One City Road, Manchester, M15 4PN

Temporary Hoarding Design

Report Ref: JCCTS23-051-TW-CAL001
Revision: 00, December 2023

Civil Engineering
Structural Engineering
Geo-Environmental Engineering

Unit 16, The Stottie Shed, Bakers Yard, Christon Road, Gosforth, Newcastle upon Tyne, NE3 1XD
T. 0191 491 4684 E. enquiries@jc-consulting.net www.jc-consulting.net

Document Control Sheet

CONSULTING

ONE CITY ROAD, MANCHESTER

TEMPORARY HOARDING DESIGN

Client: **DJL**

Client Address: **CMS Business Park**
Rear Yard/ Station Lane
Featherstone
Pontefract
WF7 6EQ

Project Reference: **JCCTS23-051**

Report Reference: **JCCTS23-051-TW-CAL001**

Status: **Final**

Author: **C. Doyle**

Revision Record:

Rev.	Date	Status	Prepared	Signed	Checked	Signed	Approved	Signed
00	05/12/23	Final	C. Doyle		A. Abelé		C. Higgins	

Structural Calculations

Project No:	JCCTS23-051
Project Title:	One City Road, Manchester
Client:	DJL

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Design Philosophy:

The following calculations relate to the design of a proposed site hoarding located in Manchester. The form of hoarding to be adopted is:

- Above Ground Timber Hoard – PCC. System adopting plywood boarding, timber rails and timber posts suitably fixed to a 685 Kg precast concrete ballast block.
- In Ground Timber Hoard – This refers to a system adopting timber fence posts in concrete pocket foundations supporting timber posts at 2.4m centres which support 4 No. timber cross rails and plywood boarding. The hoarding is to be 2.4m high.

However, wind loads have been calculated in accordance with BS6399 rather than slim column sections. All structural timbers to be orientated in their strong axis.

Above Ground Timber Hoard – PCC (All Zones): **4 no. 100x50mm C24 Grade timber rails** @ equal centres and **150x100mm C24 Grade timber posts @ 2.4m centres** supported by **1no. standard 685 Kg PCC ballast block**.

In Ground Timber Hoard – All posts to be **100x150mm C24 timber fence posts @ 2.4m centres** supporting **4 No. 100x50mm C24 timber cross rails @ equal centres** with plywood boarding (or similar approved) as per client specification. All structural timbers to be orientated in their strong axis. **Foundations to be 350x350x700mm deep** (Hanson Fast Set Postfix or similar approved) to all timber posts @ 2.4m centres.

Timber rails screwed to timber posts with 2 no. 100mm long standard wood screws per rail. Rails to be fixed end to end. Timber posts bolted to PCC block with 2 no. fischer FAZ II galv 16/160 with 100x100x10mm washer @ equal spacing. WISA 18mm plywood boards fixed to timber rails with 50mm long standard wood screws staggered arrangement. Fencing panels fixed to timber posts with minimum of 4 no. 100mm long standard screws / bolts per post.

Hoarding should be inspected regularly by site manager to ensure no reduction in performance from wear and tear, poor construction or vandalism with any repairs or maintenance to be reinstated. An inspection should be carried out of the hoarding prior to any extreme weather warnings issued by the met office by site and immediately after to assess any maintenance that may be required.

(Continue on separate sheet if necessary)

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T. 0191 491 4684 E. enquiries@jc-consulting.net www.jc-consulting.net

