Pretensioned tapered box bridge (FCM)

Principle workflow:

1. **Analysis 1** is transient (day 0 → 120 years) considering prestress, dead weight, relaxation, creep and and shrinkage during alla stages of construction.
   This analysis is transient with regard to material and active parts of structure during construction. In total there are 7 differrent construction stages.

2. **Analysis 2** is none transient and only linear. This is analysis is used for all loads acting after completed construction.

3. Results from **Analysis 1 & 2** are combined to ULS & SLS.

CONTENTS

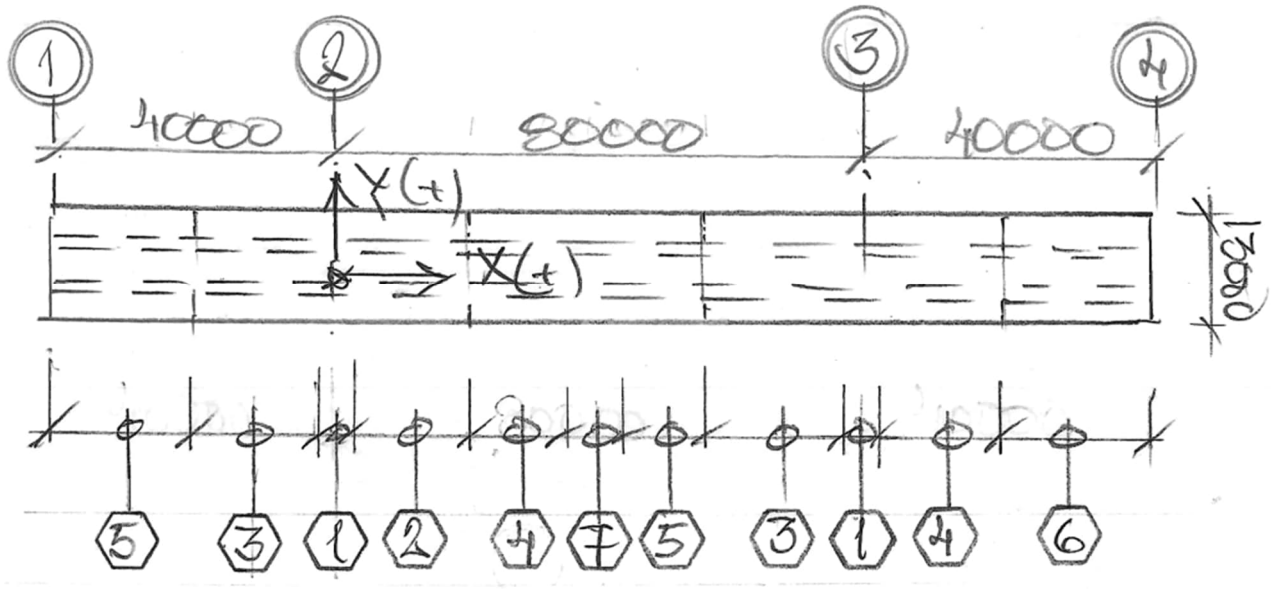
1. GENERAL / MEASUREMENT

1.1 CONSTRUCTION TYPE

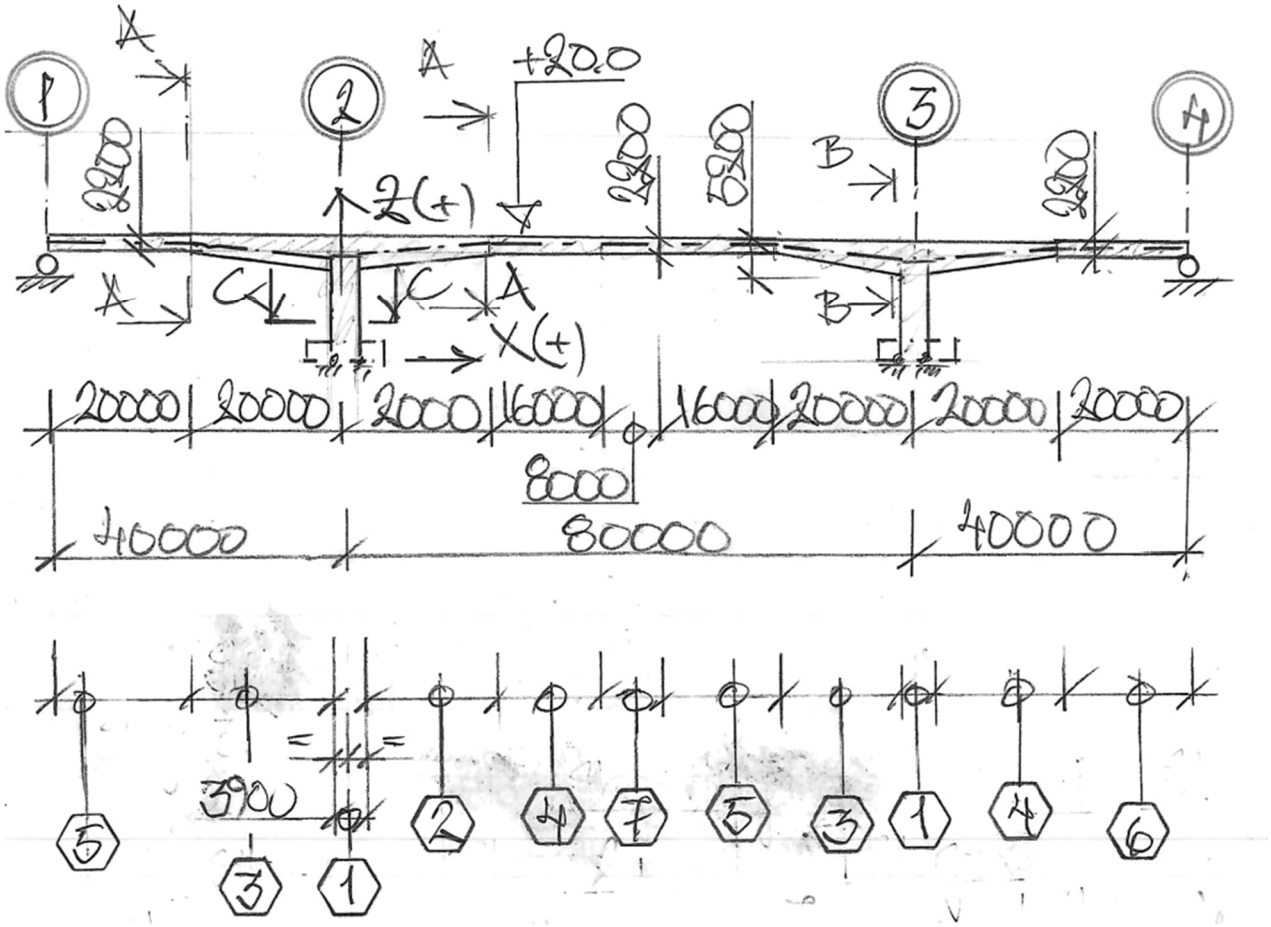
The bridge is a pretensioned single box bridge constructed using a free cantilever method (FCM).

In total 7 casting stages is assumed.

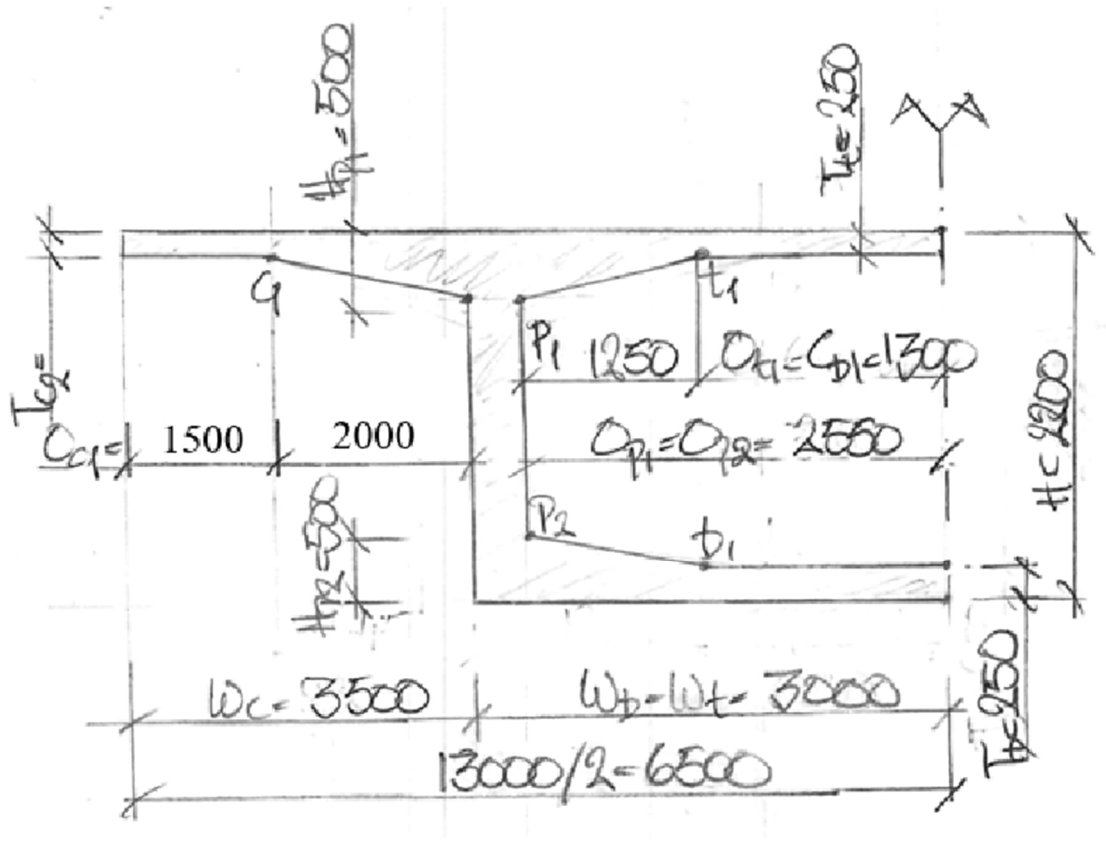
1.2 MEASURMENT



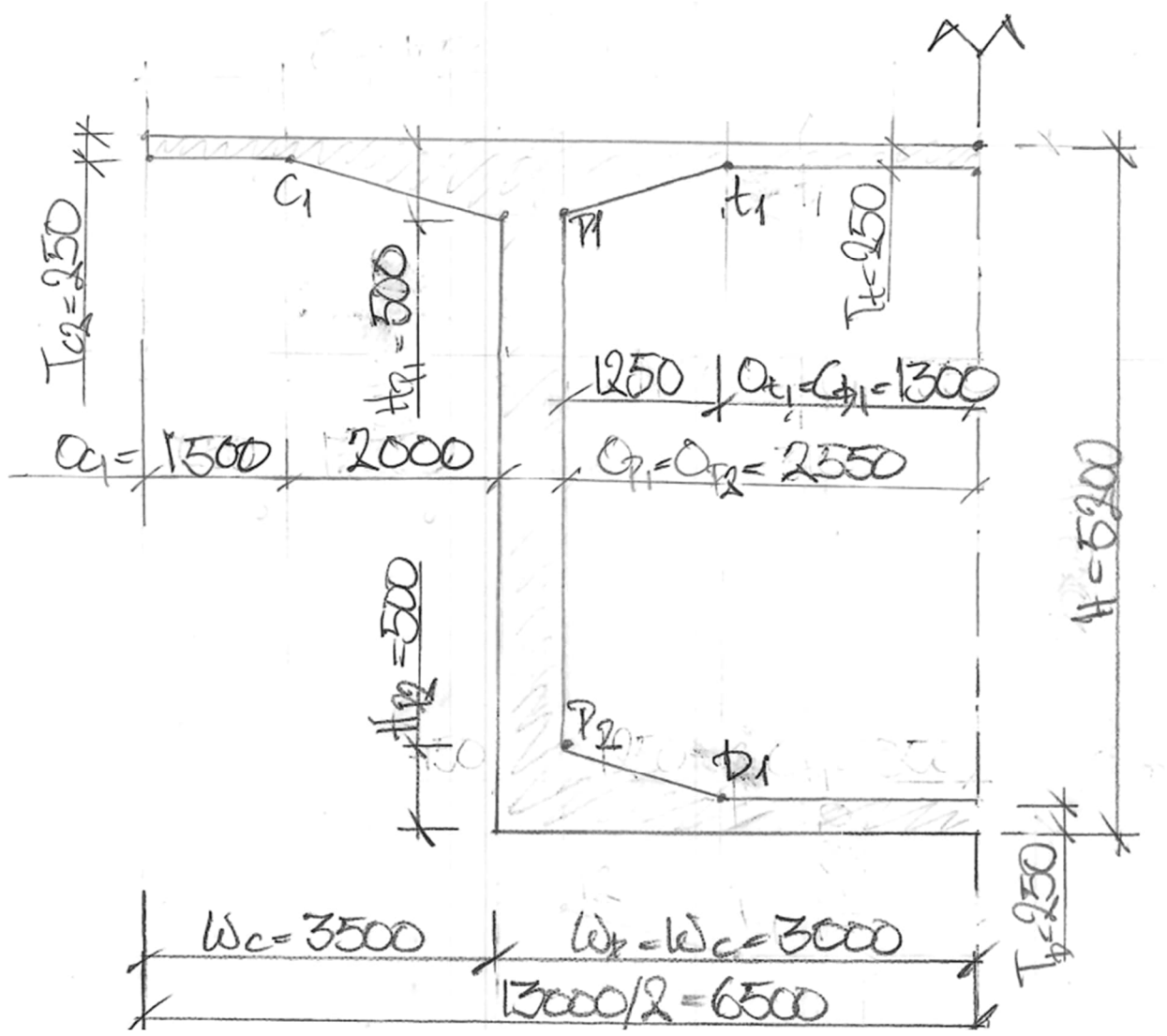
PLAN



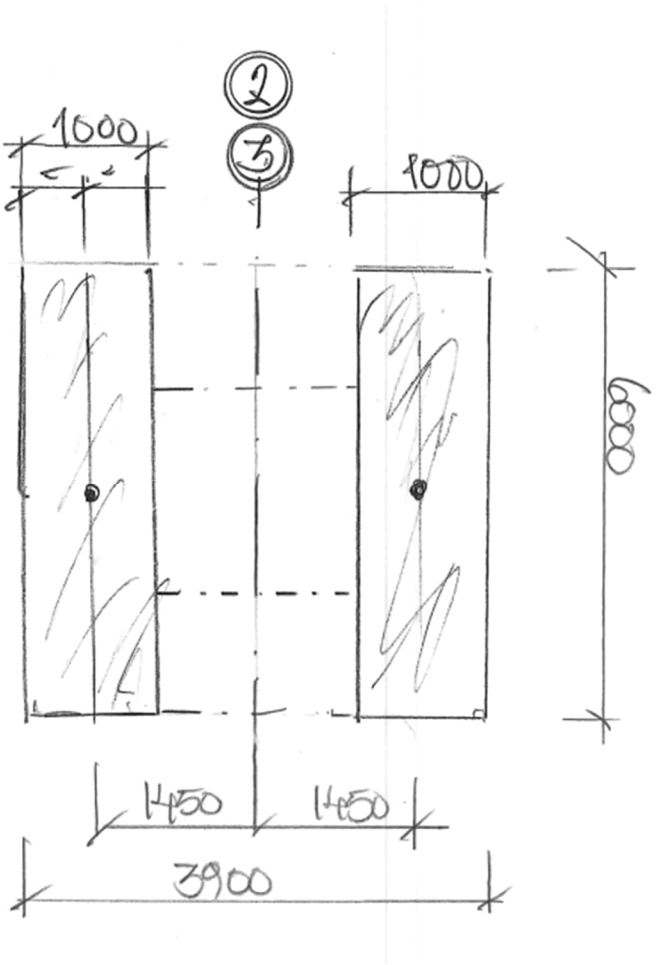
ELEVATION


Hp1=500
Tu=250
Tc2=
Cc1=
1500
2000
Hp2=500
P1
1250
Cp1=Cp1=1300
Cp1=Cp2=2550
P2
t1
t1
Hc=2200
Tb=250
Wc=3500
Wb=Wt=3000
13000/2=6500

SECTION A-A


C1
P1
t1
Tc=250
Tt=250
Hc1=500
Ht1=500
1250
Oc1=Ct1=1300
Oc1=1500
2000
Ot1=Ot2=2350
H=5200
Hc2=500
Ht2=500
P2
D1
Wc=3500
Wt=Wc=3000
13000/2=6500

SECTION B-B



SECTION C-C

1.3 FOUNDATION

Bottom slabs are assumed resting on rock.

1.4 CODE OCH TENDER DOCUMENTS

- ”Bro och broliknande konstruktion allmänna krav” (TRVINFRA-00226 v5)
- ”Bro och broliknande konstruktion byggande” (TRVINFRA-0027 v6)
- ”TSFS 2018:57 med ändringar tom TSFS 2022:50”
- ”AMA Anläggning 23”
- ”TRV ändringar och tillägg till AMA 23” (TDOK 2023:0125 v3)
- ”Geokonstruktion dimensionering och utformning” (TRVINFRA-00230 v2)
- Document SS-EN 1990 to SS-EN 1999, see TRVINFRA section A.1.2.3.2

1.5 TECHNICAL SERVICE LIFE

Technical life span 120 years (L100).

1.6 ENVIRONMENT

Road traffic enviroment (“vägmiljö”) is assumed for the overlying traffic road since salt is used at winter, see TB section B1.

1.7 MATERIAL

Concrete :	C35/45 (CEM I 42.5 N, Anläggningscement klass N)
Reinforcement :	B500B
Compacted fill :	”Förtärkningslagermaterial” according to AMA CEB.415
Backfill :	”Grovkrossad sprängsten” according to AMA CEB.524
Surfacing :	See document RKFM
Pretension:	VSL system or eqivalent

1.8 GEOTECHNICAL CLASS

Geotechnical class GK2

1.9 SAFETY CLASS

Geotechnical resistance: SK 2

Brigde structure : SK 3

1.10 CONCRETE COVER AND CRACK CRITERIA

Class identification bridge components :

Bridge components	Exposure class[1.)]	Life spann	max vct_{ekv}[2.)]	ζ [3.)]
Substructure incl. linkplate:				
▫ Wingwall towards filling	XD1/XF4	L100	0.45	1.5
▫ Wingwall from filling	XD1/XF4	L100	0.45	1.5
▫ Abutement below ground	XC2/XF3	L100	0.50	1.0
▫ Abutement in air	XC4/XF3	L100	0.50	1.2
▫ Bottom slab in general	XC2/XF3	L100	0.50	1.0
▫ Bottom slab underside	XC2/XF3	L100	0.50	1.0
▫ Link slab in general	XD3/XF2	L100	0.40	1.8
▫ Link slab underside	XD3/XF2	L100	0.40	1.8
Superstructure:				
▫ Edge beam	XD3/XF4	L100	0.40	1.8
▫ Bridge deck	XD1/XF4	L100	0.40	1.5
▫ End shield towards filling	XD1/XF4	L100	0.40	1.5
▫ End shield from filling	XC2/XF3	L100	0.50	1.0

Footnote:
1.) TRVINFRA-00227 section 5.3.2.3
2.) TSFS table 12.1
3.) TSFS table 12.3

Design parameters low corrosion sensitive reinforcement (rebars):

$c_{min.dur}$: minimum cover with regard to environmental impact

$c_{min.b}$: minimum cover with regard to adhesion requirements

Δc_{dev} : execution tolerance

$c_{min} = \max(c_{min.b}; c_{min.dur}; 10mm)$: SS-EN 1992-1-1 eq. 4.2

$c_{nom} = c_{min} + \Delta c_{dev}$: SS-EN 1992-1-1 eq. 4.1, noted as BM on the drawing

Construction part	$c_{min.dur}$ [1.]	$c_{min.b}$ [2.]	c_{min}	c_{dev} [3.]	c_{nom}	$w_{k,till}$ [4.]
Substructure incl. linkplate:						
▫ Wingwall towards filling	30	20	30	10	40	0.20
▫ Wingwall from filling	30	20	30	10	40	0.20
▫ Abutement below ground	20	20	20	10	30	0.40
▫ Abutement in air	25	20	25	10	35	0.30
▫ Bottom slab in general	20	20	20	10	30	0.40
▫ Bottom slab underside	20	20	20	10	30	0.40
▫ Link slab in general	45	20	45	10	55	0.15
▫ Link slab underside	45	20	45	10	60 [5.]	0.15
Superstructure:						
▫ Edge beam	45	20	45	10	55	0.15
▫ Bridge deck	25	20	25	10	35	0.20
▫ End shield towards filling	25	20	25	10	35	0.20
▫ End shield from filling	25	20	25	10	35	0.40

Footnotes:

1.) TSFS table 12.1

2.) SS-EN 1992-1-1 section 4.4.1.2 table 4.2

3.) SS-EN 1992-1-1 section 4.4.1.3

4.) TSFS tabele 12.2

5.) TSFS chapter 12 paragraph 3§ $k_1 = c_{min} + 15$ mm vhen casting against building foil.

Design parameters high corrosion sensitive reinforcement (pretension):

$c_{min.dur}$: minimum cover with regard to environmental impact

$c_{min.b}$: minimum cover with regard to adhesion requirements

Δc_{dev} : execution tolerance

$c_{min} = \max(c_{min.b}; c_{min.dur}; 10mm)$: SS-EN 1992-1-1 eq. 4.2

$c_{nom} = c_{min} + \Delta c_{dev}$: SS-EN 1992-1-1 eq. 4.1, noted as BM on the drawing

Construction part	$c_{min.dur}$ 1.)	$c_{min.b}$ 2.)	c_{min}	c_{dev} 3.)	c_{nom}	$w_{k,till}$ 4.)
Superstructure:						
▫ Top bridge deck	25	90	90	10	100	*
▫ Other part of bridge deck	25	90	90	10	100	*
	mm	mm	mm	mm	mm	mm

Footnotes:

1.) TSFS table 12.1

2.) SS-EN 1992-1-1 section 4.4.1.2 (3) specifies pretension tube ϕ90

3.) SS-EN 1992-1-1 section 4.4.1.3

4.) TSFS table 12.2 states that crack width is not needed when ”tensile stress” for SLS-F is less than $f_{ctk.0.05}/\zeta$

1.11 CONSTRUCTION STAGES

The construction of bridge is performed using free cantilever method (FCM).

A total of 7 stages with construction time seen below.

It is assumed that concrete is activated structurally after 7 days. The time between casting stages is assumed to be 10 days.

Stage 1
Time: 0 day → 10 day (time after casting of stage piers)

Stage 2
Time: 11 day → 20 day

Stage 3
Time: 21 day → 30 day

Stage 4
Time: 31 day → 40 day

Stage 5
Time: 41 day → 50 day

Stage 6
Time: 51 day → 60 day

Stage 7
Time: 61 day → 70 day

2. SYSTEM ANALYSIS

2.1 GENERAL

The pretensioned single box bridge constructed using a free cantilever method (FCM). The construction during 7 stages.

Entire structure is modelled with 3D-beam elements a location of nodal lines.

Entire structure is modelled using isotropic material.

In system analysis gross cross section may be used for longitudinal beams in superstructure, see SS-EN 1992-1-1 section 5.3.2.1 (4).

The effect of creep and shrinkage is considered by applying times of construction stages.

During the 7 stages of construction a method of activation is applied.

In the model the static effect of edge beam is not considered according to technical practice since edge beams generally need replacement.

When determining the long-term effect of creep, shrinkage and relaxation 120 years is considered ($\therefore$ 43 800 days).

Several different static models are applied depending on casting stage. The base analysis is the static linear model with entire structure active (= Analysis 2). During the casting stages part of superstructure are deactivated as seen in table below.

Loadcase	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Analysis
LC stage 1	Active	Deactive	Deactive	Deactive	Deactive	Deactive	Deactive	1
LC stage 2	Active	Active	Deactive	Deactive	Deactive	Deactive	Deactive	1
LC stage 3	Active	Active	Active	Deactive	Deactive	Deactive	Deactive	1
LC stage 4	Active	Active	Active	Active	Deactive	Deactive	Deactive	1
LC stage 5	Active	Active	Active	Active	Active	Deactive	Deactive	1
LC stage 6	Active	Active	Active	Active	Active	Active	Deactive	1
LC stage 7	Active	Active	Active	Active	Active	Active	Deactive	1
Longterm	Active	Active	Active	Active	Active	Active	Active	1
Traffic	Active	Active	Active	Active	Active	Active	Active	2*
Surfacing	Active	Active	Active	Active	Active	Active	Active	2*
Settlement	Active	Active	Active	Active	Active	Active	Active	2*
Wind	Active	Active	Active	Active	Active	Active	Active	2*
Braking	Active	Active	Active	Active	Active	Active	Active	2*
Lateral	Active	Active	Active	Active	Active	Active	Active	2*
Temperature	Active	Active	Active	Active	Active	Active	Active	2*

Table of construction stages
(* = Base analysis)

Appendices:

Appendix	Name
1	Input receipt
2	Results reactions
3	Results piers
4	Results superstructure

2.2 SKETCH SYSTEM ANALYSIS

2.2.1 Geometry

In order to describe geometry first POINTS are defined.

Beam elements are defined by applying attributes to LINES.

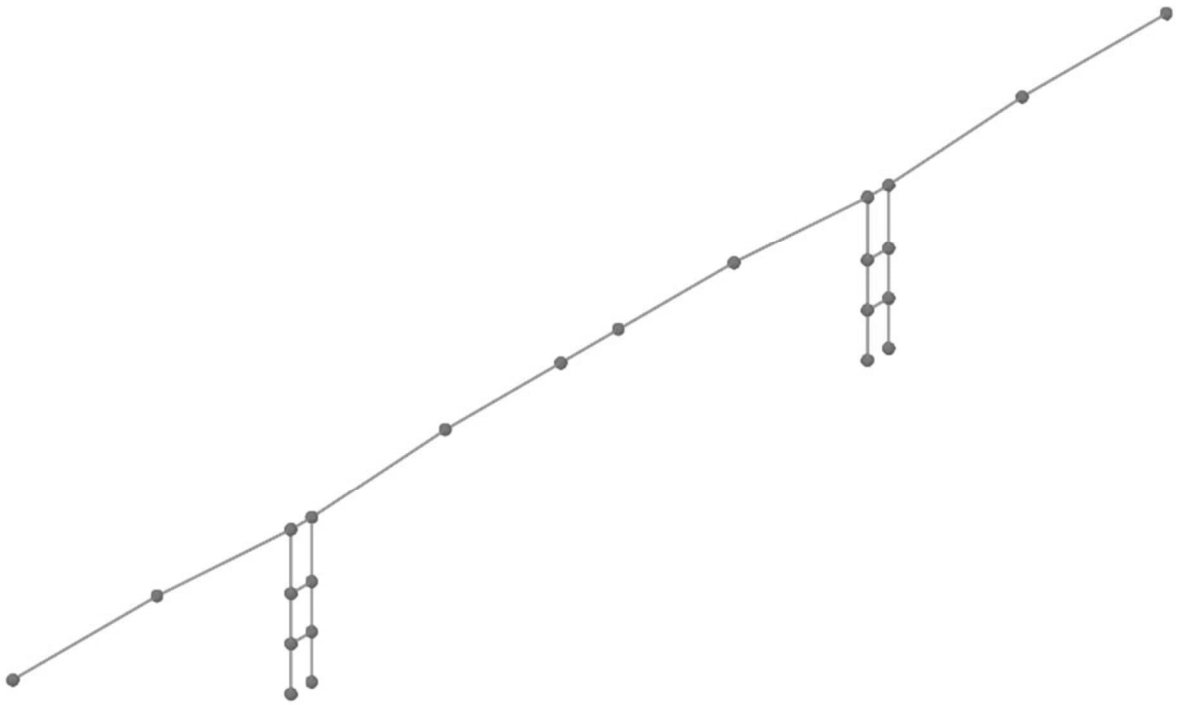
Attached pictures are retrieved from graphical sketches generated by FEM program of POINTS and LINES.

