

REINFORCEMENT CALCULATION IN PIER IN LOWER FLARED PORTION
Name Of Work :- Construction of Submersible Bridge on ON KHERWARA - JAWAS - SUVERI ROAD IN KM 9/000, ACROSS RIVER SOM

	R.L.	92.97	M TO	93.57	M			
FOR SERVICE CONDITION								
VERTICAL LOADS								
SUPER STRUCTURE	=		1463.62 kN					
SUB STRUCTURE	=		1726.81 kN			Without Buoyancy		
SUB STRUCTURE	=		1633.44 kN			With Buoyancy		
LIVE LOAD	=		788.27 kN					
Total Load without Buoyancy	=		3978.69 kN					
Total Load with Buoyancy	=		3885.32 kN					
Total LONGITUDINAL MOMENT								
Moment @ R. L.		92.97 M =		296.32 kN-m				
Total TRANSVERSE MOMENT								
Moment @ R. L.		92.97 M =		2394.70 kN-m				
CONCRETE MIX			M-25					
CHARACTERISTIC STRENGTH OF REINFORCEMENT						415 N/mm2		
PERMISSIBLE STRESSES								
IN STEEL			190					
IN CONCRETE								
CHARACTERISTIC STRENGTH OF								
Concrete		fck	=			30 N/mm2		
Permissible Compressive Stress in								
Bending		σcbc	=			8 N/mm2		
Permissible Compressive Stress in Direct								
Compression		σcc	=			8 N/mm2		
		σct	=			3.6 N/mm2		
Ultimate Axial Load P _U	=		1.5 X		3978.69 =	5968.031 kN		
Ultimate Longitudinal Moment M _U	=		1.5 X		296.32 =	444.4776 kN-m		
Ultimate Transverse Moment M _U	=		1.5 X		2394.70 =	3592.051 kN-m		
INCREASE WHEN WIND CONDITION IS CONSIDERED						33.33 %		
Neglecting area of Cut and Ease water parts Rectangular Section considered is								
		12001 mm x		1201 mm				
	Assume cover as	75						
d ¹ /d	=	87.5 /		1201.2 =		0.0728		
P _U /(f _{ck} b d)	=	5968.03 x		1000 / (30 x	12001 x	1201.2)
	=	0.0138						
FOR LONGITUDINAL MOMENT								
Mu/(f _{ck} b d ²)	=	444.48 x		1000000 / (30 x	12001 x	1201.2 ²)
	=	0.0009						

Refer Chart 31 & 32 of Design Aids for Reinforced concrete SP-16 the point lies below the range of applicability. Hence provide minimum percentage of steel.

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CRITERIA 1 FOR MINIMUM STEEL $P_t = 0.8\%$ OF GROSS SECTION AREA OF COLUMN REQUIRED FOR COMPRESSION

$$\begin{aligned}
 \text{Area Required due to Compression} &= \frac{3885.32 \times 1000}{8} \\
 &= 485665 \text{ mm}^2 \\
 \text{Area of steel @ } 0.8\% &= 0.8 \times \frac{485665}{100} \\
 &= 3885 \text{ mm}^2 \\
 \text{CRITERIA 2 FOR MINIMUM STEEL } P_t &= 0.3\% \text{ OF GROSS SECTION AREA OF COLUMN} \\
 \text{Area of steel @ } 0.3\% &= 0.3 \times \frac{12001.2 \times 1201.2}{100} \\
 &= 43248 \text{ mm}^2 \\
 \text{PROVIDE STEEL AREA} &= 43248 \text{ mm}^2 \\
 \text{NO. OF 25 MM BARS} &= 88 \text{ Nos.} \\
 \text{SPACING} &= 290 \text{ MM} \\
 \text{FOR TRANSVERSE MOMENT} &
 \end{aligned}$$

$$\begin{aligned}
 \frac{M_u}{(f_{ck} b d^2)} &= \frac{3592.05 \times 1000000}{12001.2 \times 1201.2^2} \\
 &= 0.0069
 \end{aligned}$$

Refer Chart 31 & 32 of Design Aids for Reinforced concrete SP-16 the point lies below the range of applicability. Hence provide minimum percentage of steel.

TRANSVERSE REINFORCEMENT

Shear Force to be resisted by the pier In Accordance to IS 1893

$$2394.70 / 11.87 = 201.70 \text{ kN}$$

Check for Shear

$$\begin{aligned}
 \text{Nominal Shear Stress} &= \frac{201.70 \times 1000}{12001 \times 1201} \\
 &= 0.01 \text{ N/mm}^2 \\
 P_t &= 0.30
 \end{aligned}$$

$$\text{Permissible Shear Stress} = 0.40 \text{ N/mm}^2 \quad \text{Refer table 61}$$

Nominal Shear Reinforcement will suffice

According to IRC 21-1987 Clause 306.3

$$\begin{aligned}
 \text{Dia of Transverse Reinforcement} &= \frac{25}{4} = 6.25 \text{ mm} \\
 \text{Provide} &= 12 \text{ mm dia rings}
 \end{aligned}$$

Pitch of the Transverse should be least of

$$\begin{aligned}
 \text{a) Least lateral Dimension} &= 1201.2 \text{ mm} \\
 \text{b) } 12 d &= 12 \times 1201.2 = 14414.4 \text{ mm} \\
 \text{c) } 300 \text{ mm} &= 300 \text{ mm} \\
 \text{d) As per IS 13920:1993 Cl. 7.4.6} &< \text{ or } = 100 \text{ mm} \\
 \text{Provide} &= 12 \text{ mm dia rings @ } 100 \text{ mm c/c.}
 \end{aligned}$$

This spacing is in accordance to IS 13920:1993 Cl. 7.4.6

CODE OF PRACTICE FOR DUCTILE DETAILING OF REINFORCED CONCRETE STRUCTURES SUBJECTED TO SEISMIC FORCES

Check for Size of Hoop Reinforcement

Refer IS 13920:1993 Cl. 7.4.8

$$A_{sh} = 0.18 S_h (F_{ck}/F_y) \times (A_g/A_k - 1)$$

S	=	100.00	mm	
h	=	300.00	N/mm ²	(Spacing of long. bars+ effective cover) or 300 mm whichever is less
F _{ck}	=	30.00	N/mm ²	Cover 75 mm to main reinforcement
F _y	=	415.00	N/mm ²	
A _g	=	1201.20	mm ²	Considering 1 mm Wide Pier
A _k	=	1100.20	mm ²	Considering 1 mm Wide Pier Effective
Hence A _{sh}	=	35.84	mm ²	
A _{sh} ProvideD	=	113.04	mm ²	Which is OK
d) As per IS IS 13920:1993 Cl. 7.4.6	< or =	100	mm	
Provide		12 mm dia rings @		100 mm c/c.

This spacing is in accordance to IS 13920:1993 Cl. 7.4.6

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ABSTRACT

LONGITUDINAL REINFORCEMENT

25

MM BARS

290

MM

However Adopt spacing as 250 mm

TRANSVERSE REINFORCEMENT

12mm dia rings @100mm c/c.