To:	Colin	**Ref:**	JP3626/CJB/GBPDR/001
cc:		**Rev No:**	C0
Author: **Date:**	JP 27/09/23	**Chkd:** **Appd:**	

Project:	66 Priory Road NW6 3RE
Client:	CJB Piling & Underpinning
Subject:	Ground Beam and Pile Design Report

Content

1 – Executive Summary

1.1 Project Description

The detail design of piles and the ground beam is presented in this report. The Drawings used for the calculation purpose are Ref {1.0}

1.2 Risk Assessment Notes

It is the client’s responsibility to notify us about any underground services passing through the footprint of the extension. If no notification is provided, we will assume there is no underground services running through the footprint of the extension.

1.3 Piles & Ground Beam Details

1 - The ground beam details are presented in section 3.

2 – The pile details are presented in section 7.

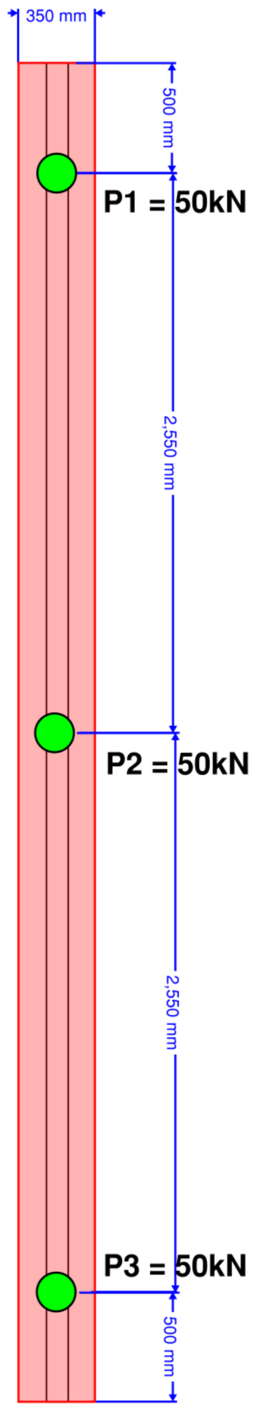
1.4 References

Ref.	Doc. No.	Revision / Date	Document Title
[1.0]			Priory Road Survey

2 – Abbreviations

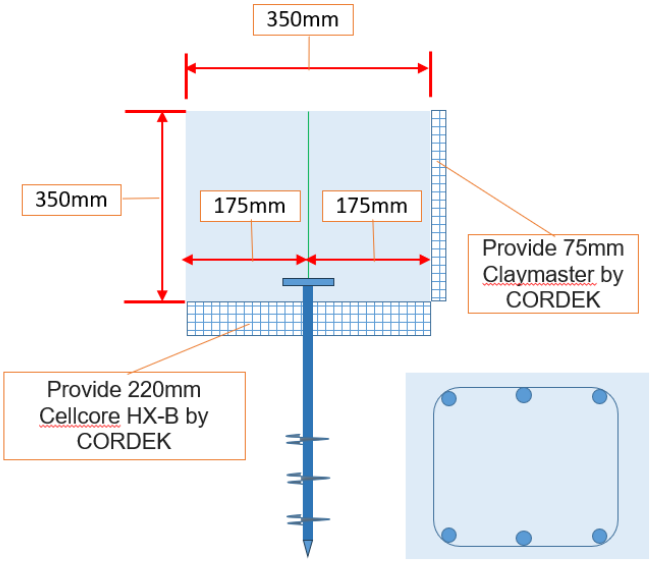
bgl	Below ground level
BGS	British Geological Survey
Cu	Undrained shear strength (kPa)
E’	Drained Young’s Modulus (kPa)
OD	Outer diameter
SPT	Standard penetration test

3 – Pile & Ground Beam Layout with Reinforcement Details



Note: All Pile reactions have been rounded up to the nearest higher multiple of 10. Minimum Pile reaction is taken as 50kN

The Ground Beam should be set out in accordance to the layout. This layout only provides the spacing between the piles.



Pile
76r Piles

Ground beams:
3B12 top and bottom

Link:
H8 link at 150mm centres.