All coordinates needed to describe POINTS are found in Appendix 1.

All POINTS needed to describe LINES are found in Appendix 1.

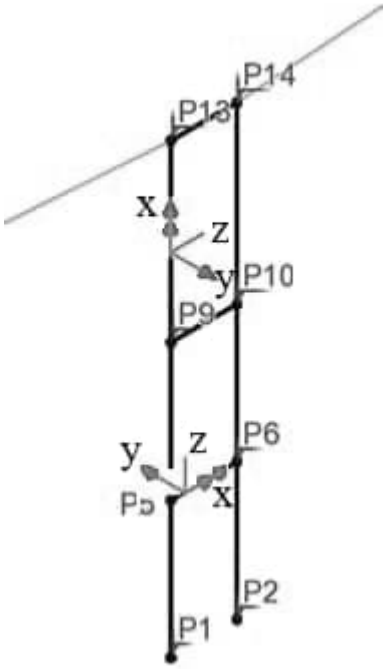
It is generally good technical practice to let nodal line be close to centroid of superstructure when large normal forces (Fx) are applied, thus nodal line is in this example chosen to be centroid of cross section.

Overview :

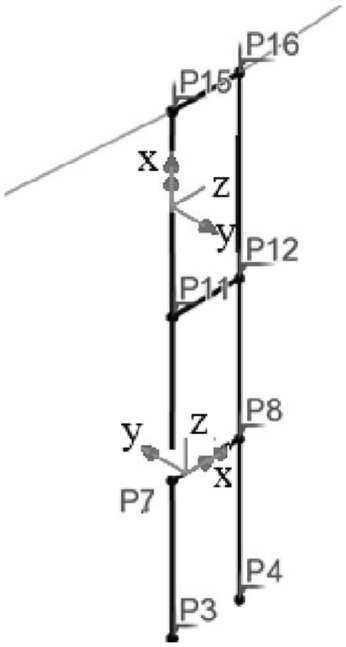


2.2.1.1 Geometry : POINTS

Pier – support 2 :

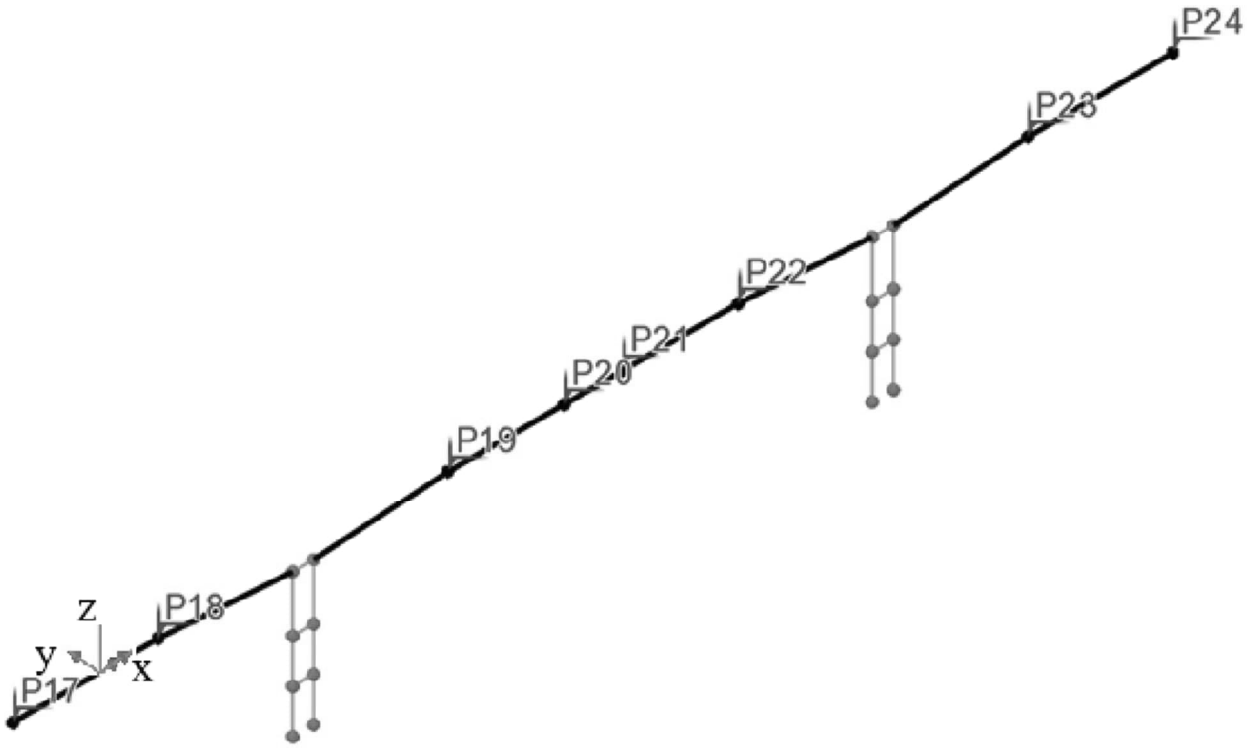


Pier – support 3 :



Remark
See direction local coordinate system.

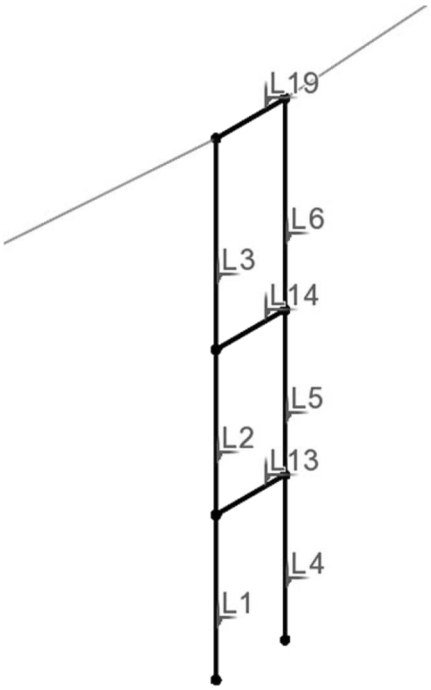
Superstructure :



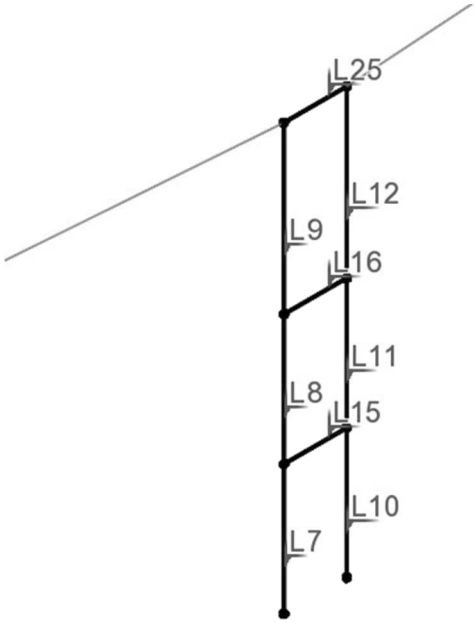
Remark
See direction local coordinate system.

2.2.1.2 Geometry : LINES

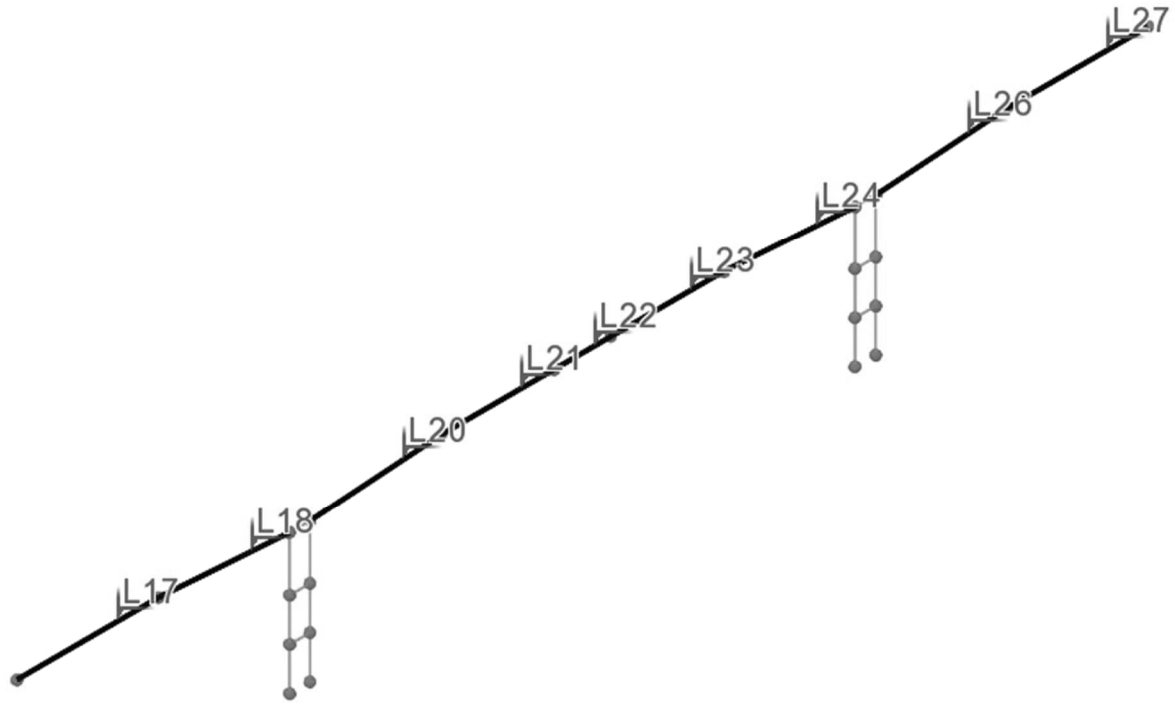
Pier – support 2 :



Pier – support 3 :



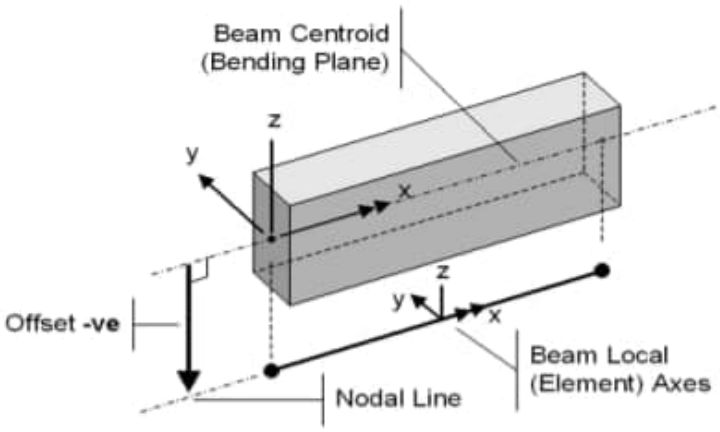
Superstructure :



2.3 CROSS SECTION PROPERTIES

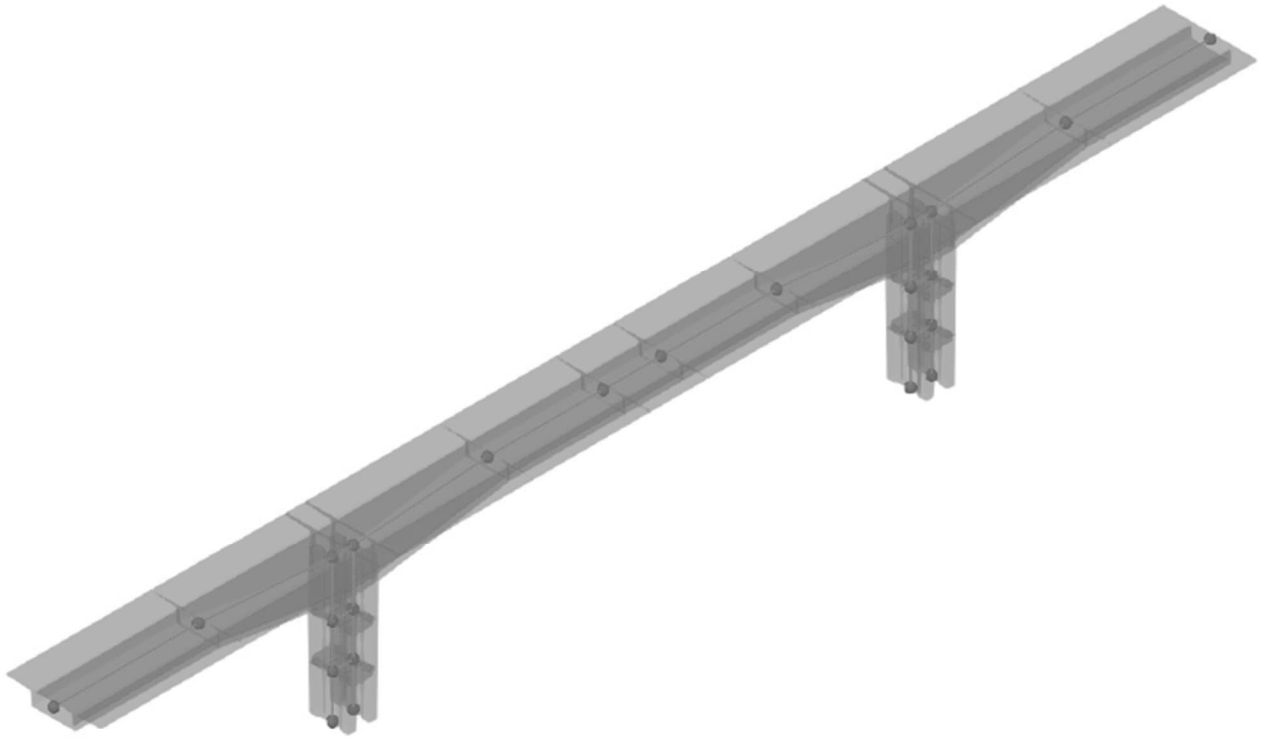
The structure only contain 3D-beams (”Thick beam” / BMS3).

Principal sketch of geometry associated to 3D beam elements are seen below.



Principal sketch
3D-element

Overview 2D
Graphic visualization



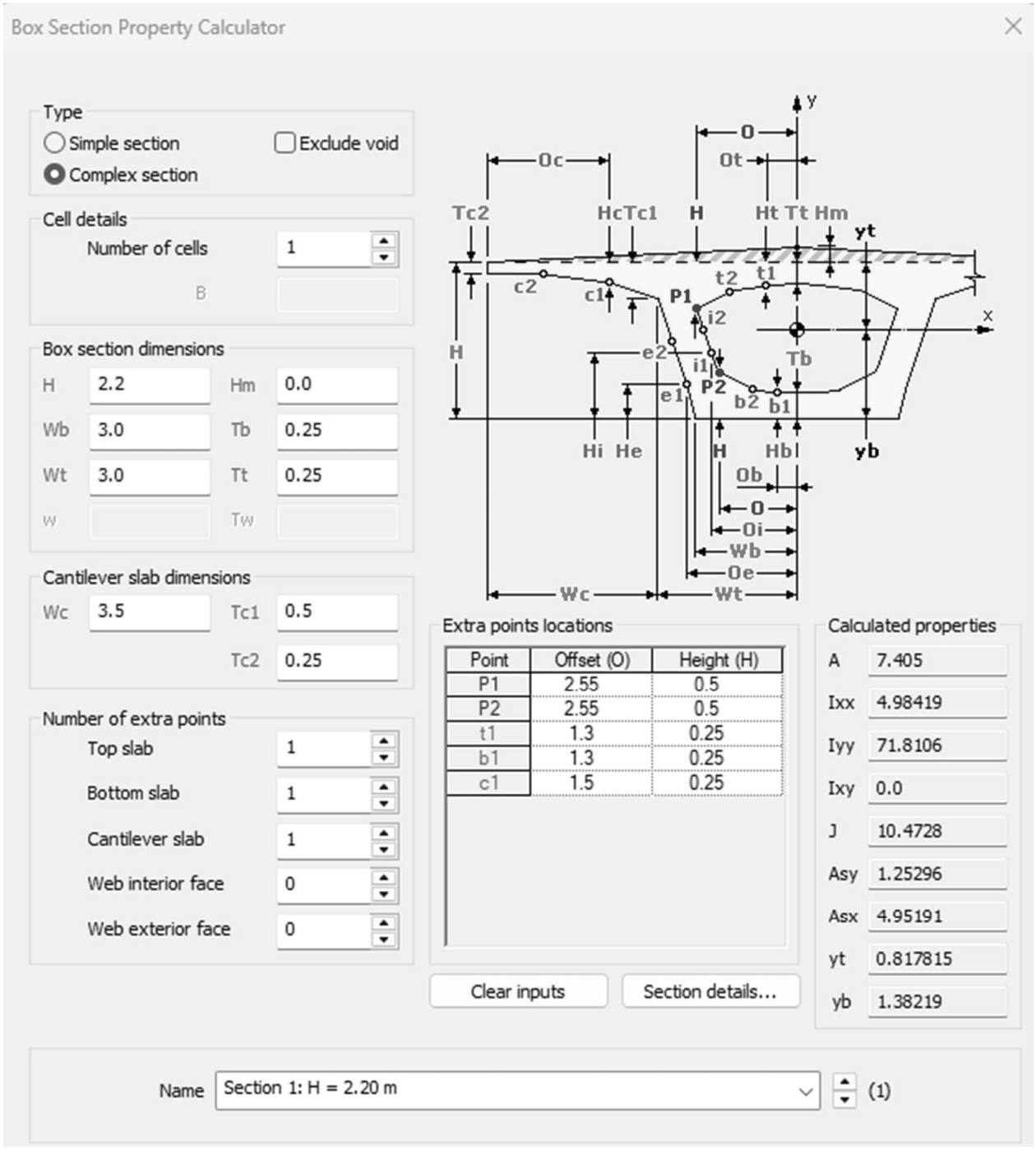
Overview 3D
Graphic visualization

2.3.1 Definition cross sections

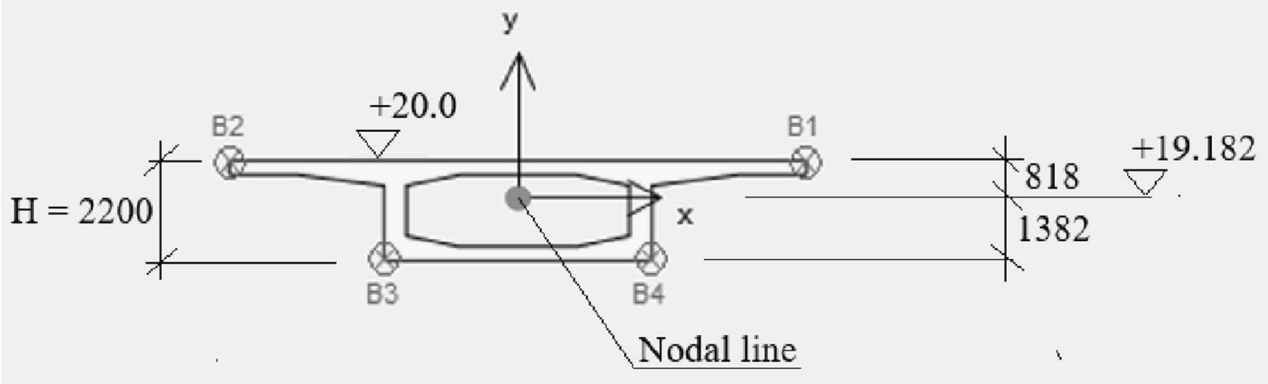
2.3.1.1 Section 1 (superstructure - H = 2.20 m)

The geometry seen below is used to calculate cross section properties.

Input measurements (see page A1:4):



Results section properties:



Cross section properties

Section Details

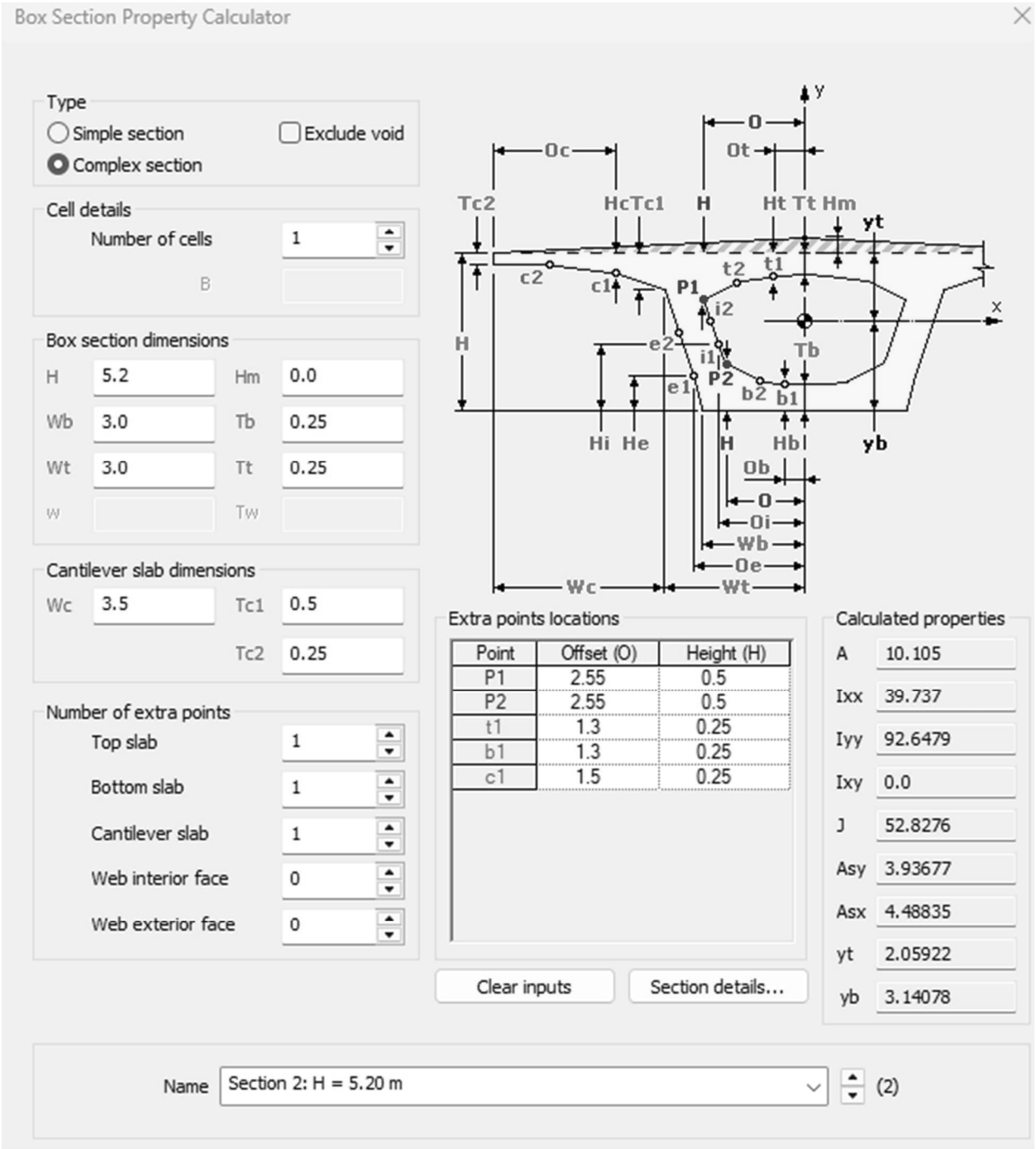
Calculated properties

		Value
Cross sectional area	A	7.405
Second moment of area about x axis	Ixx	4.98419
Second moment of area about y axis	Iyy	71.8106
Product moment of area	Ixy	0.0
Torsional constant	J	10.4728
Effective shear area in x direction	Asx	4.95191
Effective shear area in y direction	Asy	1.25296
Radius of gyration about x axis	kx	0.820417
Radius of gyration about y axis	ky	3.1141
Warping torsional constant about shear centre	Cw	9.99191
Shear centre x distance from centroid	xo	0.0
Shear centre y distance from centroid	yo	-0.30773
Monosymmetry constant about x	betax	5.18158
Monosymmetry constant about y	betay	0.0
Wagner constant 1st moment of square radius about x	Ixr	22.7589
Wagner constant 1st moment of square radius about y	Iyr	9.19688E-12
Wagner constant 4th moment of area about origin	Irr	1.46954E3
Wagner constant 2nd moment of warping about origin	Iwr	0.101117E-3
Plastic section modulus about x axis	Zpx	4.9871
Plastic section modulus about y axis	Zpy	20.2249
Plastic torsional section modulus	Zpt	10.5737
Plastic neutral axis, distance from centroid along x axis	xp	0.0
Plastic neutral axis, distance from centroid along y axis	yp	0.498134

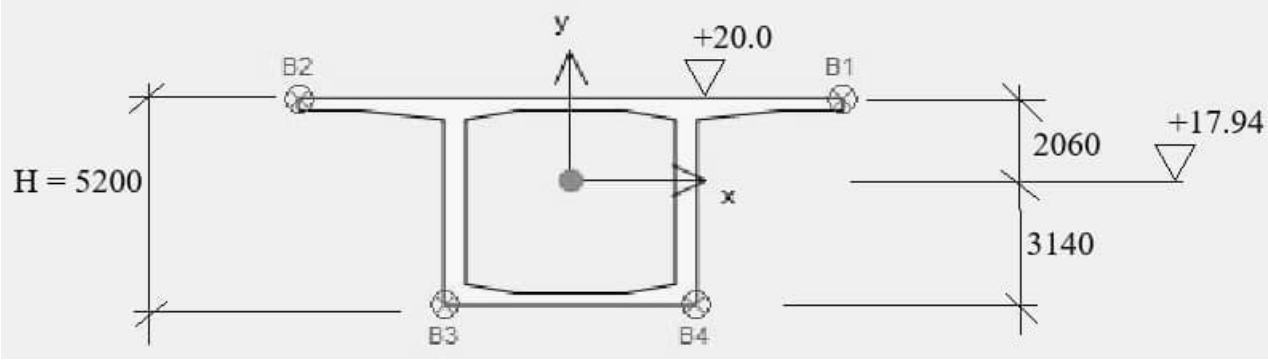
2.3.1.2 Section 2 (superstructure - H = 5.20 m)

The geometry seen below is used to calculate cross section properties.

