

Structural Design Report for PSC Box Template

Table of Contents

1. Design Conditions

- 1) General Characteristics
 - (1) Project Name
 - (2) Design Code
 - (3) Unit
 - (4) Partial Safety Factors for Materials
 - (5) Scope of Report
- 2) Materials
 - (1) Concrete
 - (2) Steel
- 3) Geometrical Shape
- 4) Loads and Load Combinations
 - (1) Loads
 - (2) Load Combinations
- 5) Reference
 - (1) Designer
 - (2) Date
 - (3) Note

2. Strut-Tie Model Design (Load Combination-1)

- 1) Construction of Strut-Tie Model
 - (1) ESO (Evolutionary Structural Optimization)
 - (2) Compressive Principal Stress Flow
 - (3) Constructed Strut-Tie Model
- 2) Analysis of Strut-Tie Model
 - (1) Loading Conditions
 - (2) Strut and Tie Types
 - (3) Strut and Tie Forces
- 3) Strength Verification and Required Rebars
 - (1) Required Area of Rebars
 - (2) Available Widths of Struts and Nodal Zones
 - (3) Strength of Struts
 - (4) Strength of Nodal Zones

3. Summary

- 1) Dimensioned Shape
- 2) Required and Used Areas of Rebars
- 3) Placement of Rebars

1. Design Conditions

1) General Characteristics

- (1) Project Name : PSC Box Template
- (2) Design Code : EuroCode 2
- (3) Unit : Kips.in
- (4) Partial Safety Factors for Materials
 - Concrete : 1.50
 - Reinforcing and prestressing steel: 1.15

(5) Scope of Report

The purpose of this report is to design structural concrete member using strut-tie model. The design is performed according to the EuroCode 2 strut-tie model provisions.

This report provides results of calculation for:

- check capacity of bearing plates
- design tie reinforcement
- check capacity of struts
- check capacity of nodal zones

2) Materials

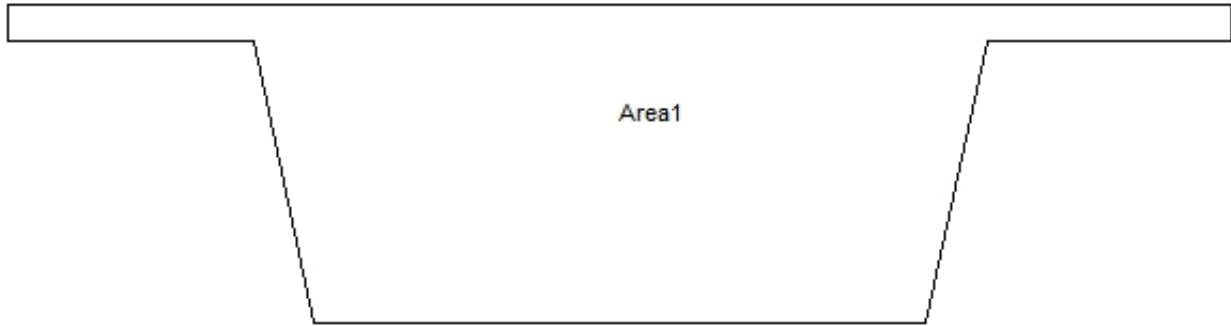
(1) Concrete

- Mass : 147 lb/ft³
- Weight : 149.6 lb/ft³
- Poisson's ratio : 0.15
- Compressive Strength of Concrete, f_{ck} : 3480.9 lb/in²
- Tensile Strength of Concrete, f_{ct} : 348.1 lb/in²
- Elastic modulus of concrete, E_c : 4,039,177 lb/in²

(2) Steel

- Mass : 490 lb/ft³
- Weight : 499.7 lb/ft³
- Poisson's ratio : 0.15
- Yield strength of steel, f_y : 58015.4 lb/in²
- Elastic modulus of steel, E_s : 29,007,699 lb/in²

3) Geometrical Shape

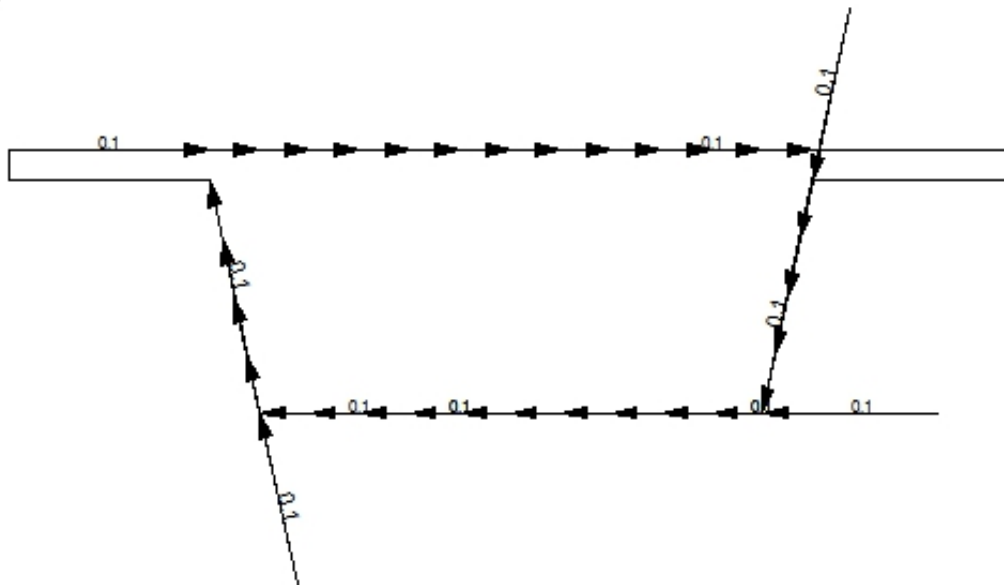


- Thickness : 14.00 in

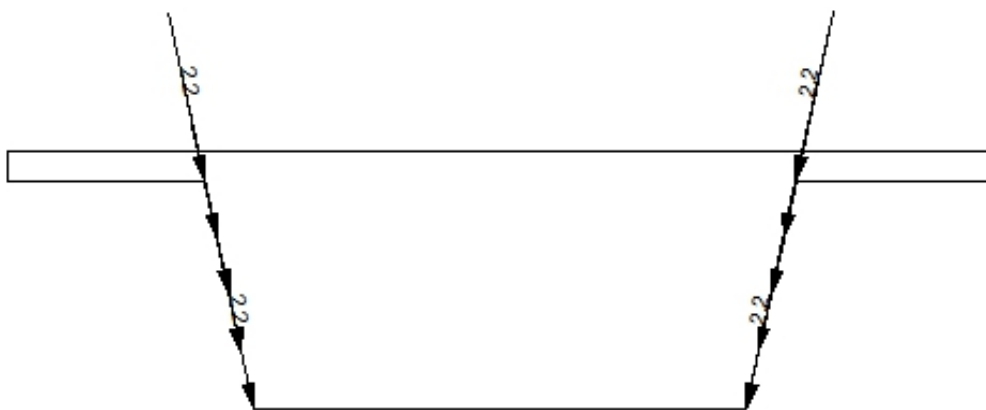
4) Loads and Load Combinations

(1) Loads

T (Moment)