Rebar cover:
Sides = 40mm
Bottom = 50mm

Concrete:
Grade C28/35

JP MANN	Client: Colin	Drawing Title: Pile & Ground Beam Layout & Details			
	Contract: 66 Priory Road NW6 3RE	Scale: NTS	Drawn: JP	Approved: JP	Date: 27.09.23
		Drawing No.: JP3626/CJB/001 Sheet 1 of 1		Rev: C0	

4 – General Notes

a. Concrete grade to be C28/35 DC-2.

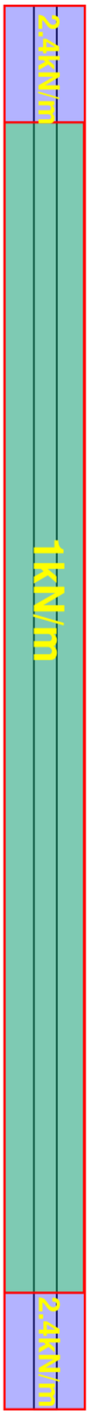
b. Expansion joints will not be required.

c. Anti-heave measures

- Provide 220mm Cellcore HX-B by CORDEK
- Provide 75mm Claymaster by CORDEK

5 – Loadings

Applied Loads



Load Takedown

						Dead Load							Live Load			
Beam 1																
Wall	1.6	kN/m2	x	0.6	m	=	0.96	kN/m								
				Total		=	0.96	kN/m				Total	=	0	kN/m	
Pier	1.6	kN/m2	x	1.5	m	=	2.4	kN/m								

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6 – Soil Parameters

A site investigation is not carried out on site. The following parameters have been obtained from BGS data.

6.1 Geological Profile

Strata	Top level of Strata	Strata Thickness
	m bgl	(m)
Made Ground	0	1
Clay	1	13 (BH ends at 14.0 m)

7 – Screw Pile Design

SCREW PILE DESIGN REPORT		JP MANN		66 priory Road NW6 3RE
Design by:	Check By	Revision	Ref. No.	Date
JP	JP	C0	JP3626-CJB	27/09/2023

Soil Condition	Silty clay	
Max. Safe Working Load, SWL for Piles	50	kN
Required minimum FOS	2.5	
Nos. of piles	3	
Screw Pile Type	76R	
Target Penetration	6.0	m
Nos. of triple helix lead flight	1.0	nos
Length of triple helix lead flight	2.0	m
Nos. of plain follows	2.0	nos
Length of plain follows	2.0	m
Screw pile load correlation chart	See Appendix A	

* or refusal when torque given in appendix A is achieved for the specified loading

Screw Pile Geotechnical Capacity Calculation

Helix Dimension

Target Penetration	6.0	**m**
Lower Helix 1 - top		
Diameter	0.3	**m**
A_{base}	0.071	**m^2**
A_{shaft}	0.942	**m^2/m**
Depth below ground	4.50	**m**
Lower Helix 2 - middle		
Diameter	0.25	**m**
A_{base}	0.049	**m^2**
A_{shaft}	0.785	**m^2/m**
Depth below ground	5.25	**m**
Lower Helix 3 - bottom		
Diameter	0.20	**m**
A_{base}	0.031	**m^2**
A_{shaft}	0.628	**m^2/m**
Depth below ground	5.85	**m**

Soil Parameter

γ'	19	kN/m^3
ϕ'	30	°
Nq	30	
Helix 1 - top		
σ'_{vb}	85.5	kN/m^2
Helix 2 - middle		
σ'_{vb}	99.75	kN/m^2
Helix 3 - bottom		
σ'_{vb}	111.15	kN/m^2

Compression Capacity

UEB =	$N_q \times \sigma'_{vb} \times A_{base}$	
Helix 1 - top		
UEB_1 =	181	**kN**
Helix 2 - middle		
UEB_2 =	147	**kN**
Helix 3 - bottom		
UEB_3 =	105	**kN**
Total UEB =	433	**kN**
Comp load=	50	**kN**
Comp FOS =	8.66	
> min FOS 2.5, sufficient capacity		

