

	Date: 25/08/2020	Client: Craven Scaffolding Ltd	Drawing Status: APPROVAL
	Prepared By: Rob Forster	Project: 108 High Street, Manchester	Drawing No: BDS-6194-01 to 03
	Date: 25/08/2020	Drawing Title: Independent Access Scaffold with Lifting Frame	Revision: N/A Date: N/A Pages: N/A
	Checked By: Lee Buckley	& Various Beam Spans	

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 TG20:13 - Page 119 - Table 5.9

Steel Tube (Type 4)

Area	= 5.57cm ²
Wall Thickness	= 4mm
Self Weight	= 4.37kg/m (0.043kN/m)
Diameter	= 48.3mm
Radius of Gyration	= 1.57cm
Plastic Modulus	= 7.87cm ³
Design Strength	= 235N/mm ²
Modulus of Elasticity	= 210000N/mm ²
Moment of Inertia	= 13.8cm ⁴
Moment Capacity	= 1.12kNm
Shear Capacity	= 29.1kN

NASC TG20:13 - Page 121 - Table 5.10

Effective Length (L_E) Slenderness ratio - λ Safe axial load -P_c

1.0m	63.5	= 58.6kN
1.2m	76.5	= 51.9kN
1.4m	88.9	= 45.3kN
1.6m	101.7	= 39.2kN
1.8m	114.4	= 33.7kN
2.0m	127.1	= 29.1kN
2.2m	139.8	= 25.3kN
2.4m	152.5	= 22.0kN
2.6m	165.2	= 19.3kN
2.8m	177.9	= 17.1kN
3.0m	190.6	= 15.2kN
3.2m	203.3	= 13.6kN
3.4m	216.0	= 12.2kN
3.6m	228.7	= 11.0kN
3.8m	241.4	= 10.0kN
4.0m	254.1	= 9.10kN

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NASC TG20:13 - Page 129 - Table 5.14

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

Vertical intervals between lines of ties	Bay lengths						
	1.2m	1.5m	1.8m	2m	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	3.0
4m	3.2	3.2	3.2	3.2	3.2	3.2	3.2
6m	4.0	4.0	4.0	4.0	4.0	4.0	4.0

NASC TG20:13 - 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 TG20:13 - Page 167 - Table C.2

Effective Length (L_E) Slenderness ratio - λ Safe axial load - P_c

1.0m	64.2	= 48.9kN
1.2m	77	= 36.6kN
1.4m	89.9	= 27.9kN
1.6m	102.7	= 21.8kN
1.8m	115.5	= 17.5kN
2.0m	128.4	= 14.4kN
2.2m	141.2	= 12.0kN
2.4m	154.0	= 10.1kN
2.6m	166.9	= 8.70kN
2.8m	179.7	= 7.50kN
3.0m	192.5	= 6.60kN

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NASC TG20:13 - Page 135 - Table 5.15

Couplers

Right Angle Coupler (Double) Class "A"	SWL = 6.1kN	Slip
Right Angle Coupler (Double) Class "B"	SWL = 9.1kN	Slip
Band & plate (Double) coupler	SWL = 6.1kN	Slip
Right Angle Coupler (Double) Self Weight	SW = 1.25kg	
Swivel Coupler Class "A"	SWL = 6.1kN	Slip
Swivel Coupler Class "B"	SWL = 9.1kN	Slip
Swivel Coupler Self Weight	SW = 1.33kg	
Sleeve Coupler Class "A"	SWL = 3.6kN	Tension
Adjustable Screw Jack	SWL = 35kN	Compression (max 200mm extension)
Girder Coupler (must be used in pairs)	SWL = 10kN	"X" Axis
	SWL = 30kN	"Y" Axis
	SWL = 12.5kN	"Z" Axis
Girder Coupler Self Weight (each)	SW = 1.5kg	

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	= 0.3kN (laced & braced)
Moment Capacity	= 10.4kNm
Shear Capacity	= 18kN

*For further information refer to manufacturer

RMD Superslim Soldiers

Moment Capacity	= 38kNm
Shear Capacity	= 75kN

*For further information refer to manufacturer

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

Self Weight	= 0.14kN (laced & braced)
Moment Capacity	= 15.7kNm
Shear Capacity	= 13.9kN

*For further information refer to manufacturer

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

Self Weight	= 0.28kN (laced & braced)
Moment Capacity	= 42.9kNm
Shear Capacity	= 45.5kN

*For further information refer to manufacturer

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

Self Weight	= Varies TBC (laced & braced)
Moment Capacity	= 71.1kNm
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	= 255kNm
Shear Capacity	= 60kN

*For further information refer to manufacturer

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	Lee Buckley		

1300mm Asterix Beams* (Aluminium)

Self Weight	= Varies TBC (laced & braced)	
Moment Capacity	= 102.2kNm	Laced at 1m c/c
Moment Capacity	= 77.7kNm	Laced at 1.5m c/c
Shear Capacity	= 42.1kN (Top & Bottom chords connected)	
Shear Capacity	= 32.6kN (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

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	Checked By: Lee Buckley		

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	:2005	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 13374	:2013	Temporary edge protection systems - Product specification, test methods.
BS 5975	:2008	Code of practise for temporary work procedures & the permissible stress design of false work.
BS 2482	:2009	Specification for timber scaffold boards.
TG3:11		Erection, use & dismantling of temporary rubbish chutes on scaffold.
TG4:19		Anchorage systems.
TG9:17		Guide to the design & construction of temporary roofs & buildings.
TG12:10		Tying down of scaffold boards.
TG13:16		Non-standard boarded platforms.
TG16:14		Anchoring to the ground.
TG20:13		Technical guidance on the use of BS EN 12811-1.
SG4:15		Preventing falls in scaffolding.
SG5:11		Overhead power sources.
SG25:14		Access & egress from scaffolds.
SG27:09		Temporary edge protection on open steelwork.
SG28:17		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

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	Lee Buckley		

Job Description

Independent access scaffold to both sides of wall with lifting frame at top lift to remove and replace capping stone.

Safe Working Load: Independent with 1N^o lift at 5kN/m² working at any one time.
All inside boards rated at 0.75kN/m² unless otherwise stated in the below calculations.

Safe Working Load: Lifting Frame, max lift 300kg working at any one time.