V (Moment)



(2) Load Combinations

1) LC01 : $1.00T + 1.00V$

5) Reference

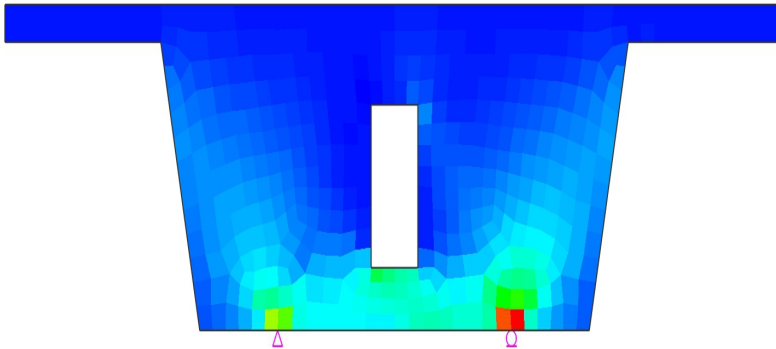
- (1) Designer : Hangil IT
(2) Date : 2017-07-19
(3) Note : Design of Hollow Types' PSC Box using Template (Eurocode 2)

2. Strut-Tie Model Design (Load Combination-1)

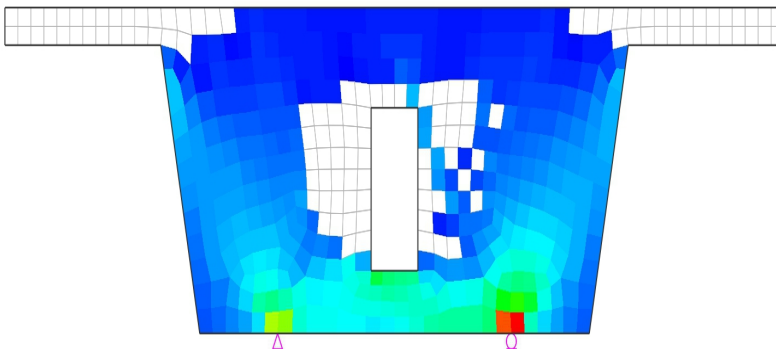
1) Construction of Strut-Tie Model

(1) ESO (Evolutionary Structural Optimization)

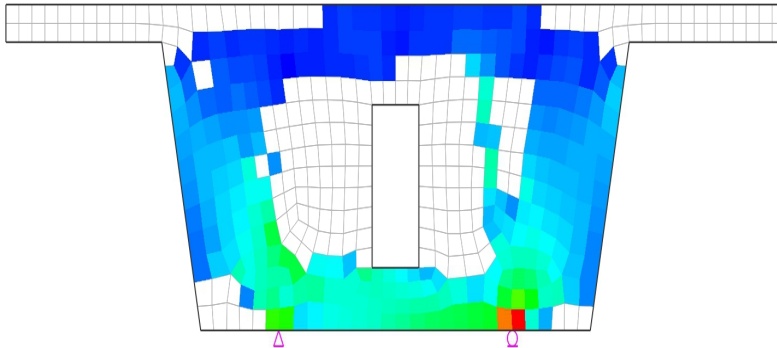
1. STAGE-01 (Initial shape)



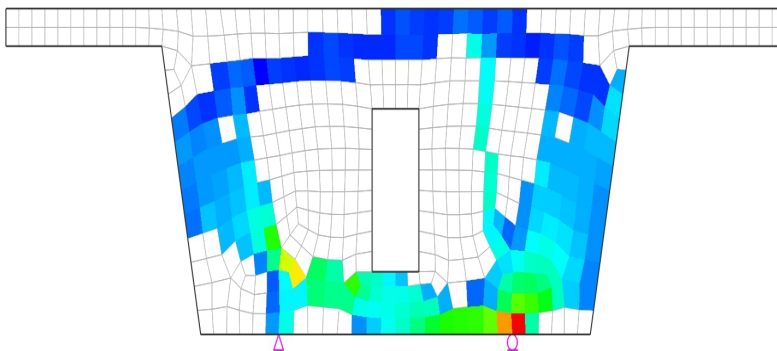
2. STAGE-04 (Elimination ratio = 25%)



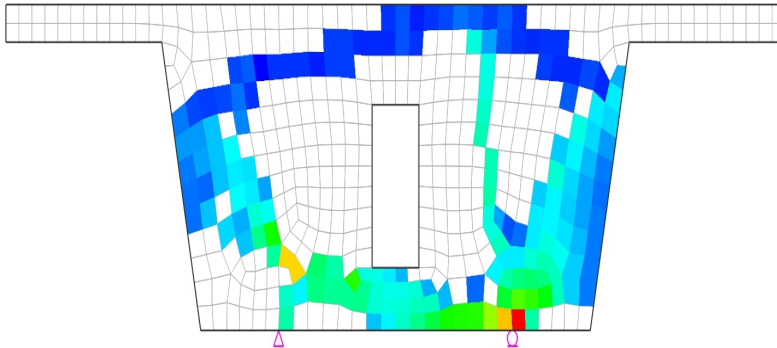
3. STAGE-07 (Elimination ratio = 45%)



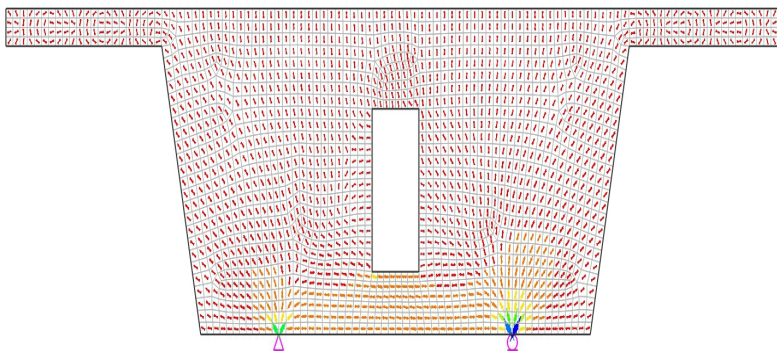
4. STAGE-10 (Elimination ratio = 58%)



