Factor	F_w		0.80
Table 3.4	Joint Mortar Factor	F_{mo}		0.90
Table 3.5	Depth factor	F_d (m)		0.80
Annex G				
	Horizontal Curve Radius, r (m)			> 600
	$v2 = \frac{1000r}{r + 150}$		Centrifugal Effect Factor $F_A = 1 + (0.2v^2/r) =$	N/A
3.24	Modified Axle Load For 2-Axle Bogie (M.A.L)		M.A.L. = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	9.38
3.27	Axle Lift Off (Y/N)	N/A		
	Axle Factor	A_f	see Fig. 3/5a & 3/5b	
	Singe Axle	1.00	Allowable A.L.	9
	2-Axle Bogie	1.00	Allowable A.L.	9
	3-Axle Bogie	1.00	Allowable A.L.	9
Table 3/6	**LOAD CAPACITY**		**Max G.V.W. (tonnes)**	**12.5**

PUNCH consulting engineers	Fortfield Road - Pedestrian Bridge - Span 3		Job No: 222102	
	Assessment using BA16/14 MEXE Method		Sheet No: 1	Rev: R0
	Pedestrian Bridge	Calc by: DW Date: 17-05-2022	Check by: KOR	Date: 18/05/2022

Ref	Calculations			Output
BA 16/14	**Modified MEXE Method**			
3.5	Arch Dimensions			
	Span	L (m)		1.28
	Rise at Crown	r_c (m)		0.46
	Rise at Quarter Point	r_q (m)		0.38
	Ring Thickness	d (m)		0.24
	Depth of Fill	h (m)		0.10
3.10	Provisional Assessment			
	Provisional Axle Loading (P.A.L.)			
	From Fig. 3/1 Nonogram, or	$\frac{740 \times (d+h)^2}{L^{1.3}}$, or 70		62.06
	Modifying Factors			
3.11	Span/Rise Factor	F_{sr}	Fig. 3.3	1.00
		L/r_c		2.78
3.12	Profile Factor	F_p	$= 2.3 \times [(r_c - r_q)/r_c]^{0.6}$	0.81
3.13	Material Factor	F_m	$= \frac{(F_b \times d) + (F_f \times h)}{h + d}$	0.91
3.16	Joint Factor	F_j	$= F_w \times F_{mo} \times F_d$	0.58
3.17	Condition Factor	F_{cM}		0.75
Table 3.1	Barrel Factor	F_b		1.00
Table 3.2	Fill Factor	F_f		0.70
Table 3.3	Joint Width Factor	F_w		0.80
Table 3.4	Joint Mortar Factor	F_{mo}		0.90
Table 3.5	Depth factor	F_d (m)		0.80
Annex G				
	Horizontal Curve Radius, r (m)			> 600
	$v2 = \frac{1000r}{r + 150}$		Centrifugal Effect Factor $F_A = 1 + (0.2v^2/r) =$	N/A
3.24	Modified Axle Load For 2-Axle Bogie (M.A.L)		M.A.L. = $F_{sr} \times F_p \times F_m \times F_j \times F_{cM} \times$ P.A.L	19.68
3.27	Axle Lift Off (Y/N)	N/A		
	Axle Factor	A_f	see Fig. 3/5a & 3/5b	
	Singe Axle	1.00	Allowable A.L.	20
	2-Axle Bogie	1.00	Allowable A.L.	20
	3-Axle Bogie	1.00	Allowable A.L.	20
Table 3/6	**LOAD CAPACITY**	**Max G.V.W. (tonnes)**		**40/44**

Appendix C Site Inspection Photographs (22/02/2024)

Site Photo 31

Site Photo 32

Site Photo 33

Site Photo 34