

What is Structural Analysis?

Worksheet

Structural analysis calculates the reactions, internal forces and stresses in a structure under load, using equilibrium equations ($F=0$, $M=0$) to keep it safe and stable.

Questions

1. For a simply supported beam with a single point load, what equations find the reactions?
A) $F=0$ and $M=0$
B) $F=ma$
C) $PV=nRT$
D) $E=mc$
2. A beam is called statically determinate when
A) it has more unknowns than equations
B) reactions can be found from equilibrium alone
C) it always fails
D) it has no supports
3. In $R = P(La)/L$, increasing 'a' (moving the load toward the right support) does what to R?
A) Increases R
B) Decreases R
C) No effect
D) Reverses direction
4. Which is NOT typically considered a structural load?
A) Dead load
B) Live load
C) Paint color
D) Wind load
5. A simply supported beam spans 8 m with a 20 kN point load placed 3 m from the left support. Find both reactions.
6. A cantilever beam of length 4 m carries a 10 kN load at its free end. Find the fixed-end reaction and moment.
7. A truss joint carries a 15 kN downward load balanced by a diagonal member on a 3-4-5 triangle (3 horizontal, 4 vertical, 5 hypotenuse). Find the member's axial force and horizontal component.
8. Define: What is structural analysis?
9. Define: What are the two basic equilibrium equations?
10. Define: Determinate vs indeterminate structure?

Answer Key

1. A) $F=0$ and $M=0$ - Static equilibrium ($F=0$, $M=0$) gives the two reaction unknowns.
2. B) reactions can be found from equilibrium alone - Determinate structures need only the 3 equilibrium equations to solve reactions.
3. B) Decreases R - As a increases, (L_a) shrinks, so R decreases - weight shifts toward R.
4. C) Paint color - Paint color is architectural, not a structural load.
5. $R = P(L_a)/L = 20(83)/8 = 12.5$ kN $R = P_a/L = 203/8 = 7.5$ kN Check: $R+R = 12.5+7.5 = 20$ kN = P
6. Vertical reaction: $R = P = 10$ kN Fixed-end moment: $M = PL = 104 = 40$ kNm
7. Vertical component must balance the load: $F(4/5) = 15$ kN $F = 155/4 = 18.75$ kN Horizontal component = $F(3/5) = 18.753/5 = 11.25$ kN
8. The process of calculating reactions, internal forces and stresses in a structure under load.
9. $F = 0$ (sum of forces) and $M = 0$ (sum of moments) about any point.
10. Determinate: reactions solvable by equilibrium alone. Indeterminate: needs extra compatibility equations.

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