Item - Independent

Max Bay Length: 1.8m
Max Bay Width: 1.18m (5 boards)
Max Transom Spacing's: 0.9m
Max Leg Load: 67.3kN / 6no standards = 11.22kN

Item – Contact Points

Max compression Load: 9.22kN



BDS SCAFFOLD
DESIGN
SPECIALISTS

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25/08/2020

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Rob Forster

Date:
25/08/2020

Checked By:
Lee Buckley

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Craven Scaffolding Ltd

Project:
108 High Street, Manchester

Drawing Title:
Independent Access Scaffold with Lifting Frame
& Various Beam Spans

Drawing Status:
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Item: Independent	Y								
Bay Lengths (m)	1.8	Consider the scaffold boards spanning		0.9 m					
Bay widths (m)	1.2	Dead load	Centres	Width	Load				
Transom C/C (m)	0.9	Boards	0.9 m	0.23 m	0.25 kN/m ²	=	0.051 kN		
No. Inside boards	1	Imposed load	0.9 m	0.23 m	5 kN/m ²	=	1.013 kN		
Boards Self-weight (kN/m ²)	0.25	Bending moment	0.051 +	1.01 X	0.9 /8	=	0.120 kNm		
Safe Working Load (kN/m ²)	5	Allowable Bending Moment for Scaffold Boards = 0.48kNm					>	0.120 kNm	
Transoms with no inside boards		Consider the transoms spanning		1.2 m					Therefore PASSES
		Dead load	Centres	Span	Load				
		Boards	0.9 m	1.2 m	0.25 kN/m ²	=	0.270 kN		
		Tube	1.2 m	X	0.043 kN/m ²	=	0.052 kN		
		Total	0.270 kN	+	0.052 kN	=	0.322 kN		
		Imposed load	0.9 m	1.2 m	5 kN/m ²	=	5.400 kN		
		Non-cantilevered Transom BM as TG20:13 - section 5.11.1.1 - M = 0.125 X W X L (kNm)							
		Bending Moment	0.125	5.72 kN	1.20 m	=	0.858 kNm		
		Allowable Bending Moment for Scaffold tube = 1.12kNm					>	0.858 kNm	
Transoms with inside boards		Consider the transoms spanning		0.23 m					Therefore PASSES
		Dead load	Centres	Span	Load				
		Boards	0.9 m	0.23 m	0.25 kN/m ²	=	0.051 kN		
		Tube	0.225 m	X	0.043 kN/m ²	=	0.010 kN		
		Total	0.051 kN	+	0.010 kN	=	0.060 kN		
		Imposed load	0.9 m	0.23 m	0.75 kN/m ²	=	0.152 kN		
		Cantilevered Transom BM as TG20:13 - section 5.11.1.2 - M _c = 0.5 X W _c X L _c (kNm)							
		Bending Moment	0.5	0.21 kN	0.225 m	=	0.024 kNm		
		Allowable Bending Moment for Scaffold tube = 1.12kNm					>	0.024 kNm	
		Therefore PASSES							



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Continuous transoms e.g. birdcage	Consider the transoms spanning		1.2 m			
	Dead load	Centres	Span	Load		
	Boards	0.9 m	1.2 m	0.25 kN/m²	=	0.270 kN
	Tube	1.2 m	X	0.043 kN/m²	=	0.0516 kN
	Total	0.270 kN	+	0.052 kN	=	0.322 kN
	Imposed load	0.9 m	1.2 m	5 kN/m²	=	5.400 kN
	Continuous Transom BM as TG20:13 - section 5.11.1.3 - $M = 0.086 \times W \times L$ (kNm)					
	Bending Moment	0.086	5.72 kN	1.20 m	=	0.590 kNm
	Allowable Bending Moment for Scaffold tube = 1.12kNm					>
Therefore PASSES						
Simply supported ledger	Consider the ledger spanning		1.8 m			
	Transom point load		3.07 kN			
	Simply supported ledger as TG20:13 - section 5.12.1.1 - $M = 0.25 \times P \times L$ (kNm)					
	Bending Moment	0.25	3.07 kN	1.80 m	=	1.383 kNm
	Allowable Bending Moment for Scaffold tube = 1.12kNm					>
Continuous Ledger	Consider the ledger spanning		1.8 m			N/A
	Transom point load		3.07 kN			
	Continuously supported ledger as TG20:13 - section 5.12.1.2 - $M = 0.167 \times P \times L$ (kNm)					
	Bending Moment	0.167	3.07 kN	1.80 m	=	0.924 kNm
	Allowable Bending Moment for Scaffold tube = 1.12kNm					>
Part continuous Ledger (end bay)	Consider the ledger spanning		1.8 m			Therefore PASSES
	Transom point load		3.07 kN			
	Part continuous supported ledger as TG20:13 - section 5.12.1.2 - $M = 0.172 \times P \times L$ (kNm)					
	Bending Moment	0.172	3.07 kN	1.80 m	=	0.951 kNm
	Allowable Bending Moment for Scaffold tube = 1.12kNm					>
Therefore PASSES						

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STANDARDS (Front Elev)

Leg Load Calculation (Typical Standards)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>			
Lift Heights:	2	m.	No. of Lifts with o/s Guardrails	7	1	No. Lifts @	5	kN/m2	
Max.No. of Lifts:	8	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2	
Max.No. of Boarded Lifts:	6	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2	
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>			
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg		
Width of Scaffold:	1.18	m.			0	kN.	0	kN	
			Inside Leg	Outside Leg		<u>Max. Leg Load.</u>			
					B/cage leg		IND IS.Leg	IND OS.Leg	
No. Lifts requiring double Standards			0	0	22.230	kN.	11.115	kN.	11.677

Leg Load Calculation (750 Beam Supports)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	2	m.	No. of Lifts with o/s Guardrails	5.5	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	7	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	5.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>		
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			Inside Leg	Outside Leg	B/cage leg	<u>Max. Leg Load.</u>		
No. Lifts requiring double Standards	0		0	0	21.247	kN.	IND IS.Leg	IND OS.Leg
							10.623	10.893
						kN.		

Leg Load Calculation (450 Beam Supports LHS)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	2	m.	No. of Lifts with o/s Guardrails	5.5	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	7	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	5.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>		
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			Inside Leg	Outside Leg	B/cage leg	<u>Max. Leg Load.</u>		
No. Lifts requiring double Standards	0		0	0	21.247	kN.	IND IS.Leg	IND OS.Leg
							10.623	10.893
						kN.		

