Structural Engineering

Calculations

Client:	**Collins Contractors**
Project Name:	**53 Warminster, Bromley**
Description:	**Proposed Underpinning Modifications**
No of sheet:	**15**
Calc Rev:	**B**
Job No:	**1016** **Date 21.12.22**
Drawing Ref:	**COL 2022-1016-01**

By: Neil Maisuria **For:** Collins Contractors

Unit 2, 30 Breakfield
Coulsdon
Surrey
CR5 2HS

Tel No : 0208 660 0080
Email: graeme@gwcoote.co.uk
Web: www.gwcsolutions.co.uk

This document has been produced by GWCoote Scaffolding Consultancy for **Scaffolding** . It may not be used by any person for any other purpose other than that specified without the express written permission of GWCoote Scaffolding Consultancy. Any liability arising out of use by a third party of this document for purposes not wholly connected with the above shall be the responsibility of that party who shall indemnify GWCoote Scaffolding Consultancy against all claims costs damages and losses arising out of such use.

	Project Name	Job Number	
	53 Warminster, Bromley	**1016**	
	Customer	Revision	
	Collins Contractors	**B**	
	Drawing Reference	Originator	Date
	COL 2022-1016-01	**GWC**	**21.12.22**

Page	Contents	

Contents Page

Design Considerations & Codes

Technical Information

Design Risk Assessment

Scope of works

Loadings

Member checks

Beams

Standards

Stability

	Project Name	Job Number	
	53 Warminster, Bromley	**1016**	
	Customer	Revision	
	Collins Contractors	**B**	
	Drawing Reference	Originator	Date
	COL 2022-1016-01	**GWC**	**21.12.22**

Design Considerations & Codes

Regulations

The Working at Height Regulations 2005

The Construction (Design and Management) Regulations 2008

Design Codes

BS 1139	Metal scaffolding
BS 2482	Timber scaffold boards
BS 5950-1:1990	Structural Steelwork
BS 5974	Temporarily installed suspended access equipment
BS 5975	Code of practice for temporary works procedures and the permissible stress design of falsework.
BS 8118 Part 1: 1991	Structural Use of Aluminium - Code of Practice for Design
BS EN 12810-1:2003	Façade scaffolds made of prefabricated components - products specifications
BS EN 12811-1:2003	Temporary works equipment: Scaffolds - Performance requirements and general design
BS EN 13374:2004	Temporary Edge Protection Systems - Product Specification, test methods
BS EN 1991 Part 1-4:2005	Eurocode 1: Actions on structures - General Actions - Wind Actions
BS EN 1991-2:2003	Eurocode 1: Actions on structures - Part 2: Traffic loads on bridges
BS EN 39: 2001	Loose steel tubes for tube and coupler scaffolds - Technical delivery conditions

Relevant Guides

HSG 33: 1999	Health & Safety in Roof Work
SG28:06	Safe System of Work for Scaffolding associated with Timber Frame Buildings
SG4	The use of Fall Arrest Equipment whilst Erecting, Altering & Dismantling Scaffolding
TG4	Anchoring systems for scaffolding
TG20	NASC Technical Guidance on the use of BS EN 12811-1
TG 21	A guide to commissioning Scaffold designs
TG14	Supplementary Coupler and Check couplers
TG9	Guide to the design and construction of temporary roofs & buildings

Design Approach

BS EN 12811-1 (Scaffolds - Performance requirements and general design) requires a limit state approach is taken for the design of scaffold structures.
In the scaffold industry, many of the published figures for components are given as permissible values. In these calculations we will achieve a limit state approach by using unfactored actions on the scaffold and using an allowable working resistance. The working resistance will be derived by dividing the characteristic resistance by the partial safety factors required by BS EN 12811-1, =1.65 (1.5 for loads x 1.1 for resistance).
This approach will be used unless noted otherwise.

