

STRUCTURAL CALCULATIONS

For:

Bridge Assessment

At:

Cygnnet Hospital, Bury

On Behalf Of:

Cygnnet Group

Project No.: 12402				
Issue Date	Revision	Status	Issued By	Checked By
27.03.26	A	FINAL	KLH	SJR
07.04.26	B	NORTH SPAN ADDED	KLH	SJR

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Calculations By KLH		Checked By SJR	Date March 2026	

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1.0 **PREAMBLE**

Reid Jones Partnership has been appointed to assess the capacity of the bridge owned by the client giving access to Cygnet Hospital to determine the maximum allowable axle load. The Gate House is being demolished and demolition rubble/ soil will be transported across the bridge as part of this work.

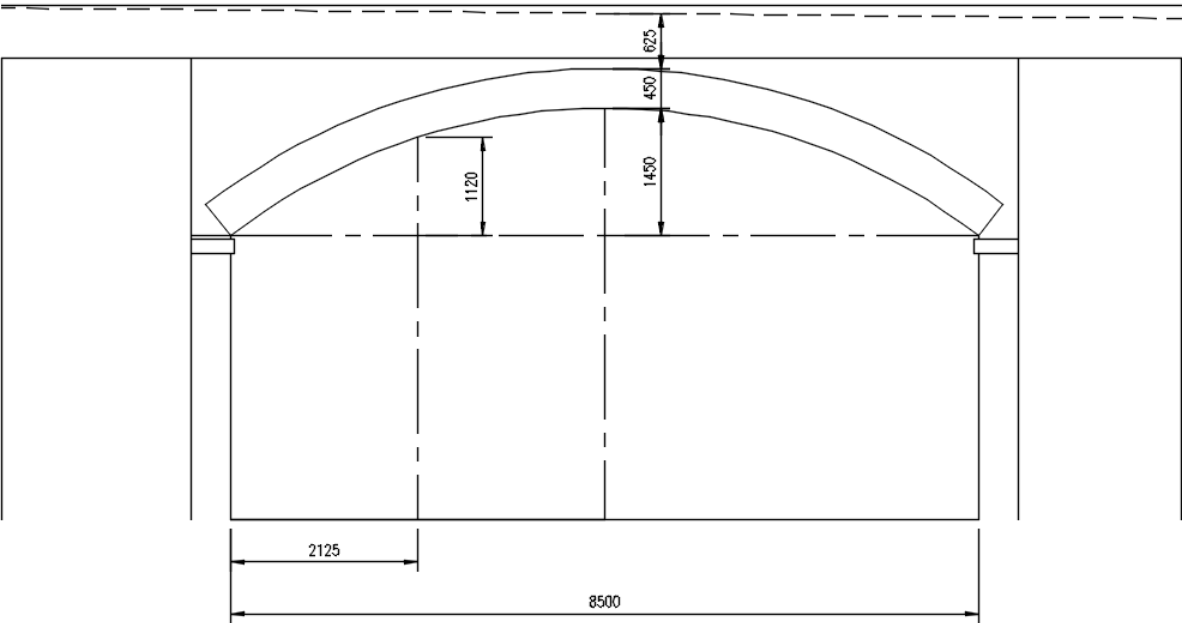
The bridge has been assessed using the MEXE method for the south span and Part 3 BD 21/97 The Assessment of Highway Bridges and Structures for the north span in accordance with site measurements taken in March 2026.

Vehicle tracking has been carried out to check vehicle access to the site for a skip lorry.

