



### GENERAL DATA

CENTRES OF BEARINGS = 78.800 m  
CENTRES OF GIRDERS = 5.500 m

### LOADING

**DEAD LOAD**  
STEEL WORK (ASSUMED) = 344.22 TONNES  
WEIGHT OF GANGWAY = 14.50 TONNES  
TRACK @ 6.0 Kg/Cm = 47.28 TONNES  
TOTAL = 406.00 TONNES

### LIVE LOAD

25t LOADING  
CDA  $0.15 + \frac{8}{6+L}$  WHERE 'L' IS LOADED LENGTH IN METRES

### WIND LOAD

@ 150 Kg/m<sup>2</sup> & RACKING FORCE @ 600 Kg/m RUN

### LONG. LOAD

25t LOADING - 2008

### STRINGER

LOADING	BENDING	SHEAR
LIVE LOAD	103.01 TONNES	117.90 TONNES
C.D.A. @ 0.599	61.70 TONNES	70.62 TONNES
TRACK @ 6.0 t/m	4.73 TONNES	4.73 TONNES
DEAD LOAD (ASSUMED)	7.00 TONNES	7.00 TONNES
	176.44 TONNES	200.25 TONNES

BENDING MOMENT FOR DESIGN = 176.44 x 78.80/8 = 8689.67 t.m.  
SHEAR FORCE FOR DESIGN = 200.25/4 = 50.06 TONNES  
SECTION WEB PLATE 80x12 & 2 FL. 450x25  
GROSS AREA OF SECTION = 89x1.2+2x45x2.5 = 331.80 Cm<sup>2</sup>  
MOMENT OF INERTIA ALONG X-X = 54153.15 Cm<sup>4</sup>, Zxx =  $\frac{I}{D/2}$  = 54153.15/942 = 57.50 Cm<sup>3</sup>

$f_{bc} = \frac{M}{Z_{xx}} = 8689.67/57.50 = 151.13 \text{ Kg/mm}^2$ ,  $f_{tbc} = \frac{M}{Z_{yy}} = 8689.67/15122.4 = 0.574 \text{ Kg/mm}^2$   
(a) BASIC PERM. BENDING STRESS = 15 Kg/mm<sup>2</sup> IN COMP. & TENSION  
(b) C<sub>x</sub> VALUE = 44.9 Kg/mm<sup>2</sup> STRESS IN BENDING COMPRESSION = 15.80 Kg/mm<sup>2</sup>  
GOVERNING VALUE, MIN. OF  $f_{bc}$  = 15.0 Kg/mm<sup>2</sup> IN COMP. & 15.0 Kg/mm<sup>2</sup> IN TENSION  
ACTUAL STRESS = 7.54 Kg/mm<sup>2</sup> IN COMP. AND 7.54 Kg/mm<sup>2</sup> IN TENSION O.K

(c) FATIGUE CHECK : (PERMISSIBLE STRESS IN FATIGUE FOR 50 GMT & 100 YEARS FOR DETAILED CATEGORY 125)  
 $f_{min} = 74.73$ ,  $f_{max} = 176.4$   
STRESS RANGE =  $7.54 \times (1 - 0.0665) = 7.04 \text{ Kg/mm}^2 = 70.4 \text{ N/mm}^2$   
 $\Delta \sigma_E, 2 = 1 \times 70.4 = 70.4 = 98.56 \text{ N/mm}^2$   
 $\therefore \sigma_{FE}, \Delta \sigma_E, 2 = 1 \times 98.56 = 98.56 \text{ N/mm}^2$   
 $\Delta \sigma_C = 125 \text{ N/mm}^2$   
 $\Delta \sigma_C = \frac{125}{1.15} = 108.70 > \sigma_{FE}, \Delta \sigma_E, 2 = 98.56 \text{ N/mm}^2$  O.K

SHEAR STRESS =  $50.06/10/89 \times 1.2 = 4.69 \text{ Kg/mm}^2$   
PERMISSIBLE SHEAR STRESS = 9.40 Kg/mm<sup>2</sup> O.K  
CLEAR DEPTH =  $\frac{800}{2} = 74.17 > 75$   
WEB THICKNESS = 12  
HENCE NO STIFFENERS ARE REQUIRED

