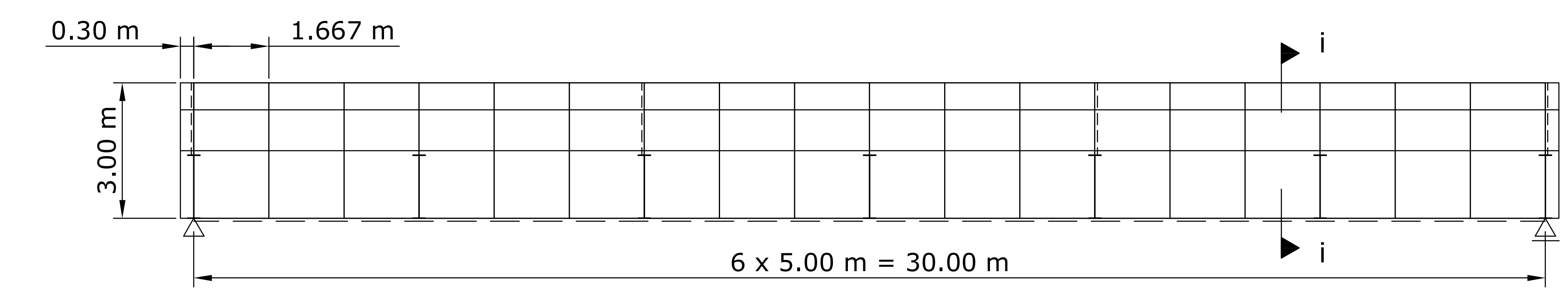
Department: Civil Engineering Level: Fourth (Classes) & Fifth (Credit) Semester: Second, 2022-2023 Subject: Bridge Engineering Code: CIE 415A & CIE 511	Ministry of Higher Education High Institute of Engineering & Technology New Damietta	Final-Term Exam Time Allowed: 3:00 hrs Full marks: 100% Page Numbers: 1 Date: 4/6/2023

Attempt all questions. *Use neat sketches when it is necessary.*
Assume any missing data reasonably.

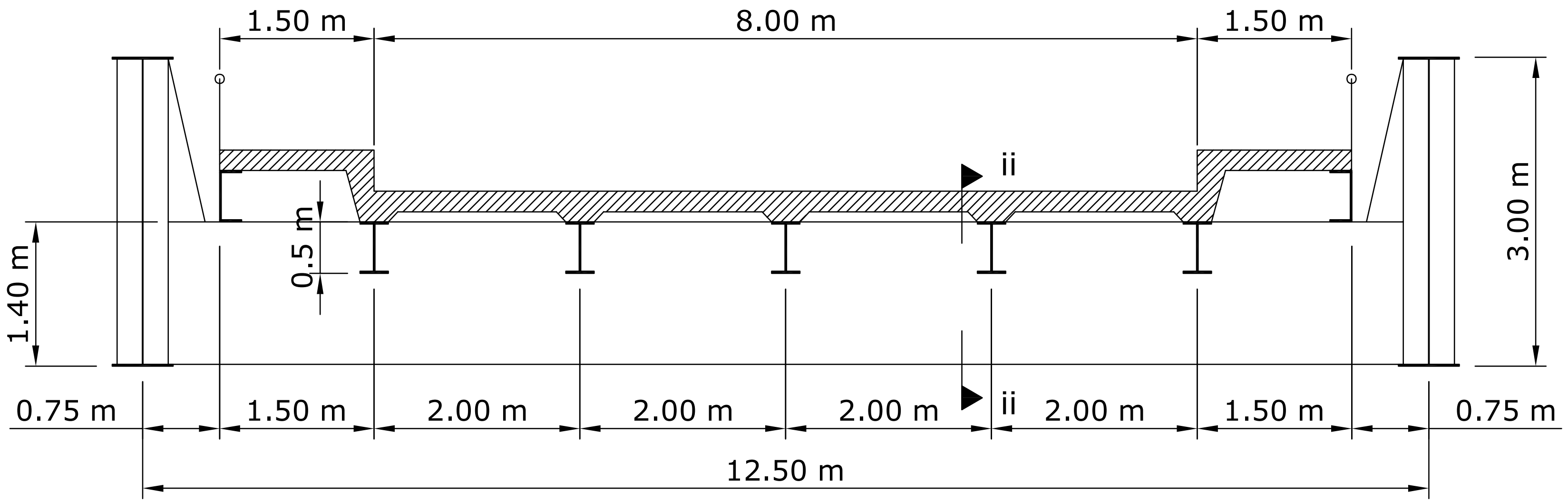
It is required to construct a roadway pony steel plate girder bridge of span 30 m. The roadway breadth is 8 m, 2 sidewalks of width 1.5 m. It is required to:	Topic	Competencies	LO's
1- (20%) Compute the loads and straining actions on an intermediate cross-girder.	3	C2 C9	a1, b3 d1
2- (20%) Design the welded plate girder of the main girder if M_{D+L+I}=1200 t.m, M_D=800 t.m, Q_{D+L+I}=180 t. Perform all checks (neglect LTB).	4	C2 C9 C12	a1, b3 d1 b1
3- (20%) Design the bolted splice of the cross-girder if Q_{D+L+I} = 100 t at the location of the splice. The draw to scale 1:10 the details of the splice.	4	C2 C9 C12	a1, b3 d1 b1
4- (20%) Design the roller support of the bridge considering the breadth of the M.G flange =40 cm & the eccentricity e = 7.5 cm. (R = 180 t, use C St 55). Then draw to scale 1:10 the details of the roller.	4	C2 C9 C12	a1, b3 d1 b1
5- (20%) Show the calculations and the path of lateral wind loads from the roadway deck-truss steel bridge to the supports. (use neat sketches)	1, 6	C2 C9	a1, b3 d1

