BDS SCAFFOLD DESIGN SPECIALISTS

Supporting Calculations

Drawn by:
Jacob Akrigg

Draft: **Approval:** 02-06-2026 **Construction:**

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Jacob Akrigg

Approval: 02-06-2026 **Construction:**

Checked by:
Joe Rigby

Draft: **Approval:** 02-06-2026 **Construction:**

Client:
Cubic Works Ltd

Project:
Winters Building, Manchester, M2 7PW

Drawing title:
Item 4 – Internal Riser Void Install

Drawing status:
APPROVAL

Drawing ref:
11743-4



Components & Material Properties

Items listed below are for information purposes only, & are not necessarily used in this design.
All tubes used in this design are based on type 4, unless otherwise stated.
All couplers used in this design are based on class "B", unless otherwise stated.

NASC TG20:21 - Page 119 - Table 5.9
Steel Tube (Type 4)

Area	=	5.57cm²
Wall Thickness	=	4mm
Self Weight	=	4.37kg/m (0.043kN/m)
Diameter	=	48.3mm
Radius of Gyration	=	1.57cm
Plastic Modulus	=	7.87cm³
Design Strength	=	235N/mm²
Modulus of Elasticity	=	210000N/mm²
Moment of Inertia	=	13.8cm⁴
Moment Capacity	=	1.12kNm
Shear Capacity	=	29.1kN

NASC TG20:21 - Page 121 - Table 5.10

Effective Length (L_E)	**Slenderness ratio - λ**	**Safe axial load -Pc**
1.0m	63.50	58.60kN
1.1m	70.00	55.25kN
1.2m	76.50	51.90kN
1.3m	82.70	48.60kN
1.4m	88.90	45.30kN
1.5m	95.30	42.25kN
1.6m	101.70	39.20kN
1.7m	108.05	36.45kN
1.8m	114.40	33.70kN
1.9m	120.75	31.40kN
2.0m	127.10	29.10kN
2.1m	133.45	27.20kN
2.2m	139.80	25.30kN
2.3m	146.15	23.65kN
2.4m	152.50	22.00kN
2.5m	158.85	20.65kN
2.6m	165.20	19.30kN
2.7m	171.55	18.20kN
2.8m	177.90	17.10kN
2.9m	184.25	16.15kN
3.0m	190.60	15.20kN
3.1m	196.95	14.40kN
3.2m	203.30	13.60kN
3.3m	209.65	12.90kN
3.4m	216.00	12.20kN

Effective Length (L_E)	Slenderness ratio - λ	Safe axial load -Pc
3.5m	222.35	11.60kN
3.6m	228.70	11.00kN
3.7m	235.05	10.50kN
3.8m	241.40	10.00kN
3.9m	247.75	9.55kN
4.0m	254.10	9.10kN

NASC TG20:21 - Page 129 - Table 5.14

Effective lengths, L_E of standards in ledger braced tied independent scaffolds with 2m lifts with effective façade bracing

Vertical intervals betw lines of ties	Bay lengths 1.2m	1.5m	1.8m	2.0m	2.1m	2.4m	2.7m
2m with 2m 1st lift	2.5	2.5	2.5	2.5	2.55	2.75	2.9
2m with 2.7m 1st lift	2.7	2.7	2.7	2.7	2.7	2.9	3
4m	3.2	3.2	3.2	3.2	3.2	3.2	3.2
6m	4	4	4	4	4	4	4

NASC TG20:21 - Page 166 - Table C1

Aluminium Tube

Area	=	6.15cm^2
Wall Thickness	=	4.47mm
Self Weight	=	1.65kg/m
Diameter	=	48.3mm
Radius of Gyration	=	1.56cm
Plastic Modulus	=	8.61cm^3
Design Strength	=	255N/mm^2
Modulus of Elasticity	=	70000N/mm^2
Moment of Inertia	=	14.9cm^4
Moment Capacity	=	1.33kNm

NASC TG20:21 - Page 167 - Table C.2

Effective Length (L_E)	Slenderness ratio - λ	Safe axial load -Pc
1.0m	64.2	48.90kN
1.2m	77	36.60kN
1.4m	89.9	27.90kN
1.6m	102.7	21.80kN
1.8m	115.5	17.50kN
2.0m	128.4	14.40kN
2.2m	141.2	12.00kN
2.4m	154	10.10kN
2.6m	166.9	8.70kN
2.8m	179.7	7.50kN