Leg Load Calculation (450 Beam Supports RHS)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	1.9	m.	No. of Lifts with o/s Guardrails	4	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	6	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	4	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>		
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			Inside Leg	Outside Leg	B/cage leg	<u>Max. Leg Load.</u>		
No. Lifts requiring double Standards	0		0	0	19.528	kN.	9.764	kN.
							IND IS.Leg	IND OS.Leg
							9.764	9.690

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PUNCHEONS (Front Elev)

Leg Load Calculation (750 Beam Puncheons)

Calculate Axial Load in Standards.			Handrails			Live Load:			
Lift Heights:	1.9	m.	No. of Lifts with o/s Guardrails	6	1	No. Lifts @	5	kN/m2	
Max.No. of Lifts:	7	No.	No. of Lifts with l/s Guardrails	0	0	No. Lifts @	0	kN/m2	
Max.No. of Boarded Lifts:	6	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2	
Max.No. of Inside Boards:	0.5	No.	Additional. Load						
Scaffold Bay Size:	1.8	m.				Ins. Leg	Outs. Leg		
Width of Scaffold:	1.18	m.				0	kN.	0	kN
			Inside Leg	Outside Leg		Max. Leg Load.			
					B/cage leg	IND IS.Leg		IND OS.Leg	
No. Lifts requiring double Standards	0		0	21.476	kN.	10.738	kN.	11.125	

Leg Load Calculation (450 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	1.8	m.	No. of Lifts with o/s Guardrails	4.5	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	5.5	No.	No. of Lifts with l/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	4.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				Additional. Load		
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			Inside Leg	Outside Leg		<u>Max. Leg Load.</u>		
					B/cage leg	IND IS.Leg		IND OS.Leg
No. Lifts requiring double Standards	0		0	19.449	kN.	9.724	kN.	9.773

Load Per Node (Independent)

Inside Node

Board _{width}	*	Bay _{length}	*	(SWL + BDS _{sw})	+	T _{sw}	
0.6m	*	1.8m	*	(5kN/m ² + 0.25kN/m ²)	+	0.45kN	= 6.12kN
0.23m	*	1.8m	*	(0.75kN/m ² + 0.25kN/m ²)			= 0.41kN
6.12kN + 0.41kN						< 15.2kN therefore passes	

Outside node

0.6m	*	1.8m	*	(5kN/m ² + 0.25kN/m ²)	+	0.45kN	= 6.12kN
6.12kN						< 15.2kN therefore passes	

Capacity of supplementary coupler = 9.1kN * 0.67 = 6.1kN
 (9.1kN * 1no fixing coupler) + (6.1kN * 1no check coupler) = **15.2kN**

5.9.2 Supplementary couplers

When it is intended to increase the safe working capacity of a joint by the use of supplementary couplers to back up the main coupler, the information required regarding the strength of the proposed arrangement may be obtained from the manufacturer or supplier based on tests carried out and interpreted in accordance with BS EN 74-1 and BS EN 12811-3. However, BS EN 12811-1 Annex C table C1 implies that the combined slip resistance of two class AA right angle couplers should be assumed as 1.5 × the slip resistance of a single coupler and the combined slip resistance of two class BB right angle couplers should be assumed as 1.67 × the slip resistance of a single coupler. Class AA and BB couplers are single class A and B couplers which have been tested as pairs in contact and found to satisfy the requirements of BS EN 74-1 table 8.

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	Prepared By: Rob Forster	Project: 108 High Street, Manchester	Drawing No: BDS-6194-01 to 03
	Date: 25/08/2020	Drawing Title: Independent Access Scaffold with Lifting Frame & Various Beam Spans	Revision: N/A Date: N/A Pages: N/A
	Checked By: Lee Buckley		

Loadings and Reactions On 750mm Apollo Beams - Front Elevation Worst Case Outside Beam

Point Loads

11.13kN @ 1.8m, 11.13kN @ 3.6m

Max Reaction

W_{Weight}	*	$N^{\circ} \text{ point loads}$	/2	
11.13kN	*	$2N^{\circ}$	/2	= 11.13kN
Support 1		Reaction = 11.13kN		< 30.4kN therefore passes
Support 2		Reaction = 11.13kN		< 30.4kN therefore passes

Max Shear

W_{Weight}	*	$N^{\circ} \text{ point loads}$	/2	
11.13kN	*	$2N^{\circ}$	/2	= 11.13kN
Max		Shear = 11.13kN		< 45.5kN therefore passes

Max BM

$(2.67 * W_{\text{Weight}})$	*	L_{Length}	/8		(EUL, 2 PL's)
$(2.67 * 11.13\text{kN})$	*	5.4m	/8	= 20.06kNm	
Bending Moment at 2.7m		Bending Moment = 20.06kNm		< 42.9kNm therefore passes	

Leg Loads To Ground To Support Beam

Position	Axial Load
Support 1	10.89kN + 11.13kN = 22.02kN
Support 2	10.89kN + 11.13kN = 22.02kN

Position	Axial Load	Effective Length (L_E)	Safe Axial Load (P_c)	Slenderness Ratio (λ)	Slenderness Ratio (λ) Max	Result
Support 1	22.02kN	2.1m	< 27.2kN	133.45	< 271	Therefore Passes
Support 2	22.02kN	2.1m	< 27.2kN	133.45	< 271	Therefore Passes

Up-Lift

N/A

Capacity of supplementary coupler = $9.1\text{kN} * 0.67 = 6.1\text{kN}$
 $(9.1\text{kN} * 2\text{no fixing couplers}) + (6.1\text{kN} * 2\text{no check couplers}) = \mathbf{30.4kN}$

5.9.2 Supplementary couplers

When it is intended to increase the safe working capacity of a joint by the use of supplementary couplers to back up the main coupler, the information required regarding the strength of the proposed arrangement may be obtained from the manufacturer or supplier based on tests carried out and interpreted in accordance with BS EN 74-1 and BS EN 12811-3. However, BS EN 12811-1 Annex C table C1 implies that the combined slip resistance of two class AA right angle couplers should be assumed as $1.5 \times$ the slip resistance of a single coupler and the combined slip resistance of two class BB right angle couplers should be assumed as $1.67 \times$ the slip resistance of a single coupler. Class AA and BB couplers are single class A and B couplers which have been tested as pairs in contact and found to satisfy the requirements of BS EN 74-1 table 8.