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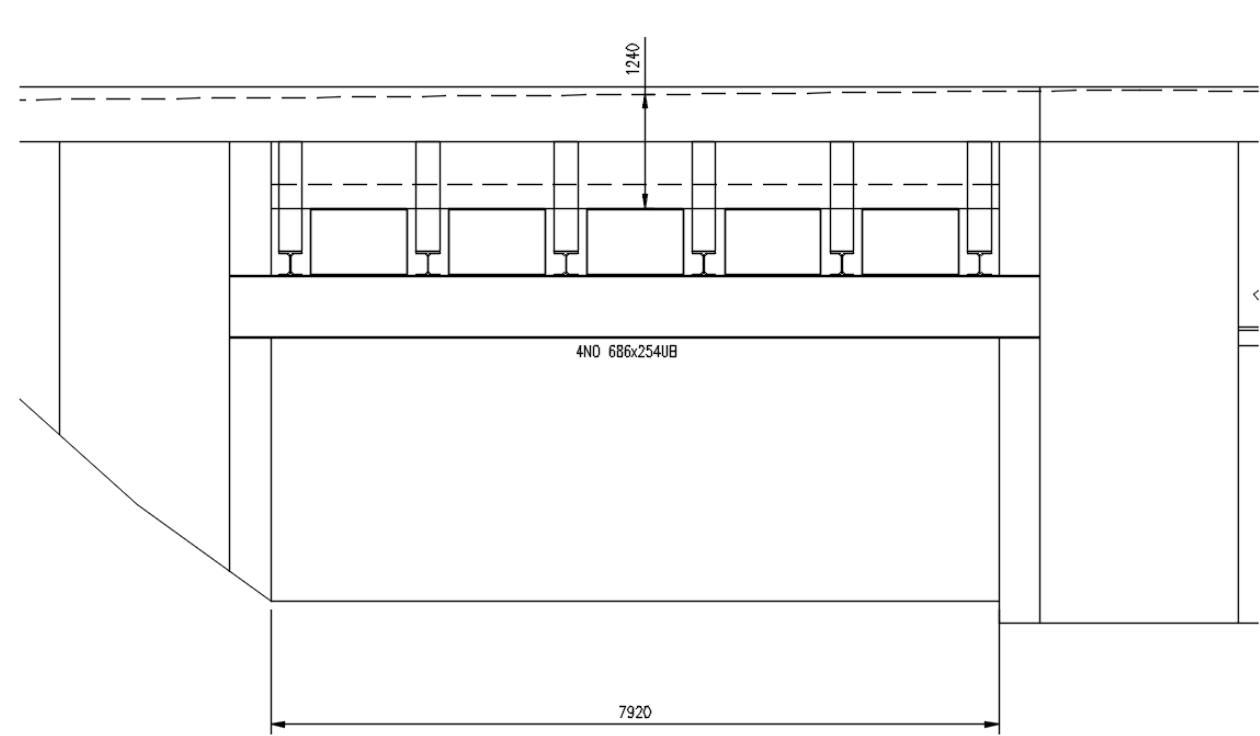
2.0 SURVEY

South Span



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North Span



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3.0 LOAD ASSESSMENT SOUTH SPAN

Provisional Assessment

$$PAL = [740 (d + h)^2] / L^{1.3}, < 70 \text{ tonnes}$$

$$PAL = [740 (0.45 + 0.625)^2] / 8.5^{1.3} = 52.94 \text{ tonnes}$$

Modification Factors

Span/ rise factor – F_{SR}

$$L / R_c = 8.5 / 1.45 = 5.86$$

Therefore $F_{SR} = 0.76$

Profile Factor – F_P

$$R_Q / R_c = 1.12 / 1.45 = 0.77$$

$$F_P = 2.3[(R_c - R_Q) / R_c]^{0.6}$$

$$F_P = 2.3[(1.45 - 1.12) / 1.45]^{0.6}$$

$$F_P = 0.946$$

Material Factor – F_m

$$F_m = \frac{F_b d + F_f h}{d + h}$$

$$F_b = 0.7 \text{ (masonry)}$$

$$F_f = 0.7 \text{ (well compacted material)}$$

$$F_m = \frac{0.7 \times 0.45 + 0.7 \times 0.625}{0.45 + 0.625} = 0.7$$

Joint Factor - F_j

$$F_j = F_w F_d F_{mo}$$

$$F_w = 0.9 \text{ – joint width 6-12.5mm}$$

$$F_d = 0.8 \text{ – some poor pointing (conservative value)}$$

$$F_{mo} = 0.9 \text{ – loose and friable mortar}$$

$$F_j = 0.9 \times 0.8 \times 0.9 = 0.648$$

Arch Barrel condition F_{cm}

$$F_{cm} = 0.7 \text{ – brick coursing shows some permanent deformation of the arch}$$

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4.0 LOAD ASSESSMENT NORTH SPAN

Road:

Dead Load	
road finishes 100mm	2.3
Misc fill 900mm average	20.7
brick jack arch 100mm	2.1
	25.1 kN/m ²

Road strengthening framework:

Dead Load	
254UC x 7.1m x 6no	37.9
686UB x 8.0m x 4no	44.8
762UB spacers 1.05 x 20no	28.1
	110.8 kN
110.8 / (7.92 x 3.85) =	3.6kN/m ²