NASC TG20:21 - Page 135 - Table 5.15

Couplers

Right Angle Coupler (Double) Class "A"	SWL =	6.10kN	Slip
Right Angle Coupler (Double) Class "B"	SWL =	9.10kN	Slip
Band & plate (Double) coupler	SWL =	6.10kN	Slip
Right Angle Coupler (Double) Self Weight	SW =	1.25kg	
Swivel Coupler Class "A"	SWL =	6.10kN	Slip
Swivel Coupler Class "B"	SWL =	9.10kN	Slip
Swivel Coupler Self Weight	SW =	1.33kg	
Sleeve Coupler Class "A"	SWL =	3.60kN	Tension
Adjustable Screw Jack (200mm extension)	SWL =	35.00kN	Compression
Girder Coupler (must be used in pairs)	SWL =	10.00kN	"X" Axis
	SWL =	30.00kN	"Y" Axis
	SWL =	12.50kN	"Z" Axis
Girder Coupler Self Weight (each)	SW =	1.50kg	

Timber Scaffold Boards

Self Weight	=	25kg/m^2
Width	=	225mm
Thickness	=	38mm
Section Modulus	=	47.5cm^3
Moment Capacity	=	0.48kNm

300mm Ladder Beams* (Steel) Laced at 1m c/c

Self Weight	=	0.30kN	(laced & braced)
Moment Capacity	=	10.40kNm	
Shear Capacity	=	18.00kN	

*For further information refer to manufacturer

RMD Superslim Soldiers

Moment Capacity	=	38.0kNm
Shear Capacity	=	75.0kN

*For further information refer to manufacturer

450mm Apollo Beams* (Aluminium) Laced at 1m c/c

Self Weight	=	0.14kN	(laced & braced)
Moment Capacity	=	15.70kNm	
Shear Capacity	=	13.90kN	

*For further information refer to manufacturer

750mm Apollo Beams* (Aluminium) Laced at 1m c/c

Self Weight	=	0.28kN	(laced & braced)
Moment Capacity	=	42.90kNm	
Shear Capacity	=	45.50kN	

*For further information refer to manufacturer

1300mm Apollo Beams* (Aluminium) Laced at 1m c/c

Self Weight	=	Varies TBC (laced & braced)
Moment Capacity	=	98.52kNm
Shear Capacity	=	44.25kN

*For further information refer to manufacturer

1500mm Apollo Beams* (Aluminium) Laced at 1m c/c

Self Weight	=	Varies TBC (laced & braced)
Moment Capacity	=	255.00kNm
Shear Capacity	=	60.00kN

*For further information refer to manufacturer

1300mm Asterix Beams* (Aluminium)

Self Weight	=	Varies TBC (laced & braced)	
Moment Capacity	=	102.20kNm	Laced at 1m c/c
Moment Capacity	=	77.70kNm	Laced at 1.5m c/c
Shear Capacity	=	42.10kN	(Top & Bottom chords connected)
Shear Capacity	=	32.60kN	(Bottom chord connected)

*For further information refer to manufacturer

450mm Layher Beams* (Aluminium) Laced at 1m c/c

Self Weight	=	0.14kN	(laced & braced)
Moment Capacity	=	13.94kNm	
Shear Capacity	=	12.32kN	

*For further information refer to manufacturer

450mm Layher Beams* (Aluminium) Laced at 1.5m c/c

Self Weight	=	0.14kN	(laced & braced)
Moment Capacity	=	8.06kNm	
Shear Capacity	=	12.32kN	

*For further information refer to manufacturer

450mm Layher Beams* (Aluminium) Laced at 2m c/c

Self Weight	=	0.14kN	(laced & braced)
Moment Capacity	=	5.14kNm	
Shear Capacity	=	12.32kN	

*For further information refer to manufacturer

780mm Dessa Beams* (Aluminium) Laced at 1m c/c. (6no. bolts 3 each side of spigot)

Self Weight	=	0.28kN	(laced & braced)
Moment Capacity	=	38.84kNm	
Shear Capacity	=	23.71kN	

*For further information refer to manufacturer

Relevant Design Standards/guidance (only a selection of the below standards are applicable for this design)