Abbreviations

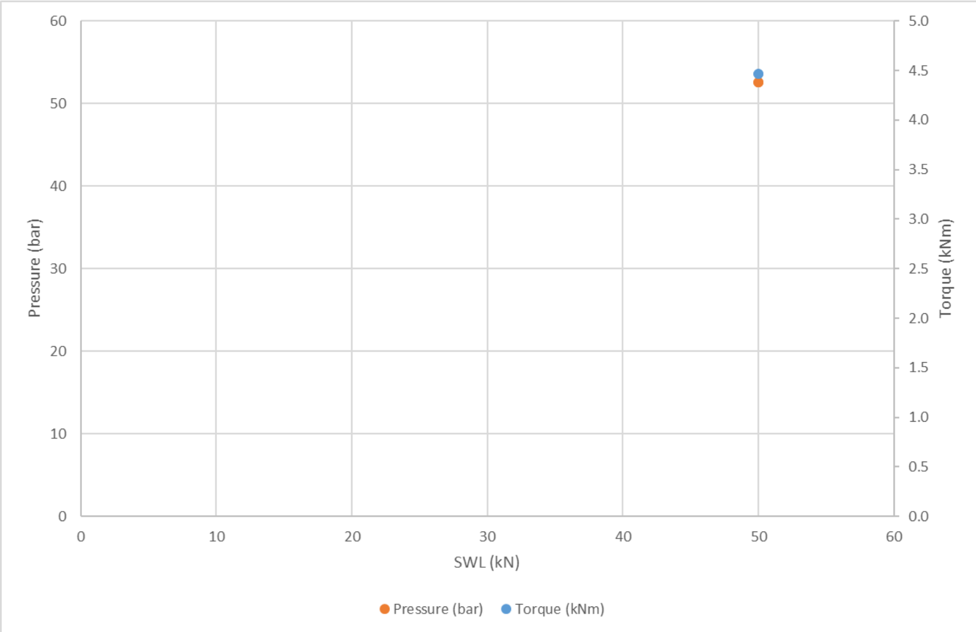
ϕ'	Internal friction angle of soil
γ'	Effective soil density
σ'_{vb}	Effective overburden pressure at helix base
CHS	Circular hollow section
Comp.	Compression
FOS	Factor of safety
SWL	Safe working load
UEB	Ultimate End Bearing
ULS	Ultimate Shaft Friction

Pile load table			
Pile No	SLS load(kN)	Torque (kNm)	Pressue (bar)
1	50	4.5	53
2	50	4.5	53
3	50	4.5	53

Appendix A

Torque Motor Head -	Digga MM-10K		
SWL	**Safe working load**	**50**	**kN**
FOS	Factor of safety	2.5	
R	Empirical torque factor =	28	
UL	Ultimate load (SWL x FOS)	125	kN
	Pressure corelation factor	11.78	
T =	(SWL x FOS) / R	4.5	kNm
T	**Torque**	**4.5**	**kNm**
P	**Pressure**	**53**	**bar**