Input measurements (see page A1:5):



Results section properties:



Cross section properties

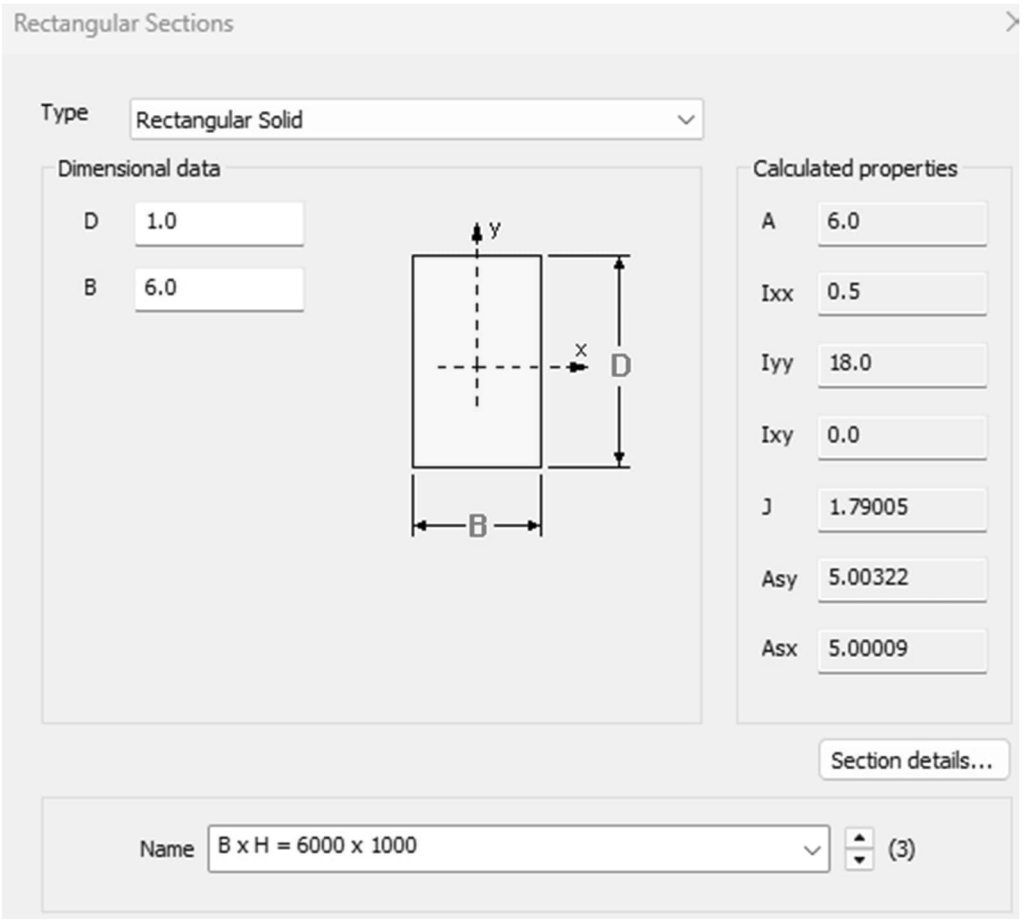
Calculated properties

		Value
Cross sectional area	A	10.105
Second moment of area about x axis	Ixx	39.737
Second moment of area about y axis	Iyy	92.6479
Product moment of area	Ixy	0.0
Torsional constant	J	52.8276
Effective shear area in x direction	Asx	4.48835
Effective shear area in y direction	Asy	3.93677
Radius of gyration about x axis	kx	1.98303
Radius of gyration about y axis	ky	3.02796
Warping torsional constant about shear centre	Cw	29.0359
Shear centre x distance from centroid	xo	0.0
Shear centre y distance from centroid	yo	-0.258516
Monosymmetry constant about x	betax	1.37144
Monosymmetry constant about y	betay	0.0
Wagner constant 1st moment of square radius about x	Ixr	33.9537
Wagner constant 1st moment of square radius about y	Iyr	31.6767E-12
Wagner constant 4th moment of area about origin	Irr	2.4264E3
Wagner constant 2nd moment of warping about origin	Iwr	-2.52373E-3
Plastic section modulus about x axis	Zpx	17.8703
Plastic section modulus about y axis	Zpy	27.7174
Plastic torsional section modulus	Zpt	23.9675
Plastic neutral axis, distance from centroid along x axis	xp	0.0
Plastic neutral axis, distance from centroid along y axis	yp	0.709232

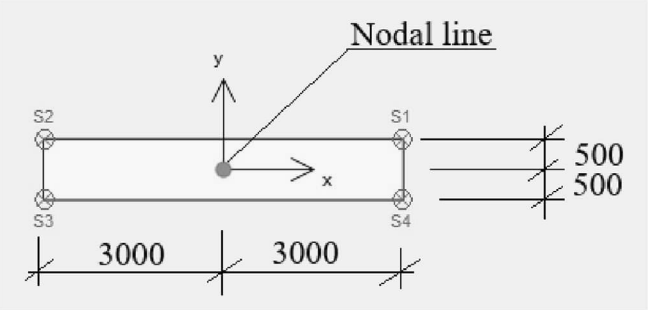
2.3.1.3 Section 3 (rectangular: B x H = 6000 x 1000)

The geometry seen below is used to calculate cross section properties.

Input measurements (see page A1:6):



Cross section properties



Cross section properties

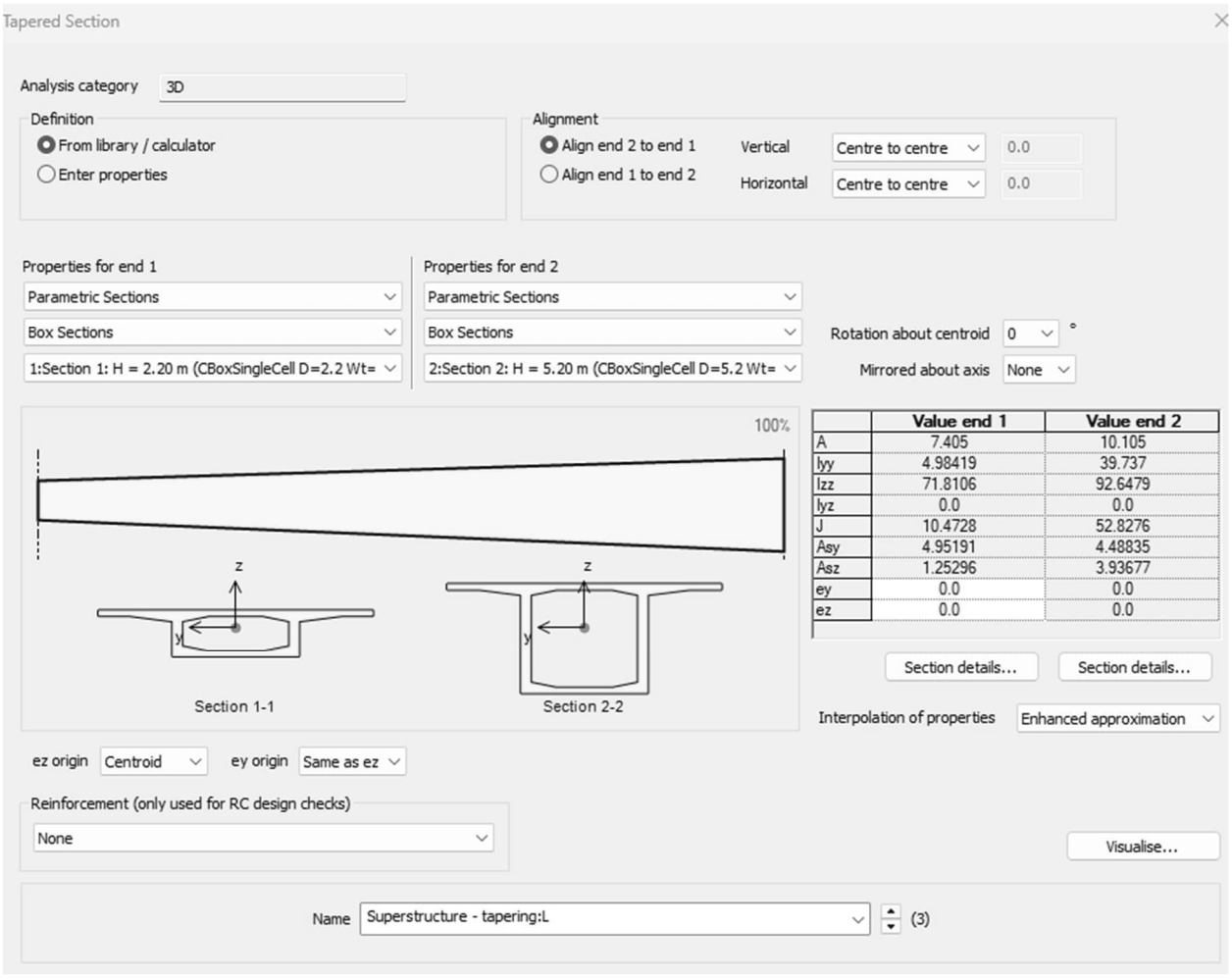
Section Details

Calculated properties

		Value
Cross sectional area	A	6.0
Second moment of area about x axis	Ixx	0.5
Second moment of area about y axis	Iyy	18.0
Product moment of area	Ixy	0.0
Torsional constant	J	1.79005
Effective shear area in x direction	Asx	5.00009
Effective shear area in y direction	Asy	5.00322
Radius of gyration about x axis	kx	0.288675
Radius of gyration about y axis	ky	1.73205
Warping torsional constant about shear centre	Cw	1.33189
Shear centre x distance from centroid	xo	0.0
Shear centre y distance from centroid	yo	0.0
Monosymmetry constant about x	betax	0.0
Monosymmetry constant about y	betay	0.0
Wagner constant 1st moment of square radius about x	Ixr	-0.116161E-15
Wagner constant 1st moment of square radius about y	Iyr	-16.9033E-15
Wagner constant 4th moment of area about origin	Irr	100.275
Wagner constant 2nd moment of warping about origin	Iwr	-10.2689E-12
Plastic section modulus about x axis	Zpx	1.5
Plastic section modulus about y axis	Zpy	9.0
Plastic torsional section modulus	Zpt	3.95898
Plastic neutral axis, distance from centroid along x axis	xp	0.0
Plastic neutral axis, distance from centroid along y axis	yp	0.0

2.3.2 Superstructure: vary height left

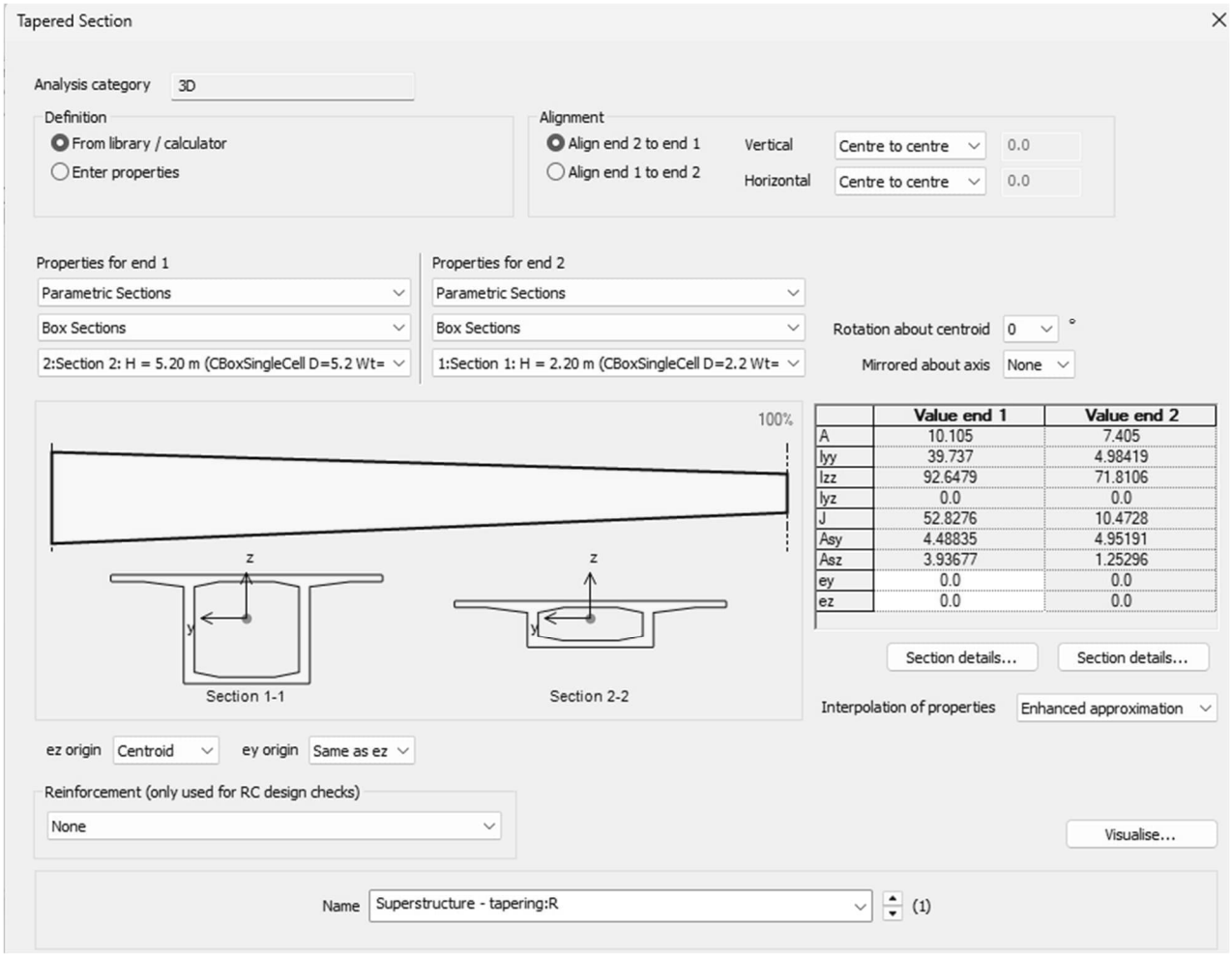
This part of beam is tapered with section varying linearly from section 1 → section 2.



‘

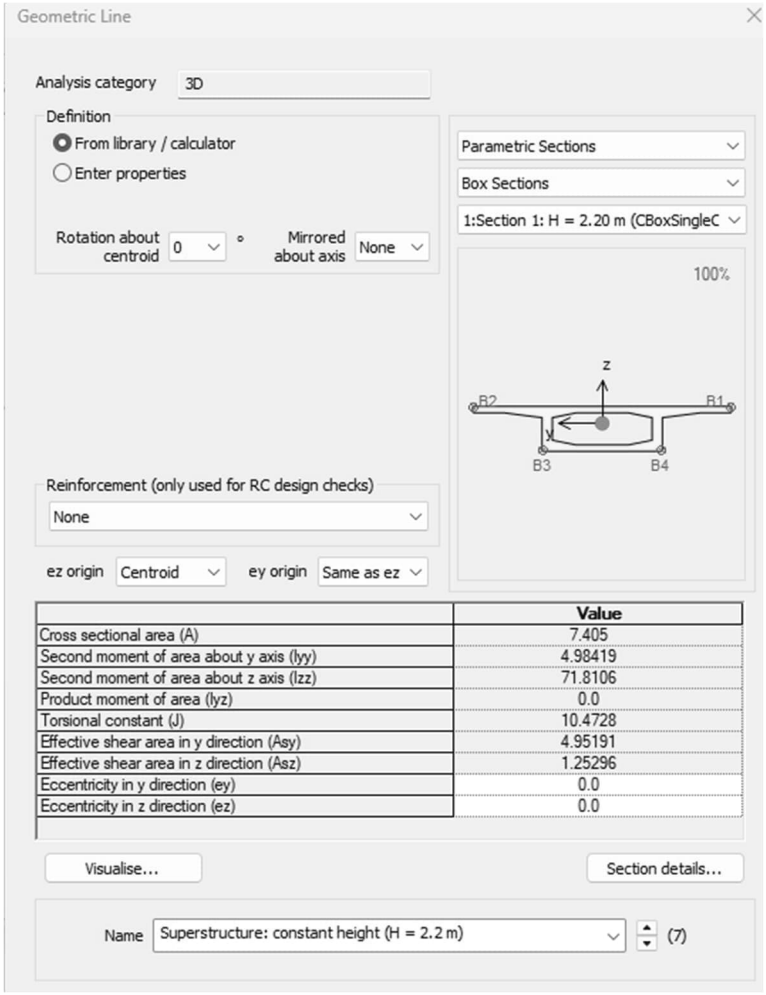
ELEVATION

2.3.3 Superstructure: vary height right



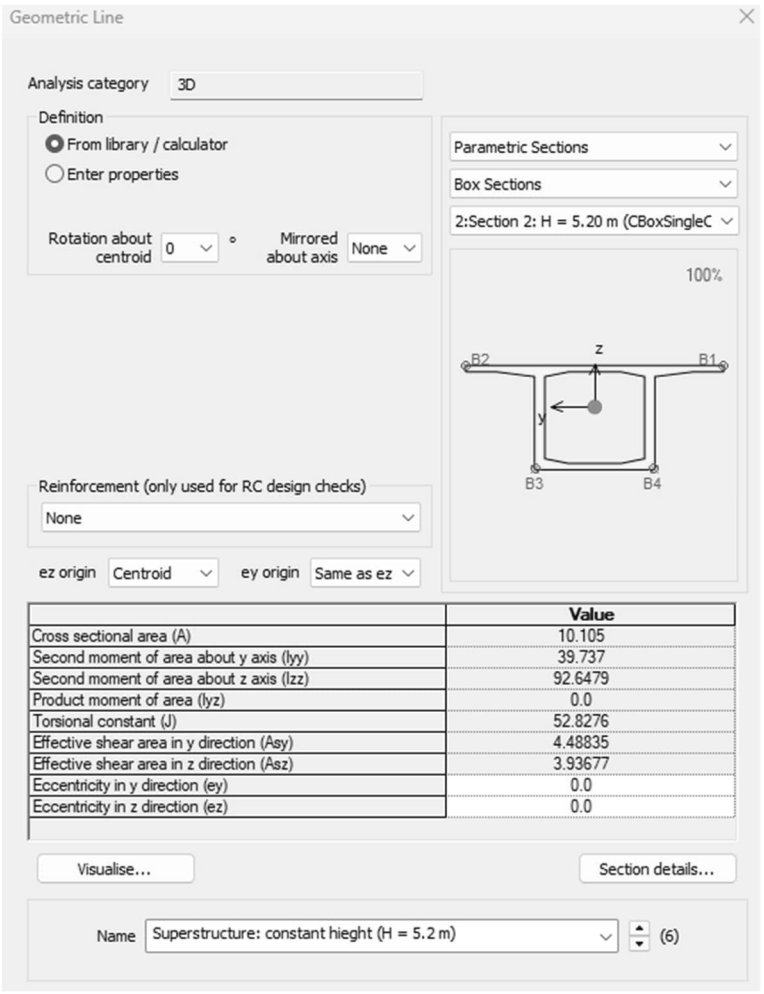
ELEVATION

2.3.4 Superstructure: constant height (H = 2.2 m)



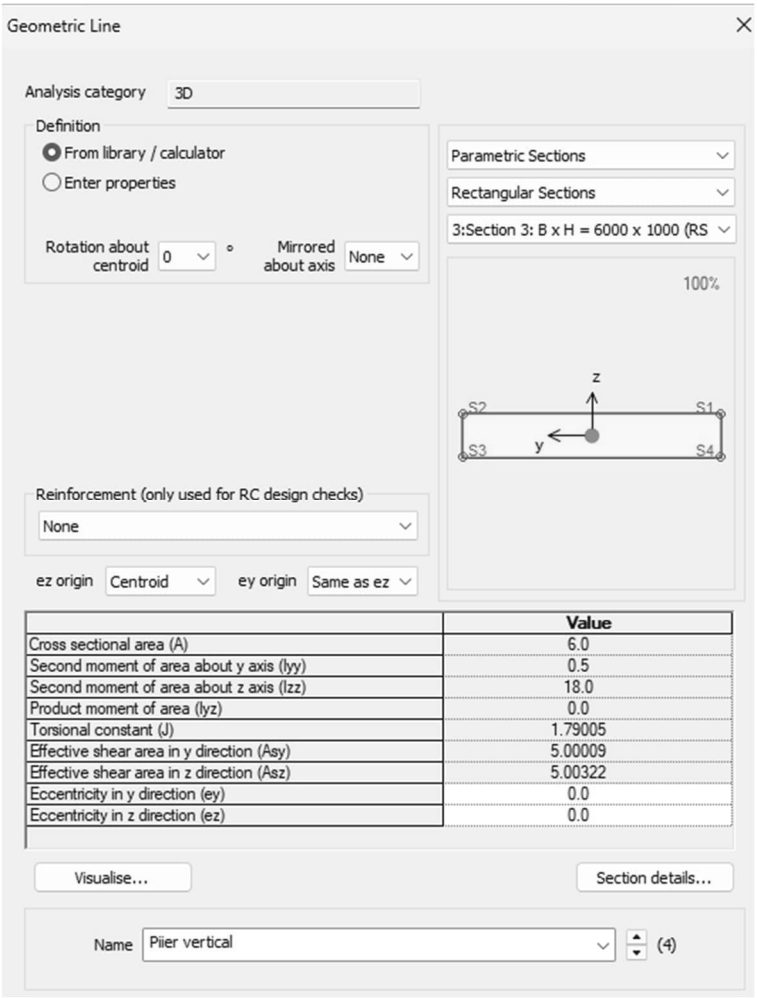
ELEVATION

2.3.5 Superstructure: constant height (H = 5.2 m)



ELEVATION

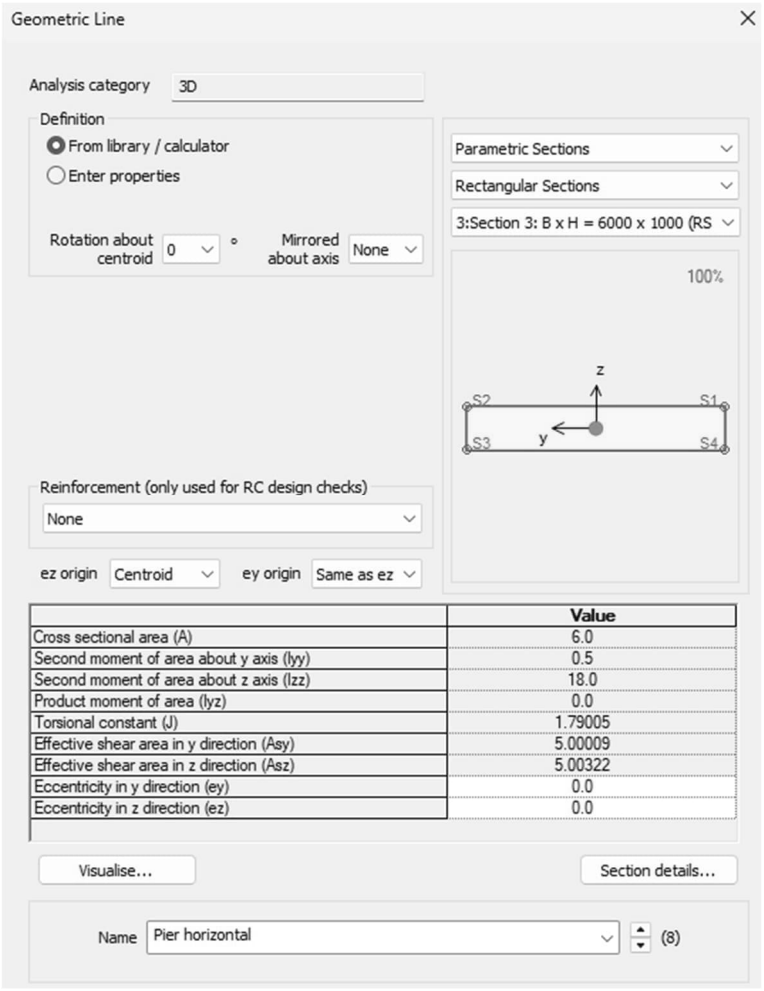
2.3.6 Pier: vertical



ELEVATION

2.3.7 Pier: horizontal

Located at level +6.0 and +12.0.

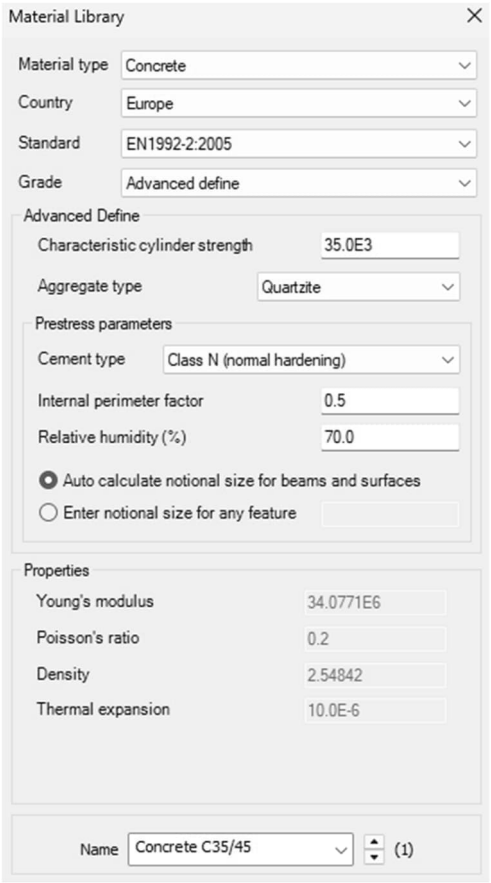


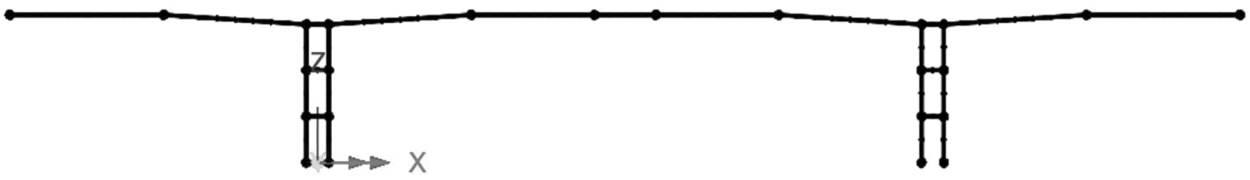
ELEVATION

2.4 MATERIAL

Material properties seen below are to be used. Relative humidity (RH) 80 % is used to determine creep and shrinkage. according to SS-EN 1992-1-1.

