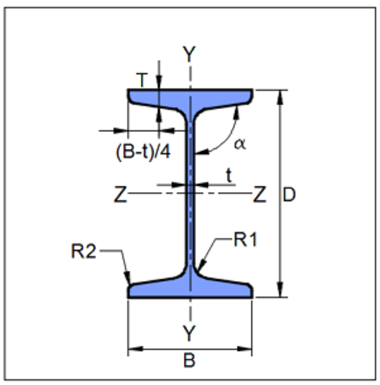
	Created with Osdag®		
Company Name	GAIL	Project Title	Fin Plate Connection
Group/Team Name	Steve & Co.	Subtitle	
Designer	Steve Sojan	Job Number	1
Date	26 /12 /2024	Client	FOSSEE

1 Input Parameters

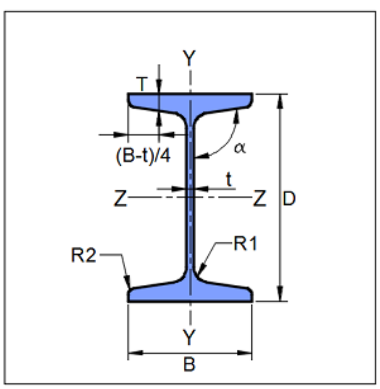
Main Module	Shear Connection
Module	Fin Plate Connection
Connectivity	Column Flange-Beam Web
Shear Force (kN)	40.0
Axial Force (kN)	87.0

Supporting Section - Mechanical Properties



Supporting Section		HB 150*	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)		410	
Yield Strength, F_y (MPa)		250	
Mass, m (kg/m)	30.15	I_z (cm^4)	1510.0
Area, A (cm^2)	38.4	I_y(cm^4)	435.0
D (mm)	150.0	r_z (cm)	6.27
B (mm)	150.0	r_y (cm)	3.36
t (mm)	8.4	Z_z (cm^3)	201.0
T (mm)	9	Z_y (cm^3)	58.0
Flange Slope	94	Z_{pz} (cm^3)	228.0
R_1 (mm)	8.0	Z_{py} (cm^3)	94.7
R_2 (mm)	4.0		

Supported Section - Mechanical Properties



Supported Section		JB 175	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)		410	
Yield Strength, F_y (MPa)		250	
Mass, m (kg/m)	8.07	I_z (cm^4)	480.0
Area, A (cm^2)	10.2	I_y(cm^4)	9.65
D (mm)	175.0	r_z (cm)	6.83
B (mm)	50.0	r_y (cm)	0.97
t (mm)	3.2	Z_z (cm^3)	54.9
T (mm)	4.8	Z_y (cm^3)	3.86
Flange Slope	91.5	Z_{pz} (cm^3)	64.2
R_1 (mm)	5.0	Z_{py} (cm^3)	6.32
R_2 (mm)	1.5		

Bolt Details - Input and Design Preference	
Diameter (mm)	[np.int64(8), np.int64(10), np.int64(12), np.int64(14), np.int64(16), np.int64(18), np.int64(20), np.int64(22), np.int64(24), np.int64(27), np.int64(30), np.int64(33) , np.int64(36), np.int64(39), np.int64(42), np.int64(45), np.int64(48), np.int64(52), np.int64(56), np.int64(6 0), np.int64(64)]
Property Class	[np.float64(3.6), np.float64(4.6), np.float64(4.8), np.f loat64(5.6), np.float64(5.8), np.float64(6.8), np.float 64(9.8), np.float64(10.9), np.float64(12.9)]
Type	Bearing Bolt
Hole Type	Standard
Bolt Tension	Non pre-tensioned
Slip Factor, (μ_f)	0.3
Detailing - Design Preference	
Edge Preparation Method	Sheared or hand flame cut
Gap Between Members (mm)	10.0
Are the Members Exposed to Corrosive Influences?	False
Plate Details - Input and Design Preference	
Thickness (mm)	[np.int64(8), np.int64(10), np.int64(12), np.int64(14), np.int64(16), np.int64(18), np.int64(20), np.int64(22), np.int64(28), np.int64(32), np.int64(36), np.int64(40) , np.int64(45), np.int64(50), np.int64(56), np.int64(63), np.int64(75), np.int64(80), np.int64(90), np.int64(1 00), np.int64(110), np.int64(120)]
Material	E 250 (Fe 410 W)A
Ultimate Strength, Fu (MPa)	410
Yield Strength, Fy (MPa)	250
Weld Details - Input and Design Preference	
Weld Type	Fillet
Type of Weld Fabrication	Shop Weld
Material Grade Overwrite, Fu (MPa)	410.0