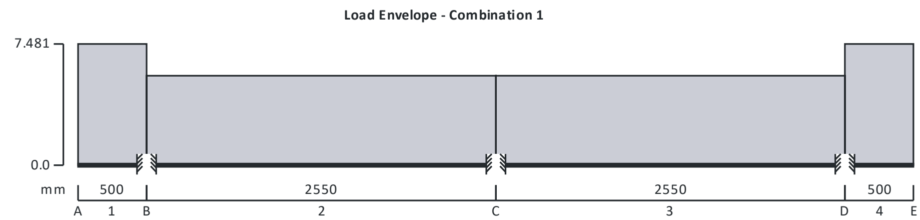
Appendix A – Check Graph

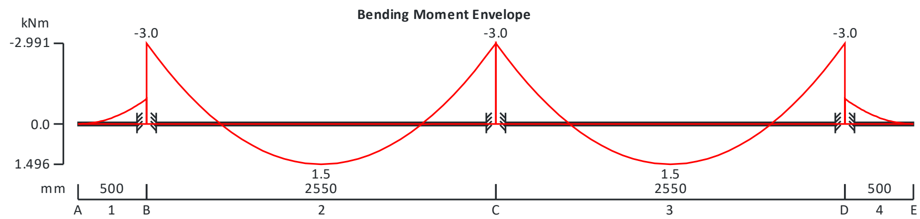


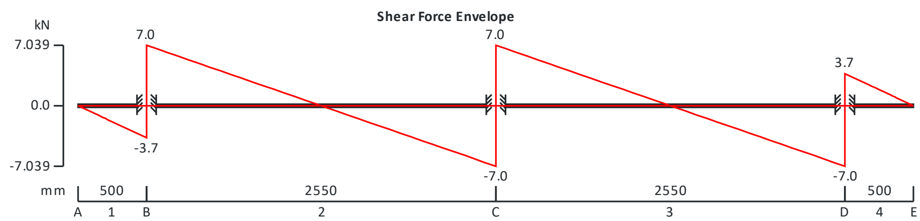
Appendix B – Ground Beam Calculations

RC BEAM ANALYSIS & DESIGN BS8110

TEDDS calculation version 2.1.14







Support conditions

Support A	Vertically free
	Rotationally free
Support B	Vertically restrained
	Rotationally restrained
Support C	Vertically restrained
	Rotationally restrained
Support D	Vertically restrained
	Rotationally restrained
Support E	Vertically free
	Rotationally free

Applied loading

Dead self weight of beam × 1

Dead partial UDL 1 kN/m from 500 mm to 5600 mm

Dead partial UDL 2.4 kN/m from 0 mm to 500 mm

Dead partial UDL 2.4 kN/m from 5600 mm to 6100 mm

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60
	Span 2	Dead × 1.40
		Imposed × 1.60
	Support C	Dead × 1.40
		Imposed × 1.60
	Span 3	Dead × 1.40
		Imposed × 1.60
	Support D	Dead × 1.40
		Imposed × 1.60
	Span 4	Dead × 1.40
		Imposed × 1.60
	Support E	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm
Maximum moment span 1 at support	M_{s1_max} = **0** kNm	M_{s1_red} = **0** kNm
Maximum moment support B	M_{B_max} = **-3** kNm	M_{B_red} = **-3** kNm
Maximum moment span 2 at 1275 mm	M_{s2_max} = **1** kNm	M_{s2_red} = **1** kNm
Maximum moment support C	M_{C_max} = **-3** kNm	M_{C_red} = **-3** kNm
Maximum moment span 3 at 1275 mm	M_{s3_max} = **1** kNm	M_{s3_red} = **1** kNm
Maximum moment support D	M_{D_max} = **-3** kNm	M_{D_red} = **-3** kNm
Maximum moment span 4 at support	M_{s4_max} = **0** kNm	M_{s4_red} = **0** kNm
Maximum moment support E	M_{E_max} = **0** kNm	M_{E_red} = **0** kNm
Maximum shear support A	V_{A_max} = **0** kN	V_{A_red} = **0** kN
Maximum shear support A span 1 at 300 mm	$V_{A\_s1\_max}$ = **-2** kN	$V_{A\_s1\_red}$ = **-2** kN
Maximum shear support B	V_{B_max} = **7** kN	V_{B_red} = **7** kN
Maximum shear support B span 1 at 204 mm	$V_{B\_s1\_max}$ = **-1** kN	$V_{B\_s1\_red}$ = **-1** kN
Maximum shear support B span 2 at 296 mm	$V_{B\_s2\_max}$ = **5** kN	$V_{B\_s2\_red}$ = **5** kN
Maximum shear support C	V_{C_max} = **-7** kN	V_{C_red} = **-7** kN
Maximum shear support C span 2 at 2250 mm	$V_{C\_s2\_max}$ = **-5** kN	$V_{C\_s2\_red}$ = **-5** kN
Maximum shear support C span 3 at 300 mm	$V_{C\_s3\_max}$ = **5** kN	$V_{C\_s3\_red}$ = **5** kN
Maximum shear support D	V_{D_max} = **-7** kN	V_{D_red} = **-7** kN
Maximum shear support D span 3 at 2250 mm	$V_{D\_s3\_max}$ = **-5** kN	$V_{D\_s3\_red}$ = **-5** kN
Maximum shear support D span 4 at 300 mm	$V_{D\_s4\_max}$ = **1** kN	$V_{D\_s4\_red}$ = **1** kN
Maximum shear support E	V_{E_max} = **0** kN	V_{E_red} = **0** kN
Maximum shear support E span 4 at 200 mm	$V_{E\_s4\_max}$ = **2** kN	$V_{E\_s4\_red}$ = **2** kN
Maximum reaction at support A	R_A = **0** kN	

