APPENDIX II-7-C

PROJECT ACTIVITY MATRIX SHEETS

Contents

No.	Bridge Name
2	David Garcia
3	Granallas
5	San Jose
6	Puangue
7	San Jose de Marchiue
8	Antivero No. 2
13	Poculon
16	San Juan

Matrix: Project activities list for the Preliminary Environmental Impact Assessment

Evaluation Key Environmental assessment matrix (Introduction on reverse side)

P : Potentially significant adverse environmental impact for which a design solution has been identified.

A : Adverse environmental impact that is potentially significant but about which insufficient information has been obtained to make a reliable prediction.

X : Residual and significant adverse environmental impact.

E : Significant environmental enhancement.

Project Loction No.2 Bridge name: David Garcia Region: V, Valparaiso, Province: Los Andes **NO. 2**

(Replacement: existing RC bridge)

			Project activities																																		
			Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
			Access roads	River crossings	Site surveying	Boring test	Site cleaning /Burning	Earthworks	Equipment	Waste disposal & recovery	Land acquisition	Resettlement/compensation	Access roads	River crossing/deture root	Earth works	Demolition	Building relocation	Reclamation	Erosion control	Drainage alteration	Piling	Structures	Equipment	Revegetation	Landscaping	Labour force	Utilities	Waste disposal & recovery	Equipment	Transportation / traffic	Pedestrian traffic	Waste disposal & recovery	Accidents	Labour force	Amenities	Utilities	Transportation
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X : Residual and significant adverse environmental impact.

E : Significant environmental enhancement.

Project Loction No.3 Bridge name: Granallas Region: V, Valparaiso, Province: San Fellipe de Aconcagua NO. 3

(Replacement: existing ST bridge)

			Project activities: Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
			Access roads	River crossings	Site surveying	Boring test	Site cleaning /Burning	Earthworks	Equipment	Waste disposal & recovery	Land acquisition	Resettlement/compensatio	Access roads	River crossing/deture root	Earth works	Demolition	Building relocation	Reclamation	Erosion control	Drainage alteration	Piling	Structures	Equipment	Revegetation	Landscaping	Labour force	Utilities	Waste disposal & recovery	Equipment	Transportation / traffic	Pedestrian traffic	Waste disposal & recovery	Accidents	Labour force	Amenities	Utilities	Transportation
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X : Residual and significant adverse environmental impact.

E : Significant environmental enhancement.

Project Loction No.10 Bridge name: San Jose Region: RM, Metropolitana, Province: Chacabuco **NO. 5**

(Replacement: existing RC bridge)

			Project activities: Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
Environmental component		**Identification of activities**	Access roads	River crossings	Site surveying	Boring test	Site cleaning /Burning	Earthworks	Equipment	Waste disposal & recovery	Land acquisition	Resettlement/compensatio	Access roads	River crossing/deture root	Earth works	Demolition	Building relocation	Reclamation	Erosion control	Drainage alteration	Piling	Structures	Equipment	Revegetation	Landscaping	Labour force	Utilities	Waste disposal & recovery	Equipment	Transportation / traffic	Pedestrian traffic	Waste disposal & recovery	Accidents	Labour force	Amenities	Utilities	Transportation
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NO. 6

Evaluation Key Environmental assessment matrix (Introduction on reverse side)

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A : Adverse environmental impact that is potentially significant but about which insufficient information has been obtained to make a reliable prediction.

X : Residual and significant adverse environmental impact.

E : Significant environmental enhancement.

Project Loction No.12 Bridge name: Puange Region: RM, Metropolitana, Province: Melipilla
(Replacement: existing RC bridge)

			Project activities																																		
			Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
Environmental component		Identification of activities	Access roads	River crossings	Site surveying	Boring test	Site cleaning /Burning	Earthworks	Equipment	Waste disposal & recovery	Land acquisition	Resettlement/compensatio	Access roads	River crossing/deture root	Earth works	Demolition	Building relocation	Reclamation	Erosion control	Drainage alteration	Piling	Structures	Equipment	Revegetation	Landscaping	Labour force	Utilities	Waste disposal & recovery	Equipment	Transportation / traffic	Pedestrian traffic	Waste disposal & recovery	Accidents	Labour force	Amenities	Utilities	Transportation
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X : Residual and significant adverse environmental impact.

E : Significant environmental enhancement.

NO. 7

Project Loction No.16 Bridge name: San Jose de March Region: VI, Libertador General O'Hinggis, Province: Cach
(Replacement: existing ST bridge)

			Project activities: Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
Environmental component		Identification of activities	Access roads	River crossings	Site surveying	Boring test	Site cleaning /Burning	Earthworks	Equipment	Waste disposal & recovery	Land acquisition	Resettlement/compensatio	Access roads	River crossing/deture root	Earth works	Demolition	Building relocation	Reclamation	Erosion control	Drainage alteration	Piling	Structures	Equipment	Revegetation	Landscaping	Labour force	Utilities	Waste disposal & recovery	Equipment	Transportation / traffic	Pedestrian traffic	Waste disposal & recovery	Accidents	Labour force	Amenities	Utilities	Transportation
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Evaluation Key Environmental assessment matrix (Introduction on reverse side)

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P : Potentially significant adverse environmental impact for which a design solution has been identified.

