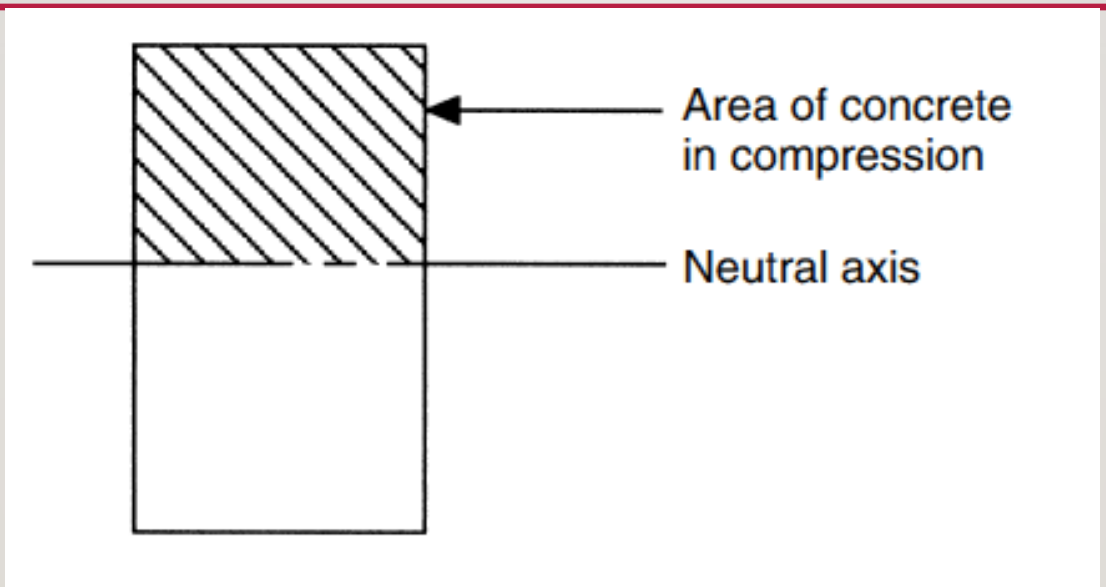
DOUBLY REINFORCED BEAM DESIGN

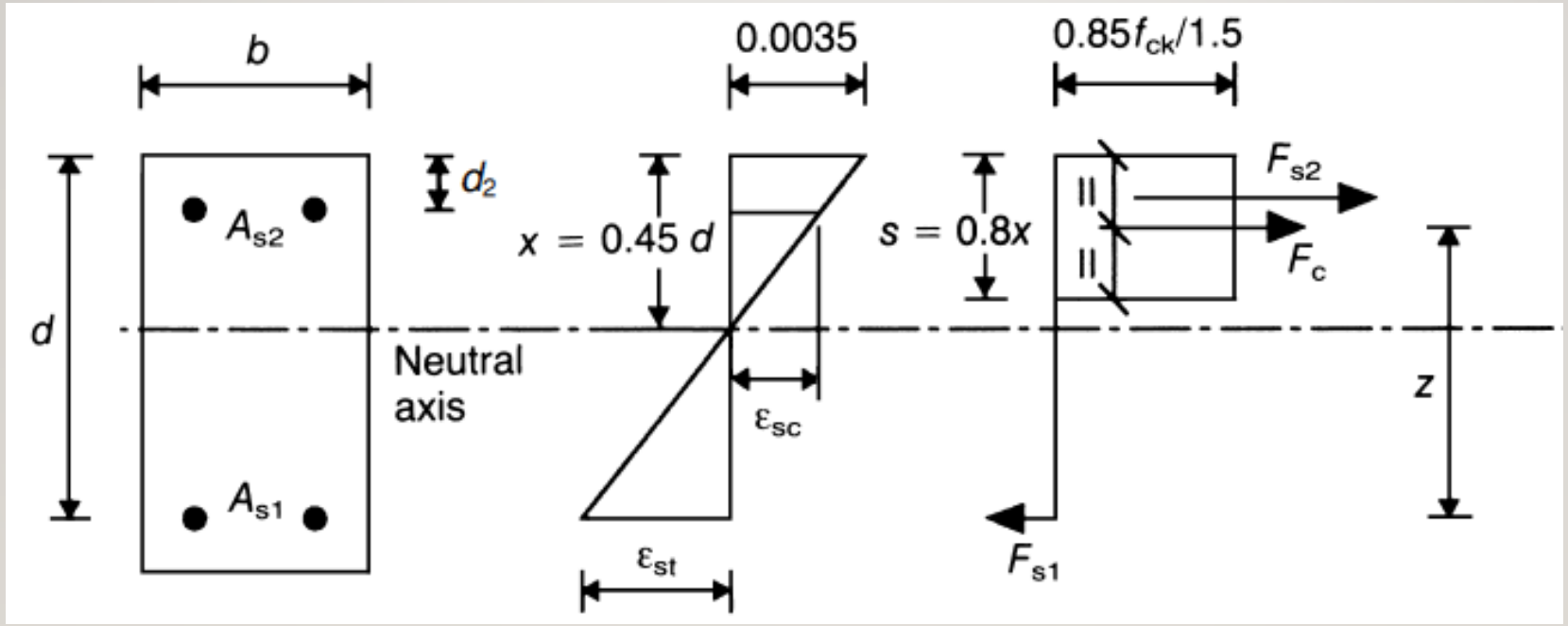
DOUBLY REINFORCED BEAMS



IF $M_{Ed} > M_{Rd}$ THE COMPRESSIVE STRESS IN THE CONCRETE WILL EXCEED THE PERMISSIBLE STRESS LEADING TO AN OVER-REINFORCED FAILURE. THIS CAN BE AVOIDED BY

- INCREASING f_{ck}, b, d
- INTRODUCING COMPRESSION STEEL

DOUBLY REINFORCED SECTION: STRAIN DISTRIBUTION AND STRESS BLOCK



REINFORCEMENT AREAS

AREA OF COMPRESSION STEEL, A_{S2}

$$A_{S2} = \frac{M - M_{Rd}}{0.87 f_y (d - d_2)}$$

AREA OF TENSION STEEL, A_{S1}

$$A_{S1} = \frac{M_{Rd}}{0.87 f_y z} + A_{S2}$$

Where

z = d[0.5 + √(0.25 – 3K/3.4)]

K = 0.167

ASSUMPTIONS

DERIVATION ASSUMES THAT THE COMPRESSION STEEL HAS YIELDED

i.e. DESIGN STRESS = 0.87fy

CHECK

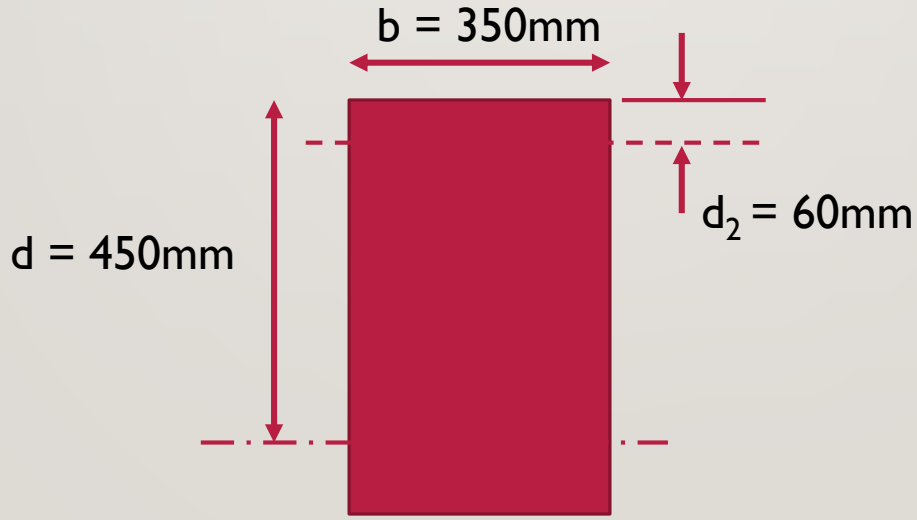
$$\frac{d_2}{x} \leq 0.38$$

WHERE

$$x = \frac{d - z}{0.4}$$

EXAMPLE – DOUBLY REINFORCED BEAM

Determine the reinforcement required for the section shown below assuming f_{ck} = 30 N/mm^2 and f_{yk} = 500 N/mm^2, d = 450 mm and d_2 = 60 mm to resist a design moment of 400 kNm.



Bar size (mm)	Number of bars									
	1	2	3	4	5	6	7	8	9	10
6 8 10	28.3 50.3 78.5	56.6 101 157	84.9 151 236	113 201 314	142 252 393	170 302 471	198 352 550	226 402 628	255 453 707	283 503 785
12 16 20	113 201 314	226 402 628	339 603 943	452 804 1260	566 1010 1570	679 1210 1890	792 1410 2200	905 1610 2510	1020 1810 2830	1130 2010 3140
25 32 40	491 804 1260	982 1610 2510	1470 2410 3770	1960 3220 5030	2450 4020 6280	2950 4830 7540	3440 5630 8800	3930 6430 10100	4420 7240 11300	4910 8040 12600