Unfactored dead load reaction at support A R_{A_Dead} = **0** kN

Maximum reaction at support B R_B = **11** kN

Unfactored dead load reaction at support B R_{B_Dead} = **8** kN

Maximum reaction at support C R_C = **14** kN

Unfactored dead load reaction at support C R_{C_Dead} = **10** kN

Maximum reaction at support D R_D = **11** kN

Unfactored dead load reaction at support D R_{D_Dead} = **8** kN

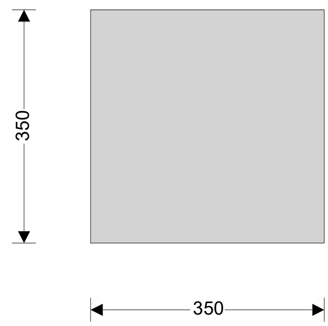
Maximum reaction at support E R_E = **0** kN

Unfactored dead load reaction at support E R_{E_Dead} = **0** kN

Rectangular section details

Section width b = **350** mm

Section depth h = **350** mm



Concrete details

Concrete strength class **C28/35**

Characteristic compressive cube strength f_{cu} = **35** N/mm^2

Modulus of elasticity of concrete $E_c = 20\text{kN/mm}^2 + 200 \times f_{cu}$ = **27000** N/mm^2

Maximum aggregate size h_{agg} = **20** mm

Reinforcement details

Characteristic yield strength of reinforcement f_y = **500** N/mm^2

Characteristic yield strength of shear reinforcement f_{yv} = **500** N/mm^2

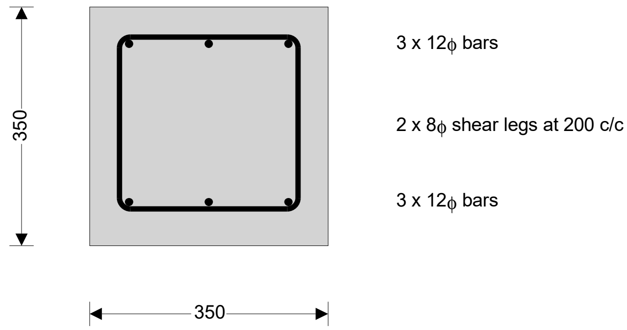
Nominal cover to reinforcement

Nominal cover to top reinforcement c_{nom_t} = **40** mm

Nominal cover to bottom reinforcement c_{nom_b} = **50** mm

Nominal cover to side reinforcement c_{nom_s} = **40** mm

Support B



Design moment resistance of rectangular section (cl. 3.4.4)

Design bending moment — $M = abs(M_{B\_red}) =$ **3** kNm

Depth to tension reinforcement — $d = h - c_{nom\_t} - \phi_v - \phi_{top} / 2 =$ **296** mm

Redistribution ratio — $\beta_b = \min(1 - m_{rB}, 1) =$ **1.000**

$K = M / (b \times d^2 \times f_{cu}) =$ **0.003**

$K' = 0.156$

K' > K - No compression reinforcement is required

Lever arm — $z = \min(d \times (0.5 + (0.25 - K / 0.9)^{0.5}), 0.95 \times d) =$ **281** mm

Depth of neutral axis — $x = (d - z) / 0.45 =$ **33** mm

Area of tension reinforcement required — $A_{s,req} = M / (0.87 \times f_y \times z) =$ **24** mm^2

Tension reinforcement provided — $3 \times 12\phi$ bars

Area of tension reinforcement provided — $A_{s,prov} =$ **339** mm^2

Minimum area of reinforcement — $A_{s,min} = 0.0013 \times b \times h =$ **159** mm^2

Maximum area of reinforcement — $A_{s,max} = 0.04 \times b \times h =$ **4900** mm^2

PASS - Area of reinforcement provided is greater than area of reinforcement required

Rectangular section in shear

Design shear force span 1 at 204 mm — $V = abs(\min(V_{B\_s1\_max}, V_{B\_s1\_red})) =$ **1** kN

Design shear stress — $v = V / (b \times d) =$ **0.014** N/mm^2

Design concrete shear stress — $v_c = 0.79 \times \min(3,[100 \times A_{s,prov} / (b \times d)]^{1/3}) \times \max(1, (400 /d)^{1/4}) \times (\min(f_{cu}, 40) / 25)^{1/3} / \gamma_m$

$v_c =$ **0.525** N/mm^2

Allowable design shear stress — $v_{max} = \min(0.8 \text{ N/mm}^2 \times (f_{cu}/1 \text{ N/mm}^2)^{0.5}, 5 \text{ N/mm}^2) =$ **4.733** N/mm^2