	Project Name: **53 Warminster, Bromley**	Job Number: **1016**	
	Customer: **Collins Contractors**	Revision: **B**	
	Drawing Reference: **COL 2022-1016-01**	Originator: **GWC**	Date: **21.12.22**

Technical Information

Properties of Steel tube

Standard scaffold tube in accordance with TG20

Outside diameter	=	48.3 mm	Z_p (S in TG20)	=	7.87	cm^3
Wall thickness	=	4 mm	Z_e	=	5.7	cm^3
Cross sectional area	=	5.57 cm^2	Allowable BM.	=	1.12	kNm
Mass	=	4.37 kg/m	Allowable shear	=	29.85	kN
I	=	13.8 cm^4	Min yield strength	=	235	N/mm^2
r	=	1.57 cm	Modulus of Elasticity	=	210000	N/mm^2

All tube will be galvanised therefore take as n the permissible stress design of falsework.

Manufacturers Information

Type		MBM	MSF	Self weight
Ladder Beam	=	10.4 kN.m	18.9 kN	0.13 kN/m
Unit Beam	=	27.5 kN.m	15 kN	0.15 kN/m
450mm Alloy Beam	=	18.12 kN.m	15 kN	0.05 kN/m
450mm Steel Beam	=	25 kN.m	18.54 kN	0.135 kN/m
750mm Alloy Beam	=	38.8 kN.m	31.6 kN	0.07 kN/m
750mm Steel Beam	=	60 kN.m	27.27 kN	0.1 kN/m

Allowable tube strut loads

Effective Length	Safe Axial Load (P_c)	Safe Axial Load (P_c)	Effective Length	Safe Axial Load (P_c)	Safe Axial Load (P_c)	Effective Length	Safe Axial Load (P_c)	Safe Axial Load (P_c)
(L_e)	Steel	Aluminium	(L_e)	Steel	Aluminium	(L_e)	Steel	Aluminium
0.6m	70.9kN	79.3kN	1.8m	33.7kN	17.5kN	3.0m	15.2kN	6.6kN
0.8m	65.0kN	64.8kN	2.0m	29.1kN	14.4kN	3.2m	13.6kN	5.8kN
1.0m	58.6kN	48.9kN	2.2m	25.3kN	12.0kN	3.4m	12.2kN	5.2kN
1.2m	51.9kN	36.5kN	2.4m	22.0kN	10.1kN	3.6m	11.0kN	4.6kN
1.4m	45.3kN	27.9kN	2.6m	19.3kN	8.7kN	3.8m	10.0kN	4.2kN
1.6m	39.2kN	21.8kN	2.8m	17.1kN	7.5kN	4.0m	9.1kN	3.8kN

Scaffold boards

Scaffold boards in accordance with TG20 / BS 2482

		Standard	Super Boards	Omega Timber Batten
Width	=	225mm	225mm	225mm
Thickness	=	38mm (±2mm)	38mm (±2mm)	63mm (±3mm)
Mass per unit length	=	6kg/m	6kg/m	10mm
Mass per unit area	=	25kg/m^2	25kg/m^2	41kg/m^2
Max. Support	=	1.2m (+100mm)	1.5m (+100mm)	2.5m
Min. Section Modulus	=	47.5cm^3	47.5cm^3	132cm^3
Allowable BM. (1 board)	=	0.48kNm	0.63kNm	1.30kNm
Allowable BM. (4 boards)	=	0.71kNm	1.01kNm	1.30kNm
Board Overhang - Min	=	50mm	50mm	50mm
Board Overhang - Max	=	150mm	150mm	250mm

Scaffold Coupler Safe Working Loads

Couplers in accordance with TG20 / EN 74

		SSL				
Right angle coupler (Class A)	=	6.10 kN	Parallel coupler	=	6.10	kN
Right angle coupler (Class B)	=	9.10 kN	Putlog coupler	=	0.63	kN
SGB MK3A right angle	=	12.50 kN	SGB Brace DH	=	5.00	kN
Swivel coupler (Class A)	=	6.25 kN	Spigot pin	=	21	kN (Shear)
Sleeve coupler (Class B)	=	3.00 kN	Adjustable Base / FH	=	30	kN (Axial)

	Project Name **53 Warminster, Bromley**	Job Number **1016**	
	Customer **Collins Contractors**	Revision **B**	
	Drawing Reference **COL 2022-1016-01**	Originator **GWC**	Date **21.12.22**