North Span

width of bridge between parapets = 3.85m

4no longitudinal beams at 1.15m spacing

internal beam load width = 1.15m

edge beam load width = $(1.15/2) + 0.2 = 0.775\text{m}$

1 notional lane

loaded length = 8m

notional lane width = 3.65m

AAHHGVF < 7 – Low traffic flow

Road surface – no defects noted - good

road category Lg

for 25 tonnes and 8m loaded length, reduction factor $K = 0.74$

Case (i) – UDL + KEL

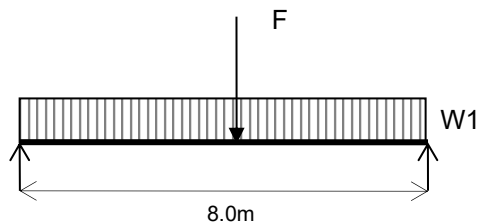
$W = 336 (1/L)^{0.67} = 336 (1/8.0)^{0.67} = 83.4\text{kN per m length of lane}$

$w = 0.74 \times (83.4 / 3.65) = 16.9\text{kN/m}^2$

Knife Edge Load, KEL = 120kN

KEL across lane = $0.74 \times 120 / 3.65 = 24.35\text{kN/m}$

Loading internal longitudinal beam



F	KEL	LL	24.35×1.15	=	28.0	kN
W1	road	DL	25.1×1.15	=	28.85	kN/m
	steel frame	DL	3.6×1.15	=	4.15	kN/m
	live udl	LL	16.9×1.15	=	19.45	kN/m

AXIAL WITH MOMENTS (MEMBER)

Longitudinal UDL + KEL: Span 1

Span 1 Between 3.250 and 4.750 m, in Load Case 1

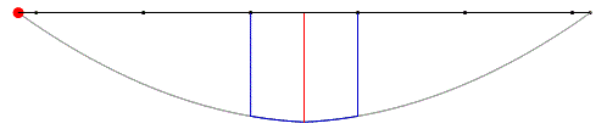
Member Loading and Member Forces

Loading Combination : 1 UT + 1.35 D1 + 1.5 L1

D1 UDLY -033.000 (kN/m)

L1 UDLY -019.450 (kN/m)

L1 PY -028.000 4.000 (kN,m)



Member Forces in Load Case 1 and Maximum Deflection from Load Case 3

Span No.	Axial Force (kN)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm)	Maximum Deflection (mm @ m)
		End 1	End 2	Node 1	Node 2		
1	0.00C	315.90	-315.90	0.00	0.00	673.80 @ 4.000	12.49 @ 4.000

Classification and Effective Area (EN 1993: 2006)

Section (125.0 kg/m)

686x254 UB 125 [Grade 43]

Class = Fn(b/T,d/t,f_y,N,M_y,M_z)

7.81, 52.57, 265, 0, 673.8, 0

(Axial: Non-Slender)

Class 1

Auto Design Load Cases

1

Shear Capacity Check

 $V_{y,Ed}/V_{pl,y,Rd} = 76.301 / 1290.05 =$

0.059

OK

Moment Capacity Check M.c.y.Rd

 $V_{y,Ed}/V_{pl,y,Rd} = 21.008 / 1290.05 =$

0.016

Low Shear

 $M_{c,y,Rd} = f_y \cdot W_{pl,y} / \gamma_{M0}$

265 x 3994.1/1

1058.437 kN.m

 $M_{y,Ed}/M_{c,y,Rd} = 673.8 / 1058.437 =$

0.637

OK

Equivalent Uniform Moment Factor C1

 $C_1 = f_n(M_1, M_2, \sim y) = 637.4, 637.4, 1.000$

1.000

Not Loaded

Lateral Buckling Check M.b.Rd

 $L_e = 1.0 L = 1 \times 1.5 =$

1.5 m

 $M_{cr} = F_n(C_1, L_e, I_{z,y}, I_{w,E})$

1.000, 1.500, 4397, 116.2, 4.786, 210000

13504.940 kN.m

 $\lambda_{LT} = \sqrt{W_{pl,y}/M_{cr}}$
 $\sqrt{3994.1 \times 265 / 13504.94}$

0.280

 $C_{LT} = F_n(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT0})$

0.280, 0.000, 0.000, 0.000

1.000

Curve d

 $C_{LT,mod} = F_n(C_{LT}, \lambda_{LT}, k_c, f)$

1.000, 0.280, 0.000, 0.000

1.000

6.3.2.3

 $M_{b,Rd} = c W_{pl,y} \cdot f_y \leq M_{c,y,Rd}$
 $1.000 \times 3994 \times 265 \leq 1058.437 =$