A : Adverse environmental impact that is potentially significant but about which insufficient information has been obtained to make a reliable prediction.

X : Residual and significant adverse environmental impact.

E : Significant environmental enhancement.

Project Loction Bridge name: Antivero No.2 Region: VI, Libertador General O'Higgis, Province: Colchagua
(Replacement: existing RC bridge)

			Project activities: Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
Environmental component		**Identification of activities**	Access roads	River crossings	Site surveying	Boring test	Site cleaning /Burning	Earthworks	Equipment	Waste disposal & recover	Land acquisition	Resettlement/compensatio	Access roads	River crossing/deture root	Earth works	Demolition	Building relocation	Reclamation	Erosion control	Drainage alteration	Piling	Structures	Equipment	Revegetation	Landscaping	Labour force	Utilities	Waste disposal & recover	Equipment	Transportation / traffic	Pedestrian traffic	Waste disposal & recover	Accidents	Labour force	Amenities	Utilities	Transportation
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E : Significant environmental enhancement.

Project Loction No.99 Bridge name: Poculon Region: IX, La Alaucania, Province: Cautin **NO. 13**

(Replacement: existing TM bridge)

		Project activities																																			
			Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
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E : Significant environmental enhancement.

Project Loction No.40 Bridge name: San Juan Region: IX, La Alaucania, Province: Cautin
(Replacement: existing TM bridge)

			Project activities																																		
			Pre-construction stage										Construction stage																Operation and maintenance stage						Consequent projects		
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APPENDIX II-8

STRENGTHENING DESIGN FOR GRANALLAS BRIDGE

[illegible]

[illegible]

Strengthening Design for Granallas Bridge

A sample of how to strengthen a steel bridge is demonstrated taking Granalls Bridge, which consists of two span simply supported steel girders with timber deck. There was no signpost showing the load capacity, and neither the structural analysis nor the drawings of the bridge of those days were found.

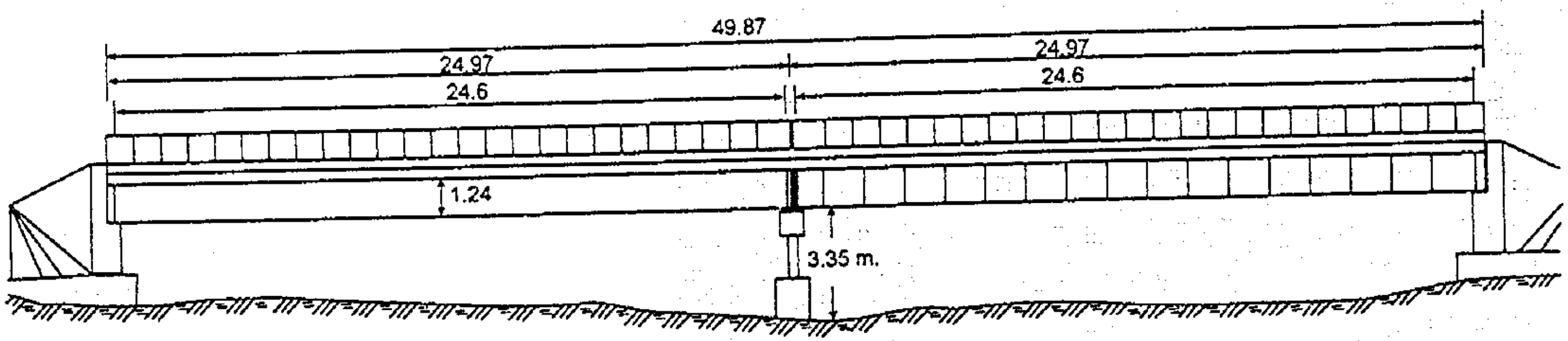
The calculation refers briefly to:

- analytical estimation of the present load carrying capacity of the bridge, and
- strengthening and improvement by replacing the timber deck by concrete slab to compose the steel girders with the concrete slab.

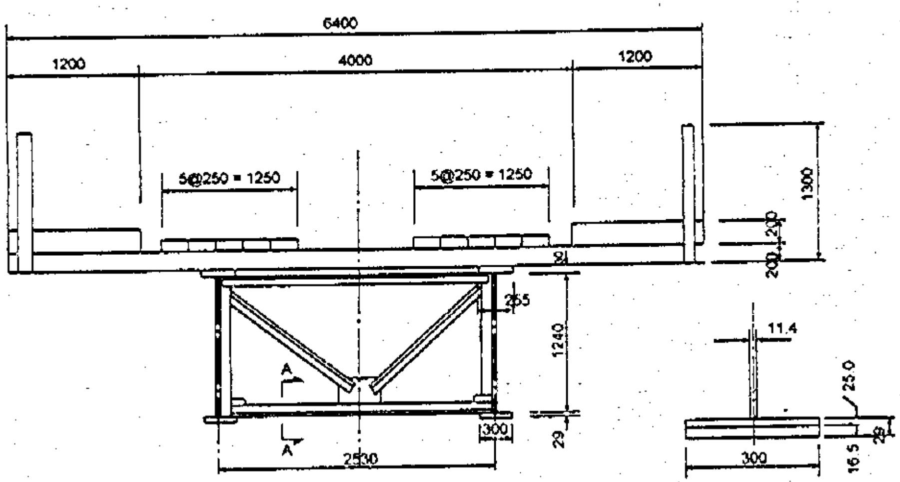
The result of the calculation shows that:

- the bridge has at present the load carrying capacity of equivalent HS10-44 through a simple estimation, and
- in order to replace the timber deck by concrete as shown in the figure, lower flange plates have to be reinforced by thick steel cover plates, because the neutral axis goes up higher and then stronger tension stress works in the lower flange after the two materials are composed.