BS EN 39	:2001	Specification for steel scaffold tube.
BS EN 74-1	:2022	Couplers, spigot pins & baseplates for use in falsework & scaffolds.
BS EN 12811-1	:2003	Temporary works equipment: Scaffolds - Performance requirements & general design.
BS EN 12812-1	:2008	Falsework: Performance requirements & general design.
BS EN 1139-1-2	:1990	Metal scaffolding - part 1: Tubes - Specification for aluminium tube.
BS EN 1139-2-2	:2009	Metal scaffolding - part 2: Couplers - Specification for aluminium couplers.
BS EN 1991-1-1	:2002	Eurocode 1: Actions on structures - Densities, self-weight & imposed loads.
BS EN 1991-1-3	:2003	Eurocode 1: Actions on structures - Snow loads.
BS EN 1991-1-4	:2005	Eurocode 1: Actions on structures - Wind loads.
BS EN 1991-2	:2003	Eurocode 1: Actions on structures - Part2: Traffic load and bridges
BS EN 13374	:2013	Temporary edge protection systems - Product specification, test methods.
BS 5975	:2019	Code of practise for temporary work procedures & the per design of false work.
BS 2482	:2009	Specification for timber scaffold boards.

TG3:25	Erection, use & dismantling of temporary rubbish chutes on scaffold.
TG4:25	Anchorage systems.
TG9:18	Guide to the design & construction of temporary roofs & buildings.
TG12:22	Tying down of scaffold boards.
TG13:23	Non-standard boarded platforms.
TG16:21	Anchoring to the ground.
TG20:21	Technical guidance on the use of BS EN 12811-1.

SG4:22	Preventing falls in scaffolding.
SG5:18	Overhead power sources.
SG25:20	Access & egress from scaffolds.
SG27:22	Temporary edge protection on open steelwork.
SG28:25	Safe system of work for scaffolding associated with timber frame building construction.
SG29:17	Internal edge protection on scaffold platforms.
SG32:17	Provision of extended & telescopic transoms & board brackets.
SG34:17	Guidance on protection of the public

Safe Working Loads:	Crash Deck with 1no. Lift at:						10 kN/m²
SWL Crash Deck:	Slab Depth		0.30m				
	1.00m	*	1.00m	*	0.30m	=	0.30 kN/m³
	0.30m³	*	25kN/m³			=	7.5 kN/m²
	8kN/m²	*	25%			=	1.88 kN/m²
	8kN/m²	+	1.88kN/m²			=	9.38 kN/m²
					Therefore Use =		10.00 kN/m²

Item: Independent			Item: Loading Bay	
Max Bay Length:	0.75m		Max Bay Length:	N/A
Max Bay Width:	1.40m	(6 bds)	Max Bay Width:	N/A
Max Transom Centres:	0.35m		Max Transom Centres:	N/A
Max Standard Load:	Refer to DWG's		Max Standard Load:	N/A
Item: Birdcage			Item: Buttress	
Max Bay Length:	N/A		Max Bay Length:	N/A
Max Bay Width:	N/A		Max Bay Width:	N/A
Max Transom Centres:	N/A		Max Transom Centres:	N/A
Max Standard Load:	N/A		Max Standard Load:	N/A
Item: Ties (Tension)			Item: Ties (Shear)	
Max Tie Load:	N/A		Max Tie Load:	N/A
Preliminary Test:	N/A		Preliminary Test:	N/A
Proof Test:	N/A		Proof Test:	N/A

Additional Comments (if required)	Wind Parameters	
- Scaffold internally founded & not subject to wind, therefore no further analysis required	Site Location (Postcode):	N/A
	Structure Height:	N/A
	Altitude Above Sea Level (m):	N/A
	Peak Wind Velocity (Qp):	N/A
	Basic Wid Velocity (m/s):	N/A
	Wind Speed (mph):	N/A
	Wind Speed (Km/h):	N/A
	Snow Load (kN/m²):	N/A

Item: **Independent** Y

Bay Lengths (m)	Bay Widths (m)	Transom C/C (m)	No. Inside Boards	SWL (kN/m²)
0.75	**1.4**	**0.35**	**0**	**12**