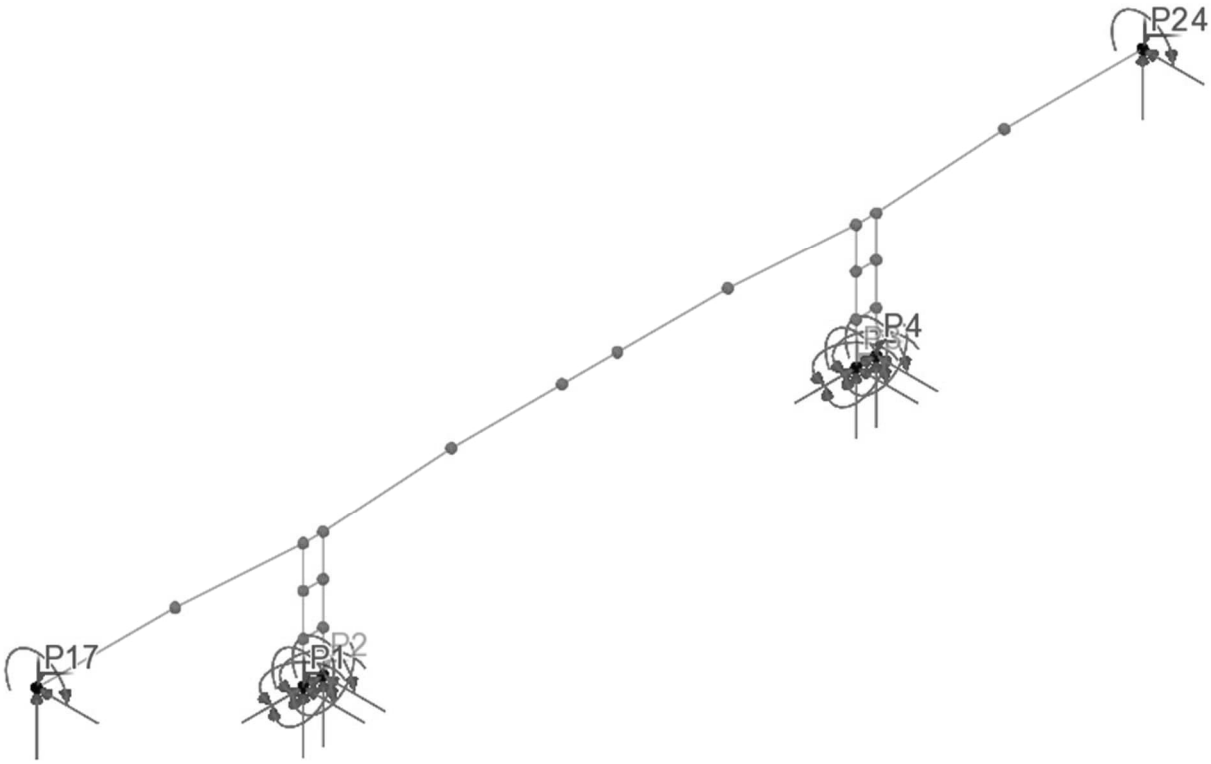
Concrete C35/45 : E_{cm} = 34 GPa





ELEVATION

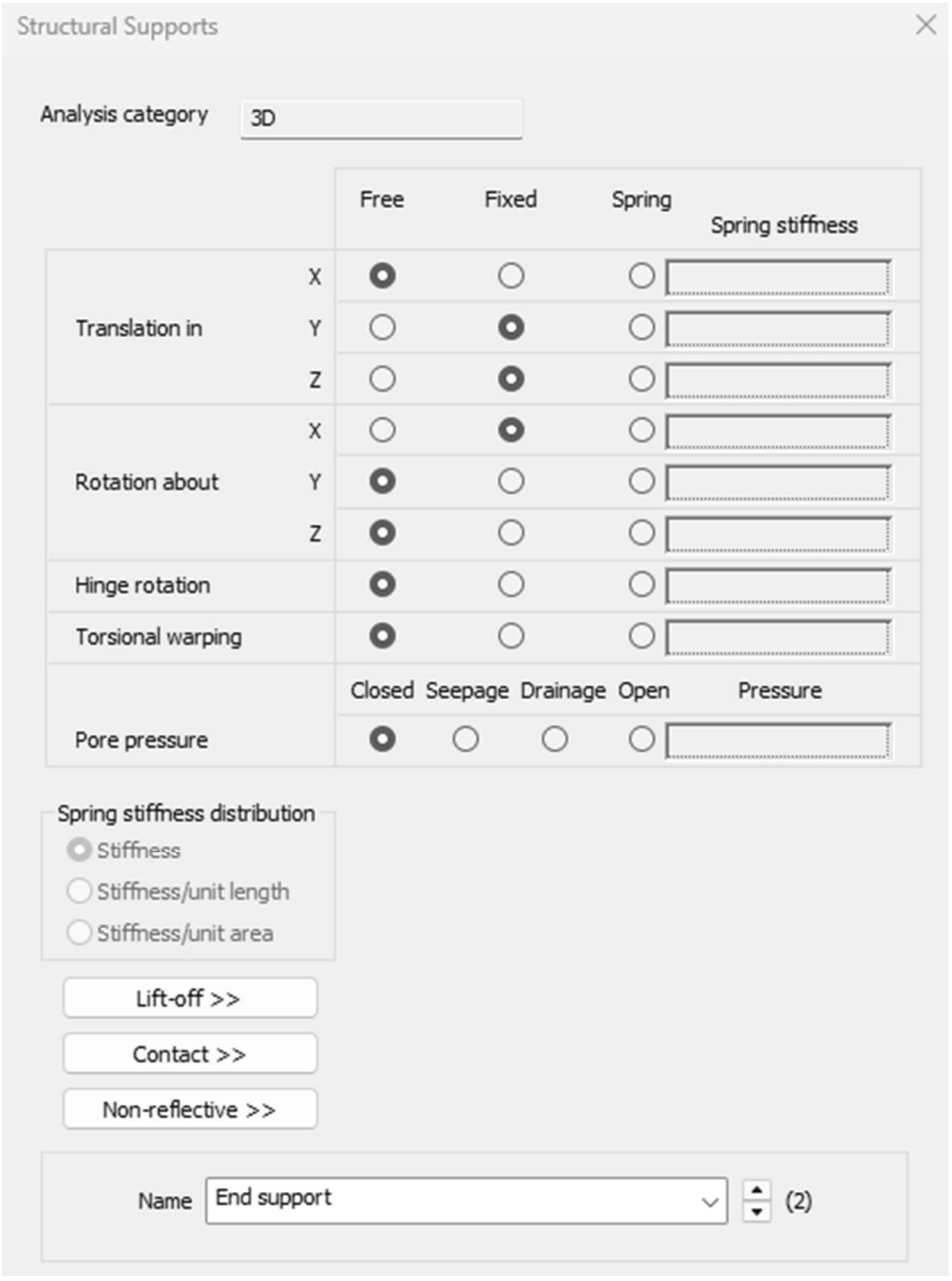
2.5 BOUNDARY CONDITIONS



Overview

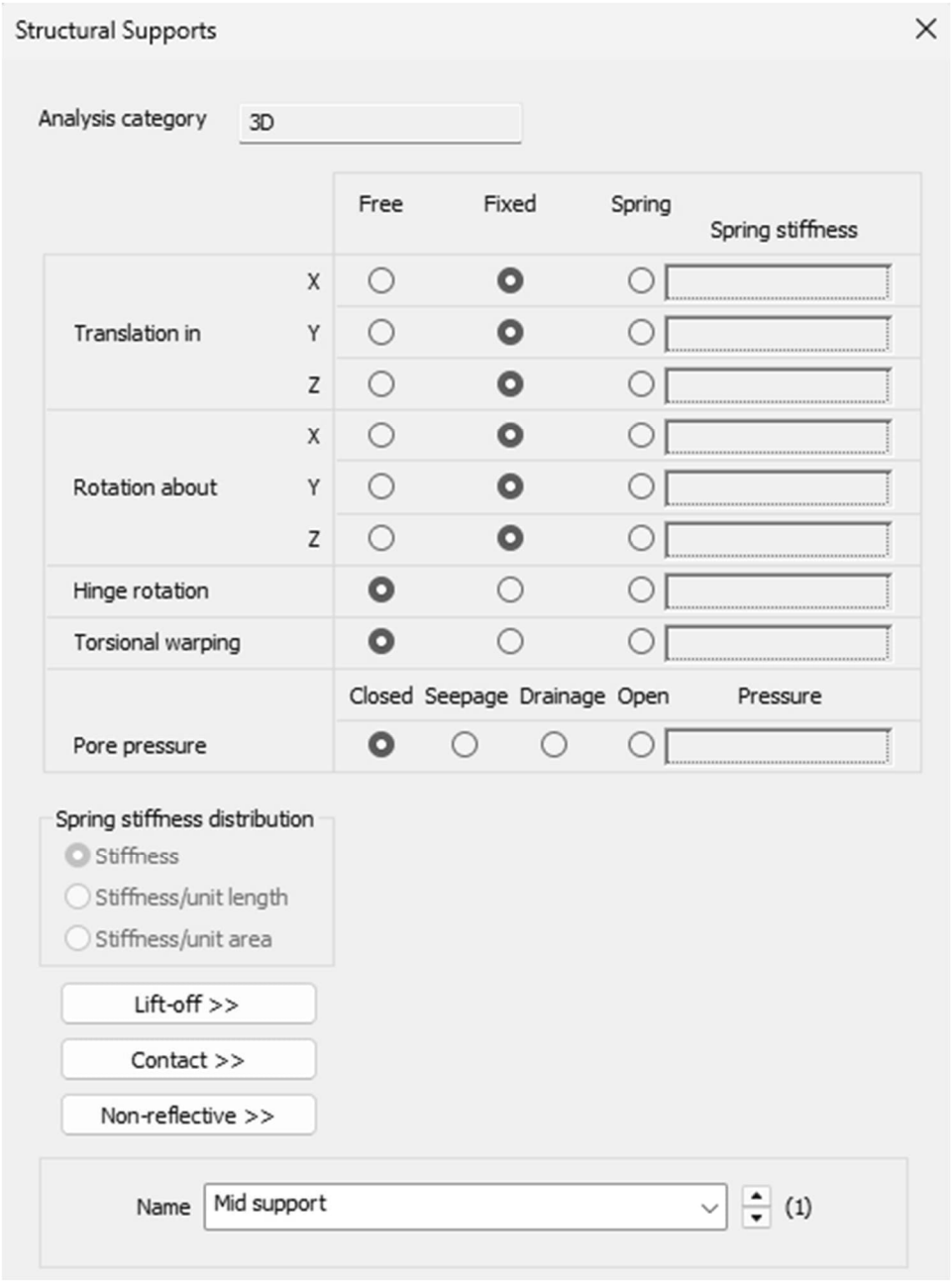
2.5.1 Boundary conditions: end support

At points P17 & P24 boundary condition seen below is applied.



2.5.2 Boundary conditions: mid support

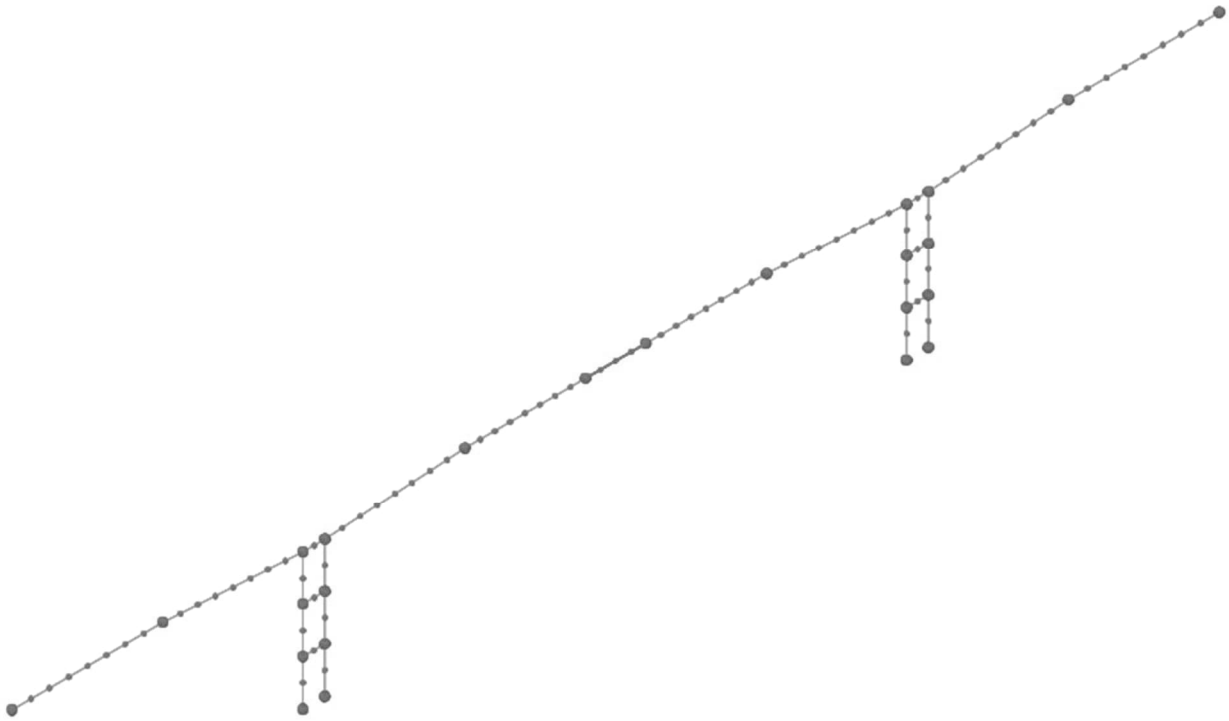
At points P1, P2, P3 & P4 boundary condition seen below is applied.



2.6 MESH

Linear beams elements (BM21) are with various subdivisions as seen below.

Typ	Divisions	End release: Start	End release: End
Element 2	1	None	None
Element 4	2	None	None
Element 8	4	None	None

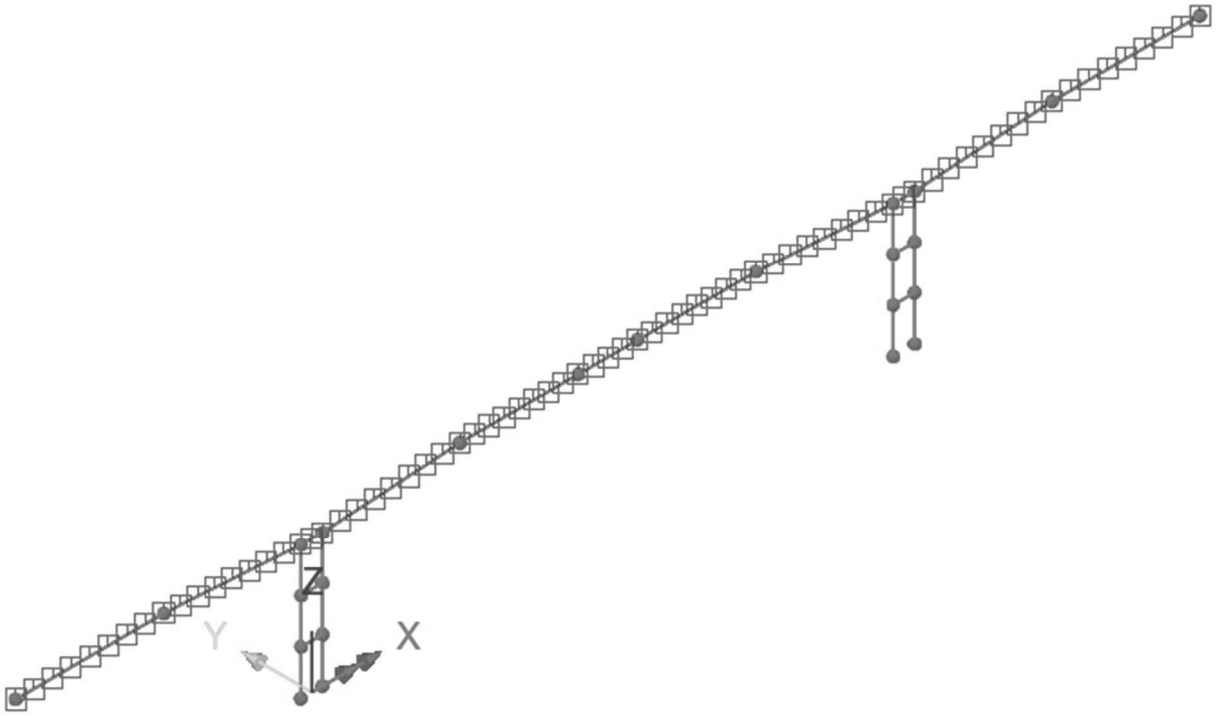


Overview

2.7 SEARCH AREA

Discrete load can be applied to structure as geometrical load areas. In FEM program load areas are termed Search Area.

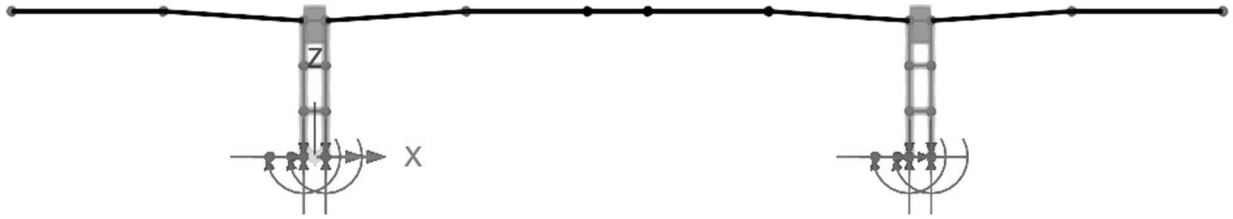
Search area : “Superstructure”



Overview

2.8 STUCTURE ACTIVATION

All part are active unless deactivated.



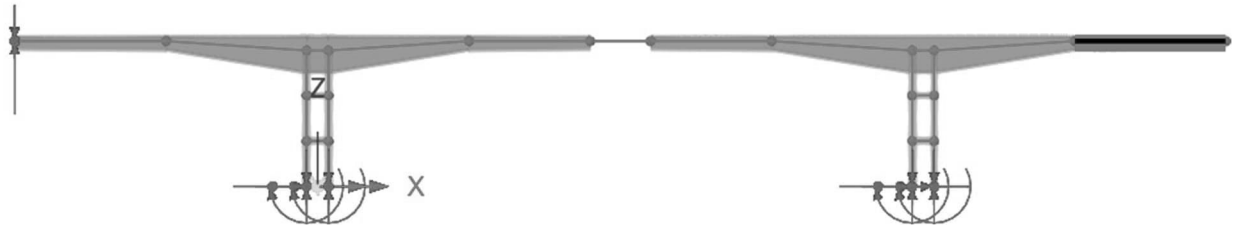
Stage 1: (Analysis 1)
Entire superstructure is assigned as “DEACTIVE” (stage 2-7).

Stage 2: (Analysis 1)
Marked stage 2 is assigned as “ACTIVE”.

Stage 3: (Analysis 1)
Marked stage 3 is assigned as “ACTIVE”.

Stage 4: (Analysis 1)
Marked stage 4 is assigned as “ACTIVE”.

Stage 5: (Analysis 1)
Marked stage 5 is assigned as “ACTIVE”.



Stage 6: (Analysis 1)
Marked stage 6 and boundary at support line 1 (P17) is assigned as “ACTIVE”.

Stage 7: (Analysis 1)
Marked stage 7 and boundary at support line 4 (P24) is assigned as “ACTIVE”.

During operation (Analysis 2)
Entire superstructure is active including all boundary supports.

3. LOADS

3.1 DEAD WEIGHT

$\gamma_c = 25 \cdot \frac{kN}{m^3}$: concrete

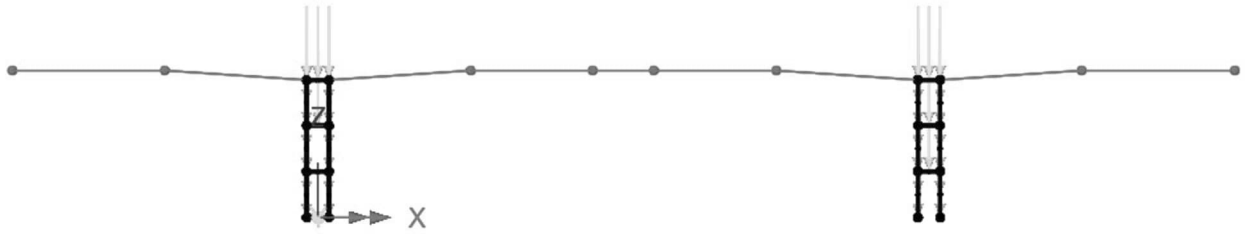
3.1.1 Body loads

Load: Dead weight 1

Linear acceleration in Z (a_z) : -10 $\frac{m}{s^2}$

Load case : Stage 1→ until end analysis 1

Load: Dead weight´1



ELEVATION

Load case : Stage 2→ until end analysis 1

Load: Dead weight 1

ELEVATION

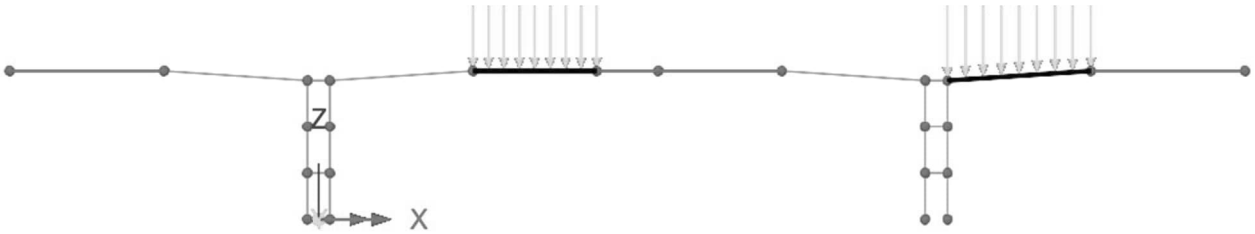
Load case : Stage 3→ until end analysis 1

Load: Dead weight 1

ELEVATION

Load case : Stage 4→ until end analysis 1

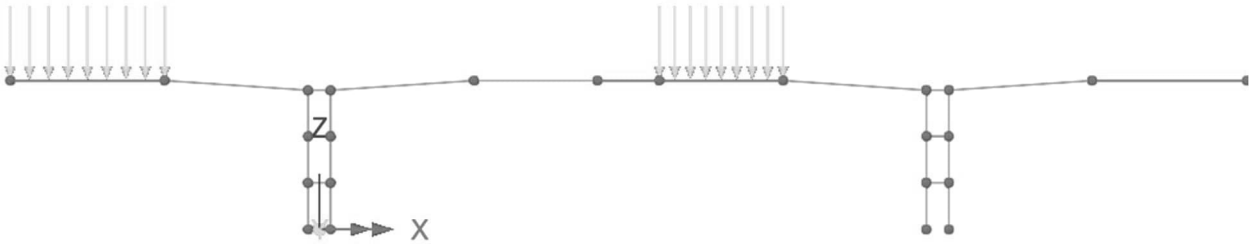
Load: Dead weight 1



ELEVATION

Load case : Stage 5→ until end analysis 1

Load: Dead weight 1



ELEVATION

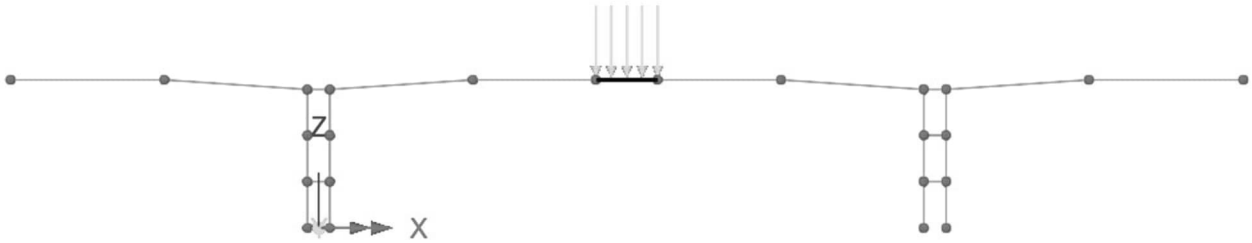
Load case : Stage 6→ until end analysis 1

Load: Dead weight 1

ELEVATION

Load case : Stage 7→ until end analysis 1

Load: Dead weight 1



ELEVATION

3.1.2 Edge beams including railing

Along each edge bream a line load is introduced. The load includes weight of both edge beams and railings.

$p_{räcke} = 0.7\frac{kN}{m}$: weight railing

$$\rightarrow p_z = 2p_{räcke} + 2p_{KB} = 2 \cdot 0.7\frac{kN}{m} + 2 \cdot 0.45m \cdot 0.45m \cdot 25\frac{kN}{m^3} = -12\frac{kN}{m}$$

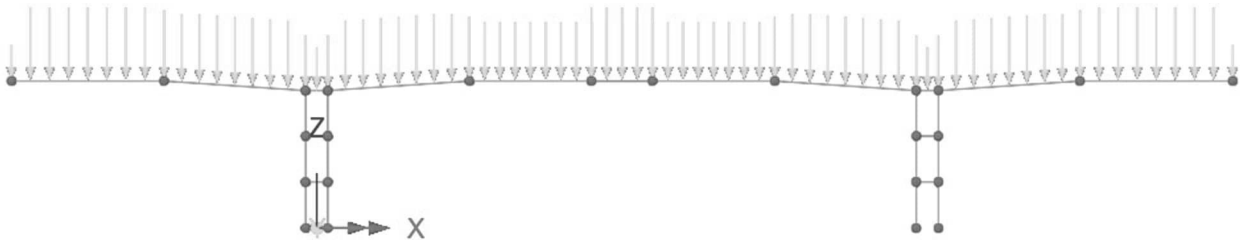
Load: Dead weight 2

Structural loading : Global distributed

Line load per unit length in Z direction: -12 $\frac{kN}{m}$

Load case : Stage 7→ until end analysis 1

Load: Dead weight 2



ELEVATION

3.2 SURFACING

Thickness pavement with a thickness of 95 mm built as follows:

- Wearing course ABS 11 40 mm
- Combined protective and binder course PGJA 50 mm
- Waterproofing layer 5 mm

$\gamma = 23\frac{kN}{m^3}$: course

$q_{matta} = 0.11kPa$: waterproofing

$$q_{beläggning} = \gamma_{beläggning} \cdot t + q_{matta} = 23\frac{kN}{m^3} \cdot 0.09m + 0.11kPa = 2.2kPa$$

$$\rightarrow p_z = B \cdot q_{beläggning} = 13.0m \cdot 2.2kPa = -29\frac{kN}{m}$$

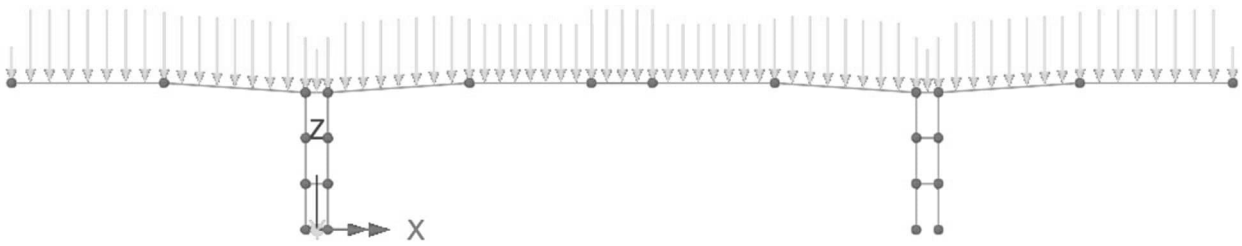
Load : Surfacing

Structural loading : Global distributed

Surface load per unit length in Z direction: -29 $\frac{kN}{m}$

Load case : Stage 7→ until end analysis 1

Load: Surfacing



ELEVATION

3.3 TIME MANAGEMENT

The effect of creep, shrinkage and relaxation is determined by assuming construction times see below.

$t_0 = 5\ days$

$t_1 = 120\ years\ \therefore$ 43800 days

Only "Analysis 1 " use time dependent nonlinear analysis with regard to material. Below time table used for this analysis.

"Age at placement" : time after casting until concrete is assumed statically active

"Age at shrinkage" : time after casting until concrete is assumed statically active

"Stage duration" : length between casting stages

	Loadcase	Age at Placement	Age at shrinkage	Stage Duration	Response Time
⊕	Stage 1	7	7	10	10
⊕	Stage 2	7	7	10	20
⊕	Stage 3	7	7	10	30
	Prestress (stage 3)	-	-	0	30
	Dead weight (stage 3)	-	-	0	30
⊕	Stage 4	7	7	10	40
	Prestress (stage 4)	-	-	0	40
	Dead weight (stage 4)	-	-	0	40
⊕	Stage 5	7	7	10	50
	Prestress (stage 5)	-	-	0	50
	Dead weight (stage 5)	-	-	0	50
⊕	Stage 6	7	7	10	60
	Prestress (stage 6)	-	-	0	60
	Dead weight (stage 6)	-	-	0	60
⊕	Stage 7	7	7	7	67
	Prestress (stage 7)	-	-	0	67
	Dead weight (stage 7)	-	-	0	67
	Longterm	-	-	43800	43867
	Prestresss (Longterm)	-	-	0	43867

3.4 CREEP

Creep is determined according to SS-EN 1992-1-1 §3.1.4.

Time for first loading (= time when formwork was removed) is termed t_0.

$t_0 = 5\ days$

$t_1 = 120\ years$

In this analysis only used to determine pretension loss over time.

3.5 SHRINKAGE

Shrinkage is determined according to SS-EN 1992-1-1 §3.1.4.

Time for first loading (= time when formwork was removed) is termed t_0.

