| Tekla Tedds<br>Steel Construction Institute | Project | | | | Job no. | |
|---|---|---|---|---|---|---|
| | Calcs for | | | | Start page no./Revision<br>1 | |
| | Calcs by<br>TT | Calcs date<br>24/01/2024 | Checked by | Checked date | Approved by | Approved date |

# SCI TEDDS MODULES

Steel Knowledge

## 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**

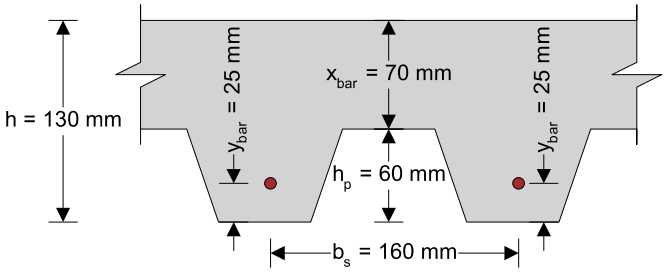
Calculation Version: **1.0.01**

| | | | |
|---|---|---|---|
| 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**

| | |
|---|---|
| Deck profile | **Trapezoidal** |
| Span | L = **3.5** m |
| Depth | h = **130** mm |
| Profile Depth | $h_p$ =**60** mm |
| Pitch of the Troughs | $b_s$ = **160** mm |
| Height of Reinforcement Bars in Troughs | $y_{bar}$ = **25** mm |



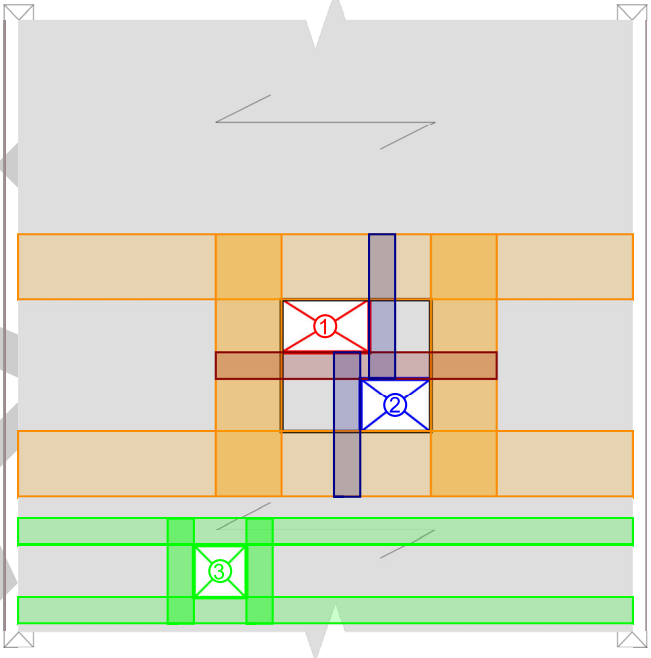
## MATERIAL PROPERTIES

| | |
|---|---|
| Characteristic Concrete Strength | $f_{ck}$ = **25** N/mm$^2$ |
| Concrete Partial Factor | $\gamma_c$ = 1.50 |
| Design Concrete Strength | $f_{cd}$ = **17** N/mm$^2$ |
| Dry Density of Reinforced Concrete | $\rho_{rc}$ = 2500 kg/m$^3$ |
| Characteristic Yield Strength of Steel | $f_{yk}$ = **500** N/mm$^2$ |
| Steel Partial Factor | $\gamma_s$ = 1.15 |
| Design Yield Strength | $f_{yd}$ = **435** N/mm$^2$ |

## LOADING

| | |
|---|---|
| Factored Permanent Loads | $w_{permanent}$ = **3.0** kN/m$^2$ |
| Factored Variable Loads | $w_{variable}$ = **1.0** kN/m$^2$ |
| Total Factored Load | $w_{tot}$ = **4.0** kN/m$^2$ |

## DESIGN RESULTS



## OPENING 3

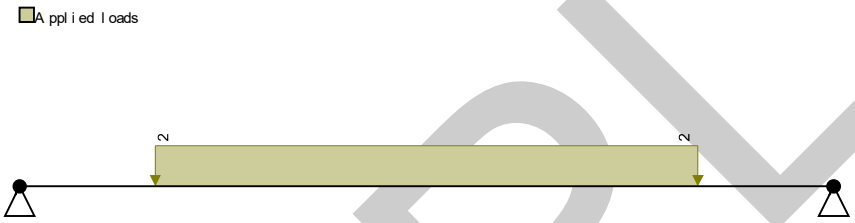
| | |
|---|---|
| Opening Reference | Opening #3 |
| Mid-Span Offset | $x_{centre,3}$ = -600 mm |
| Transverse Offset | $y_{centre,3}$ = -1400 mm |
| Longitudinal Dimensions | $L_{long,3}$ = 300 mm |
| Transverse Dimension | $L_{trans,3}$ = 300 mm |