2 Design Checks

Design Status	Pass

2.1 Initial Section Check

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)	40.0	$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{175.0 \times 3.2 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 73.48$ [Ref. IS 800:2007, Cl.10.4.3]	Pass
Allowable Shear Capacity (kN)	40.0	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 73.48$ $= 44.09$ [Limited to low shear]	Pass
Tension Yielding Capacity (kN)	87.0	$T_{\mathrm{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 175.0 \times 3.2$ $= \frac{560.0 \times 250}{1.1 \times 10^3}$ $= 127.27$ [Ref. IS 800:2007, Cl.6.2]	Pass

2.2 Load Consideration

Check	Required	Provided	Remarks
Applied Axial Force (kN)	87.0	87.0	

Check	Required	Provided	Remarks
Applied Shear Force (kN)	40.0	$V_{y_{\min}} = \min(0.15V_{d_y},\ 40.0)$ $= \min(0.15 \times 73.48,\ 40.0)$ $= 40$ $V_u = \max(V_y,\ V_{y_{\min}})$ $= \max(40.0, 40)$ $= 40.0$ [Ref. IS 800:2007, Cl.10.7]	

2.3 Bolt Design

Check	Required	Provided	Remarks
Diameter (mm)		8.0	
Property Class		9.8	
Plate Thickness (mm)	$t_w = 3.2$	8.0	**Pass**
No. of Bolt Columns		2	**Pass**
No. of Bolt Rows		6	
Min. Pitch Distance (mm)	$p_{\min} = 2.5d$ $= 2.5 \times 8.0$ $= 20.0$ [Ref. IS 800:2007, Cl.10.2.2]	25	**Pass**
Max. Pitch Distance (mm)	$p/g_{\max} = \min(32t,\ 300)$ $= \min(32 \times 3.2,\ 300)$ $= \min(102.4,\ 300)$ $= 102.4$ Where, $t = \min(8.0, 3.2)$ [Ref. IS 800:2007, Cl.10.2.3]	25	**Pass**

Check	Required	Provided	Remarks
Min. Gauge Distance (mm)	$p_{\text{min}} = 2.5d$ $= 2.5 \times 8.0$ $= 20.0$ [Ref. IS 800:2007, Cl.10.2.2]	20	**Pass**
Max. Gauge Distance (mm)	$p/g_{\text{max}} = \min(32t,\ 300)$ $= \min(32 \times 3.2,\ 300)$ $= \min(102.4,\ 300)$ $= 102.4$ Where, $t = \min(8.0, 3.2)$ [Ref. IS 800:2007, Cl.10.2.3]	20	**Pass**
Min. End Distance (mm)	$e_{\text{min}} = 1.7d_0$ $= 1.7 \times 8$ $= 13.6$ [Ref. IS 800:2007, Cl.10.2.4.2]	15	**Pass**
Max. End Distance (mm)	$e_{\text{max}} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 8.0 \times \sqrt{\frac{250}{250}} = 96.0$ $e_2 = 12 \times 3.2 \times \sqrt{\frac{250}{250}} = 38.4$ $e_{\text{max}} = \min(e_1,\ e_2) = 38.4$ [Ref. IS 800:2007, Cl.10.2.4.3]	15	**Pass**
Min. Edge Distance (mm)	$e'_{\text{min}} = 1.7d_0$ $= 1.7 \times 8$ $= 13.6$ [Ref. IS 800:2007, Cl.10.2.4.2]	15	**Pass**

Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{\max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 8.0 \times \sqrt{\frac{250}{250}} = 96.0$ $e_2 = 12 \times 3.2 \times \sqrt{\frac{250}{250}} = 38.4$ $e'_{\max} = min(e_1,\ e_2) = 38.4$ [Ref. IS 800:2007, Cl.10.2.4.3]	15	**Pass**
Moment Demand (kNm)		$M_d = (V_u \times \text{ecc} + M_w)$ ecc = eccentricity M_w = external moment acting on web $= \frac{(40.0 \times 10^3 \times 35.0 + 0.0 \times 10^6)}{10^6}$ $= 1.4$	
Bolt Force Parameter(s) (mm)	l_n = length available $l_n = p\ (n_r - 1)$ $= 25 \times (6 - 1)$ $= 125$ $y_{\max} = l_n/2$ $= 125/2$ $= 62.5$ $x_{\max} = g(n_c - 1)/2$ $= 20 \times (2 - 1)/2$ $= 10.0$		