WEB CONNECTION WITH FLANGE  
HORIZONTAL SHEAR =  $50.06/10/89 \times 1.2 = 4.69 \text{ Kg/mm}^2$   
PERM. STRESS IN WELD IN FATIGUE FOR DETAILED CATEGORY 80  
= 80/1.15 = 69.56 N/mm<sup>2</sup>  
SIZE OF FILLET WELDS =  $1.4 \times 0.47 \times 10^3 \times (1 - 0.0665) / (2 \times 0.7 \times 69.56) = 6.39 \text{ mm}$ , provided 12 mm  
END CONNECTION  
PROVIDED 2L 150x150x12  
SHOW STRENGTH OF 22 DIA BOLT IN  
SS =  $1 \times 0.3 \times 18.2/1.4 = 3.9$   
DS = 2x3.9 = 7.8  
IN BEARING WITH 12 mm =  $2.35 \times 1.2 \times 2.2 = 6.204$   
[A] ONE SPAN LOADED SHEAR AT END = 50.06 t  
NOW AT REQUIRED 22 DIA BOLT TO CONNECT TO CLEAT  
(i) WITH STRINGER = 50.06/6.204 = 8.06 SAY 9  
(ii) WITH CROSS GIRDER = 50.06/3.9 = 12.83 SAY 13  
(B) BOTH SPAN LOADED  
NO. OF 22 DIA BOLT REQUIRED TO CONNECT WITH CROSS GIRDER =  $68.785/6.204 = 11.09$  SAY 12

### CROSS GIRDER

LOADING	SPAN = 5.50 m
LIVE LOAD REACTION FROM STRINGER = 172.27/4	= 43.07 TONNES
IMPACT @ 0.461	= 19.86
DEAD LOAD OF STRINGER AND TRACK	= 5.86
TOTAL REACTION AT STRINGER	= 68.785
MAX. BENDING MOMENT = 68.785x1.80	= 12381.3 t.Cm
SELf BENDING MOMENT = 5x5.50 <sup>2</sup> /8	= 343.8 t.Cm
TOTAL DESIGN BENDING MOMENT = 12381.3+343.8	= 12727.1 t.Cm
SHEAR FORCE = 68.785/2.5	= 27.513 TONNES
SECTION WEB PLATE 140x12, 2 FL. PL. 400x20	
GROSS AREA OF SECTION = 2X40x2.0 + 140x1.2	= 328 Cm <sup>2</sup>
MOMENT OF INERTIA ALONG X-X = 108103.33 Cm <sup>4</sup> , Zxx = $\frac{I}{D/2}$ = 108103.33/1442 = 74.99 Cm <sup>3</sup>	

$f_{bc} = \frac{M}{Z_{xx}} = 12727.1/74.99 = 170.14 \text{ Kg/mm}^2 = 0.848 \text{ Kg/mm}^2$   
(a) BASIC PERM. BENDING STRESS = 15.4 Kg/mm<sup>2</sup> IN COMP. & TENSION  
(b) C<sub>x</sub> VALUE = 539.18 Kg/mm<sup>2</sup>; STRESS IN BENDING COMP. = 15.8 Kg/mm<sup>2</sup>  
GOVERNING VALUE MINIMUM OF  $f_{bc}$  = 15.4 Kg/mm<sup>2</sup>  
IN COMP. AND 15.4 Kg/mm<sup>2</sup> IN TENSION.

ACTUAL STRESS = 8.46 Kg/mm<sup>2</sup> IN COMP. AND 8.46 Kg/mm<sup>2</sup> IN TENSION O.K  
(c) FATIGUE CHECK : (PERMISSIBLE STRESS IN FATIGUE FOR 50 GMT & 100 YEARS FOR DETAILED CATEGORY 125)  
 $f_{min} = 52x5.86 = 0.117$   
 $f_{max} = 52x68.785 = 3575.8$   
STRESS RANGE =  $8.46 \times (1 - 0.117) = 7.49 \text{ Kg/mm}^2 = 74.9 \text{ N/mm}^2$   
 $\Delta \sigma_E, 2 = 1 \times 74.9 = 74.9 = 96.92 \text{ N/mm}^2$   
 $\therefore \sigma_{FE}, \Delta \sigma_E, 2 = 1 \times 96.92 = 96.92 \text{ N/mm}^2$   
 $\Delta \sigma_C = 125 \text{ N/mm}^2$   
 $\Delta \sigma_C = \frac{125}{1.15} = 108.70 > \sigma_{FE}, \Delta \sigma_E, 2 = 96.92 \text{ N/mm}^2$  O.K