*(Results details continue on the next page)*

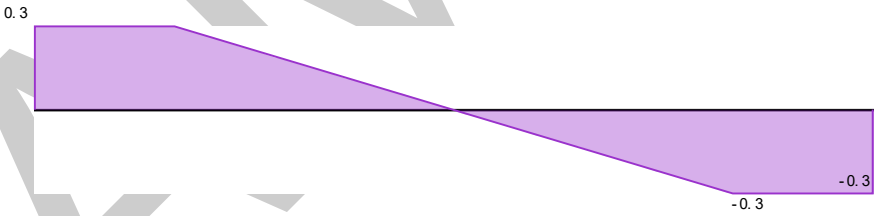
## RESULTS FOR EXTERIOR LEFT STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 0.45 m |
| Width of the strip | $b_w$ = 150 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

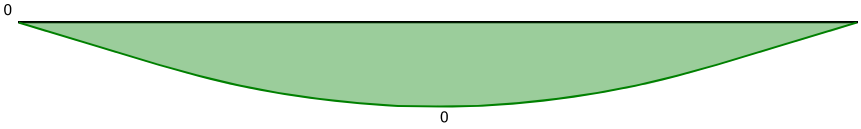
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*



***ANALYSIS RESULTS***

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 0.30 kN |
| Maximum Bending Moment | $M_{Ed}$ = 0.05 kNm |

***DESIGN RESULTS***

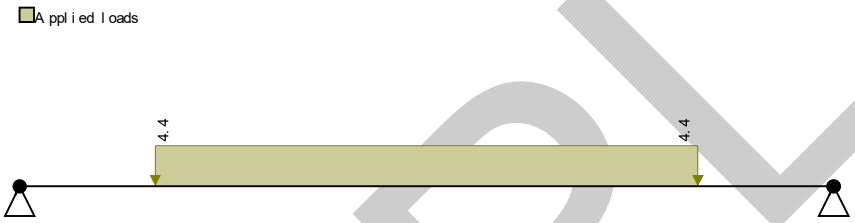
| | |
|---|---|
| Minimum Steel Area | $A_s = \min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 1.5\ mm^2$ |
| Design shear resistance | $V_{Rd,c,1} = (C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck})^{1/3} \times b_w \times x_{bar} = 1.8$ kN |
| Minimum shear resistance | $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2$ kN |
| Shear resistance check | $\max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$<br>Pass |

*(Results details continue on the next page)*

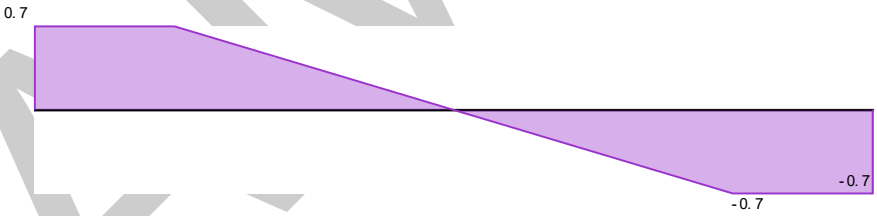
## RESULTS FOR EXTERIOR RIGHT STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 0.45 m |
| Width of the strip | $b_w$ = 150 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

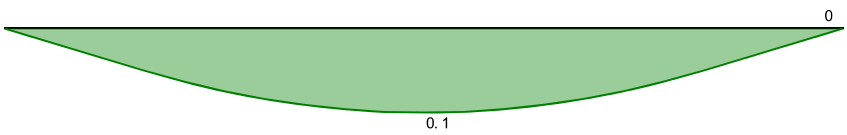
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*



***ANALYSIS RESULTS***

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 0.66 kN |
| Maximum Bending Moment | $M_{Ed}$ = 0.10 kNm |