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	Checked By: Lee Buckley		

Loadings and Reactions On 450mm Layher Beams – Front & Rear Elevation Worst Case Outside Beam

Point Loads

9.77kN @ 1.8m

Max Reaction

W_{Weight}	*	N° point loads	/2	
9.77kN	*	$1N^{\circ}$	/2	= 4.89kN
Support 1		Reaction = 4.89kN		< 30.4kN therefore passes
Support 2		Reaction = 4.89kN		< 30.4kN therefore passes

Max Shear

W_{Weight}	*	N° point loads	/2	
9.77kN	*	$1N^{\circ}$	/2	= 4.89kN
Max		Shear = 4.89kN		< 12.32kN therefore passes

Max BM

W_{Weight}	*	L_{Length}	/4		(Centre point load)
9.77kN	*	3.6m	/4	= 8.79kNm	
Bending Moment at 1.8m		Bending Moment = 8.79kNm		< 13.94kNm therefore passes	

Leg Loads To Ground To Support Beam

Position	Axial Load
Support 1	10.89kN + 4.89kN = 15.78kN
Support 2	9.69kN + 4.89kN = 14.58kN

Position	Axial Load	Effective Length (L_E)	Safe Axial Load (P_c)	Slenderness Ratio (λ)	Slenderness Ratio (λ) Max	Result
Support 1	15.78kN	2.1m	< 27.2kN	133.45	< 271	Therefore Passes
Support 2	14.58kN	2.1m	< 27.2kN	133.45	< 271	Therefore Passes

Up-Lift

N/A

	Date:	Client:	Drawing Status:
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			Date: N/A
Checked By:	Lee Buckley	& Various Beam Spans	Pages: N/A

PUNCHEONS (Rear Elev)

Leg Load Calculation (750 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	1.6	m.	No. of Lifts with o/s Guardrails	3	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	5	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	3	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>		
Scaffold Bay Size:	0.79	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			<u>Inside Leg</u>	<u>Outside Leg</u>	<u>B/cage leg</u>	<u>Max. Leg Load.</u>	<u>IND IS.Leg</u>	<u>IND OS.Leg</u>
No. Lifts requiring double Standards	0		0	0	9.375	kN.	4.687	kN.
								4.609

Leg Load Calculation (750 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	1.6	m.	No. of Lifts with o/s Guardrails	3	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	5	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	3	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>		
Scaffold Bay Size:	1.57	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			<u>Inside Leg</u>	<u>Outside Leg</u>	<u>B/cage leg</u>	<u>Max. Leg Load.</u>	<u>IND IS.Leg</u>	<u>IND OS.Leg</u>
No. Lifts requiring double Standards	0		0	0	16.080	kN.	8.040	kN.
								7.791

Leg Load Calculation (750 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	1.7	m.	No. of Lifts with o/s Guardrails	4	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	5	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	3.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>		
Scaffold Bay Size:	1.59	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			<u>Inside Leg</u>	<u>Outside Leg</u>	<u>B/cage leg</u>	<u>Max. Leg Load.</u>	<u>IND IS.Leg</u>	<u>IND OS.Leg</u>
No. Lifts requiring double Standards	0		0	0	16.592	kN.	8.296	kN.
								8.231

Leg Load Calculation (750 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>		
Lift Heights:	1.7	m.	No. of Lifts with o/s Guardrails	5	1	No. Lifts @	5	kN/m2
Max.No. of Lifts:	6	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2
Max.No. of Boarded Lifts:	4.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2
Max.No. of Inside Boards:	0.5	No.				<u>Additional. Load</u>		
Scaffold Bay Size:	1.7	m.			Ins. Leg		Outs. Leg	
Width of Scaffold:	1.18	m.			0	kN.	0	kN
			<u>Inside Leg</u>	<u>Outside Leg</u>	<u>B/cage leg</u>	<u>Max. Leg Load.</u>	<u>IND IS.Leg</u>	<u>IND OS.Leg</u>
No. Lifts requiring double Standards	0		0	0	18.776	kN.	9.388	kN.
								9.525

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	Checked By:	& Various Beam Spans	Pages: N/A
	Lee Buckley		

Leg Load Calculation (750 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>			
Lift Heights:	1.7	m.	No. of Lifts with o/s Guardrails	5	1	No. Lifts @	5	kN/m2	
Max.No. of Lifts:	7	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2	
Max.No. of Boarded Lifts:	5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2	
Max.No. of Inside Boards:	0.5	No.				Additional. Load			
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg		
Width of Scaffold:	1.18	m.			0	kN.	0	kN	
			Inside Leg	Outside Leg		<u>Max. Leg Load.</u>			
					B/cage leg		IND IS.Leg	IND OS.Leg	
No. Lifts requiring double Standards	0		0	0	20.643	kN.	10.322	kN.	10.473

Leg Load Calculation (750 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>			
Lift Heights:	1.7	m.	No. of Lifts with o/s Guardrails	5	1	No. Lifts @	5	kN/m2	
Max.No. of Lifts:	6	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2	
Max.No. of Boarded Lifts:	4.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2	
Max.No. of Inside Boards:	0.5	No.				Additional. Load			
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg		
Width of Scaffold:	1.18	m.			0	kN.	0	kN	
			Inside Leg	Outside Leg	B/cage leg	<u>Max. Leg Load.</u>			
						IND IS.Leg		IND OS.Leg	
No. Lifts requiring double Standards	0		0	0	19.697	kN.	9.848	kN.	9.985

Leg Load Calculation (750 Beam Puncheons)

<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>			
Lift Heights:	1.7	m.	No. of Lifts with o/s Guardrails	4	1	No. Lifts @	5	kN/m2	
Max.No. of Lifts:	5	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2	
Max.No. of Boarded Lifts:	3.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2	
Max.No. of Inside Boards:	0.5	No.				Additional. Load			
Scaffold Bay Size:	1.8	m.			Ins. Leg		Outs. Leg		
Width of Scaffold:	1.18	m.			0	kN.	0	kN	
			Inside Leg	Outside Leg		<u>Max. Leg Load.</u>			
					B/cage leg	IND IS.Leg		IND OS.Leg	
No. Lifts requiring double Standards	0		0	0	18.434	kN.	9.217	kN.	9.127

Leg Load Calculation (750 Beam Puncheons)