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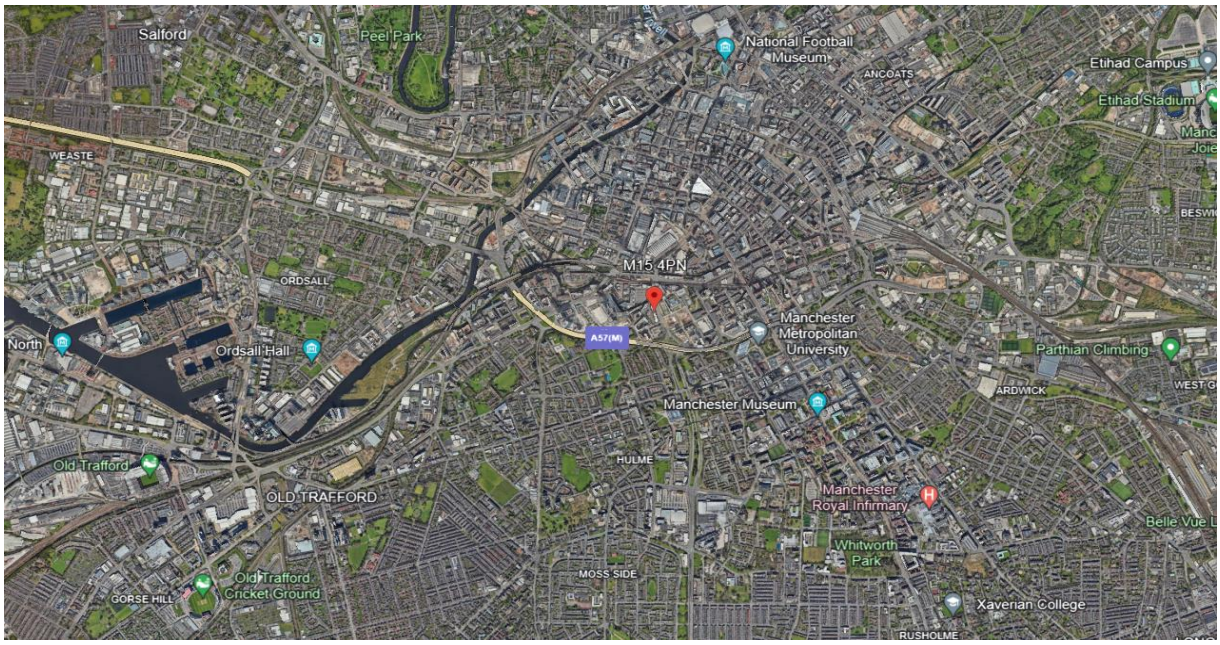
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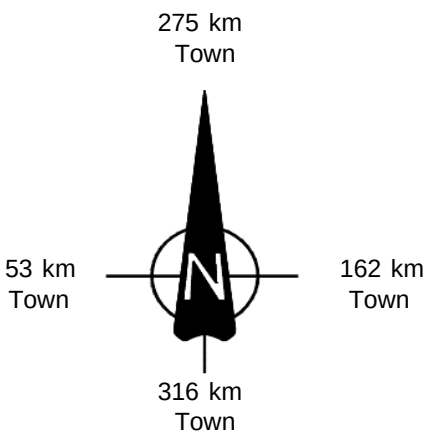
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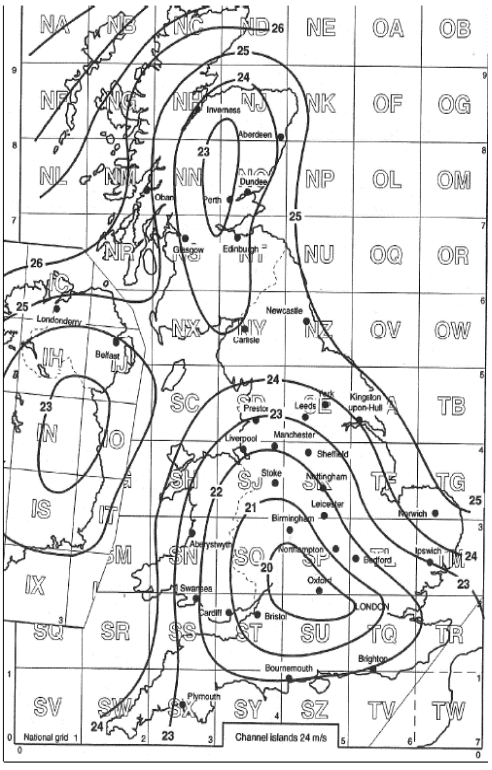
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	Date: Dec-23
	By: CD
Work Section: Wind Speed	Checked: AA
	Revision: -
	Sheet: 01



AERIAL PHOTOGRAPH

Address:	One City Road, Manchester, M15 4PN
Northing:	53°28'20"
Westing:	2°14'52"
Altitude:	30 m Above Sea Level
Site Wind Speed:	22.5 Vb (m/s)





