

Project				Job no.	
Calcs for				Start page no./Re	evision
					1
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TT	24/01/2024				

SCI TEDDS MODULES



SCI P300 - Composite Slab Openings Designer

SCI P300 – Composite Slabs and Beams using Steel Decking: Best Practice for Design and Construction (available at https://portal.steel-sci.com/shop.html) covers the design and construction of composite floors, paying particular attention to the good practice aspects. This module addresses the topic of service openings in composite slabs, providing a method to design the reinforcement required around individual or multiple service openings. The calculation method is based on the guidance provided in SCI P300 and extended through AD 447 and other recent work by SCI.

CALCULATION DETAILS Calculation Version: 1.0.01

Project Name: SCI Tedds Modules Prepared By: DEF

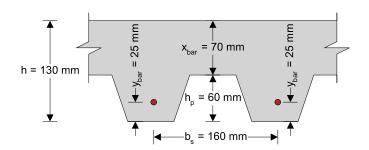
Client: Demo Checked By: ABC

Design Reference: Sample Analysis Time: 24/01/2024 - 09:59

USER INPUTS

SLAB PROPERTIES

 $\begin{array}{lll} \text{Deck profile} & & & \textbf{Trapezoidal} \\ \text{Span} & & L = 3.5 \text{ m} \\ \text{Depth} & & h = 130 \text{ mm} \\ \text{Profile Depth} & & h_p = 60 \text{ mm} \\ \text{Pitch of the Troughs} & & b_s = 160 \text{ mm} \\ \text{Height of Reinforcement Bars in Troughs} & & y_{\text{bar}} = 25 \text{ mm} \\ \end{array}$





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MATERIAL PROPERTIES

Characteristic Concrete Strength $f_{ck} = 25 \text{ N/mm}^2$

Concrete Partial Factor $\gamma_c = 1.50$

Design Concrete Strength $f_{cd} = 17 \text{ N/mm}^2$ Dry Density of Reinforced Concrete $\rho_{rc} = 2500 \text{ kg/m}^3$ $f_{yk} = 500 \text{ N/mm}^2$ Characteristic Yield Strength of Steel

Steel Partial Factor $y_s = 1.15$

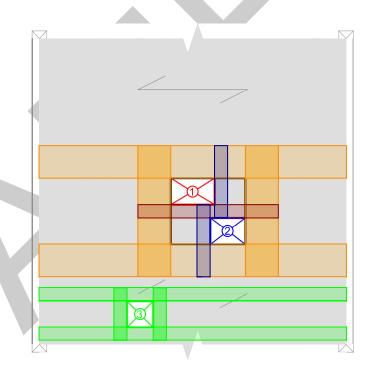
Design Yield Strength $f_{yd} = 435 \text{ N/mm}^2$

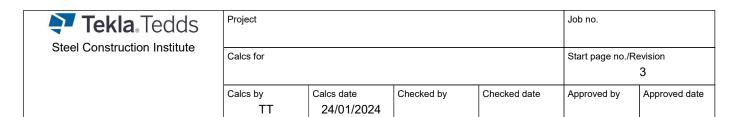
LOADING

 $W_{permanent} = 3.0 \text{ kN/m}^2$ **Factored Permanent Loads** Factored Variable Loads $W_{\text{variable}} = 1.0 \text{ kN/m}^2$ Total Factored Load