Design Risk Assessment

ACTIVITY OR OPERATION	HAZARD	RESIDUAL RISK	CONTROL MEASURES
Erecting Scaffolding	Fall of persons, materials and equipment	Low	Only trained competent operatives to erect, modify or dismantle scaffolding structures. Erection to be in accordance with: NASC Guidance TG20:13 SG4:15 & The Work at Height Regulations 2005.
	Lift heights & bay lengths not erected in accordance with the drawing	Low	Max lift heights and bay lengths indicated on the drawing, on completion scaffold to be inspected and the relevant procedures for approval prior to use carried out.
	Incorrect beams used or beams not suitably laced and braced in accordance with the drawing	Low	Beam type and depth are indicated on drawing together with max centres for top and bottom chords, position and frequency of plan and section bracing.
	Incorrect positioning and connection of standards and puncheons to bridging beams	Low	All dimensions and measurements indicated on the drawing, on completion scaffold to be inspected and the relevant procedures for approval prior to use carried out.
	Incorrect installation of check fittings or supplementary couplers.	Low	Details showing location, position and number of check or supplementary couplers required indicated on the drawing.
	Incorrect loading to the scaffold	Low	Maximum number of boarded lifts to be indicated on drawing. Maximum number of working lifts together with maximum imposed loading to these lifts indicated on drawing.
	Incorrect tying of scaffold	Low	Position and frequency of ties indicated on drawing. Type of tie together with connection details indicated on drawing. Where anchors are required the safe working load required is indicated on the drawing.
	Incorrect ledger, sway or plan bracing	Low	Position and frequency of bracing indicated on drawing
	Storing components and overloading the scaffold during the erection and dismantling	Low	Suitable plan of works and methods statements to incorporate storage methods
Dismantling scaffolding	Dismantling components or members which endangers the stability of the remaining structure	Low	The stability of the structure is to be assured by fixing a similar or otherwise adequate member in place lower down before the member is removed
	Collapse of an insecure structure	Low	The procedure of dismantling is to be orderly and well planned and should be generally from top in horizontal sections. Consideration should be made to changes that are often made to a scaffold during its working life. The scaffold, especially its tying and bracing, should be inspected prior to dismantling
Weather Conditions	Loads from adverse weather exceeded on scaffold	Low	Maximum dynamic pressure considered and stated on drawing. This is accompanied by a note stating that should these pressures/speeds be exceeded by forecast, any cladding should be removed and that all scaffolds should be inspected after any adverse weather conditions prior to being worked on.
Foundations	Instability of ground to carry imposed scaffold loads	Low	Maximum leg loads are indicated on drawing to enable main contractor to determine any ground works required or check the suitability of any supporting structure to carry the loads.

Ref.	Calculations	Output

Scope of Works

Briefly described, this design covers the required modifications to the scaffold at the rear of the property to allow for underpinning works to be completed. The scaffold has a temporary roof at high level, and whilst this has been considered within the calculations and design, the full stability of the temporary roof and the surrounding scaffold has not been designed/checked within this document - it is purely the modifications works at the rear.

Ref.	Calculations	Output

Loadings

Imposed Load

Imposed load on boarded platform

Main working platform = 1.50 kN/m^2

Levels loaded = 1.00 @100%

Inside boards = 0.75 kN/m^2

Levels loaded = 1.00 @100%

Environmental Loads

Peak Wind load = 0.74 kN/m^2

Structural Factor = 1.00

Sheeted	Side Face Zones			Windward	Leeward
Zone	A	B	C	D	E
C_{pe}	1.20	-0.80	-0.50	0.80	-0.52
P (kN/m^2)	**0.89**	**-0.59**	**-0.37**	**0.59**	**-0.38**

Snow load = 0.37 kN/m^2

Ref.	Calculations	Output

Member design checks

Platform components on access scaffold

By inspection Boards, Transoms & Ledgers Ok, for further information refer to TG20:13

	Project Name	Job Number	
	53 Warminster, Bromley	**1016**	
	Customer	Revision	
	Collins Contractors	**B**	
	Drawing Reference	Originator	Date
	COL 2022-1016-01	**GWC**	**21.12.22**