***DESIGN RESULTS***

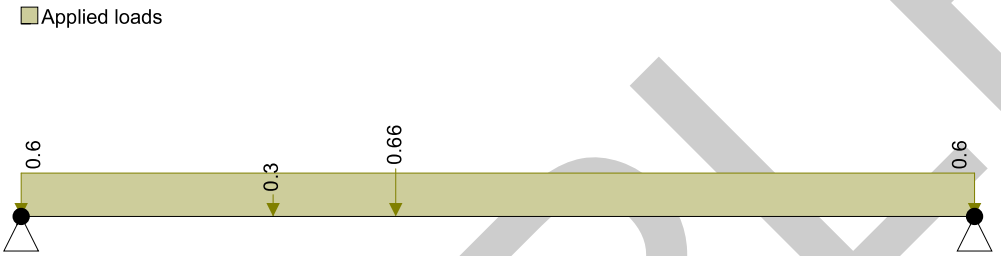
| | |
|---|---|
| Minimum Steel Area | $A_s = \min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 3.3$ mm$^2$ |
| Design shear resistance | $V_{Rd,c,1} = (C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck})^{1/3} \times b_w \times x_{bar} = 2.3$ kN |
| Minimum shear resistance | $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2$ kN |
| Shear resistance check | $\max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$<br>Pass |

*(Results details continue on the next page)*

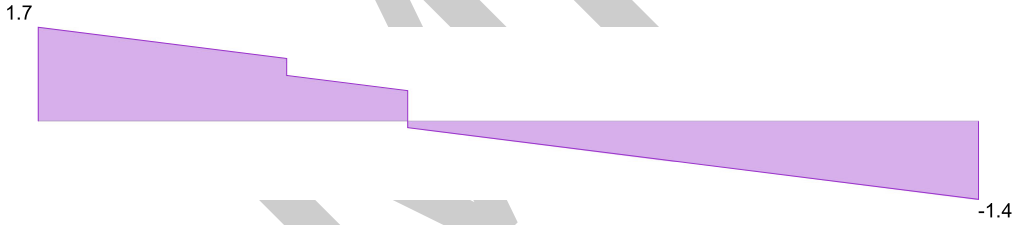
## RESULTS FOR EXTERIOR TOP STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 3.50 m |
| Width of the strip | $b_w$ = 150 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

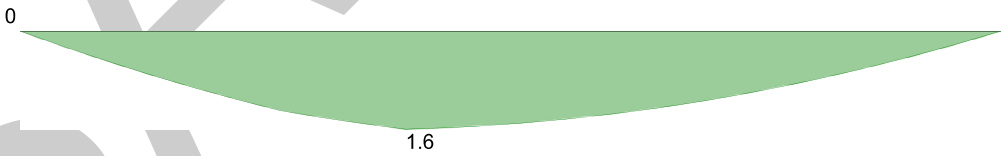
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 1.67 kN |
| Maximum Bending Moment | $M_{Ed}$ = 1.60 kNm |

### *DESIGN RESULTS*

| | |
|---|---|
| Minimum Steel Area | $A_s = \min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 57.2\ mm^2$ |

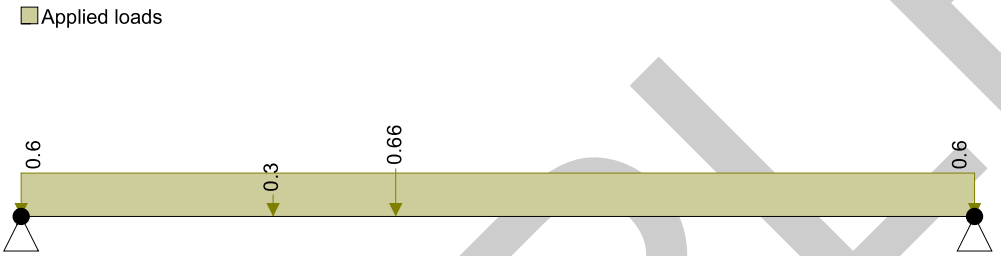
| | |
|---|---|
| Design shear resistance | $V_{Rd,c,1} = (C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck})^{1/3} \times b_w \times x_{bar} = 6.0$ kN |
| Minimum shear resistance | $V_{Rd,c,2} = 0.035 \times k^{3/2} \times f_{ck}^{1/2} \times b_w \times x_{bar} = 5.2$ kN |
| Shear resistance check | $\max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$<br>Pass |