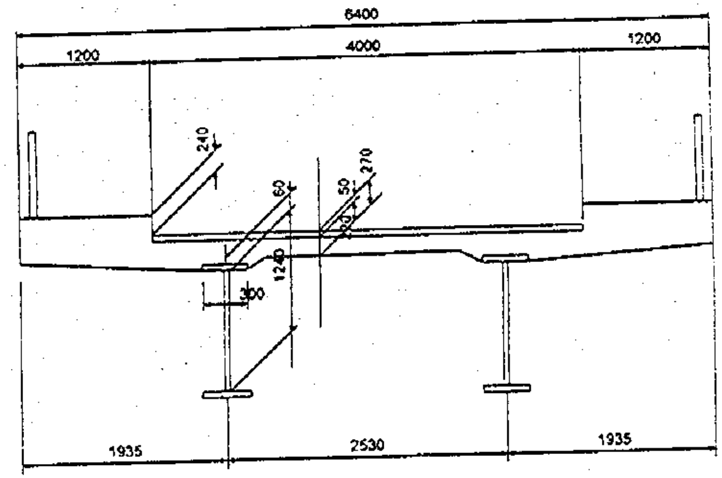
The calculation process is given on the following pages.



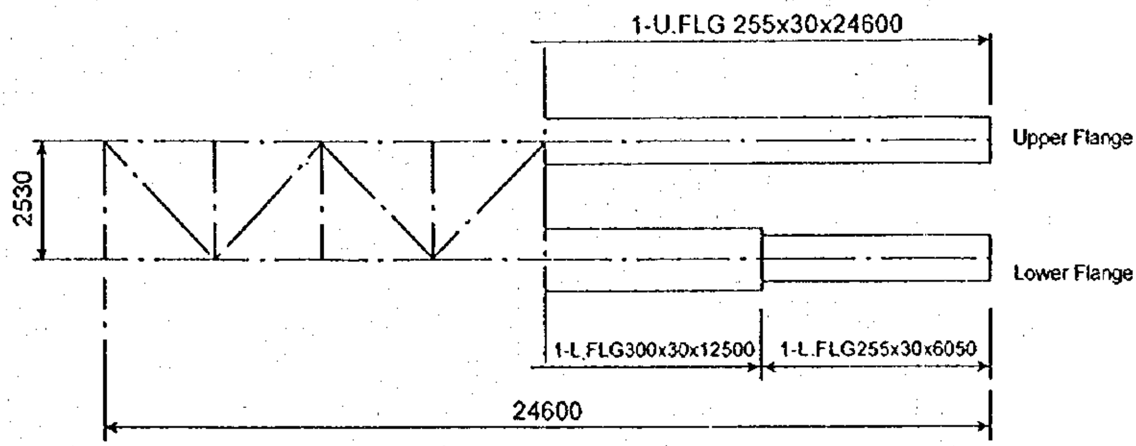
Existing Timber Deck



Optional Concrete Deck



Sample Strengthening Design for Granallas Bridge



1. Notes on Inspection of Superstructure

- After the penetration dye test of the fillet weld connecting the web plate with the bottom plate, no defect was found.

- Generally, it is impossible to measure the thickness of the web plates by a caliper nor a micrometer, except the edge part of the plate. In order to measure general parts of a plate, an ultrasonic thickness meter was introduced for the detail survey of steel bridges.

- According to the result from the ultrasonic test, the thickness of the web plates ranged from 11.0 to 11.4 millimeters.

- The thickness of the bottom flange was measured to be approximately 30 millimeters by a ruler, but the ultrasonic meter read 12.5 millimeters when applied to the top surface of the bottom flange, and 16.5 millimeters when applied to the bottom. Later the bottom flange was observed and turned out to be double-layered.

- The web plate constitutes of several plates which were connected by welds each other.

2. Calculation of Existing Load Carrying Capacity

(1) Assumed Intensity of Dead Load

As the superstructure is made of timber, metal fixtures and steel girders, the total dead load per unit length is assumed as shown in the next page.

