

**Input Data****Load data**

Applied load w\* = 4.15 kN/m<sup>2</sup>

**Fire data**

Time equivalent ( user defined value ) = 60 min

**Slab mesh reinforcement and concrete strength**

fc`20 (at 20°C) = 35 MPa  
 Rib height or depth, hrc = 75 mm  
 Total slab thickness, t0 = 140 mm  
 Slab type = Trapezoidal deck profile

**Layer 1**

fyr20, reinforcement (at 20°C) = 420 MPa  
 TOP cover x direction, Cxreo = 51 mm  
 TOP cover y direction, Cyreo = 45 mm  
 bar spacing in x, Sxreo = 150 mm  
 bar diameter in x, dxreo = 6 mm  
 bar spacing in y, Syreo = 150 mm  
 bar diameter in y, dyreo = 6 mm  
 Reinforcement type = Cold-worked mesh

**Secondary beams**

Secondary Beam = yes  
 Beam direction = Lx  
 Beam top flange yield stress, fytfb20 (at 20°C) = 355 MPa  
 Beam web yield stress, fywsb20 (at 20°C) = 355 MPa  
 Beam top flange width, bf,tf = 10.1 mm  
 Beam top flange thickness, tf,tf = 8.9 mm  
 Beam web thickness, tw = 6 mm  
 Beam depth, d = 308 mm  
 Beam spacing, Ssb = 2.54 mm  
 Depth of web openings = 8.9 mm  
 Beam shear capacity, phi Vv (at 20°C) = 420 kN

**Slab panel and support beam dimensions**

Lx, slab panel = 7.62 m  
 Ly, slab panel = 7.62 m  
 Lxb, max = 7.62 m  
 Lyb, max = 7.62 m  
 Total slab thickness, t0 = 140 mm

**Slab panel edge conditions**

Side 1 = fixed  
 Side 2 = simple  
 Side 3 = simple  
 Side 4 = fixed

**Slab reinforcement interior support bars, x-direction**

fyr20, isbx (value at 20°C)	=	420	MPa
bar diameter	=	8	mm
bar spacing	=	150	mm
Top Cover	=	51	mm

**Slab reinforcement interior support bars, y-direction**

fyr20, isby (value at 20°C)	=	420	MPa
bar diameter	=	8	mm
bar spacing	=	150	mm

**Slab reinforcement deck trough bars**

fyr20, dtb (value at 20°C)	=	0	MPa
bar diameter	=	0	mm
bar spacing	=	0	mm

**BOTTOM covers for heat flow calculation**

c1	=	0	mm
c2	=	0	mm
c3	=	0	mm

**Secondary beam to primary beam connection**

No. of bolts in each secondary beam to primary beam connection	=	3	
Ambient temperature design shear capacity of bolt, ( $\phi V_{fn}$ )	=	90	kN

**Research Data**

Limiting deflection d limit	=	281	mm
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Table 2 - Design Temperatures of Unprotected Secondary Beam Elements

	Bottom Flange	Web	Top Flange
FHC 1, NWC	750	750	650
FHC 2, NWC	850	800	750
FHC 3, NWC	900	850	800
FHC 1, LWC	850	850	750
FHC 2, LWC	1000	950	900
FHC 3, LWC	1050	1000	950

**Output Data****Temperatures**

Layer 1, reinforcement x direction	=	448	°C
Layer 1, reinforcement y direction	=	411	°C
Layer 2, reinforcement x direction	=	0	°C
Layer 2, reinforcement y direction	=	0	°C
Interior support bars x direction	=	455	°C
Interior support bars y direction	=	411	°C
Deck trough bars	=	0	°C
Rib bars	=	0	°C

**Areas of the reinforcement**

Arx, Layer 1	=	188	mm <sup>2</sup> /m
Ary, Layer 1	=	188	mm <sup>2</sup> /m
Arx, Layer 2	=	0	mm <sup>2</sup> /m
Ary, Layer 2	=	0	mm <sup>2</sup> /m
Interior support bars, x	=	335	mm <sup>2</sup> /m
Interior support bars, y	=	335	mm <sup>2</sup> /m
Deck trough bars	=	0	mm <sup>2</sup> /m
Rib bars	=	0	mm <sup>2</sup> /m

**Yieldline load-carrying capacity of the slab panel**

mx	=	11	kN/m
my	=	3	kN/m
Negative moment capacity mx'	=	0	kN/m
Negative moment capacity my'	=	0	kN/m
Yieldline dimension L1	=	2	m
Yieldline load carrying capacity wyl, theta	=	2	kN/m <sup>2</sup>
wyl, theta,ss	=	2	kN/m <sup>2</sup>
Limiting deflection d limit	=	281	mm
Maximum deflection dmax	=	357	mm
Tensile membrane enhancement factor e	=	1	

**Moment internal actions**

ax	=	2	mm
ay	=	2	mm
erx	=	131	mm
ery	=	48	mm
Rtsx,total	=	88	kN/m
Rtsy,total	=	66	kN/m
Rtssx,total	=	0	kN/m

**Design load-carrying capacity of the slab panel**

wu	=	5	kN/m <sup>2</sup>
w*	=	4	kN/m <sup>2</sup>

Panel moment/tension membrane capacity is adequate.

