JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2025

M.Tech-II Semester (CE)

COURSE CODE (CREDITS): 11M1WCE133 (3) MAX. MARKS: 25

COURSE NAME: BRIDGE ENGINEERING

COURSE INSTRUCTORS: Dr. KAUSHAL KUMAR MAX. TIME: 1 Hour 30 Min

Note: *(a) All questions are compulsory.*

(b) IRC 6 and IRC 21 and Piqeaud's curve are allowed. Assume values not given.

Q.No	Question	Marks
Q1.	For the design of a slab culvert over an effective span of 7.0 m for the following data are given: • Clear carriageway width: 7.0 m • Width of kerb: 650 mm on either side • Load: IRC Class A • Thickness of wearing coat: 80 mm Material Grades: Use M25 concrete and Fe415 steel ***Calculate the Bending Moment and Shear Force for the design of culvert.***	**10**
Q2.	A T-beam bridge (as shown below) has to be provided across a channel having the following data: • Road: National highway (8.9 m) • Footpath: 650 mm wide on either side • Loading: IRC Class AA (tracked) • Materials: M40 concrete Fe415 steel • No. of longitudinal girders: 3	
a.	For the cantilever slab portion (Figure-2), of the bridge given in Ques. 2 above, **calculate the design moment and design shear** only.	**8**
b.	For the interior panel (Figure-3), of the bridge given in Ques. 2 above, **calculate the design moment and design shear only.** Take moment reduction factor for continuous slab as 0.2 .	**7**