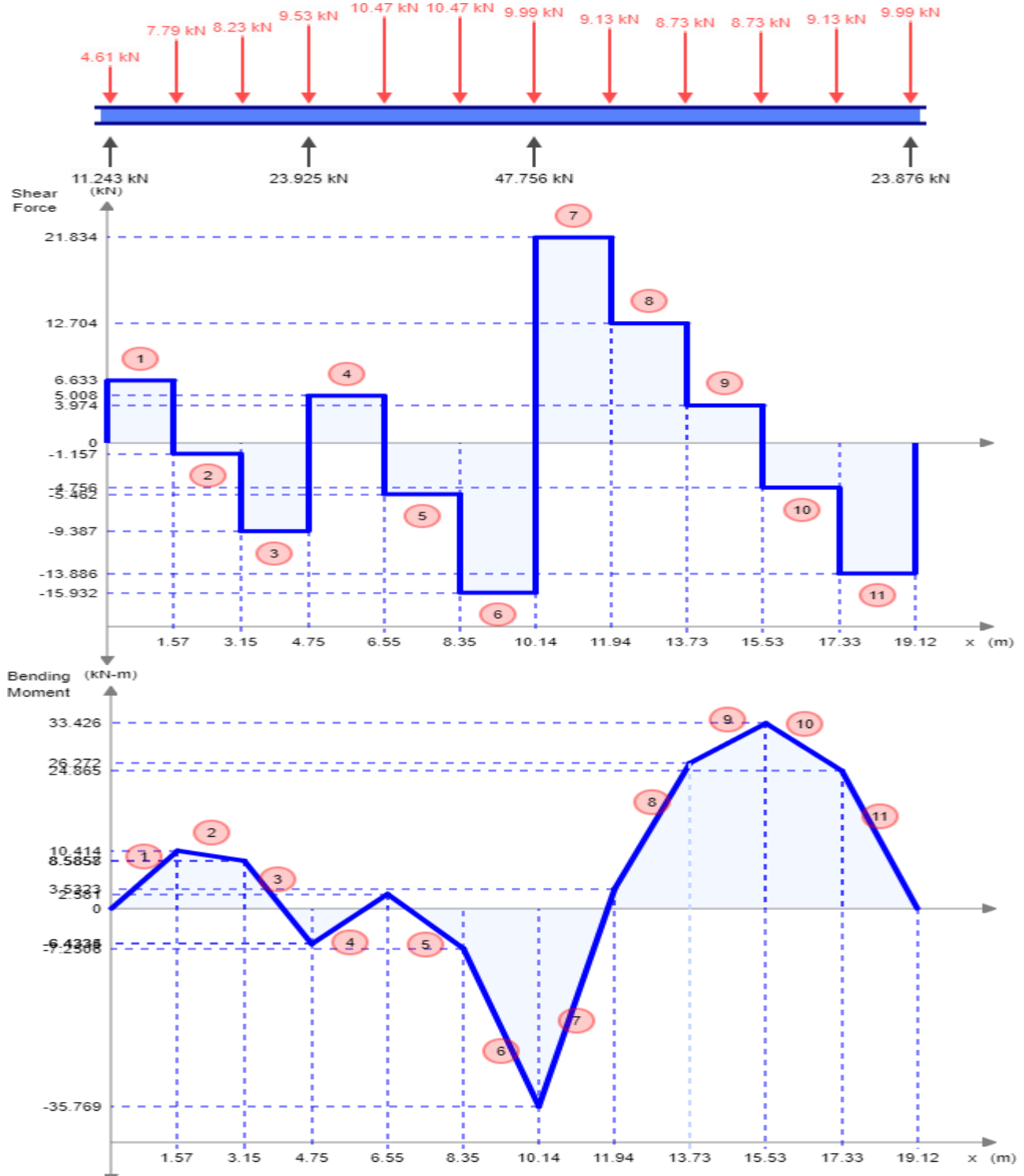
<u>Calculate Axial Load in Standards.</u>			<u>Handrails</u>			<u>Live Load:</u>			
Lift Heights:	1.6	m.	No. of Lifts with o/s Guardrails	3	1	No. Lifts @	5	kN/m2	
Max.No. of Lifts:	5	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0	kN/m2	
Max.No. of Boarded Lifts:	3	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0	kN/m2	
Max.No. of Inside Boards:	0.5	No.	Additional. Load						
Scaffold Bay Size:	1.8	m.				Ins. Leg	Outs. Leg		
Width of Scaffold:	1.18	m.				0	kN.	0	kN
			Inside Leg	Outside Leg	B/cage leg	<u>Max. Leg Load.</u>			
						IND IS.Leg		IND OS.Leg	
No. Lifts requiring double Standards	0		0	0	18.057	kN.	9.029	kN.	8.729

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	Checked By: Lee Buckley		

Loadings and Reactions On 750mm Apollo Beams - Rear Elevation Outside Beam

Point Loads

4.61kN @ 0m, 7.79kN @ 1.57m, 8.23kN @ 3.15m, 9.53kN @ 4.75m, 10.47kN @ 6.55m, 10.47kN @ 8.35m, 9.99kN @ 10.14m, 9.13kN @ 11.94m, 8.73kN @ 13.73m, 8.73kN @ 15.53m, 9.13kN @ 17.33m, 9.99kN @ 19.12m



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Max Reaction

Support 1	Reaction = 11.24kN / 2no ladder beams = 5.62kN	< 30.4kN therefore passes
Support 2	Reaction = 23.93kN / 2no ladder beams = 11.97kN	< 30.4kN therefore passes
Support 3	Reaction = 47.76kN / 2no ladder beams = 23.88kN	< 30.4kN therefore passes
Support 4	Reaction = 23.88kN / 2no ladder beams = 11.94kN	< 30.4kN therefore passes

Max Shear

Max	Shear = 21.83kN	< 45.5kN therefore passes
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Max BM

Bending Moment at 10.14m	Bending Moment = 35.77kNm	< 42.9kNm therefore passes
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Loads Applied To Ladder Beam Supports

Position Axial Load

Support 1	= 11.24kN
Support 2	= 23.93kN
Support 3	= 47.76kN
Support 4	= 23.88kN

Up-Lift

N/A

Leg Load Calculation (Ladder Beam Support Towers)

Calculate Axial Load in Standards			Handrails		Live Load:		
Lift Heights:	1.1	m.	No. of Lifts with o/s Guardrails	2	1	No. Lifts @	0 kN/m2
Max.No. of Lifts:	3	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0 kN/m2
Max.No. of Boarded Lifts:	0	No.	No. of Guardrails per Lift.	1	0	No. Lifts @	0 kN/m2
Max.No. of Inside Boards:	0	No.				Additional. Load	
Scaffold Bay Size:	0.25	m.				Ins. Leg	Outs. Leg
Width of Scaffold:	0.25	m.				0 kN.	0 kN
			Inside Leg	Outside Leg	Max. Leg Load.		
				B/cage leg	IND IS.Leg		
No. Lifts requiring double Standards	0		#N/A	1.074 kN.	IND OS.Leg		
					0.537 kN.		
					0.653		

Leg Load Calculation (750 Beam Supports)