PASS - Design shear stress is less than maximum allowable

Value of v from Table 3.7 — $v < 0.5v_c$

Design shear resistance required — $v_s = \max(v - v_c, 0.4 \text{ N/mm}^2) =$ **0.400** N/mm^2

Area of shear reinforcement required — $A_{sv,req} = v_s \times b / (0.87 \times f_{yv}) =$ **322** mm^2/m

Shear reinforcement provided — $2 \times 8\phi$ legs at 200 c/c

Area of shear reinforcement provided — $A_{sv,prov} =$ **503** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Maximum longitudinal spacing — $s_{vl,max} = 0.75 \times d =$ **222** mm

PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Design shear force span 2 at 296 mm — $V = \max(V_{B\_s2\_max}, V_{B\_s2\_red}) =$ **5** kN

Design shear stress $v = V / (b \times d) = \mathbf{0.052}$ N/mm^2

Design concrete shear stress $v_c = 0.79 \times \min(3,[100 \times A_{s,prov} / (b \times d)]^{1/3}) \times \max(1, (400 /d)^{1/4}) \times (\min(f_{cu}, 40) / 25)^{1/3} / \gamma_m$

$v_c = \mathbf{0.525}$ N/mm^2

Allowable design shear stress $v_{max} = \min(0.8 \text{ N/mm}^2 \times (f_{cu}/1 \text{ N/mm}^2)^{0.5}, 5 \text{ N/mm}^2) = \mathbf{4.733}$ N/mm^2

PASS - Design shear stress is less than maximum allowable

Value of v from Table 3.7 $v < 0.5v_c$

Design shear resistance required $v_s = \max(v - v_c, 0.4 \text{ N/mm}^2) = \mathbf{0.400}$ N/mm^2

Area of shear reinforcement required $A_{sv,req} = v_s \times b / (0.87 \times f_{yv}) = \mathbf{322}$ mm^2/m

Shear reinforcement provided $2 \times 8\phi$ legs at 200 c/c

Area of shear reinforcement provided $A_{sv,prov} = \mathbf{503}$ mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Maximum longitudinal spacing $s_{vl,max} = 0.75 \times d = \mathbf{222}$ mm

PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Spacing of reinforcement (cl 3.12.11)

Actual distance between bars in tension $s = (b - 2 \times (c_{nom\_s} + \phi_v + \phi_{top}/2)) /(N_{top} - 1) - \phi_{top} = \mathbf{109}$ mm

Minimum distance between bars in tension (cl 3.12.11.1)

Minimum distance between bars in tension $s_{min} = h_{agg} + 5 \text{ mm} = \mathbf{25}$ mm

PASS - Satisfies the minimum spacing criteria

Maximum distance between bars in tension (cl 3.12.11.2)

Design service stress $f_s = (2 \times f_y \times A_{s,req}) / (3 \times A_{s,prov} \times \beta_b) = \mathbf{24.0}$ N/mm^2

Maximum distance between bars in tension $s_{max} = \min(47000 \text{ N/mm} / f_s, 300 \text{ mm}) = \mathbf{300}$ mm

PASS - Satisfies the maximum spacing criteria

Span to depth ratio (cl. 3.4.6)

Basic span to depth ratio (Table 3.9) $span\_to\_depth_{basic} = \mathbf{7.0}$

Design service stress in tension reinforcement $f_s = (2 \times f_y \times A_{s,req})/ (3 \times A_{s,prov} \times \beta_b) = \mathbf{24.0}$ N/mm^2

Modification for tension reinforcement

$f_{tens} = \min(2.0, 0.55 + (477\text{N/mm}^2 - f_s) / (120 \times (0.9\text{N/mm}^2 + (M / (b \times d^2))))) = \mathbf{2.000}$

Modification for compression reinforcement

$f_{comp} = \min(1.5, 1 + (100 \times A_{s2,prov} / (b \times d)) / (3 + (100 \times A_{s2,prov} / (b \times d)))) = \mathbf{1.098}$

Modification for span length $f_{long} = 1.000$

Allowable span to depth ratio $span\_to\_depth_{allow} = span\_to\_depth_{basic} \times f_{tens} \times f_{comp} = \mathbf{15.4}$

Actual span to depth ratio $span\_to\_depth_{actual} = L_{s1} / d = \mathbf{1.7}$

PASS - Actual span to depth ratio is within the allowable limit