1) Weight of Timber per Unit Length

No.		Section	Length	Quantity	Timber Inch	Weight (kg/m)
1	Travesaño	8x8	6.40	3	34.13	
2	Tablón Parado	3x8	4.20	36	100.80	
3	Guarda Rueda	6x8	3.60	2	9.60	
4	Tacos de Madera	6x8	1.60	6	12.80	
5	Tablón Pasillo	2x8	3.60	8	12.80	
6	Pilar Baranda	4x4	1.20	6	3.20	
7	Pasamanos Baranda	4x4	3.60	2	3.20	
8	Cinta Baranda	2x6	3.60	2	2.40	
9	Tablón de Rodeo	3x10	3.60	10	30.00	
10	Total				208.93	1077.2

0 Timber Inch = 1" x 10" x 3.6 m = 0.0232 m^3
108.93 x 0.0232 = 4.847 m^2
Weight per Unit Length = 4.847 x 800/3.6 = 1077.1 kg/m

2) Weight of Metal Fixtures per Unit Length

(55 kg/3.6m) = 14 kg/m

3) Weight of Steel Girder per Unit Length

(Two Girders) x 0.030 m^2 (Cross-sectional Area) x 7850 (Specific Weight) x 1.08 (Coefficient) = 507 kg/m

4) Total Dead Weight per Unit length

Timber	1077.0
Metal Fixtures	15.0
Steel Girder	508.0
Total Dead Load	1600.0

Thus the total dead load of the whole width per unit length is assumed to be 1.6 tons per meter.

(2) Calculation of Bending Moment per a Girder by Dead Load at Span Center

1) Span Length ; 24.6 m = 24600/305 = 80.7 ft.

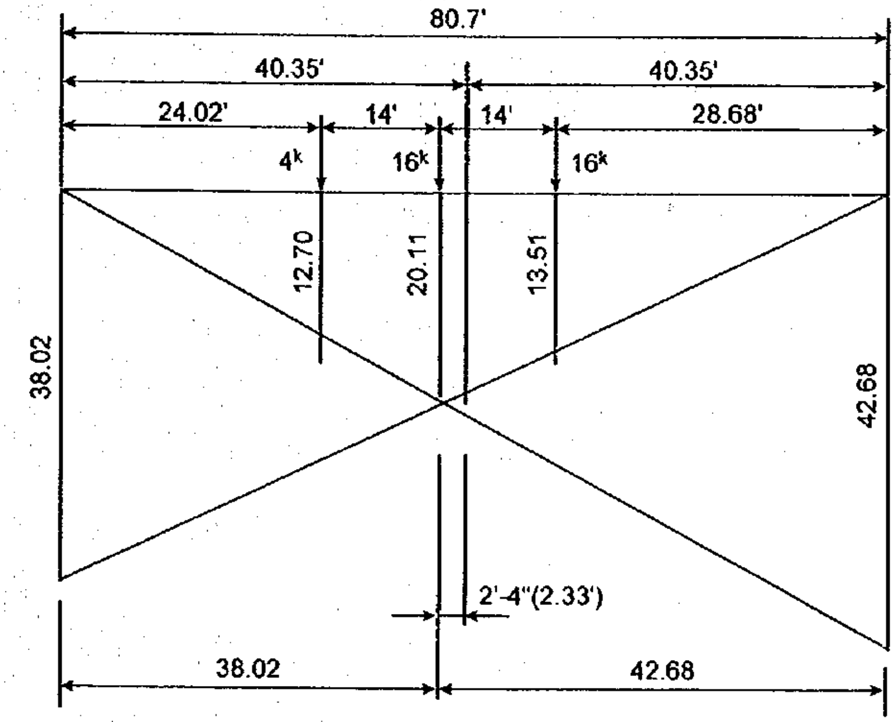
2) Bending Moment

$M_d = \frac{1}{8} \times d \times L^2 = \frac{1}{8} \times 1.6 \times 24.6^2 \times \frac{1}{2} = 60.5^{tm}$

(3) Calculation of Maximum Bending Moment per a Girder by Live Load

1) Highway Load

a. Influence Line"

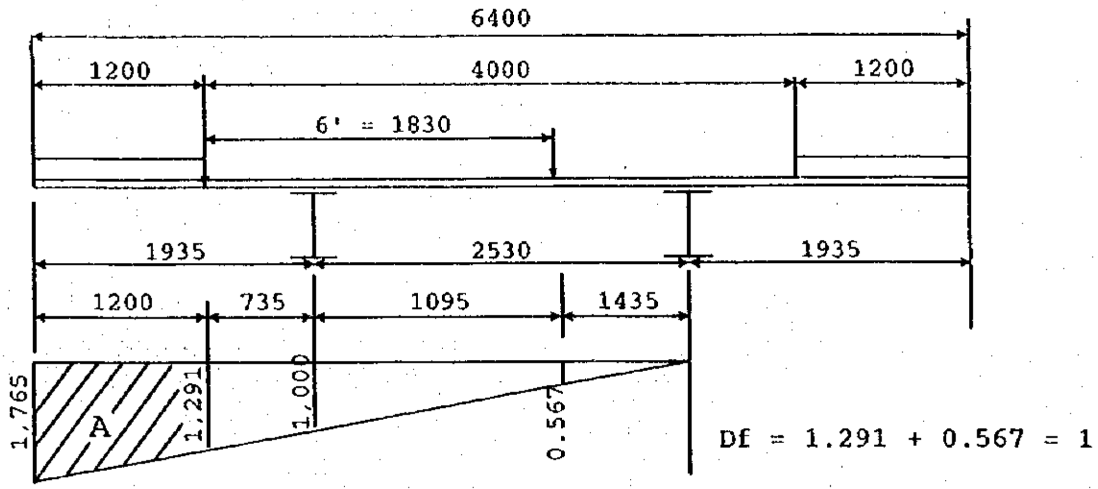


b. Bending Moment

$M_{LO} = 12.7 \times 4^K + 20.11 \times 16^K \times 13.51 \times 16^K = 588.7^{Kft} = 81.4^{tm}$

c. Distribution Factor

S; Average stringer spacing : $S = \frac{2530}{305} = 8.3$ ft.
On steel stringers 6" or more and S = 8.3 > 5.5. According to the footnote "f", both girders are assumed to act as a simple beam.