Data:

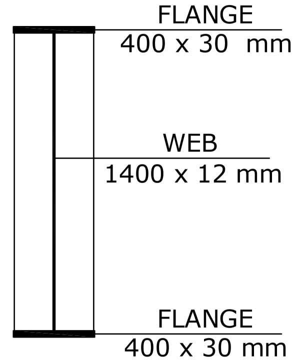
Steel Grade ***St52***
Thickness of RC slab + haunches = 21 cm
Weight of asphalt ***200 kg/m²***
Own weight of stringer ***200 kg/m`***
Allowable stress range, F_{sr} ***1.68 t/cm²***
Bolts used for all connections are high strength bolts M27, Grade 10.9, Ps=9.03 t.



ELEVATION



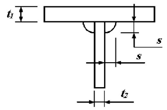
SIDE VIEW (i-i)



Cross Girder Section (ii-ii)

Grade of Steel	t < 40 mm		t > 40 mm	
	F_y t/cm^2	F_u t/cm^2	F_y t/cm^2	F_u t/cm^2
St 44	2.80	4.40	2.55	4.10
St 52	3.60	5.20	3.35	4.90

Maximum Weld Size s (mm)	Minimum Weld Size: Max. $\{t_1$ or $t_2\}$ (mm)	s (mm)
Min. $\{t_1$ or $t_2\}$	≤ 10	≥ 4
	> 10 ~ 20	≥ 5
	> 20 ~ 30	≥ 6
	> 30 ~ 50	≥ 8
	> 50 ~ 100	≥ 10

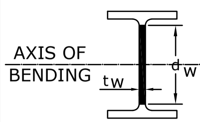


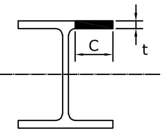
Material	Primary Stresses: Bending F_b t/cm^2	Compression F_c t/cm^2	Allowable Bearing Stress F_{brg} t/cm^2	Allowable Reaction $V = F\,d\,l$ (ton)
1. Rolled Steel: St 44	1.6	1.6	6.5	0.055 $d\,l$
2. Cast Steel: C St 44, C St 55	1.8	1.8	8.5	0.095 $d\,l$
3. Forged Steel: F St 50, F St 56	2.0	2.0	9.5	0.117 $d\,l$

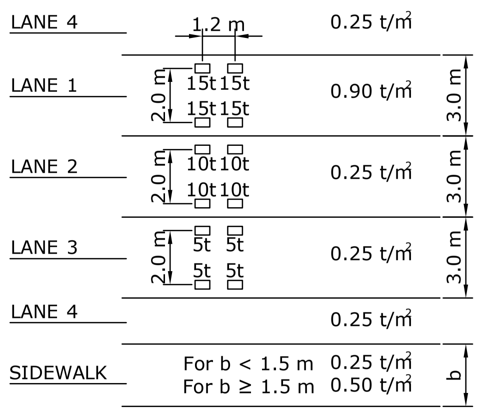
The aforesaid allowable stresses may be exceeded by 20% when the maximum combination of primary and additional stresses is considered.

Allowable Shear Stress q_{all} (t/cm^2) and Buckling Shear Stress q_b (t/cm^2)			
Web Condition	Un-stiffened Webs	Stiffened Webs	
Dimensions			
Aspect Ratio, α	$d_1 = \infty,\ \alpha = \infty$	$\alpha = d_1/d$	
Buckling Factor, k_q	$k_q = 5.34$	$\alpha \le 1.0$: $k_q = 4.00 + \dfrac{5.34}{\alpha^2}$	$\alpha > 1.0$: $k_q = 5.34 + \dfrac{4.00}{\alpha^2}$
Buckling Shear Limit for $\dfrac{d}{t_w}$	$\dfrac{105}{\sqrt{F_y}}$	$45\sqrt{\dfrac{k_q}{F_y}}$	
$\dfrac{d}{t_w}$ > Limit, $\lambda_q = \dfrac{1}{57}\dfrac{d}{t_w}\sqrt{\dfrac{F_y}{k_q}}$; $\lambda_q \le 0.8$	$q_b = q_{all} = 0.35\,F_y$		
$0.8 < \lambda_q < 1.2$	$q_b = (1.5 - 0.625\,\lambda_q) \times 0.35\,F_y$		
$\lambda_q \ge 1.2$	$q_b = \dfrac{0.9}{\lambda_q} \times 0.35\,F_y$		
Reduction of Allowable Bending Stress $F_b = (0.8 - 0.36\,\dfrac{q_{act}}{q_b})\,F_y \le 0.58\,F_y$			

	Web Subjected to Bending		Flange Subjected to Compression	
Compact	$\dfrac{d_w}{t_w} \le \dfrac{127}{\sqrt{F_y}}$	Rolled	$\dfrac{C}{t_f} \le \dfrac{16.9}{\sqrt{F_y}}$	
		Welded	$\dfrac{C}{t_f} \le \dfrac{15.3}{\sqrt{F_y}}$	
Non-Compact	$\dfrac{d_w}{t_w} \le \dfrac{190}{\sqrt{F_y}}$	Rolled	$\dfrac{C}{t_f} \le \dfrac{23}{\sqrt{F_y}}$	
		Welded	$\dfrac{C}{t_f} \le \dfrac{21}{\sqrt{F_y}}$	







Roadway Live Loads