*(Results details continue on the next page)*

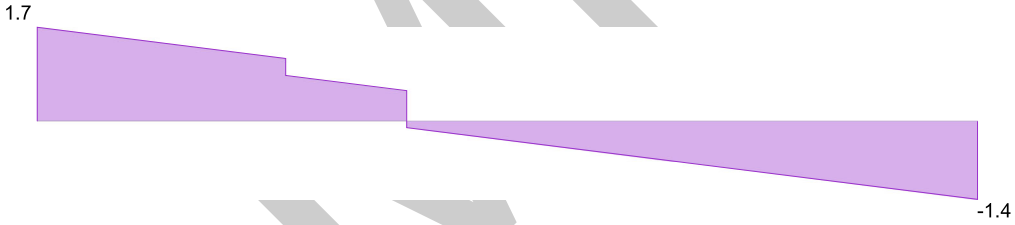
## RESULTS FOR EXTERIOR BOTTOM STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 3.50 m |
| Width of the strip | $b_w$ = 150 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

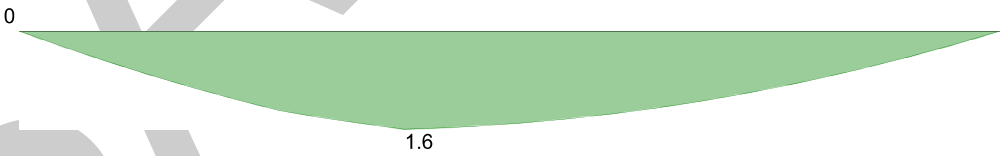
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 1.67 kN |
| Maximum Bending Moment | $M_{Ed}$ = 1.60 kNm |

### *DESIGN RESULTS*

| | |
|---|---|
| Minimum Steel Area | $A_s = \min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 57.2\ mm^2$ |

Design shear resistance

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

Minimum shear resistance

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

Shear resistance check

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

Pass

## MULTIPLE OPENING 0 (Openings 1 and 2)

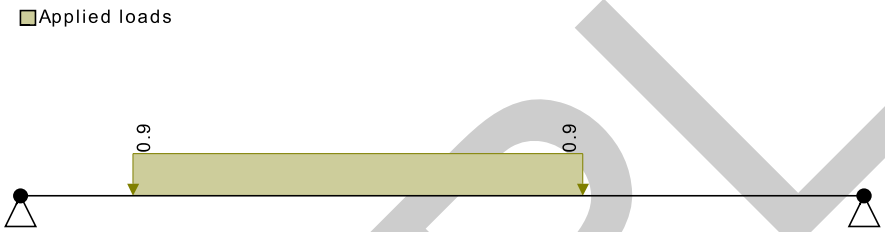
| | |
|---|---|
| Opening Reference | Opening #1 and Opening #2 |
| Mid-Span Offset | $x_{centre,0}$ = 200 mm |
| Transverse Offset | $y_{centre,0}$ = -225 mm |
| Longitudinal Dimensions | $L_{long,0}$ = 850 mm |
| Transverse Dimension | $L_{trans,0}$ = 750 mm |

*(Results details continue on the next page)*

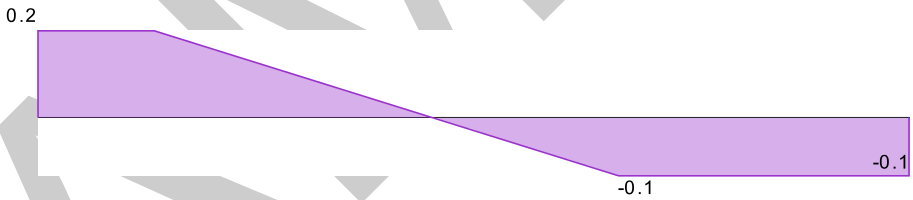
## RESULTS FOR INTERIOR LEFT STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 0.56 m |
| Width of the strip | $b_w$ = 150 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

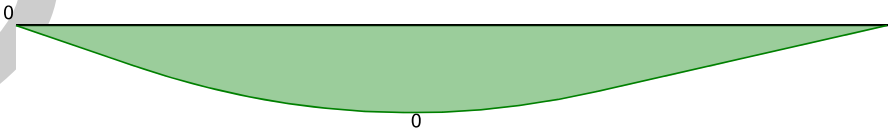
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 0.16 kN |

Maximum Bending Moment $M_{Ed}$ = 0.03 kNm

***DESIGN RESULTS***

Minimum Steel Area

$A_s = \min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 0.9\ mm^2$

Design shear resistance

$V_{Rd,c,1} = (C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck})^{1/3} \times b_w \times x_{bar} = 1.5$ kN

