LET'S ASSUME THAT M_{Ed} IS HIGHER

$M_{Ed} = 1000\ kNm$

$$S_c = \frac{M_{Ed}}{f_{cd} \cdot b \cdot d^2} = \frac{1000 \cdot 10^6}{17 \cdot 400 \cdot 550} = 0.4861$$

$$\zeta_{eff} = 1 - \sqrt{1 - 2S_c} = 1 - \sqrt{1 - 2 \cdot 0.4861} = 0.8335$$

$\zeta_{eff} = 0.8335 \geq \zeta_{eff,lim} = 0.493$ – DOUBLY REINFORCED SECTION

$$A_{s,1} = \frac{f_{cd} \cdot b \cdot \zeta_{eff,lim} \cdot d}{f_{yd}} = \frac{17 \cdot 400 \cdot 0.493 \cdot 550}{434,78} = 4245\ mm^2$$

BOTTOM REINFORCEMENT FOR FULL HEIGHT OF COMPRESSION ZONE

$$M'_{sd} = f_{cd} \cdot b \cdot \zeta_{eff,lim} \cdot d \cdot \left(d - \frac{\zeta_{eff,lim} \cdot d}{2}\right) =$$

$$= 17 \cdot 400 \cdot 0.493 \cdot 550 \cdot \left(550 - \frac{0.493 \cdot 550}{2}\right) = 764\ kNm$$

MAXIMUM CAPACITY FOR FULL HEIGHT OF COMPRESSION ZONE

$$A''_{s1} = A_{s2} = \frac{\Delta M_{sd}}{f_{yd}(d - a_2)} = \frac{(1000 - 764) \cdot 10^6}{434,78 (550 - 50)} = 1085\ mm^2$$

REQUIRED AMOUNT OF COMPRESSION REINFORCEMENT

$$A_s = A_{s1} + A_{s2} = 4245 + 1085 = 5330\ mm^2$$

REQUIRED AMOUNT OF TENSILE REINFORCEMENT

ASSUMED $8\phi32$ $(6432\ mm^2)$ BOTTOM
$4\phi20$ $(1257\ mm^2)$ TOP $\leq A_{s,max} = 9600\ mm^2$

$$A_{s,max} = 0.04 A_c = 0.04 \cdot 400 \cdot 600 = 9600\ mm^2$$ [..., P. 9.2.1]

MAXIMUM REINFORCEMENT