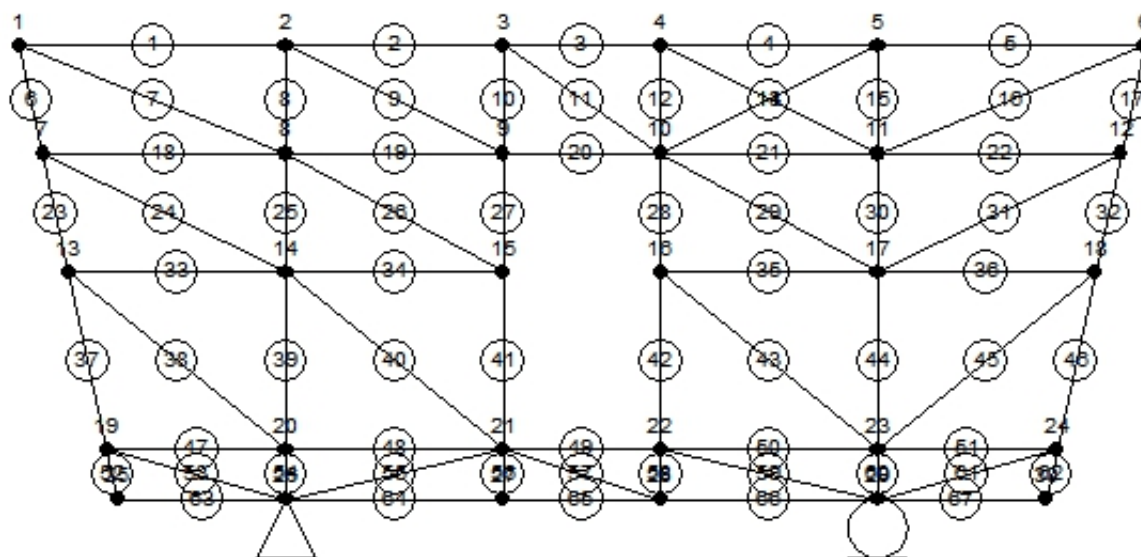
5. STAGE-11 (Elimination ratio = 62%)



(2) Compressive Principal Stress Flow



(3) Constructed Strut-Tie Model



(A) Nodal Coordinates

Node No.	X coordi.	Z coordi.	Node No.	X coordi.	Z coordi.
1	85.859	-6.000	2	140.000	-6.000
3	184.000	-6.000	4	216.000	-6.000
5	260.000	-6.000	6	314.141	-6.000
7	90.642	-28.000	8	140.000	-28.000
9	184.000	-28.000	10	216.000	-28.000
11	260.000	-28.000	12	309.358	-28.000
13	95.859	-52.000	14	140.000	-52.000
15	184.000	-52.000	16	216.000	-52.000
17	260.000	-52.000	18	304.141	-52.000
19	103.685	-88.000	20	140.000	-88.000
21	184.000	-88.000	22	216.000	-88.000
23	260.000	-88.000	24	296.315	-88.000
25	105.859	-98.000	26	140.000	-98.000
27	184.000	-98.000	28	216.000	-98.000
29	260.000	-98.000	30	294.141	-98.000

(B) Element Connectivity

Element No.	Start Node	End Node	Element No.	Start Node	End Node
1	1	2	2	2	3
3	3	4	4	4	5

2. Strut-Tie Model Design (Load Combination-1)



5	5	6	6	1	7
7	1	8	8	2	8
9	2	9	10	3	9
11	3	10	12	4	10
13	10	5	14	4	11
15	5	11	16	11	6
17	6	12	18	7	8
19	8	9	20	9	10
21	10	11	22	11	12
23	7	13	24	7	14
25	8	14	26	8	15
27	9	15	28	10	16
29	10	17	30	11	17
31	17	12	32	12	18
33	13	14	34	14	15
35	16	17	36	17	18
37	13	19	38	13	20
39	14	20	40	14	21
41	15	21	42	16	22
43	16	23	44	17	23
45	23	18	46	18	24
47	19	20	48	20	21
49	21	22	50	22	23
51	23	24	52	19	25
53	19	26	54	20	26
55	21	26	56	21	27
57	21	28	58	22	28
59	22	29	60	23	29
61	24	29	62	24	30
63	25	26	64	26	27
65	27	28	66	28	29
67	29	30			

