Company:	**Example calculations**	Reference:	N/A
Project:	N/A	Client ref.	N/A
Title:	N/A		
Made by:	DH	Checked by: JB	Date: 14/05/14

Annexe 2: Scaffold frame brackets

Assumptions

This appendix covers normal working conditions only. It does not include loads that may be applied to the scaffold frame by a fall arrest system.

The loads on one scaffold frame bracket are the weight of the frame and all loading on one bay of the scaffold.

Each individual scaffold frame bracket is held in position by two angle cleats. The lower cleat carries all the weight of the frame and the applied vertical loads. The upper cleat carries the tension loads due to load eccentricity from the wall.

A check coupler is normally added above the upper cleat as an additional safety measure. The check coupler must be fitted 10mm above the top of the cleat so that under normal circumstances it does not carry any vertical load.

Where two fixings are used to hold a cleat to the wall, all load is assumed to be carried by the fixing closest to the corner of the steel angle section

The allowable load on a fixing under combined tension and shear loading is calculated using the method given in the Hilti Fastening Technology Manual

Warning

The scaffold should not be used in service when restrained by the bracket fixings alone. A secondary restraint system such as a tensioned steel wire rope around the structure should be used to hold all scaffold frames on to the structure.

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

Dead loads for one bay of scaffold

Number of scaffold tubes		4	
Overall length of each tube		1.50	m
Weight of a single scaffold tube per metre		0.046	kN/m
Total weight of scaffold tubes		0.27	kN
Number of scaffold boards including toe boards		6	
Overall length of each board		1.50	m
Weight of a single scaffold board per metre		0.044	kN/m
Total weight of scaffold boards		0.39	kN
Number of scaffold fixings		12	
Weight of one scaffold fixing		0.01	kN
Total weight of scaffold fixings		0.12	kN
Scaffold frame bracket		0.26	kN
Total dead load on one scaffold bay	W_D	1.05	kN

Live loads for one bay of scaffold

Maximum number of operatives on one bay			2	
Weight of operative			0.88	kN
Total weight of operatives			1.77	kN
Maximum equipment on one bay	100	kg	0.98	kN
Total live load on one scaffold bay	W_L		2.75	kN
Total dead plus live load on one scaffold bay	W_{D+L}		3.80	kN

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

Scaffold frame fixing resistance

Default scaffold fixing type	Hilti HUS-H screw anchor
Override scaffold fixing type	
Base material for fixing	1

(Enter 1 for concrete, 2 for solid brick, enter details for other materials)

Base material for fixing: Concrete

	Default	Override	Units
Scaffold frame fixing diameter	14		mm
Nominal anchor length	90		mm
Drill bit diameter for drilling anchor hole	14		mm
Diameter of fixing hole in cleat	18		mm
Fixing recommended tension resistance	6.80		kN
Fixing recommended shear resistance	18.80		kN

Note that the recommended tension or shear resistance of the fixing is the allowable unfactored or serviceability load. The allowable load values should be appropriate for the base material. For materials other than concrete or solid brick, or for alternative fixings an override fixing tension and shear resistance must be input.

The following are the fixing details used in the calculation:

Scaffold frame fixing type: Hilti HUS-H screw anchor

Scaffold frame fixing diameter	14.0	mm
Nominal anchor length	90.0	mm
Drill bit diameter for drilling anchor hole	14.0	mm
Diameter of fixing hole in cleat	18.0	mm

Base material for fixing: Concrete

Fixing recommended tension resistance	6.80	kN
Fixing recommended shear resistance	18.80	kN

