

Centroid of loads

$$x_{bar} = \Sigma \text{Moment} / \Sigma \text{UDL} = 87 \text{ mm}$$

Initially assume no moment transferred into slab due to load/reaction eccentricitySum of unfactored longitud'l and eff'tive line loads $\Sigma \text{UDLsls} = 7.0 \text{ kN/m}$

Allowable bearing width

$$b_{allow} = 2 \times x_{bar} + 2 \times h_{coreslab} \times \tan(30) = 348 \text{ mm}$$

Bearing pressure due to line/point loads

$$q_{linepoint} = \Sigma \text{UDLsls} / b_{allow} = 20.1 \text{ kN/m}^2$$

Total applied bearing pressure

$$q_{edge} = q_{linepoint} + w_{udledge} = 39.3 \text{ kN/m}^2$$

PASS - $q_{edge} \leq q_{allow}$ - Allowable bearing pressure is not exceeded**Edge beam bending check**

Divider for moments due to udl's

$$\beta_{udl} = 10.0$$

Applied bending moments

Span of edge beam

$$l_{edge} = \phi_{depth} + d_{edgetop} = 1602 \text{ mm}$$

Ultimate self weight udl

$$w_{edgeult} = 1.4 \times w_{edge} = 4.9 \text{ kN/m}$$

Ultimate slab udl (approx)

$$w_{edgeslab} = \max(0 \text{ kN/m}, 1.4 \times w_{slab} \times ((\phi_{depth}/2 \times 3/4) - (b_{edge} + (h_{edge} - h_{slab})/\tan(\alpha_{edge}))))$$

$$w_{edgeslab} = 0.6 \text{ kN/m}$$

Self weight and slab bending moment

$$M_{edgesw} = (w_{edgeult} + w_{edgeslab}) \times l_{edge}^2 / \beta_{udl} = 1.4 \text{ kNm}$$

Self weight shear force

$$V_{edgesw} = (w_{edgeult} + w_{edgeslab}) \times l_{edge} / 2 = 4.4 \text{ kN}$$

Moments due to applied uniformly distributed loads

Ultimate udl (approx)

$$w_{edgeudl} = w_{udlult} \times \phi_{depth} / 2 \times 3/4 = 7.6 \text{ kN/m}$$

Bending moment

$$M_{edgeudl} = w_{edgeudl} \times l_{edge}^2 / \beta_{udl} = 1.9 \text{ kNm}$$

Shear force

$$V_{edgeudl} = w_{edgeudl} \times l_{edge} / 2 = 6.1 \text{ kN}$$

Moment and shear due to load number 1

Bending moment

$$M_{edge1} = w_{ultedge1} \times l_{edge}^2 / \beta_{udl} = 2.6 \text{ kNm}$$

Shear force

$$V_{edge1} = w_{ultedge1} \times l_{edge} / 2 = 8.2 \text{ kN}$$

Resultant moments and shears

Total moment (hogging and sagging)

$$M_{\Sigma edge} = 6.0 \text{ kNm}$$

Maximum shear force

$$V_{\Sigma edge} = 18.6 \text{ kN}$$

Reinforcement required in top

Width of section in compression zone

$$b_{edgetop} = b_{edge} + b_{boot} = 475 \text{ mm}$$

Average web width

$$b_w = b_{edge} + (h_{edge} / \tan(\alpha_{edge})) / 2 = 387 \text{ mm}$$

K factor

$$K_{edgetop} = M_{\Sigma edge} / (f_{cu} \times b_{edgetop} \times d_{edgetop}^2) = 0.006$$

Lever arm

$$Z_{edgetop} = d_{edgetop} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{edgetop}/0.9)}) = 239 \text{ mm}$$

Area of steel required for bending

$$A_{sedgetopbend} = M_{\Sigma edge} / ((1.0/\gamma_s) \times f_y \times Z_{edgetop}) = 57 \text{ mm}^2$$

Minimum area of steel required

$$A_{sedgetopmin} = 0.0013 \times 1.0 \times b_w \times h_{edge} = 151 \text{ mm}^2$$

Area of steel required

$$A_{sedgetopreq} = \max(A_{sedgetopbend}, A_{sedgetopmin}) = 151 \text{ mm}^2$$

PASS - $A_{sedgetopreq} \leq A_{sedgetop}$ - Area of reinforcement provided in top of edge beams is adequate**Reinforcement required in bottom**

Width of section in compression zone

$$b_{edgebtm} = b_{edge} + (h_{edge} - h_{slab}) / \tan(\alpha_{edge}) + 0.1 \times l_{edge} = 547 \text{ mm}$$

K factor

$$K_{edgebtm} = M_{\Sigma edge} / (f_{cu} \times b_{edgebtm} \times d_{edgebtm}^2) = 0.005$$

Lever arm

$$Z_{edgebtm} = d_{edgebtm} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{edgebtm}/0.9)}) = 235 \text{ mm}$$

Area of steel required for bending

$$A_{sedgetmbend} = M_{\Sigma edge} / ((1.0/\gamma_s) \times f_y \times Z_{edgebtm}) = 58 \text{ mm}^2$$

Minimum area of steel required

$$A_{sedgetmbmin} = 0.0013 \times 1.0 \times b_w \times h_{edge} = 151 \text{ mm}^2$$

Area of steel required

$$A_{sedgetmbreq} = \max(A_{sedgetmbend}, A_{sedgetmbmin}) = 151 \text{ mm}^2$$

PASS - $A_{sedgetmbreq} \leq A_{sedgetmb}$ - Area of reinforcement provided in bottom of edge beams is adequate