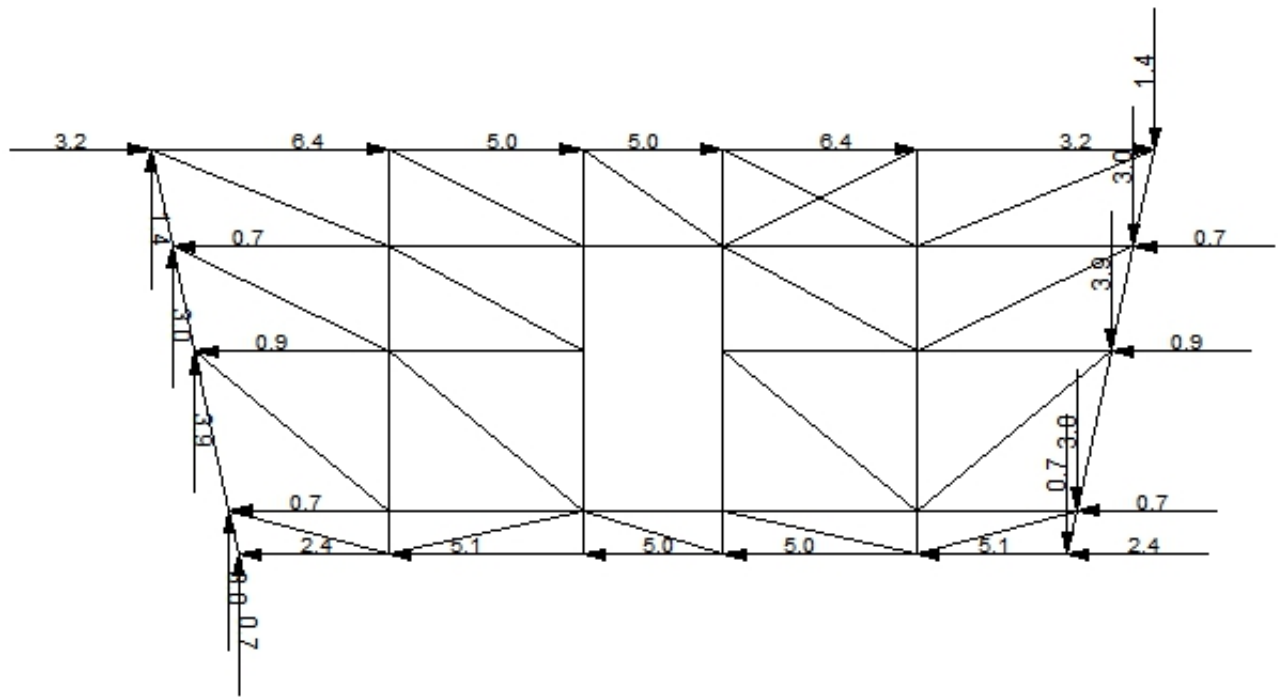
(C) Restraints

Node	Ux	Uy	Uz	Rx	Ry	Rz
26	0	0	0	0	-	0
29	-	-	0	-	-	-

2) Analysis of Strut-Tie Model

(1) Loading Conditions

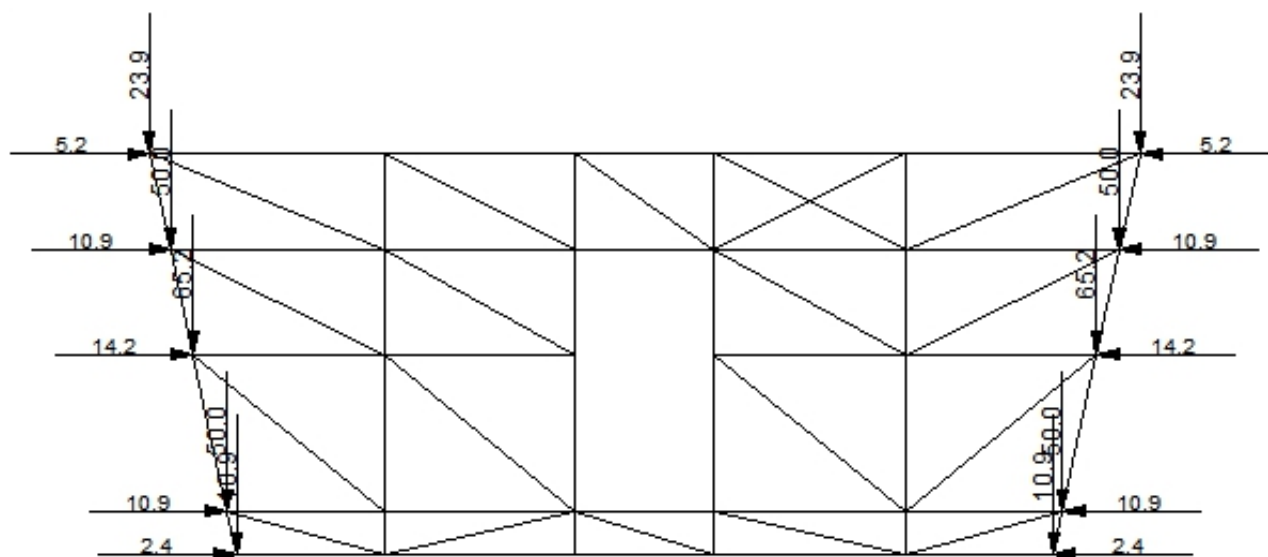
(1) Moment Load (T)



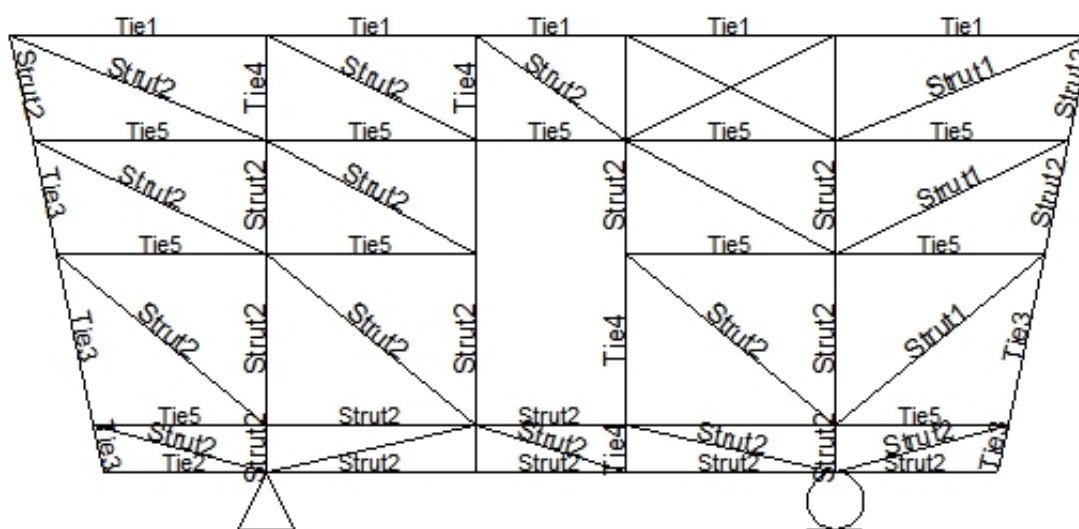
2. Strut-Tie Model Design (Load Combination-1)

StrutTie 2017

(2) Shear Load (V)



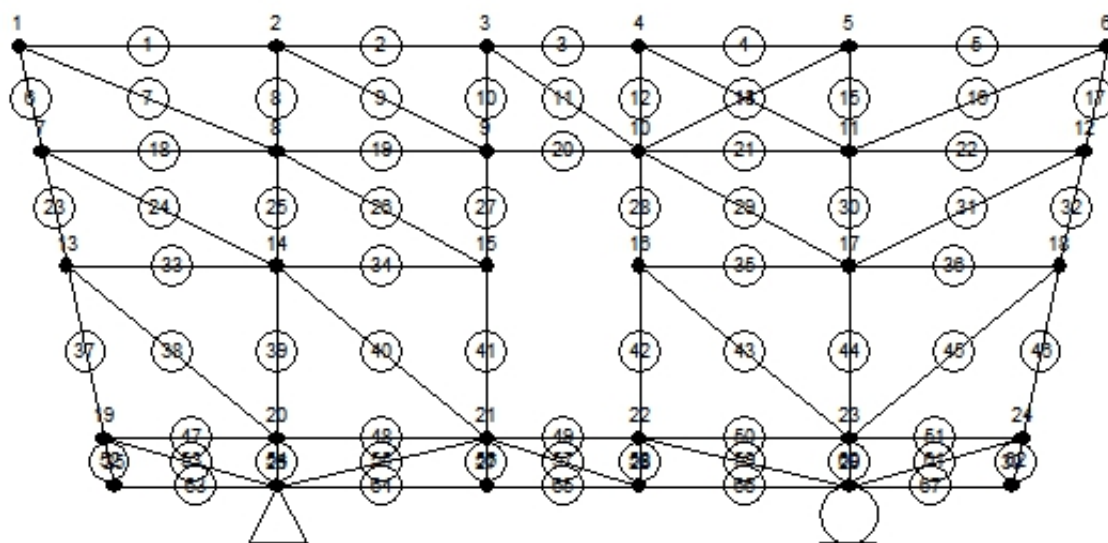
(2) Strut and Tie Types



- Strut1 : Strut without Transverse Tension
- Strut2 : Strut with Transverse Tension
- Tie1 : Tie for top rebars
- Tie2 : Tie for bottom rebars
- Tie3 : Tie for inclined main rebars
- Tie4 : Tie for intermediate vertical rebars
- Tie5 : Tie for intermediate horizontal rebars