SHEAR STRESS =  $71.285/10/(140 \times 1.2) = 4.24 \text{ Kg/mm}^2$   
PERMISSIBLE SHEAR STRESS = 9.40 Kg/mm<sup>2</sup> O.K  
CLEAR DEPTH = 1400 = 116.67 > 75  
WEB THICKNESS = 12  
HENCE STIFF. ARE REQUIRED.  
SECTION L 75x75x10

ISS = 365.785 Cm<sup>4</sup> > 219.52 Cm<sup>4</sup> SAFE  
WEB CONNECTION WITH FLANGE  
HORIZONTAL SHEAR =  $108103.33$   
PERM. STRESS IN WELD IN FATIGUE = 80/1.15 = 69.56 N/mm<sup>2</sup>  
SIZE OF FILLET WELD =  $1.294 \times 0.375 \times 10^3 \times (1 - 0.117) / (2 \times 0.7 \times 69.56) = 4.4 \text{ mm}$  PROVIDED 12 mm

END CONNECTION  
SIZE OF END FILLET WELDS =  $71.285/(1 - 0.117) \times 1.294 \times 10^3 = 5.14 \text{ mm}$  PROVIDED 12 mm  
CONNECTION WITH MAIN GUSSET  
NO. OF 22 mm DIA. HSPG BOLTS REQUIRED = 71.285 = 18.28 SAY 19  
3.9

### CHECKING OF MEMBERS FOR COMBINED AXIAL AND BENDING STRESSES WITH SEISMIC

MEMBER	AXIAL STRESS	BENDING STRESS	$\frac{f_a}{F_a} + \frac{f_b}{F_b}$
L <sub>0</sub> -U <sub>1</sub>	11.28	4.14	$\frac{11.28}{13.48 \times 1.167} + \frac{4.14}{1.167 \times 16.3} = 0.93 < 1$
U <sub>1</sub> -U <sub>2</sub> U <sub>2</sub> -U <sub>3</sub>	14.32	0.335	$\frac{14.32}{14.42 \times 1.167} + \frac{0.335}{1.167 \times 16.3} = 0.87 < 1$