$t_0 = 5\ days$

$t_1 = 120\ years$

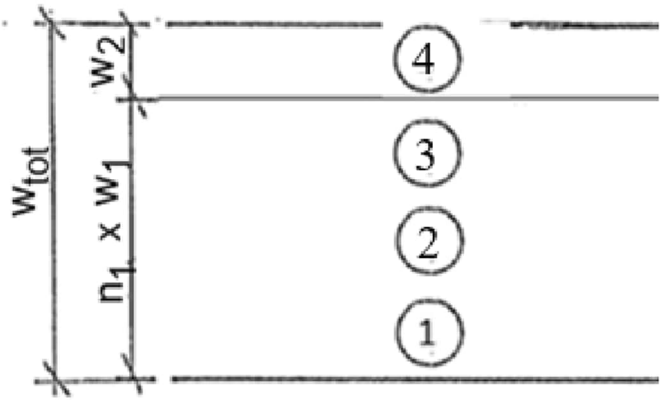
In this analysis only used to determine pretension loss over time.

3.6 TRAFFIC

Evaluation of vertical traffic is performed for LM 1 and LM 2 according to SS-EN 1991-2 section 4.3.

Evaluation will also be performed EG A/B = 180kN/300 kN according to TRVFS 2011:12 chapter 6 point 3§.

3.6.1 Traffic lane division



Total traffic width : $w_{tot} = 13.0\ m$

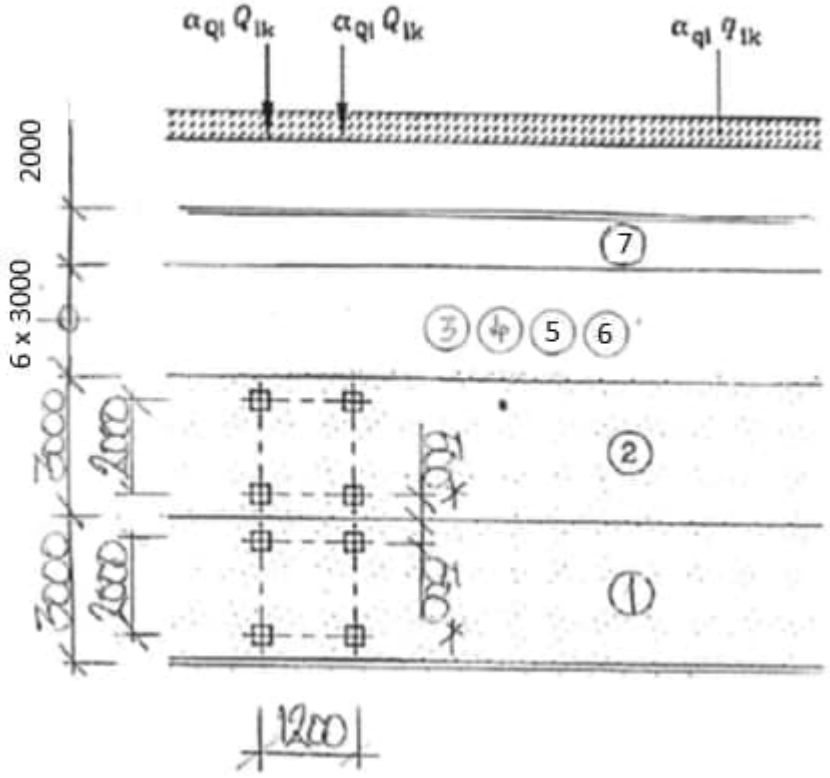
Number of traffic lanes : $n_1 = Integer\left[\frac{w_{tot}}{3.0m}\right] = 4\ lanes$

Full traffic width : $w_1 = 3.0m$

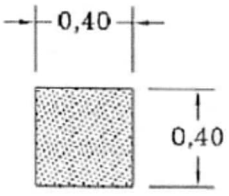
Remaining width : $w_2 = 1.0m$

3.6.2 Load model 1 (LM 1)

Characteristic values according to SS-EN 1991-2 §4.3.2.



* = When studying local effects 250 mm is to be assumed.



Axellaster :

α_Q : national adaptation factor according to TRVFS 2011:12 table 7.1

$Q'_k = \alpha_Q \cdot Q_k$: characteristic value including national adaptation factor

Traffic lane	Q_k	α_Q	Q'_k	Remark
1	300	0,9	270	LM1- 2 x 270 kN
2	200	0,9	180	LM1- 2 x 180 kN
3-4	100	0	0	No load
-	kN	-	kN	-

Utbredda laster :

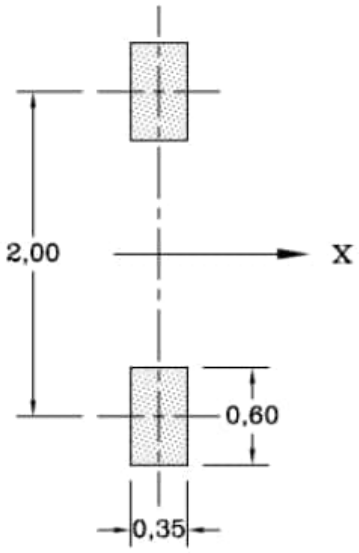
α_q : national adaptation factor according to TRVFS 2011:12 table 7.1

$q'_k = \alpha_q \cdot q_k$: characteristic value including national adaptation factor

Traffic lane	q_k	α_q	q'_k
1	9.0	0.8	7.2
2-4	2.5	1.0	2.5
-	kPa	-	kPa

3.6.3 Load model 2 (LM 2)

Characteristic vertical load according to SS-EN 1991-2 §4.3.3.



$\beta_Q = \alpha_Q = 0.90$: national adaptation factor

$Q_k = 400$ kN : characteristic value

$Q'_k = \beta_k \cdot Q_k = 360$ kN : characteristic value including national adaptation factor

Tire pressure

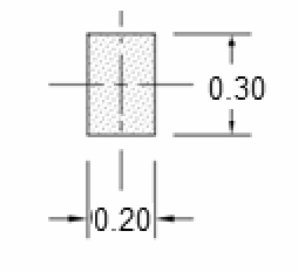
TSFS Chapter 11 Section 4 states that the same contact surface as LM 1 may be used.

3.6.4 Load model EG A/B

Calculation is performed using traffic load EG A/B = 180 kN/300 kN excluding dynamic factor.

Traffic load EG A/B are applied to two traffic lanes. Traffic on first lane is multiplied by 1.00 while second lane is multiplied 0.80.

The center distance between the wheel pressures is 2.0 meters according to TSFS chapter 11 §2.



Wheel pressure

ε_{dyn} = 25 % : dynamic factor [1.)]

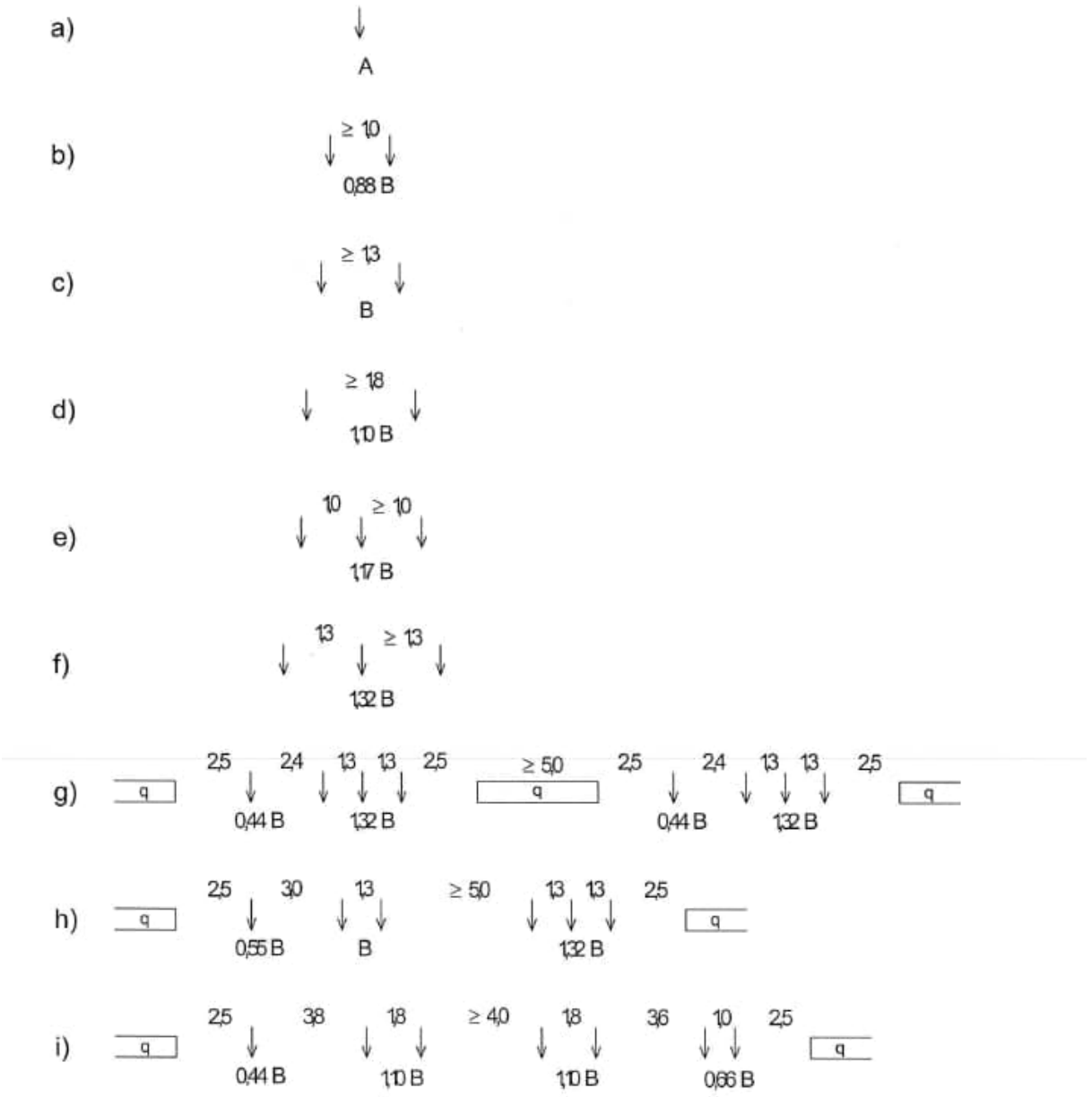
A´= A·(1 + ε_{dyn}) = 180 kN·(1+0.25) = 225 kN : single load including dynamic factor

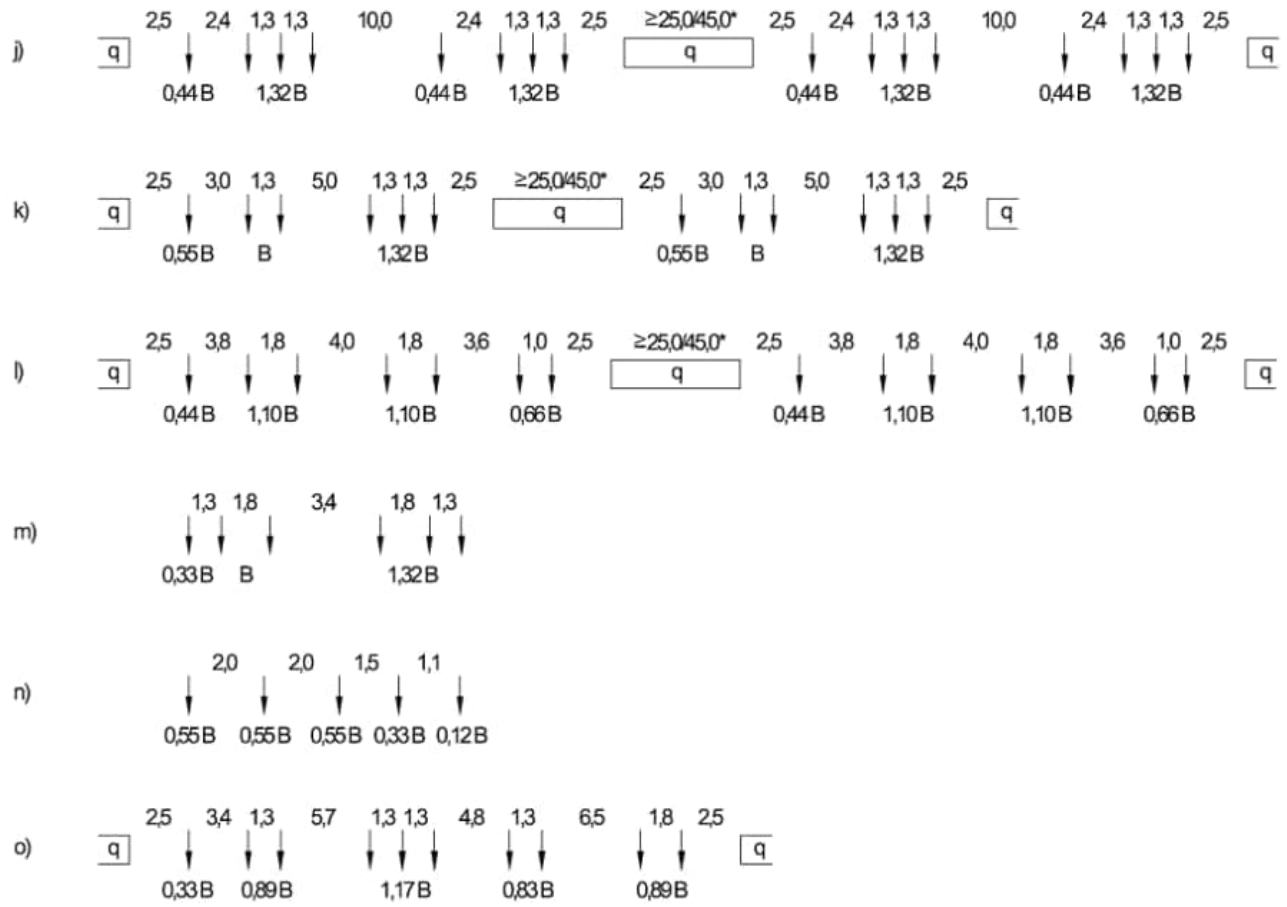
B´= B·(1 + ε_{dyn}) = 300 kN·(1+0.25) = 375 kN : tandem load including dynamic factor

$p = 5\frac{kN}{m}$: surface load

Footnote:
[1.)] TRVINFRA-00227 table 7.1-5 section 4.2.1(1) states apply 25 % ..

Graphic presentation of common vehicle types:
(Vehicle types according to TRVINFRA-00331 Appendix 1)





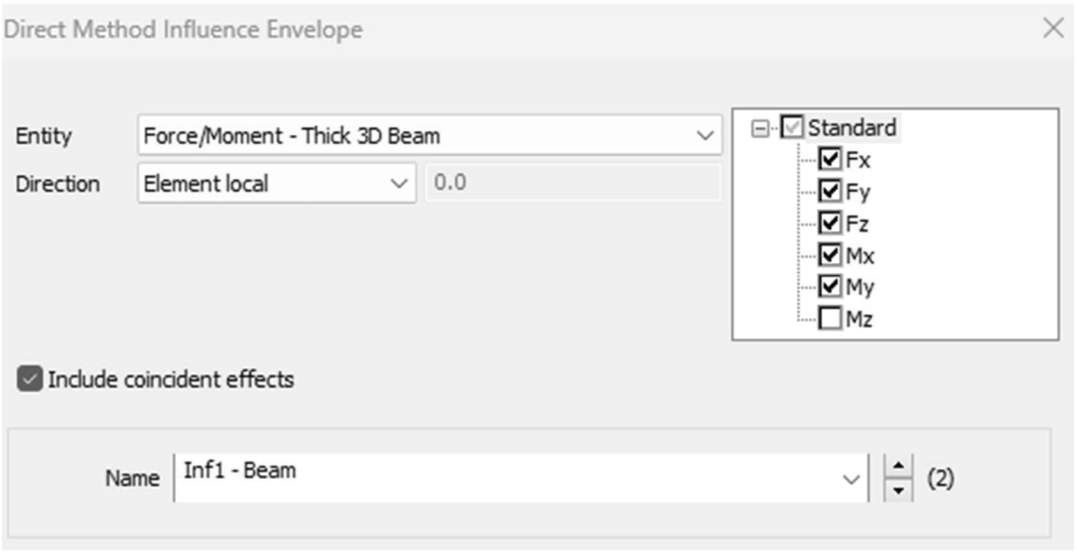
Note:
Evaluation is carried out with the script Vehicle Load Optimization (VLO), see sections 3.5.3 and 3.5.4.
Since there is no motorway, * = 45 m is applied according to TRVINFRA-00331 section 8.3.2.2.1 for vehicle types j, k, and l.

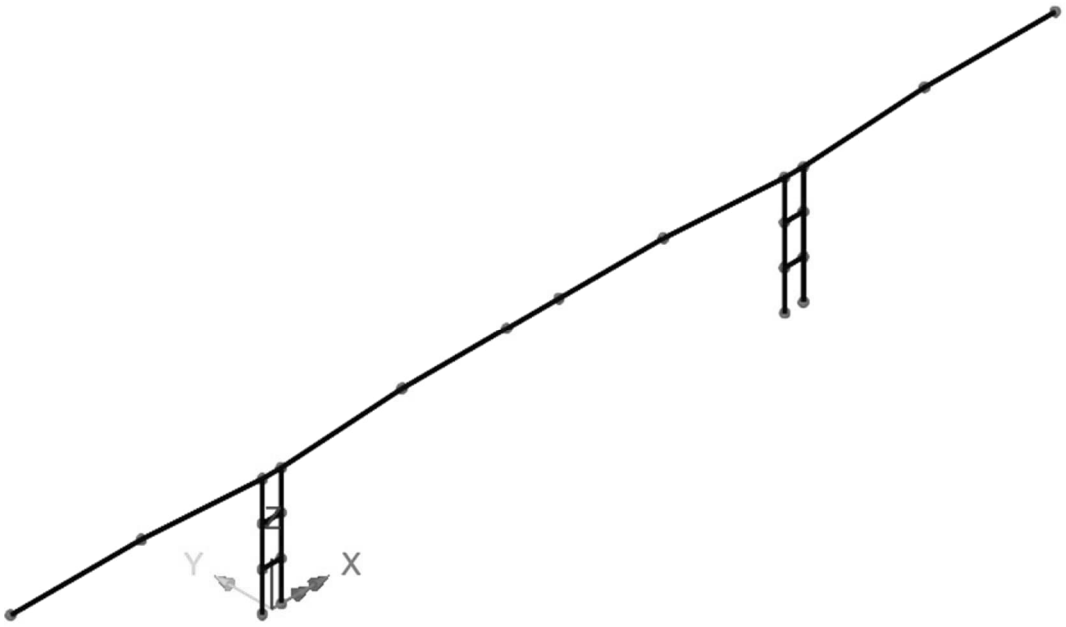
3.6.5 Vehicle Load Optimization (VLO)

Influence surfaces are created using *Method Influence Envelope* for indicated components.

Influence	Components	Entity	Method
Inf1 - Beam	Fx, Fy, Fz, Mx, My	Forces 3D-beam	*Influence Envelope*
Inf2 - Reaction	FX, FY, FZ, MX, MY	Reaction	*Influence Envelope*

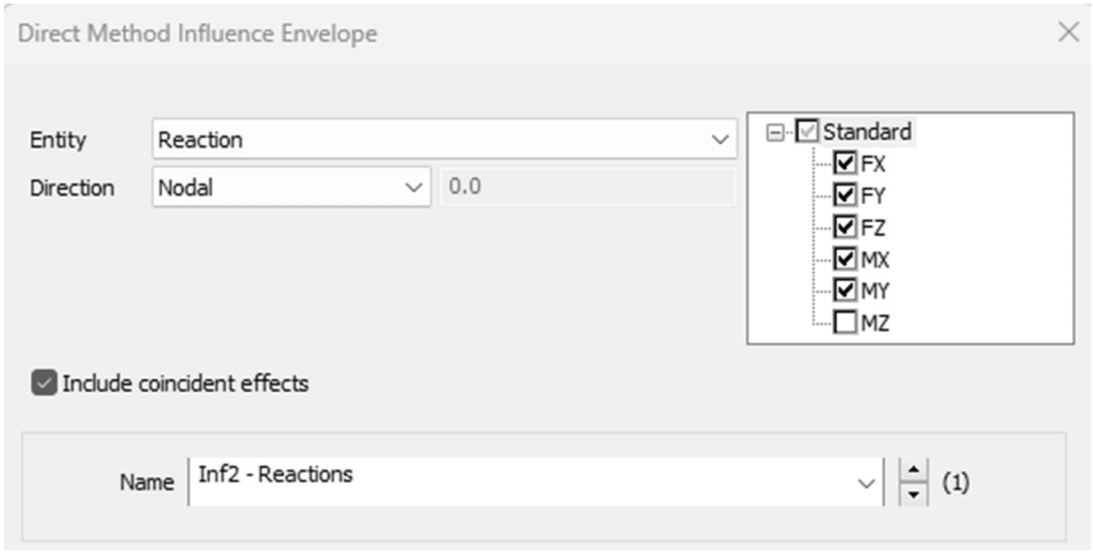
Inf1 – Beam :

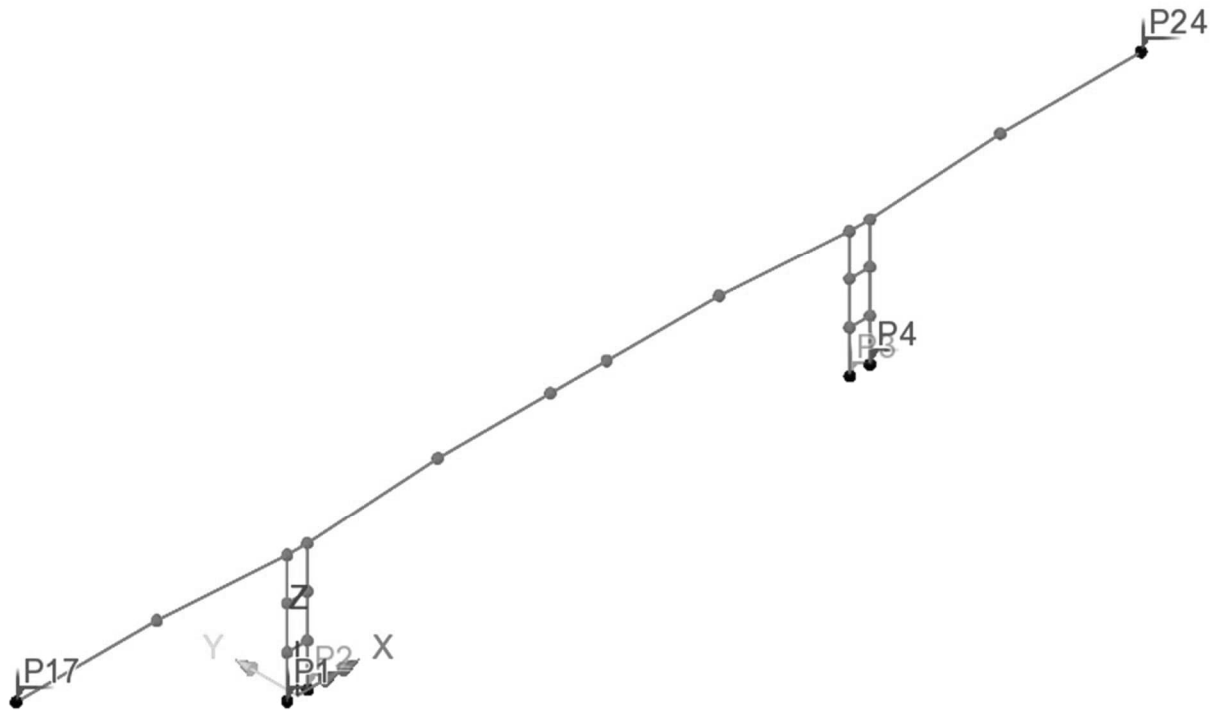




Overview 3D

Inf2 – Reactions :





Overview 3D

3.6.5.2 Influence surface analysis

Influence surfaces :

Search area: Superstructure

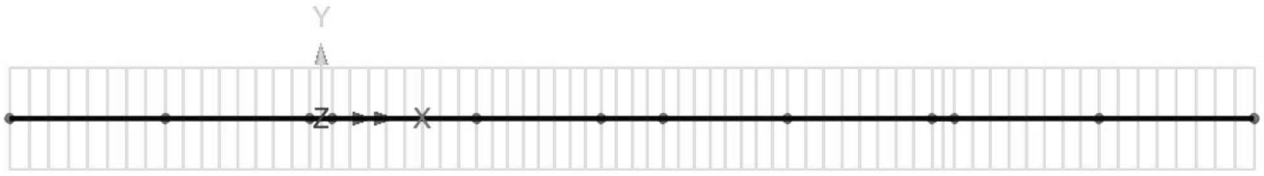
Definition type: Grid

Path: Centerline X

Transverse width: 13.0 m

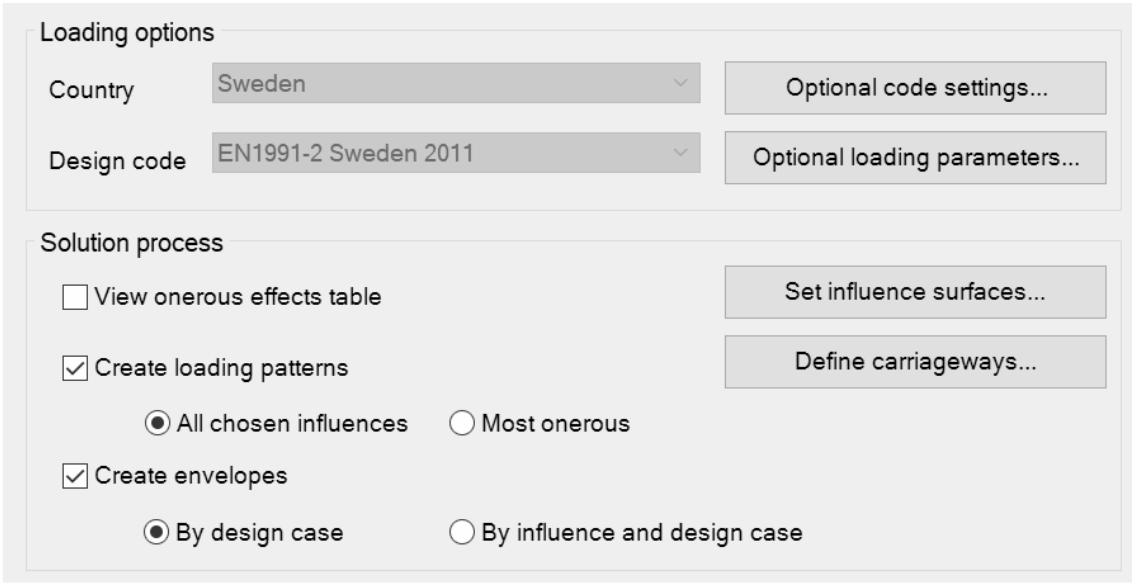
Longitudinal spacing: 1.0 m

Transversal spacing: 1.0 m



PLAN

3.6.5.3 Traffic load analysis (VLO)



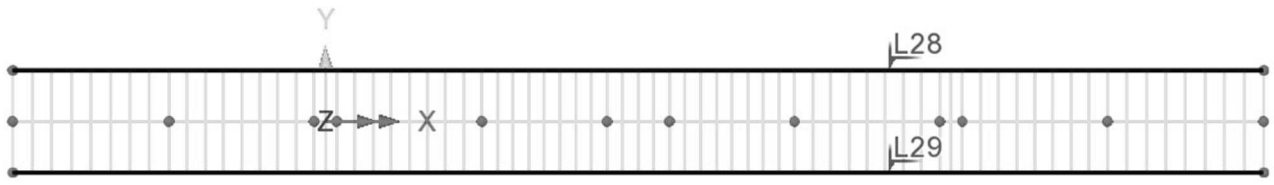
Vehicle longitudinal incremental movement: 0.25 m

Vehicle transverse incremental movement: 0.25 m

Vehicle direction: both

Definition of carriageway (kerbs): L28 & L29

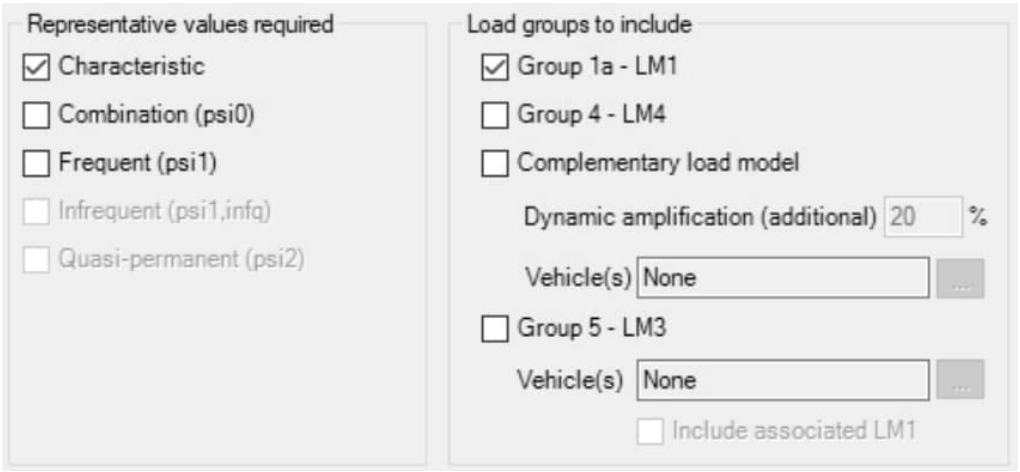
Influence surfaces: Include all (positive & negative)



PLAN

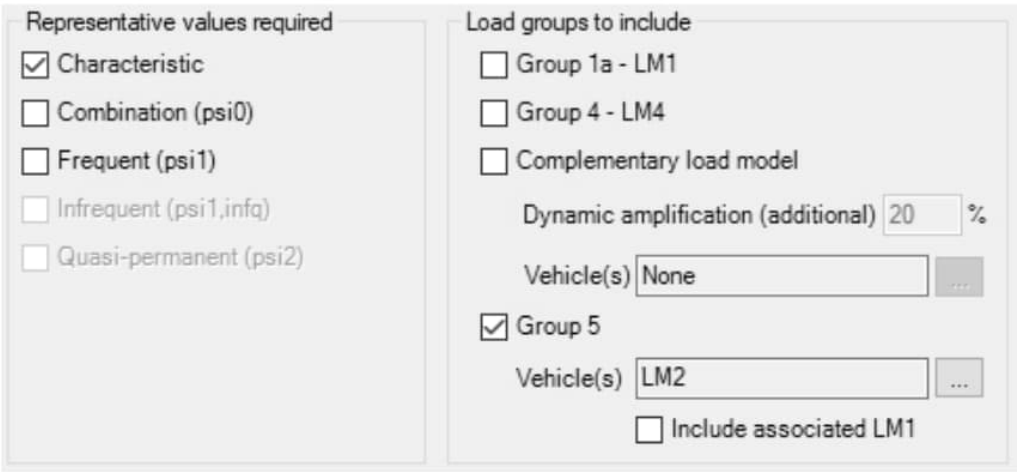
3.6.5.4 Envelope : LM 1

Load model 1 (LM1) defined in SS-EN 1991-2 section 4.3.2.