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

General arrangement of scaffold frame bracket

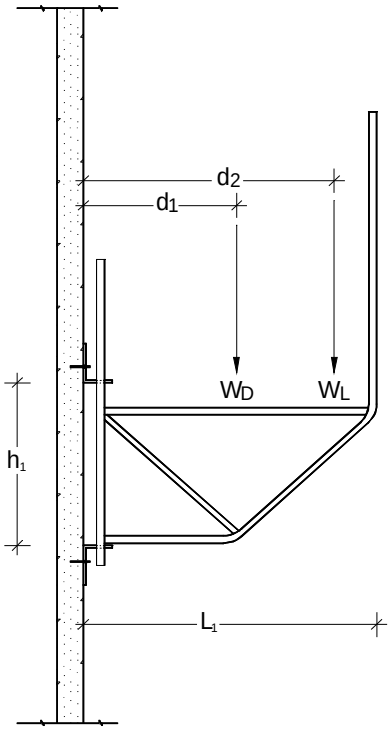

Figure 1: Elevation of scaffold frame bracket

Fixing cleat details

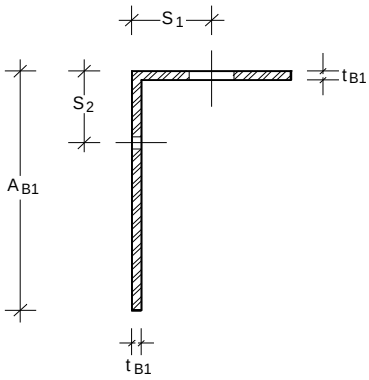

Figure 2a Lower cleat B1

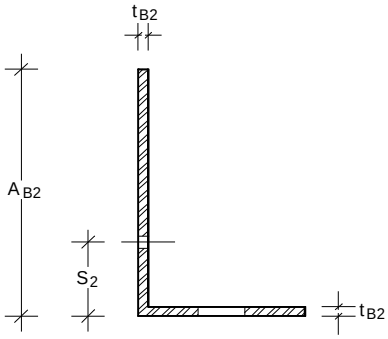

Figure 2b Upper cleat B2

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

Positions of loads

Refer to Figure 1

The lines of action of the vertical dead and live loads are defined by the distances from the face of the structure.

The line of action of the dead load is taken at a distance from the structure equal to one half of the overall width of the scaffold frame bracket.

The line of action of the live load is taken at a distace from the structure equal to the width of the scaffold frame bracket less 300mm.

Overall width of scaffold frame bracket	L_1	1.200	m
Distance to line of action of dead load	d_1	0.600	m
Distance to line of action of live load	d_2	0.900	m
Vertical distance between cleats	h_1	1.200	m

This distance is measured between the horizontal legs of the scaffold frame cleats

Loads at supports

Dead load on lower cleat B1	W_D	1.05	kN
Live load on lower cleat B1	W_L	2.75	kN
Total vertical load on lower cleat B1	W_{D+L}	3.80	kN

Horizontal load on upper cleat = $(W_D \times d_1 + W_L \times d_2) / h_1$

Horizontal load on upper cleat B2	H_{B2}	2.59	kN

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

Cleat dimensions

Angle section from which cleats are cut	Leg 1 (mm)	Leg 2 (mm)	Thickness (mm)
	200	150	12

For an unequal angle the longer leg is assumed to be vertical

Distance from outside corner of angle to centre of hole in horizontal leg	s_1	55	mm
Distance from outside corner of angle to centre of closest hole in vertical leg	s_2	75	mm
Diameter of scaffold tube hole in cleat	d_s	50	mm
Diameter of fixing hole in cleat	d_f	18	mm
Width of cleat (length cut from steel angle)	L_B	150	mm

Lower cleat B1 dimensions used in calculations

Length of vertical leg of cleat	A_{B1}	200	mm
Thickness of cleat	t_{B1}	12	mm
Horizontal distance from corner of cleat to centre of scaffold frame inner vertical tube	s_1	55	mm
Vertical distance from outside corner of cleat to closest fixing	s_2	75	mm
Diameter of scaffold tube hole in cleat	d_s	50	mm
Width of cleat	L_{B1}	150	mm