Minimum shear resistance

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

Shear resistance check

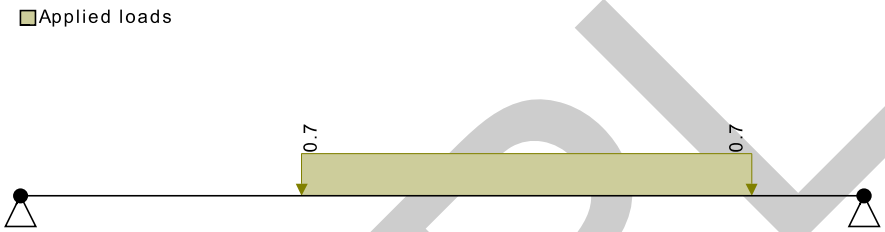
$\max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$
Pass

*(Results details continue on the next page)*

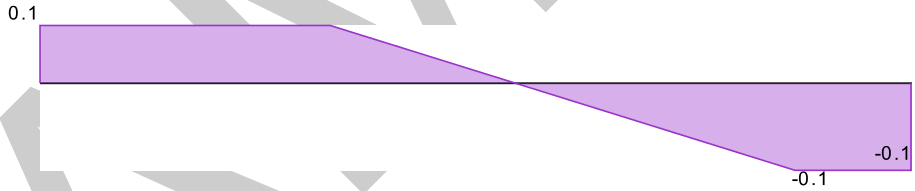
## RESULTS FOR INTERIOR RIGHT STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 0.56 m |
| Width of the strip | $b_w$ = 150 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

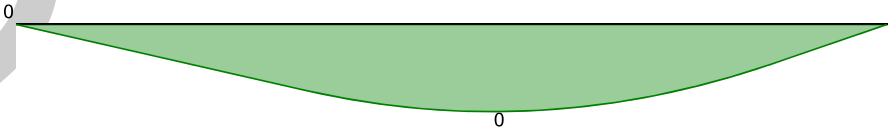
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 0.13 kN |

Maximum Bending Moment $M_{Ed}$ = 0.02 kNm

***DESIGN RESULTS***

Minimum Steel Area

$A_s = \min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 0.7\ mm^2$

Design shear resistance

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

Minimum shear resistance

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

Shear resistance check

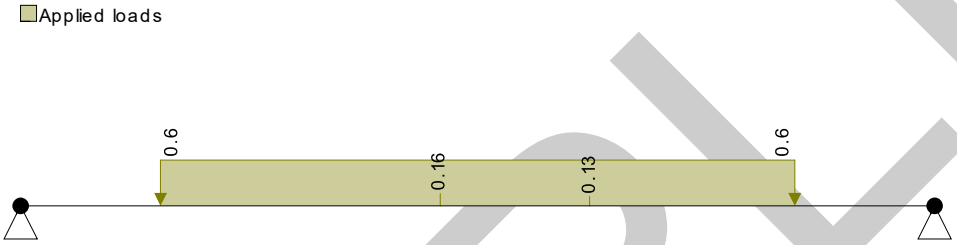
$\max(V_{Rd,c,1}, V_{Rd,c,2}) > V_{Ed}$
Pass

*(Results details continue on the next page)*

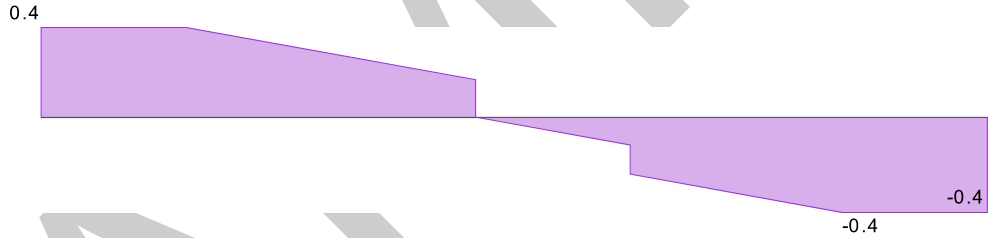
## RESULTS FOR INTERIOR MAIN STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 1.23 m |
| Width of the strip | $b_w$ = 150 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

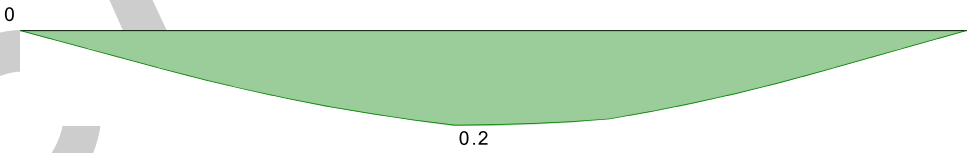
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 0.41 kN |
| Maximum Bending Moment | $M_{Ed}$ = 0.18 kNm |