2. Strut-Tie Model Design (Load Combination-1)

(3) Strut and Tie Forces



Elem. No.	Force (kip)	Elem. No.	Force (kip)	Elem. No.	Force (kip)	Elem. No.	Force (kip)
1	29.0	2	28.9	3	28.5	4	22.8
5	16.4	6	-8.2	7	-38.5	8	3.1
9	-7.0	10	3.2	11	-5.6	12	-0.4
13	0.0	14	0.9	15	-0.0	16	-15.2
17	-20.1	18	113.9	19	82.4	20	76.1
21	71.5	22	86.4	23	7.1	24	-141.6
25	-9.1	26	-4.7	27	0.0	28	-3.6
29	0.0	30	-5.3	31	-107.4	32	-26.2
33	101.9	34	4.2	35	27.7	36	124.2
37	47.7	38	-159.8	39	-46.8	40	-38.3
41	-2.2	42	19.1	43	-35.7	44	-52.3
45	-194.9	46	29.1	47	36.1	48	-87.8
49	-32.6	50	0.0	51	123.4	52	10.5
53	-39.8	54	-147.8	55	0.0	56	0.0
57	-88.8	58	26.5	59	-33.5	60	-198.1
61	-136.1	62	11.8	63	2.2	64	-31.0
65	-26.1	66	-105.9	67	-2.2		

3) Strength Verification and Required Rebars

(1) Required Area of Rebars

1) Main Rebars

(A) Horizontal Rebars

$$A_{s,req} = (F_u / \cos \theta) / (f_y / \gamma_s) < A_{s,used}$$

where,

F_u = member force of steel tie

γ_s = partial safety factor for steel tie : 1.15

f_y = yield strength of steel : 58015.4 lb/in²

θ = angle of steel tie measured from positive horizontal axis

(+: counterclockwise)

Tie No.	Types	F_u (kip)	θ (deg.)	Rebars	$A_{s,req}$ (in ²)	$A_{s,used}$ (in ²)	Note
1	Top	6.52	0.0	8-#8	1	6	O.K
4	Top	5.13	0.0	8-#8	0	6	O.K
5	Top	3.69	0.0	8-#8	0	6	O.K
63	Bottom	0.50	0.0	8-#8	0	6	O.K

(B) Inclined Rebars

$$A_{s,req} = (F_u / \cos(\theta_1 - \theta_2)) / (f_y / \gamma_s) < A_{s,used}$$

where,

F_u = member force of steel tie

γ_s = partial safety factor for steel tie : 1.15

f_y = yield strength of steel : 58015.4 lb/in²

θ_1 = angle of inclined rebar measured from positive horizontal axis

(+: counterclockwise)

θ_2 = angle of steel tie measured from positive horizontal axis

(+: counterclockwise)

Tie No.	F_u (kip)	θ_1 (deg.)	θ_2 (deg.)	Rebars	$A_{s,req}$ (in ²)	$A_{s,used}$ (in ²)	Note
23	1.60	77.7	77.7	10-#8	0	8	O.K
37	10.73	77.7	77.7	10-#8	1	8	O.K
46	6.53	77.7	77.7	10-#8	1	8	O.K
52	2.35	77.7	77.7	10-#8	0	8	O.K
62	2.65	77.7	77.7	10-#8	0	8	O.K

2) Transverse Rebars

(A) Horizontal Rebars

Tie No.	F_u (kip)	θ (deg.)	Rebars	$w_{eff, tie}$ (in)	S_h (in)	ϕF_n (kip)	Note
---------	----------------	--------------------	--------	------------------------	------------	---------------------	------

2. Strut-Tie Model Design (Load Combination-1)



18	25.61	0.0	4-#6	0.8	0.2	68.1	0.K
19	18.52	0.0	4-#6	0.9	0.2	74.7	0.K
20	17.11	0.0	4-#6	0.3	0.2	27.1	0.K
21	16.07	0.0	4-#6	0.9	0.2	74.7	0.K
22	19.42	0.0	4-#6	0.8	0.2	68.1	0.K
33	22.91	0.0	4-#6	0.8	0.2	72.8	0.K
34	0.93	0.0	4-#6	0.9	0.2	81.4	0.K
35	6.22	0.0	4-#6	0.9	0.2	81.4	0.K
36	27.93	0.0	4-#6	0.8	0.2	72.8	0.K
47	8.11	0.0	4-#6	0.4	0.2	33.9	0.K
51	27.73	0.0	4-#6	0.4	0.2	33.9	0.K

$$\phi \cdot F_n = A_{vh} \cdot (f_y / \gamma_s) \cdot W_{eff, tie} \cdot \cos \theta / S_h > F_u$$

where,

F_u = member force of steel tie

γ_s = partial safety factor for steel tie : 1.15

f_y = yield strength of steel : 58015.4 lb/in²

θ = angle of steel tie measured from positive horizontal axis
(+: counterclockwise)

S_h = spacing of horizontal rebars

$W_{eff, tie}$ = effective width of tie

(C) Vertical Rebars

Tie No.	F_u (kip)	θ (deg.)	Rebars	$W_{eff, tie}$ (in)	S_v (in)	ϕF_n (kip)	Note
8	0.71	90.0	2-#5	1.7	0.3	38.9	0.K
10	0.71	90.0	2-#5	1.3	0.3	28.3	0.K
42	4.29	90.0	2-#5	0.3	0.3	7.1	0.K
58	5.96	90.0	2-#5	1.3	0.3	28.3	0.K

$$\phi \cdot F_n = A_{vh} \cdot (f_y / \gamma_s) \cdot W_{eff, tie} \cdot \sin \theta / S_v > F_u$$

where,

F_u = member force of steel tie

γ_s = partial safety factor for steel tie : 1.15

f_y = yield strength of steel : 58015.4 lb/in²

θ = angle of steel tie measured from positive horizontal axis
(+: counterclockwise)

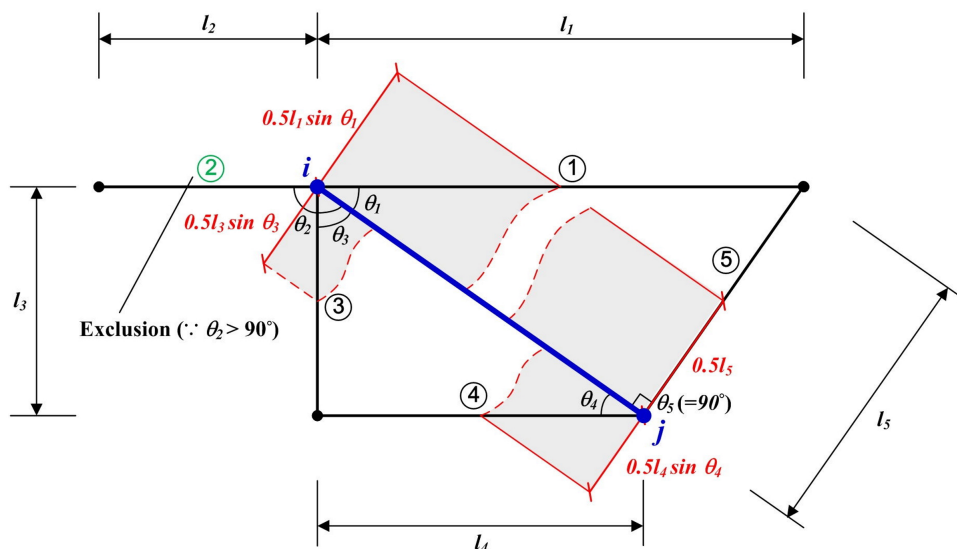
S_v = spacing of vertical rebars

$W_{eff, tie}$ = effective width of tie

(2) Available Widths of Struts and Nodal Zones

The available widths of a strut at both ends and nodal zone faces are determined by taking the minimum ones from the values calculated below for three cases.