Dynamic Load Applied	Board Dead Load (kN/m²)
YES	**0.25**

Consider Scaffold Boards Spanning

1.4 m

Dead Load	Centres		Width		Load		Results	
Boards	0.35 m		0.225 m		0.25	kN/m²	(kN) =	0.020
Imposed Loads	0.35 m		0.225 m		12	kN/m²	(kN) =	0.945
Bending Moment	0.020	+	0.945	X	0.35	/8	(kNm) =	0.042

Allowable Bending Moment For Scaffold Boards = **0.48kNm** (kNm) > **0.042**

PASSES

Transoms With No Inside Boards

Consider The Transoms Spanning 1.4 m

Dead Load	Centres		Span		Load		Results	
Boards	0.35 m		1.4 m		0.25	kN/m²	(kN) =	0.123
Tube	1.4 m		X		0.043	kN/m	(kN) =	0.060
Total	0.123 kN		+		0.060	kN	(kN) =	0.183
Imposed Load	0.35 m		1.4 m		12	kN/m²	(kN) =	5.880

Non-cantilevered Transom BM as TG20:21 - section 5.11.1.1 - M = 0.125 X W X L (kNm)

Bending Moment	0.125		6.06 kN		1.4 m		(kNm) =	1.061

Allowable Bending Moment For Scaffold Tube = **1.12kNm** (kNm) > **1.061**

PASSES

Transoms With Inside Boards

Consider The Transoms Spanning 0 m

Dead Load	Centres		Span		Load		Results	
Boards	0.35 m		0 m		0.25	kN/m²	(kN) =	0.000
Tube	0 m		X		0.043	kN/m	(kN) =	0.000
Total	0.000 kN		+		0.000	kN	(kN) =	0.000
Imposed Load	0.35 m		0 m		0.75	kN/m²	(kN) =	0.000

Cantilevered Transom BM as TG20:21 - section 5.11.1.2 - Mc = 0.5 X Wc X Lc (kNm)

Bending Moment	0.5		0.00 kN		0 m		(kNm) =	0.000

Allowable Bending Moment For Scaffold Tube = **1.12kNm** (kNm) > **0.000**

PASSES

Continuous Transoms e.g. Birdcage

Consider The Transoms Spanning 1.4 m

Dead Load	Centres		Span		Load		Results	
Boards	0.35	m	1.4	m	0.25	kN/m²	(kN) =	0.123
Tube	1.4	m	X		0.043	kN/m	(kN) =	0.060
Total	0.123	kN	+		0.060	kN	(kN) =	0.183
Imposed Load	0.35	m	1.4	m	12	kN/m²	(kN) =	5.880

Continuous Transom BM as TG20:21 - section 5.11.1.3 - M = 0.086 X W X L (kNm)

Bending Moment	0.086	6.06	kN	1.4	m	(kNm) =	0.730
	Allowable Bending Moment For Scaffold Tube = **1.12kNm**					(kNm) >	**0.730**
							PASSES

Simply Supported Ledger

Consider The Ledger Spanning 0.75 m

Transom Point Load 3.03 kN

Simply supported ledger as TG20:21 - section 5.12.1.1 - M = 0.25 X P X L (kNm)

Bending Moment	0.25	3.03	kN	0.75	m	(kNm) =	0.568
	Allowable Bending Moment For Scaffold Tube = **1.12kNm**					(kNm) >	**0.568**
							PASSES

Continuous Ledger

Consider The Ledger Spanning 0.75 m

Transom Point Load 3.03 kN

Continuously supported ledger as TG20:21 - section 5.12.1.2 - M = 0.167 X P X L (kNm)

Bending Moment	0.167	3.03	kN	0.75	m	(kNm) =	0.380
	Allowable Bending Moment For Scaffold Tube = **1.12kNm**					(kNm) >	**0.380**
							PASSES

Part Continuous Ledger (end bay)

Consider The Ledger Spanning 0.75 m

Transom Point Load 3.03 kN

Part continuous supported ledger as TG20:21 - section 5.12.1.2 - M = 0.172 X P X L (kNm)

Bending Moment	0.172	3.03	kN	0.75	m	(kNm) =	0.391
	Allowable Bending Moment For Scaffold Tube = **1.12kNm**					(kNm) >	**0.391**
							PASSES

Additional Platform Check Comments (if required)

