CONSTRUCTION LOADS

OF BOX GIRDER SUPERSTRUCTURE

641

A. MATERIAL PROPERTY INPUT

A.1. Compressive Strength of Concrete @ 28 days, fc' :

Box Girder	35	40.00 MPa
Column	30	28.00 MPa
Footing	30	28.00 MPa
Piles	30	28.00 MPa

A.2. Modulus of Elasticity of Concrete, Ec :

Box Girder	29.15×10^3 MPa
Column	24.86×10^3 MPa
Footing	24.86×10^3 MPa
Piles	24.86×10^3 MPa

B. ERECTION LOADS DURING CONSTRUCTION

B.1 Dead Load

B.1.1 Dead Load of Superstructure, (DL) Unit weight of concrete, γ_w = ~~24.80~~ 24.4 KN/m.^{3} ✓

B.1.2 Differential load from one cantilever, (DIFF.) w = 2% of the DL applied to one cantilever ✓

Member	Ave. A (m.^{2})	ΔL (m.)	γ_w (KN/m.^{3})	W (KN)
1	15.92	2.00	24.80	789.58
2	15.919	4.00	24.80	1579.16
3	15.357	3.00	24.80	1142.56
4	14.849	3.00	24.80	1104.77
5	14.319	3.00	24.80	1065.33
6	13.767	3.00	24.80	1024.26
7	13.192	3.00	24.80	981.48
8	12.595	3.00	24.80	937.07
9	11.976	3.00	24.80	891.01
10	11.661	3.50	24.80	1012.17
11	11.661	3.50	24.80	1012.17
12	11.661	3.50	24.80	1012.17
13	11.661	3.50	24.80	1012.17
14	11.661	3.50	24.80	1012.17
15	11.661	3.50	24.80	1012.17
Summation		48.00		15588.29

Assume a uniform weight throughout the entire cantilever span :

Ave. wt, w = W/L = 324.76 KN/m.

Differential Load , $w_{diff.}$

$w_{diff.}$ = 2% of w

$w_{diff.}$ = 6.50 KN/m.

B.1.3 Segment Unbalance, (U)

✓ Consider one segment unbalance load, P = 1012.00 KN

B.2. Live Load

B.2.1 Distr. Construction Live Load, (CLL) Lane Width = 16.00 m. 16.20

w_{LL1} = 7.66 KN/m. 7.76

0.4788 KN/m² w_{LL2} = 3.83 KN/m. 3.88

B.2.2 Specialized Construction Equipment , i.e. wagon, etc., (CE)

Weight of wagon + supports + etc. = 1,010.00 KN

B.2.3 Impact Load from equipment, (IE)

Impact, per AASHTO requirement, 10% = 101.00 KN

B.3. Wind Load

B.3.1 Wind Load on the Superstructure, (W)

Loaded Lane = 16.00 m.

Wind intensity, q = 2.40 KN/m.^{2}

Wind Load, w_{wl} = 38.40 KN/m.

B.3.2 Wind Uplift on cantilever applied on one side only, (WUP)

Uplift Intensity, w = 0.24 KN/m.^{2}

16.2 Wind uplift load = 3.84 KN/m. 3.89

B.4. Creep, Shrinkage and Temperature

B.4.1 Effect of Creep, (R)

B.4.2 Shrinkage Load, (S)

B.4.3 Thermal Load,(T)

ANALYSIS OUTPUT – STAAD III

OF BOX GIRDER SUPERSTRUCTURE

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
1	1	1	0.01	1.04	41.55	-0.02	-83.68	1.81
		2	28.90	1,011.13	-41.55	0.02	-79.69	-1,772.26
	2	1	0.06	0.29	-0.12	0.00	0.23	0.34
		2	0.59	22.46	0.12	0.00	0.23	-39.44
	3	1	-28.84	-1,011.37	0.03	0.00	-0.02	0.54
		2	28.84	1,011.37	-0.03	0.00	-0.02	-3,541.91
	4	1	0.00	0.13	0.00	0.00	0.00	0.24
		2	0.76	26.68	0.00	0.00	0.00	-46.83
	5	1	-31.71	-1,110.22	0.01	0.00	-0.01	0.00
		2	31.71	1,110.22	-0.01	0.00	0.01	-3,888.71
	6	1	-2.89	-100.98	0.02	0.00	-0.03	0.00
		2	2.89	100.98	-0.02	0.00	-0.03	-353.48
	7	1	0.00	-0.05	-0.10	0.00	0.08	-0.37
		2	3.84	134.45	0.10	0.00	0.05	-235.43
	8	1	0.03	-0.02	0.00	0.00	0.01	0.09
		2	-0.41	-13.39	0.00	0.00	0.01	23.57
2	1	2	-31.81	-1,010.56	-12.28	0.01	25.56	1,774.14
		3	63.62	2,022.74	12.28	-0.01	23.09	-7,086.39
	2	2	-0.76	-22.92	-0.01	0.00	0.03	39.44
		3	1.48	45.67	0.01	0.00	0.01	-159.85
	3	2	-31.80	-1,012.97	0.03	0.00	-0.07	3,540.14
		3	31.80	1,012.97	-0.03	0.00	-0.08	-7,086.00
	4	2	-0.87	-27.04	0.00	0.00	0.00	46.68
		3	1.71	53.85	0.00	0.00	-0.01	-187.89
	5	2	-34.89	-1,109.64	0.01	0.00	-0.01	3,889.46
		3	34.89	1,109.64	-0.01	0.00	-0.01	-7,776.30
	6	2	-3.17	-100.97	0.00	0.00	-0.01	353.45
		3	3.17	100.97	0.00	0.00	-0.01	-707.05
	7	2	-4.23	-134.50	-0.34	0.00	0.62	235.15
		3	8.45	268.90	0.34	0.00	0.31	-941.38
	8	2	0.44	13.33	0.00	0.00	0.01	-23.52
		3	-0.86	-26.73	0.00	0.00	0.01	93.76
3	1	3	-57.78	-2,021.09	-19.99	0.02	40.72	7,093.51
		4	86.70	3,033.27	19.99	-0.02	42.56	-15,943.81
	2	3	-1.23	-45.11	0.06	0.00	-0.10	159.86
		4	1.88	67.86	-0.06	0.00	-0.10	-357.89

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	PAXIAL (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	3	3	-28.75	-1,010.63	0.01	0.00	-0.04	7,084.02
		4	28.75	1,010.63	-0.01	0.00	-0.02	-10,626.08
	4	3	-1.53	-53.70	0.00	0.00	0.00	187.47
		4	2.29	80.51	0.00	0.00	0.00	-422.61
	5	3	-31.73	-1,110.58	0.02	0.00	-0.04	7,776.63
		4	31.73	1,110.58	-0.02	0.00	-0.02	-11,666.12
	6	3	-2.89	-100.96	0.01	0.00	-0.01	707.00
		4	2.89	100.96	-0.01	0.00	-0.01	-1,060.53
	7	3	-7.68	-268.82	-0.08	0.00	-0.28	941.09
		4	11.52	403.22	0.08	0.00	-0.24	-2,118.03
	8	3	0.76	26.71	0.00	0.00	0.01	-94.10
		4	-1.15	-40.12	0.00	0.00	0.01	210.99
4	1	4	-95.40	-3,035.73	7.72	-0.01	-11.82	15,947.72
		5	127.21	4,047.91	-7.72	0.01	-1.04	-28,352.99
	2	4	-2.15	-68.44	-0.02	0.00	0.03	358.38
		5	2.87	91.19	0.02	0.00	0.04	-637.51
	3	4	-31.79	-1,011.05	0.05	0.00	-0.07	10,625.84
		5	31.79	1,011.05	-0.05	0.00	-0.09	-14,168.21
	4	4	-2.53	-80.43	0.00	0.00	0.01	422.42
		5	3.37	107.24	0.00	0.00	0.01	-751.09
	5	4	-34.90	-1,110.81	0.05	0.00	-0.07	11,664.74
		5	34.90	1,110.81	-0.05	0.00	-0.07	-15,554.82
	6	4	-3.17	-100.95	0.01	0.00	-0.01	1,060.49
		5	3.17	100.95	-0.01	0.00	-0.01	-1,414.01
	7	4	-12.66	-402.69	0.74	0.00	-1.44	2,118.22
		5	16.88	537.09	-0.74	0.00	-1.31	-3,764.21
	8	4	1.24	40.26	0.00	0.00	0.00	-211.24
		5	-1.66	-53.66	0.00	0.00	0.00	375.57
5	1	5	-115.69	-4,050.18	-6.93	0.00	9.98	28,352.05
		6	144.61	5,062.36	6.93	0.00	4.60	-44,302.92
	2	5	-2.58	-91.06	-0.03	0.00	0.04	637.23
		6	3.23	113.81	0.03	0.00	0.03	-995.93
	3	5	-28.61	-1,010.64	-0.01	0.00	0.00	14,168.78
		6	28.61	1,010.64	0.01	0.00	0.01	-17,708.70
	4	5	-3.04	-107.05	-0.01	0.00	0.02	751.35
		6	3.80	133.86	0.01	0.00	0.02	-1,173.07

STAAD FILE FRMC-1

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Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P AXIAL (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	5	5	-31.73	-1,110.45	-0.03	0.00	0.07	15,554.36
		6	31.73	1,110.45	0.03	0.00	0.07	-19,442.08
	6	5	-2.88	-100.95	0.00	0.00	0.00	1,414.04
		6	2.88	100.95	0.00	0.00	0.00	-1,767.47
	7	5	-15.36	-537.73	-0.46	0.00	0.59	3,764.56
		6	19.20	672.13	0.46	0.00	0.62	-5,882.74
	8	5	1.53	53.65	0.00	0.00	0.00	-375.49
		6	-1.91	-67.06	0.00	0.00	0.00	586.76
6	1	6	-159.09	-5,062.30	-12.86	0.00	19.39	44,300.54
		7	190.90	6,074.47	12.86	0.00	14.37	-63,798.27
	2	6	-3.57	-113.63	0.01	0.00	-0.02	996.19
		7	4.28	136.38	-0.01	0.00	-0.02	-1,433.62
	3	6	-31.61	-1,011.44	0.02	0.00	-0.01	17,709.48
		7	31.61	1,011.44	-0.02	0.00	-0.01	-21,252.07
	4	6	-4.25	-133.99	0.01	0.00	-0.01	1,173.45
		7	5.09	160.80	-0.01	0.00	-0.02	-1,689.78
	5	6	-34.89	-1,110.29	-0.02	0.00	0.05	19,442.81
		7	34.89	1,110.29	0.02	0.00	0.05	-23,330.65
	6	6	-3.17	-100.95	0.00	0.00	0.00	1,767.48
		7	3.17	100.95	0.00	0.00	0.00	-2,121.01
	7	6	-21.12	-672.09	0.30	0.00	-0.26	5,882.54
		7	25.34	806.49	-0.30	0.00	-0.29	-8,471.00
	8	6	2.13	67.08	0.00	0.00	0.00	-586.67
		7	-2.55	-80.48	0.00	0.00	0.00	844.93
7	1	7	161.98	-6,073.09	0.59	0.00	-3.01	63,793.83
		8	-185.75	6,964.25	-0.59	0.00	-6.02	-83,361.67
	2	7	3.63	-136.64	0.02	0.00	-0.02	1,434.10
		8	-4.15	156.14	-0.02	0.00	0.00	-1,872.75
	3	7	27.39	-1,012.65	0.01	0.00	-0.01	21,250.22
		8	-27.39	1,012.65	-0.01	0.00	-0.03	-24,289.97
	4	7	4.29	-160.84	0.00	0.00	0.01	1,689.83
		8	-4.90	183.82	0.00	0.00	0.01	-2,207.07
	5	7	29.63	-1,110.81	0.05	0.00	-0.08	23,330.57
		8	-29.63	1,110.81	-0.05	0.00	-0.06	-26,664.40
	6	7	2.69	-100.95	0.00	0.00	-0.01	2,121.02
		8	-2.69	100.95	0.00	0.00	-0.01	-2,423.98

THE STUDY ON THE CONSTRUCTION OF THE BRIDGE
OVER THE RIVER RUPSA IN KHULNA- PHASE 2

Job No. :	Date : 11/2/99	Designed by :	Checked by :