1058.437 kN.m

 $M_{y,Ed}/M_{b,Rd}$
 $673.8 / 1058.437$

0.637

OK

Deflection Check - Load Case 3

In-span $\delta \leq \text{Span}/360$
 $12.49 \leq 8000 / 360$

12.49 mm

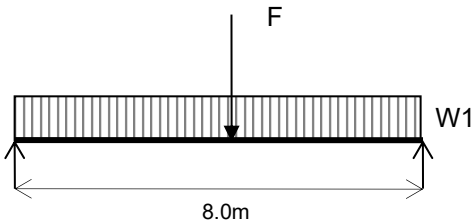
OK

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Case (ii) – Single Axle Load

for 25 tonnes, Low traffic flow, good surface
single axle load = 150kN, conservatively assume full single axle load is supported on one longitudinal beam

Loading longitudinal beam



F	single axle load	LL	=	150	kN
W1	road	DL 25.1 x 1.15	=	28.85	kN/m
	steel frame	DL 3.6 x 1.15	=	4.15	kN/m

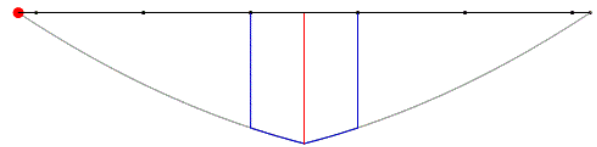
AXIAL WITH MOMENTS (MEMBER)

Longitudinal single axle load: Span 1

Span 1 Between 3.250 and 4.750 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.35 D1 + 1.5 L1

D1 UDLY -033.000 (kN/m)
L1 PY -150.000 4.000 (kN,m)


Member Forces in Load Case 1 and Maximum Deflection from Load Case 3

Span No.	Axial Force (kN)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm)	Maximum Deflection (mm @ m)
		End 1	End 2	Node 1	Node 2		
1	0.00C	290.70	-290.70	0.00	0.00	806.40 @ 4.000	13.56 @ 4.000

Classification and Effective Area (EN 1993: 2006)

Section (125.0 kg/m)

686x254 UB 125 [Grade 43]

Class = $F_n(b/T, d/t, f_y, N, M_y, M_z)$

7.81, 52.57, 265, 0, 806.4, 0

(Axial: Non-Slender)

Class 1

Auto Design Load Cases

1

Shear Capacity Check

 $V_{y,Ed}/V_{pl,y,Rd} = 145.917 / 1290.05 =$

0.113

OK

Moment Capacity Check $M_{c,y,Rd}$

 $V_{y,Ed}/V_{pl,y,Rd} = 112.504 / 1290.05 =$

0.087

Low Shear

 $M_{c,y,Rd} = f_y \cdot W_{pl,y} / \gamma_{M0}$
 $265 \times 3994.1 / 1$

1058.437 kN.m

 $M_{y,Ed}/M_{c,y,Rd} = 806.4 / 1058.437 =$

0.762

OK

Equivalent Uniform Moment Factor C_1

 $C_1 = f_n(M_1, M_2, \sim y) = 709.6, 709.6, 1.000$

1.000

Not Loaded

Lateral Buckling Check $M_{b,Rd}$

 $L_e = 1.0 L = 1 \times 1.5 =$

1.5 m

 $M_{cr} = F_n(C_1, L_e, I_{z,y}, I_{t,y}, E)$
 $1.000, 1.500, 4397, 116.2, 4.786, 210000$

13504.930 kN.m

 $\lambda_{LT} = \sqrt{W_{pl,y}/M_{cr}}$
 $\sqrt{3994.1 \times 265 / 13504.93}$

0.280

 $C_{LT} = F_n(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT0})$
 $0.280, 0.000, 0.000, 0.000$

1.000

Curve d

 $C_{LT,mod} = F_n(C_{LT}, \lambda_{LT}, k_c, f)$
 $1.000, 0.280, 0.000, 0.000$

1.000

6.3.2.3

 $M_{b,Rd} = c W_{pl,y} \cdot f_y \leq M_{c,y,Rd}$
 $1.000 \times 3994 \times 265 \leq 1058.437 =$

1058.437 kN.m

 $M_{y,Ed}/M_{b,Rd}$
 $806.4 / 1058.437$

0.762

OK

Deflection Check - Load Case 3

In-span $\delta \leq \text{Span}/360$
 $13.56 \leq 8000 / 360$

13.56 mm

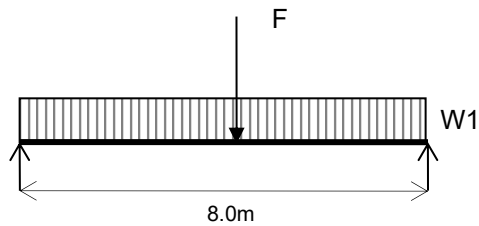
OK

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Case (iii) – Single Wheel Load

for 25 tonnes, Low traffic flow, good surface
single wheel load = 82kN, conservatively assume full single wheel load is supported on one longitudinal beam