Consider Load Per Node Capacities

Item: **Independent**

Bay Widths (m)	Bay Length (m)	SWL (kN/m²)	Bds Dead Load (kN/m2)	Tube Dead Load (kN)
1.4	**0.75**	**10**	**0.25**	**0.45**

No. Inside Boards	SWL (kN/m²) inside bds
0	**0**

Coupler Type Used -	Class A:		6.1kN	No. of Primary Connections:	**1**
Coupler Type Used -	Class B:	**Y**	9.1kN	No. of Supplementary Connections:	**1**
				Strength of Connection:	**15.20kN**

Loads in accordance with TG20:21, 5.9.2

Inside Node

Bay Width	*	Bay Length	*	(SWL	+	BDSsw)	+	Tsw	Result
0.70m	*	0.75m	*	10	+	0.25	+	0.45kN	**5.83kN**
0.00m	*	0.75m	*	0	+	0.25			**0.00kN**
								=	**5.83kN**
					5.83kN	<	15.20kN	Therefore	**PASSES**

Outside Node

Bay Width	*	Bay Length	*	(SWL	+	BDSsw)	+	Tsw	Result
0.70m	*	0.75m	*	10	+	0.25	+	0.45kN	**5.83kN**
					5.83kN	<	15.20kN	Therefore	**PASSES**

OUTSIDE STANDARD Allowance For Double Width: N/A

Tube DL (kN/m)	0.043	Boards DL (kN/m2) (kN/m)	0.25 0.056	Fittings (kN)	0.018	**Length (m)**	**Width (m)**	**Quantity**	**Length (or) Area**
Bay Size						0.75m	1.40m		
Standards (lift height)								1	1.18m
Ledgers								1	0.75m
Beam							kN/m	0	0.75m
Transom								4	0.70m
Guardrails								0.2	0.75m
Boarded (Main Platform)								1	0.53
Boarded (Inside Boards)								0	0.00
Toe Boards								0	0.75m
Ledger Bracing								0.7	2.19m
Façade Bracing								0.7	1.87m
Plan Bracing								0	1.98m
Fittings								6.6	N/A

Live Loads Applied

			Total Number of Lifts:	12
			Number of Boarded Lifts:	4
(SWL) 100%	10.00kN	/m²	Total Dead Load Per Lift:	0.45kN
(SWL) 50%	5.00kN	/m²	Total Dead Load	**5.94kN**
(SWL) Inside bds	0.75kN	/m²		
Maximum No. Lifts at 100%	1		Total Live Load:	**5.25kN**
Maximum No. Lifts at 50%	0			
No. Lifts with inside bds loaded	1		Total Load Combined:	**11.19kN**

No. Support Stds/Puncheons 1

Axial Load	Effective Length (LE)	Safe Axial Load (Pc)	Slenderness Ratio (λ)	Slenderness Max (λ)	Result
11.19kN	2.0 m	29.10kN	127.1	271	**PASSES**

Ground Bearing Pressure (GBP)

		Sole Pad Arrangements		
		Pad Width (m)	Pad Length (m)	Pad Area (sqm)
Typical Arrangement	y	0.225	0.450	0.10125
Increased Arrangement		0.450	0.450	0.2025
Tredda Plate		0.210	0.210	0.0441
Other				0

Imposed Load: 11.19 kN

GBP: 110.47 kN/m²

Additional Comments If Required

OUTSIDE STANDARD Allowance For Double Width: N/A

Tube DL (kN/m)	0.043	Boards DL (kN/m2) (kN/m)	0.25 0.056	Fittings (kN)	0.018	Length (m)	Width (m)	Quantity	Length (or) Area
Bay Size						0.75m	1.40m		
Standards (lift height)								1	1.18m
Ledgers								1	0.75m
Beam							kN/m	0	0.75m
Transom								4	0.70m
Guardrails								0.2	0.75m
Boarded (Main Platform)								1	0.53
Boarded (Inside Boards)								0	0.00
Toe Boards								0	0.75m
Ledger Bracing								0.7	2.19m
Façade Bracing								0.7	1.87m
Plan Bracing								0	1.98m
Fittings								6.6	N/A