MEMBER	C.D.A.	AREA OF INFLUENCE LINE IN Cm <sup>2</sup>	DEAD LOAD IN TONNES PER Cm RUN	LIVE LOAD IN TONNES PER Cm RUN	FORCE IN TONNES DUE TO								MAX. FORCE IN TONNES	LONG. FORCE IN TONNES	SEISMIC EFFECT IN TONNES						MAX. FORCE IN TONNES WITH SEISMIC	EFFECTIVE LENGTH IN Cm	LEAST RADIUS OF GYRATION IN Cm	(L/r)	PERMISSIBLE STRESS IN Kg/mm <sup>2</sup>				NET SECTION REQUIRED IN Cm <sup>2</sup>		GROSS SECTION REQUIRED IN Cm <sup>2</sup>		AREA IN Cm <sup>2</sup> PROVIDED		NUMBER OF HSPG BOLT REQUIRED	MEMBER
					DEAD LOAD		LIVE LOAD		SEISMIC ON MOVING LOAD AND BOTTOM CHORD		SEISMIC ON TOP CHORD				SEISMIC EFFECT (t)	L.F.+D.L.+L.	L	WITHOUT OCCASIONAL LOAD		WITH OCCASIONAL LOAD					WITHOUT OCC. LOAD	WITH OCC. LOAD	NET SECTION	EFFECTIVE GROSS AREA								
					DEAD LOAD	LIVE LOAD	C.D.A.	HORZ. BENDING	VERT. BENDING	HORZ. BENDING	VERT. BENDING	HORZ. BENDING						VERT. BENDING	COMP.	TENSION									COMP.	TENSION						
L <sub>0</sub> -L <sub>1</sub>	0.244	2660	0.026	0.0467	+69.16	+124.22	30.31	223.69	65	+37.95	+36.44	+3.86	+7.23	+10.94	+96.42	+385.11	65	27.74	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	302.20	302.20	85	L <sub>0</sub> -L <sub>1</sub>	
L <sub>1</sub> -L <sub>2</sub>	0.244	2660	0.026	0.0467	+69.16	+124.22	30.31	223.69	63	+105.41	+36.44	+11.08	+7.23	+10.94	+171.10	+457.79	63	27.74	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	302.20	302.20	63	L <sub>1</sub> -L <sub>2</sub>		
L <sub>2</sub> -L <sub>3</sub>	0.244	6210	0.026	0.0467	+161.46	+290.00	70.76	522.23	63	+156.02	+85.08	+16.86	+16.89	+10.94	+285.79	+871.02	63	27.74	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	564.10	564.10	96	L <sub>2</sub> -L <sub>3</sub>		
L <sub>3</sub> -L <sub>4</sub>	0.244	6210	0.026	0.0467	+161.46	+290.00	70.76	522.23	63	+189.74	+85.08	+21.67	+16.89	+10.94	+324.33	+909.56	63	27.74	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	564.10	564.10	100	L <sub>3</sub> -L <sub>4</sub>		
L <sub>4</sub> -L <sub>5</sub>	0.244	7392	0.026	0.0467	+192.19	+345.21	84.23	621.63	63	+206.62	+101.27	+22.61	+20.10	+10.94	+361.54	+1046.17	63	27.74	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	664.77	664.77	115	L <sub>4</sub> -L <sub>5</sub>		
U <sub>1</sub> -U <sub>2</sub>	0.244	4732	0.026	0.0467	-123.03	-220.98	-53.92	-397.93	-	-	+64.83	-	+12.87	+6.75	-	+84.45	-482.38	669.8	24.14	27.74	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	344.80	344.80	107	U <sub>1</sub> -U <sub>2</sub>		
U <sub>2</sub> -U <sub>3</sub>	0.244	4732	0.026	0.0467	-123.03	-220.98	-53.92	-397.93	-	-	+64.83	-	+12.87	+18.32	-	+96.02	-493.95	669.8	24.14	27.74	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42	344.80	344.80	68	U <sub>2</sub> -U <sub>3</sub>		
U <sub>3</sub> -U <sub>4</sub>	0.244	7096	0.026	0.0467	-184.49	-331.38	-80.86	-596.74	-	-	+97.22	-	+19.30	+26.03	-	+142.55	-739.29	669.8	23.85	28.08	13.39	15.63	15.63	15.63	15.63	15.63	15.63	15.63	15.63	15.63	543.5	543.5	82	U <sub>3</sub> -U <sub>4</sub>		
U <sub>4</sub> -U <sub>5</sub>	0.244	7096	0.026	0.0467	-184.49	-331.38	-80.86	-596.74	-	-	+97.22	-	+19.30	+29.91	-	+146.43	-743.17	669.8	23.85	28.08	13.39	15.63	15.63	15.63	15.63	15.63	15.63	15.63	15.63	543.5	543.5	82	U <sub>4</sub> -U <sub>5</sub>			
L <sub>0</sub> -U <sub>1</sub>	0.244	4433	0.026	0.0495	-115.26	-219.43	-53.54	-388.23	-	-	+63.84	-	+12.11	-	+718.22	+82.06	1115.9	23.82	46.85	13.48	15.73	15.73	15.73	15.73	15.73	15.73	15.73	15.73	15.73	431.80	431.80	108	L <sub>0</sub> -U <sub>1</sub>			
U <sub>1</sub> -L <sub>2</sub>	-0.692 0.255	-55 3502	0.026	-0.0722 0.0499	+89.62	-3.97 +174.75	-2.75 44.56	308.93	-	-	+49.64	-	+9.37	-	+59.01	+367.94	-	200.6	204.79	-	-	200.6	204.79	200.6	204.79	200.6	204.79	200.6	204.79	261.2	261.2	81	U <sub>1</sub> -L <sub>2</sub>			
L <sub>2</sub> -U <sub>3</sub>	0.490 -0.269	219 -2682	0.026	0.0595 -0.0503	-64.04	+13.03 -134.90	6.38 -36.29	-44.63 -235.23	-	-	+35.47	-	+6.69	-	+42.16	-277.39	918.96	14.32	64.19	12.17	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20	256	256	61	L <sub>2</sub> -U <sub>3</sub>		
U <sub>3</sub> -L <sub>4</sub>	-0.398 0.287	-493 1970	0.026	-0.0552 0.0510	+38.4	-27.21 +100.47	-10.24 28.83	0.36 167.70	-	-	+21.27	-	+4.02	-	+25.29	+192.99	-	152.53	107.39	-	-	152.53	107.39	152.53	107.39	152.53	107.39	152.53	107.39	178.6	178.6	43	U <sub>3</sub> -L <sub>4</sub>			
L <sub>4</sub> -U <sub>5</sub>	0.345 -0.311	876 -1368	0.026	0.0531 -0.0518	-12.79	+46.52 -22.04	16.05 -105.69	49.78 -105.69	-	-	+7.09	-	+1.34	-	+8.43	-114.12	-	133.8	95.68	-	-	133.8	95.68	133.8	95.68	133.8	95.68	133.8	95.68	156.72	156.72	28	L <sub>4</sub> -U <sub>5</sub>			
U <sub>1</sub> -L <sub>1</sub> U <sub>5</sub> -L <sub>5</sub>	0.518	788	0.026	0.0609	+20.49	+47.99	24.86	93.34	-	-	+11.35	-	+2.14	-	+13.49	+106.83	-	96.80	59.44	-	-	96.80	59.44	96.80	59.44	96.80	59.44	96.80	59.44	105.6	105.6	24	U <sub>1</sub> -L <sub>1</sub> U <sub>5</sub> -L <sub>5</sub>			
U <sub>2</sub> -L <sub>2</sub> U <sub>4</sub> -L <sub>4</sub>	-	-	-	-	-8.0	-	-	-8.0	-	-	0.0	-	+1.718	-	+1.718	-9.718	735	5.64	130.23	5.70	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	115	115	3	U <sub>2</sub> -L <sub>2</sub> U <sub>4</sub> -L <sub>4</sub>			