Ref.	Calculations	Output
	Beams	
	Roof Bridging beam	
REV B	*Section Removed.*	

	Project Name	Job Number
	53 Warminster, Bromley	**1016**
	Customer	Revision
	Collins Contractors	**B**
	Drawing Reference	Originator / Date
	COL 2022-1016-01	**GWC** / **21.12.22**

Ref.	Calculations	Output

REV B

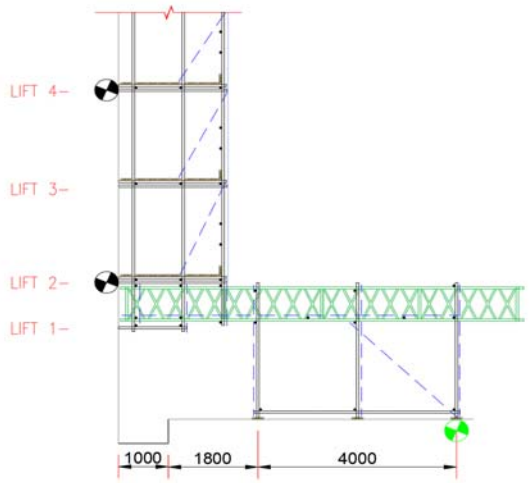
Cantilevered beams (Worst case, Section C-C)

Temporary Roof removed.

Beam type = Apollo 750mm Deep Alu.

Overall beam Span = 6.50 m

Self weight of beam (incl. lacing and bracing) = 0.40 kN/m



Load from inside standard/puncheon:

Self weight of tubes:

Standards	1	no.	x	17.00	m	=	17.00 m
Ledgers	8	no.	x	2.30	m	=	18.40 m
Transoms	16	no.	x	1.00	m	=	16.00 m
Ledger bracing	8	no.	x	1.60	m	=	12.80 m

Total length of tube = 64.20 m

Self weight of tube = 4.37 kg/m

Weight of tube = 280.55 kg

Fittings 35 no. x 1.19 kg = 41.65 kg

Self weight of tube and fittings = 322.20 kg

= 3.16 kN

Self weight of boards (No. of boards is averaged across each lift):

	4.0	Bds.	x	2.30	m	x	0.225	m	=	2.07 m^2
Levels:	6.0	No.	x	2.07	m^2	x	0.25	kN/m^2	=	3.11 kN

Imposed load (Main):

	2.0	Bds.	x	2.30	m	x	0.225	m	=	1.04 m^2
Levels:	1.0	No.	x	1.04	m^2	x	1.50	kN/m^2	=	1.55 kN

	Project Name	Job Number
	53 Warminster, Bromley	**1016**
	Customer	Revision
	Collins Contractors	**B**
	Drawing Reference	Originator / Date
	COL 2022-1016-01	**GWC** / **21.12.22**

Ref.	Calculations	Output

Imposed load (Inside):

	2.0	Bds.	x	2.30	m	x	0.225	m	=	1.04	m^2
Levels:	1.0	No.	x	1.04	m^2	x	0.75	kN/m^2	=	0.78	kN

Total load through puncheon = 7.82 kN

Load through inside/central puncheon without live load = 6.27 kN

Self weight of outside standards:

Standards	1	no.	x	17.00	m	=	17.00 m
Ledgers	8	no.	x	2.30	m	=	18.40 m
Transoms	16	no.	x	0.60	m	=	9.60 m
Handrails	16	no.	x	2.30	m	=	36.80 m
Ledger bracing	8	no.	x	1.04	m	=	8.35 m
Face bracing	6	no.	x	1.52	m	=	9.14 m

Total length of tube = 99.30 m

Self weight of tube = 4.37 kg/m

Weight of tube = 433.92 kg

Fittings	57	no.	x	1.19	kg	=	67.83 kg

Self weight of tube and fittings = 501.75 kg

= 4.92 kN

Self weight of boards:

	3.0	Bds.	x	2.30	m	x	0.225	m	=	1.55	m^2
Levels:	2.0	No.	x	1.55	m^2	x	0.25	kN/m^2	=	0.78	kN

Imposed load:

	2.0	Bds.	x	2.30	m	x	0.225	m	=	1.04	m^2
Levels:	1.0	No.	x	1.04	m^2	x	1.50	kN/m^2	=	1.55	kN

Total load through outside standard = 7.25 kN

Load through outside standard (no live load) = 5.70 kN

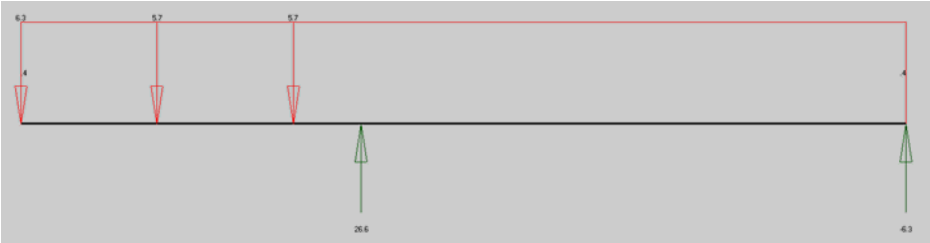
	Project Name: **53 Warminster, Bromley**	Job Number: **1016**	
	Customer: **Collins Contractors**	Revision: **B**	
	Drawing Reference: **COL 2022-1016-01**	Originator: **GWC**	Date: **21.12.22**

Ref.	Calculations	Output

Beam Analysis:

Load through outside standard (no live load) = 5.70 kN

Load through inside/central puncheon without live load = 6.27 kN



Max. Bending moment =	28.40 kNm	
Max. Permissible bending moment =	35.00 kNm	PASS
Max. Shear Load =	18.70 kN	
Max. Permissible shear load =	35.00 kN	PASS
Max. reaction =	26.60 kN	
Capacity of 2no. Class B Couplers with 2no. Supplementary Couplers =	30.39 kN	PASS
Uplift at rear of Cantilevered beams =	6.30 kN	

	Project Name	Job Number
	53 Warminster, Bromley	**1016**
	Customer	Revision
	Collins Contractors	**B**
	Drawing Reference	Originator / Date
	COL 2022-1016-01	**GWC** / **21.12.22**