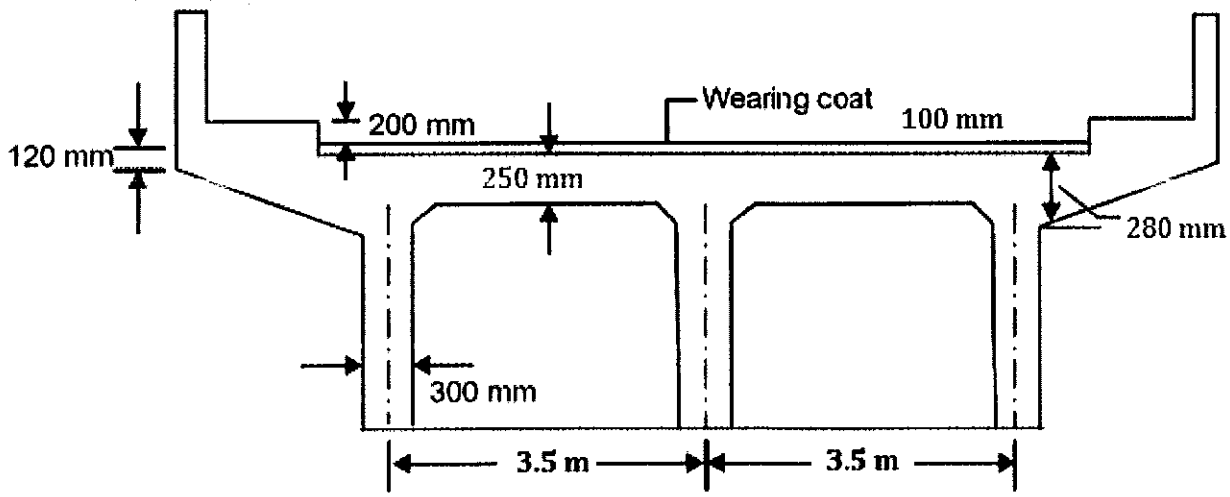


Figure 1 : Cross section of Girder bridge

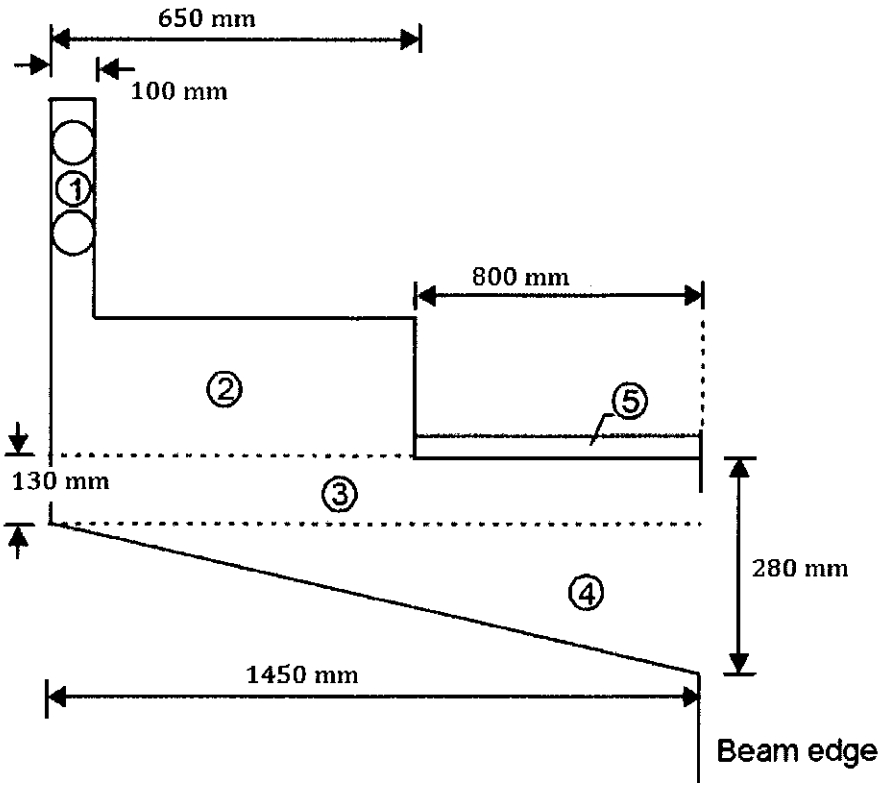


Figure 2 : Cantilever Section of Bridge

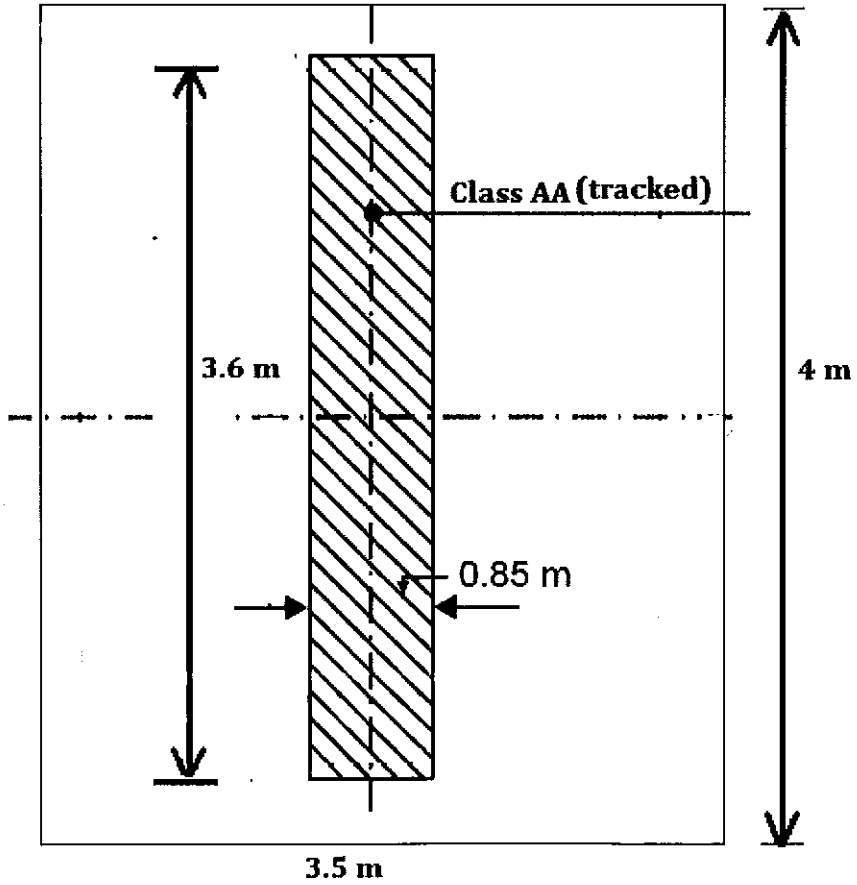


Figure 3 : IRC Class AA load, acting in the interior panel

IRC Class A Loading (IRC 6:2017)