 $w_{tot} = 4.0 \text{ kN/m}^2$

DESIGN RESULTS



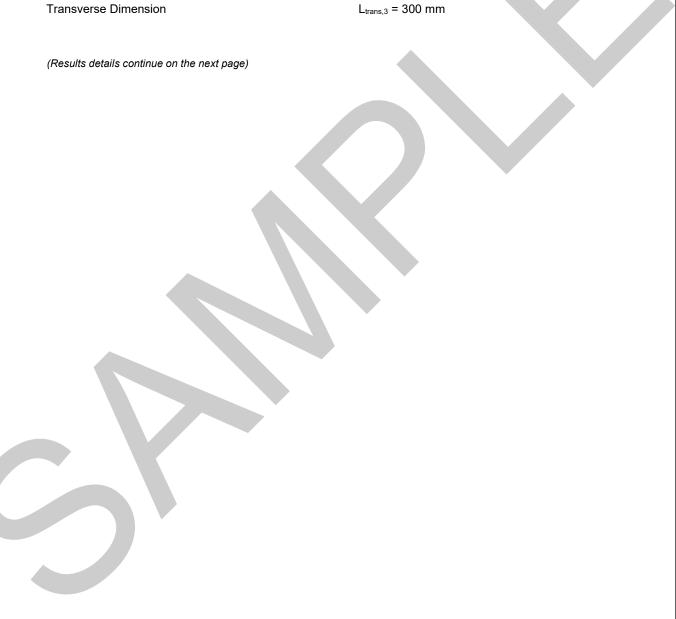


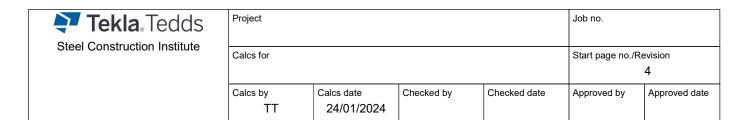
OPENING 3

Opening Reference
Mid-Span Offset
Transverse Offset
Longitudinal Dimensions
Transverse Dimension

Opening #3

 $x_{centre,3}$ = -600 mm $y_{centre,3}$ = -1400 mm $L_{long,3}$ = 300 mm





RESULTS FOR EXTERIOR LEFT STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

☐A pplied Ioads

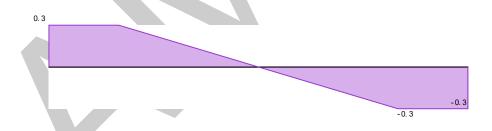
 $L_s = 0.45 \text{ m}$ $b_w = 150 \text{ mm}$

 $x_{bar} = 70 \text{ mm}$

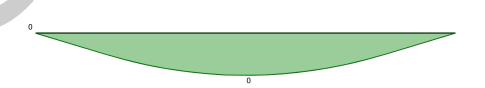
APPLIED LOADS



SHEAR FORCE DIAGRAM



BENDING MOMENT DIAGRAM





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ANALYSIS RESULTS

 $\label{eq:maximum Shear Force} $V_{Ed} = 0.30 \text{ kN}$ $$\text{Maximum Bending Moment}$ $M_{Ed} = 0.05 \text{ kNm}$$

DESIGN RESULTS

 $\text{Minimum Steel Area} \qquad \qquad \text{A}_{s} = \min(0.425 \times (f_{cd} \times 2 \times b_{w})/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^{2} - (2 \times b_{w})/f_{yd})}) + (x_{bar}^{2} + (x_{bar}^$

 M_{Ed})/(0.85 × f_{cd} × b_w))) = 1.5 mm²

Design shear resistance $V_{Rd,c,1} = (C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck})^{1/3} \times b_w \times x_{bar} = 1.8$

kΝ

Minimum shear resistance $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2 \text{ kN}$

Shear resistance check $max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$

Pass



RESULTS FOR EXTERIOR RIGHT STRIP

Length of the strip
Width of the strip

☐A pplied Ioads

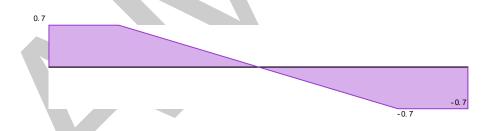
 $L_s = 0.45 \text{ m}$ $b_w = 150 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

Depth of the strip (concrete above deck)

APPLIED LOADS



SHEAR FORCE DIAGRAM



BENDING MOMENT DIAGRAM



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ANALYSIS RESULTS

 $\label{eq:Ved} \mbox{Maximum Shear Force} & \mbox{V_{Ed} = 0.66 kN} \\ \mbox{Maximum Bending Moment} & \mbox{M_{Ed} = 0.10 kNm} \\ \mbox{}$