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	7	7	21.50	-806.27	0.63	0.00	-0.69	8,471.47
		8	-24.57	921.47	-0.63	0.00	-0.64	-11,063.78
	8	7	-2.12	80.23	0.00	0.00	0.00	-845.26
		8	2.43	-91.72	0.00	0.00	0.00	1,103.23
8	1	8	185.67	-6,961.54	-10.36	0.02	5.44	83,362.37
		9	-210.65	7,898.61	10.36	-0.02	2.75	-105,665.00
	2	8	4.10	-156.11	-0.05	0.00	0.07	1,872.76
		9	-4.62	175.61	0.05	0.00	0.07	-2,370.27
	3	8	27.12	-1,010.81	-0.03	0.00	0.04	24,288.59
		9	-27.12	1,010.81	0.03	0.00	0.05	-27,322.54
	4	8	4.88	-183.72	0.01	0.00	-0.01	2,207.20
		9	-5.49	206.70	-0.01	0.00	-0.01	-2,793.05
	5	8	29.60	-1,110.65	0.02	0.00	-0.03	26,664.16
		9	-29.60	1,110.65	-0.02	0.00	-0.03	-29,996.89
	6	8	2.69	-100.99	0.00	0.00	0.00	2,423.94
		9	-2.69	100.99	0.00	0.00	-0.01	-2,727.04
	7	8	24.59	-921.66	0.24	0.00	-0.34	11,064.01
		9	-27.66	1,036.86	-0.24	0.00	-0.50	-14,003.05
	8	8	-2.44	91.96	0.00	0.00	0.00	-1,103.58
		9	2.74	-103.45	0.00	0.00	0.00	1,396.60
9	1	9	210.63	-7,900.77	0.99	0.00	1.18	105,669.50
		10	-236.80	8,882.26	-0.99	0.00	1.46	-130,854.30
	2	9	4.69	-175.58	-0.01	0.00	0.01	2,370.32
		10	-5.21	195.08	0.01	0.00	0.01	-2,926.41
	3	9	26.52	-1,012.20	0.03	0.00	-0.03	27,324.50
		10	-26.52	1,012.20	-0.03	0.00	-0.04	-30,359.57
	4	9	5.49	-206.65	0.00	0.00	0.01	2,793.71
		10	-6.11	229.63	0.00	0.00	0.00	-3,448.09
	5	9	29.61	-1,110.41	-0.02	0.00	0.02	29,997.38
		10	-29.61	1,110.41	0.02	0.00	0.03	-33,329.73
	6	9	2.69	-100.92	0.00	0.00	0.00	2,727.08
		10	-2.69	100.92	0.00	0.00	0.00	-3,029.93
	7	9	27.65	-1,036.82	-0.12	0.00	0.29	14,003.12
		10	-30.72	1,152.02	0.12	0.00	0.21	-17,287.55
	8	9	-2.70	103.48	0.00	0.00	0.00	-1,396.69
		10	3.01	-114.97	0.00	0.00	0.00	1,724.22

STAAD FILE FRMC-1

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MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
10	1	10	236.86	-8,885.77	8.53	0.00	-14.45	130,851.00
		11	-264.17	9,910.03	-8.53	0.00	-10.82	-159,054.80
	2	10	5.18	-194.51	0.00	0.00	0.00	2,926.96
		11	-5.70	214.01	0.00	0.00	0.00	-3,540.01
	3	10	26.77	-1,012.16	-0.02	0.00	0.02	30,359.15
		11	-26.77	1,012.16	0.02	0.00	0.02	-33,396.65
	4	10	6.08	-229.50	0.00	0.00	0.00	3,448.83
		11	-6.70	252.48	0.00	0.00	0.00	-4,172.16
	5	10	29.63	-1,110.56	0.00	0.00	0.00	33,329.83
		11	-29.63	1,110.56	0.00	0.00	0.01	-36,663.00
	6	10	2.69	-100.95	-0.01	0.00	0.01	3,030.00
		11	-2.69	100.95	0.01	0.00	0.01	-3,332.98
	7	10	30.74	-1,152.27	0.32	0.00	-0.51	17,287.27
		11	-33.81	1,267.47	-0.32	0.00	-0.51	-20,918.22
	8	10	-3.03	114.77	0.00	0.00	0.00	-1,724.53
		11	3.34	-126.26	0.00	0.00	0.00	2,086.12
11	1	11	264.15	-9,909.36	2.08	-0.03	2.71	159,049.40
		12	-292.56	10,974.70	-2.08	0.03	-2.72	-190,385.10
	2	11	5.66	-215.09	0.00	0.00	-0.01	3,540.32
		12	-6.18	234.59	0.00	0.00	-0.01	-4,214.08
	3	11	26.93	-1,014.39	0.00	0.00	-0.02	33,392.85
		12	-26.93	1,014.39	0.00	0.00	-0.01	-36,435.83
	4	11	6.68	-252.92	0.00	0.00	0.00	4,172.67
		12	-7.29	275.90	0.00	0.00	0.00	-4,965.64
	5	11	29.63	-1,110.75	-0.03	0.00	0.05	36,662.70
		12	-29.63	1,110.75	0.03	0.00	0.05	-39,996.20
	6	11	2.69	-100.94	0.00	0.00	0.00	3,333.05
		12	-2.69	100.94	0.00	0.00	0.00	-3,635.95
	7	11	33.80	-1,267.01	-0.03	0.00	0.03	20,918.29
		12	-36.87	1,382.21	0.03	0.00	0.06	-24,893.58
	8	11	-3.28	126.35	0.00	0.00	0.00	-2,086.54
		12	3.59	-137.84	0.00	0.00	0.00	2,482.85
12	1	12	292.77	-10,976.10	-0.22	-0.05	3.45	190,378.90
		13	-322.23	12,080.86	0.22	0.05	-1.24	-224,975.30
	2	12	6.14	-233.90	-0.02	0.00	0.02	4,214.15
		13	-6.66	253.40	0.02	0.00	0.03	-4,944.95

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	PAXIAL (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	3	12	26.27	-1,013.82	-0.02	0.00	0.02	36,427.50
		13	-26.27	1,013.82	0.02	0.00	0.02	-39,472.91
	4	12	7.31	-275.96	0.00	0.00	0.00	4,965.67
		13	-7.92	298.94	0.00	0.00	0.00	-5,828.21
	5	12	29.63	-1,110.66	0.01	0.00	-0.02	39,995.88
		13	-29.63	1,110.66	-0.01	0.00	-0.01	-43,329.12
	6	12	2.69	-100.97	0.00	0.00	0.00	3,635.98
		13	-2.69	100.97	0.00	0.00	0.00	-3,939.01
	7	12	36.88	-1,382.55	0.11	0.00	-0.19	24,894.00
		13	-39.95	1,497.75	-0.11	0.00	-0.04	-29,215.93
	8	12	-3.62	137.93	0.00	0.00	0.00	-2,482.62
		13	3.93	-149.42	0.00	0.00	0.00	2,913.98
13	1	13	281.92	-12,080.11	-0.61	0.03	-0.38	224,971.10
		14	-308.58	13,222.67	0.61	-0.03	2.85	-262,932.70
	2	13	5.77	-252.89	0.02	0.00	-0.04	4,946.50
		14	-6.22	272.39	-0.02	0.00	-0.04	-5,734.47
	3	13	22.53	-1,010.25	0.00	0.00	0.00	39,470.75
		14	-22.53	1,010.25	0.00	0.00	0.01	-42,501.58
	4	13	6.82	-298.46	0.00	0.00	0.00	5,828.21
		14	-7.36	321.44	0.00	0.00	0.00	-6,758.44
	5	13	25.92	-1,110.79	0.00	0.00	0.00	43,329.04
		14	-25.92	1,110.79	0.00	0.00	0.01	-46,662.02
	6	13	2.36	-100.96	0.00	0.00	0.00	3,939.02
		14	-2.36	100.96	0.00	0.00	0.00	-4,241.98
	7	13	34.95	-1,497.87	-0.15	0.00	0.24	29,215.59
		14	-37.64	1,613.07	0.15	0.00	0.26	-33,883.50
	8	13	-3.42	149.27	0.00	0.00	0.00	-2,913.99
		14	3.68	-160.76	0.00	0.00	0.00	3,379.34
14	1	14	330.60	-13,220.71	-0.77	0.00	0.92	262,931.30
		15	-370.08	14,799.87	0.77	0.00	1.85	-318,990.80
	2	14	6.64	-273.21	0.00	0.00	0.00	5,735.06
		15	-7.29	299.21	0.00	0.00	0.00	-6,880.19
	3	14	25.26	-1,011.82	0.00	0.00	0.00	42,504.45
		15	-25.26	1,011.82	0.00	0.00	0.00	-46,551.32
	4	14	8.00	-321.70	0.00	0.00	0.00	6,759.08
		15	-8.77	352.34	0.00	0.00	0.00	-8,107.49

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	5	14	27.77	-1,110.64	0.00	0.00	0.00	46,662.11
		15	-27.77	1,110.64	0.00	0.00	0.00	-51,105.98
	6	14	2.52	-100.97	0.00	0.00	0.00	4,241.99
		15	-2.52	100.97	0.00	0.00	0.00	-4,646.00
	7	14	40.32	-1,612.89	-0.01	0.00	0.00	33,883.30
		15	-44.16	1,766.49	0.01	0.00	-0.03	-40,644.27
	8	14	-3.97	160.85	0.00	0.00	0.00	-3,379.48
		15	4.35	-176.17	0.00	0.00	0.00	4,053.77
15	1	15	222.14	-14,796.04	0.27	-0.06	0.72	318,999.50
		16	-233.99	15,585.62	-0.27	0.06	-0.37	-349,384.00
	2	15	4.36	-298.99	0.00	0.00	0.00	6,879.75
		16	-4.56	311.99	0.00	0.00	0.00	-7,491.01
	3	15	15.32	-1,013.06	0.00	0.00	0.00	46,551.14
		16	-15.32	1,013.06	0.00	0.00	0.01	-48,577.32
	4	15	5.27	-352.59	0.00	0.00	0.00	8,107.56
		16	-5.50	367.91	0.00	0.00	0.00	-8,828.15
	5	15	16.67	-1,110.81	0.00	0.00	-0.01	51,106.14
		16	-16.67	1,110.81	0.00	0.00	0.00	-53,328.05
	6	15	1.52	-101.00	0.00	0.00	0.00	4,646.01
		16	-1.52	101.00	0.00	0.00	0.00	-4,848.00
	7	15	26.49	-1,767.15	-0.05	0.00	0.03	40,643.89
		16	-27.65	1,843.95	0.05	0.00	0.09	-44,255.58
	8	15	-2.67	176.24	0.00	0.00	0.00	-4,053.88
		16	2.78	-183.90	0.00	0.00	0.00	4,413.96
16	1	16	1,168.72	15,574.26	1.67	0.04	-1.18	349,793.10
		17	-1,109.51	-14,784.68	-1.67	-0.04	-0.55	-319,344.30
	2	16	0.05	-0.23	0.00	0.00	0.00	-0.17
		17	-0.05	0.23	0.00	0.00	0.00	-0.23
	3	16	0.09	-0.52	0.00	0.00	0.00	-0.81
		17	-0.09	0.52	0.00	0.00	0.00	-0.71
	4	16	13.80	183.69	0.00	0.00	0.00	4,418.70
		17	-13.23	-176.03	0.00	0.00	0.00	-4,057.98
	5	16	83.10	1,107.78	0.00	0.00	0.00	53,328.06
		17	-83.10	-1,107.78	0.00	0.00	0.00	-51,106.09
	6	16	7.55	100.72	0.00	0.00	0.00	4,848.00
		17	-7.55	-100.72	0.00	0.00	0.00	-4,645.99

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	7	16	138.18	1,842.49	-0.03	0.00	-0.02	44,303.13
		17	-132.42	-1,765.69	0.03	0.00	0.07	-40,684.57
	8	16	-0.03	-0.03	0.00	0.00	0.00	-0.08
		17	0.03	0.03	0.00	0.00	0.00	0.01
17	1	17	1,256.43	14,780.90	1.51	0.03	-2.15	319,341.30
		18	-1,122.20	-13,201.73	-1.51	-0.03	-3.39	-263,173.00
	2	17	0.06	0.03	0.00	0.00	0.00	0.13
		18	-0.06	-0.03	0.00	0.00	0.00	-0.08
	3	17	-0.43	-0.12	0.00	0.00	0.00	-0.80
		18	0.43	0.12	0.00	0.00	0.00	-0.24
	4	17	14.96	175.92	0.00	0.00	0.00	4,057.87
		18	-13.66	-160.60	0.00	0.00	0.00	-3,382.47
	5	17	94.10	1,107.00	0.00	0.00	0.00	51,106.03
		18	-94.10	-1,107.00	0.00	0.00	0.00	-46,662.02
	6	17	8.55	100.64	0.00	0.00	0.00	4,646.00
		18	-8.55	-100.64	0.00	0.00	0.00	-4,242.00
	7	17	149.94	1,763.98	0.00	0.01	0.07	40,684.95
		18	-136.88	-1,610.38	0.00	-0.01	-0.02	-33,912.00
	8	17	-0.03	-0.02	0.00	0.00	0.00	-0.05
		18	0.03	0.02	0.00	0.00	0.00	0.01
18	1	18	1,100.28	13,203.13	-5.20	-0.05	8.76	263,174.30
		19	-1,005.07	-12,060.57	5.20	0.05	5.77	-225,148.60
	2	18	0.11	0.29	0.00	0.00	-0.01	0.53
		19	-0.11	-0.29	0.00	0.00	0.00	0.55
	3	18	0.73	-0.09	0.01	0.00	-0.03	-1.05
		19	-0.73	0.09	-0.01	0.00	-0.02	-1.65
	4	18	13.49	160.76	0.00	0.00	0.00	3,382.59
		19	-12.53	-149.27	0.00	0.00	0.00	-2,915.92
	5	18	92.26	1,107.21	0.00	0.00	-0.01	46,662.15
		19	-92.26	-1,107.21	0.00	0.00	-0.01	-43,328.89
	6	18	8.39	100.64	0.01	0.00	-0.01	4,241.97
		19	-8.39	-100.64	-0.01	0.00	-0.01	-3,939.03
	7	18	134.23	1,610.70	0.09	0.00	-0.13	33,912.13
		19	-124.63	-1,495.50	-0.09	0.00	-0.18	-29,236.71
	8	18	-0.09	-0.22	0.00	0.00	0.00	-0.32
		19	0.09	0.22	0.00	0.00	0.00	-0.27