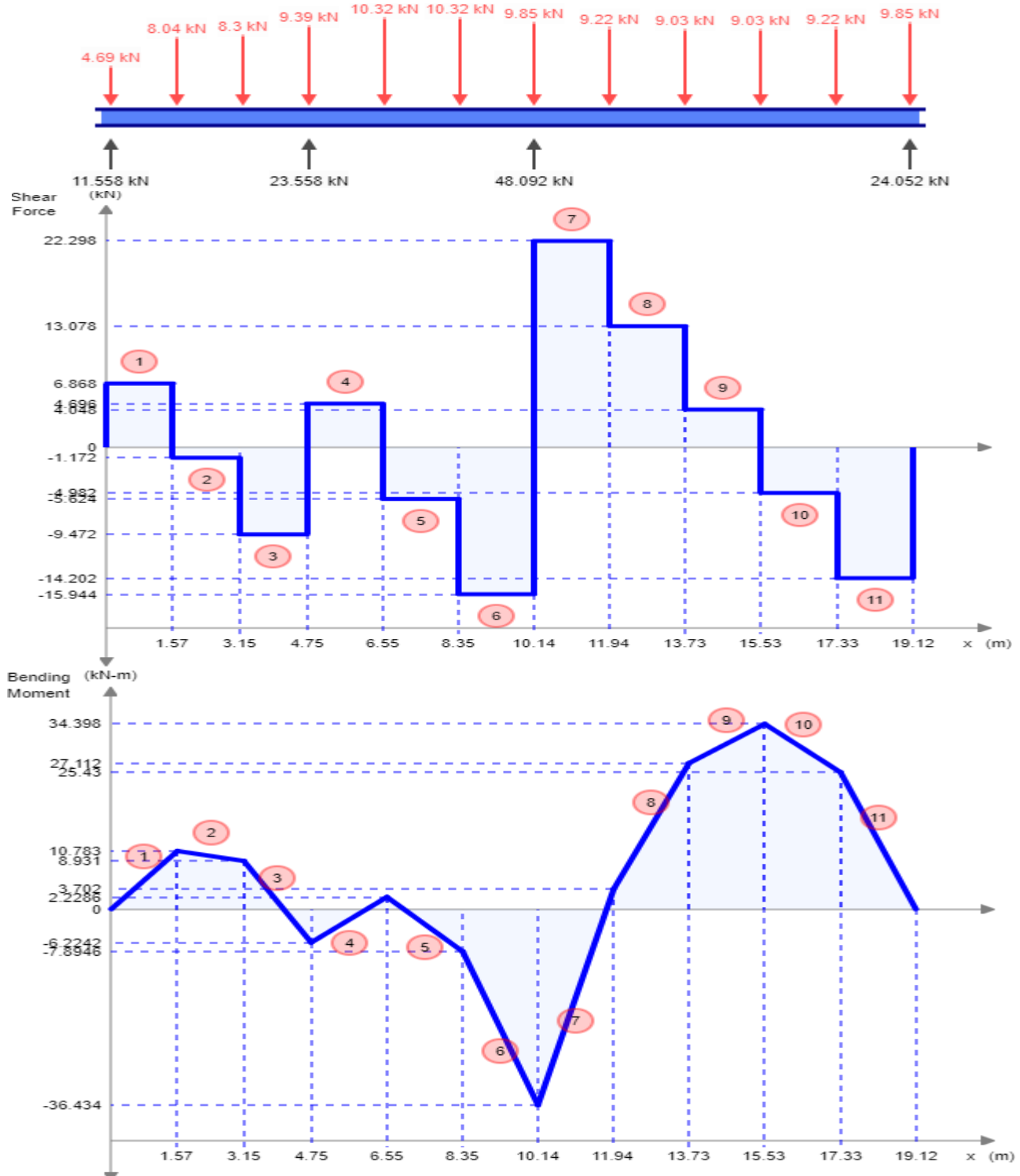
Calculate Axial Load in Standards			Handrails		Live Load:		
Lift Heights:	2	m.	No. of Lifts with o/s Guardrails	5.5	1	No. Lifts @	5 kN/m2
Max.No. of Lifts:	7	No.	No. of Lifts with I/s Guardrails	0	0	No. Lifts @	0 kN/m2
Max.No. of Boarded Lifts:	5.5	No.	No. of Guardrails per Lift.	2	0	No. Lifts @	0 kN/m2
Max.No. of Inside Boards:	0.5	No.				Additional. Load	
Scaffold Bay Size:	1.8	m.				Ins. Leg	Outs. Leg
Width of Scaffold:	1.18	m.				0 kN.	0 kN
			Inside Leg	Outside Leg	Max. Leg Load.		
				B/cage leg	IND IS.Leg		
No. Lifts requiring double Standards	0		0	21.247 kN.	IND OS.Leg		
					10.623 kN.		
					10.893		

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Loadings and Reactions On 750mm Apollo Beams - Rear Elevation Inside Beam

Point Loads

4.69kN @ 0m, 8.04kN @ 1.57m, 8.3kN @ 3.15m, 9.39kN @ 4.75m, 10.32kN @ 6.55m, 10.32kN @ 8.35m, 9.85kN @ 10.14m, 9.22kN @ 11.94m, 9.03kN @ 13.73m, 9.03kN @ 15.53m, 9.22kN @ 17.33m, 9.85kN @ 19.12m



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Max Reaction

Support 1	Reaction = 11.56kN / 2no ladder beams = 5.78kN	< 30.4kN therefore passes
Support 2	Reaction = 23.56kN / 2no ladder beams = 11.78kN	< 30.4kN therefore passes
Support 3	Reaction = 48.09kN / 2no ladder beams = 24.05kN	< 30.4kN therefore passes
Support 4	Reaction = 24.05kN / 2no ladder beams = 12.03kN	< 30.4kN therefore passes

Max Shear

Max	Shear = 22.3kN	< 45.5kN therefore passes
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Max BM

Bending Moment at 10.14m	Bending Moment = 36.43kNm	< 42.9kNm therefore passes
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Loads Applied To Ladder Beam Supports

Position	Axial Load
Support 1	= 11.56kN
Support 2	= 23.56kN
Support 3	= 48.09kN
Support 4	= 24.05kN