DESIGN RESULTS

Minimum Steel Area $A_s = min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times b_w)/f_{yd})})$

 M_{Ed})/(0.85 × f_{cd} × b_w))) = 3.3 mm²

Design shear resistance $V_{Rd,c,1} = \left(C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck}\right)^{1/3} \times b_w \times x_{bar} = 2.3$

kΝ

 $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2 \ kN$

Shear resistance check $max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$

Pass



Project				Job no.	
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RESULTS FOR EXTERIOR TOP STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

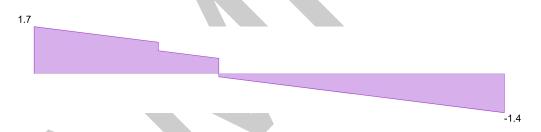
 $L_s = 3.50 \text{ m}$ $b_w = 150 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

APPLIED LOADS





SHEAR FORCE DIAGRAM



BENDING MOMENT DIAGRAM

0

1.6

ANALYSIS RESULTS

Maximum Shear Force
Maximum Bending Moment

 V_{Ed} = 1.67 kN M_{Ed} = 1.60 kNm

DESIGN RESULTS

Minimum Steel Area

$$\begin{split} A_s &= min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 57.2 \ mm^2 \end{split}$$



Project				Job no.	
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Design shear resistance

 $V_{\text{Rd,c,1}} = (C_{\text{Rd,c}} \times k \times 100 \times \rho_{\text{I}} \times f_{\text{ck}})^{1/3} \times b_{\text{w}} \times x_{\text{bar}} = 6.0$

kΝ

Minimum shear resistance

 $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2 \text{ kN}$

Shear resistance check

 $max(V_{Rd,c,1},\,V_{Rd,c,2}) > V_{Ed}$

Pass



Project				Job no.	
Calcs for				Start page no./Revision	
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RESULTS FOR EXTERIOR BOTTOM STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

 $b_w = 150 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

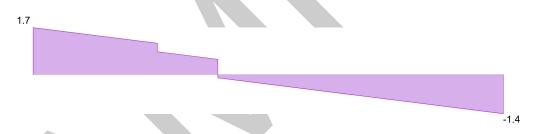
 $L_s = 3.50 \text{ m}$

APPLIED LOADS





SHEAR FORCE DIAGRAM



BENDING MOMENT DIAGRAM

1.6

ANALYSIS RESULTS

Maximum Shear Force
Maximum Bending Moment

 V_{Ed} = 1.67 kN M_{Ed} = 1.60 kNm

DESIGN RESULTS

Minimum Steel Area

$$\begin{split} A_s &= min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 57.2 \ mm^2 \end{split}$$

