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CLTdesigner
Version 7.0.3

Summary of results

Project number:

Project:

Structural element:

Cross section: User-defined cross section: 5s - 180 mm

Description:

Date: May 25, 2020

Time: 9:22:14 AM

Author:

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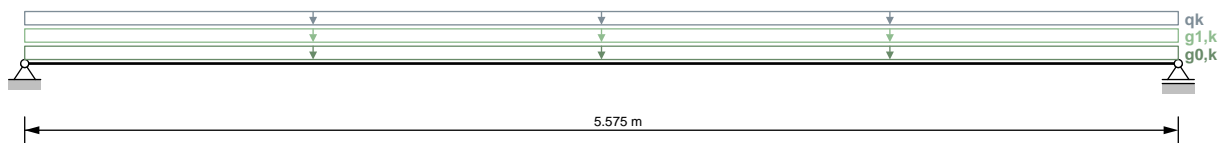
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1 General

Service class 1

2 Structural system

Single span girder



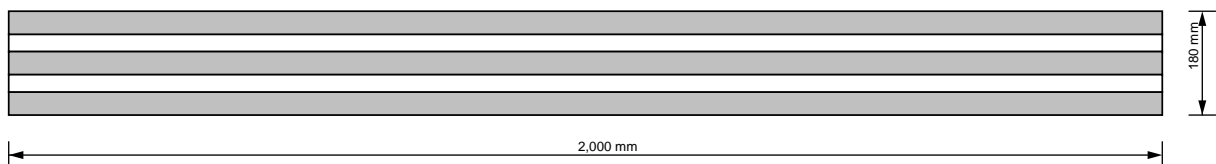
2.1 Supports

Support	x	Width
A	0.0 m	0.1 m
B	5.575 m	0.1 m

3 Cross section

User-defined cross section

5 layers (width: 2,000 mm / thickness: 180 mm)



3.1 Layer composition

Layer	Thickness	Orientation	Material
# 1	40 mm	0	C24_SINTEF
# 2	30 mm	90	C24_SINTEF

# 3	40 mm	0	C24_SINTEF
# 4	30 mm	90	C24_SINTEF
# 5	40 mm	0	C24_SINTEF

Orientation 0 = top layer longitudinal to span; Orientation 90 = top layer perpendicular to span

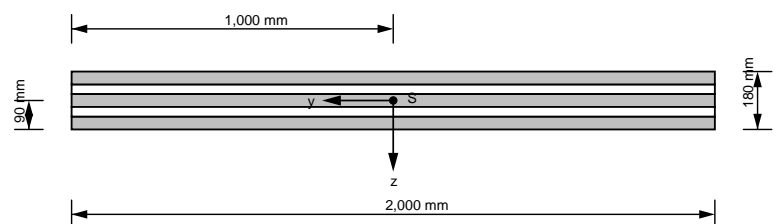
3.2 Material parameters

Partial safety factor $\gamma_M = 1.25$

Material parameters for	C24_SINTEF
bending strength [N/mm ²]	$k_{sys} \cdot 24.0$
tensile strength parallel [N/mm ²]	14.0
tensile strength perpendicular [N/mm ²]	0.4
compressive strength parallel [N/mm ²]	21.0
compressive strength perpendicular [N/mm ²]	5.3
shear strength [N/mm ²]	2.5
rolling shear strength [N/mm ²]	0.7
Youngs modulus parallel [N/mm ²]	11,000.0
5%-quantile from Youngs modulus parallel [N/mm ²]	7,400.0
Youngs modulus perpendicular [N/mm ²]	370.0 (0.0)
shear modulus [N/mm ²]	690.0
rolling shear modulus [N/mm ²]	69.0
density [kg/m ³]	380.0
density mean value [kg/m ³]	500.0

3.3 Cross-sectional values

EA_{ef}	2.64E9 N
$EI_{yy,A}$	3.52E11 N·mm ²
$EI_{yy,B}$	8.624E12 N·mm ²
$GA_{z,A}$	inf N
$GA_{z,B}$	3.978E7 N



4 Loads

Field	$g_{0,k}$	$g_{1,k}$	q_k	Category	s_k	Altitude/Region	w_k
1	1.7658 kN/m	0.6 kN/m ²	2 kN/m ²	A			

Partial safety factors:

$$\gamma_G = 1.35$$

$$\gamma_Q = 1.5$$

Load position:

Plate weight: Total

Permanent loads: Total

Imposed loads: Field-by-field

Snow: Field-by-field

Wind: Total

Combinations:

Combination factors: according to NA

Combinations of distributed and concentrated loads:

q_k and Q_k will be considered as one load group

s and S will be considered as one load group

w_k and W_k will be considered as one load group

5 Specification concerning structural fire design

Fire duration: 90 minutes

Side exposed to fire: below

Use of an adhesive with increased fire resistance

$$k_{fire} = 1.15$$

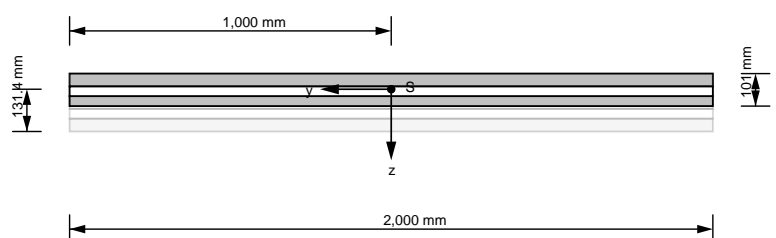
$$d_0 = 7 \text{ mm}$$

Partial safety factor $\gamma_{M,fi} = 1.0$

Charring rate $\beta_n = 0.80 \text{ mm/min}$

5.1 Cross-sectional values in case of fire

EA_{ef}	1.562E9 N
$EI_{yy,A}$	1.72E11 N·mm ²
$EI_{yy,B}$	1.648E12 N·mm ²
$GA_{z,A}$	inf N
$GA_{z,B}$	1.765E7 N



6 Information concerning vibrations

high requirements

Damping factor: 1.0 %

Support: 2-sided

Width perpendicular to the main load bearing direction: 2.0 m

7 Results

Referenced standards: EN 1995-1-1:2009, ON B 1995-1-1/NA:2014-11-15

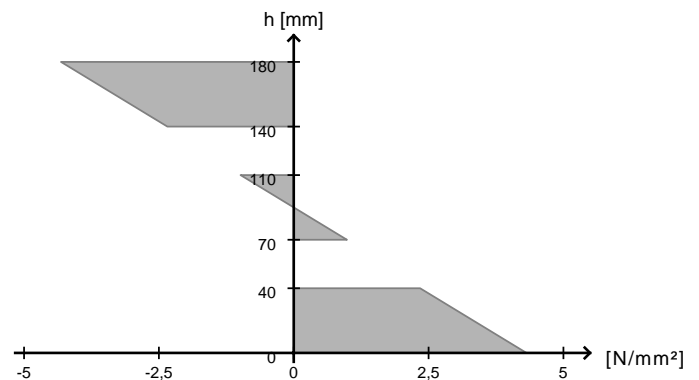
Underlying calculation method: Shear Analogy Method

Maximum linking distance: 0.18 m

7.1 ULS

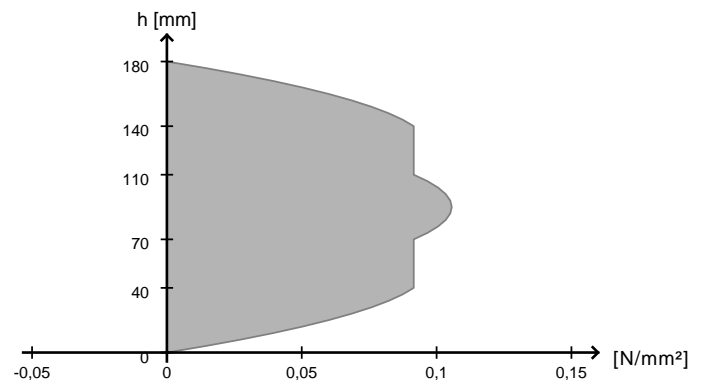
7.1.1 Bending

Utilisation ratio	25.5 %
k_{mod}	0.8
at x	2.788 m
E_k	2
Fundamental combination	$1.35 \cdot g_{0,k} + 1.35 \cdot g_{1,k} + 1.50 \cdot 1.00 \cdot q_k$



7.1.2 Shear

Utilisation ratio	20.4 %
k_{mod}	0.8
at x	0.0 m
E_k	2
Fundamental combination	$1.35 \cdot g_{0,k} + 1.35 \cdot g_{1,k} + 1.50 \cdot 1.00 \cdot q_k$



7.1.3 Bearing pressure

Utilisation ratio	3.2 %
k_{mod}	0.8
at x	0.0 m
E_k	2
Fundamental combination	$1.35 \cdot g_{0,k} + 1.35 \cdot g_{1,k} + 1.50 \cdot 1.00 \cdot q_k$