A = 1/2 (1.765 + 1.291) x 1.2 + 1.834

d. Impact Allowance: $I = \frac{50}{L + 125} = \frac{50}{80.7 + 125} = 0.243 < 0.3$

e. Bending Moment by Highway Load

$M_{l+i} = 81.4 \times 1.858 \times (1 + 0.243) = 188.0^{tm}$

2) Sidewalk Load

$q_o = 85\ lb/ft^2 = 428\ kg/m^2$

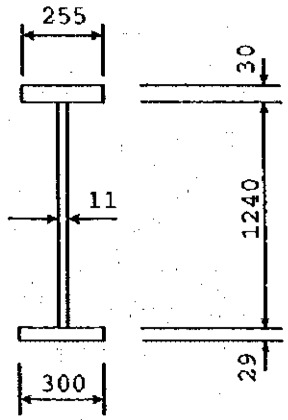
$P = q_o \bullet A = 428 \times 1.834 = 786\ kg/m$

$M_p = \frac{1}{8} \times 786 \times 24.6^2 = 59.4^{tm}$

(4) Total Bending Moment

$\Sigma M = M_d + M_{l+i} + Mp = 60.5 + 188.0 + 59.4 = 307.9^{tm}$

(5) Working Stress in a Cross Section at the Span Center



	A	y	Ay	I
1-U.Flg PL 255x30	76.5	63.5	4860	300000
1-Web PL 1240 x 11	136.4			175000
1-L.Flg PL.300 x 29	87.0	-63.5	-5520	350000
	230.9		-660	825000

$$\delta = \frac{-660}{230.9} = -2.8 \text{ cm}$$

$$I = 825000 - 2000 = 823000 \text{ cm}^4$$

$Y_u = 124.0/2 + 2.8 + 3.0 = 67.8$ cm $\quad W_u = 12200$ cm^3

$Y_l = 124.0/2 - 2.8 + 2.9 = 62.1$ cm $\quad W_l = 13200$ cm^3

1) Allowable Stress

$\sigma_a = 1400$ kg/cm^2 $\quad$ {D + (L + I)}
$\sigma_a = 1400 \times 1.25 = 1750$ kg/cm^2 $\quad$ {L + (L + I) + P}

2) Stress by Dead Load

$$\sigma_{du} = \frac{60.5 \times 10^5}{12200} = 496 \text{ kg/cm}^2 \quad \sigma_{dl} = \frac{60.5 \times 10^5}{13200} = 458 \text{ kg/cm}^2$$

3) Stress by Highway Load and Impact

$$\sigma_{l+i,u} = \frac{188.0 \times 10^5}{12200} = 1541 \text{ kg/cm}^2 \quad \sigma_{l+i,l} = \frac{188.0 \times 10^5}{13200} = 1424 \text{ kg/cm}^2$$

4) Stress by Sidewalk Load

$$\sigma_{pu} = \frac{59.4 \times 10^5}{12200} = 486 \text{ kg/cm}^2 \quad \sigma_{pl} = \frac{59.4 \times 10^5}{13200} = 450 \text{ kg/cm}^2$$

(6) Stress Check on Combined Loads

1) Dead Load and Highway Load

$\sigma_u = 496 + 1541 = 2037$ kg/cm^2 > 1400"
$\sigma_l = 458 + 1424 = 1882$ " $>$ "

2) Dead Load, Highway Load and Pedestrian Load

$\sigma_u = 496 + 1541 + 486 = 2523$ kg/cm^2 > 1750 kg/cm^2
$\sigma_l = 458 + 1424 + 450 = 2332$ kg/cm^2 $>$ "

(7) Calculation of Load Limit

Here HS-10 is assumed to be the maximum, and the working stresses are compared with the allowable stresses.

1) Stress by HS-10

$\sigma_u = 1541 \times (10/20) = 771$ kg/cm^2
$\sigma_l = 1424 \times (10/20) = 712$ "