\* THIS IS DUE TO PORTAL EFFECT.

⊙ THE MAX. SEISMIC EFFECT IS DUE TO FULL SEISMIC FORCE THROUGH PORTAL. FOR OTHER MEMBERS SEISMIC EFFECT IS DUE TO 50% SEISMIC FORCE THROUGH PORTAL PLUS 50% THROUGH SWAY BRACINGS.

△ THE AREA PROVIDED IS FOR DIRECT AXIAL FORCE AND BENDING MOMENT = 3949.4 t.cm.

PANEL	SHEAR DUE TO SEISMIC & RACK FORCE IN TONNES	TRACTIVE EFFORT IN TONNES	FORCE IN TONNES	TOTAL FORCE IN TONNES	EFFECTIVE LENGTH IN Cm	L/r	PERM. STRESS IN Kg/mm <sup>2</sup>	SECTION PROVIDED	ACTUAL STRESS IN Kg/mm <sup>2</sup>	20 DIA HSPG BOLTS REQD. IN S.S. (21.5 DIA. HOLES)
L <sub>0</sub> -L <sub>1</sub>	59.062	39.651	51.59	12.09	63.68	314.5	58.13	12.72	10.68	18
L <sub>1</sub> -L <sub>2</sub>	46.672	39.651	40.77	12.09	52.86	314.5	58.13	12.72	8.86	15
L <sub>2</sub> -L <sub>3</sub>	34.111	39.651	29.796	12.09	41.886	314.5	58.56	12.69	8.36	12
L <sub>3</sub> -L <sub>4</sub>	22.018	39.651	19.233	12.09	31.323	314.5	58.56	12.69	6.25	9
L <sub>4</sub> -L <sub>5</sub>	10.405	39.651	9.09	12.09	21.18	314.5	58.56	12.69</		