Loading longitudinal beam



F	single wheel load	LL	=	82	kN
W1	road	DL 25.1 x 1.15	=	28.85	kN/m
	steel frame	DL 3.6 x 1.15	=	4.15	kN/m

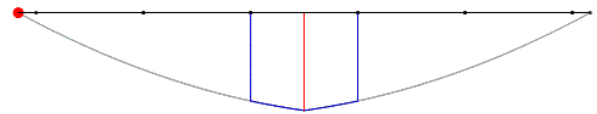
AXIAL WITH MOMENTS (MEMBER)

Longitudinal single wheel load: Span 1

Span 1 Between 3.250 and 4.750 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.35 D1 + 1.5 L1

D1 UDLY -033.000 (kN/m)
L1 PY -082.000 4.000 (kN,m)


Member Forces in Load Case 1 and Maximum Deflection from Load Case 3

Span No.	Axial Force (kN)	Shear Force (kN)		Bending Moment (kNm)		Maximum Moment (kNm)	Maximum Deflection (mm @ m)
		End 1	End 2	Node 1	Node 2		
1	0.00C	239.70	-239.70	0.00	0.00	602.40 @ 4.000	10.63 @ 4.000

Classification and Effective Area (EN 1993: 2006)

Section (125.0 kg/m) 686x254 UB 125 [Grade 43]
Class = $F_n(b/T, d/t, f_y, N, M_y, M_z)$ 7.81, 52.57, 265, 0, 602.4, 0

(Axial: Non-Slender)

Class 1

Auto Design Load Cases

1

Shear Capacity Check

 $V_{y,Ed}/V_{pl,y,Rd}$ 94.917 / 1290.05 =

0.074

OK

Moment Capacity Check $M_{c,y,Rd}$

 $V_{y,Ed}/V_{pl,y,Rd}$ 61.504 / 1290.05 =

0.048

Low Shear

 $M_{c,y,Rd} = f_y \cdot W_{pl,y} / \gamma_{M0}$

265 x 3994.1/1

1058.437 kN.m

 $M_{y,Ed}/M_{c,y,Rd}$ 602.4 / 1058.437 =

0.569

OK

Equivalent Uniform Moment Factor C_1

 $C_1 = f_n(M_1, M_2, \sim y)$ 543.8, 543.8, 1.000

1.000

Not Loaded

Lateral Buckling Check $M_{b,Rd}$

 $L_e = 1.0 L$ 1 x 1.5 =

1.5 m

 $M_{cr} = F_n(C_1, L_e, I_{zr}, I_{tr}, I_w, E)$

1.000, 1.500, 4397, 116.2, 4.786, 210000

13504.930 kN.m

 $\lambda_{LT} = \sqrt{W_{pl,y}/M_{cr}}$
 $\sqrt{3994.1 \times 265 / 13504.93}$

0.280

 $C_{LT} = F_n(\lambda_{LT}, \Phi_{LT}, \beta, \lambda_{LT0})$

0.280, 0.000, 0.000, 0.000

1.000

Curve d

 $C_{LT,mod} = F_n(C_{LT}, \lambda_{LT}, k_c, f)$

1.000, 0.280, 0.000, 0.000

1.000

6.3.2.3

 $M_{b,Rd} = c W_{pl,y} \cdot f_y \leq M_{c,y,Rd}$
 $1.000 \times 3994 \times 265 \leq 1058.437 =$

1058.437 kN.m

 $M_{y,Ed}/M_{b,Rd}$

602.4 / 1058.437

0.569

OK

Deflection Check - Load Case 3

In-span $\delta \leq \text{Span}/360$
 $10.63 \leq 8000 / 360$

10.63 mm

OK

bridge north span is suitable for 18 tonne weight restriction as south span

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5.0 VEHICLE TRACKING

Vehicle tracking has been undertaken to determine the suitability of the existing road configuration to allow access for a skip lorry to the site to remove spoil and demolition rubble.

A small skip lorry as specified on the attached drawing can manouvre around site during the works. It is recommended that the hoarding line does not extend beyond the existing kerb line to allow all other vehicles already accessing the site to be able to continue to access the hospital/ sailing club.