JC Consulting	Project	One City Road, Manchester	Wind Loading Calculations		
Civil Engineering	Client	DJL	Made by	Date	Job No
Structural Engineering	Description	Wind Loading	CD	05.12.23	TS23-051
Geo-Environmental Engineering			Checked	Revision	Page No
Originated from Wind Design Workbook © 2000 Chris Buczkowski		Complimentary Copy	AA		02

Design in accordance with BS 6399 : Part 2 : 1997

Standard Wind Speeds

Dynamic Augmentation Factor (Cr)			
Kb	H (m)	Cr	
8	2.4	0.079	equ (C.2)
Cr okay - proceed with design			

Basic Wind Speed Vb (m/s)	Reference height Hr (m)
22.5	2.4

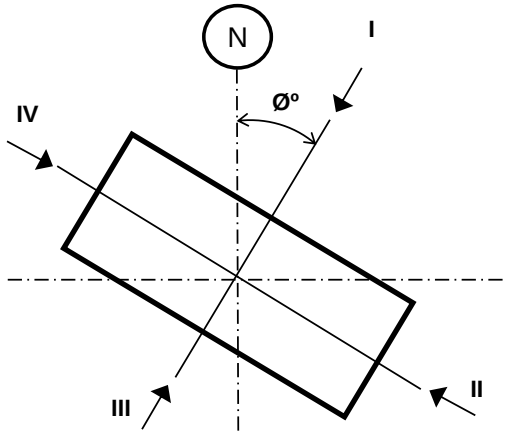
Ss	Sp
1.00	0.75

Standard values:
Ss=1.0 Sp=1.0

Altitude factor for non significant topography

Site altitude, Δ_S (m)	30
Altitude factor, Sa	1.030

equ (9)



Wind directions

☑ Building orientation unknown

☑ Nearby buildings ignored

		Wind Direction			
		I	II	III	IV
		~~10~~	~~100~~	~~190~~	~~280~~
Direction factor	Sd	1.000	1.000	1.000	1.000
Site Wind Speed (m/s)	Vs	17.38	17.38	17.38	17.38

equ (8)

			~~12~~	~~12~~	~~12~~	~~12~~
			~~10~~	~~50~~	~~10~~	~~50~~
Effective Height (m)		**He**	2.40	2.40	2.40	2.40

Distance to sea (km)		275	162	316	53
Terrain		town	town	town	town
Terrain and building factor	Sb	1.13	1.13	1.13	1.15
Effective Wind Speed (m/s)	Ve	19.60	19.60	19.60	19.99
Dynamic Pressure (N/m²)	**qs**	**235.5**	**235.5**	**235.5**	**245.0**

equ (12)

equ (1)

JC Consulting	Project	One City Road, Manchester	Wind Loading Calculations		
Civil Engineering	Client	DJL	Made by	Date	Job No
Structural Engineering	Description	Free-Standing Walls	CD	05.12.23	TS23-021
Geo-Environmental Engineering			Checked	Revision	Page No
Originated from Wind Design Workbook © 2000 Chris Buczkowski		Complimentary Copy	AA		03

Design in accordance with BS 6399 : Part 2 : 1997

Free-Standing Walls and Parapets

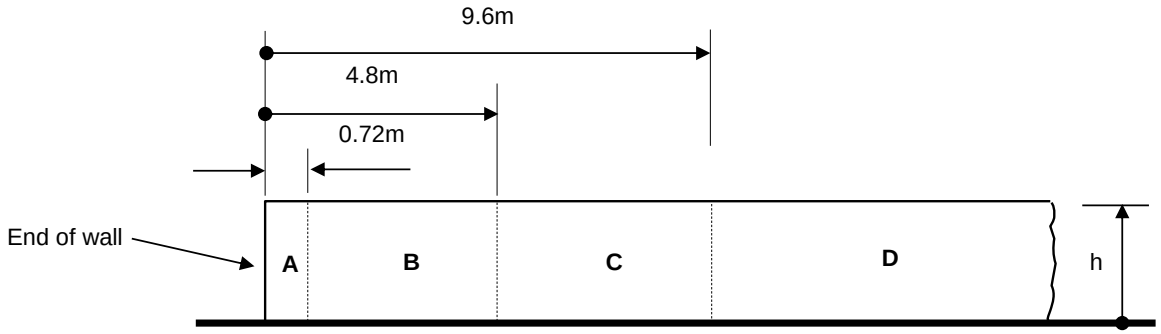
Dynamic Pressure, qs (N/m²)	245

Wall Dimensions	
Height h (m)	Length L (m)
2.4	100

Return Corners	
Return corners at both ends?	Yes
Is return wall longer than 0.8m ?	Yes