Up-Lift

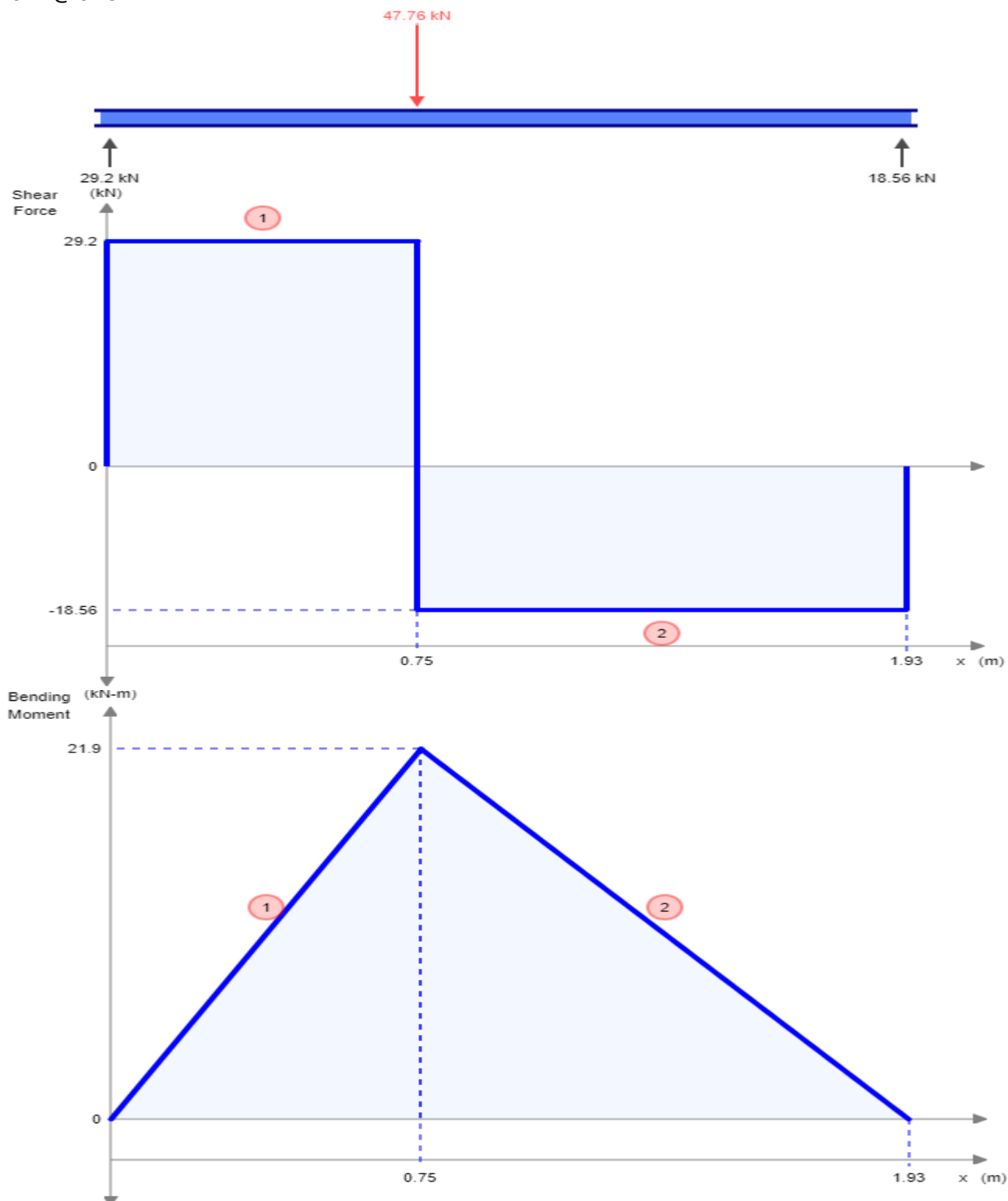
N/A

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	Checked By: Lee Buckley	& Various Beam Spans	Date: N/A Pages: N/A

Loadings and Reactions On 300mm Ladder Beams - Worst Case Ladder Beam Supports

Point Loads

47.76kN @ 0.75m



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Max Reaction

Support 1 Reaction = **29.2kN** < 30.4kN therefore **passes**
Support 2 Reaction = **18.56kN** < 30.4kN therefore **passes**

Max Shear

Max Shear = **29.2kN** > 18kN therefore **triple beams required**
29.2kN / 3no beams = **9.73kN** < 18kN therefore **passes**

Max BM

Bending Moment at **0.75m** Bending Moment = **21.9kNm** > 10.4kNm therefore **triple beams required**
21.9kNm / 3no beams = **7.3kNm** < 10.4kNm therefore **passes**

Leg Loads To Ground To Support Beam

Position Axial Load

Support 1 0.65kN + 29.2kN
= **29.85kN**
Support 2 0.65kN + 48.09kN + 18.56kN
= **67.3kN**

Position	Axial Load	Effective Length (L _E)	Safe Axial Load (P _c)	Slenderness Ratio (λ)	Slenderness Ratio (λ) Max	Result
Support 1	29.85kN / 6no standards = 4.98kN	1.3m	< 48.6kN	82.7	< 271	Therefore Passes
Support 2	67.3kN / 6no standards = 11.22kN	1.3m	< 48.6kN	82.7	< 271	Therefore Passes

Up-Lift

N/A

Ground Bearing Pressure

Foundation Type

Sole Pad - Single Standard		0.225 m X 0.450 m =	0.10125 m ²
Sole Pad - Double Standard		0.225 m X 0.750 m =	0.16875 m ²
Sole Pad - Double Standard		0.450 m X 0.450 m =	0.2025 m ²
Tredda Plate - Single Standard		0.210 m X 0.210 m =	0.0441 m ²

Standard Load = **11.22** kN

Ground Bearing Pressure = **254.42** kN/m²

Client to confirm that the ground is capable of supporting imposed standard loads from the scaffold

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	Date: 25/08/2020	Drawing Title: Independent Access Scaffold with Lifting Frame & Various Beam Spans	Revision: N/A Date: N/A Pages: N/A
	Checked By: Lee Buckley		

Wind Loads- as TG20, TG9:18 Appendix E, EN 12811 and NA to BS EN 1991-1-4:2005

(Appendix E to be used with scaffolds < 100m high with no significant topo or < 50m with significant topo)

Distance from Shoreline	>10	in km	Cc	2.83	Table E 1 (combination)
Significant Topography	n	y or n	Vb.map	22.5	Fig E 1 App E
Altitude above sea - A	50	in m	Cdir	1	Table NA.1 page 4
Cprob- do not use twf if <1	1		Cseason	1	Table NA.2 page 6
			Twind	1	Fig E 3

1) Peak Wind Pressure $Q_p = 0.613 \cdot C_c \cdot S_{wind}^2$ Appendix E

2) $S_{wind} = T_{wind} \cdot V_{map} \cdot (1 + 0.001 \cdot A) \cdot C_{prob} \cdot C_{dir} \cdot C_{season}$ Appendix E

3) $S_{wind} = 23.63$

4) $Q_p = 0.97 \text{ kN/m}^2 \cdot 0.70 \text{ tw factor} = 0.68 \text{ kN/m}^2$

Wind Load Per Contact Point

(Cpe for sheeting-Cpe*1, for debris netting Cpe*0.5, for unsheeted Cpe *0.26)

Ae- Max Area acting on 1 tie =	11.34	in m2	1
Qp=	0.68	kN/m ²	
Cpe +ve=	1.2		ind-TG20 page 150, sign-7.4.3 EN 1991, net cpe 2walls- NA4
Cpe -ve	0.8		

1) Load = $Q_p \cdot A_e \cdot C_f$

2) Therefore max push in = 9.22 kN

3) Therefore max pull out = 6.15 kN

4) Max tie load: 9.22kN < 18.2kN therefore **passes**

Client to confirm that the structure is capable of supporting imposed tie loads from the scaffold