2) Stress under Dead Load and HS-10

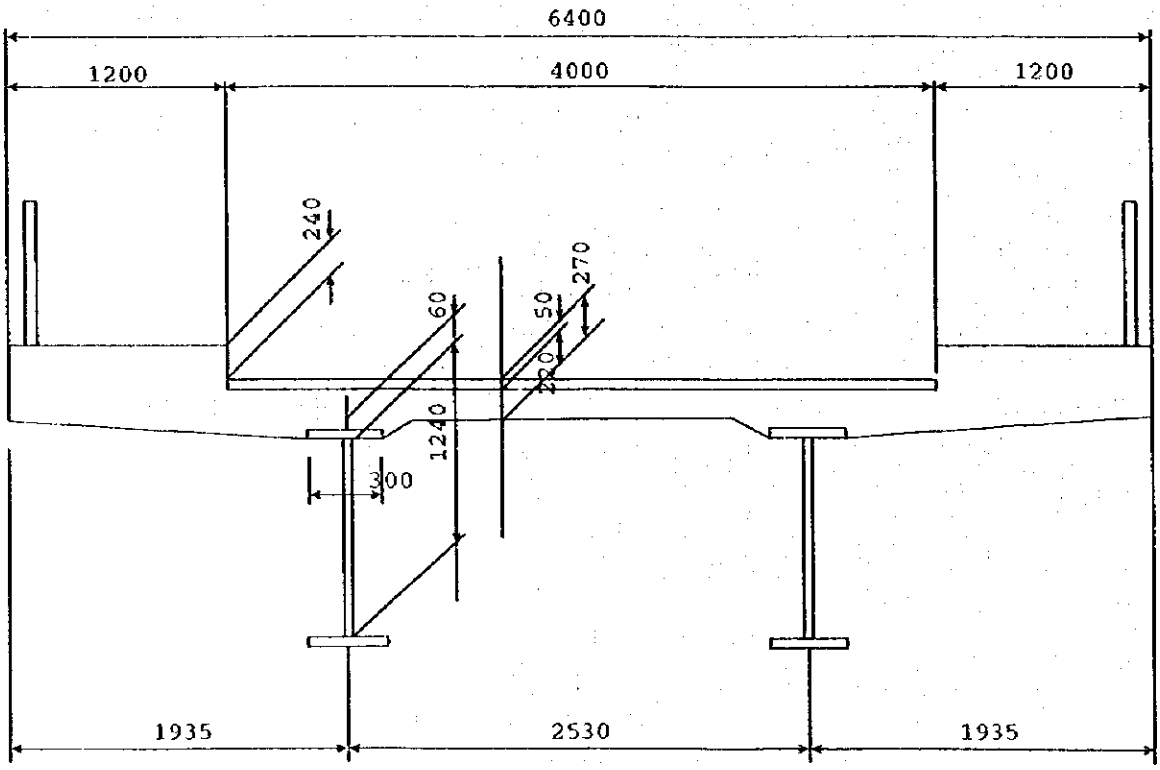
$\sigma_u = 496 + 771 = 1267$ kg/cm^3 < 1400"
$\sigma_l = 458 + 712 = 1170$ " < 1400"

3) Stress under Dead Load, HS-10 and Pedestrian Load

$\sigma_u = 496 + 771 + 486 = 1753 \doteq 1750$
$\sigma_l = 458 + 712 + 450 = 1620 < 1750$

3. Calculation for Replacement of Timber Deck by Concrete Slab.

(1) Cross Section (Assumed)



(2) Loads (per a girder)

1) Dead Load before Composition

Steel	1/2 x 508 kg/m	= $0.254^{t/m}$
Concrete Slab	1/2 x 6.4 x 0.22 x $2.4^{t/m^3}$	= $1.690^{t/m}$
Haunch	1/2 (2.235 + 0.3) x 0.05 x 2.4	= $0.152^{t/m}$
		$D_1 = 2.096^{t/m}$

2) Dead Load after Composition

Sidewalk	1.20 x 0.29 x 2.4	= $0.835^{t/m}$
Hand Rail		= $0.030^{t/m}$
Pavement	1/2 x 2.0 x 0.05 x 2.4	= $0.120^{t/m}$
		$D_2 = 0.985^{t/m}$

3) Live Load

Live load and impact are same as in the case of the timber floor, but distribution factor is different from the timber one.

$$Df = \frac{S}{7.0} \times \frac{2530/305}{7.0} = 1{,}185$$

(3) Bending Moment

1) Bending Moment due to Dead Load before Composition

$$MD_1 = \frac{1}{8} \times 2.096 \times 24.6^2 = 158.6^{tm}$$

2) Bending Moment due to Dead Load after Composition

$$Md_2 = \frac{1}{8} \times 0.985 \times 24.6^2 = 74.5^{tm}$$

3) Bending Moment due to Live Load and Impact

$$M_{L+I} = M_{L,o} \times D_f \times (1 + I) = 81.4 \times 1.185 \times 1.243 = 119.9^{tm}$$

(4) Ratio of Moduli of Elasticity

1) Compressive Strength of Concrete

Assumed to be f' = 300 kg/cm² = 4267 lb/in²

3600 lb/in² < f' < 4500 lb/in², then n = 8

n' = 3n = 3 x 8 = 24

n : Ratio of Moduli of Elasticity after Composition

n' : Ratio of Moduli of Elasticity before Composition

(5) Effective Width of Concrete Deck Slab

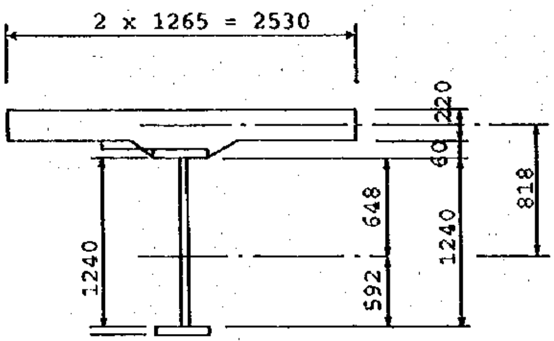
Effective width of the concrete slab is the least value of those shown below.