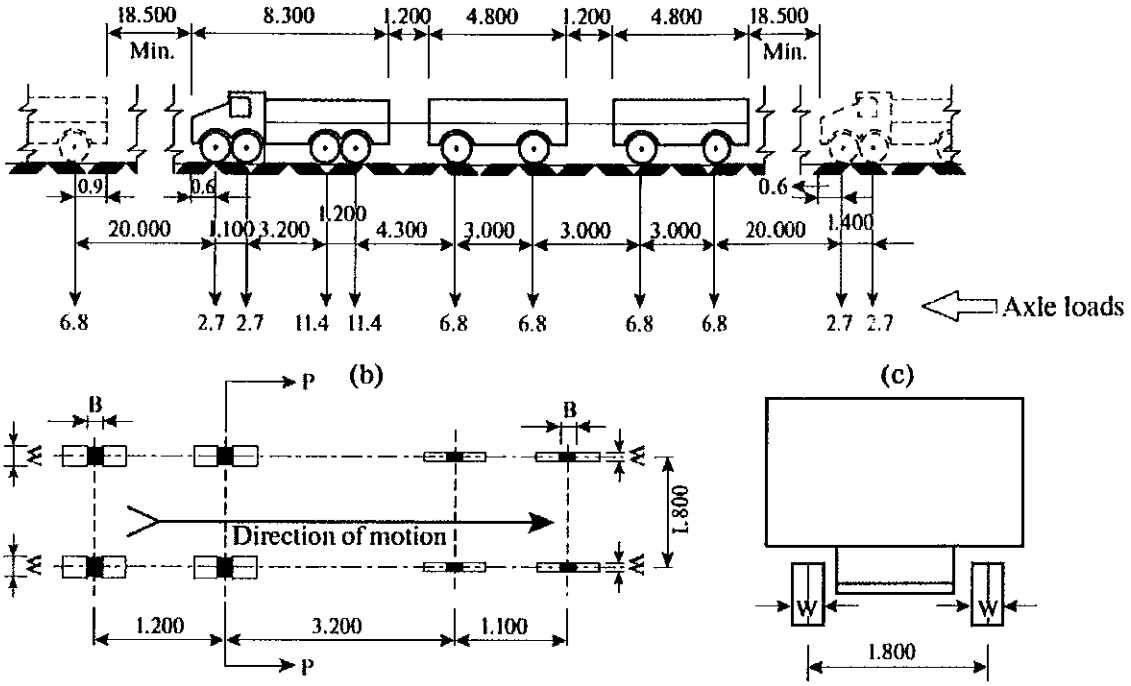


Table 2: Ground Contact Dimensions for Class A Loading

Axle load (tonne)	*Ground contact area*	
	B (mm)	*W (mm)*
11.4	250	500
6.8	200	380
2.7	150	200

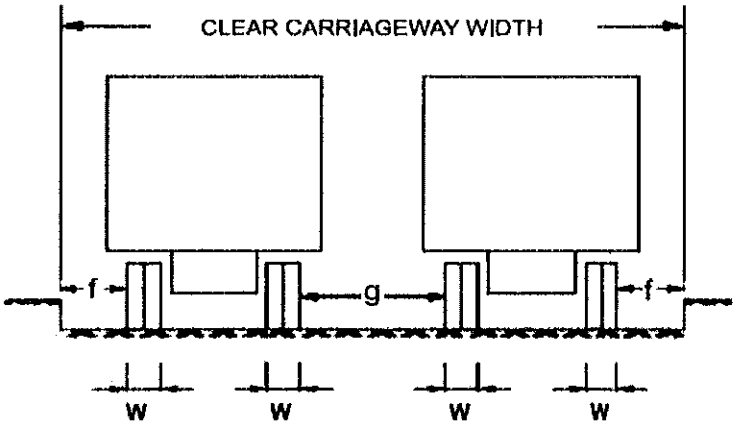


Fig. 3: Minimum Clearance for 2 Class A Train Vehicles

5) *The minimum clearance, f, between outer edge of the wheel and the roadway face of the kerb and the minimum clearance, g, between the outer edges of passing or crossing vehicles on multi-lane bridges shall be as given in* ***Table 3.***