THE STUDY ON THE CONSTRUCTION OF THE BRIDGE
OVER THE RIVER RUPSA IN KHULNA- PHASE 2

Job No. :	Date : 11/2/99	Designed by :	Checked by :

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
19	1	19	1,044.79	12,058.55	1.58	-0.01	-4.33	225,148.20
		20	-949.05	-10,953.78	-1.58	0.01	-5.95	-190,503.50
	2	19	0.19	0.15	0.01	0.00	-0.02	0.16
		20	-0.19	-0.15	-0.01	0.00	-0.01	0.33
	3	19	1.00	1.31	0.02	0.00	-0.02	2.09
		20	-1.00	-1.31	-0.02	0.00	-0.02	1.25
	4	19	13.00	149.14	0.00	0.00	0.00	2,916.13
		20	-12.01	-137.65	0.00	0.00	0.00	-2,484.38
	5	19	95.94	1,106.97	0.01	0.00	0.00	43,329.11
		20	-95.94	-1,106.97	-0.01	0.00	0.00	-39,995.83
	6	19	8.72	100.63	0.00	0.00	0.00	3,939.03
		20	-8.72	-100.63	0.00	0.00	0.00	-3,635.99
	7	19	129.59	1,494.90	-0.20	-0.01	0.21	29,236.97
		20	-119.60	-1,379.70	0.20	0.01	0.36	-24,908.62
	8	19	-0.02	-0.08	0.00	0.00	0.00	-0.29
		20	0.02	0.08	0.00	0.00	0.00	-0.13
20	1	20	949.14	10,953.23	7.78	-0.07	-10.87	190,504.70
		21	-856.81	-9,887.90	-7.78	0.07	-4.57	-159,128.40
	2	20	0.10	-0.25	-0.01	0.00	0.02	-0.10
		21	-0.10	0.25	0.01	0.00	0.00	-0.21
	3	20	0.09	0.89	0.01	0.00	-0.02	1.86
		21	-0.09	-0.89	-0.01	0.00	-0.03	1.23
	4	20	11.95	137.80	0.00	0.00	0.00	2,484.45
		21	-10.95	-126.31	0.00	0.00	0.00	-2,087.12
	5	20	95.93	1,107.01	0.01	0.00	-0.02	39,996.10
		21	-95.93	-1,107.01	-0.01	0.00	-0.01	-36,662.85
	6	20	8.72	100.62	0.00	0.00	0.00	3,636.00
		21	-8.72	-100.62	0.00	0.00	0.00	-3,333.00
	7	20	119.57	1,379.58	0.23	0.00	-0.37	24,908.63
		21	-109.59	-1,264.38	-0.23	0.00	-0.37	-20,927.73
	8	20	0.01	-0.19	0.00	0.00	0.00	-0.51
		21	-0.01	0.19	0.00	0.00	0.00	-0.45
21	1	21	856.81	9,885.46	3.62	-0.06	5.68	159,125.60
		22	-768.04	-8,861.19	-3.62	-0.06	2.32	-130,898.90
	2	21	0.06	0.29	-0.02	0.00	0.02	0.36
		22	-0.06	-0.29	0.02	0.00	0.02	0.30

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STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	3	21	-0.10	0.03	-0.02	0.00	0.01	0.34
		22	0.10	-0.03	0.02	0.00	0.02	-0.23
	4	21	10.97	126.26	0.00	0.00	0.00	2,087.59
		22	-9.98	-114.77	0.00	0.00	-0.01	-1,724.50
	5	21	95.96	1,106.87	0.00	0.00	0.00	36,662.84
		22	-95.96	-1,106.87	0.00	0.00	0.00	-33,330.02
	6	21	8.72	100.64	0.00	0.00	0.00	3,333.03
		22	-8.72	-100.64	0.00	0.00	0.00	-3,029.99
	7	21	109.59	1,264.41	0.39	0.00	-0.66	20,927.32
		22	-99.61	-1,149.21	-0.39	0.00	-0.62	-17,293.13
	8	21	-0.06	0.04	0.00	0.00	0.00	0.04
		22	0.06	-0.04	0.00	0.00	0.00	0.08
22	1	22	768.36	8,863.52	-5.32	0.08	5.02	130,898.70
		23	-683.30	-7,882.04	5.32	-0.08	4.62	-105,686.50
	2	22	0.04	-0.22	-0.02	0.00	0.03	-0.18
		23	-0.04	0.22	0.02	0.00	0.03	-0.07
	3	22	0.25	0.64	-0.05	0.00	0.07	-1.83
		23	-0.25	-0.64	0.05	0.00	0.07	-0.49
	4	22	9.93	114.66	0.00	0.00	0.00	1,724.69
		23	-8.94	-103.17	0.00	0.00	0.00	-1,397.01
	5	22	95.90	1,106.56	0.01	0.00	-0.01	33,329.48
		23	-95.90	-1,106.56	-0.01	0.00	-0.01	-29,997.51
	6	22	8.72	100.66	-0.01	0.00	0.02	3,030.04
		23	-8.72	-100.66	0.01	0.00	0.02	-2,726.94
	7	22	99.60	1,149.46	-0.15	0.00	0.24	17,292.90
		23	-89.61	-1,034.26	0.15	0.00	0.06	-14,005.37
	8	22	-0.03	-0.12	0.00	0.00	0.00	-0.05
		23	0.03	0.12	0.00	0.00	0.00	-0.04
23	1	23	683.14	7,882.44	34.39	0.03	-47.34	105,688.40
		24	-601.92	-6,945.37	-34.39	-0.03	-47.68	-83,363.67
	2	23	0.05	-0.12	-0.06	0.00	0.10	-0.05
		24	-0.05	0.12	0.06	0.00	0.08	-0.11
	3	23	0.46	-0.10	-0.02	0.00	0.03	-1.77
		24	-0.46	0.10	0.02	0.00	0.05	-1.61
	4	23	8.98	103.26	0.00	0.00	0.00	1,397.01
		24	-7.98	-91.77	0.00	0.00	0.00	-1,103.46

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	5	23	95.93	1,106.59	-0.01	0.00	0.02	29,996.66
		24	-95.93	-1,106.59	0.01	0.00	0.01	-26,664.17
	6	23	8.72	100.60	0.01	0.00	-0.01	2,726.95
		24	-8.72	-100.60	-0.01	0.00	-0.01	-2,424.03
	7	23	89.62	1,034.10	-0.34	0.00	0.61	14,005.58
		24	-79.64	-918.90	0.34	0.00	0.49	-11,064.52
	8	23	0.01	-0.11	0.00	0.00	0.00	-0.16
		24	-0.01	0.11	0.00	0.00	0.00	-0.23
24	1	24	601.85	6,943.73	-17.36	0.01	16.97	83,364.44
		25	-524.62	-6,052.57	17.36	-0.01	14.96	-63,797.14
	2	24	0.02	0.12	0.02	0.00	-0.03	0.19
		25	-0.02	-0.12	-0.02	0.00	-0.04	0.18
	3	24	-0.49	-1.01	0.00	0.00	0.00	-0.45
		25	0.49	1.01	0.00	0.00	-0.02	-0.67
	4	24	7.96	91.72	0.00	0.00	0.00	1,103.66
		25	-6.97	-80.23	0.00	0.00	0.00	-844.92
	5	24	95.93	1,106.87	-0.01	0.00	0.01	26,663.99
		25	-95.93	-1,106.87	0.01	0.00	0.01	-23,331.11
	6	24	8.72	100.61	0.00	0.00	-0.01	2,423.98
		25	-8.72	-100.61	0.00	0.00	-0.01	-2,121.02
	7	24	79.63	918.85	0.59	0.00	-0.79	11,064.50
		25	-69.65	-803.65	-0.59	0.00	-0.76	-8,471.29
	8	24	-0.03	0.03	0.00	0.00	0.00	0.09
		25	0.03	-0.03	0.00	0.00	0.00	0.18
25	1	25	173.57	6,071.62	-6.61	0.00	4.93	63,793.77
		26	-144.65	-5,059.45	6.61	0.00	5.33	-44,305.14
	2	25	-0.06	0.23	0.01	0.00	-0.02	0.28
		26	0.06	-0.23	-0.01	0.00	-0.02	0.23
	3	25	-0.01	0.54	-0.04	0.00	0.07	0.35
		26	0.01	-0.54	0.04	0.00	0.05	0.93
	4	25	2.35	80.37	0.00	0.00	-0.01	844.83
		26	-1.96	-66.97	0.00	0.00	-0.01	-586.81
	5	25	31.73	1,110.63	-0.03	0.00	0.06	23,330.88
		26	-31.73	-1,110.63	0.03	0.00	0.05	-19,442.55
	6	25	2.88	100.95	-0.01	0.00	0.01	2,121.00
		26	-2.88	-100.95	0.01	0.00	0.01	-1,767.52

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
Load 2- Differential DL on one cantilever
Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	7	25	23.05	806.38	-0.43	0.00	0.98	8,471.06
		26	-19.21	-671.98	0.43	0.00	0.83	-5,882.77
	8	25	-0.04	0.07	0.00	0.00	0.00	0.11
		26	0.04	-0.07	0.00	0.00	0.00	0.18
26	1	26	159.07	5,061.57	-0.09	0.03	-5.43	44,303.27
		27	-127.26	-4,049.40	0.09	-0.03	-6.34	-28,354.71
	2	26	0.02	0.02	-0.04	0.00	0.07	0.10
		27	-0.02	-0.02	0.04	0.00	0.08	0.17
	3	26	0.38	-0.76	0.00	0.00	-0.01	-0.86
		27	-0.38	0.76	0.00	0.00	-0.01	-0.93
	4	26	2.08	67.02	-0.02	0.00	0.03	586.66
		27	-1.66	-53.61	0.02	0.00	0.03	-375.59
	5	26	34.90	1,110.80	0.01	0.00	-0.03	19,442.94
		27	-34.90	-1,110.80	-0.01	0.00	-0.03	-15,553.59
	6	26	3.17	100.96	0.00	0.00	0.00	1,767.51
		27	-3.17	-100.96	0.00	0.00	0.01	-1,413.99
	7	26	21.12	671.94	-0.54	0.00	0.79	5,882.77
		27	-16.89	-537.54	0.54	0.00	0.80	-3,764.84
	8	26	0.02	-0.08	0.00	0.00	0.00	-0.10
		27	-0.02	0.08	0.00	0.00	0.00	-0.12
27	1	27	115.66	4,047.32	1.01	0.01	-2.41	28,352.95
		28	-86.74	-3,035.14	-1.01	-0.01	-10.25	-15,950.47
	2	27	-0.06	-0.12	0.01	0.00	-0.03	-0.57
		28	0.06	0.12	-0.01	0.00	-0.03	-0.39
	3	27	0.18	0.93	0.04	0.00	-0.04	1.87
		28	-0.18	-0.93	-0.04	0.00	-0.03	1.66
	4	27	1.53	53.74	-0.01	0.00	0.02	375.61
		28	-1.14	-40.33	0.01	0.00	0.02	-211.11
	5	27	31.72	1,110.78	0.03	0.00	-0.03	15,554.27
		28	-31.72	-1,110.78	-0.03	0.00	-0.04	-11,665.10
	6	27	2.88	100.94	0.01	0.00	-0.02	1,413.95
		28	-2.88	-100.94	-0.01	0.00	-0.02	-1,060.55
	7	27	15.34	537.49	-0.06	0.00	0.13	3,764.67
		28	-11.50	-403.09	0.06	0.00	-0.04	-2,118.14
	8	27	-0.04	0.00	0.00	0.00	0.00	-0.06
		28	0.04	0.00	0.00	0.00	0.00	-0.14

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
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Load 3- Segment Unbalance
Load 4- Dist. Construction Live Load
Load 5 - Costruction Equipment + Impact
Load 6 - Impact Load from equipment
Load 7 - Wind load on superstructure
Load 8 - Wind uplift on one cantilever
Load 9 - Creep Effect
Load 10- Shrinkage
Load 11 - Thermal

MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
28	1	28	95.54	3,035.40	1.15	0.00	0.81	15,947.33
		29	-63.73	-2,023.23	-1.15	0.00	-5.60	-7,090.43
	2	28	0.00	0.09	0.02	0.00	-0.03	0.01
		29	0.00	-0.09	-0.02	0.00	-0.04	-0.02
	3	28	0.01	-0.11	0.06	0.00	-0.09	-1.29
		29	-0.01	0.11	-0.06	0.00	-0.08	-0.55
	4	28	1.30	40.18	0.00	0.00	0.00	211.19
		29	-0.88	-26.78	0.00	0.00	0.00	-93.83
	5	28	34.89	1,110.09	0.02	0.00	-0.02	11,664.96
		29	-34.89	-1,110.09	-0.02	0.00	-0.02	-7,777.40
	6	28	3.17	100.92	0.00	0.00	-0.01	1,060.42
		29	-3.17	-100.92	0.00	0.00	-0.01	-707.03
	7	28	12.66	402.74	-0.14	0.00	0.14	2,116.97
		29	-8.44	-268.34	0.14	0.00	-0.09	-942.03
	8	28	-0.01	-0.09	0.00	0.00	0.01	-0.10
		29	0.01	0.09	0.00	0.00	0.01	-0.13
29	1	29	57.74	2,020.52	-11.26	0.01	21.69	7,081.02
		30	-28.83	-1,008.34	11.26	-0.01	21.69	-1,779.22
	2	29	-0.01	-0.11	-0.04	0.00	0.06	-0.17
		30	0.01	0.11	0.04	0.00	0.05	-0.32
	3	29	0.57	-0.53	0.04	0.00	-0.09	-0.41
		30	-0.57	0.53	-0.04	0.00	-0.07	-1.67
	4	29	0.80	26.81	0.00	0.00	0.00	93.91
		30	-0.41	-13.40	0.00	0.00	0.00	-23.51
	5	29	31.75	1,110.82	0.01	0.00	-0.03	7,777.77
		30	-31.75	-1,110.82	-0.01	0.00	-0.01	-3,887.67
	6	29	2.88	100.96	0.01	0.00	-0.03	707.00
		30	-2.88	-100.96	-0.01	0.00	-0.02	-353.54
	7	29	7.69	268.89	-0.15	0.00	0.12	941.13
		30	-3.85	-134.49	0.15	0.00	0.17	-235.47
	8	29	0.01	0.13	0.00	0.00	0.00	0.24
		30	-0.01	-0.13	0.00	0.00	0.00	0.31
30	1	30	31.74	1,008.77	40.58	0.00	-78.19	1,767.26
		31	0.07	3.41	-40.58	0.00	-76.83	-6.95
	2	30	0.04	-0.01	-0.07	0.00	0.12	0.10
		31	-0.04	0.01	0.07	0.00	0.12	-0.06

STAAD FILE FRMC-1

Load 1- Selweight of Superstructure
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MEM	LOAD	NODE	P_{AXIAL} (KN)	Vy (KN)	Vz (KN)	Mx (KN m.)	My (KN-m.)	Mz (KN-m.)
	3	30	-0.41	-0.07	0.07	0.00	-0.13	0.14
		31	0.41	0.07	-0.07	0.00	-0.13	-0.79
	4	30	0.41	13.41	0.01	0.00	-0.01	23.50
		31	0.01	0.00	-0.01	0.00	-0.02	0.01
	5	30	34.87	1,109.70	-0.01	0.00	0.03	3,887.15
		31	-34.87	-1,109.70	0.01	0.00	0.04	-1.04
	6	30	3.17	100.95	0.02	0.00	-0.03	353.47
		31	-3.17	-100.95	-0.02	0.00	-0.04	-0.03
	7	30	4.20	133.92	-0.54	0.00	0.80	234.44
		31	0.02	0.48	0.54	0.00	0.82	-0.66
	8	30	-0.02	0.13	0.00	0.00	0.01	0.13
		31	0.02	-0.13	0.00	0.00	0.00	0.06

PRELIMINARY DESIGN

OF BOX GIRDER SUPERSTRUCTURE

COMB	Dead Load			Live Load				Wind Load		(1) Allowable Stress***		R +S + T	(2) Allow. Stress*** Superstr DL + R + S + T	
	DL	DIFF	U	CLL	CE	IE	CLE	W	WUP	Comp. fc	Tens., ft		Comp. fc	Tens. ft
1	1	1	0	1	1	1	0	0	0	0.5fc'	$498fc'^{1/2}$	1	0.5fc'	$581fc'^{1/2}$
2	1	0	1	1	1	1	0	0	0	0.5fc'	$498fc'^{1/2}$	1	0.5fc'	$581fc'^{1/2}$
3	1	1	0	0	0	0	0	0.7*	0.7	0.5fc'	$498fc'^{1/2}$	1	0.5fc'	$581fc'^{1/2}$
4	1	1	0	1	1	1	0	0.7*	1	0.5fc'	$581fc'^{1/2}$	1	0.5fc'	$581fc'^{1/2}$
5	1	0	1	1	1	1	0	0.3**	0	0.5fc'	$581fc'^{1/2}$	1	0.5fc'	$581fc'^{1/2}$
6	1	0	0	1	1	1	1	0.3**	0	0.5fc'	$581fc'^{1/2}$	1	0.5fc'	$581fc'^{1/2}$

The allowable stresses in Columns (1) and (2) apply to the summation of all the loads multiplied by their tabulated coefficients in all columns to the left.

* - Reduction to allow for lesser probability of maximum wind during construction period
** - Reduction is to allow for limiting wind beyond which contruction is halted
*** - When less than 60% of the tendon capacity is provided by internal tendons, the maximum allowable construction stresses shall be $249fc'^{1/2}$ for Type A joints, and 0 for Type B joints

Note : For the allowable tension, the fc' shall be in Mpa to give a result in Kpa

DL - Dead weight of the superstructure alone
DIFF - Differential dead load from one cantilever
U - Segment Unbalance
CLL - Distributed construction Live Load
CE - Specialized construction equipment
IE - Impact Load from equipment
CLE - Longitudinal construction equipment
W - Wind load on superstructure
WUP - Wind uplift on cantilever
R, S, T - Effect of creep, shrinkage and temperature

PRELIMINARY DESIGN

A. Computed Load Due to Construction Loading (See STAAD Output)

NODE	Dead Load			Live Load			Wind Load	
	DL	DIFF	U	CLL	CE	IE	W	WUP
15	319,000	6,880	46,551	8,108	51,106	4,646	40,644	-4,054
14	262,931	5,735	42,504	6,759	46,662	4,242	33,883	-3,379
13	224,971	4,947	39,471	5,828	43,329	3,939	29,216	-2,914
12	190,379	4,214	36,428	4,966	39,996	3,636	24,894	-2,483
11	159,049	3,540	33,393	4,173	36,663	3,333	20,918	-2,087
10	130,851	2,927	30,359	3,449	33,330	3,030	17,287	-1,725
9	105,670	2,370	27,325	2,794	29,997	2,727	14,003	-1,397
8	83,362	1,873	24,289	2,207	26,664	2,424	11,064	-1,104
7	63,794	1,434	21,250	1,690	23,331	2,121	8,471	-845
6	44,301	996	17,709	1,173	19,443	1,767	5,883	-587
5	28,352	637	14,169	751	15,554	1,414	3,765	-375
4	15,948	358	10,626	422	11,665	1,060	2,118	-211
3	7,094	160	7,084	187	7,777	707	941	-94
2	1,774	39	3,540	47	3,889	353	235	-24
1	0	0	0	0	0	0	0	0

B. Load Combination

NODE	Load Combination						Prelim. Design Moment	
	M_1	M_2	M_3	M_4	M_5	M_6	M_{max}	M_{min}
15	389,739	429,410	351,492	414,136	441,604	395,052	441,604	351,492
14	326,330	363,099	290,019	346,668	373,264	330,759	373,264	290,019
13	283,014	317,538	248,329	300,551	326,303	286,832	326,303	248,329
12	243,191	275,404	210,281	258,134	282,872	246,445	282,872	210,281
11	206,758	236,611	175,772	219,314	242,886	209,493	242,886	175,772
10	173,587	201,019	144,672	183,963	206,205	175,846	206,205	144,672
9	143,558	168,512	116,864	151,963	172,713	145,389	172,713	116,864
8	116,530	138,946	92,207	123,172	142,265	117,977	142,265	92,207
7	92,369	112,185	70,566	97,454	114,727	93,477	114,727	70,566
6	67,680	84,394	49,004	71,212	86,159	68,449	86,159	49,004
5	46,709	60,241	31,362	48,969	61,370	47,201	61,370	31,362
4	29,454	39,721	17,641	30,725	40,357	29,731	40,357	17,641
3	15,924	22,849	7,846	16,489	23,131	16,047	23,131	7,846
2	6,103	9,604	1,962	6,244	9,674	6,134	9,674	1,962
1	0	0	0	0	0	0	0	0

C. Preliminary No. of Strands/Cables

Compressive Strength @ Transfer, fci' = 25,000 KPa

Allowable Compression, fc = $0.55fc_i'$ = -13,750 KPa

Allowable Tension, ft = $498fc_i'^{1/2}$ = 2,490 Kpa for Load Combination 1, 2, 3

Allowable Tension, ft = $581fc_i'^{1/2}$ = 2,905 Kpa for Load Combination 4, 5, 6

Distance of cable center to top of slab = 0.175 m.

NODE	Preliminary Design Parameters						
	A	I	c_t	c_b	e	fc	ft
15	16.232	86.606	2.515	3.403	2.340	-13,750	2,490
14	15.605	71.230	2.294	3.177	2.119	-13,750	2,490
13	15.108	60.680	2.126	3.008	1.951	-13,750	2,490
12	14.590	50.990	1.956	2.842	1.781	-13,750	2,490
11	14.048	42.174	1.786	2.676	1.611	-13,750	2,490
10	13.485	34.238	1.616	2.510	1.441	-13,750	2,490
9	12.899	27.182	1.447	2.343	1.272	-13,750	2,490
8	12.291	21.001	1.279	2.175	1.104	-13,750	2,490
7	11.661	15.686	1.113	2.005	0.938	-13,750	2,490
6	11.661	15.686	1.113	2.005	0.938	-13,750	2,490
5	11.661	15.686	1.113	2.005	0.938	-13,750	2,490
4	11.661	15.686	1.113	2.005	0.938	-13,750	2,490
3	11.661	15.686	1.113	2.005	0.938	-13,750	2,490
2	11.661	15.686	1.113	2.005	0.938	-13,750	2,490
1	11.661	15.686	1.113	2.005	0.938	-13,750	2,490

Basic Equation :

@ top: $ft = -P_i/A - P_i e c_t/I + Mc_t/I = 2{,}490$

@ bottom: $fb = -P_i/A + P_i e c_b/I - Mc_b/I = -13{,}750$

For Tension : $P_i = \dfrac{(Mc_t/I - ft)}{(1/A + ec_t/I)}$ For Comp.: $P_i = \dfrac{(Mc_b/I + fb)}{-1/A + ec_b/I)}$

NODE	Location	M	c/I	f	1/A	ec/I	P_i	Use P_i
15	top	441,604	0.02904	2,490	0.06161	0.06795	79,762	
	top	351,492	0.02904	2,490	0.06161	0.06795	59,565	
	bottom	441,604	0.03929	-13,750	0.06161	0.09195	118,722	
	bottom	351,492	0.03929	-13,750	0.06161	0.09195	2,015	118,722
14	top	373,264	0.03221	2,490	0.06408	0.06824	72,028	
	top	290,019	0.03221	2,490	0.06408	0.06824	51,768	
	bottom	373,264	0.04460	-13,750	0.06408	0.09451	95,247	
	bottom	290,019	0.04460	-13,750	0.06408	0.09451	-26,769	95,247