3.6.5.5 Envelope : LM 2

Load model 2 (LM2) defined in SS-EN 1991-2 section 4.3.3. The load is defined in Group 5 vehicle) since Group 1b is not defined in present version of software.



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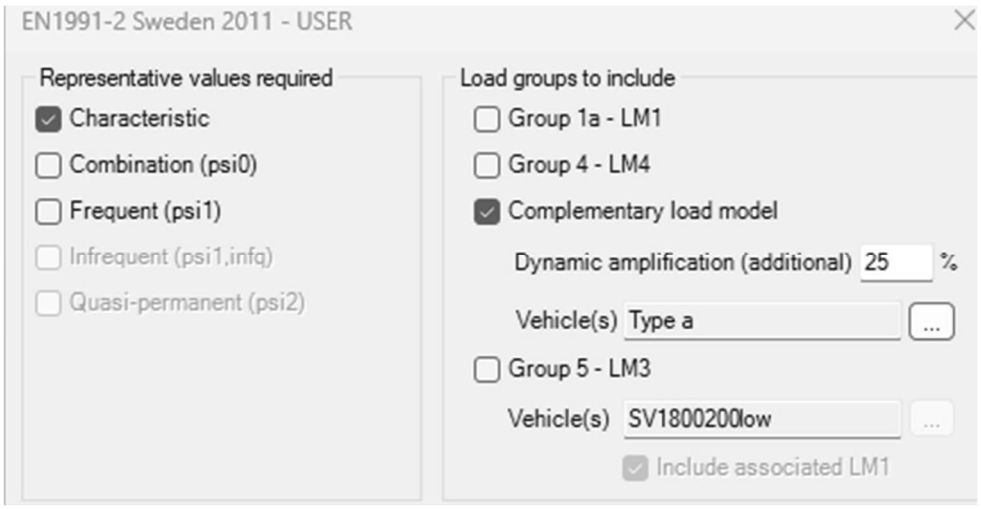
3.6.5.6 Envelope : EG A

EG A is defined as complementary load model with options seen below.

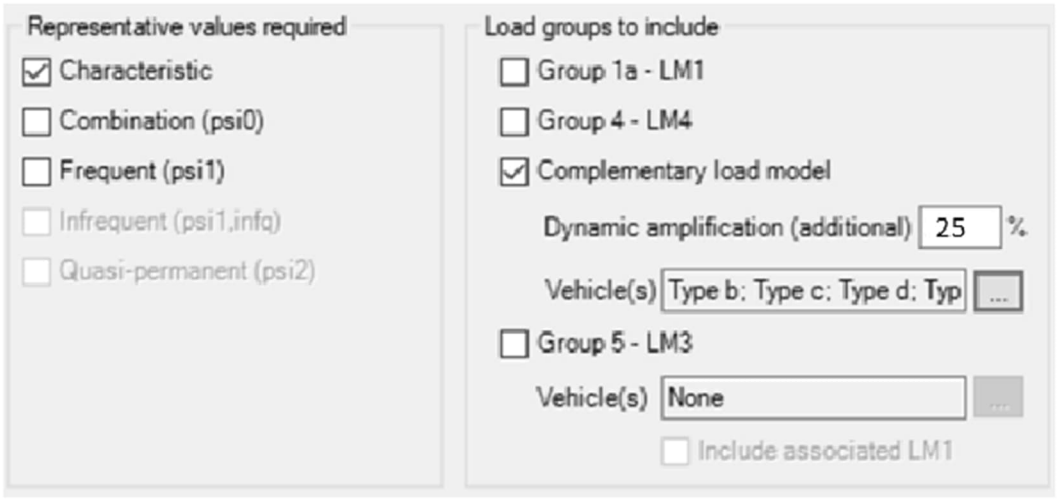


Dynamic amplification (additional): 25 %

Vehicle selection: Type a

3.6.5.7 Envelope : EG B

EG B is defined as complementary load model with options seen below.



Dynamic amplification (additional): 25 %

Vehicle selection: Type b → o

3.6.5.8 Combined traffic load (TRAFIK)

There are a total 4 different traffic loads termed LM 1, LM2, EG A and EG B.

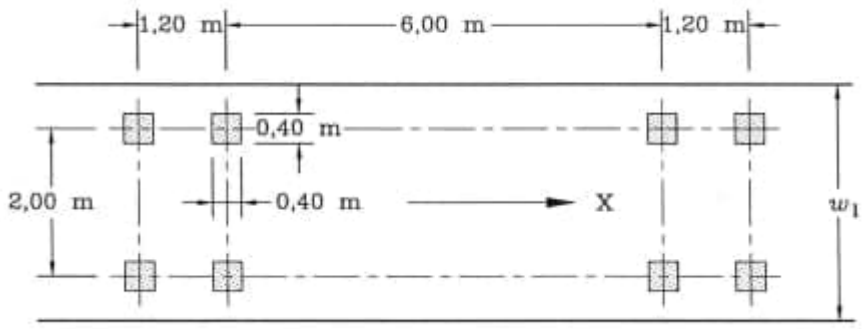
The envelope is used to identify the most onerous load effect.

Envelope TRAFIK :

Envelope
LM 1
LM 2
EG A
EG B

3.6.5.9 Fatigue model

Fatigue model 3 (UTM3) defined in SS-EN 1991-2 section 4.6.4. The load is defined in Group 5 (special vehicle) in present version of software.



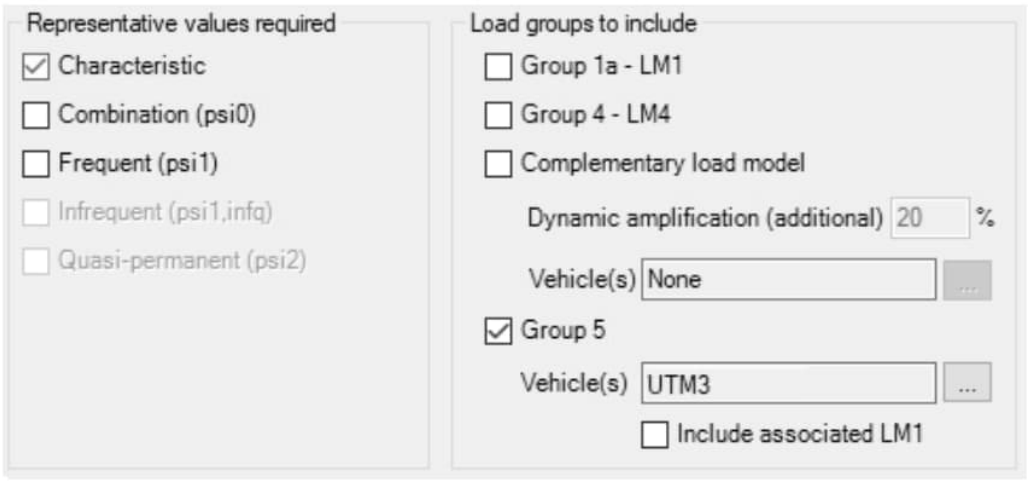
Q_k = 120 kN : characteristic value including nation adaptation factors.

Traffic category:
TRVINFRA-0027 table 7.1-5(h) gives traffic category 3

Reference values for the number of heavy vehicles:
According to SS-EN 1991-2 section 4.6.1 table 4.5(n), Category 3 is obtained

→ N_{obs} = 125,000 vehicles/year

The load definition:
The load UTM3 is defined as a special vehicle in "load group 5."



3.7 PRESTESS

Analysis of pre tensioned cable is studied at times : t_0 (5 days) until t_2 (120 years).

3.7.1 General

Properties chosen system 37ϕ15.

Material :

$f_{p0.1k} = 1640\,MPa$

$f_{pk} = 1860MPa$

$E_{sk} = 195GPa$

$\mu = 0.18$

$k = 0.005 \cdot \frac{1}{m}$

Casting tube :
80 mm / 86 mm

Slip during locking:
6 mm

Permissible curvature :

$R_{\min} = 5.7m$

Cabel area :

$A_p = 5050mm^2$

Anchor plate :
290 mm x 290 mm (same for both passiv and active anchorage)

Ultimate load :

$F_u = 5050mm^2 \cdot 1860MPa = 9393kN$

Permissible stress before locking :
See SS-EN 1992-1-1 section 5.10.2.1

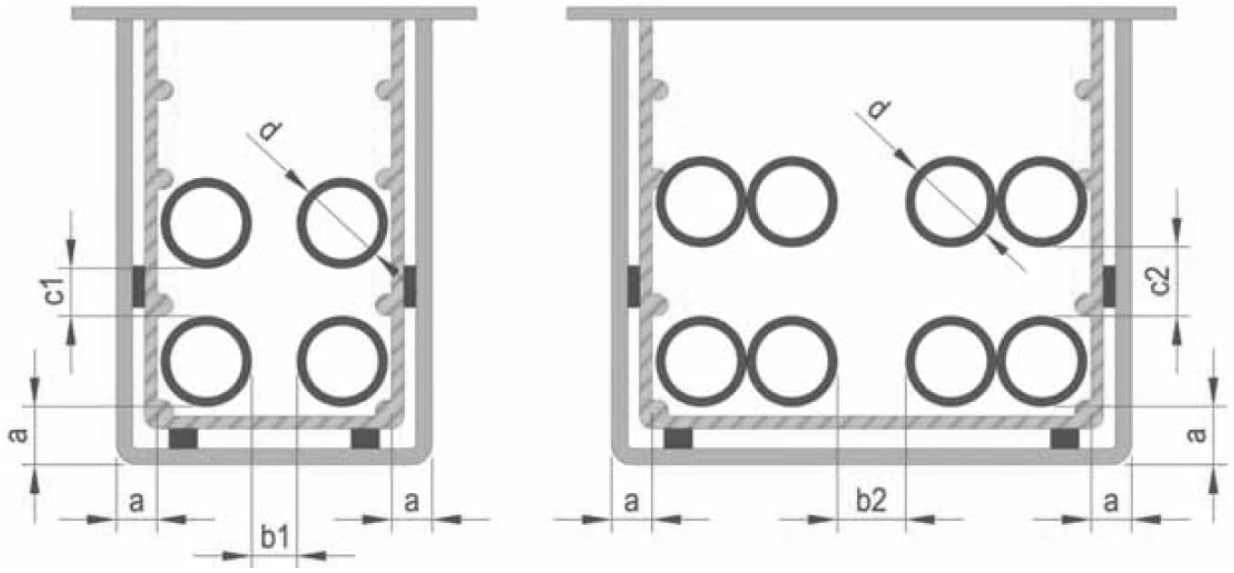
$\sigma_{p,\max}^{före} = \min(0.8 f_{pk}; 0.9 f_{p0.1k}) = \min(1488\,MPa; 1476\,MPa) = 1476\,MPa$

Permissible stress after locking :
See SS-EN 1992-1-1 section 5.10.3

$\sigma_{p,\max}^{efter} = \min(0.75 f_{pk}; 0.85 f_{p0.1k}) = \min(1395\,MPa; 1394\,MPa) = 1394\,MPa$

3.7.2 Execution

Recommended measurements :



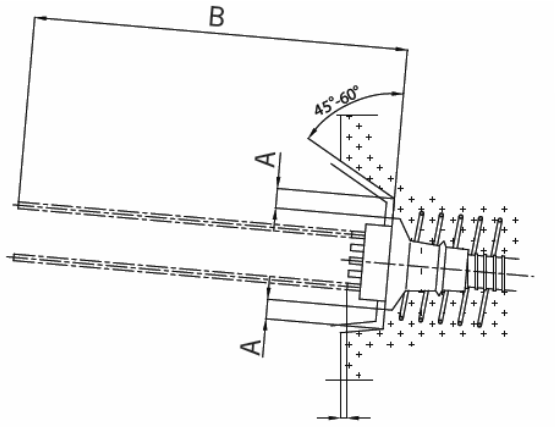
d = 90 mm

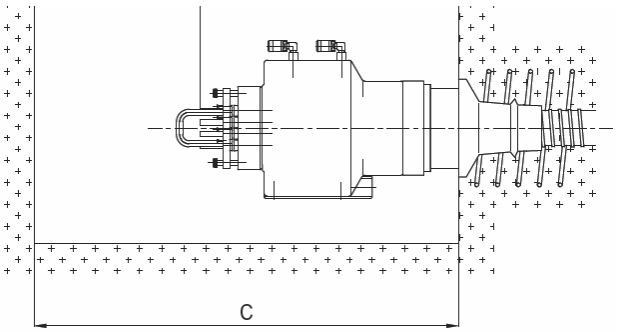
a > 50 mm

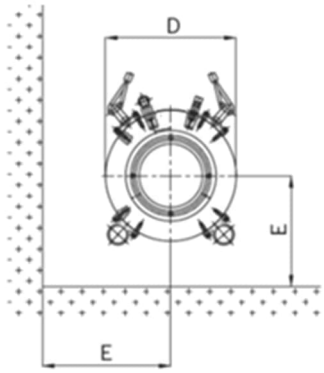
b1, c1 > 0.7d = 63 mm but 100 chosen !

b2, c2 > 1.0d = 90 mm but 100 mm chosen !

Demand for space during tensioning :





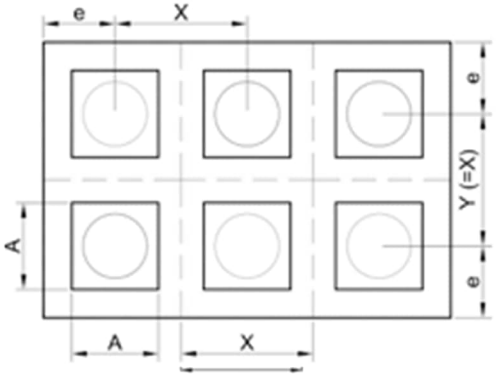


A = 70 mm

B = 1200 mm

C = 1700 mm

Measurements of cables 37ϕ15 :



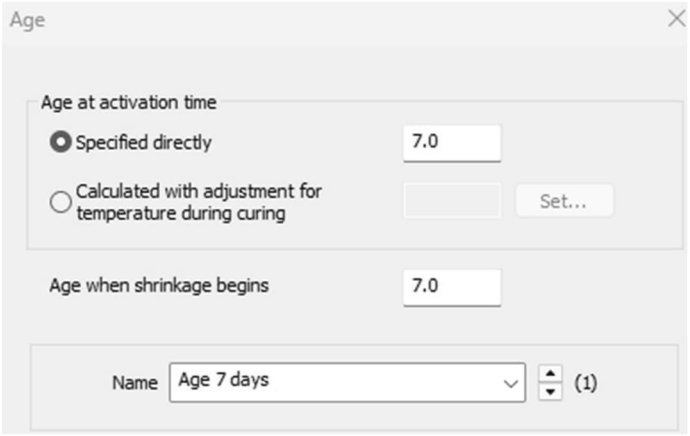
A = 290 mm

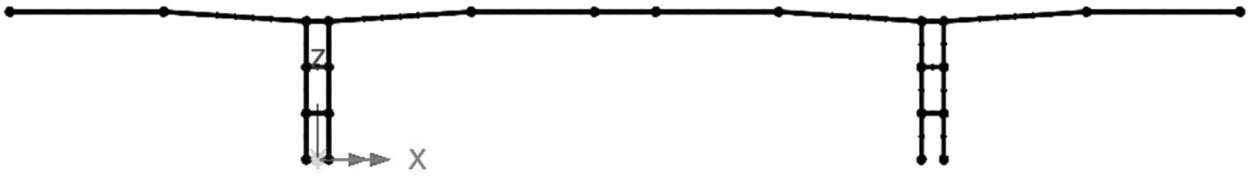
e ≥ 175 mm + TB

X ≥ 400 mm

3.7.3 Time concrete aging

In order to determine time losses due to shrinkage and creep all parts of bridge is assumed to be statically active 7 days after casting, see page A3:7.

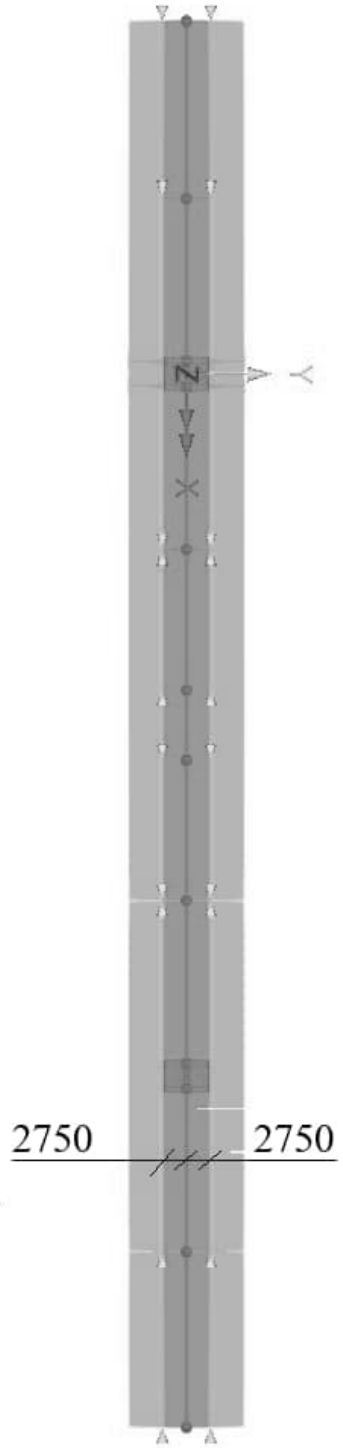




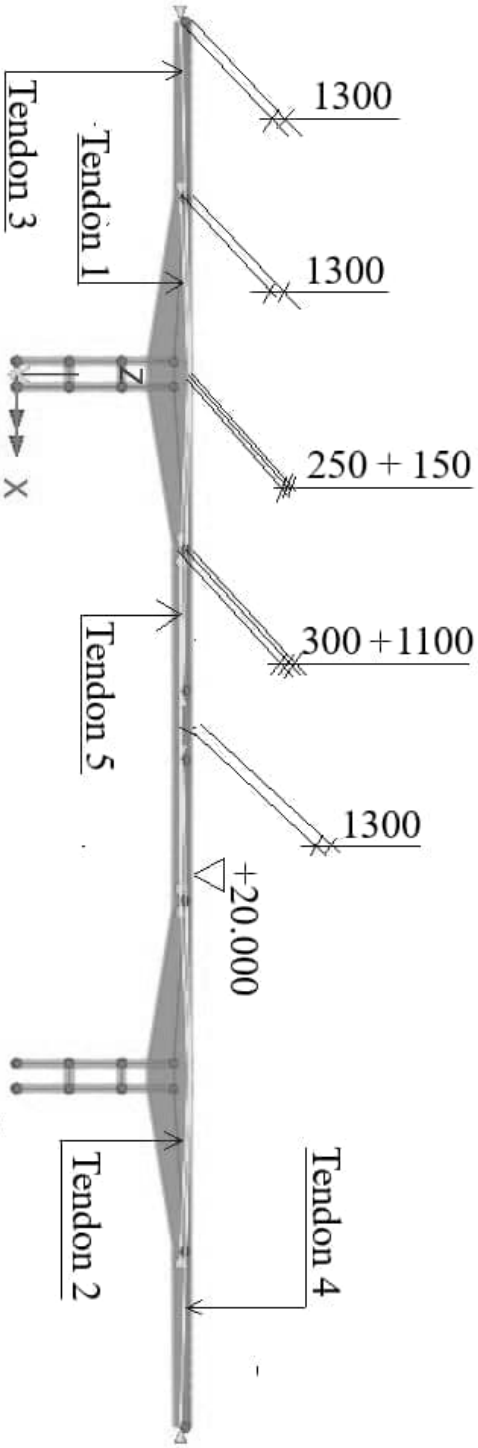
ELEVATION

3.7.4 Tendon location

Cables are defined using “global coordinates”.



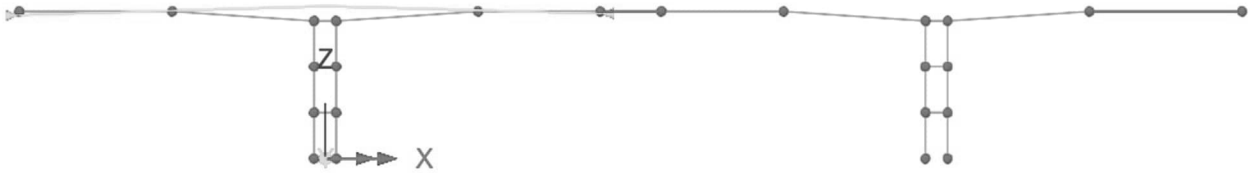
PLAN



ELEVATION

ELEVATION
Tendon 1

ELEVATION
Tendon 2



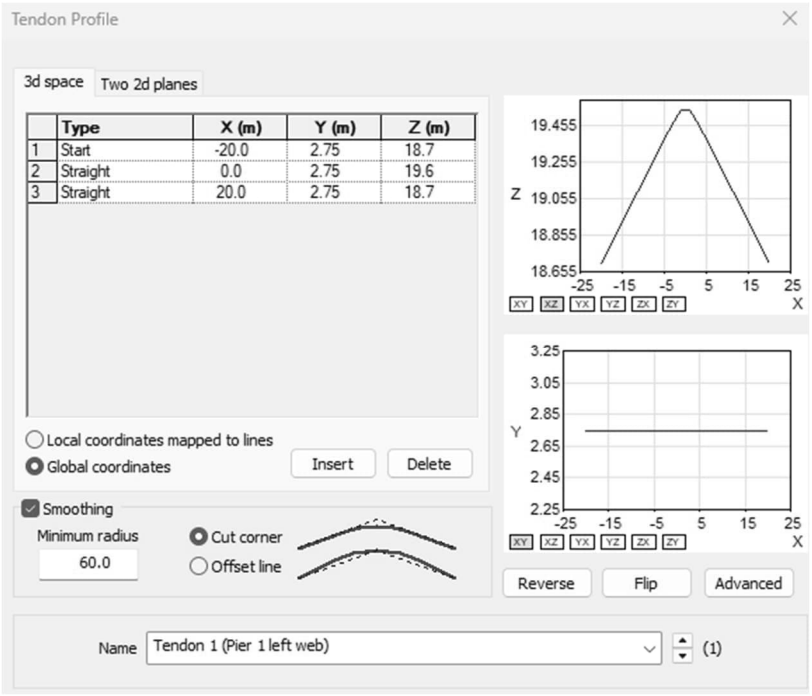
ELEVATION
Tendon 3

ELEVATION
Tendon 4

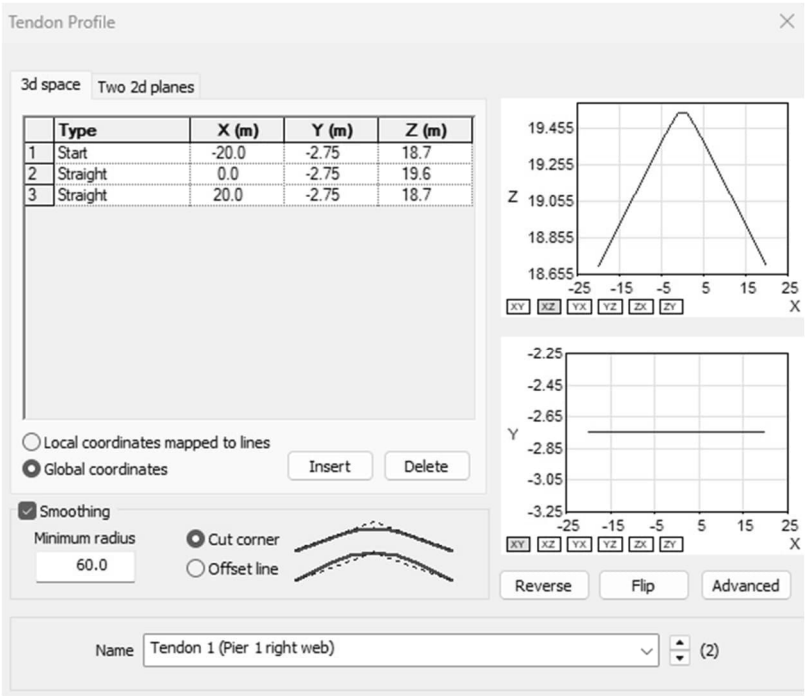
ELEVATION
Tendon 5

3.7.4.1 Tendon 1

Tendon 1 - left :