**Shear capacity per metre**

Through the slab (vu,slab)	=	11	kN/m
Through the secondary beam (vu,sb,min)	=	16	kN/m
Total design shear capacity (vu)	=	27	kN/m
Design shear (v*)	=	15	kN/m

The shear capacity is ok.

**Time equivalent fire severity**

Time equivalent ( user defined value )	=	60	min
Fire Hazard Category	=	2	

**Concrete compression check**

Cc	=	224	kN
Ccr	=	0	kN
T,cr	=	20	°C
ac,sp	=	62	mm
The concrete passed the compression test			

**Integrity**

The area of reinforcement is sufficient  
Bar spacing in layer 1 is sufficient

**Calculation Sheet**

$w^* = 4,15$	kN/m <sup>2</sup>	Equation A1
$teq = 60$	min	Equation A2
$FRR_{,reo} = 60$	min	Equation A3
$U3x_{,reoL1} = 11$	mm	Equation A4.1.1 / A50.1
$U3x_{,reoL2} = 65$	mm	Equation A4.1.1 / A50.1
$U3y_{,reoL1} = 17$	mm	Equation A4.2.1 / A50.3
$U3y_{,reoL2} = 65$	mm	Equation A4.2.1 / A50.3
$\theta_{sx,reoL1} = 447,92$	°C	Equation A6
$\theta_{sx,reoL2} = 195,36$	°C	Equation A6
$U3_{,isbx} = 10$	mm	Equation A8.1 / A51.1
$U3_{,dtb} = 0$	mm	Equation A4.1.1
$Rtsx_{,reoL1} = 59,23$	kN/m	Equation A11.1 / A53
$Rtsx_{,reoL2} = 0$	kN/m	Equation A11.1
$Rtsx_{,sfj} = 0$	kN/m	Equation A52 - Speedfloor
$Rtsbx_{,tf} = 2,14$	kN/m	Equation A11.2
$Rtsbx_{,w} = 25,95$	kN/m	Equation A11.3
$Rtsbx_{,bf} = 1,07$	kN/m	Equation A11.4
$Rtsx_{,total} = 88,39$	kN/m	Equation A11.5 / A54
$erx = 131,35$	mm	Equation A12 / A56
$ax = 2,97$	mm	Equation A13 / A55
$mx = 11,48$	kNm/m	Equation A14 / A57
$fysb\theta_{,tf} = 60,35$	MPa	Equation A15
$fysb\theta_{,w} = 39,05$	MPa	Equation A15
$fysb\theta_{,bf} = 30,17$	MPa	Equation A15
$Rt_{,crb} = 0$	kN/m	Equation A15.1
$Rtsy_{,reoL1} = 66,73$	kN/m	Equation A16.1 / A58
$Rtsy_{,reoL2} = 0$	kN/m	Equation A16.1
$Rtsy_{,dtb} = 0$	kN/m	Equation A16.2
$Rtsy_{,total} = 66,73$	kN/m	Equation A16.3
$ery = 48$	mm	Equation A17
$ay = 2,24$	mm	Equation A18 / A59
$my = 3,13$	kNm/m	Equation A19 / A60
$m'x = 0$	kNm/m	Equation A20.2 / A62
$m'y = 0$	kNm/m	Equation A21
$Wyl\theta = 2,86$	kN/m <sup>2</sup>	Equation A22
$Wyl\theta_{,ss} = 2,86$	kN/m <sup>2</sup>	Equation A22
$\Delta limit = 281$	mm	Equation A23.3
$\Delta max = 357,2$	mm	Equation A23.6
$L1 = 2,56$	mm	Equation A24
$\mu = 3,67$		Equation A14/A19
$a = 1$		Equation A25
$n = 0,34$		Equation A26
$K = 1,32$		Equation A27
$k = 1,3$		Equation B2
$f_{cu} = 41,18$		
$A = 0,55$		Equation B3.1
$B = 0,34$		Equation B3.2
$b = 1,04$		Equation B3
$m = 0,02$		Equation B4

gox = 0,95		Equation 33.1
goy = 0,91		Equation 33.2
ax = 0,48		Equation 34.1
ay = 0,46		Equation 34.2
bx = 0,01		Equation 35.1
by = 0,02		Equation 35.2
b > F1 (Inelastic stress away from tensile membrane)		
v = 0		Equation B11.1
e1mx = 0,91		Equation B12.1
e2my = 0,96		Equation B12.1
e1bx = 0,88		Equation B13.1
e2by = 1,08		Equation B13.2
e1 = 1,79		Equation B7.1
e2 = 2,03		Equation B7.2
e = 1,86		Equation B8
wu = e . wylq	kN/m <sup>2</sup>	Equation 43
5,33 = 2,86 . 1,86		
vu = 11,29	kN/m	Equation 44 / 63
vu,sb-pb = 42,14	kN/m	Equation 47.1
vu,vsb = 79,25	kN/m	Equation 47.2
vu,sb = 42,14	kN/m	Equation 47.3
V* = 15,81	kN/m	Equation 48 / A65