Standard Pressure Coefficients

	Zone A	Zone B	Zone C	Zone D
Solidity	1	1	1	-
Cp	2.1	1.8	1.4	1.2



Wall Elevation

Standard Wind Loads

Size effect factor, Ca	
Effective height, He (m)	2.4
Distance to sea (km)	53
Terrain	town
Site exposure type	C
Diagonal dimension (m)	100.029
Ca	0.740

Net Pressures On Wall, p					
	Zone A	Zone B	Zone C	Zone D	
p (N/m²)	380.7	326.3	253.8	217.5	equ (5)

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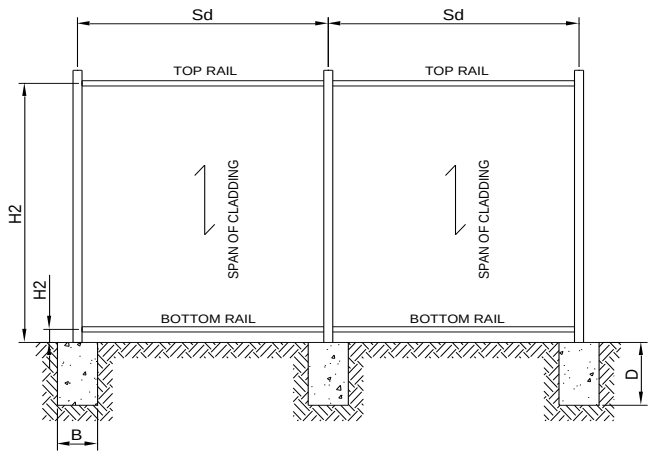
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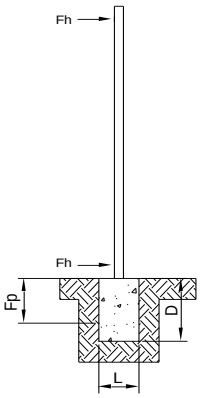
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Project Title:	Project Number: JCCTS23-051
One City Road, Manchester, M15 4PN	Date: Dec-23
	By: CD
Work Section:	Checked: AA
Foundation Check	Revision: -
	Sheet: 04

Location: **All Zones**



ELEVATION ON TYPICAL BAY OF FENCING



SECTION

Design Parameters:

Design Wind Load:	Wd=	0.326	kN/m2
Post Spacing:	Sd=	2.400	m
Post Height:	H1=	2.400	m
	H2=	0.10	m
Ground Conditions:	G	450.0	kN/m2

Trial Foundation Size:

Depth D	=	0.70	m
Width W	=	0.35	m
Length L	=	0.35	m

Check Foundation

Fh = Wd x Sd x H1/2 **0.93888 kN**

Fulcrum Point Fp= .707 x D = 0.4949 m

O/T = Fh x (H1+Fp) + Fh x (H2+Fp) = **3.28 kNm**

F.O.S. = 1.2 5 O/T (ULS) = **4.91476 kNm**

Resistance Mg = (G x D^3 x P) / 10 = **5.40225 kNm**

FOUNDATION IS SATISFACTORY

Use 0.35m x 0.35m x 0.7m deep foundation

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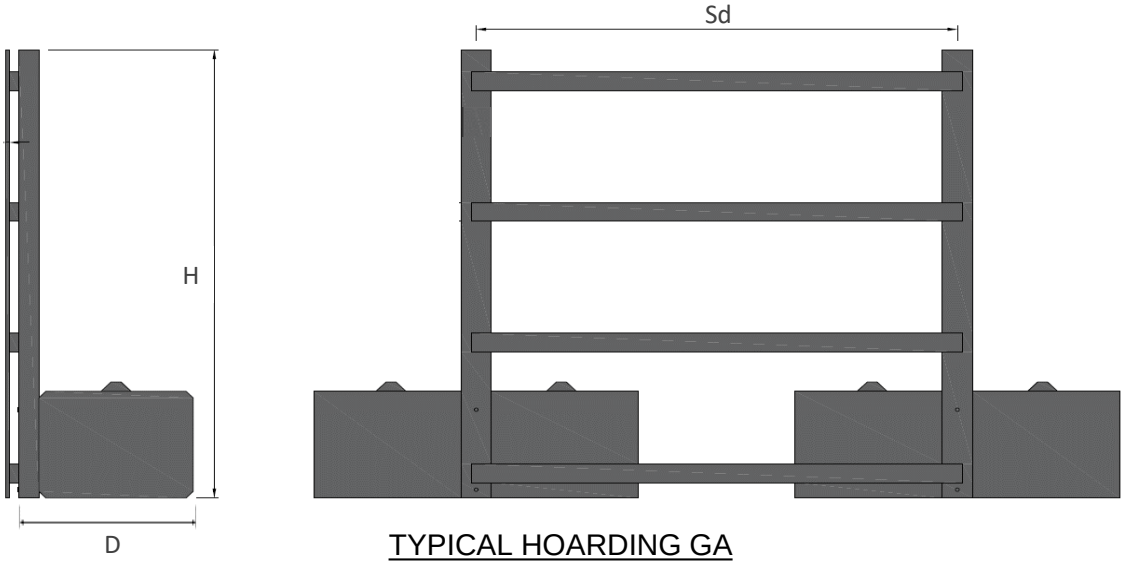
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Project Title: One City Road, Manchester, M15 4PN	Project Number: JCCTS23-051
	Date: Dec-23
	By: CD
Work Section: Ballast Check	Checked: AA
	Revision: -
	Sheet: 05

Location: **All Zones**



TYPICAL HOARDING GA

Design Parameters:

Design Wind Load:	Wd=	0.326	kN/m2
Post Spacing:	Sd=	2.400	m
Post Height:	H=	2.400	m
Depth of Tray:	D=	0.95	m

Overturning Moment

Mo = Wd x Sd x H x (H/2) **2.255 kNm**

Ballast Required

B = (Mo x 1.25) / (D/2) **5.935 kN/frame**

605 Kg/frame (total ballast required)

-80 Kg/frame (additional ballast on 685kg blocks)

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Project Title: One City Road, Manchester, M15 4PN	Project Number: JCCTS23-051
	Date: Dec-23
	By: CD
Work Section: Timber Rail & Post Design	Checked: AA
	Revision: -
	Sheet: 06

Location: All Zones

Wind loading (kN/m2)	0.3263
Post height (m)	2.4
Post spacing (m)	2.4
Number of rails	4

(Rails are spaced equally up the height of the hoarding)

Timber, grade bending stress parallel to the grain (N/mm2)	7.5
K2, for service class 3	0.8
K3, for very short term loading under wind	1.75

(5.3 for C16 and 7.5 for C24)

1) Design of timber rails

Rail spacing (mm)	800
Applied bending moment to rail (kNm)	0.1879
Depth (mm)	100
Width (mm)	50
K7, depth factor =	1.1285
Permissible bending stress parallel to the grain (N/mm2)	11.849
Timber elastic section modulus, major axis (mm3)	83333
Timber bending capacity (kNm)	0.9874

Status: Timber size adequate **Use 4 No 100 x 50 mm timber rails**

2) Design of timber posts

Applied bending moment to post (kNm)	2.2554	(Treated as a UDL along the height of the post)
Depth (mm)	100	
Width (mm)	150	
K7, depth factor =	1.1285	
Permissible bending stress parallel to the grain (N/mm2)	11.849	
Timber elastic section modulus, major axis (mm3)	250000	
Timber bending capacity (kNm)	2.9622	