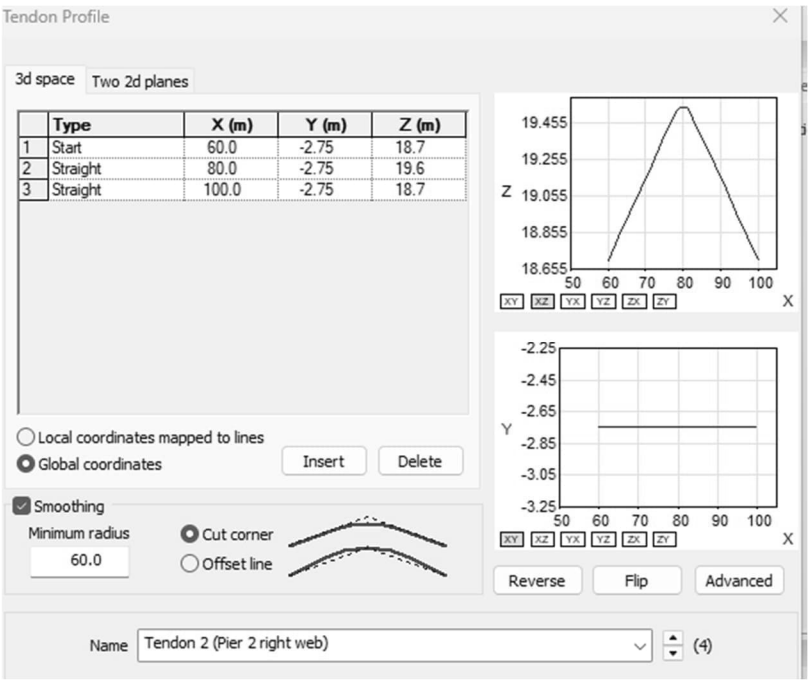


Tendon 1 - right:

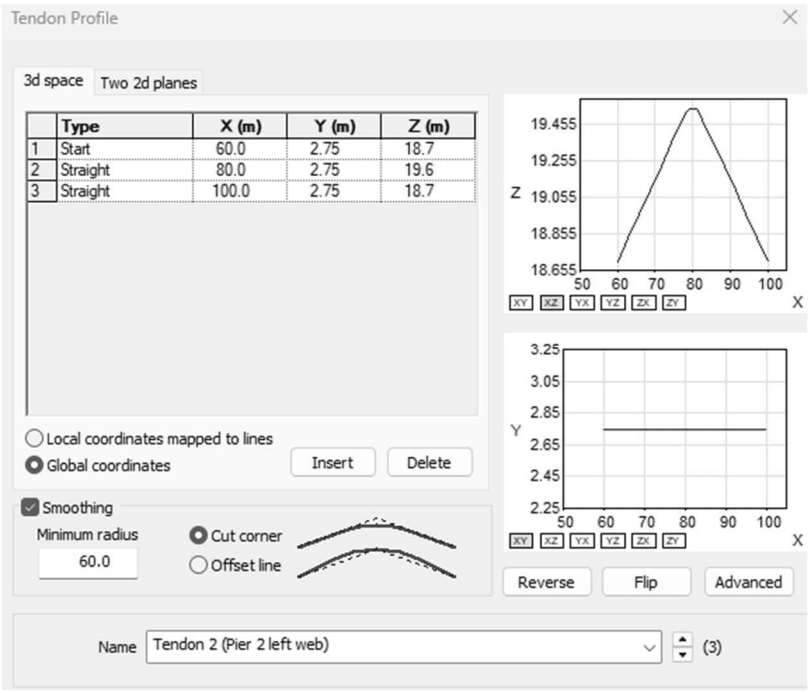


3.7.4.2 Tendon 2

Tendon 2 - left :

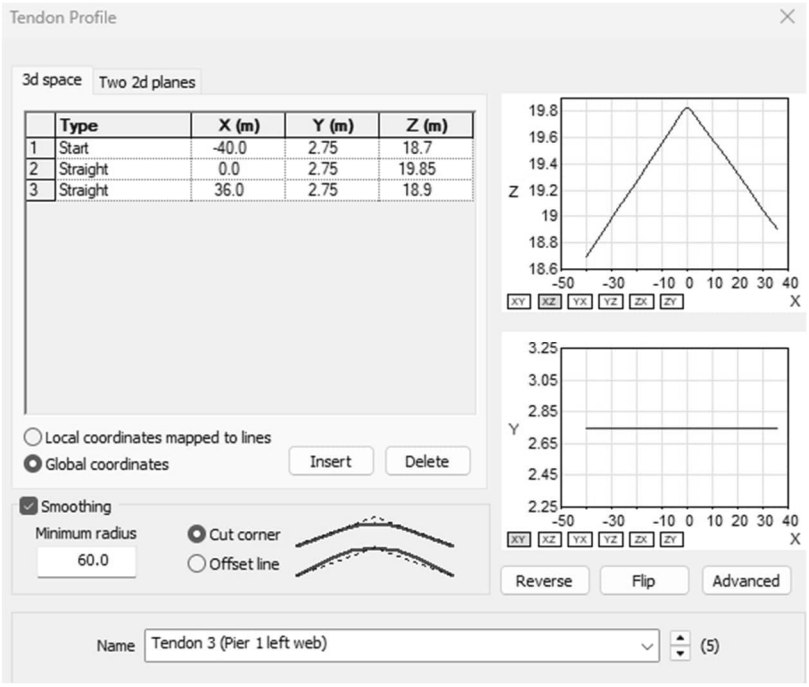


Tendon 2 - right:

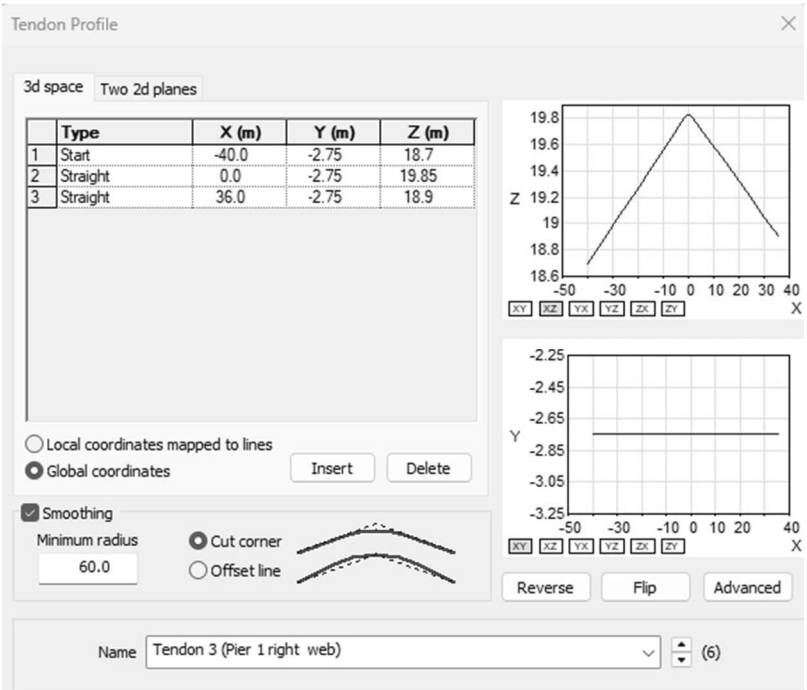


3.7.5.3 Tendon 3

Tendon 3 - left :

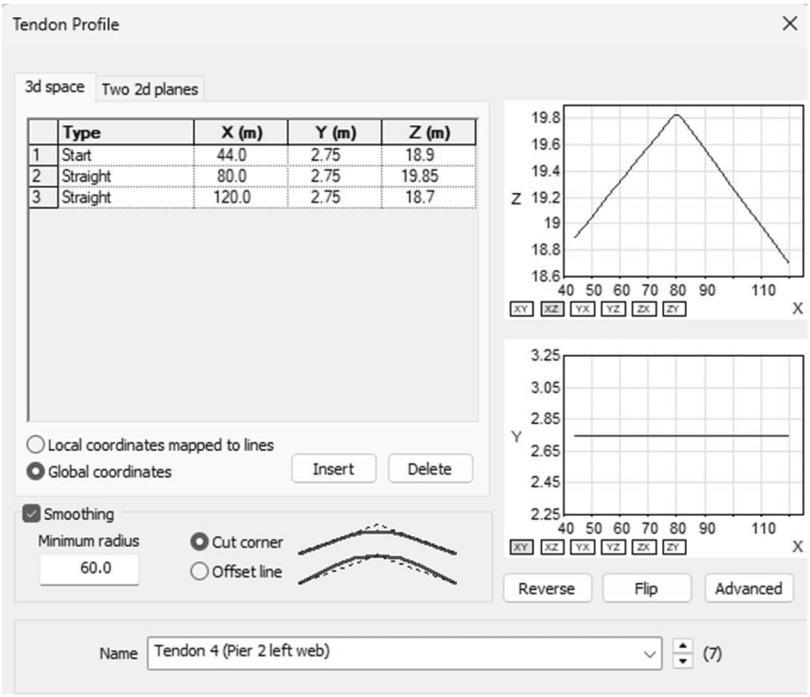


Tendon 3 - right:

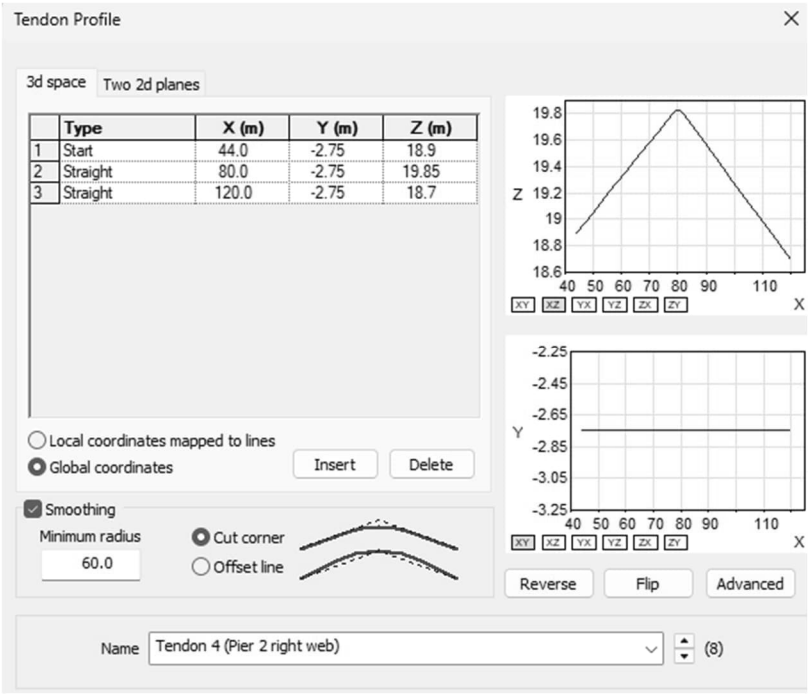


3.7.4.4 Tendon 4

Tendon 4 - left :

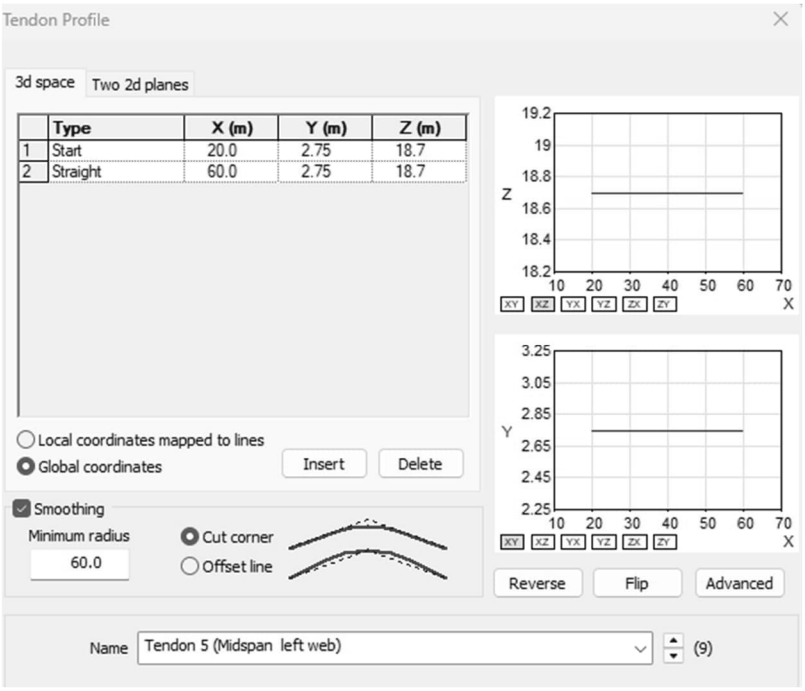


Tendon 4 - right:

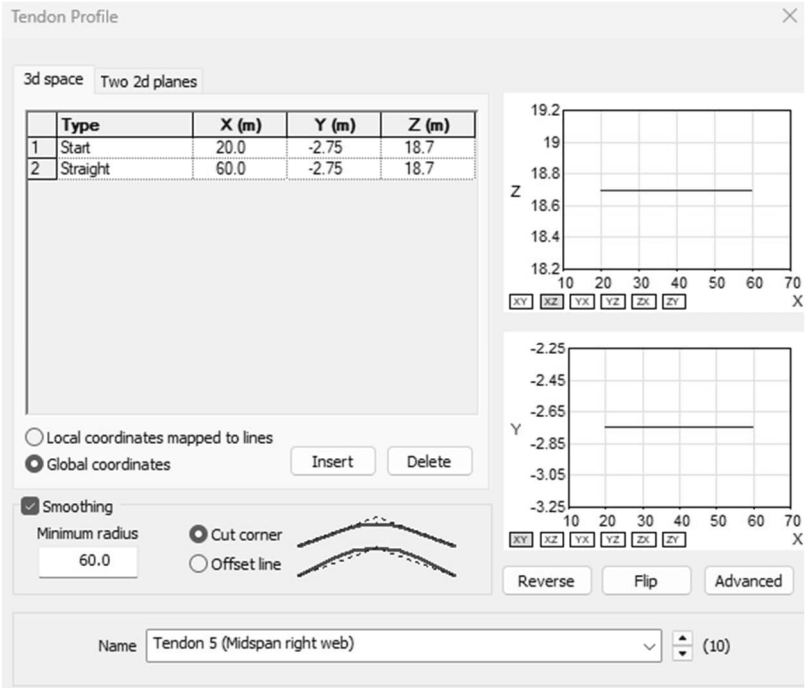


3.7.4.5 Tendon 5

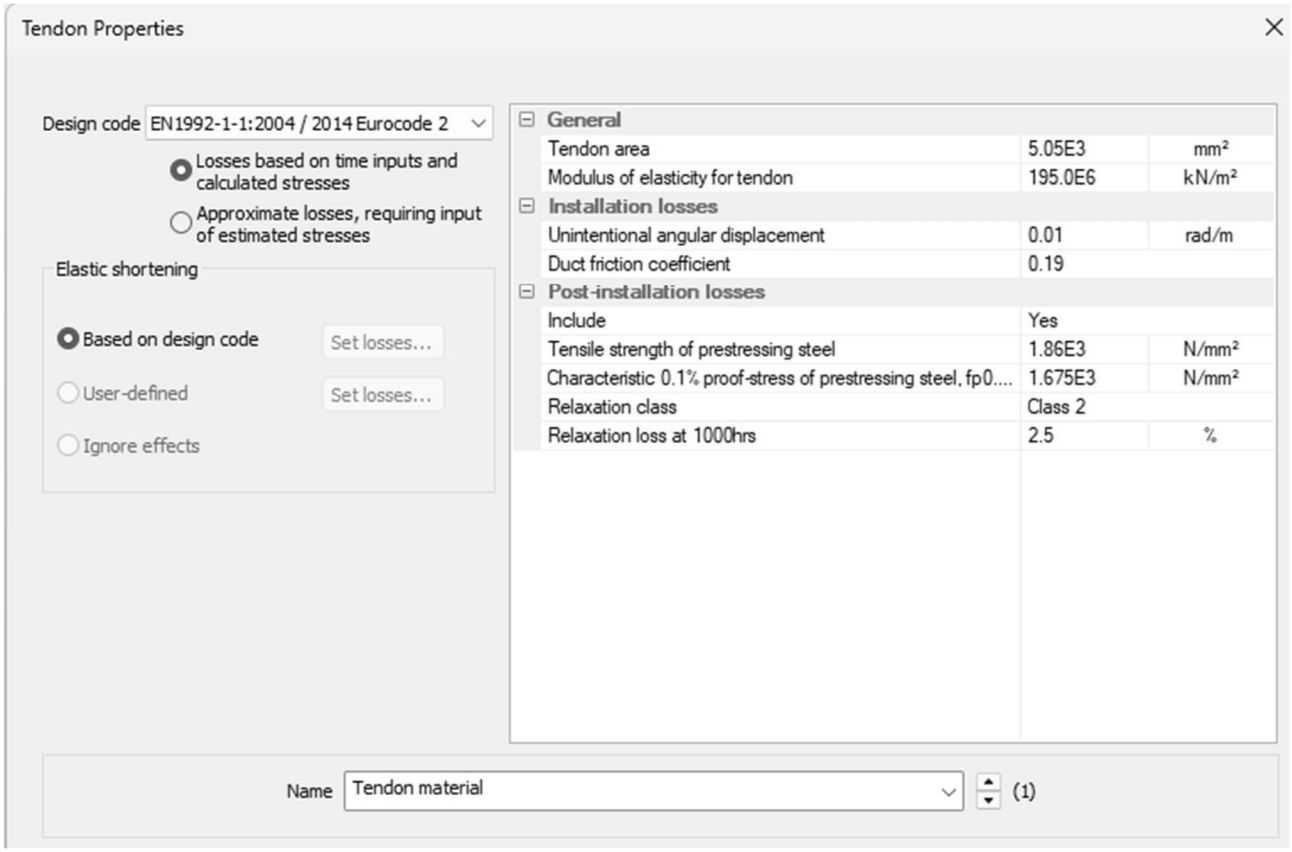
Tendon 5 - left :



Tendon 5 - right:



3.7.5 Tendon material



Friction coefficient installation

$$P_{(x)} = P_o \cdot e^{-\mu(\alpha + k \cdot x)}$$

μ = 0.19

$$k = 0.010 \frac{rad}{m}$$

3.7.6 Load definition

Load	Angle	Slip	Left side	Right side	Stage	Property
Tendon 1:L	0	5	Active	Active	3-7	Tendon material
Tendon 1:R	0	5	Active	Active	3-7	Tendon material
Tendon 2:R	0	5	Active	Active	4-7	Tendon material
Tendon 2:R	0	5	Active	Active	4-7	Tendon material
Tendon 3:L	0	5	Active	Active	5-7	Tendon material
Tendon 3:R	0	5	Active	Active	5-7	Tendon material
Tendon 4:R	0	5	Active	Active	6-7	Tendon material
Tendon 4:R	0	5	Active	Active	6-7	Tendon material
Tendon 5:L	0	5	Active	Active	7	Tendon material
Tendon 5:R	0	5	Active	Active	7	Tendon material
-	deg	mm	-	-		

3.7.7 Envelope prestress

Envelope PT::

Load case	Permanent factor	Variable factor
Prestress (stage 7)	1.00	0
Prestress (longtem	0.90	0.20

3.8 LOAD COMBINATIONS

Verification of load capacity shall be carried out for several limit states as detailed in this section.

Fatigue Limit State:
The risk of fatigue according to the partial factor method is checked using equation 6.69 provided in document SS-EN 1992-1-1.

Other Limit States:
For other limit states, section 6.4.3 of EN-1990 is applied.

Verification of load capacity shall be carried out for several limit states as detailed in this section.

Fatigue Limit State:
The risk of fatigue according to the partial factor method is checked using equation 6.69 provided in document SS-EN 1992-1-1.

Other Limit States:
For other limit states, section 6.4.3 of EN-1990 is applied.

3.8.1 Ultimate Limit States (ULS)

When checking the ultimate limit state, the load factors vary depending on the type of failure as detailed below:

STR: Verification of structural bearing capacity

GEO: Verification of geotechnical bearing capacity

For checking the ultimate limit state, TRVNFRA-00227 section 7.1.6.3 specifies requirements for load combinations as follows.

Design Method D2 (Set B):
Design Method D2 (Set B) according to TSFS 2018:57 Table 4.4 shall be applied for the structural bearing capacity of the construction (STR; SK 3).

Design Method is defined according to EN-1990 equations 6.10a and 6.10b as detailed below.

$$E_{Sd}^{10a} = \sum_{j\geq 1} \gamma_{G.j} \cdot G_{k,j} + \gamma_{Q.1} \cdot \psi_{0,1} \cdot Q_{k.1} + \sum_{i>1} \gamma_{Q.i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi\gamma_{ULS-A} \cdot (\sum_{j>1} G_{k,j} + \sum_{i>1} Q_{k,i})$$

$$E_{sd}^{10b} = \sum_{j\geq 1} \xi_j \cdot \gamma_{G.j} \cdot G_{k,j} + \gamma_{Q.1} \cdot Q_{k.1} + \sum_{i>1} \gamma_{Q.i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi\gamma_{ULS-B} \cdot (\sum_{j>1} G_{k,j} + \sum_{i>1} Q_{k,i})$$

Equation 6.10a refers to the (ULS-A) case where the permanent loads are dominant, usually during the construction phase.

Equation 6.10b refers to the (ULS-B) case where the variable loads are dominant.
Design method 2 (set B) according to TSFS 2018:57 table 4.4 shall be applied for the structural capacity (STR; SK3).

Design method D3 (set C):

Design method D3 (set C) according to TSFS 2018:57 table 4.5 shall be applied for determining geotechnical bearing capacity (GEO; SK 2).

The design method is defined according to EN-1990 equation 6.10a and 6.10b as presented below.

$$E_{Sd}^{10a} = \sum_{j\geq 1} \gamma_{G.j} \cdot G_{k,j} + \gamma_{Q.1} \cdot \psi_{0,1} \cdot Q_{k.1} + \sum_{i>1} \gamma_{Q.i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi\gamma_{ULS-GA} \cdot (\sum_{j>1} G_{k,j} + \sum_{i>1} Q_{k,i})$$

$$E_{sd}^{10b} = \sum_{j\geq 1} \xi_j \cdot \gamma_{G.j} \cdot G_{k,j} + \gamma_{Q.1} \cdot Q_{k.1} + \sum_{i>1} \gamma_{Q.i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi\gamma_{ULS-GB} \cdot (\sum_{j>1} G_{k,j} + \sum_{i>1} Q_{k,i})$$

Equation 6.10a refers to the (ULS-A) case where the permanent loads are dominant, usually during the construction phase.

Equation 6.10b (ULS-B) refers to the case where the variable loads are dominant.

Design method 3 (set C) according to TSFS 2018:57 table 4.5 shall be applied for determining geotechnical bearing capacity (GEO).

Simplified Design Method ULS

To limit the number of load combinations, design method D2 (STR) is also applied for checking geotechnical bearing capacity (GEO). This is done by adjusting load coefficients associated with the geotechnical loads.
When applying the geotechnical loads, the earth pressure coefficient corresponding to D2 is applied.

Permanent loads:

Nr	Load		$\psi\gamma_{ULS-A}$	$\psi\gamma_{ULS-B}$		$\psi\gamma_{ULS}$
1	Dead weight	max	1.35	1.20		1.20
		min	1.00	1.00		1.00
2	Surfacing	max	1.49	1.33		1.33
		min	0.90	0.90		0.90
3	Fillling	max	1.49	1.33		1.33
		min	0.90	0.90		0.90
4	Earth pressure	max	1.49	1.33	$\Rightarrow$	1.48[1.)]
		min	0.90	0.90		0.90
5	Water pressure	max	1.35	1.09		1.09
		min	1.00	1.00		1.00
6	Support settlement	max	1.35	1.20		1.20
		min	1.00	1.00		1.00
7	Shrinkage	max	1.35	1.20		1.20
		min	1.00	1.00		1.00
8	Prestress	max	1.35	1.35		1.35
		min	1.00	1.00		1.00

Variable loads:

Nr	Load	$\psi\gamma_{ULS-A}$	$\psi\gamma_{ULS-B}$		$\psi\gamma_{ULS}$
	Load model LM 1 :				
9	Tandem axel	1.13	1.03/1.50		1.03/1.50
10	Surface load	0.60	0.60/1.50		0.60/1.50
11	Braking force	0.84	0.84/1.13		0.84/1.13
12	Lateral force	0.84	0.84/1.13		0.84/1.13
13	Centrifugal force	0.84	0.84/1.13		0.84/1.13
	Load model LM 2 :				
14	Single axel	0	0/1.50		0/1.50
	Complementary load EG A/B :				
15	Vehicle EG A/B	1.13	1.13/1.50		1.13/1.50
16	Braking force	0.84	0.84/1.13		0.84/1.13
17	Lateral force	0.84	0.84/1.13		0.84/1.13
18	Centrifugal force	0.84	0.84/1.13	$\Rightarrow$	0.84/1.13
19	Temperature	0.90	0.90/1.50		0.90/1.50
	Wind load:				
20	Wind against bridge	0.45	0.45/1.50		0.45/1.50
21	Wind against vehicles	0.45	0.45/1.50		0.45/1.50
22	Surcharge	1.13	1.13/1.50		1.13/1.50

Load combination smart *ULS-PERM :*

Load case	Permanent factor	Variable factor
Dead weight (stage 7	1.00	0.20
Surfacing	0.90	0.43

Load combination smart *ULS-VAR :*

Load case	Permanent factor	Variable factor
TRAFIK	1.03	0.47

Load combination smart *ULS :*

Load case	Permanent factor	Variable factor
ULS-PERM	1	0
PT	1	0.35
ULS-VAR	0	1

Load combination smart *ULS-0 :*
(Is identical to ULS but does not contain prestress)

Load case	Permanent factor	Variable factor
ULS-PERM	1	0
ULS-VAR	0	1

3.14.2 Service limit state (SLS)

The service limit state is divided into 3 load combinations based on their duration. The load combinations are presented below.

Load combination	Duration
SLS:K	Characteristic
SLS:F	Frequent
SLS:Q	Quasi-permanent

Load Combination SLS:K according to EN 1990 equation 6.14b is presented below.

$$E_{Sd} = \sum_{j\geq 1} G_{k,j} + Q_{k.1} + \sum_{i>1} \psi_{0,i} \cdot Q_{k,i} = \psi\gamma_{SLS.K} \cdot (\sum_{j>1} G_{k,j} + \sum_{i>1} Q_{k,i})$$

Load Combination SLS:F according to EN 1990 equation 6.15b is presented below.

$$E_{Sd} = \sum_{j\geq 1} G_{k,j} + \psi_1 \cdot Q_{k.1} + \sum_{i>1} \psi_{2,i} \cdot Q_{k,i} = \psi\gamma_{SLS.2} \cdot (\sum_{j>1} G_{k,j} + \sum_{i>1} Q_{k,i})$$

Load Combination SLS:Q according to EN 1990 equation 6.16b is presented below.

$$E_{Sd} = \sum_{j\geq 1} G_{k,j} + \sum_{i>0} \psi_{2,i} \cdot Q_{k,i} = \psi\gamma_{SLS.Q} \cdot (\sum_{j>1} G_{k,j} + \sum_{i>1} Q_{k,i})$$

When designing, load coefficients according to equations 6.14a, 6.15b, and 6.16b are applied.