Live Loads Applied

		Total Number of Lifts:	3	
		Number of Boarded Lifts:	1	
(SWL) 100%	10.00kN /m²	Total Dead Load Per Lift:		0.45kN
(SWL) 50%	5.00kN /m²	Total Dead Load		**1.48kN**
(SWL) Inside bds	0.75kN /m²			
Maximum No. Lifts at 100%	1	Total Live Load:		**5.25kN**
Maximum No. Lifts at 50%	0			
No. Lifts with inside bds loaded	1	Total Load Combined:		**6.73kN**

Consider Worst Case Propping Load

Dead Load	+	Worst Case	=	Total Load
1.48kN	+	**11.19kN**	=	**12.67kN**

No. Support Stds/Puncheons 1

Axial Load	Effective Length (Le)	Safe Axial Load (Pc)	Slenderness Ratio (λ)	Slenderness Max (λ)	Result
12.67kN	2.0 m	29.10kN	127.1	271	**PASSES**

Ground Bearing Pressure (GBP)

		Sole Pad Arrangements		
		Pad Width (m)	Pad Length (m)	Pad Area (sqm)
Typical Arrangement	y	0.225	0.450	0.10125
Increased Arrangement		0.450	0.450	0.2025
Tredda Plate		0.210	0.210	0.0441
Other				0

Imposed Load:	12.67	kN
GBP:	125.12	kN/m²

Consider Timber Pad Foundation **Timber Pad Type:** **Single Sole Pad**

Timber Sole Pad Information	
Timber Grade:	C24
Bending Strength:	24N/mm2
Shear Strength:	2.5N/mm2
Modulus Elasticity (E):	10800mpa
Length (L):	450mm
Width/Bredth (b):	750mm
Depth/Height (h):	38mm

Point Load Information	
Consider Point Load (P):	11.19kN
Conversion (P):	11185N

Consider Bearing Stress On Timber Under A Steel Base Plate

					Result			
Area of Plate:	150mm	*	150mm	=	22500mm2			Result
$\sigma Bearing =$	11185N	/	22500mm2	=	0.50N/mm2	<	24N/mm2	PASSES

Consider Timber Section Properties

Area (A): $A = bh$

b	*	h	=	A
750mm	*	38mm	=	28500mm²

Second Moment of Area (I): $\frac{I = bh^3}{12}$

b	*	h³	/	12	=	I
750mm	*	38mm³	/	12	=	3429500/mm4

Section Modulus (Z): $z = \frac{I}{bh/2}$

b	*	h²	/	6	=	Z
750mm	*	38mm²	/	6	=	180500/mm³

Consider Global Bending (Simply Supported, Mid-Point Load)

Bending Moment: $Mmax = \frac{PL}{4}$

P	*	L	/	4	=	$Mmax$
11185N	*	450mm	/	4	=	1258324Nmm

Bending Stress: $\sigma b = \frac{Mmax}{z}$

Mmax	/	Z	=	σb		Capacity	Result
1258324N/mm	/	180500/mm³	=	6.97N/mm²	<	24N/mm2	PASSES

Consider Global Shear (Reactions At Supports)

Reaction: $V = P/2$

P	/	2	=	V
11185N	/	2	=	5593N

Rectangular Section: $Tmax = 1.5\frac{V}{A}$

V	/	A	=	Result
5593N	/	28500mm²	=	0.20N/mm²

1.5	*	Result	=	$Tmax$		Capacity	Result
1.5	*	0.20N/mm²	=	0.29N/mm²	<	2.5N/mm2	PASSES

Consider Deflection

Deflection: $\delta max = \frac{PL^3}{48EI}$

P	*	L³	=	Result
11185N	*	450mm³	=	1019242273950Nmm³

48	*	E	*	I	=	Result
48	*	10800mpa	*	3429500/mm4	=	1777852800000Nmm²

Result	/	Result	=	δmax
1019242273950Nmm³	/	1777852800000Nmm²	=	0.57mm

Allowable Deflection: $L/300$

L	/	300	=	Capacity		δmax	Result
450mm	/	300	=	1.50mm	>	0.57N/mm2	PASSES

Conclusion

	σb		Capacity	Result
Bending Stress:	6.97N/mm²	<	24N/mm2	PASSES

	$Tmax$		Capacity	Result
Global Shear:	0.29N/mm²	<	2.5N/mm2	PASSES

	δmax		Capacity	Result
Deflection:	0.57mm	<	1.50mm	PASSES