### *DESIGN RESULTS*

Minimum Steel Area

$A_s = \min(0.425 \times (f_{cd} \times 2 \times b_w)/f_{yd} \times (x_{bar} \pm \sqrt{(x_{bar}^2 - (2 \times M_{Ed})/(0.85 \times f_{cd} \times b_w)))} = 5.9\ mm^2$

Design shear resistance

$V_{Rd,c,1} = (C_{Rd,c} \times k \times 100 \times \rho_l \times f_{ck})^{1/3} \times b_w \times x_{bar} = 2.8$ kN

Minimum shear resistance

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

Shear resistance check

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

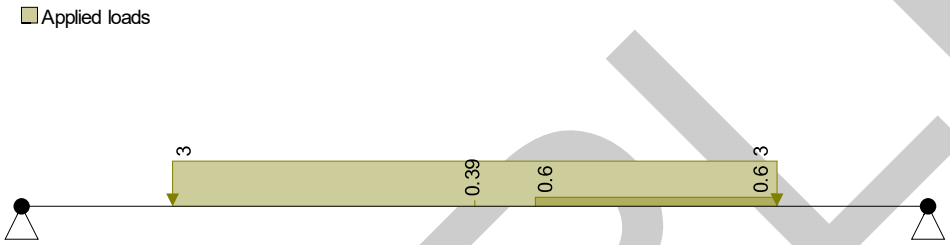
Pass

*(Results details continue on the next page)*

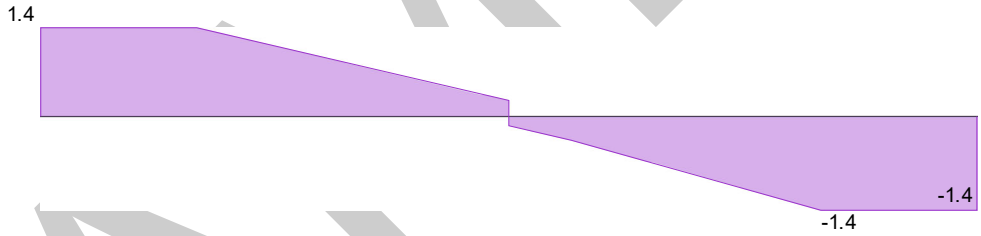
## RESULTS FOR EXTERIOR LEFT STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 1.13 m |
| Width of the strip | $b_w$ = 375 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

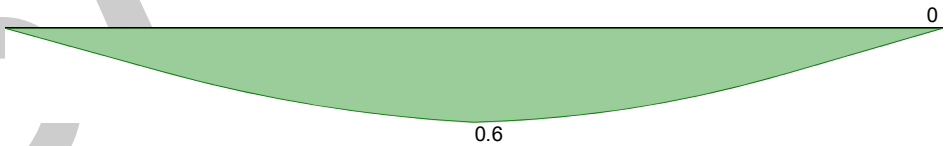
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 1.45 kN |
| Maximum Bending Moment | $M_{Ed}$ = 0.56 kNm |

### *DESIGN RESULTS*

| | |
|---|---|
| Minimum Steel Area | N/A |
| Design shear resistance | N/A |
| Minimum shear resistance | N/A |
| Shear resistance check | N/A |

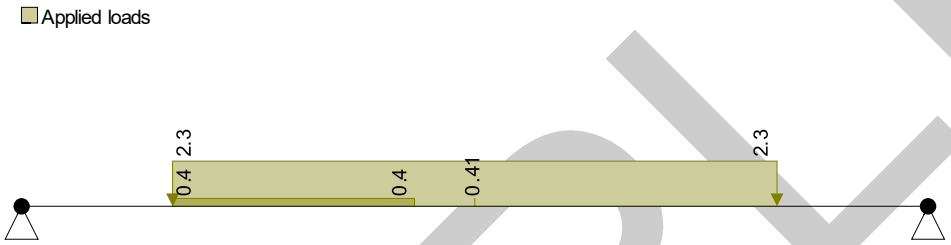
**The opening should be trimmed with additional structural steel connected back to the slab supporting structure. You can use the provided forces to design the trimming steelwork.**

*(Results details continue on the next page)*

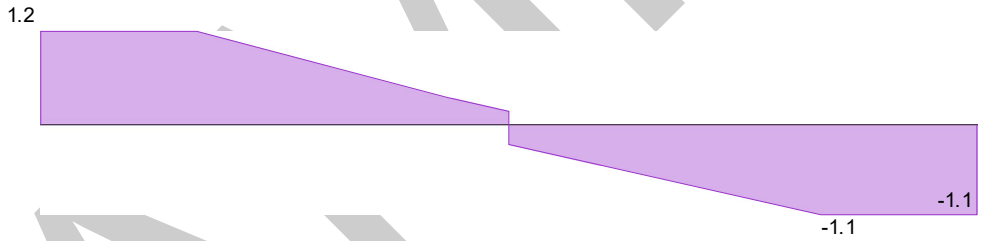
## RESULTS FOR EXTERIOR RIGHT STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 1.13 m |
| Width of the strip | $b_w$ = 375 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