NODE	Location	M	c/I	f	1/A	ec/I	P_i	Use P_i
13	top	326,303	0.03504	2,490	0.06619	0.06836	66,464	
	top	248,329	0.03504	2,490	0.06619	0.06836	46,159	
	bottom	326,303	0.04957	-13,750	0.06619	0.09671	79,457	
	bottom	248,329	0.04957	-13,750	0.06619	0.09671	-47,175	79,457
12	top	282,872	0.03836	2,490	0.06854	0.06832	61,092	
	top	210,281	0.03836	2,490	0.06854	0.06832	40,746	
	bottom	282,872	0.05574	-13,750	0.06854	0.09927	65,620	
	bottom	210,281	0.05574	-13,750	0.06854	0.09927	-66,057	65,620
11	top	242,886	0.04235	2,490	0.07118	0.06822	55,921	
	top	175,772	0.04235	2,490	0.07118	0.06822	35,534	
	bottom	242,886	0.06345	-13,750	0.07118	0.10222	53,534	
	bottom	175,772	0.06345	-13,750	0.07118	0.10222	-83,678	55,921
10	top	206,205	0.04720	2,490	0.07416	0.06801	50,944	
	top	144,672	0.04720	2,490	0.07416	0.06801	30,515	
	bottom	206,205	0.07331	-13,750	0.07416	0.10564	43,418	
	bottom	144,672	0.07331	-13,750	0.07416	0.10564	-99,863	50,944
9	top	172,713	0.05323	2,490	0.07753	0.06771	46,160	
	top	116,864	0.05323	2,490	0.07753	0.06771	25,690	
	bottom	172,713	0.08620	-13,750	0.07753	0.10964	35,412	
	bottom	116,864	0.08620	-13,750	0.07753	0.10964	-114,478	46,160
8	top	142,265	0.06090	2,490	0.08136	0.06724	41,550	
	top	92,207	0.06090	2,490	0.08136	0.06724	21,034	
	bottom	142,265	0.10357	-13,750	0.08136	0.11434	29,837	
	bottom	92,207	0.10357	-13,750	0.08136	0.11434	-127,373	41,550
7	top	114,727	0.07095	2,490	0.08576	0.06656	37,098	
	top	70,566	0.07095	2,490	0.08576	0.06656	16,526	
	bottom	114,727	0.12782	-13,750	0.08576	0.11990	26,787	
	bottom	70,566	0.12782	-13,750	0.08576	0.11990	-138,551	37,098
6	top	86,159	0.07095	2,490	0.08576	0.06656	23,789	
	top	49,004	0.07095	2,490	0.08576	0.06656	6,481	
	bottom	86,159	0.12782	-13,750	0.08576	0.11990	-80,173	
	bottom	49,004	0.12782	-13,750	0.08576	0.11990	-219,281	23,789
5	top	61,370	0.07095	2,490	0.08576	0.06656	12,241	
	top	31,362	0.07095	2,490	0.08576	0.06656	-1,738	
	bottom	61,370	0.12782	-13,750	0.08576	0.11990	-172,982	
	bottom	31,362	0.12782	-13,750	0.08576	0.11990	-285,333	12,241

NODE	Location	M	c/I	f	1/A	ec/I	P_i	Use P_i
4	top	40,357	0.07095	2,490	0.08576	0.06656	2,452	
	top	17,641	0.07095	2,490	0.08576	0.06656	-8,130	
	bottom	40,357	0.12782	-13,750	0.08576	0.11990	-251,656	
	bottom	17,641	0.12782	-13,750	0.08576	0.11990	-336,704	2,452
3	top	23,131	0.07095	2,490	0.08576	0.06656	-5,572	
	top	7,846	0.07095	2,490	0.08576	0.06656	-12,693	
	bottom	23,131	0.12782	-13,750	0.08576	0.11990	-316,149	
	bottom	7,846	0.12782	-13,750	0.08576	0.11990	-373,375	0
2	top	9,674	0.07095	2,490	0.08576	0.06656	-11,841	
	top	1,962	0.07095	2,490	0.08576	0.06656	-15,434	
	bottom	9,674	0.12782	-13,750	0.08576	0.11990	-366,531	
	bottom	1,962	0.12782	-13,750	0.08576	0.11990	-395,407	0
1	top	0	0.07095	2,490	0.08576	0.06656	-16,348	
	top	0	0.07095	2,490	0.08576	0.06656	-16,348	
	bottom	0	0.12782	-13,750	0.08576	0.11990	-402,752	
	bottom	0	0.12782	-13,750	0,08576	0.11990	-402,752	0

Ultimate Stess of P/S Cables (Grade270) = 1860 MPa

Number of prestressing strands per cable = 19 pcs.

Diameter of Prestressing Strands = 15.24 mm. Area = 140.00 mm.^{2}

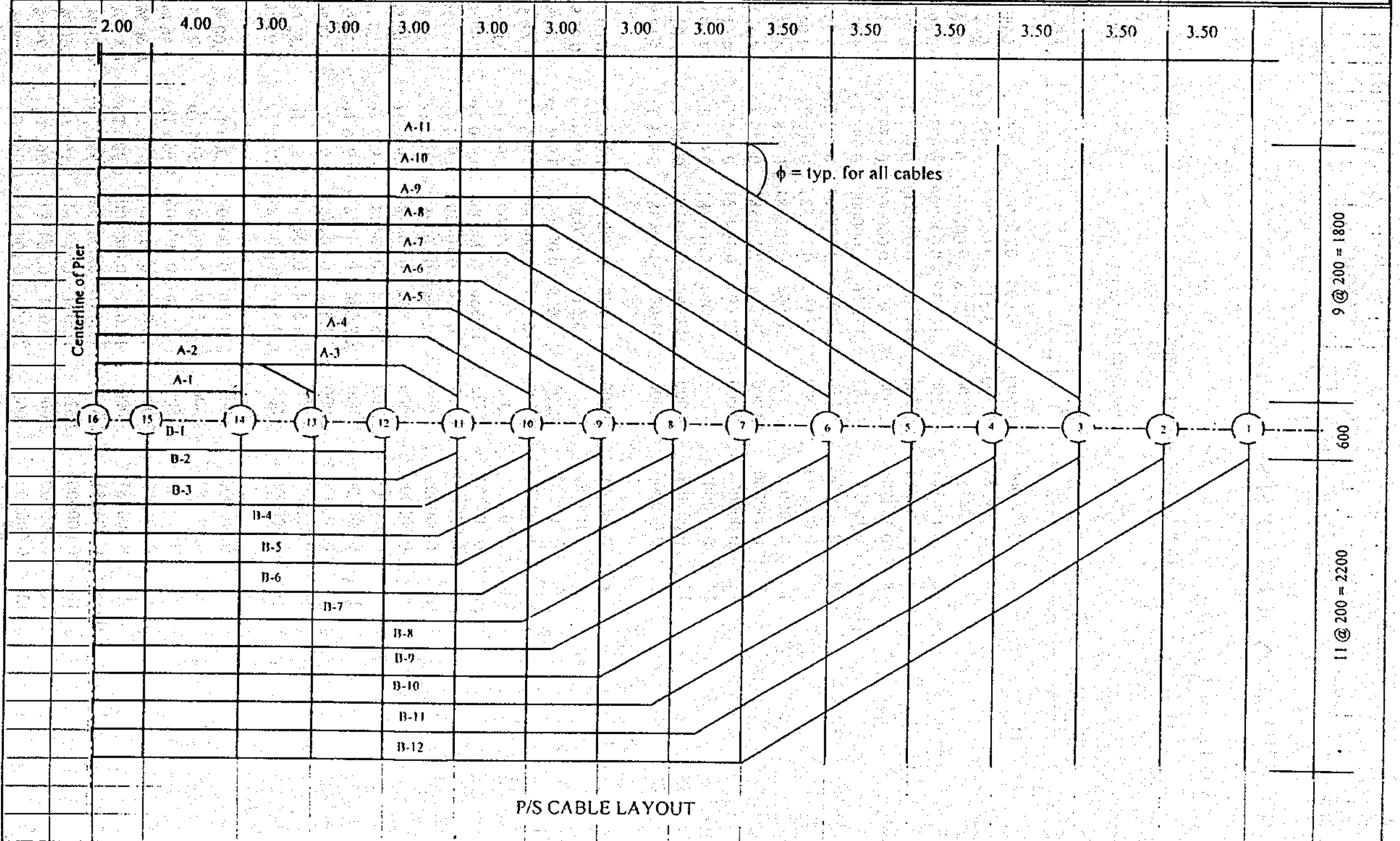
NODE	Total Pi	Load per 1- 15.2 mm. diam. strand				No. of Strands	No. of 19 - strands/cable
		Pu	Pj =.75Pu	Estimated Init. Loss	Pi		
15	118,722	260.40	195.30	0.15	166.01	715	38 - *19T15.24*
14	95,247	260.40	195.30	0.15	166.01	574	30 - *19T15.24*
13	79,457	260.40	195.30	0.15	166.01	479	25 - *19T15.24*
12	65,620	260.40	195.30	0.15	166.01	395	21 - *19T15.24*
11	55,921	260.40	195.30	0.15	166.01	337	18 - *19T15.24*
10	50,944	260.40	195.30	0.15	166.01	307	16 - *19T15.24*
9	46,160	260.40	195.30	0.15	166.01	278	15 - *19T15.24*
8	41,550	260.40	195.30	0.15	166.01	250	13 - *19T15.24*
7	37,098	260.40	195.30	0.15	166.01	223	12 - *19T15.24*
6	23,789	260.40	195.30	0.15	166.01	143	8 - *19T15.24*
5	12,241	260.40	195.30	0.15	166.01	74	4 - *19T15.24*
4	2,452	260.40	195.30	0.15	166.01	15	1 - *19T15.24*
3	0	260.40	195.30	0.15	166.01	0	0 - *19T15.24*
2	0	260.40	195.30	0.15	166.01	0	0 - *19T15.24*
1	0	260.40	195.30	0.15	166.01	0	0 - *19T15.24*

PRESTRESS LOSSES

OF BOX GIRDER SUPERSTRUCTURE

THE STUDY ON THE CONSTRUCTION OF THE BRIDGE
OVER THE RIVER RUPSA IN KHULNA- PHASE 2

Job No. :	Date : November 10, 1999	Designed by :	Checked by :



P/S CABLE LAYOUT

COMPUTATION OF P/S LOSSES

A.1. Friction Loss, FR : $T_x = T_o e^{-(\mu\alpha - kl)}$

Tx = Force at distance l from jacking end — where :

T_o = Force at the jacking end — μ = 0.25

l = distance of section from jacking end — k = 0.000656 /m.

Cable No.	Node	φ	H	L	α	T_x	FR
A-11	3	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	4	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	5	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	6	0.104381	3.500	10.557	0.000000	0.993 To	0.69 %
	7	0.104381	3.500	14.077	0.000000	0.991 To	0.92 %
	8	0.104381	3.000	17.093	0.000000	0.989 To	1.12 %
	Bend	0.104381	0.182	17.276	0.000000	0.989 To	1.13 %
	9	0.000000	2.818	20.094	0.104381	0.961 To	3.85 %
	10	0.000000	3.000	23.094	0.104381	0.960 To	4.04 %
	11	0.000000	3.000	26.094	0.104381	0.958 To	4.23 %
	12	0.000000	3.000	29.094	0.104381	0.956 To	4.42 %
	13	0.000000	3.000	32.094	0.104381	0.954 To	4.61 %
	14	0.000000	3.000	35.094	0.104381	0.952 To	4.79 %
	15	0.000000	4.000	39.094	0.104381	0.950 To	5.04 %
	16	0.000000	2.000	41.094	0.104381	0.948 To	5.17 %
A-10	4	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	5	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	6	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	7	0.104381	3.500	10.557	0.000000	0.993 To	0.69 %
	8	0.104381	3.000	13.574	0.000000	0.991 To	0.89 %
	Bend	0.104381	1.773	15.356	0.000000	0.990 To	1.00 %
	9	0.000000	1.227	16.584	0.104381	0.964 To	3.63 %
	10	0.000000	3.000	19.584	0.104381	0.962 To	3.82 %
	11	0.000000	3.000	22.584	0.104381	0.960 To	4.01 %
	12	0.000000	3.000	25.584	0.104381	0.958 To	4.20 %
	13	0.000000	3.000	28.584	0.104381	0.956 To	4.39 %
	14	0.000000	3.000	31.584	0.104381	0.954 To	4.57 %
	15	0.000000	4.000	35.584	0.104381	0.952 To	4.82 %
	16	0.000000	2.000	37.584	0.104381	0.951 To	4.95 %
A-9	5	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	6	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	7	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	8	0.104381	3.000	10.055	0.000000	0.993 To	0.66 %
	9	0.104381	3.000	13.071	0.000000	0.991 To	0.85 %
	Bend	0.104381	0.364	13.437	0.000000	0.991 To	0.88 %
	10	0.000000	2.634	16.071	0.104381	0.964 To	3.60 %
	11	0.000000	3.000	19.071	0.104381	0.962 To	3.79 %
	12	0.000000	3.000	22.071	0.104381	0.960 To	3.98 %
	13	0.000000	3.000	25.071	0.104381	0.958 To	4.16 %