Check	Required	Provided	Remarks
Bolt Force (kN)	$vbv = V_u/(n_r \times n_c) = \frac{40.0}{(6 \times 2)} = 3.33$ $tmh = \frac{M_d \times y_{\max}}{\Sigma r_i^2} = \frac{1.4 \times 62.5}{23.08} = 3.79$ $tmv = \frac{M_d \times x_{\max}}{\Sigma r_i^2} = \frac{1.4 \times 10.0}{23.08} = 0.61$ $abh = \frac{A_u}{(n_r \times n_c)} = \frac{87.0}{(6 \times 2)} = 7.25$ $v_{\text{res}} = \sqrt{(vbv + tmv)^2 + (tmh + abh)^2} = \sqrt{(3.33 + 0.61)^2 + (3.79 + 7.25)^2} = 11.72$		
Shear Capacity (kN)		$V_{\text{dsb}} = \frac{f_{ub} n_n A_{nb}}{\sqrt{3}\gamma_{mb}} = \frac{900.0 \times 1 \times 36.6}{1000 \times \sqrt{3} \times 1.25} = 15.21$ [Ref. IS 800:2007, Cl.10.3.3]	

Check	Required	Provided	Remarks
Kb		$k_b = \min\left(\frac{e}{3d_0},\ \frac{p}{3d_0} - 0.25,\ \frac{f_{ub}}{f_u},\ 1.0\right)$ $= \min\left(\frac{15}{3\times 8},\ \frac{25}{3\times 8} - 0.25,\ \frac{900.0}{410},\ 1.0\right)$ $= \min(0.62, 0.79, 2.2, 1.0)$ $= 0.62$ [Ref. IS 800:2007, Cl.10.3.4]	
Bearing Capacity (kN)		$V_{\text{dpb}} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.62 \times 8.0 \times 3.2 \times 410}{1000 \times 1.25}$ $= 13.02$ [Ref. IS 800:2007, Cl.10.3.4]	
Capacity (kN)		$V_{\text{db}} = \min\ (V_{\text{dsb}},\ V_{\text{dpb}})$ $= \min\ (15.21,\ 13.02)$ $= 13.02$ [Ref. IS 800:2007, Cl.10.3.2]	
Long Joint Reduction Factor	if $l_j \geq 15d$ then $V_{\text{rd}} = \beta_{lj} V_{\text{db}}$ if $l_j < 15d$ then $V_{\text{rd}} = V_{\text{db}}$ where, $l_j = ((nc \text{ or } nr) - 1) \times (p \text{ or } g)$ $\beta_{lj} = 1.075 - l/(200d)$ but $0.75 \leq \beta_{lj} \leq 1.0$ [Ref. IS 800:2007, Cl.10.3.3.1]	$l_j = (n_r - 1) \times p$ $= (6 - 1) \times 25 = 125$ $l = 125$ $15 \times d = 15 \times 8.0 = 120.0$ since, $l_j \geq 15\ d$ then $V_{\text{rd}} = \beta_{lj}\ V_{\text{db}}$ $\beta_{lj} = 1.075 - 125/(200\ \times 8.0) = 1.0$ [Ref. IS 800:2007, Cl.10.3.3.1]	
Capacity (kN)	11.72	13.02	Pass

2.4 Plate Design

Check	Required	Provided	Remarks
Min. Plate Height (mm)	$0.6 \times (d_b - 2 \times t_f - 2 \times r_r)$ $= 0.6 \times (175.0 - 2 \times 4.8 - 2 \times 5.0)$ $= 93.24$ [Ref. INSDAG, Ch.5, sec.5.2.3]	155	**Pass**
Max. Plate Height (mm)	$d_b - 2(t_{bf} + r_{b1} + \text{gap})$ $= 175.0 - 2 \times (4.8 + 5.0 + 10)$ $= 155.4$	155	**Pass**
Min. Plate Width (mm)	$2e_{\min} + (n_c - 1)p_{\min})$ $= 2 \times 13.6 + (2 - 1) \times 20.0$ $= 57.2$	60.0	**Pass**
Min. Plate Thickness (mm)	$t_w = 3.2$	8.0	**Pass**
Shear Yielding Capacity (kN)		$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{155 \times 8.0 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 162.71$ [Ref. IS 800:2007, Cl.10.4.3]	
Allowable Shear Capacity (kN)	$V = 40.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 162.71$ $= 97.62$ [Limited to low shear]	**Pass**
Shear Rupture Capacity (kN)		$V_{d_n} = \frac{0.75 A_{v_n} f_u}{\sqrt{3}\gamma_{m1}}$ $= 1 \times \frac{(155 - (6 \times 8)) \times 8.0 \times 410}{\sqrt{3} \times 1.25}$ $= 263.22$ [Ref. AISC, sect. J4]	