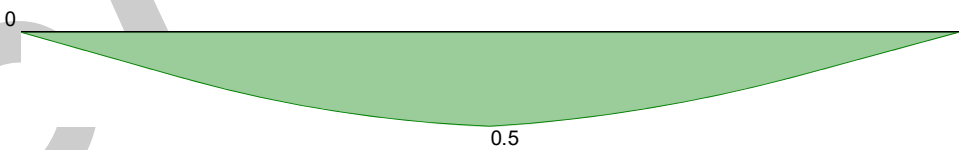
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

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

### *DESIGN RESULTS*

| | |
|---|---|
| Minimum Steel Area | N/A |
| Design shear resistance | N/A |
| Minimum shear resistance | N/A |
| Shear resistance check | N/A |

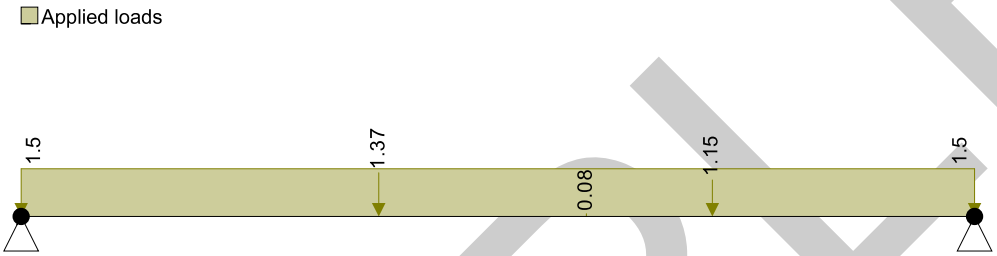
**The opening should be trimmed with additional structural steel connected back to the slab supporting structure. You can use the provided forces to design the trimming steelwork.**

*(Results details continue on the next page)*

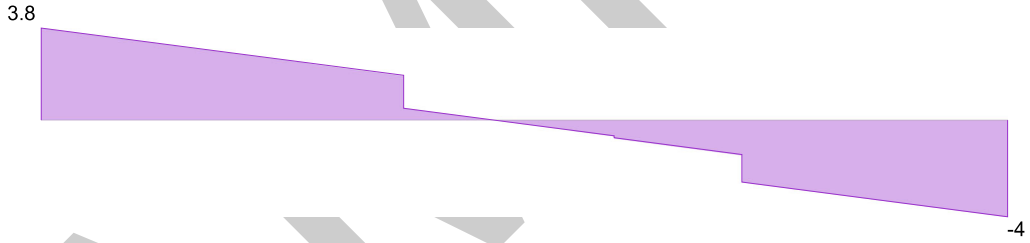
## RESULTS FOR EXTERIOR TOP STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 3.50 m |
| Width of the strip | $b_w$ = 375 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

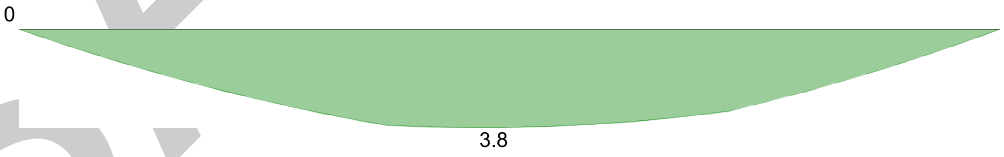
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

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

### *DESIGN RESULTS*

| | |
|---|---|
| Minimum Steel Area | N/A |

| | |
|---|---|
| Design shear resistance | N/A |
| Minimum shear resistance | N/A |
| Shear resistance check | N/A |

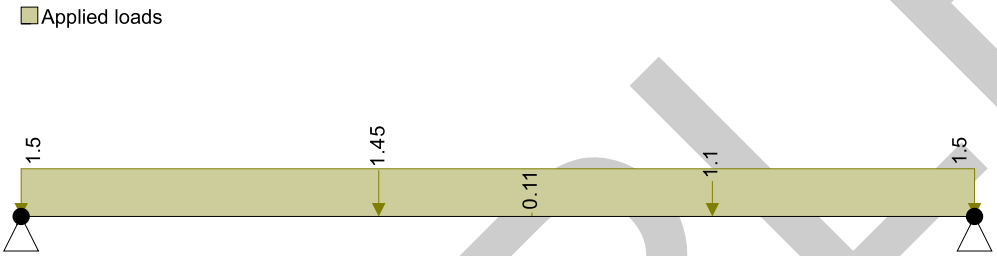
**The opening should be trimmed with additional structural steel connected back to the slab supporting structure. You can use the provided forces to design the trimming steelwork.**