Consider Spurs

$300\text{kg} (2.94\text{kN}) / \sin(65^\circ) = 3.24\text{kN}$

< 9.1kN therefore **passes**



BDS SCAFFOLD
DESIGN
SPECIALISTS

Date:
25/08/2020
Prepared By:
Rob Forster
Date:
25/08/2020
Checked By:
Lee Buckley

Client:
Craven Scaffolding Ltd
Project:
108 High Street, Manchester
Drawing Title:
Independent Access Scaffold with Lifting Frame
& Various Beam Spans

Drawing Status:
APPROVAL
Drawing No:
BDS-6194-01 to 03
Revision: N/A
Date: N/A
Pages: N/A

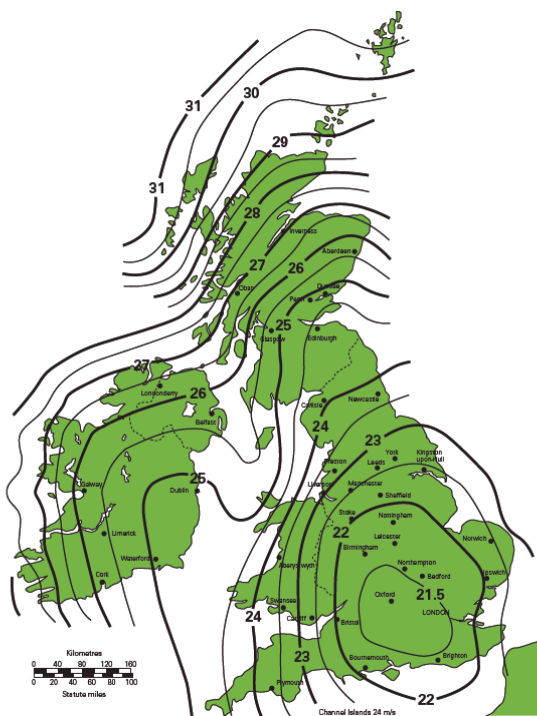


Figure E.1 – Wind speed, V_{Bsp} (m/s)

Table E1: Combined exposure factor, C_e

Height $Z = h_{eff}$ (m)	Site in country or adjacent to sea				Site in town, more than 2 km from the edge of the town		
	Closest distance to the shoreline (km)				Distance to shoreline (km)		
	≤ 0.1	2	10	≥ 100	≥ 2	10	≥ 100
≤ 2	1.90	1.60	1.50	1.40	1.07	1.01	0.94
3	2.15	1.84	1.73	1.62	1.32	1.25	1.17
4	2.31	2.03	1.90	1.78	1.54	1.44	1.35
5	2.43	2.18	2.05	1.90	1.72	1.62	1.50
10	2.82	2.65	2.50	2.32	2.33	2.20	2.04
15	3.07	3.02	2.85	2.67	2.81	2.65	2.48
20	3.20	3.05	2.98	2.78	2.90	2.83	2.64
30	3.42	3.43	3.27	3.04	3.40	3.24	3.01
50	3.68	3.68	3.62	3.39	3.68	3.62	3.39
100	3.98	3.98	3.98	3.80	3.98	3.98	3.80

Notes: (1) Interpolation may be used in this table
(2) Based on Figure NA.7 and Figure NA.8 in the NA to BS EN 1991-1-4

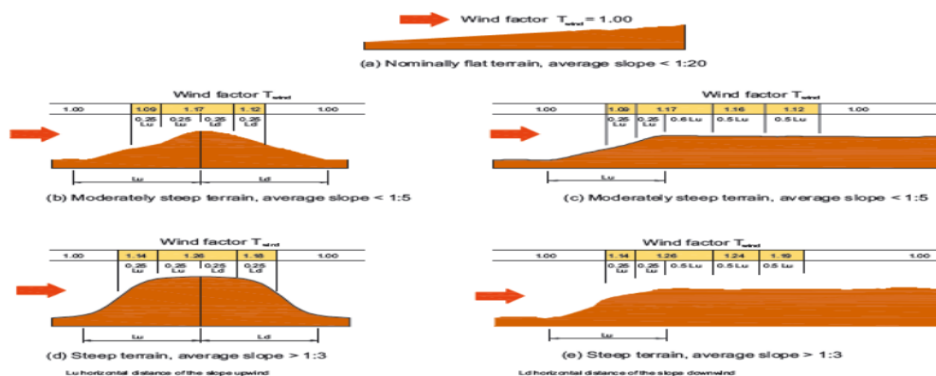


Figure E.2 – Topography factor, T_{wind}



Figure E.3 – Displacement height

Table NA.1 Directional factor c_{dir}

Direction	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
c_{dir}	0.78	0.73	0.73	0.74	0.73	0.80	0.85	0.93	1.00	0.99	0.91	0.82

NOTE 1 Interpolation may be used within Table NA.1.

NOTE 2 The directions are defined by angles from due North in a clockwise direction.

NOTE 3 Where the wind loading on a building is assessed only for orthogonal load cases, the maximum value of the factor for the directions that lie $\pm 45^\circ$ either side of the normal to the face of the building is to be used.

NOTE 4 Conservatively, c_{dir} may be taken as 1.0 for all directions.

	Date: 25/08/2020	Client: Craven Scaffolding Ltd	Drawing Status: APPROVAL
	Prepared By: Rob Forster	Project: 108 High Street, Manchester	Drawing No: BDS-6194-01 to 03
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	Checked By: Lee Buckley		

Project	108 High Street, Manchester
Drawing Reference No	BDS-6194-01 to 03
Item	Independent Access Scaffold with Lifting Frame & Various Beam Spans
Revision (if applicable)	N/A
Category of Check (1, 2, or 3)	2

Description of Temporary Works:

Independent access scaffold to both sides of wall with lifting frame at top lift to remove and replace capping stone.

I certify for and on behalf of BDS Ltd, that in my opinion, the erection proposals and proposed temporary works details, specified in the schedule attached hereto relating to the construction of the above contract, are satisfactory for the proper discharge of responsibilities for the safe temporary works design elements of the works, and for their safe execution and removal (if applicable) in accordance with the drawings and specification, and without detriment to the related permanent Works.

Schedule of Drawings and other documents:

BDS-6194-01: Plan A-A, Plan B-B, Elevation C-C
 BDS-6194-02: Section D-D, Section E-E
 BDS-6194-03: Section F-F, Section G-G
 Supporting Calculations: Page 1 to 22
 Check Certificate: Page 23 of Calculations Document

Designer's signature	
Name	Rob Forster
Company	Buckley Design Solutions Ltd
Design checker's signature	
Name	Lee Buckley
Company	Buckley Design Solutions Ltd
Date	25/08/2020