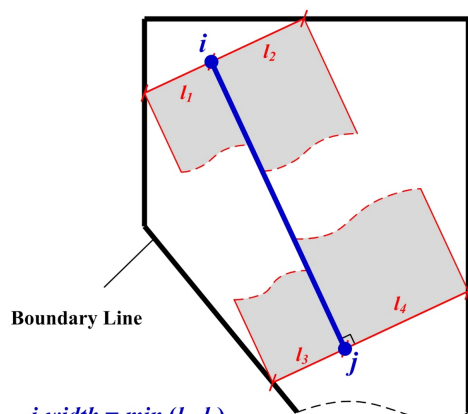
[CASE 1]



$$i\text{-width} = \min(l_1 \sin \theta_1, l_3 \sin \theta_3)$$

$$j\text{-width} = \min(l_4 \sin \theta_4, l_5)$$

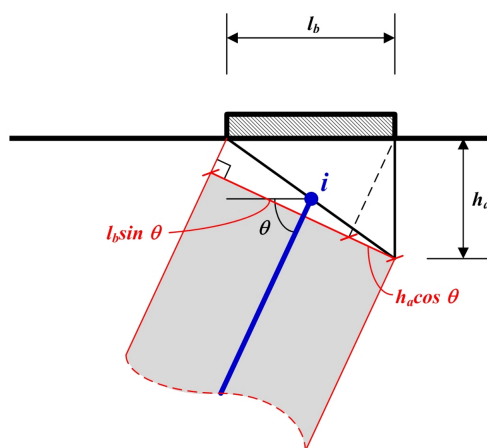
[CASE 2]



$$i\text{-width} = \min(l_1, l_2)$$

$$j\text{-width} = \min(l_3, l_4)$$

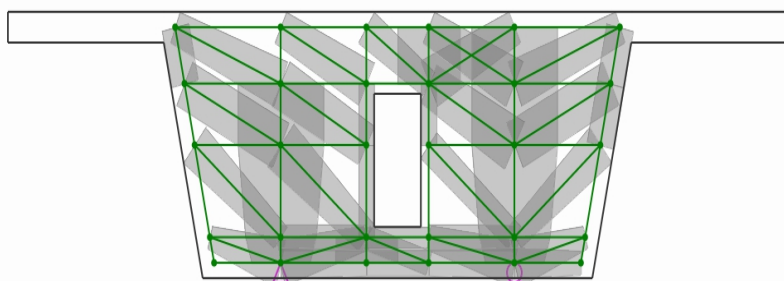
[CASE 3]



$$i\text{-width} = l_b \sin \theta + h_a \cos \theta$$

2. Strut-Tie Model Design (Load Combination-1)

The available widths of struts and ties determined by the methods introduced above are shown below



Elem. No.	i-width	j-width	Available Width	Elem. No.	i-width	j-width	Available Width
6	14.0	14.0	14.0	7	12.9	18.5	12.9
9	13.4	18.3	13.4	11	14.5	11.0	11.0
16	18.5	12.9	12.9	17	14.0	14.0	14.0
24	18.6	19.3	18.6	25	44.0	44.0	44.0
26	19.6	17.0	17.0	28	8.0	8.0	8.0
30	44.0	44.0	44.0	31	19.3	18.6	18.6
32	14.0	14.0	14.0	38	17.8	10.5	10.5
39	44.0	36.3	36.3	40	21.4	12.9	12.9
41	8.0	8.0	8.0	43	13.0	10.8	10.8
44	44.0	36.3	36.3	45	10.5	17.8	10.5
48	10.0	10.0	10.0	49	8.0	8.0	8.0
53	9.0	19.5	9.0	54	36.3	30.0	30.0
57	9.5	9.5	9.5	59	9.5	18.3	9.5
60	36.3	30.0	30.0	61	9.0	19.5	9.0
64	11.9	10.0	10.0	65	10.0	10.0	10.0
66	10.0	11.9	10.0	67	11.9	9.4	9.4

(3) Strength of Struts

- Design strength of concrete strut without transverse tension (Type 1)

$$W_{req} = F_u / ((\alpha_{cc} \cdot f_{ck} / \gamma_c) \cdot b) < W_{prov}$$
 (See Eurocode 2 Section 6.5.2(1))
- Design strength of concrete strut with transverse tension (Type 2)

$$W_{req} = F_u / (0.6 \cdot (1 - f_{ck} / 36,260) \cdot (\alpha_{cc} \cdot f_{ck} / \gamma_c) \cdot b) < W_{prov}$$
 (See Eurocode 2 Section 6.5.2(2))

$$\gamma_c = \text{partial safety factor for concrete} = 1.50$$

2. Strut-Tie Model Design (Load Combination-1)



alpha_cc = coefficient of long term effects = 1.00

Strut No.	Type	theta	Fu (kip)	b (in)	Wreq (in)	Wprov (in)	Note
6	2	77.7	8.2	14.0	0.5	14.0	O.K
7	2	22.1	38.5	14.0	2.2	13.0	O.K
9	2	26.6	7.0	14.0	0.4	13.4	O.K
11	2	34.5	5.6	14.0	0.3	11.0	O.K
16	1	22.1	15.2	14.0	0.5	13.0	O.K
17	2	77.7	20.1	14.0	1.1	14.0	O.K
24	2	25.9	141.6	14.0	8.0	18.6	O.K
25	2	90.0	9.1	14.0	0.5	44.0	O.K
26	2	28.6	4.7	14.0	0.3	17.0	O.K
28	2	90.0	3.6	14.0	0.2	8.0	O.K
30	2	90.0	5.3	14.0	0.3	44.0	O.K
31	1	25.9	107.4	14.0	3.3	18.6	O.K
32	2	77.7	26.2	14.0	1.5	14.0	O.K
38	2	39.2	159.8	14.0	9.1	10.5	O.K
39	2	90.0	46.8	14.0	2.7	36.3	O.K
40	2	39.3	38.3	14.0	2.2	12.9	O.K
41	2	90.0	2.2	14.0	0.1	8.0	O.K
43	2	39.3	35.7	14.0	2.0	10.9	O.K
44	2	90.0	52.3	14.0	3.0	36.3	O.K
45	1	39.2	194.9	14.0	6.0	10.5	O.K
48	2	0.0	87.8	14.0	5.0	10.0	O.K
49	2	0.0	32.6	14.0	1.9	8.0	O.K
53	2	15.4	39.8	14.0	2.3	9.1	O.K
54	2	90.0	147.8	14.0	8.4	30.0	O.K
57	2	17.4	88.8	14.0	5.0	9.5	O.K
59	2	12.8	33.5	14.0	1.9	9.6	O.K
60	2	90.0	198.1	14.0	11.2	30.0	O.K
61	2	15.4	136.1	14.0	7.7	9.1	O.K
64	2	0.0	31.0	14.0	1.8	10.0	O.K
65	2	0.0	26.1	14.0	1.5	10.0	O.K
66	2	0.0	105.9	14.0	6.0	10.0	O.K
67	2	0.0	2.2	14.0	0.1	9.4	O.K