Cable No.	Node	ϕ	H	L	α	T_x	FR
A-9	14	0.000000	3.000	28.071	0.104381	0.956 To	4.35 %
	15	0.000000	4.000	32.071	0.104381	0.954 To	4.60 %
	16	0.000000	2.000	34.071	0.104381	0.953 To	4.73 %
A-8	6	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	7	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	8	0.104381	3.000	6.536	0.000000	0.996 To	0.43 %
	9	0.104381	3.000	9.552	0.000000	0.994 To	0.62 %
	Bend	0.104381	1.955	11.517	0.000000	0.992 To	0.75 %
	10	0.000000	1.045	12.563	0.104381	0.966 To	3.38 %
	11	0.000000	3.000	15.563	0.104381	0.964 To	3.57 %
	12	0.000000	3.000	18.563	0.104381	0.962 To	3.75 %
	13	0.000000	3.000	21.563	0.104381	0.961 To	3.94 %
	14	0.000000	3.000	24.563	0.104381	0.959 To	4.13 %
	15	0.000000	4.000	28.563	0.104381	0.956 To	4.38 %
	16	0.000000	2.000	30.563	0.104381	0.955 To	4.51 %
A-7	7	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	8	0.104381	3.000	3.016	0.000000	0.998 To	0.20 %
	9	0.104381	3.000	6.033	0.000000	0.996 To	0.39 %
	10	0.104381	3.000	9.049	0.000000	0.994 To	0.59 %
	Bend	0.104381	0.545	9.598	0.000000	0.994 To	0.63 %
	11	0.000000	2.455	12.052	0.104381	0.967 To	3.34 %
	12	0.000000	3.000	15.052	0.104381	0.965 To	3.53 %
	13	0.000000	3.000	18.052	0.104381	0.963 To	3.72 %
	14	0.000000	3.000	21.052	0.104381	0.961 To	3.91 %
	15	0.000000	4.000	25.052	0.104381	0.958 To	4.16 %
	16	0.000000	2.000	27.052	0.104381	0.957 To	4.29 %
A-6	8	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	9	0.104381	3.000	3.016	0.000000	0.998 To	0.20 %
	10	0.104381	3.000	6.033	0.000000	0.996 To	0.39 %
	Bend	0.104381	1.636	7.678	0.000000	0.995 To	0.50 %
	11	0.000000	1.364	9.042	0.104381	0.968 To	3.15 %
	12	0.000000	3.000	12.042	0.104381	0.967 To	3.34 %
	13	0.000000	3.000	15.042	0.104381	0.965 To	3.53 %
	14	0.000000	3.000	18.042	0.104381	0.963 To	3.72 %
	15	0.000000	4.000	22.042	0.104381	0.960 To	3.97 %
	16	0.000000	2.000	24.042	0.104381	0.959 To	4.10 %
A-5	9	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	10	0.104381	3.000	3.016	0.000000	0.998 To	0.20 %
	Bend	0.104381	2.727	5.759	0.000000	0.996 To	0.38 %
	11	0.000000	0.273	6.031	0.104381	0.970 To	2.96 %
	12	0.000000	3.000	9.031	0.104381	0.968 To	3.15 %
	13	0.000000	3.000	12.031	0.104381	0.967 To	3.34 %
	14	0.000000	3.000	15.031	0.104381	0.965 To	3.53 %
	15	0.000000	4.000	19.031	0.104381	0.962 To	3.78 %

Cable No.	Node	ϕ	H	L	α	T_x	FR
	16	0.000000	2.000	21.031	0.104381	0.961 To	3.91 %
A-4	10	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	11	0.104381	0.818	0.823	0.000000	0.999 To	0.05 %
	Bend	0.104381	2.182	3.016	0.000000	0.998 To	0.20 %
	12	0.000000	3.000	6.016	0.104381	0.970 To	2.96 %
	13	0.000000	3.000	9.016	0.104381	0.968 To	3.15 %
	14	0.000000	3.000	12.016	0.104381	0.967 To	3.34 %
	15	0.000000	4.000	16.016	0.104381	0.964 To	3.59 %
	16	0.000000	2.000	18.016	0.104381	0.963 To	3.72 %
A-3	11	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	Bend	0.104381	1.909	1.919	0.000000	0.999 To	0.13 %
	12	0.000000	1.091	3.010	0.104381	0.972 To	2.77 %
	13	0.000000	3.000	6.010	0.104381	0.970 To	2.96 %
	14	0.000000	3.000	9.010	0.104381	0.969 To	3.15 %
	15	0.000000	4.000	13.010	0.104381	0.966 To	3.40 %
	16	0.000000	2.000	15.010	0.104381	0.965 To	3.53 %
A-2	13	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	Bend	0.104381	1.909	1.919	0.000000	0.999 To	0.13 %
	14	0.000000	1.090	3.009	0.104381	0.972 To	2.77 %
	15	0.000000	4.000	7.009	0.104381	0.970 To	3.02 %
	16	0.000000	2.000	9.009	0.104381	0.969 To	3.15 %
A-1	14	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	15	0.000000	4.000	4.000	0.000000	0.997 To	0.26 %
	16	0.000000	2.000	6.000	0.000000	0.996 To	0.39 %
B-12	1	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	2	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	3	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	4	0.104381	3.500	10.557	0.000000	0.993 To	0.69 %
	5	0.104381	3.500	14.077	0.000000	0.991 To	0.92 %
	6	0.104381	3.500	17.596	0.000000	0.989 To	1.15 %
	7	0.104381	3.500	21.115	0.000000	0.986 To	1.38 %
	8	0.000000	3.000	24.115	0.104381	0.959 To	4.10 %
	9	0.000000	3.000	27.115	0.104381	0.957 To	4.29 %
	10	0.000000	3.000	30.115	0.104381	0.955 To	4.48 %
	11	0.000000	3.000	33.115	0.104381	0.953 To	4.67 %
	12	0.000000	3.000	36.115	0.104381	0.951 To	4.86 %
	13	0.000000	3.000	39.115	0.104381	0.950 To	5.04 %
	14	0.000000	3.000	42.115	0.104381	0.948 To	5.23 %
	15	0.000000	4.000	46.115	0.104381	0.945 To	5.48 %
	16	0.000000	2.000	48.115	0.104381	0.944 To	5.60 %

Cable No.	Node	ϕ	H	L	α	T_x	FR
B-11	2	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	3	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	4	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	5	0.104381	3.500	10.557	0.000000	0.993 To	0.69 %
	6	0.104381	3.500	14.077	0.000000	0.991 To	0.92 %
	7	0.104381	3.500	17.596	0.000000	0.989 To	1.15 %
	Bend	0.104381	1.591	19.195	0.000000	0.987 To	1.25 %
	8	0.000000	1.409	20.604	0.104381	0.961 To	3.88 %
	9	0.000000	3.000	23.604	0.104381	0.959 To	4.07 %
	10	0.000000	3.000	26.604	0.104381	0.957 To	4.26 %
	11	0.000000	3.000	29.604	0.104381	0.956 To	4.45 %
	12	0.000000	3.000	32.604	0.104381	0.954 To	4.64 %
	13	0.000000	3.000	35.604	0.104381	0.952 To	4.82 %
	14	0.000000	3.000	38.604	0.104381	0.950 To	5.01 %
	15	0.000000	4.000	42.604	0.104381	0.947 To	5.26 %
	16	0.000000	2.000	44.604	0.104381	0.946 To	5.39 %
B-10	3	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	4	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	5	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	6	0.104381	3.500	10.557	0.000000	0.993 To	0.69 %
	7	0.104381	3.500	14.077	0.000000	0.991 To	0.92 %
	8	0.104381	3.000	17.093	0.000000	0.989 To	1.12 %
	Bend	0.104381	0.180	17.274	0.000000	0.989 To	1.13 %
	9	0.000000	2.820	20.094	0.104381	0.961 To	3.85 %
	10	0.000000	3.000	23.094	0.104381	0.960 To	4.04 %
	11	0.000000	3.000	26.094	0.104381	0.958 To	4.23 %
	12	0.000000	3.000	29.094	0.104381	0.956 To	4.42 %
	13	0.000000	3.000	32.094	0.104381	0.954 To	4.61 %
	14	0.000000	3.000	35.094	0.104381	0.952 To	4.79 %
	15	0.000000	2.000	37.094	0.104381	0.951 To	4.92 %
	16	0.000000	4.000	41.094	0.104381	0.948 To	5.17 %
B-9	4	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	5	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	6	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	7	0.104381	3.500	10.557	0.000000	0.993 To	0.69 %
	8	0.104381	3.000	13.574	0.000000	0.991 To	0.89 %
	Bend	0.104381	1.773	15.356	0.000000	0.990 To	1.00 %
	9	0.000000	1.227	16.584	0.104381	0.964 To	3.63 %
	10	0.000000	3.000	19.584	0.104381	0.962 To	3.82 %
	11	0.000000	3.000	22.584	0.104381	0.960 To	4.01 %
	12	0.000000	3.000	25.584	0.104381	0.958 To	4.20 %
	13	0.000000	3.000	28.584	0.104381	0.956 To	4.39 %
	14	0.000000	3.000	31.584	0.104381	0.954 To	4.57 %
	15	0.000000	4.000	35.584	0.104381	0.952 To	4.82 %
	16	0.000000	2.000	37.584	0.104381	0.951 To	4.95 %

Cable No.	Node	ϕ	H	L	α	T_x	FR
B-8	5	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	6	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	7	0.104381	3.500	7.038	0.000000	0.995 To	0.46 %
	8	0.104381	3.000	10.055	0.000000	0.993 To	0.66 %
	9	0.104381	3.000	13.071	0.000000	0.991 To	0.85 %
	Bend	0.104381	0.364	13.437	0.000000	0.991 To	0.88 %
	10	0.000000	2.634	16.071	0.104381	0.964 To	3.60 %
	11	0.000000	3.000	19.071	0.104381	0.962 To	3.79 %
	12	0.000000	3.000	22.071	0.104381	0.960 To	3.98 %
	13	0.000000	3.000	25.071	0.104381	0.958 To	4.16 %
	14	0.000000	3.000	28.071	0.104381	0.956 To	4.35 %
	15	0.000000	4.000	32.071	0.104381	0.954 To	4.60 %
	16	0.000000	2.000	34.071	0.104381	0.953 To	4.73 %
B-7	6	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	7	0.104381	3.500	3.519	0.000000	0.998 To	0.23 %
	8	0.104381	3.000	6.536	0.000000	0.996 To	0.43 %
	9	0.104381	3.000	9.552	0.000000	0.994 To	0.62 %
	Bend	0.104381	1.955	11.517	0.000000	0.992 To	0.75 %
	10	0.000000	1.045	12.563	0.104381	0.966 To	3.38 %
	11	0.000000	3.000	15.563	0.104381	0.964 To	3.57 %
	12	0.000000	3.000	18.563	0.104381	0.962 To	3.75 %
	13	0.000000	3.000	21.563	0.104381	0.961 To	3.94 %
	14	0.000000	3.000	24.563	0.104381	0.959 To	4.13 %
	15	0.000000	4.000	28.563	0.104381	0.956 To	4.38 %
	16	0.000000	2.000	30.563	0.104381	0.955 To	4.51 %
B-6	7	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	8	0.104381	3.000	3.016	0.000000	0.998 To	0.20 %
	9	0.104381	3.000	6.033	0.000000	0.996 To	0.39 %
	10	0.104381	3.000	9.049	0.000000	0.994 To	0.59 %
	Bend	0.104381	0.545	9.598	0.000000	0.994 To	0.63 %
	11	0.000000	2.455	12.052	0.104381	0.967 To	3.34 %
	12	0.000000	3.000	15.052	0.104381	0.965 To	3.53 %
	13	0.000000	3.000	18.052	0.104381	0.963 To	3.72 %
	14	0.000000	3.000	21.052	0.104381	0.961 To	3.91 %
	15	0.000000	4.000	25.052	0.104381	0.958 To	4.16 %
	16	0.000000	2.000	27.052	0.104381	0.957 To	4.29 %
B-5	8	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	9	0.104381	3.000	3.016	0.000000	0.998 To	0.20 %
	10	0.104381	3.000	6.033	0.000000	0.996 To	0.39 %
	Bend	0.104381	1.636	7.678	0.000000	0.995 To	0.50 %
	11	0.000000	1.364	9.042	0.104381	0.968 To	3.15 %
	12	0.000000	3.000	12.042	0.104381	0.967 To	3.34 %
	13	0.000000	3.000	15.042	0.104381	0.965 To	3.53 %
	14	0.000000	3.000	18.042	0.104381	0.963 To	3.72 %
	15	0.000000	4.000	22.042	0.104381	0.960 To	3.97 %

Cable No.	Node	ϕ	H	L	α	T_x	FR
B-5	16	0.000000	2.000	24.042	0.104381	0.959 To	4.10 %
B-4	9	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	10	0.104381	3.000	3.016	0.000000	0.998 To	0.20 %
	Bend	0.104381	2.727	5.759	0.000000	0.996 To	0.38 %
	11	0.000000	0.273	6.031	0.104381	0.970 To	2.96 %
	12	0.000000	3.000	9.031	0.104381	0.968 To	3.15 %
	13	0.000000	3.000	12.031	0.104381	0.967 To	3.34 %
	14	0.000000	3.000	15.031	0.104381	0.965 To	3.53 %
	15	0.000000	4.000	19.031	0.104381	0.962 To	3.78 %
	16	0.000000	2.000	21.031	0.104381	0.961 To	3.91 %
B-3	10	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	11	0.104381	0.818	0.823	0.000000	0.999 To	0.05 %
	Bend	0.104381	2.182	3.016	0.000000	0.998 To	0.20 %
	12	0.000000	3.000	6.016	0.104381	0.970 To	2.96 %
	13	0.000000	3.000	9.016	0.104381	0.968 To	3.15 %
	14	0.000000	3.000	12.016	0.104381	0.967 To	3.34 %
	15	0.000000	4.000	16.016	0.104381	0.964 To	3.59 %
	16	0.000000	2.000	18.016	0.104381	0.963 To	3.72 %
B-2	11	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	Bend	0.104381	1.909	1.919	0.000000	0.999 To	0.13 %
	12	0.000000	1.091	3.010	0.104381	0.972 To	2.77 %
	13	0.000000	3.000	6.010	0.104381	0.970 To	2.96 %
	14	0.000000	3.000	9.010	0.104381	0.969 To	3.15 %
	15	0.000000	4.000	13.010	0.104381	0.966 To	3.40 %
	16	0.000000	2.000	15.010	0.104381	0.965 To	3.53 %
B-1	12	0.000000	0.000	0.000	0.000000	1.000 To	0.00 %
	13	0.000000	3.000	3.000	0.000000	0.998 To	0.20 %
	14	0.000000	3.000	6.000	0.000000	0.996 To	0.39 %
	15	0.000000	3.000	9.000	0.000000	0.994 To	0.59 %
	16	0.000000	3.000	12.000	0.000000	0.992 To	0.78 %

