

Internal Loadings Cheat Sheet

Method, sign conventions and 20 worked answers

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
Method	Reactions → cut member → $\Sigma F = 0$, $\Sigma M = 0$ on one piece	Check with the other piece
Equilibrium	$\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M = 0$	
Shear-load relation	$dV/dx = -w$	Slope of V is minus the distributed load
Moment-shear relation	$dM/dx = V$	Peak M where $V = 0$
Shaft torque from power	$T = P / \omega$, $\omega = 2\pi n / 60$	n in rpm, ω in rad/s
Stress link	$\sigma = N/A$, $\sigma = M y / I$, $\tau = T \rho / J$	Loadings feed the stress formulas

Key takeaways

- Sign conventions (as the article states them): N positive in tension; V positive when it pushes the cut's left face up; M positive for sagging; T by the right-hand rule, thumb pointing away from the cut.
- The 20 problems cover reactions (1–3), axial force (4–6), torque (7–9), shear and moment (10–14), and frames and machine members (15–20).

Selected answers reported in the article

Problem	Result
2 Simply supported beam	$R_A = 18.38 \text{ kN}$, $R_B = 19.62 \text{ kN}$
7 Four-gear shaft	$T_{AB} = 800$, $T_{BC} = 500$, $T_{CD} = 150 \text{ N}\cdot\text{m}$
9 Motor torque at 1,200 rpm	238.7 and 143.2 N·m
10 Point-load beam, $x = 2 \text{ m}$	$V = 14.4 \text{ kN}$, $M = 28.8 \text{ kN}\cdot\text{m}$
12 Cantilever, wall reactions	55 kN and 175 kN·m
16 Locking pliers	Grip force 200 N
20 C-clamp frame	$N = 1,200 \text{ N (T)}$, $M = 96 \text{ N}\cdot\text{m}$