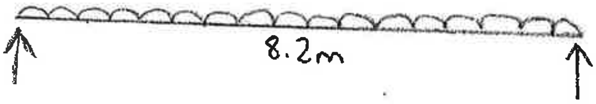
JACOBS **CALCULATION SHEET**

Office	Page No.		Cont'n Page No.	
Job No. & Title	Originator		Date	
Section	Checker		Date	

Task 2

$w = 12\ kNm^{-1}$

dead load $= 12\ kNm^{-1}$
live load $= 10\ kNm^{-1}$



Concrete section size

try $h = 600mm$, $b = 300mm$, $d = 547mm$

using $K = \frac{M}{bd^2 f_c}$

where $M = \frac{WL}{8}$

$= \frac{((12 \times 1.4 + 10 \times 1.6) \times 8.2) \times 8.2}{8}$

$M = 275.7\ kNm$

$K = \frac{275.7 \times 10^6\ Nmm}{300mm \times 547^2 mm \times 30 N/mm^2}$

$K = 0.102$ which is < 0.156

$\therefore$ Use $h = 600mm$, $b = 300mm$, $d = 547mm$

Lever arm (z)

$z = d\left(0.5 + \sqrt{0.25 - \frac{K}{0.9}}\right)$

$= 547\left(0.5 + \sqrt{0.25 - \frac{0.102}{0.9}}\right)$

$= 547\,(0.5 + 0.37)$

$z = 476\ mm$

Area of steel

$A_s = \frac{M}{0.87 f_y z}$ $\qquad$ f_y for high yield steel = $500 N/mm^2$

$= \frac{275.7 \times 10^6 Nmm}{0.87 \times 500 N/mm^2 \times 476 mm}$

$A_s = 1331 mm^2$ $\quad \therefore$ Use 3no. 25mm ø bars ($1474 mm^2$)
(From handout)

Checking % of steel

$= \frac{\text{Area steel}}{\text{Area concrete}} \times 100\%$

$= \frac{1474 mm^2}{300mm \times 600mm} \times 100\%$

$= 0.82\%$

Max amount of steel = 4%
Min amount of high yield steel = 0.12% $\quad \therefore$ 0.82% is OK

Check deflection

Span = 8.2m

BS 5950 states that the span to depth ratio of not more than 20

$\frac{8200mm}{547mm}$
$= 15 \quad \therefore$ OK

Modification factor

Service stress $= \frac{5}{8} f_y \frac{A_{st} \text{ required}}{A_{st} \text{ provided}}$

$= \frac{5 \times 500 \frac{N}{mm^2}}{8} \times \frac{1331 mm^2}{1474 mm^2}$

$= 282 N/mm^2$

JACOBS **CALCULATION SHEET**

Office		Page No.		Cont'n Page No.	
Job No. & Title		Originator		Date	
Section		Checker		Date	

$$\frac{M}{bd^2} = \frac{275.7 \times 10^6 \,Nmm}{300mm \times 547^2 mm}$$

$$= 3.1 \frac{N}{mm^2}$$

Modification factor from table = 1.03

$\therefore$ allowable $\frac{span}{depth}$ ratio = $20 \times 1.03 = 20.6$

actual $\frac{8200mm}{547m}$ ratio = 15 $\therefore$ OK

<u>Shear (ULS)</u>

Ultimate design shear force = ~~[illegible]~~ 90.2 kN

<u>Compressive failure in concrete</u>

design shear stress $v = \frac{V}{bd}$

$$= \frac{90.2 kN}{300mm \times 547mm}$$

$$= 0.55 \, N/mm^2$$

must be less than $0.8\sqrt{f_{cu}}$ and never more than $5 \, N/mm^2$

$$0.8\sqrt{f_{cu}} = 0.8\sqrt{30 \, N/mm^2}$$
$$= 4.38 \, N/mm^2$$

$0.55 \, N/mm^2 < 4.38 \, N/mm^2$ $\therefore$ no concrete compression failure

<u>Shear reinforcement Clinks)</u>

$$A_{sv} = \frac{b s_v (v - v_c)}{0.87 f_{yv}}$$

To calculate v_c

$$= \frac{100 A_s}{bd}$$

$$= \frac{100 \times 1747 mm^2}{300mm \times 547mm}$$

$$= 1.06 \, N/mm^2$$

JACOBS

CALCULATION SHEET

Office	Page No.		Cont'n Page No.	
Job No. & Title	Originator		Date	
Section	Checker		Date	

$$\frac{A_{sv}}{s_v} = \frac{0.4 \times b}{0.95 f_{yv}}$$

$$= \frac{0.4 \times 300}{0.95 \times 500}$$

$$\frac{A_{sv}}{s_v} = 0.25$$

$\therefore$ <u>use 8mm Ø at 300mm spacing</u> - from BS 8110 table 3.12