Summary of Friction Loss, FR

Area per Cable, A = 2,660 mm.[2] Ultimate Load per Cable, Pu = 4,948 KN
Ult. Strength, fpu = 1,860 MPa Jacking Load, Pj = 0.75 Pu = 3,711 KN

Cable No.	Node-16		Node-15		Node-14		Node-13	
	% Loss	Pi	% Loss	Pi	% Loss	Pi	% Loss	Pi
Total no. of cables =		46		46		46		44
A-11	5.17	3,519	5.04	3,524	4.79	3,533	4.61	3,540
A-10	4.95	3,527	4.82	3,532	4.57	3,541	4.39	3,548
A-9	4.73	3,535	4.60	3,540	4.35	3,549	4.16	3,556
A-8	4.51	3,543	4.38	3,548	4.13	3,557	3.94	3,564
A-7	4.29	3,552	4.16	3,556	3.91	3,566	3.72	3,573
A-6	4.10	3,559	3.97	3,563	3.72	3,573	3.53	3,580
A-5	3.91	3,566	3.78	3,570	3.53	3,580	3.34	3,587
A-4	3.72	3,573	3.59	3,577	3.34	3,587	3.15	3,594
A-3	3.53	3,580	3.40	3,585	3.15	3,594	2.96	3,601
A-2	3.15	3,594	3.02	3,599	2.77	3,608	0.00	3,711
A-1	0.39	3,696	0.26	3,701	0.00	3,711	0.00	0
B-12	5.60	3,503	5.48	3,507	5.23	3,517	5.04	3,524
B-11	5.39	3,511	5.26	3,516	5.01	3,525	4.82	3,532
B-10	5.17	3,519	4.92	3,528	4.79	3,533	4.61	3,540
B-9	4.95	3,527	4.82	3,532	4.57	3,541	4.39	3,548
B-8	4.73	3,535	4.60	3,540	4.35	3,549	4.16	3,556
B-7	4.51	3,543	4.38	3,548	4.13	3,557	3.94	3,564
B-6	4.29	3,552	4.16	3,556	3.91	3,566	3.72	3,573
B-5	4.10	3,559	3.97	3,563	3.72	3,573	3.53	3,580
B-4	3.91	3,566	3.78	3,570	3.53	3,580	3.34	3,587
B-3	3.72	3,573	3.59	3,577	3.34	3,587	3.15	3,594
B-2	3.53	3,580	3.40	3,585	3.15	3,594	2.96	3,601
B-1	0.78	3,682	0.59	3,689	0.39	3,696	0.20	3,703
Total Pi =		163,781		164,014		164,429		157,508
Total Pj =		170,692		170,692		170,692		163,271
Ave. Loss =		4.05 %		3.91 %		3.67 %		3.53 %

Cable No.	Node-12		Node-11		Node-10		Node-9	
	% Loss	Pi	% Loss	Pi	% Loss	Pi	% Loss	Pi
Total no. of cables =		42		40		36		32
A-11	4.42	3,547	4.23	3,554	4.04	3,561	3.85	3,568
A-10	4.20	3,555	4.01	3,562	3.82	3,569	3.63	3,576
A-9	3.98	3,563	3.79	3,570	3.60	3,577	0.85	3,679
A-8	3.75	3,572	3.57	3,578	3.38	3,585	0.75	3,683
A-7	3.53	3,580	3.34	3,587	0.59	3,689	0.39	3,696
A-6	3.34	3,587	3.15	3,594	0.39	3,696	0.20	3,703
A-5	3.15	3,594	2.96	3,601	0.20	3,703	0.00	3,711

Cable No.	Node-12 % Loss	Node-12 Pi	Node-11 % Loss	Node-11 Pi	Node-10 % Loss	Node-10 Pi	Node-9 % Loss	Node-9 Pi
A-4	2.96	3,601	0.05	3,709	0.00	3,711	0.00	0.000
A-3	2.77	3,608	0.00	3,711	0.00	0.000	0.00	0.000
A-2	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-1	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-12	4.86	3,530	4.67	3,537	4.48	3,544	4.29	3,552
B-11	4.64	3,539	4.45	3,546	4.26	3,553	4.07	3,560
B-10	4.42	3,547	4.23	3,554	4.04	3,561	3.85	3,568
B-9	4.20	3,555	4.01	3,562	3.82	3,569	3.63	3,576
B-8	3.98	3,563	3.79	3,570	3.60	3,577	0.85	3,679
B-7	3.75	3,572	3.57	3,578	3.38	3,585	0.62	3,688
B-6	3.53	3,580	3.34	3,587	0.59	3,689	0.39	3,696
B-5	3.34	3,587	3.15	3,594	0.39	3,696	0.20	3,703
B-4	3.15	3,594	2.96	3,601	0.20	3,703	0.00	3,711
B-3	2.96	3,601	0.05	3,709	0.00	3,711	0.00	0.000
B-2	2.77	3,608	0.00	3,711	0.00	0	0.00	0.000
B-1	0.00	3,711	0.00	0.000	0.00	0	0.00	0.000
Total Pi =		150,380		144,026		130,559		116,696
Total Pj =		155,849		148,428		133,585		118,742
Ave. Loss =		3.51 %		2.97 %		2.27 %		1.72 %

Cable No.	Node-8 % Loss	Node-8 Pi	Node-7 % Loss	Node-7 Pi	Node-6 % Loss	Node-6 Pi	Node-5 % Loss	Node-5 Pi
Total no. of cables =		28		24		20		16
A-11	1.12	3,669	0.92	3,677	0.69	3,685	0.46	3,694
A-10	0.89	3,678	0.69	3,685	0.46	3,694	0.23	3,702
A-9	0.66	3,686	0.46	3,694	0.23	3,702	0.00	3,711
A-8	0.43	3,695	0.23	3,702	0.00	3,711	0.00	0.000
A-7	0.20	3,703	0.00	3,711	0.00	0.000	0.00	0.000
A-6	0.00	3,711	0.00	0.000	0.00	0.000	0.00	0.000
A-5	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-4	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-3	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-2	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-1	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-12	4.10	3,559	1.38	3,659	1.15	3,668	0.92	3,677
B-11	3.88	3,567	1.15	3,668	0.92	3,677	0.69	3,685
B-10	1.12	3,669	0.92	3,677	0.69	3,685	0.46	3,694
B-9	0.89	3,678	0.69	3,685	0.46	3,694	0.23	3,702
B-8	0.66	3,686	0.46	3,694	0.23	3,702	0.00	3,711
B-7	0.43	3,695	0.23	3,702	0.00	3,711	0.00	0.000
B-6	0.20	3,703	0.00	3,711	0.00	0.000	0.00	0.000
B-5	0.00	3,711	0.00	0.000	0.00	0.000	0.00	0.000
B-4	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-3	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000

B-2	0.00	0	0.00	0	0.00	0	0.00	0
B-1	0.00	0	0.00	0	0.00	0	0.00	0
Total Pi =		102,818		88,528		73,856		59,149
Total Pj =		103,900		89,057		74,214		59,371
Ave. Loss =		1.04 %		0.59 %		0.48 %		0.37 %

Cable No.	Node-4		Node-3		Node-2		Node-1	
	% Loss	Pi	% Loss	Pi	% Loss	Pi	% Loss	Pi
Total no. of cables =		12		8		4		2
A-11	0.23	3,702	0.00	3,711	0.00	0.000	0.00	0.000
A-10	0.00	3,711	0.00	0.000	0.00	0.000	0.00	0.000
A-9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-5	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-4	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-3	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-2	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
A-1	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-12	0.69	3,685	0.46	3,694	0.23	3,702	0.00	3,711
B-11	0.46	3,694	0.23	3,702	0.00	3,711	0.00	0.000
B-10	0.23	3,702	0.00	3,711	0.00	0.000	0.00	0.000
B-9	0.00	3,711	0.00	0.000	0.00	0.000	0.00	0.000
B-8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-5	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-4	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-3	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-2	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
B-1	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total Pi =		44,409		29,634		14,826		7,421
Total Pj =		44,528		29,686		14,843		7,421
Ave. Loss =		0.27 %		0.17 %		0.11 %		0.00 %

A.2. Elastic Shortening

$ES = 0.50n\,(f_{cir})$

$E_s =$ 194,000 MPa

$E_{ci} =$ 23,660 MPa

where : $n = E_s/E_{ci} = 8.20$

M_{DL} = Dead Load on beam immediately after transfer of P/S force

Pi = 0.95(Pj - FR) assuming 5% loss in elastic shortening

Node	M_{DL} (KN-m.)	P_i (KN)	A ($m.^2$)	I ($m.^4$)	e (m.)	f_{cir} (KPa)	ES (KPa)	ES (KN)
16	349.384	155,592	16.232	86.606	2.340	-9.983	40.927	5.008
15	319,000	155,814	16.232	86.606	2.340	-10,831	44.406	5.433
14	262,931	156,208	15.605	71.230	2.119	-12,035	49.341	6.037
13	224,971	149,633	15.108	60.680	1.951	-12.057	49,431	5,785
12	190,379	142,861	14.590	50.990	1.781	-12,029	49,316	5,510
11	159,049	136,824	14.048	42.174	1.611	-12,084	49.542	5,271
10	130,851	124,031	13.485	34.238	1.441	-11.213	45,969	4,402
9	105,670	110,862	12.899	27.182	1.272	-10,249	42.017	3,576
8	83,362	97,677	12.291	21.001	1.104	-9,234	37,855	2,819
7	63,794	84,101	11.661	15.686	0.938	-8,115	33,268	2,124
6	44,301	70,163	11.661	15.686	0.938	-7,303	29,941	1,593
5	28,352	56,192	11.661	15.686	0.938	-6,275	25,727	1,095
4	15,948	42,188	11.661	15.686	0.938	-5,031	20,624	658
3	7,094	28,153	11.661	15.686	0.938	-3,569	14,633	311
2	1,774	14,084	11.661	15.686	0.938	-1,892	7,756	41

A.3 Steel Relaxation, CRs

For Stress-relieved steel :

$CRc = f_{si}\{[\log 24t - \log 24t_i]/10\}[f_{si}/f_{py} - 0.55]$ $f_{si} = f_j - FR - ES$

Assume : t_i = time 24 hours after prestressing 1 day

t = time 30 days after prestressing 30 days

f_{py} = 0.85 fpu for stress- relieved strands 1,581,000 Kpa

Node	f_j (Kpa)	FR (Kpa)	ES (Kpa)	f_{si} (Kpa)	log 24t - log $24t_i$	f_{si}/f_{py} -.55	CRs (Kpa)	CRs (KN)
16	1,395,000	56,482	40,927	1,297,591	1.477	0.27074	51,893	6,350
15	1,395,000	54,575	44,406	1,296,019	1.477	0.26975	51,640	6,319
14	1,395,000	51,184	49,341	1,294,474	1.477	0.26877	51,391	6,288
13	1,395,000	49,238	49,431	1,296,331	1.477	0.26994	51,690	6,050
12	1,395,000	48,958	49,316	1,296,726	1.477	0.27019	51,753	5,782
11	1,395,000	41,376	49,542	1,304,082	1.477	0.27485	52,943	5,633
10	1,395,000	31,604	45,969	1,317,426	1.477	0.28329	55,128	5,279
9	1,395,000	24,038	42,017	1,328,946	1.477	0.29057	57,040	4,855
8	1,395,000	14,528	37,855	1,342,617	1.477	0.29922	59,342	4,420
7	1,395,000	8,289	33,268	1,353,443	1.477	0.30607	61,189	3,906
6	1,395,000	6,738	29,941	1,358,321	1.477	0.30915	62,029	3,300
5	1,395,000	5,214	25,727	1,364,059	1.477	0.31278	63,022	2,682

Node	f_j (Kpa)	FR (Kpa)	ES (Kpa)	f_{si} (Kpa)	log 24t - log 24t_i	f_{si}/f_{py} -.55	CRs	CRs
4	1,395,000	3,743	20,624	1,370,632	1.477	0.31694	64,167	2,048
3	1,395,000	2,406	14,633	1,377,961	1.477	0.32158	65,454	1,393
2	1,395,000	1,604	7,756	1,385,640	1.477	0.32643	66,813	711