Check	Required	Provided	Remarks
Block Shear Capacity in Shear (kN)		$V_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{\text{db}} = \min(V_{db1},\ V_{db2}) = 194.53$ [Ref. IS 800:2007, Cl.6.4]	
Shear Capacity (kN)	40.0	$V_d = \min(S_c,\ V_{d_n},\ V_{d_b})$ $= \min(97.62,\ 263.22,\ 194.53)$ $= 97.62$ [Ref. IS 800:2007, Cl.6.1]	**Pass**
Tension Yielding Capacity (kN)		$T_{\text{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 155 \times 8.0$ $= \frac{1240.0 \times 250}{1.1 \times 10^3}$ $= 281.82$ [Ref. IS 800:2007, Cl.6.2]	
Tension Rupture Capacity (kN)		$T_{\text{dn}} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (155 - 6 \times 8) \times 8.0 \times 410}{1.25}$ $= 328.26$ [Ref. IS 800:2007, Cl.6.3.1]	

Check	Required	Provided	Remarks
Block Shear Capacity in Tension (kN)		$T_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{\text{db}} = \min(T_{db1},\ T_{db2}) = 274.22$ [Ref. IS 800:2007, Cl.6.4]	
Tension Capacity (kN)	87.0	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{dn}},\ T_{\text{db}})$ $= \min(281.82, 328.26, 274.22)$ $= 274.22$ [Ref.IS 800:2007, Cl.6.1]	Pass
Moment Capacity (kNm)	1.4	$M_{d_z} = \frac{\beta_b Z_p f y}{\gamma_{m0}}$ $= \frac{1.0 \times 48050.0 \times 250}{1.1 \times 10^6}$ $= 10.92$ [Ref. IS 800:2007, Cl.8.2.1.2]	Pass
Interaction Ratio	≤ 1	$\frac{1.4}{10.92} + \frac{87.0}{274.22} = 0.45$ [Ref. IS 800:2007, Cl.10.7]	Pass

2.5 Section Design

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{175.0 \times 3.2 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 73.48$ [Ref. IS 800:2007, Cl.10.4.3]	

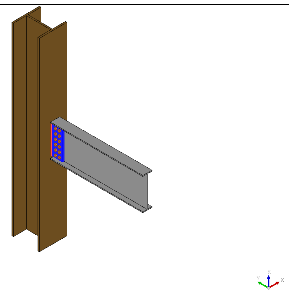
Check	Required	Provided	Remarks
Allowable Shear Capacity (kN)	$V = 40.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 73.48$ $= 44.09$ [Limited to low shear]	**Pass**
Shear Rupture Capacity (kN)		$V_{d_n} = \frac{0.75 A_{v_n} f_u}{\sqrt{3}\gamma_{m1}}$ $= 1 \times \frac{(175.0 - (6 \times 8)) \times 3.2 \times 410}{\sqrt{3} \times 1.25}$ $= 124.97$ [Ref. AISC, sect. J4]	
Block Shear Capacity in Shear (kN)		$V_{\mathrm{dbl1}} = \frac{A_{\mathrm{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{\mathrm{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{\mathrm{db}} = \min(V_{db1},\ V_{db2}) = 77.81$ [Ref. IS 800:2007, Cl.6.4]	
Shear Capacity (kN)	40.0	$V_d = \min(S_c,\ V_{d_n},\ V_{d_b})$ $= \min(44.09,\ 124.97,\ 77.81)$ $= 44.09$ [Ref. IS 800:2007, Cl.6.1]	**Pass**
Tension Yielding Capacity (kN)		$T_{\mathrm{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 175.0 \times 3.2$ $= \frac{560.0 \times 250}{1.1 \times 10^3}$ $= 127.27$ [Ref. IS 800:2007, Cl.6.2]	