(4) Strength of Nodal Zones

2. Strut-Tie Model Design (Load Combination-1)



The verification of the nodal zone strength should be done through comparing the available nodal zone area with that required. In this report, if the thickness of the structural concrete is consistent, the verification will be done by comparing the available nodal zone width, W_{prov} , with that required, W_{req}

$W_{req} = F_u / (k \cdot (1 - f_{ck}/36,260) \cdot (\alpha_{cc} \cdot f_{ck} / \gamma_c) \cdot b) < W_{prov}$ (See Eurocode 2 Section 6.5.4(4))

$k = 1.00$ (compression nodes where no ties are anchored at the node)

0.85 (compression-tension nodes with anchored ties provided in one direction)

0.75 (compression-tension nodes with anchored ties provided in more than one direction)

Under the conditions listed below, the design compressive stress values given in 6.5.4(4) may be increased by up to 10 percent where at least one of the following applies:

- triaxial compression is assured
- all angles between struts and ties are $> 55^\circ$
- the stresses applied at supports or at point loads are uniform, and the node is confined by stirrups
- the reinforcement is arranged in multiple layers
- the node is reliably confined by means of bearing arrangement or friction

Node No.	k	Type	Element	F_u (kip)	W_{req} (in)	W_{prov} (in)	Note
1	0.85	CCT	T-1	29.0	1.2	12.0	O.K
			C-6	8.2	0.3	14.0	O.K
			C-7	38.5	1.5	13.0	O.K
2	0.75	CTT	T-1	0.1	0.0	12.0	O.K
			T-2	-	-	-	-
			T-8	3.1	0.1	44.0	O.K
			C-9	7.0	0.3	13.4	O.K
3	0.75	CTT	T-2	0.3	0.0	12.0	O.K
			T-3	-	-	-	-
			T-10	3.2	0.1	32.0	O.K
			C-11	5.6	0.3	14.6	O.K
6	0.85	CCT	T-5	16.4	0.7	12.0	O.K
			C-16	15.2	0.6	13.0	O.K
6	0.85	CCT	C-17	20.1	0.8	14.0	O.K
			C-6	8.2	0.4	14.0	O.K
7	0.75	CTT	T-18	113.9	5.2	20.1	O.K
			T-23	7.1	0.3	14.0	O.K
			C-24	141.6	6.4	18.6	O.K

2. Strut-Tie Model Design (Load Combination-1)



8	0.75	CTT	C-7	38.5	1.7	18.6	0.K
			T-8	3.1	0.1	44.0	0.K
			T-18	31.5	1.4	22.0	0.K
			T-19	-	-	-	-
8	0.75	CTT	C-25	9.1	0.4	44.0	0.K
			C-26	4.7	0.2	19.7	0.K
			C-9	7.0	0.3	18.3	0.K
			T-10	3.2	0.1	32.0	0.K
			T-19	6.3	0.3	22.0	0.K
			T-20	-	-	-	-
10	0.75	CTT	C-11	5.6	0.3	11.0	0.K
			T-20	4.6	0.2	8.0	0.K
			T-21	-	-	-	-
			C-28	3.6	0.2	8.0	0.K
11	0.75	CTT	C-16	15.2	0.7	18.6	0.K
			T-21	-	-	-	-
			T-22	14.9	0.7	22.0	0.K
			C-30	5.3	0.2	44.0	0.K
12	0.85	CCT	C-17	20.1	0.8	14.0	0.K
			T-22	86.4	3.5	20.1	0.K
			C-31	107.4	4.3	18.6	0.K
			C-32	26.2	1.1	14.0	0.K
13	0.75	CTT	T-23	-	-	-	-
			T-33	101.9	4.6	21.5	0.K
			T-37	40.6	1.8	14.0	0.K
			C-38	159.8	7.3	17.9	0.K
14	0.75	CTT	C-24	141.6	6.4	19.3	0.K
			C-25	9.1	0.4	44.0	0.K
			T-33	97.7	4.4	24.0	0.K
			T-34	-	-	-	-
14	0.75	CTT	C-39	46.8	2.1	44.0	0.K
			C-40	38.3	1.7	21.4	0.K
			C-26	4.7	0.2	17.0	0.K
			T-34	4.2	0.2	24.0	0.K
			C-41	2.2	0.1	8.0	0.K
			C-28	3.6	0.2	8.0	0.K
16	0.75	CTT	T-35	27.7	1.3	24.0	0.K
			T-42	19.1	0.9	8.0	0.K

2. Strut-Tie Model Design (Load Combination-1)



16	0.75	CTT	C-43	35.7	1.6	13.0	0.K
17	0.75	CTT	C-30	5.3	0.2	44.0	0.K
			C-31	107.4	4.9	19.3	0.K
			T-35	-	-	-	-
			T-36	96.6	4.4	24.0	0.K
17	0.75	CTT	C-44	52.3	2.4	44.0	0.K
			C-32	26.2	1.2	14.0	0.K
			T-36	124.2	5.6	21.5	0.K
			C-45	194.9	8.8	17.9	0.K
			T-46	29.1	1.3	14.0	0.K
19	0.75	CTT	T-37	37.3	1.7	14.0	0.K
			T-47	36.1	1.6	10.0	0.K
			T-52	-	-	-	-
			C-53	39.8	1.8	9.1	0.K
20	0.85	CCT	C-38	159.8	6.4	10.5	0.K
			C-39	46.8	1.9	36.3	0.K
			T-47	36.1	1.4	10.0	0.K
			C-48	87.8	3.5	10.0	0.K
20	0.85	CCT	C-54	147.8	5.9	36.3	0.K
			C-40	38.3	1.3	12.9	0.K
			C-41	2.2	0.1	8.0	0.K
			C-48	87.8	3.0	10.0	0.K
			C-49	32.6	1.1	8.0	0.K
21	1.00	CCC	C-57	88.8	3.0	9.5	0.K
			T-42	-	-	-	-
			C-49	32.6	1.5	8.0	0.K
			T-58	7.4	0.3	32.0	0.K
			C-59	33.5	1.5	9.6	0.K
23	0.85	CCT	C-43	35.7	1.4	10.9	0.K
			C-44	52.3	2.1	36.3	0.K
			C-45	194.9	7.8	10.5	0.K
			T-51	123.4	4.9	10.0	0.K
23	0.85	CCT	C-60	198.1	7.9	36.3	0.K
			T-46	17.3	0.8	14.0	0.K
			T-51	123.4	5.6	10.0	0.K
			C-61	136.1	6.2	9.1	0.K
			T-62	-	-	-	-
26	0.85	CCT	R	158.3	6.3	30.0	0.K