Table 3: Minimum Clearance for Class A Train Vehicle

Clear carriageway width	g	f
5.3 m(*) to 6.1 m(**)	Varying between 0.4 m to 1.2 m	150 mm for all carriageway widths
Above 6.1 m	1.2 m	

204.3 Combination of Live Load

This clause shall be read in conjunction with Clause **104.3** of **IRC:6**. The carriageway live load combination shall be considered for the design as shown in **Table 6** .

Table 6: Live Load Combination

S. No.	Carriageway Width (CW)	Number of Lanes for Design Purposes	Load Combination (Refer Table 6A for diagrammatic representation)
1)	Less than 5.3 m	1	One lane of Class A considered to occupy 2.3 m. The remaining width of carriageway shall be loaded with 500 kg/m^2
2)	5.3 m and above but less than 9.6 m	2	One lane of Class 70R OR two lanes for Class A
3)	9.6 m and above but less than 13.1 m	3	One lane of Class 70R for every two lanes with one lanes of Class A on the remaining lane OR 3 lanes of Class A
4)	13.1 m and above but less than 20.1 m	4	One lane of Class 70R for every two lanes with one lane of Class A for the remaining lanes, if any, OR one lane of Class A for each lane.
5)	16.6 m and above but less than 20.1 m	5	
6)	20.1 m and above but less than 23.6 m	6	

208 IMPACT

208.1 Provision for impact or dynamic action shall be made by an increment of the live load by an impact allowance expressed as a fraction or a percentage of the applied live load.

208.2 For Class A or Class B Loading

In the members of any bridge designed either for Class A or Class B loading (vide Clause **204.1**), this impact percentage shall be determined from the curves indicated in **Fig.9**. The impact fraction shall be determined from the following equations which are applicable for spans between 3 m and 45 m

i) Impact factor fraction for reinforced concrete bridges = $\frac{4.5}{6+L}$

ii) Impact factor fraction for steel bridges = $\frac{9}{13.5+L}$

Where L is length in meters of the span as specified in Clause **208.5**

208.3 For Class AA Loading and Class 70R Loading

The value of the impact percentage shall be taken as follows:-

a) For spans less than 9 m

For tracked vehicles : 25 percent for spans upto 5 m linearly reducing to 10 percent for spans upto 9 m

For wheeled vehicles : 25 Percent

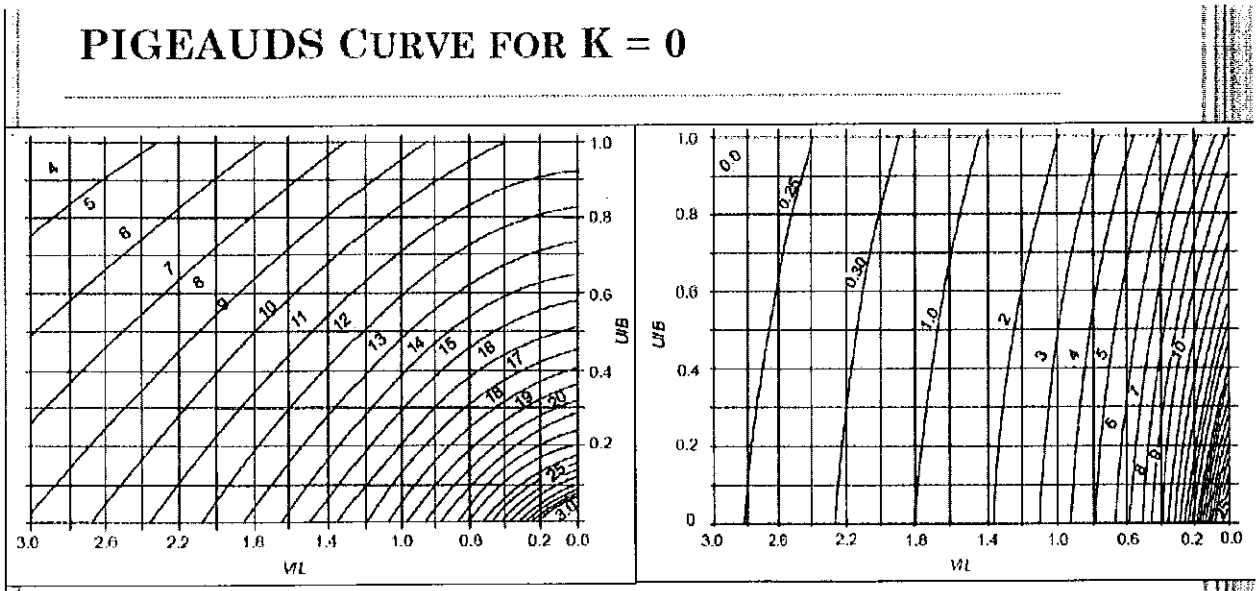
For the Design of Culverts using effective width method