1) (Span Length) x 1/12 = 24.6 x 1/12 = 2.05m

2) (Thickness of Slab) x 6 = 0.22 x 6 = 1.32m

3) (Spacing of Girders) x 1/2 = 2.53 x 1/2 = 1.265m = Effective Width

(6) Calculation of Cross Section



A_c = 253 x 22 = 5566 cm^2
I_c = 1/12 x 22.0^3 x 253.0 = 224000 cm^4

1) Steel Girder Section (See Calculation in the case of timber floor)

I_s = 823000 cm^4	As =
Y_u = 67.8 cm	W_u = 12200 cm^3
Y_l = 62.1 cm	W_L = 13200 "

2) Composed Section for Dead Load (n = 24)

	A	Y	Ay	I
Concrete Sec.	231.9	81.8	18970	9000
				1552000
Steel Sec.	230.9			823000
	462.8		18970	2384000

δ = 18970/462.8 = 40.9 cm
I_{VD} = 2384000 – 40.9^2 x 462.8 = 1610000 cm^4

Y_u = 64.8 – 40.9 + 3.0 = 26.9 cm Y_l = 59.2 + 40.9 + 3.0 = 103.1 cm

3) Composed Section for Live Load (n = 8)

	A	Y	Ay	I
Concrete Sec.	695.8	81.8	56920	28000
				4656000
Steel Sec.	230.9			823000
	926.7		56920	5507000

$\delta = 56920/926.7 = 61.4$ cm

$I_{VL} = 5507000 - 61.4^2 \times 926.7 = 2013000$ cm^4

$Y_u = 64.8 - 61.4 + 3.0 - 6.4$ cm $\qquad Y_l = 59.2 + 61.4 + 2.9 = 123.5$ cm

(7) Calculation of Working Stress

1) Stresses due to Dead Load before Composition

$$\sigma_u = \frac{158.6 \times 10^5}{823000} = 1307 \text{ kg/cm}^2$$

$$\sigma_l = \frac{158.6 \times 10^5}{823000} \times 62.1 = 1197 \text{ kg/cm}^2$$

2) Stresses due to Dead Load after Composition

$$\sigma_u = \frac{74.5 \times 10^5}{1610000} \times 26.9 = 123 \text{ kg/cm}^2$$

$$\sigma_l = \frac{74.5 \times 10^5}{1610000} \times 103.1 = 477 \text{ kg/cm}^2$$

3) Stresses due to Highway Load

$$\sigma_u = \frac{119.9 \times 10^5}{2013000} \times 6.4 = 38 \text{ kg/cm}^2$$

$$\sigma_l = \frac{119.9 \times 10^5}{2013000} \times 123.5 = 736 \text{ kg/cm}^2$$

4) Stresses due to Pedestrian Load

$$\sigma_u = \frac{59.4}{2013000} \times 6.4 = 18 \text{ kg/cm}^2$$

$$\sigma_l = \frac{59.4}{2013000} \times 123.5 = 364 \text{ kg/cm}^2$$

(8) Combination of Stresses

1) Dead Load and Highway Load

$$\sigma_u = 1307 + 125 + 38 = 1470 \text{ kg/cm}^2 = \sigma_a = 1400$$

$$\sigma_l = 1197 + 477 + 736 = 2410 \text{ kg/cm}^2 > \sigma_a = 1400$$

2) Dead Load, Highway Load and Pedestrian Load

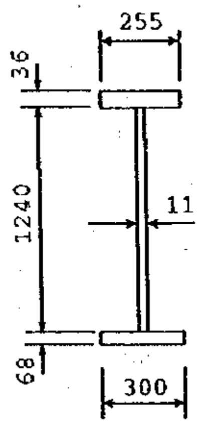
$\sigma_u = 1470 + 18 = 1488\ kg/cm^2 = 1.25\ \sigma a = 1750\ kg/cm^2$

$\sigma_l = 2410 + 364 = 2774 > 1750$

Therefore the existing lower flange plate has to be reinforced by steel cover plate.

(9) As the present steel section with concrete slab cannot support AASHTO HS-10, the section has to be reinforced by adding plates to the existing flange plates.