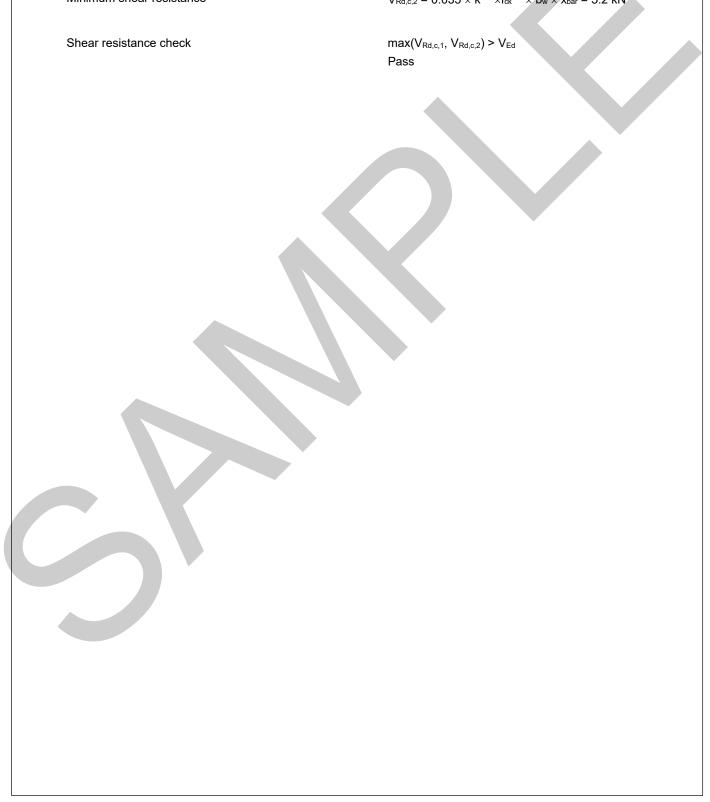


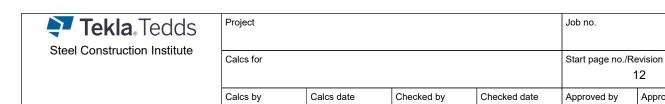
Project				Job no.	
Calcs for				Start page no./Re	evision 1
Calcs by	Calcs date 24/01/2024	Checked by	Checked date	Approved by	Approved date

Design shear resistance $V_{Rd,c,1} = \left(C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck}\right)^{1/3} \times b_w \times x_{bar} = 6.0$

kΝ

Minimum shear resistance $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2 \text{ kN}$





TT

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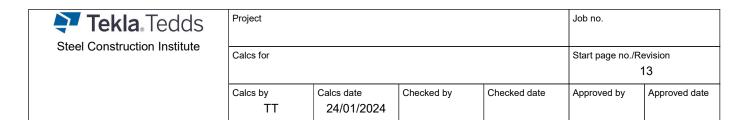
MULTIPLE OPENING 0 (Openings 1 and 2)

Opening Reference Mid-Span Offset Transverse Offset Longitudinal Dimensions Transverse Dimension Opening #1 and Opening #2

Approved date

 $x_{centre,0}$ = 200 mm $y_{centre,0}$ = -225 mm $L_{long,0}$ = 850 mm $L_{trans,0}$ = 750 mm





RESULTS FOR INTERIOR LEFT STRIP

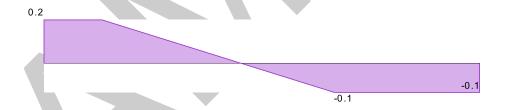
Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

 $L_s = 0.56 \text{ m}$ $b_w = 150 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

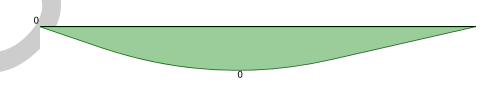
APPLIED LOADS



SHEAR FORCE DIAGRAM



BENDING MOMENT DIAGRAM



ANALYSIS RESULTS

Maximum Shear Force

 $V_{Ed} = 0.16 \text{ kN}$

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Maximum Bending Moment

 M_{Ed} = 0.03 kNm

DESIGN RESULTS

 M_{Ed})/(0.85 × f_{cd} × b_w))) = 0.9 mm²

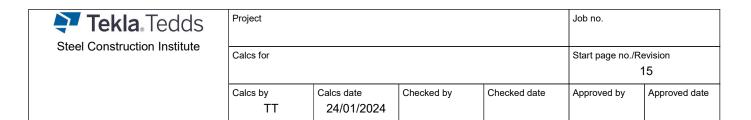
Design shear resistance $V_{Rd,c,1} = \left(C_{Rd,c} \times k \times 100 \times \rho_{I} \times f_{ck}\right)^{1/3} \times b_{w} \times x_{bar} = 1.5$

kΝ

Minimum shear resistance $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2 \text{ kN}$

Shear resistance check $max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$

Pass



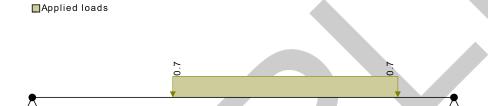
RESULTS FOR INTERIOR RIGHT STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