Status: Timber size adequate **Use 150 x 100 mm timber posts**

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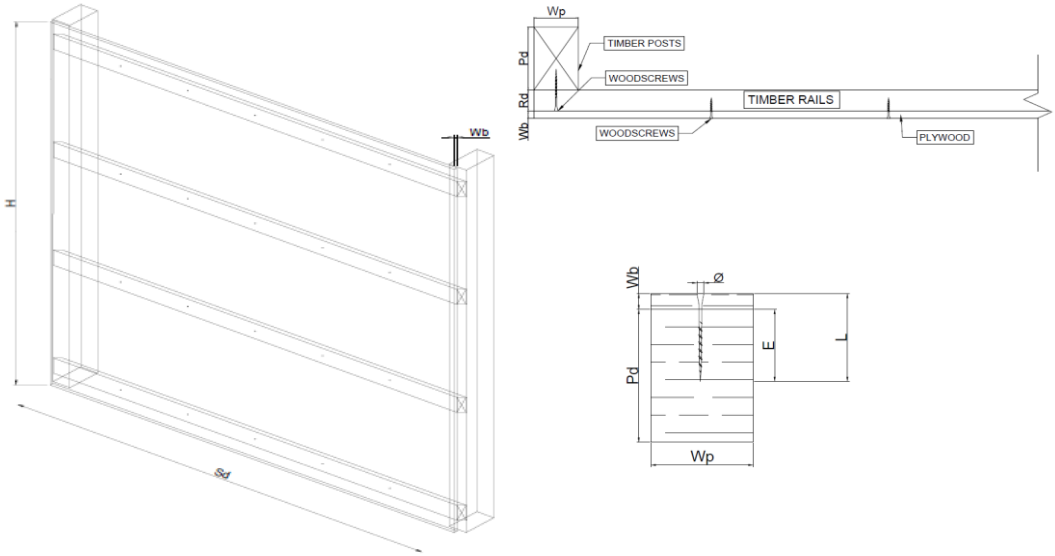
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One City Road, Manchester, M15 4PN	Date: Dec-23
	By: CD
Work Section:	Checked: AA
Face Material Connection	Revision: -
	Sheet: 07

Location: **All Zones**



Timber, grade bending stress parallel to the grain (N/mm2)	7.5	(5.3 for C16 and 7.5 for C24)
K2, for service class 3	0.8	
K3, for very short term loading under wind	1.75	

Design Parameters:

Design Wind Load:	Wd=	0.326	kN/m2
Post Spacing:	Sd=	2.4	m
Post Height:	H1=	2.4	m
Plywood Width	Wb=	18	mm

Trial Design Parameters:

Screw Diameter:	Ø=	5	mm
Screw Length:	L=	50	mm
No. of Screws:	N=	4	

Basic Withdrawal Load (W) :

Based on Table 67 of BS 5268-2:2002:

Ø (mm)	W (N/mm)
3	13.1
3.5	14.7
4	16.3
4.5	17.8
5	19.2
5.5	20.7
6	22.1
7	24.8
8	27.4
10	32.4

Screw Penetration Depth (E) :

E = L - Wb **E =** **0.032** **m**

Permissible Load Per Metre (P) :

P = ((W x E x K3 x K2) / (Sd / N))

P = **1.4336** **kN/m**

Governing Factor = Wd x Sd

G = **0.78312** **kN/m**

P > G, Therefore OK

Use 4 No 50 x 5 mm Woodscrews

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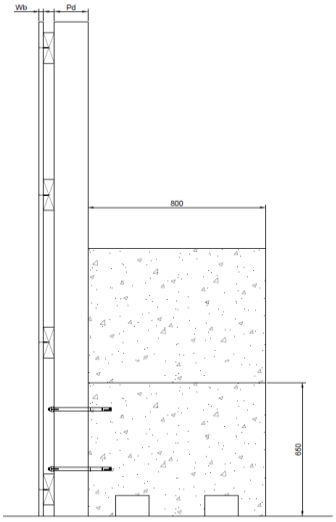
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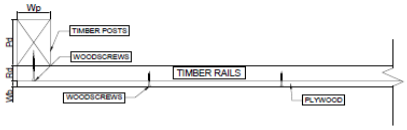
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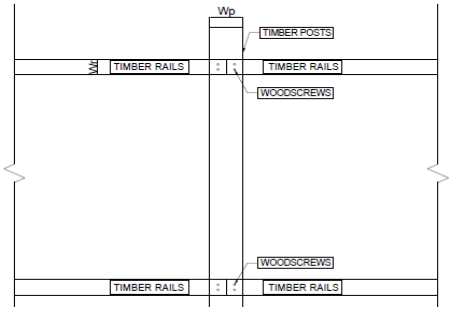
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One City Road, Manchester, M15 4PN	Date: Dec-23
	By: CD
Work Section:	Checked: AA
Rails to Post Connection	Revision: -
	Sheet: 08

