Scheme Of Evaluation

Internal Assessment Test 1 – March 2019

Sub:	Design of steel structures							**Code:**	15CV62
Date:		Duration:	90mins	Max Marks:	50	**Sem:**	III	**Branch:**	ISE

Note: Answer ALL TWO Questions

Question #		**Description**	**Marks Distribution**		**Max Marks**
1	a)	**Explain difference between working stress design and limit state design of steel structures.** Working stress design- Explanation Philosophy Limit state design of steel structures- Limit state of strength; and Limit state of serviceability.	2M 2M 2M 2M	08 M	25 M
	b)	**Explain the terms plastic hinge, plastic moment, shape factor and collapse mechanism.** Plastic Hinge- The cross section is not capable of resisting any additional moment but may maintain this moment for some amount of rotation in which case it acts like a plastic hinge. Plastic Moment- As the load continues to increase, more and more fibers reach the yield stress and the stress distribution is as. Eventually the whole of the cross section reaches the yield stress and the corresponding stress distribution. The moment corresponding to this state is known as the plastic moment of the cross section and is denoted by Mp. In order to find out the fully plastic moment of a yielded section of a beam, we employ the force equilibrium equation, namely the total force in compression and the total force in tension over that section Shape Factor- The bending moment at any section of the structure should not be more than the fully plastic moment of the section. The ratio of the plastic moment to the yield moment Collapse Mechanism- When a system of loads is applied to an elastic body, it will deform and will show a resistance against deformation. Such a body is known as a structure. On the other hand if no resistance is set up against deformation in the body, then it is known as a mechanism	1M 1M 1M 1M	04 M	
	c)	**Design a bolted connection for lap joint of plate thickness of 10mm and 12mm to carry a service load of 100kN. Use M16 4.6 grade bolt. Give the details with neat sketch.** $V_{dsb} = V_{nsb}/1.25$ $V_{nsb} = 47.8kN$ $V_{dsb} = 38kN$ $V_{dpb} = V_{npb}/1.25$ $V_{dpb} = 92kN$ No. of bolts =load /design capacity = 100/38 = 3 No.	5M 6M 2M	13 M	
2	a)	**Explain the various modes of failure of bolted connection with neat sketch.** **Shear failure of bolts** The shear stress in the bolt may exceed the working shear stress in the bolt. Shear stresses are generated because the plates slip due to applied forces. **Shear failure of plates** The internal pressure of overdriven (shank length more than the grip) bolts placed at a lesser edge distance than specified causes this failure. This can be checked by providing proper edge distance between the center of the hole and the end of the plate as specified by I.S.800. **Tension or tearing failure of plates** The tensile stress in the plate at the net cross-section may exceed the working tensile stress. Tearing failure occurs when bolts are stronger than the plates. **Splitting of plates** Bolts may have been placed at a lesser edge distance than required causing the plates to split or shear out.	1M each	08 M	25 M

Bearing failure of plates

The plate may be crushed when the bearing stress in the plate exceeds the working bearing stress.

Bearing failure of bolts

The bolt is crushed around the half circumference. The plate may be strong in bearing and the heaviest stressed plate may press the bolt.

2M

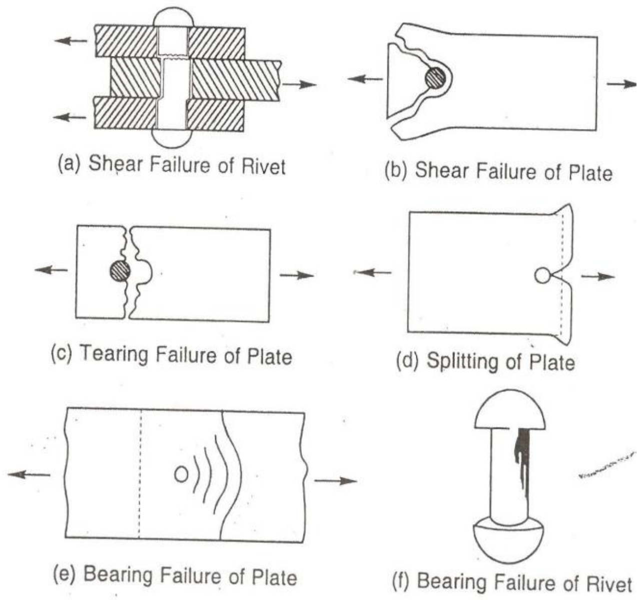

Fig. 2.3 Failure of Riveted Joints

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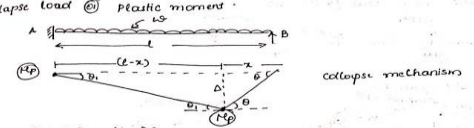
b) **Find out the collapse load for a propped cantilever subjected to uniformly distributed load/unit length. The palstoc capacity of the beam is M_p** — 07 M

Q.3. Propped cantilever

A beam of span 'l' subjected to UDL throughout, determine collapse load or plastic moment.



$\Delta = x\theta = (l-x)\theta_1$

$\boxed{\theta = \left(\frac{l-x}{x}\right)\theta_1}$

External work done = (load) (Area below the load)

EWD $= w \times \frac{1}{2} \times l \times \Delta = \frac{wl}{2} \times (l-x)\theta_1$ —— ①

3M

Internal work done $= M_p \times$ Rotation

IWD $= M_p\theta_1 + M_p(\theta + \theta_1)$

$= M_p\theta + 2M_p\theta_1$

$= M_p\left(\frac{l-x}{x}\right)\theta_1 + 2M_p\theta_1$

$= M_p\theta_1\left[\frac{l-x}{x} + 2\right]$

$= M_p\theta_1\left[\frac{l+x}{x}\right]$

Equating EWD = IWD.

$\frac{wl}{2}(l-x)\theta_1 = M_p\theta_1\left(\frac{l+x}{x}\right)$

3M

$M_p = \frac{wl(l-x)x}{2(l+x)}$

$\boxed{M_p = \frac{wl}{2} \times \frac{(l-x)x}{l+x}} = \frac{wl}{2} \times \frac{lx - x^2}{l+x}$

For maximum moment. $\frac{\partial M_p}{\partial x} = 0. = \frac{wl}{2}\left[\frac{(l+x)(l-2x)-(lx-x^2)}{(l+x)^2}\right]$

01M

On solving $\longrightarrow$ $M_p = 0.0857\, w_c l$

$\boxed{w_c = \frac{11.65\, M_p}{l}}$

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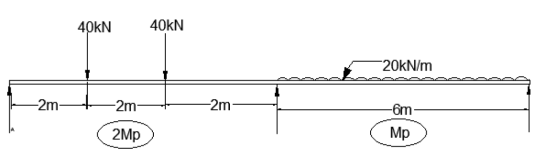
c) **Analyse the continuous beam shown in the fig below. Calculate the maximum plastic moment. Take the load factor as 1.5** — 10 M



EWD= 360 θ_1

IWD = 7M_p θ_1

		EWD = IWD **M_p= 51.42kN-m** **EWD= 360** θ_1 **IWD = 7M_p** θ_1 **EWD = IWD** **M_p= 51.42kN-m** **W_c=11.656 M_p/L** **M_p = 92.65 kN-m**	4M 4M 2M		