A.4 Creep of Concrete, CRc Consider 30 days from transfer of prestress force

CRc = (UCR)(SCF)(MCF)(PCR)f_{cir} = 2.9106 f_{cir}

where : fc'= Concrete strength @ 28- days = 38,000 Kpa
Ec = Modulus of Elasticity of conc. = 2.92E+07 Kpa
UCR = 95 -2.90E_c/1000000 > 11 11.00
V/S = Volume to Surface ratio = <1.00
SCF = Creep factor depends on Volume to Surface Ratio = 1.05
MCF = Creep factor depends age of P/S and period of cure = 0.72
PCR = Variation of creep with time after prestress transfer = 0.35
f_{cir} = Concrete compressive strength at cgs of P/S steel at time t_i

Node	P_i (KN)	M_{DL} (KN m.)	A ($m.^2$)	I ($m.^4$)	e (m.)	f_{cir} (KPa)	CRc (KPa)	CRc (KN)
16	152,424	349,384	16.232	86.606	2.340	-9,587	27,905	3,414
15	152,262	319,000	16.232	86.606	2.340	-10,388	30,235	3,700
14	152,104	262,931	15.605	71.230	2.119	-11,513	33,511	4,100
13	145,673	224,971	15.108	60.680	1.951	-11,547	33,608	3,933
12	139,088	190,379	14.590	50.990	1.781	-11,536	33,576	3,751
11	133,121	159,049	14.048	42.174	1.611	-11,593	33,742	3,590
10	120,878	130,851	13.485	34.238	1.441	-10,788	31,399	3,007
9	108,265	105,670	12.899	27.182	1.272	-9,893	28,794	2,451
8	95,578	83,362	12.291	21.001	1.104	-8,941	26,024	1,938
7	82,497	63,794	11.661	15.686	0.938	-7,887	22,957	1,466
6	68,963	44,301	11.661	15.686	0.938	-7,133	20,761	1,105
5	55,372	28,352	11.661	15.686	0.938	-6,159	17,926	763
4	41,702	15,948	11.661	15.686	0.938	-4,962	14,441	461
3	27,930	7,094	11.661	15.686	0.938	-3,538	10,297	219
2	6,669	1,774	11.661	15.686	0.938	-840	2,445	26

A.5 Shrinkage, SH

SH = (USH)(SSF)(PSH)

USH = 186,165 - 3,000 Ec/1,000,000 > 82,740 Kpa = 98,673 KPa
SSF = Shrinkage factor for effect of size and shape = 1.04
PSH = Ultimate shrinkage over time interval t_i to t = 0.42

SH = (USH)(SSF)(PSH) = 43,101 KPa

SECTIONAL STRESSES

OF BOX GIRDER SUPERSTRUCTURE

Initial Prestressing Force, Pi

Immediately after transfer, $P_i = P_j - FR - ES$

30 Days after transfer, $P_i = P_j - FR - ES - CRs - CRc - SH$

Node	P_j (KN)	FR (KN)	ES (KN)	CRs (KN)	CRc (KN)	SH (KN)	P_i (KN) Immed. @ transfer	After 30 days
16	170,692	6,911	5,008	6,350	3,414	5,274	158,773	143,735
15	170,692	6,678	5,433	6,319	3,700	5,274	158,581	143,289
14	170,692	6,263	6,037	6,288	4,100	5,274	158,392	142,729
13	163,271	5,763	5,785	6,050	3,933	5,044	151,723	136,695
12	155,849	5,470	5,510	5,782	3,751	4,815	144,870	130,522
11	148,428	4,402	5,271	5,633	3,590	4,586	138,754	124,945
10	133,585	3,026	4,402	5,279	3,007	4,127	126,157	113,744
9	118,742	2,046	3,576	4,855	2,451	3,669	113,120	102,145
8	103,900	1,082	2,819	4,420	1,938	3,210	99,998	90,430
7	89,057	529	2,124	3,906	1,466	2,752	86,404	78,280
6	74,214	358	1,593	3,300	1,105	2,293	72,263	65,565
5	59,371	222	1,095	2,682	763	1,834	58,054	52,775
4	44,528	119	658	2,048	461	1,376	43,751	39,866
3	29,686	51	311	1,393	219	917	29,323	26,794
2	14,843	17	41	711	26	459	14,784	13,589

FINAL CHECKING

A. Check Stresses At Transfer of P/S Load :

Allowable Stresses :

Compressive Strength of concrete @ transfer, f_{ci}' = 25,000 Kpa
Allowable Compression, fc = 0.55 fci' = -13,750 Kpa
Allowable Tension, $ft = 249(f_{ci}')^{1/2}$ = 1,245 Kpa

Basic equation : $f_t = -Pi/A + (M_t - P_i e)c_t/I$
$f_b = -P_i/A - (M_t - P_i e)c_b/I$

where Mt = loads at transfer of prestress force
Mt = superstructure weight + equipment weight at ends
Pi = Pj - Friction Loss - Elastic Shortening Loss

Note : Units in KN,m.

Node	Location	M_t	P_i	A	I	e	c	P_i/A	P_iec/I	M_tc/I	f	Remark
16	top	402,712	158,773	16.232	86.606	2.340	2.515	-9,781	-10,789	11,695	-8,876	O.K.
	bottom						3.403	-9,781	14,598	-15,824	-11,007	O.K.
15	top	370,106	158,581	16.232	86.606	2.340	2.515	-9,770	-10,776	10,748	-9,798	O.K.
	bottom						3.403	-9,770	14,581	-14,543	-9,731	O.K.
14	top	309,593	158,392	15.605	71.230	2.119	2.294	-10,150	-10,809	9,971	-10,989	O.K.
	bottom						3.177	-10,150	14,970	-13,808	-8,989	O.K.
13	top	268,300	151,723	15.108	60.680	1.951	2.126	-10,043	-10,371	9,400	-11,013	O.K.
	bottom						3.008	-10,043	14,674	-13,300	-8,669	O.K.
12	top	230,375	144,870	14.590	50.990	1.781	1.956	-9,929	-9,898	8,837	-10,990	O.K.
	bottom						2.842	-9,929	14,381	-12,840	-8,389	O.K.

THE STUDY ON THE CONSTRUCTION OF THE BRIDGE
OVER THE RIVER RUPSA IN KHULNA- PHASE 2

Job No. :	Date : 04-Nov-99	Designed by :	Checked by :

Note : Units in KN,m.

Node	Location	M_i	P_i	A	I	e	c	P_i/A	P_iec/I	M_ic/I	f	Remark
11	top	195,712	138,754	14.048	42.174	1.611	1.786	-9,877	-9,466	8,288	-11,055	O.K.
	bottom						2.676	-9,877	14,183	-12,418	-8,112	O.K.
10	top	164,181	126,157	13.485	34.238	1.441	1.616	-9,355	-8,580	7,749	-10,187	O.K.
	bottom						2.510	-9,355	13,327	-12,036	-8,064	O.K.
9	top	135,667	113,120	12.899	27.182	1.272	1.447	-8,770	-7,660	7,222	-9,207	O.K.
	bottom						2.343	-8,770	12,403	-11,694	-8,061	O.K.
8	top	110,026	99,998	12.291	21.001	1.104	1.279	-8,136	-6,723	6,701	-8,159	O.K.
	bottom						2.175	-8,136	11,434	-11,395	-8,097	O.K.
7	top	87,125	86,404	11.661	15.686	0.938	1.113	-7,410	-5,751	6,182	-6,978	O.K.
	bottom						2.005	-7,410	10,359	-11,136	-8,187	O.K.
6	top	63,744	72,263	11.661	15.686	0.938	1.113	-6,197	-4,809	4,523	-6,483	O.K.
	bottom						2.005	-6,197	8,664	-8,148	-5,681	O.K.
5	top	43,906	58,054	11.661	15.686	0.938	1.113	-4,979	-3,864	3,115	-5,727	O.K.
	bottom						2.005	-4,979	6,960	-5,612	-3,630	O.K.
4	top	27,613	43,751	11.661	15.686	0.938	1.113	-3,752	-2,912	1,959	-4,704	O.K.
	bottom						2.005	-3,752	5,246	-3,530	-2,036	O.K.
3	top	14,871	29,323	11.661	15.686	0.938	1.113	-2,515	-1,952	1,055	-3,411	O.K.
	bottom						2.005	-2,515	3,516	-1,901	-900	O.K.
2	top	5,664	14,784	11.661	15.686	0.938	1.113	-1,268	-984	402	-1,850	O.K.
	bottom						2.005	-1,268	1,773	-724	-219	O.K.
1	top	0	7,421	11.661	15.686	0.938	1.113	-636	-494	0	-1,130	O.K.
	bottom						2.005	-636	890	0	253	O.K

B. Check Construction Loads

Allowable Stresses :

Comp. Strength of Concrete , f_c' = 38,000 Kpa
Allowable Comp., fc = 0.50 fc' = -20,900 Kpa
Allowable Tension, $ft = 498(f_{ci}')^{1/2}$ = 3,070 Kpa for Load Combination 1,2,3
Allowable Tension, $ft = 581(f_{ci}')^{1/2}$ = 3582 Kpa for Load Combination 4,5,6

Note :
Assume that the girder be checked for the construction loads after 30 days of transfer of the prestressing force

Basic equation : $f_t = -Pi/A + (M_t - P_ie)c_t/I$
$f_b = -P_i/A - (M_t - P_ie)c_b/I$

where M = governing Load Combination
Pi = Pj - FR - ES - (SH + CRc + CRs)

Note : Units in KN,m.

Node	Location	M_t	P_i	A	I	e	c	P_i/A	P_iec/I	M_tc/I	f	Remark
16	top	478,242	143,735	16.232	86.606	2.340	2.515	-8,855	-9,767	13,888	-4,734	O.K.
	bottom						3.403	-8,855	13,216	-18,792	-14,431	O.K.
15	top	441,604	143,289	16.232	86.606	2.340	2.515	-8,828	-9,737	12,824	-5,740	O.K.
	bottom						3.403	-8,828	13,175	-17,352	-13,005	O.K.
14	top	373,264	142,729	15.605	71.230	2.119	2.294	-9,146	-9,740	12,021	-6,866	O.K.
	bottom						3.177	-9,146	13,490	-16,648	-12,305	O.K.
13	top	326,303	136,695	15.108	60.680	1.951	2.126	-9,048	-9,344	11,432	-6,959	O.K.
	bottom						3.008	-9,048	13,220	-16,175	-12,003	O.K.
12	top	282,872	130,522	14.590	50.990	1.781	1.956	-8,946	-8,917	10,851	-7,012	O.K.
	bottom						2.842	-8,946	12,956	-15,766	-11,756	O.K.
11	top	242,886	124,945	14.048	42.174	1.611	1.786	-8,894	-8,524	10,286	-7,132	O.K.
	bottom						2.676	-8,894	12,772	-15,411	-11,534	O.K.

THE STUDY ON THE CONSTRUCTION OF THE BRIDGE
OVER THE RIVER RUPSA IN KHULNA- PHASE 2

Job No. :	Date : 04-Nov-99	Designed by :	Checked by :

Note : Units in KN,m.

Node	Location	M_t	P_i	A	I	e	c	P_i/A	P_iec/I	M_tc/I	f	Remark
10	top	206,205	113,744	13.485	34.238	1.441	1.616	-8,435	-7,736	9,733	-6,438	O.K.
	bottom						2.510	-8,435	12,016	-15,117	-11,536	O.K.
9	top	172,713	102,145	12.899	27.182	1.272	1.447	-7,919	-6,917	9,194	-5,641	O.K.
	bottom						2.343	-7,919	11,199	-14,887	-11,607	O.K.
8	top	142,265	90,430	12.291	21.001	1.104	1.279	-7,357	-6,080	8,664	-4,773	O.K.
	bottom						2.175	-7,357	10,340	-14,734	-11,752	O.K.
7	top	114,727	78,280	11.661	15.686	0.938	1.113	-6,713	-5,210	8,140	-3,783	O.K.
	bottom						2.005	-6,713	9,386	-14,665	-11,992	O.K.
6	top	86,159	65,565	11.661	15.686	0.938	1.113	-5,623	-4,364	6,113	-3,873	O.K.
	bottom						2.005	-5,623	7,861	-11,013	-8,775	O.K.
5	top	61,370	52,775	11.661	15.686	0.938	1.113	-4,526	-3,512	4,355	-3,684	O.K.
	bottom						2.005	-4,526	6,327	-7,844	-6,043	O.K.
4	top	40,357	39,866	11.661	15.686	0.938	1.113	-3,419	-2,653	2,864	-3,208	O.K.
	bottom						2.005	-3,419	4,780	-5,158	-3,797	O.K.
3	top	23,131	26,794	11.661	15.686	0.938	1.113	-2,298	-1,783	1,641	-2,440	O.K.
	bottom						2.005	-2,298	3,212	-2,957	-2,042	O.K.
2	top	9,674	13,589	11.661	15.686	0.938	1.113	-1,165	-904	686	-1,383	O.K.
	bottom						2.005	-1,165	1,629	-1,237	-773	O.K.
1	top	0	7,050	11.661	15.686	0.938	1.113	-605	-469	0	-1,074	O.K.
	bottom						2.005	-605	845	0	241	O.K