2. Strut-Tie Model Design (Load Combination-1)



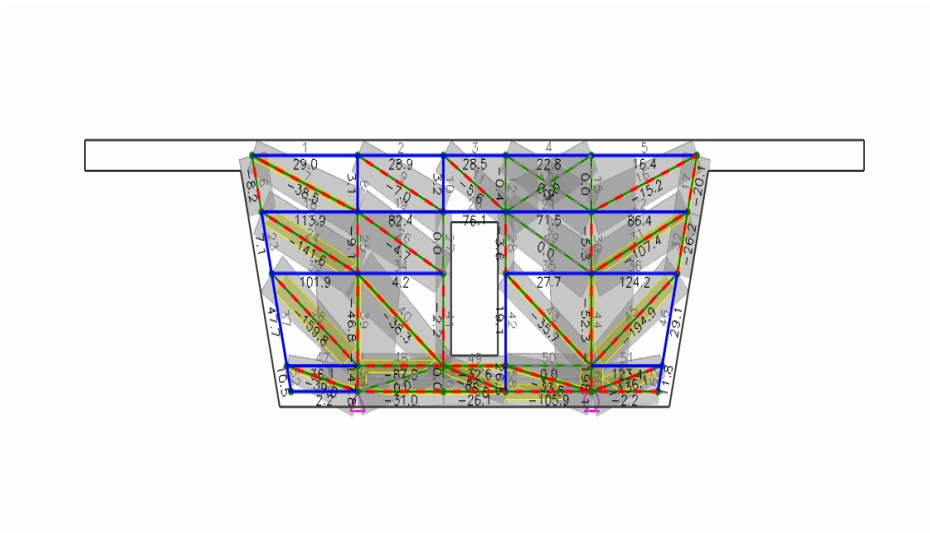
26	0.85	CCT	C-53	39.8	1.6	19.5	0.K
			C-54	147.8	5.9	30.0	0.K
			T-63	2.2	0.1	12.0	0.K
26	0.85	CCT	C-64	31.0	1.2	12.0	0.K
			C-64	31.0	1.1	10.0	0.K
27	1.00	CCC	C-65	26.1	0.9	10.0	0.K
			C-57	88.8	3.6	9.5	0.K
			T-58	26.5	1.1	32.0	0.K
			C-65	26.1	1.0	10.0	0.K
			C-66	105.9	4.2	10.0	0.K
29	1.00	CCC	R	241.7	8.2	30.0	0.K
			C-59	33.5	1.1	18.4	0.K
29	1.00	CCC	C-60	198.1	6.7	30.0	0.K
			C-61	136.1	4.6	19.5	0.K
			C-66	105.9	3.6	12.0	0.K
			C-67	2.2	0.1	12.0	0.K
30	0.85	CCT	T-62	11.8	0.5	14.0	0.K
			C-67	2.2	0.1	9.4	0.K

C: compression; T: tension; V: vertical force; H: horizontal force

3. Summary

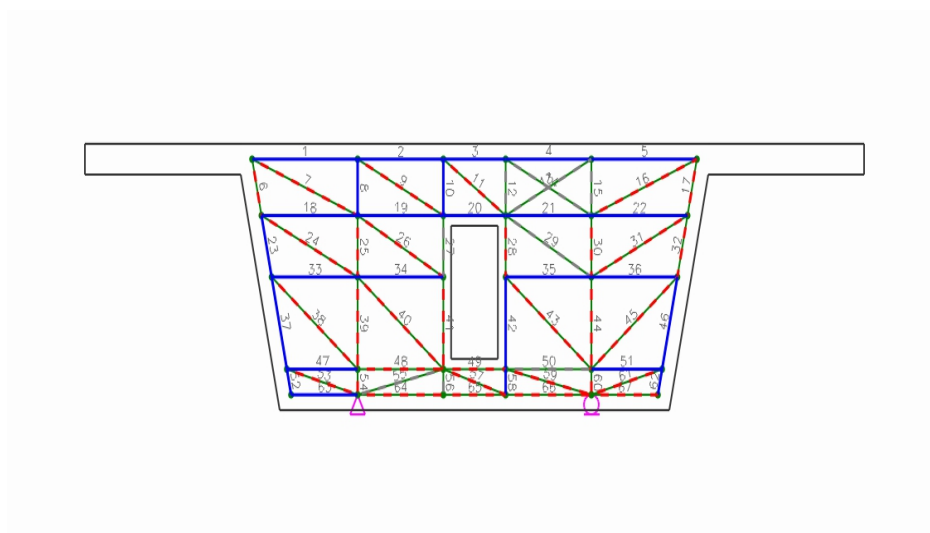
1) Dimensioned Shape

1) Load Combination - 1



2) Required and Used Areas of Rebars

1) Load Combination - 1



(A) Main Rebars

Tie No.	Types	Fu (kip)	theta (deg.)	Rebars	As.req (in ²)	As.used (in ²)	Note
1	Top	6.52	0.0	8-#8	1	6	0.K

3. Summary



4	Top	5.13	0.0	8-#8	0	6	0.K
5	Top	3.69	0.0	8-#8	0	6	0.K
63	Bottom	0.50	0.0	8-#8	0	6	0.K

Tie No.	Fu (kip)	theta1 (deg.)	theta2 (deg.)	Rebars	As.req (in ²)	As.used (in ²)	Note
23	1.60	77.7	77.7	10-#8	0	8	0.K
37	10.73	77.7	77.7	10-#8	1	8	0.K
46	6.53	77.7	77.7	10-#8	1	8	0.K
52	2.35	77.7	77.7	10-#8	0	8	0.K
62	2.65	77.7	77.7	10-#8	0	8	0.K

(B) Transverse Rebars

Tie No.	Fu (kip)	theta (deg.)	Rebars	Weff,tie (in)	Sh (in)	phi Fn (kip)	Note
18	25.61	0.0	4-#6	0.8	0.2	68.1	0.K
19	18.52	0.0	4-#6	0.9	0.2	74.7	0.K
20	17.11	0.0	4-#6	0.3	0.2	27.1	0.K
21	16.07	0.0	4-#6	0.9	0.2	74.7	0.K
22	19.42	0.0	4-#6	0.8	0.2	68.1	0.K
33	22.91	0.0	4-#6	0.8	0.2	72.8	0.K
34	0.93	0.0	4-#6	0.9	0.2	81.4	0.K
35	6.22	0.0	4-#6	0.9	0.2	81.4	0.K
36	27.93	0.0	4-#6	0.8	0.2	72.8	0.K
47	8.11	0.0	4-#6	0.4	0.2	33.9	0.K
51	27.73	0.0	4-#6	0.4	0.2	33.9	0.K

- Vertical Rebars

Tie No.	Fu (kip)	theta (deg.)	Rebars	Weff,tie (in)	Sv (in)	phi Fn (kip)	Note
8	0.71	90.0	2-#5	1.7	0.3	38.9	0.K
10	0.71	90.0	2-#5	1.3	0.3	28.3	0.K
42	4.29	90.0	2-#5	0.3	0.3	7.1	0.K
58	5.96	90.0	2-#5	1.3	0.3	28.3	0.K