Stresses in lower cleat B1 Refer to Figure 2a

Vertical load on lower cleat B1	W_{D+L}	3.80	kN

Bending moment at root of angle = $W_{D+L} \times (s_1 - t_{B1})$

Bending moment at root of angle	M_{B1}	0.16	kNm

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

Stresses in lower cleat B1 (continued)

Effective width of cleat = minimum of L_{B1} and (d_s+ 2 x s_1)

Effective width of cleat	L_e	150	mm

Bending stress at root of angle = M_{B1} / (1/6 x L_e x (t_{B1})^2)

Bending stress at root of angle	45.4	N/mm^2
Allowable bending stress in steel cleat	180	N/mm^2
Ratio of bending stress to allowable value	0.25	

The cleat is satisfactory

Fixing loads for lower cleat B1

Vertical load on lower cleat B1	W_{D+L}	3.80	kN

Tension load in fixing = W_{D+L} x s_1 / (A_{B1} - s_2)

Tension load in fixing	1.67	kN
Shear load in fixing	3.80	kN
Combined tension and shear load	4.15	kN
Angle of combined load to tension load	1.16	radians
Angle in degrees	66	degrees
Fixing recommended tension resistance	6.80	kN
Fixing recommended shear resistance	18.80	kN
Fixing recommended combined resistance	11.65	kN
Ratio of tension load to allowable value	0.25	Satisfactory
Ratio of shear load to allowable value	0.20	Satisfactory
Ratio of combined load to allowable value	0.36	Satisfactory

The fixing is satisfactory

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

Upper cleat B2 dimensions

Length of vertical leg of cleat	A_{B2}	200	mm
Thickness of cleat	t_{B2}	12	mm
Vertical distance from corner of angle to first fixing	s_2	75	mm
Diameter of fixing hole in cleat	d_f	18	mm
Width of cleat	L_{B2}	150	mm

Stresses in upper cleat B2

Horizontal load on upper cleat B2	H_{B2}	2.59	kN

Bending moment at fixing closest to corner of angle = $H_{B2} \times s_2$

Bending moment at fixing position	M_{B2}	0.19	kNm

Effective width of cleat = $L_{B2} - d_f$

Maximum effective width of cleat	L_e	132	mm

Bending stress at in cleat at fixing = $M_{B2} / (1/6 \times L_e \times (t_{B2})^2)$

Bending stress in cleat at fixing	61	N/mm^2
Allowable bending stress in steel cleat	180	N/mm^2
Ratio of bending stress to allowable value	0.34	

The cleat is satisfactory

Fixing loads for upper cleat B2

Horizontal load on upper cleat B2	H_{B2}	2.59	kN

Tension load in fixing = $H_{B2} \times A_{B2} / (A_{B2} - s_2)$

Tension load in fixing	4.14	kN
Fixing recommended tension resistance	6.80	kN
Ratio of tension load to allowable value	0.61	

The fixing is satisfactory

Company: **Example calculations** Reference: N/A
Project: N/A Client ref. N/A
Title: N/A
Made by: DH Checked by: JB Date: 14/05/14

Annexe 2: Scaffold frame brackets

Summary of scaffold bracket fixing design results

Scaffold frame fixing type	Hilti HUS-H screw anchor		
Scaffold frame fixing diameter	14	mm	
Nominal anchor length	90.0	mm	
Drill bit diameter for drilling anchor hole	14.0	mm	
Base material for fixing	Concrete		
Fixing recommended tension resistance	6.80	kN	
Fixing recommended shear resistance	18.80	kN	
Angle section from which cleats are cut	Leg 1	200	mm
	Leg 2	150	mm
	Thickness	12	mm
	Length	150	mm

Lower cleat stress ratio	0.25	The cleat is satisfactory
Lower fixing maximum load ratio	0.36	The fixing is satisfactory
Upper cleat stress ratio	0.34	The cleat is satisfactory
Upper fixing load ratio	0.61	The fixing is satisfactory

The design of the cleats and fixings is satisfactory