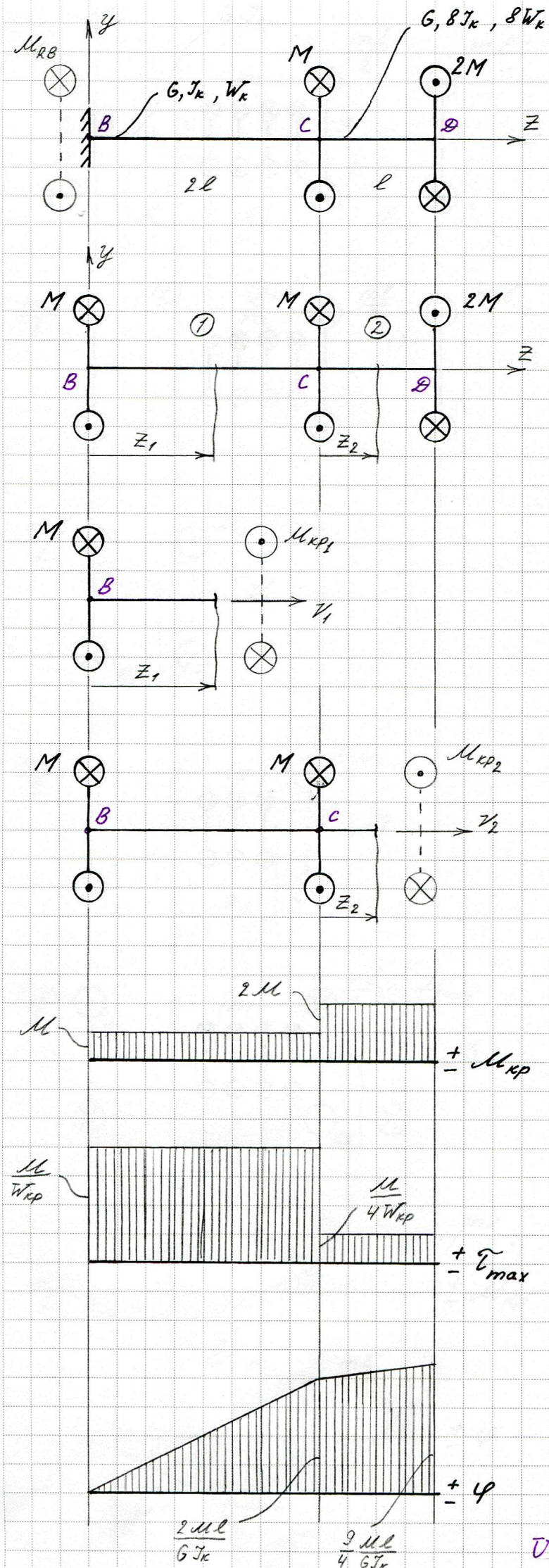

Дано: $ℓ, M, G, J_к, W_к$

Найти: $M_{кр}, \tau_{max}, \varphi, A, U$

$$\sum M_z = 0 = -M_{RB} - M + 2M$$

$$M_{RB} = M$$

$$\sum M_{y_1} = 0 = -M + M_{кр1} \Rightarrow M_{кр1} = M$$

$$\sum M_{y_2} = 0 = -M - M + M_{кр2} \Rightarrow M_{кр2} = 2M$$

$$\tau_{max_1} = \frac{M_{кр1}}{W_{кр1}} = \frac{M}{W_к}$$

$$\tau_{max_2} = \frac{M_{кр2}}{W_{к2}} = \frac{2M}{8 \cdot W_к} = \frac{M}{4W_к}$$

$$\varphi_1 = \varphi_0^{кон} + \int_0^{z_1} \frac{M_{кр1}\,dz_1}{G_1 J_{к1}} = \int_0^{z_1} \frac{M \cdot dz_1}{GJ_к} =$$

$$= \frac{M}{GJ_к} z_1$$

$$z_1 = 0: \quad \varphi_1^{нач.} = 0$$

$$z_1 = 2ℓ: \quad \varphi_1^{кон.} = \frac{2Mℓ}{GJ_к} = \frac{8M}{4GJ}$$

$$\varphi_2 = \varphi_1^{кон} + \int_0^{z_2} \frac{M_{кр2} \cdot dz_2}{G_2 \cdot J_{к2}} =$$

$$= \frac{2Mℓ}{GJ_к} + \int_0^{z_2} \frac{2M \cdot dz_2}{8GJ_к} = \frac{2Mℓ}{GJ_к} + \frac{M \cdot z_2}{4GJ_к}$$

$$z_2 = 0: \quad \varphi_2^{нач.} = \frac{2Mℓ}{GJ_к}$$

$$z_2 = ℓ: \quad \varphi_2^{кон} = \frac{9}{4} \cdot \frac{Mℓ}{GJ_к}$$

$$A = \underbrace{\frac{1}{2}(M)0}_{M_B\ \varphi_B} + \underbrace{\frac{1}{2}(-M)\frac{2Mℓ}{GJ_к}}_{M_C\ \varphi_C} + \underbrace{\frac{1}{2}2M\frac{9}{4}\frac{Mℓ}{GJ_к}}_{M_D\ \varphi_D} = \frac{5}{4}\frac{M^2ℓ}{GJ_к}$$

$$U = \frac{M^2 2ℓ}{2GJ_к} + \frac{(2M)^2 ℓ}{2G8J_к} = \frac{5}{4}\frac{M^2ℓ}{GJ_к}$$

$A = U$