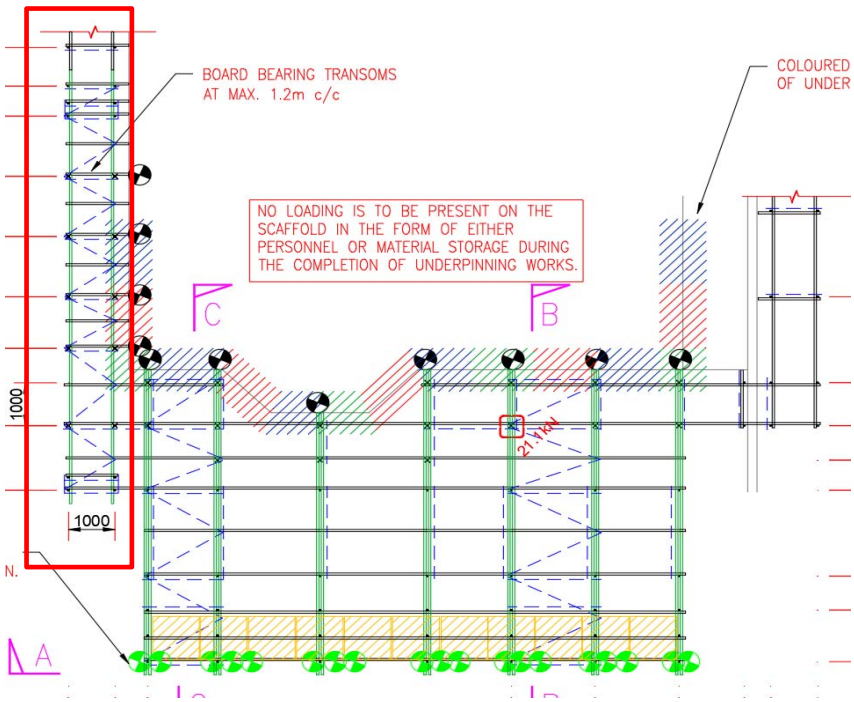
Ref.	Calculations	Output

Bridging Beam on side Elevation

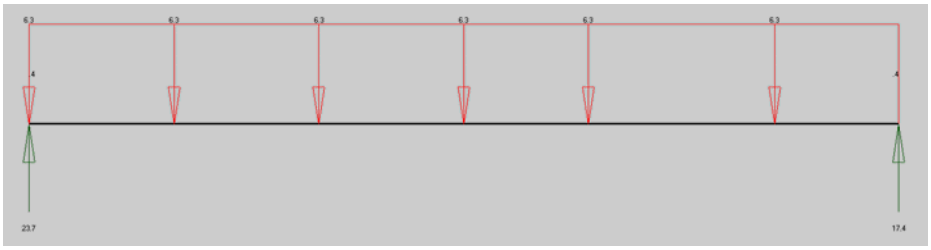
Beam type = Apollo 750mm Deep Alu.

Overall beam Span = 8.70 m

Self weight of beam (incl. lacing and bracing) = 0.40 kN/m



Inside and Outside standard loads (no roof beams) = 6.27 kN



Max. Bending moment = 43.21 kNm

Max. Permissible bending moment = 82.00 kNm PASS

Max. Shear Load = 17.43 kN

Max. Permissible shear load = 74.00 kN PASS

Max. reaction = 23.73 kN

Capacity of 4no. Class B Couplers with 2no. Supplementary Couplers = 60.79 kN PASS

	Project Name	Job Number
	53 Warminster, Bromley	**1016**
	Customer	Revision
	Collins Contractors	**B**
	Drawing Reference	Originator / Date
	COL 2022-1016-01	**GWC** / **21.12.22**

Ref.	Calculations	Output

Standard Loads

Self weight of Beam support standards:

Standards	1	no.	x	3.00	m	=	3.00 m
Ledgers	2	no.	x	2.00	m	=	4.00 m
Transoms	2	no.	x	1.00	m	=	2.00 m
Ledger bracing	1	no.	x	1.12	m	=	1.12 m
Face bracing	1	no.	x	1.41	m	=	1.41 m
Total length of tube						=	11.53 m
					Self weight of tube	=	4.37 kg/m
					Weight of tube	=	50.40 kg
Fittings	9	no.	x	1.19	kg	=	10.71 kg
					Self weight of tube and fittings	=	61.11 kg
						=	0.60 kN
					Load through standard	=	0.60 kN
					Reaction from Canti. Beam	=	26.60 kN
					Total Load in standard	=	27.20 kN
					Allowable Load in 1.00m Standard	=	58.60 kN PASS

	Project Name	Job Number
	53 Warminster, Bromley	**1016**
	Customer	Revision
	Collins Contractors	**B**
	Drawing Reference	Originator / Date
	COL 2022-1016-01	**GWC** / **21.12.22**

Ref.	Calculations	Output

Stability

REV B

Load on low level ties at rear

	Height:		Width:			
Contributory wind area:	2.30	x	2.30	m	=	5.29 m^2

Wind Load = 0.59 kN/m^2

Axial Load on tie from wind = 3.13 kN

Class	Couplers	No.	Capacity	Wind Overstress	Max. Permissible	
B	Main	1	1.00	1.00	9.10	kN
	Suppl.	0	0.67			

Pass

Anchor Type	No. of Bolts	Permissible Load per Bolt	Total Permissible	
Apollobolt M12	1	9.00	9.00	kN

Pass

Overturning of Cantilevered beams

Uplift at rear of beams = 6.30 kN

Safety Factor for overturning = 1.50

Uplift including safety factor = 9.45 kN

If using ground anchors 900mm:

Ground anchor manufacturers tested load = 1260.0 kg
= 12.36 kN

Safety factor on anchors = 1.50

Safe working load of ground anchors = 8.24 kN

Required No. of ground anchors at each standard location = 2.00 No.

If using Kentledge Blocks:

Weight of 1000L IBC = 10.00 kN

No. of Kentledge blocks required per Standard = 1.00 No.