*(Results details continue on the next page)*

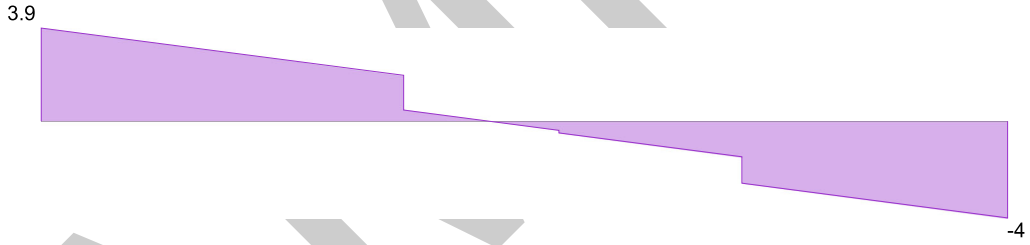
## RESULTS FOR EXTERIOR BOTTOM STRIP

| | |
|---|---|
| Length of the strip | $L_s$ = 3.50 m |
| Width of the strip | $b_w$ = 375 mm |
| Depth of the strip (concrete above deck) | $x_{bar}$ = **70** mm |

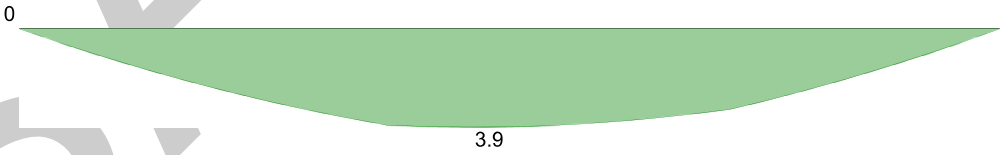
### *APPLIED LOADS*




### *SHEAR FORCE DIAGRAM*




### *BENDING MOMENT DIAGRAM*




### *ANALYSIS RESULTS*

| | |
|---|---|
| Maximum Shear Force | $V_{Ed}$ = 4.02 kN |
| Maximum Bending Moment | $M_{Ed}$ = 3.88 kNm |

### *DESIGN RESULTS*

| | |
|---|---|
| Minimum Steel Area | N/A |

| | |
|---|---|
| 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 mm |
| Transverse Offset | $y_{centre,3}$ = -1400 mm |
| Longitudinal Dimensions | $L_{long,3}$ = 300 mm |
| Transverse Dimension | $L_{trans,3}$ = 300 mm |

**RESULTS FOR OPENING: 3**

| **Classification** | **Medium Opening** | | | |
|---|---|---|---|---|
| **Strip Position** | **Required Area of Steel** ($A_s$) | **Shear Resistance Check** ($V_{Rd,c} > V_{Ed}$) | **Maximum Shear Force** ($V_{Ed}$) | **Maximum Bending Moment** ($M_{Ed}$) |
| Exterior Left | **1.5 mm²** | **Pass** | **N/A** | **N/A** |
| Exterior Right | **3.3 mm²** | **Pass** | **N/A** | **N/A** |
| Exterior Top | **57.2 mm²** | **Pass** | **N/A** | **N/A** |
| Exterior Bottom | **57.2 mm²** | **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 mm |
| Transverse Offset | $y_{centre,0}$ = -225 mm |
| Longitudinal Dimensions | $L_{long,0}$ = 850 mm |
| Transverse Dimension | $L_{trans,0}$ = 750 mm |

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

| **Classification** | **Large Opening ˣ** | | | |
|---|---|---|---|---|
| **Strip Position** | **Required Area of Steel** ($A_s$) | **Shear Resistance Check** ($V_{Rd,c} > V_{Ed}$) | **Maximum Shear Force** ($V_{Ed}$) | **Maximum Bending 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** |

| | | | | |
|---|---|---|---|---|
| Interior Main | **5.9 mm²** | **Pass** | **N/A** | **N/A** |
| Interior Left | **0.9 mm²** | **Pass** | **N/A** | **N/A** |
| Interior Right | **0.7 mm²** | **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.**