7.2 SLS

7.2.1 Deflection

Limit values according to EN 1995-1-1

Instantaneous deformation $w_{\text{inst}} t = 0$: $l/300$ (10.4 mm, 55.9 %)

Final deformation $w_{\text{net,fin}} t = \text{inf}$: $l/250$ (15.7 mm, 70.3 %)

Final deformation $w_{\text{fin}} t = \text{inf}$: $l/150$ (15.7 mm, 42.2 %)

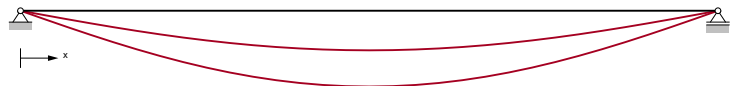
Limit values according to ON B 1995-1-1/NA:2014-11-15

Instantaneous deformation $w_{\text{inst}} t = 0$: $l/300$ (10.4 mm, 55.9 %)

Final deformation $w_{\text{net,fin}} t = \text{inf}$: $l/250$ (11.5 mm, 51.5 %)

Final deformation $w_{\text{fin}} t = \text{inf}$: $l/150$ (15.7 mm, 42.2 %)

Utilisation ratio	70.3 %
w_{max}	15.7 mm
k_{def}	0.85
at x	2.788 m
E_k	10
Final deformation $w_{\text{net,fin}} t = \text{inf}$ ($l/250$)	



7.2.2 Vibration

The verification is only valid for residential ceilings!

7.2.2.1 Verification corresponding to EN 1995-1-1

Eigenfrequency: $f_1 = 8.45 \text{ Hz} > 8.0 \text{ Hz}$

Stiffness: $w_{1\text{kN}} = 0.869 \text{ mm} < 1.00 \text{ mm}$

Velocity/Unit impuls: $v = 2.335 \text{ mm/s} < 11.78 \text{ mm/s}$

---> Vibration verification fulfilled (94.7 %)

7.2.2.2 Verification corresponding to ON B 1995-1-1/NA:2014-11-15

Eigenfrequency: $f_1 = 8.45 \text{ Hz} > 8.0 \text{ Hz}$

Stiffness: $w_{1kN} = 0.869 \text{ mm} > 0.25 \text{ mm}$

---> Vibration verification not fulfilled (347.4 %)

7.2.2.3 Verification corresponding to DIN 1052

$w_{perm} = 6.21 \text{ mm} > 6.0 \text{ mm}$ ---> Vibration verification is not fulfilled or more accurate verification is needed! (103.5 %)

7.2.2.4 Verification according to Hamm/Richter

Eigenfrequency: $f_1 = 8.71 \text{ Hz} > 8.0 \text{ Hz}$

Stiffness: $w_{2kN} = 0.804 \text{ mm} > 0.50 \text{ mm}$

---> Vibration verification not fulfilled (160.9 %)

7.2.2.5 Verification according to modified Hamm/Richter

Eigenfrequency: $f_1 = 8.7 \text{ Hz} > 8.0 \text{ Hz}$

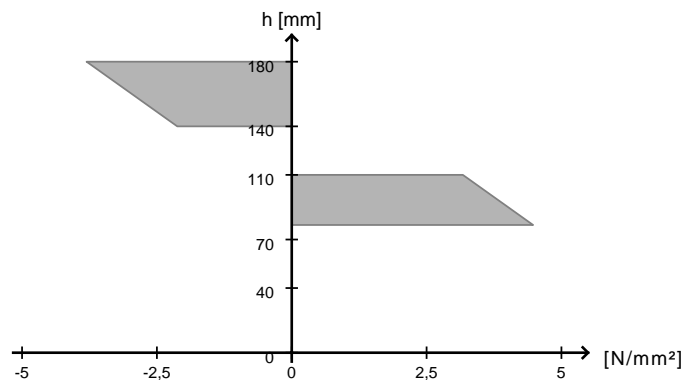
Stiffness: $w_{2kN} = 0.804 \text{ mm} > 0.50 \text{ mm}$

---> Vibration verification not fulfilled (160.9 %)

7.3 ULS in case of fire

7.3.1 Bending

Utilisation ratio	14.7 %
k_{mod}	1.0
at x	2.788 m
E_k	6
Accidental combination	$g_{0,k} + g_{1,k} + 0.30 \cdot q_k$



7.3.2 Shear

Utilisation ratio	10.1 %
k_{mod}	1.0
at x	0.0 m
E_k	6
Accidental combination	$g_{0,k} + g_{1,k} + 0.30 \cdot q_k$