Check	Required	Provided	Remarks
Tension Rupture Capacity (kN)		$T_{\text{dn}} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1\times\ 0.9\times(175.0-6\times 8)\times 3.2\times 410}{1.25}$ $= 119.97$ [Ref. IS 800:2007, Cl.6.3.1]	
Block Shear Capacity in Tension (kN)		$T_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn} f_u}{\gamma_{m1}}$ $T_{\text{dbl2}} = \frac{0.9A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{\text{db}} = \min(T_{db1},\ T_{db2}) = 109.69$ [Ref. IS 800:2007, Cl.6.4]	
Tension Capacity (kN)	87.0	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{dn}},\ T_{\text{db}})$ $= \min(127.27, 119.97, 109.69)$ $= 109.69$ [Ref.IS 800:2007, Cl.6.1]	**Pass**
Moment Capacity (kNm)	1.4	$M_{dz} = \frac{\beta_b Z_p fy}{\gamma_{m0}}$ $= \frac{1.0\times 64200.0\times 250}{1.1\times 10^6}$ $= 14.59$ [Ref. IS 800:2007, Cl.8.2.1.2]	**Pass**
Interaction Ratio	≤ 1	$\frac{1.4}{14.59} + \frac{87.0}{109.69} = 0.89$ [Ref. IS 800:2007, Cl.10.7]	**Pass**

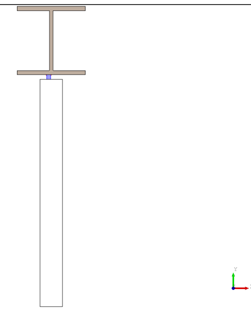
2.6 Weld Design

Check	Required	Provided	Remarks
Min. Weld Size (mm)	$t_{w_{\min}}$ based on thinner part $= \max(8,\ 8)$ $s_{\min}$ based on thicker part $= 3$ [Ref. IS 800:2007, Table 21, Cl.10.5.2.3]	3	**Pass**
Max. Weld Size (mm)	Thickness of thinner part $= \min(9,\ 8.0) = 8.0$ $s_{\max} = 8$ [Ref. IS 800:2007, Cl.10.5.3.1]	3	**Pass**
Weld Strength (N/mm)	$R_{\mathrm{w}} = \sqrt{(T_{\mathrm{wh}} + A_{\mathrm{wh}})^2 + (T_{\mathrm{wv}} + V_{\mathrm{wv}})^2}$ $T_{\mathrm{wh}} = \frac{M \times y_{\max}}{I_{pw}} = \frac{1400000.0 \times 74.5}{551324.83}$ $T_{\mathrm{wv}} = \frac{M \times x_{\max}}{I_{pw}} = \frac{1400000.0 \times 0.0}{551324.83}$ $V_{\mathrm{wv}} = \frac{V}{l_w} = \frac{40000.0}{298}$ $A_{\mathrm{wh}} = \frac{A}{l_w} = \frac{87000.0}{298}$ $R_{\mathrm{w}} = \sqrt{(189.18 + 291.95)^2 + (0.0 + 134.23)^2}$ $= 499.5$	$f_w = \frac{t_t f_u}{\sqrt{3}\gamma_{mw}}$ $= \frac{3 \times 410}{\sqrt{3} \times 1.25}$ $= 568.11$ [Ref. IS 800:2007, Cl.10.5.7.1.1]	**Pass**

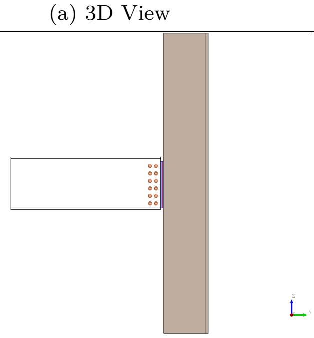
3 3D Views



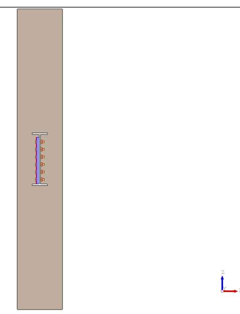
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2024-12-26 08:42:02 - Osdag - INFO - === End Of Design ===

2024-12-26 08:42:02 - Osdag - INFO - : The minimum recommended weld throat thickness suggested by IS 800:2007 is 3 mm, as per cl. 10.5.3.1. Weld throat thickness is not considered as per cl. 10.5.3.2. Please take necessary detailing precautions at site accordingly.