Table 7.1 Values of α for slabs (IRC 21)

B/l	*α for sss**	*α for cs**	*B/l*	*α for sss*	*α for cs*
0.1	0.40	0.40	1.1	2.60	2.28
0.2	0.80	0.80	1.2	2.64	2.36
0.3	1.16	1.16	1.3	2.72	2.40
0.4	1.48	1.44	1.4	2.80	2.48
0.5	1.72	1.68	1.5	2.84	2.48
0.6	1.96	1.84	1.6	2.88	2.52
0.7	2.12	1.96	1.7	2.92	2.56
0.8	2.24	2.08	1.8	2.96	2.60
0.9	2.36	2.16	1.9	3.00	2.60
1.0	2.48	2.24	2.0 and above	3.00	2.60

* sss = simply supported slab, cs = continuous slab

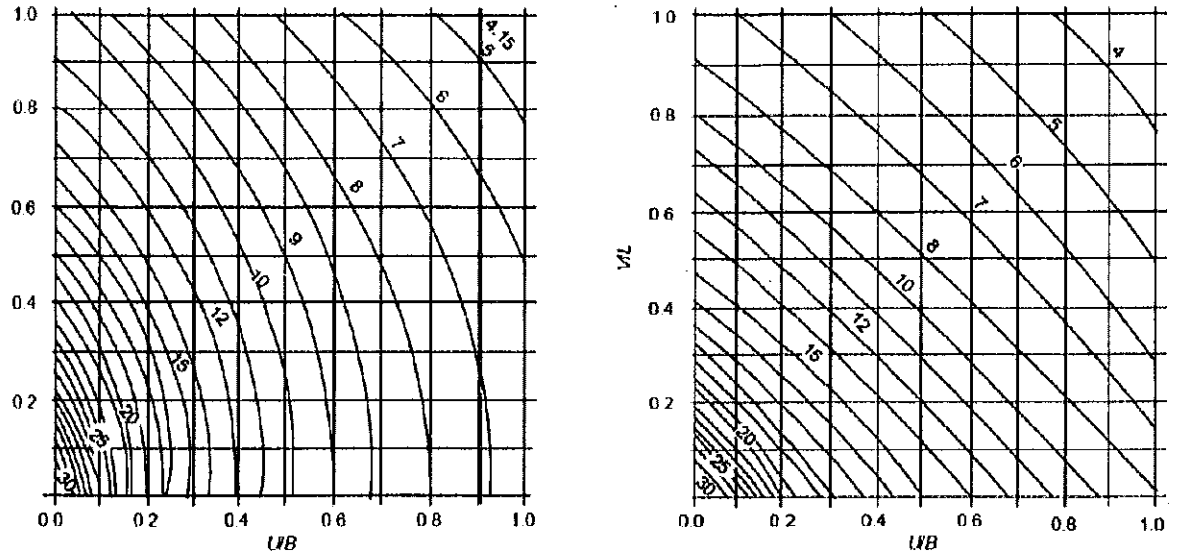
Piqueads Curves for Interior Panel Design



a). Coefficient m1 x 10^(-2) b). Coefficient m2 x 10^(-2)

Moment coefficients m1 and m2 for K = 0

PIGEAUDS CURVE FOR K = 0.9



PIGEAUDS CURVE FOR K = 1