Location: **All Zones**







Timber, grade bending stress parallel to the grain (N/mm2)	7.5	(5.3 for C16 and 7.5 for C24)
K2, for service class 3	0.8	
K3, for very short term loading under wind	1.75	

Design Parameters:

Design Wind Load:	Wd=	0.326	kN/m2
Post Spacing:	Sd=	2.4	m
Post Height:	H1=	2.4	m
Rail Width	Wr=	50	mm

Trial Design Parameters:

Screw Diameter:	Ø=	5	mm
Screw Length:	L=	100	mm
No. of Screws:	N=	2	

Basic Withdrawal Load (W) :

Based on Table 67 of BS 5268-2:2002:

Ø (mm)	W (N/mm)
3	13.1
3.5	14.7
4	16.3
4.5	17.8
5	19.2
5.5	20.7
6	22.1
7	24.8
8	27.4
10	32.4

Screw Penetration Depth (E) :

E = L - Wb **E = 50.000 mm**

Full Wind Load (Wl) :

Wl = ((Wd x (H / 4)) x (Sd / 2))

Wl = 0.234936 kN

Permissible Load Per Joint (Pb):

Pb = (E x W x K3 x K2 x N) / 1000

Pb = 2.688 kN/m

Pb > Wl, Therefore OK

Use 2 No 100 x 5 mm Woodscrews

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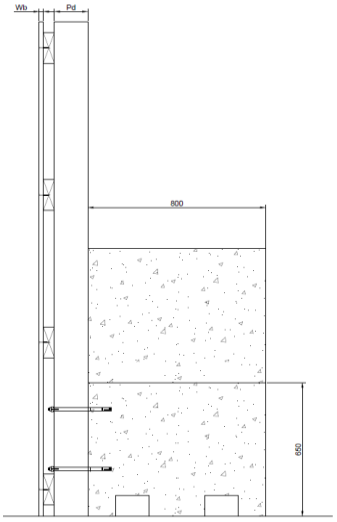
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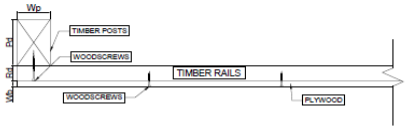
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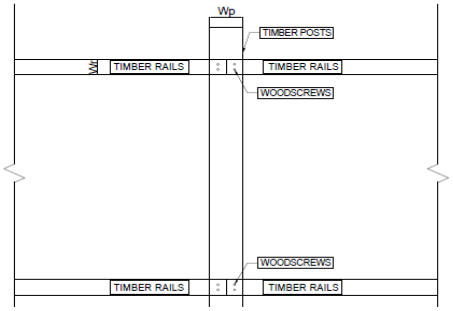
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	Date: Dec-23
	By: CD
Work Section: Ballast Connection	Checked: AA
	Revision: -
	Sheet: 09

Location: All Zones







Timber, grade bending stress parallel to the grain (N/mm2)	7.5	(5.3 for C16 and 7.5 for C24)
K2, for service class 3	0.8	
K3, for very short term loading under wind	1.75	

Design Parameters:

Design Wind Load:	Wd=	0.326	kN/m2
Post Spacing:	Sd=	2.4	m
Post Height:	H1=	2.4	m
Rail Width	Wr=	50	mm

Trial Design Parameters:

Bolt Diameter:	Ø=	16	mm
Screw Length:	L=	100	mm
No. of Bolts:	N=	2	

Overtunring Moment (M) = 2.255 kNm

Restoring Moment (Mr): 12.60 kN

M / 0.290m < Bolt Permissible Tension Load

2.2554 / 0.29 = **7.7772**

7.7772 < 12.6

M < Mr, Therefore OK.