Calculation of stress working in the reinforced section



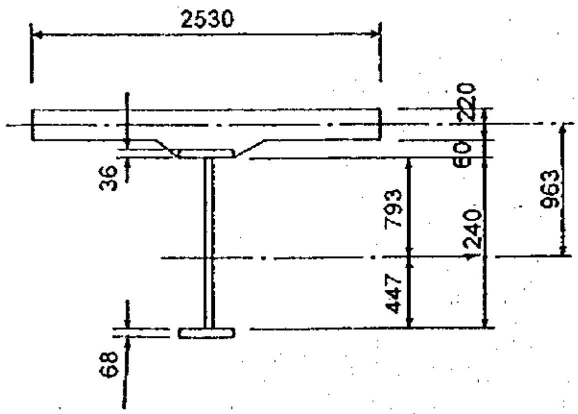
		A	Y	Ay	I
1-U.F/g	255 x 36	91.8	63.8	5860	374000
1-Web	1240 x 11	136.4			175000
1-L.F/g	300 x 68	204.0	-65.4	-13340	873000
		432.2		-7480	1422000

$$\delta = \frac{-7480}{432.2} = -17.3$$

$Y_u = 124.0/2 + 17.3 + 3.6 = 82.9$ cm

$Y_l = 124.0/2 - 17.3 + 6.8 = 51.5$ cm

(10) Calculation of Composed Section



$A_c = 253.0 \times 22.0 = 5566\ cm^2$

$I_c = 1/12 \times 22.0^3 \times 253.0 = 224000\ cm^3$

1) Steel Girder Section

$I_s = 1293000\ cm^4$ $A_s = 432.2\ cm^2$
$Y_u = 82.9$ cm $Y_l = 51.5$ cm

2) Composed Section for Dead Load (n = 24)

	A	Y	Ay	I
Concrete Sec.	231.9	96.3	22330	9000
				2151000
Steel Sec.	432.2			1293000
	664.1		22330	3453000

$\delta = 22330/664.1 = 33.6$ cm
$I_{VD} = 3453000 - 33.6^2 \times 664.1 = 2703000\ cm^4$
$Y_u = 79.3 - 33.6 + 3.6 = 49.3$ cm
$Y_l = 44.7 + 33.6 + 6.8 = 85.1$ cm

3) Composed Section for Live Load (n = 8)

	A	Y	Ay	I
Concrete Sec.	695.8	96.3	67010	28000
				6353000
Steel Sec.	432.2			1293000
	1128.0		67010	7774000

$\delta = 67010/1128.0 = 59.4$ cm
$I_{VL} = 7774000 - 59.4^2 \times 1128.0 = 3794000\ cm^4$
$Y_u = 79.3 - 59.4 + 3.6 = 23.5$ cm
$Y_l = 44.7 + 59.4 + 6.8 = 110.9$ cm

(11) Calculation of Working Stress

1) Stress due to Dead Load before Composition

$$\sigma_u = \frac{158.6 \times 10^5}{1293000} \times 82.9 = 1017\ kg/cm^2$$
$$\sigma_l = \frac{158.6 \times 10^5}{1293000} \times 51.5 = 632\ kg/cm^2$$

2) Stress due to Dead Load after Compression

$$\sigma_u = \frac{74.5 \times 10^5}{2703000} \times 49.3 = 136\ kg/cm^2$$
$$\sigma_l = \frac{74.5 \times 10^5}{2703000} \times 85.1 = 235\ kg/cm^2$$

3) Stress due to Highway Load

$$\sigma_u = \frac{119.9 \times 10^5}{3794000} \times 23.5 = 74 \text{ kg/cm}^2$$
$$\sigma_l = \frac{119.9 \times 10^5}{3794000} \times 110.9 = 350 \text{ kg/cm}^2$$

4) Stress due to Pedestrian Load

$$\sigma_u = \frac{59.4 \times 10^5}{3794000} \times 23.5 = 37 \text{ kg/cm}^2$$
$$\sigma_l = \frac{59.4 \times 10^5}{3794000} \times 110.9 = 174 \text{ kg/cm}^2$$

(12) Combination of Stresses

1) Dead Load and Highway Load

$\sigma_u = 1017 + 136 + 74 = 1227 \text{ kg/cm}^2 < 1400$
$\sigma_l = 632 + 235 + 350 = 1217 \text{ kg/cm}^2 < 1400$

2) Dead Load, Highway Load and Pedestrian Load

$\sigma_u = 1227 + 37 = 1264 \text{ kg/cm}^2 \quad < \sigma_a = 1.25 \times 1400 = 1750 \text{ kg/cm}^2$
$\sigma_l = 1217 + 174 = 1391$ " $\quad < 1750 \text{ kg/cm}^2$

(13) Reinforcement of Upper and Lower Flanges

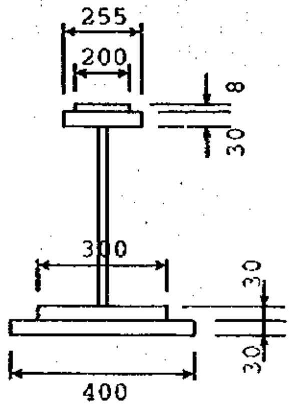
1) 1-U.F/g 255 x 30 → 1-U.F/g 255 x 36

$\Delta t = t_1 - t_0 = 36 - 30 = 6$
therefore
a plate of 255 x 6, or 200 x 8 whose area is greater than that of the former, shall be welded to the upper surface of the existing upper flange.

2) 1-L.F/g 300 x 29 → 1-L.F/g 300 x 68

$\Delta t = t_1 - t_0 = 68 - 29 = 39$
therefore
a plate of 300 x 39, or 400 x 30 of which area corresponds with the former, shall be welded to the bottom of existing lower flange.

Reinforced Sectio



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