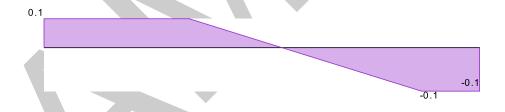
 $L_s = 0.56 \text{ m}$ $b_w = 150 \text{ mm}$

 $x_{bar} = 70 \text{ mm}$

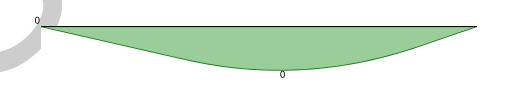
APPLIED LOADS



SHEAR FORCE DIAGRAM



BENDING MOMENT DIAGRAM



ANALYSIS RESULTS

Maximum Shear Force

 $V_{Ed} = 0.13 \text{ kN}$

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Maximum Bending Moment

 M_{Ed} = 0.02 kNm

DESIGN RESULTS

 M_{Ed})/(0.85 × f_{cd} × b_w))) = 0.7 mm²

Design shear resistance $V_{Rd,c,1} = \left(C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck}\right)^{1/3} \times b_w \times x_{bar} = 1.4$

kΝ

Minimum shear resistance $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2 \text{ kN}$

Shear resistance check $max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$

Pass



Project				Job no.	
Calcs for				Start page no./Re	evision 7
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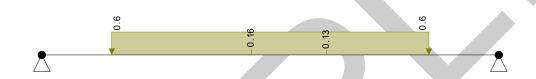
RESULTS FOR INTERIOR MAIN STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

 $L_s = 1.23 \text{ m}$ $b_w = 150 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

APPLIED LOADS





SHEAR FORCE DIAGRAM

0.4

-0.4

BENDING MOMENT DIAGRAM

0

0.2

ANALYSIS RESULTS

Maximum Shear Force
Maximum Bending Moment

 $V_{Ed} = 0.41 \text{ kN}$ $M_{Ed} = 0.18 \text{ kNm}$

DESIGN RESULTS



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Minimum Steel Area

 $A_s = min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times b_w)/f_{yd})^2})$

 M_{Ed})/(0.85 × f_{cd} × b_w))) = 5.9 mm²

Design shear resistance

 $V_{\text{Rd,c,1}} = (C_{\text{Rd,c}} \times k \times 100 \times \rho_{\text{I}} \times f_{\text{ck}})^{1/3} \times b_{\text{w}} \times x_{\text{bar}} = 2.8$

kΝ

Minimum shear resistance

 $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2 \text{ kN}$

Shear resistance check

 $max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$

Pass



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RESULTS FOR EXTERIOR LEFT STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

 $L_s = 1.13 \text{ m}$ $b_w = 375 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

