

d) At Support B ($M = 35 \times 10^6$ - Hogging moment)

(P3)

Ultimate moment of resistance,

$$M_u = 0.156 f_{cu} b d^2 = 0.156 \times 30 \times 250 \times 456^2 \\ = 243 \text{ kNm}$$

$M_u > M$, NO compression steel is required

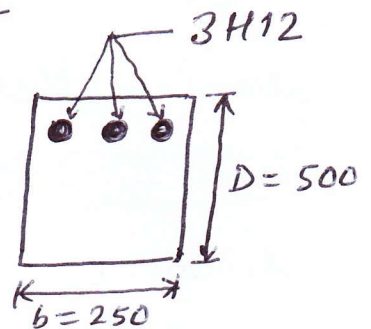
$$k = \frac{M}{f_{cu} b d^2} = \frac{35 \times 10^6}{30 \times 250 \times 456^2} = 0.0224$$

$$z = 456 \left[0.5 + \sqrt{0.25 - 0.0224/0.9} \right] = 444 \text{ mm but,}$$

$$z \leq 0.95d \leq 433 \text{ mm}$$

$$\text{Area of Steel, } A_s = \frac{35 \times 10^6}{0.87 \times 400 \times 433} = 232 \text{ mm}^2$$

Provide 3 H12 ($A_s = 339 \text{ mm}^2$) on top fibre



e) At Support C

$$M = 32 \times 10^6 \text{ (Hogging moment)}$$

Area of Steel same as 3a above.

$$A_s = 212 \text{ mm}^2$$

Provide 2 H12 ($A_s = 226 \text{ mm}^2$) on top fibre

Note: Since bending moment is zero at end supports A and D, 50% of the bars are curtailed near these supports. The curtailment lengths will be adopted in accordance of simplified rules for beams in clause 3.12.10.2 of BS8110.