APPLIED LOADS





SHEAR FORCE DIAGRAM

1.4

-1.4

BENDING MOMENT DIAGRAM

0

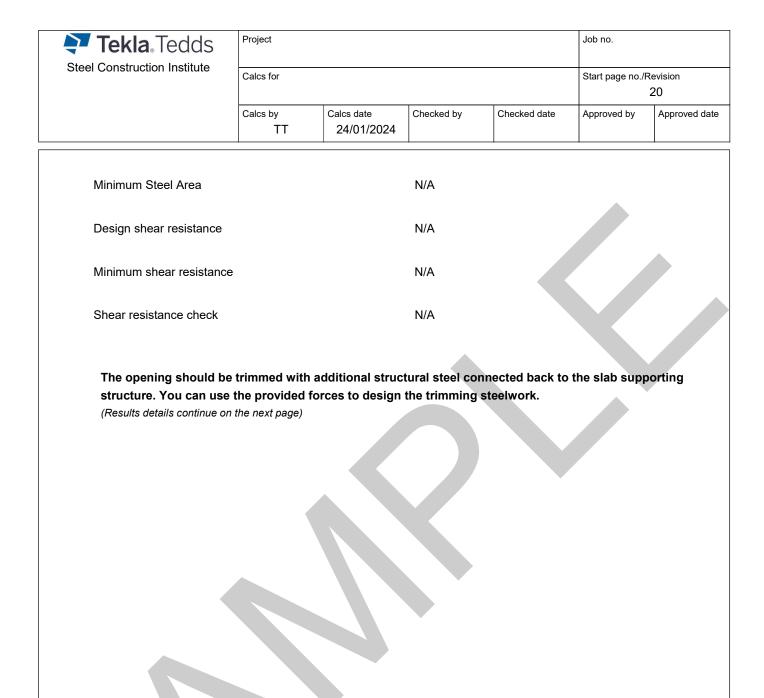
0.6

ANALYSIS RESULTS

Maximum Shear Force
Maximum Bending Moment

 V_{Ed} = 1.45 kN M_{Ed} = 0.56 kNm

DESIGN RESULTS





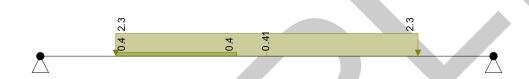
Project				Job no.	
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Calcs by TT	Calcs date 24/01/2024	Checked by	Checked date	Approved by	Approved date

RESULTS FOR EXTERIOR RIGHT STRIP

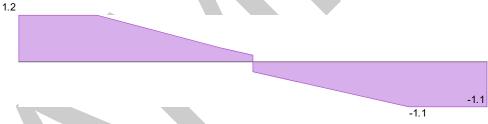
Length of the strip Width of the strip Depth of the strip (concrete above deck) $L_s = 1.13 \text{ m}$ $b_{w} = 375 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

APPLIED LOADS





SHEAR FORCE DIAGRAM



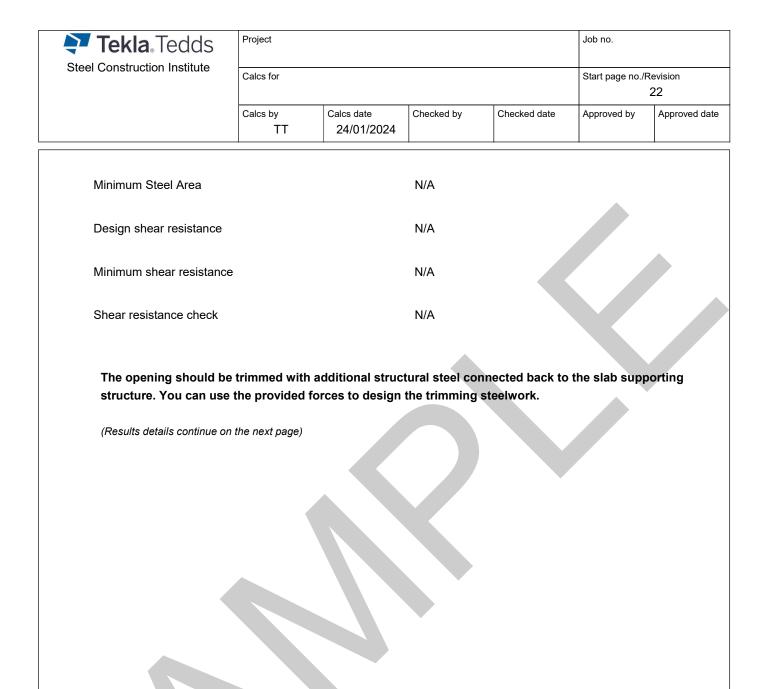
BENDING MOMENT DIAGRAM

0.5

ANALYSIS RESULTS

Maximum Shear Force Maximum Bending Moment $V_{Ed} = 1.15 \text{ kN}$ $M_{Ed} = 0.46 \text{ kNm}$

DESIGN RESULTS





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RESULTS FOR EXTERIOR TOP STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

 $L_s = 3.50 \text{ m}$ $b_w = 375 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

APPLIED LOADS

Applied loads



SHEAR FORCE DIAGRAM

3.8

BENDING MOMENT DIAGRAM

0

3.8

ANALYSIS RESULTS

Maximum Shear Force Maximum Bending Moment V_{Ed} = 4.02 kN M_{Ed} = 3.82 kNm

DESIGN RESULTS

Minimum Steel Area

N/A

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Steel Construction Institute	Calcs for	Calcs for			Start page no./Revision 24	
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Design shear resistance			N/A			
Minimum shear resistance	;		N/A			
Shear resistance check			N/A			

The opening should be trimmed with additional structural steel connected back to the slab supporting structure. You can use the provided forces to design the trimming steelwork.





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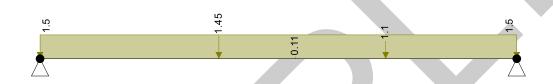
RESULTS FOR EXTERIOR BOTTOM STRIP

Length of the strip
Width of the strip
Depth of the strip (concrete above deck)

 $L_s = 3.50 \text{ m}$ $b_w = 375 \text{ mm}$ $x_{bar} = 70 \text{ mm}$

APPLIED LOADS

Applied loads



SHEAR FORCE DIAGRAM

3.9

BENDING MOMENT DIAGRAM

0

3.9

ANALYSIS RESULTS

Maximum Shear Force
Maximum Bending Moment

 V_{Ed} = 4.02 kN M_{Ed} = 3.88 kNm

DESIGN RESULTS

Minimum Steel Area

N/A



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Design shear resistance N/A

Minimum shear resistance N/A

Shear resistance check N/A

The opening should be trimmed with additional structural steel connected back to the slab supporting structure. You can use the provided forces to design the trimming steelwork.

PARAMETERS FOR OPENING: 3

Opening Reference Opening #3

Mid-Span Offset $x_{centre,3} = -600 \text{ mm}$ Transverse Offset $y_{centre,3} = -1400 \text{ mm}$ Longitudinal Dimensions $L_{long,3} = 300 \text{ mm}$ Transverse Dimension $L_{trans,3} = 300 \text{ mm}$

RESULTS FOR OPENING: 3

Classification	Medium Opening						
Strip Position	Required Area of Steel (As)	Shear Resistance Check (V _{Rd,c} > V _{Ed})	Maximum Shear Force (V_{Ed})	Maximum Bending Moment (M _{Ed})			
Exterior Left	1.5 mm ²	Pass	N/A	N/A			
Exterior Right	3.3 mm ²	Pass	N/A	N/A			
Exterior Top	57.2 mm ²	Pass	N/A	N/A			
Exterior Bottom	57.2 mm ²	Pass	N/A	N/A			

PARAMETERS FOR THE MULTIPLE OPENING CASE (Opening 1 and Opening 2)

Opening Reference Opening #1 and Opening #2

Mid-Span Offset $x_{centre,0} = 200 \text{ mm}$ Transverse Offset $y_{centre,0} = -225 \text{ mm}$ Longitudinal Dimensions $L_{long,0} = 850 \text{ mm}$ Transverse Dimension $L_{trans,0} = 750 \text{ mm}$

RESULTS FOR THE MULTIPLE OPENING CASE (Opening 1 and Opening 2)

Classification	Large Opening ×						
Strip Position	Required Area of	Shear Resistance	Maximum Shear	Maximum Bending			
Strip Position	Steel (As)	Check $(V_{Rd,c} > V_{Ed})$	Force (V _{Ed})	Moment (M _{Ed})			
Exterior Left	N/A	N/A	1.4 kN	0.6 kNm			
Exterior Right	N/A	N/A	1.2 kN	0.5 kNm			
Exterior Top	N/A	N/A	4.0 kN	3.8 kNm			
Exterior Bottom	N/A	N/A	4.0 kN	3.9 kNm			

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Interior Main	5.9 mm ²	Pass	N/A	N/A
Interior Left	0.9 mm ²	Pass	N/A	N/A
Interior Right	0.7 mm ²	Pass	N/A	N/A

* The opening should be trimmed with additional structural steel connected back to the slab supporting structure. You can use the provided forces to design the trimming steelwork.

Contact:

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Steel Knowledge