Permanent loads:

Nr	Load		$\psi\gamma_{SLS-K}$	$\psi\gamma_{SLS-F}$	$\psi\gamma_{SLS-Q}$
1	Dead weight	max	1.00	1.00	1.00
		min	1.00	1.00	1.00
2	Surfacing	max	1.10	1.10	1.00
		min	0.90	0.90	1.00
3	Fillling	max	1.10	1.10	1.00
		min	0.90	0.90	1.00
4	Earth pressure	max	1.48[3.)]	1.48[3.)]	1.34[3.)]
		min	0.90	0.90	1.00
5	Water pressure	max	1.00	1.00	1,00
		min	1.00	1.00	1.00
6	Support settlement	max	1.00	1.00	1.00
		min	1.00	1.00	1.00
7	Shrinkage	max	1.00	1.00	1.00
		min	1.00	1.00	1.00
8	Prestress	max	1.00	1.00	1.00
		min	1.00	1.00	1.00

Variable loads:

Nr	Load	$\psi\gamma_{SLS-K}$	$\psi\gamma_{SLS-F}$	$\psi\gamma_{SLS-Q}$
	Load model LM 1 :			
9	Tandem axel	0.75/1.00	0/0.75	0
10	Surface load	0.40/1.00	0/0.40	0
11	Braking force	0.56/0.75	0/0.56	0
12	Lateral force	0.56/0.75	0/0.56	0
13	Centrifugal force	0.56/0.75	0/0.56	0
	Load model LM 2 :			
14	Single axel	0.75/1.00	0/0.75	0
	Complementary load EG A/B :			
15	Vehicle EG A/B	0.75/1.00	0/0.75	0
16	Braking force	0.56/0.75	0/0.56	0
17	Lateral force	0.56/0.75	0/0.56	0
18	Centrifugal force	0.56/0.75	0/0.56	0
19	Temperature	0.60/1.00	0.50/0.60	0.50
	Wind load:			
20	Wind against bridge	0.30/1.00	0/0.30	0
21	Wind against vehicles	0.30/1.00	0/0.30	0
22	Surcharge	0.75/1.35	0/0.75	0

Load combination smart *SLS-PERM :*

Loadcase	Permanent factor	Variable factor
Dead weight (stage 7)	1.00	0
Surfacing	0.90	0.20

Load combination smart *SLS-K-VAR :*

Load case	Permanent factor	Variable factor
TRAFIK	0.75	0.25

Load combination smart *SLS-F-VAR :*

Load case	Permanent factor	Variable factor
TRAFIK	0	0.75

Load combination smart *SLS-K :*

Load case	Permanent factor	Variable factor
SLS-PERM	1	0
PT	1	0
SLS-K-VAR	0	1

Load combination smart *SLS-F :*

Load case	Permanent factor	Variable factor
SLS-PERM	1	0
PT	1	0
SLS-F-VAR	0	1

Load combination smart *SLS-Q :*

Load case	Permanent factor	Variable factor
Dead weight (stage 7)	1.00	0
Surfacing	1.00	0.20
Prestress (longterm)	1	0

3.14.4 Fatigue load combination

Fatigue is considered according to SS EN 1992-1-1, 6.8.4 and 6.8.6, and SS EN 1992-2, 6.8 and Appendix NN.

The risk of fatigue is checked using a simplified method, denoted as the λ-method.
Load combination according to equation SS-EN 1992-1-1 section 6.8.3 equation 6.69.

In this load combination, the traffic load is considered to consist of UTM, whereby other traffic loads are excluded.

$$E_{Sd} = \sum_{j\geq 1} G_{k,j} + P + \psi_{1,1} \cdot Q_{k,1} + \sum_{i>1} \psi_{2,i} \cdot Q_{k,i} + Q_{fat} = \psi\gamma_{UTM} \cdot (\sum_{j\geq 1} G_{k,j} + P + \sum_{i\geq 1} Q_{k,i} + Q_{fat})$$

Permanent loads:

Nr	Load		$\psi\gamma_{UTM}$
1	Egentyngd	max	1.00
		min	1.00
2	Beläggning	max	1.10
		min	0.90
3	Överfyllnad	max	1.10
		min	0.90
4	Jordtryck	max	1.48
		min	0.90
5	Vattentryck	max	1.00
		min	1.00
6	Stödförskjutning	max	1.00
		min	1.00
7	Krympning	max	1.00
		min	1.00
8	Prestress	max	1.00
		min	1.00

Variable loads:

Nr	Load	$\psi\gamma_{UTM}$
	Lastmodell LM 1 :	
9	Boggiesystem	-
10	Utbredd last	-
11	Bromskraft	-
12	Sidokraft	-
13	Centrifugalkraft	-
	Lastmodell LM 2 :	
14	Enstaka axellast	-
	Typfordon EG A/B :	
15	Typfordon EG A/B	-
16	Bromskraft	-
17	Sidokraft	-
18	Centrifugalkraft	-
19	Temperatur	0.60
	Vindlaster:	
20	Vindlast mot bro	0.30
21	Vindlast mot trafik	0.30
22	Överlast	1.01
23	UTM3	1.00

Load combination smart FAT :

Load case	Permanent factor	Variable factor
Dead weight (stage 7)	1.00	0
Surfacing	1.00	0
Prestress (longterm)	1.0	0
UTM3	-	1.00

Title: Input receipt

Model Units: kN,m,t,s,C
Report Units: kN,m,t,s,C

Model Title: System 001
Model File: System 001

Clarification of definitions.

In the report, the letter “T” is used to describe a range. The letter is an abbreviation of “to”.

See example of assignment below.

Assignment to Lines:
105T110;114T119

This expression means that the assignment occurs to the lines L105 → L110 and L114 → L119.

Assignment to Points:
6; 13

This expression means that the assignment occurs at point P6 and P13.

Table of Contents

1. Points

Point	X coordinate	Y coordinate	Z coordinate
1	-1.4	0.0	0.0
2	1.4	0.0	0.0
3	78.5	0.0	0.0
4	81.5	0.0	0.0
5	-1.4	0.0	6.0
6	1.4	0.0	6.0
7	78.5	0.0	6.0
8	81.5	0.0	6.0
9	-1.4	0.0	12.0
10	1.4	0.0	12.0
11	78.5	0.0	12.0
12	81.5	0.0	12.0
13	-1.4	0.0	17.9
14	1.4	0.0	17.9
15	78.5	0.0	17.9
16	81.5	0.0	17.9
17	-40.0	0.0	19.2
18	-20.0	0.0	19.2
19	20.0	0.0	19.2
20	36.0	0.0	19.2
21	44.0	0.0	19.2
22	60.0	0.0	19.2
23	100.0	0.0	19.2
24	120.0	0.0	19.2
25	-40.0	6.5	21.0
26	120.0	6.5	21.0
27	-40.0	-6.5	21.0
28	120.0	-6.5	21.0

2. Lines

Line	Points	Line	Points
1	1,5	2	5,9
3	9,13	4	2,6
5	6,10	6	10,14
7	7,3	8	11,7
9	15,11	10	8,4
11	12,8	12	16,12
13	5,6	14	9,10
15	7,8	16	11,12
17	17,18	18	18,13
19	13,14	20	14,19
21	19,20	22	20,21
23	21,22	24	22,15
25	15,16	26	16,23
27	23,24		

3. MESH:Line

Attribute: 1Title: Element 8

Sub Type = Line Mesh **Element Type = BMI21**

Mesh spacing	Nr. of elements	Start node end releases:	End node end releases:
Uniform	8	None	None

Assignment to Lines: **Beta angle = 0.0**

17;18;20;21;23;24;26;27

Attribute: 3 Title: Element 2

Sub Type = Line Mesh **Element Type = BMI21**

Mesh spacing	Nr. of elements	Start node end releases:	End node end releases:
Uniform	2	None	None

Assignment to Lines: **Beta angle = 0.0**

1T16;19;25

Attribute: 4 Title: Element 4

Sub Type = Line Mesh **Element Type = BMI21**

Mesh spacing	Nr. of elements	Start node end releases:	End node end releases:
Uniform	4	None	None

Assignment to Lines: **Beta angle = 0.0**

22

4. Analysis

4.1 Transient analysis

Analysis : Analyis 1
Type = Nonelinear & Transient
Base analysis: No
Incrementation: Manual (Time management)

4.2 Static analysis

Analysis : Analyis 2
Type = Linear & stactic
Base analysis: Yes
Incrementation: None

5. Age

Attribute: 1 Title: Age 7 days

Sub Type = Age
Assigned in: Analysis 1

Property	Symbol	Value
Age of material	t	604800.0
Age of material when shrinkage begins	s	604800.0
Type	type	"specified"

Assignment to Lines:
1T27

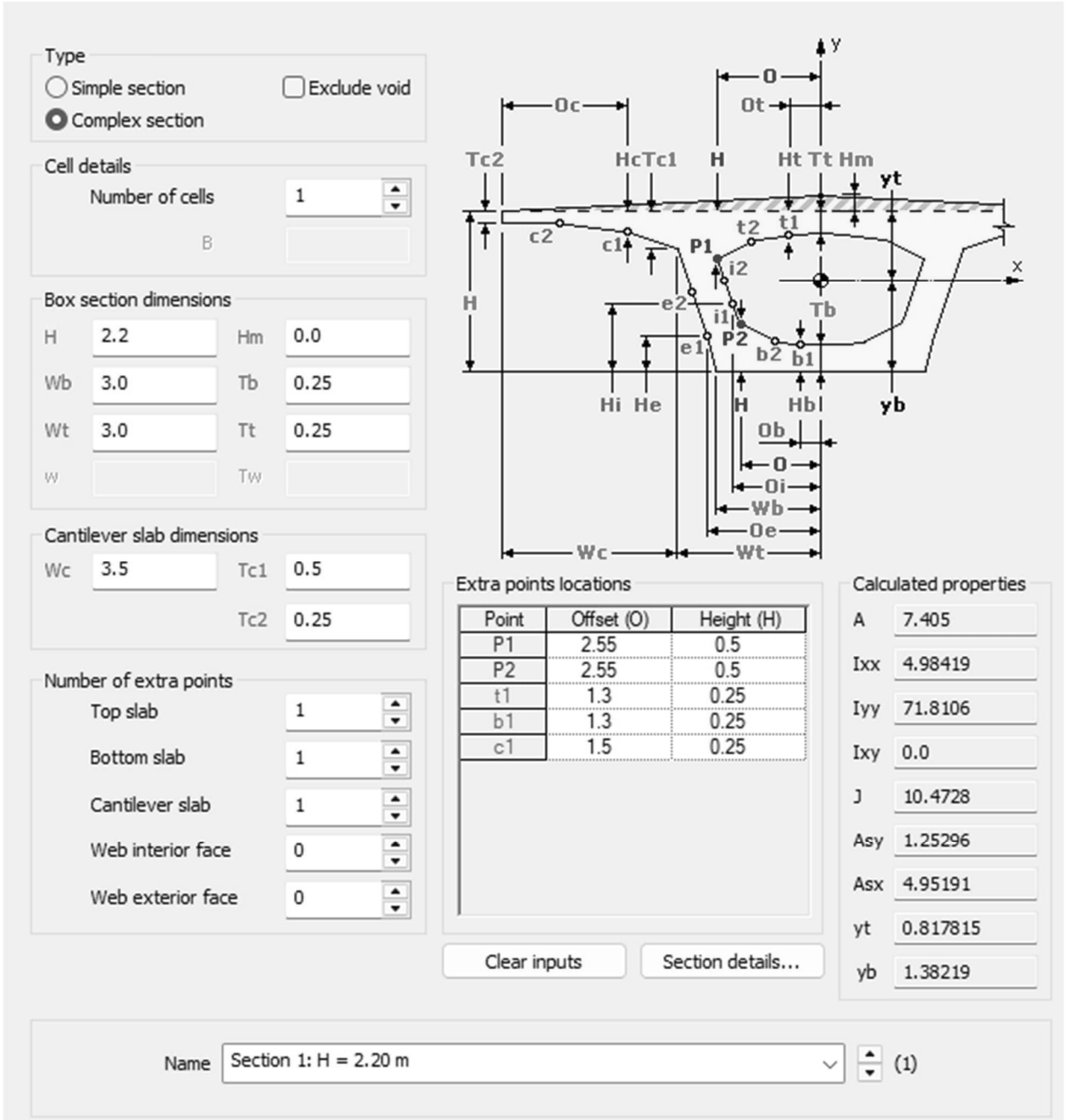
6. Time management

Analysis : Analyis 1

LC	Age of placement	Age at shrinkage	Stage duration	Response time
Stage 1	7	7	10	10
Stage 2	7	7	10	20
Stage 3	7	7	10	30
Prestess (stage 3)	-	-	0	30
Dead weight (stage 3)	-	-	0	30
Stage 4	7	7	10	40
Prestess (stage 3)	-	-	0	40
Dead weight (stage 3)	-	-	0	40
Stage 5	7	7	10	50
Prestess (stage 3)	-	-	0	50
Dead weight (stage 3)	-	-	0	50
Stage 6	7	7	10	60
Prestess (stage 3)	-	-	0	60
Dead weight (stage 3)	-	-	0	60
Stage 7	7	7	0	67
Prestess (stage 3)	-	-	0	67
Dead weight (stage 3)	-	-	7	67
Longterm	-	-	43800	43800
Prestess (longterm)	-	0		43800

7. Geometric : Line

7.1 Section definition



Type

Simple section Exclude void

Complex section

Cell details

Number of cells: 1

B:

Box section dimensions

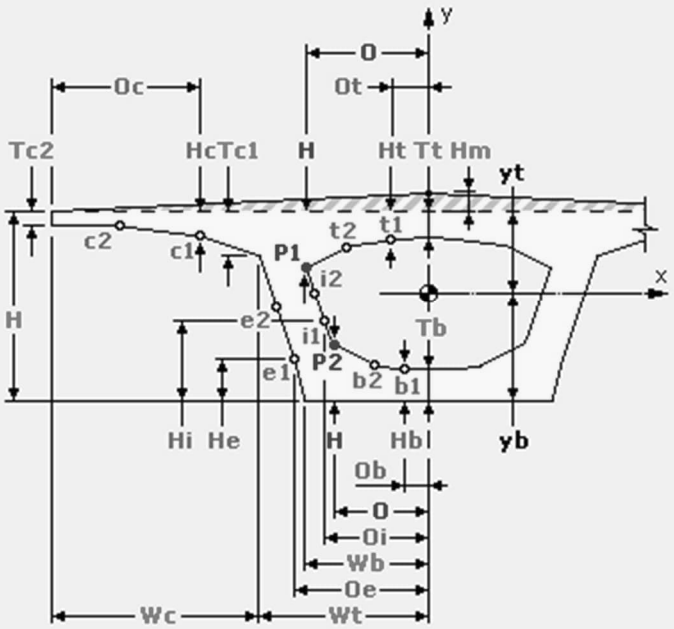
H	5.2	Hm	0.0
Wb	3.0	Tb	0.25
Wt	3.0	Tt	0.25
w		Tw	

Cantilever slab dimensions

Wc	3.5	Tc1	0.5
		Tc2	0.25

Number of extra points

Top slab	1
Bottom slab	1
Cantilever slab	1
Web interior face	0
Web exterior face	0



Extra points locations

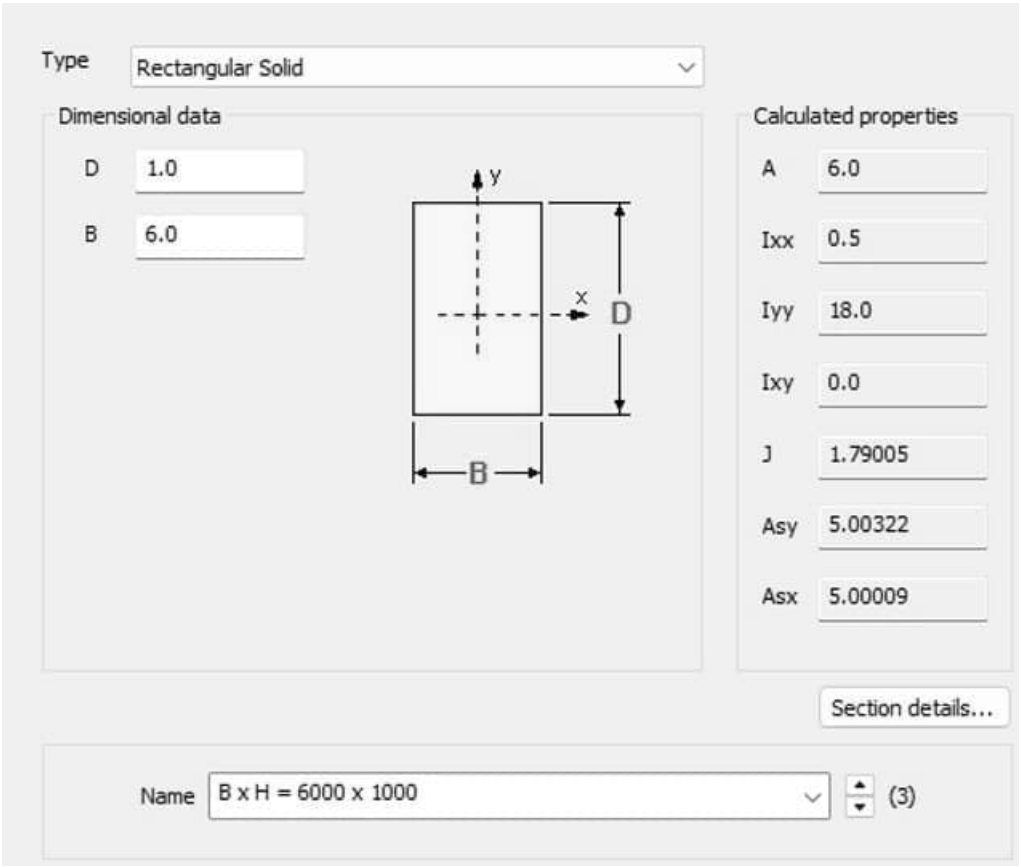
Point	Offset (O)	Height (H)
P1	2.55	0.5
P2	2.55	0.5
t1	1.3	0.25
b1	1.3	0.25
c1	1.5	0.25

Calculated properties

A	10.105
Ixx	39.737
Iyy	92.6479
Ixy	0.0
J	52.8276
Asy	3.93677
Asx	4.48835
yt	2.05922
yb	3.14078

Clear inputs Section details...

Name: Section 2: H = 5.20 m (2)


Type
Rectangular Solid
Dimensional data
D
1.0
B
6.0
y
x
D
B
Calculated properties
A
6.0
Ixx
0.5
Iyy
18.0
Ixy
0.0
J
1.79005
Asy
5.00322
Asx
5.00009
Section details...
Name
B x H = 6000 x 1000
(3)

7.2 Constant beams

Attribute: 2 Title: Pier vertical (Section 3: B x H = 6000 x 1000 (RSS D=1 B=6))
Sub Type = Line Geometric
Assigned in: Analysis 1

Property	Symbol	Value
Cross sectional area	A	6.0
Second moment of area about y axis	Iyy	0.5
Second moment of area about z axis	Izz	18.0
Product moment of area	Iyz	0.0
Torsional constant	J	1.8
Eccentricity in local z direction, relative to specified origin	ez0	0.0
Eccentricity in local y direction, relative to specified origin	ey0	0.0
Eccentricity in local z direction, relative to beam centroid	ez	0.0
Eccentricity in local y direction, relative to beam centroid	ey	0.0
Wagner constant 1st moment of square radius about y (Iyr)	Iyr	0.0
Wagner constant 1st moment of square radius about z (Izr)	Izr	0.0
Wagner constant 4th moment of area about origin (Irr)	Irr	100.3
Wagner constant 2nd moment of warping about origin (Iwr)	Iwr	0.0
Effective shear area in local z direction	Asz	5.0
Effective shear area in local y direction	Asy	5.0
Plastic area	Ap	6.0
Plastic modulus for bending about y	Zpy	1.5
Plastic modulus for bending about z	Zpz	9.0
Plastic neutral axis, distance from centroid along y axis	yp	0.0
Plastic neutral axis, distance from centroid along z axis	zp	0.0
Plastic torsional section modulus	Zpt	4.0
Warping torsional constant about shear centre	Cw	1.3
Shear centre about y axis	yo	0.0
Shear centre about z axis	zo	0.0
Monosymmetry constant about y	betay	0.0
Monosymmetry constant about z	betaz	0.0
Radius of gyration about y axis	ky	0.3
Radius of gyration about z axis	kz	1.7
y axis extreme fibre, top	yt	3.0
y axis extreme fibre, bottom	yb	-3.0
z axis extreme fibre, top	zt	0.5
z axis extreme fibre, bottom	zb	-0.5
Shape code identifier	Type	1
Breadth of this section	B	6.0
Depth of this section	D	1.0
Element type	elementType	"3D Thick Beam"
Reinforcement	reinforcement	None

Assignment to Lines:
15;16;25

Attribute: 4 Title: Pier vertical (Section 3: B x H = 6000 x 1000 (RSS D=1 B=6))

Sub Type = Line Geometric

Assigned in: Analysis 2 (Base analysis); Analysis 1

Property	Symbol	Value
Cross sectional area	A	6.0
Second moment of area about y axis	Iyy	0.5
Second moment of area about z axis	Izz	18.0
Product moment of area	Iyz	0.0
Torsional constant	J	1.8
Eccentricity in local z direction, relative to specified origin	ez0	0.0
Eccentricity in local y direction, relative to specified origin	ey0	0.0
Eccentricity in local z direction, relative to beam centroid	ez	0.0
Eccentricity in local y direction, relative to beam centroid	ey	0.0
Wagner constant 1st moment of square radius about y (Iyr)	Iyr	0.0
Wagner constant 1st moment of square radius about z (Izr)	Izr	0.0
Wagner constant 4th moment of area about origin (Irr)	Irr	100.3
Wagner constant 2nd moment of warping about origin (Iwr)	Iwr	0.0
Effective shear area in local z direction	Asz	5.0
Effective shear area in local y direction	Asy	5.0
Plastic area	Ap	6.0
Plastic modulus for bending about y	Zpy	1.5
Plastic modulus for bending about z	Zpz	9.0
Plastic neutral axis, distance from centroid along y axis	yp	0.0
Plastic neutral axis, distance from centroid along z axis	zp	0.0
Plastic torsional section modulus	Zpt	4.0
Warping torsional constant about shear centre	Cw	1.3
Shear centre about y axis	yo	0.0
Shear centre about z axis	zo	0.0
Monosymmetry constant about y	betay	0.0
Monosymmetry constant about z	betaz	0.0
Radius of gyration about y axis	ky	0.3
Radius of gyration about z axis	kz	1.7
y axis extreme fibre, top	yt	3.0
y axis extreme fibre, bottom	yb	-3.0
z axis extreme fibre, top	zt	0.5
z axis extreme fibre, bottom	zb	-0.5
Shape code identifier	Type	1
Breadth of this section	B	6.0
Depth of this section	D	1.0
Element type	elementType	"3D Thick Beam"
Reinforcement	reinforcement	None

Assignment to Lines:

1T12

Attribute: 6 Title: Superstructure: constant hieght (H = 5.2 m) (Section 2: H = 5.20 m (CBoxSingleCell D=5.2 Wt=3 Wb=3 Tt=0.25 Tb=0.25))

Sub Type = Line Geometric

Assigned in: Analysis 2 (Base analysis)

Property	Symbol	Value
Cross sectional area	A	10.1
Second moment of area about y axis	Iyy	39.7
Second moment of area about z axis	Izz	92.6
Product moment of area	Iyz	0.0
Torsional constant	J	52.8
Eccentricity in local z direction, relative to specified origin	ez0	0.0
Eccentricity in local y direction, relative to specified origin	ey0	0.0
Eccentricity in local z direction, relative to beam centroid	ez	0.0
Eccentricity in local y direction, relative to beam centroid	ey	0.0
Wagner constant 1st moment of square radius about y (Iyr)	Iyr	34.0
Wagner constant 1st moment of square radius about z (Izr)	Izr	0.0
Wagner constant 4th moment of area about origin (Irr)	Irr	2426.4
Wagner constant 2nd moment of warping about origin (Iwr)	Iwr	0.0
Effective shear area in local z direction	Asz	3.9
Effective shear area in local y direction	Asy	4.5
Plastic area	Ap	10.1
Plastic modulus for bending about y	Zpy	17.9
Plastic modulus for bending about z	Zpz	27.7
Plastic neutral axis, distance from centroid along y axis	yp	0.0
Plastic neutral axis, distance from centroid along z axis	zp	0.7
Plastic torsional section modulus	Zpt	24.0
Warping torsional constant about shear centre	Cw	29.0
Shear centre about y axis	yo	0.0
Shear centre about z axis	zo	-0.3
Monosymmetry constant about y	betay	1.4
Monosymmetry constant about z	betaz	0.0
Radius of gyration about y axis	ky	2.0
Radius of gyration about z axis	kz	3.0
y axis extreme fibre, top	yt	6.5
y axis extreme fibre, bottom	yb	-6.5
z axis extreme fibre, top	zt	2.1
z axis extreme fibre, bottom	zb	-3.1
Shape code identifier	Type	28
n	n	1.0
Wt	Wt	3.0
Wb	Wb	3.0
H	H	5.2
Wc	Wc	3.5
Tc1	Tc1	0.5
Tc2	Tc2	0.3
Hm	Hm	0.0
Tt	Tt	0.3
Tb	Tb	0.3
nt	nt	1.0
nb	nb	1.0
nc	nc	1.0
ni	ni	0.0
ne	ne	0.0
Element type	elementType	"3D Thick Beam"
Reinforcement	reinforcement	None

Assignment to Lines:

19;25

Attribute: 7 Title: Superstructure: constant height (H = 2.2 m) (Section 1: H = 2.20 m (CBoxSingleCell D=2.2 Wt=3 Wb=3 Tt=0.25 Tb=0.25))

Sub Type = Line Geometric

Assigned in: Analysis 2 (Base analysis)

Property	Symbol	Value
Cross sectional area	A	7.4
Second moment of area about y axis	Iyy	5.0
Second moment of area about z axis	Izz	71.8
Product moment of area	Iyz	0.0
Torsional constant	J	10.5
Eccentricity in local z direction, relative to specified origin	ez0	0.0
Eccentricity in local y direction, relative to specified origin	ey0	0.0
Eccentricity in local z direction, relative to beam centroid	ez	0.0
Eccentricity in local y direction, relative to beam centroid	ey	0.0
Wagner constant 1st moment of square radius about y (Iyr)	Iyr	22.8
Wagner constant 1st moment of square radius about z (Izr)	Izr	0.0
Wagner constant 4th moment of area about origin (Irr)	Irr	1469.5
Wagner constant 2nd moment of warping about origin (Iwr)	Iwr	0.0
Effective shear area in local z direction	Asz	1.3
Effective shear area in local y direction	Asy	5.0
Plastic area	Ap	7.4
Plastic modulus for bending about y	Zpy	5.0
Plastic modulus for bending about z	Zpz	20.2
Plastic neutral axis, distance from centroid along y axis	yp	0.0
Plastic neutral axis, distance from centroid along z axis	zp	0.5
Plastic torsional section modulus	Zpt	10.6
Warping torsional constant about shear centre	Cw	10.0
Shear centre about y axis	yo	0.0
Shear centre about z axis	zo	-0.3
Monosymmetry constant about y	betay	5.2
Monosymmetry constant about z	betaz	0.0
Radius of gyration about y axis	ky	0.8
Radius of gyration about z axis	kz	3.1
y axis extreme fibre, top	yt	6.5
y axis extreme fibre, bottom	yb	-6.5
z axis extreme fibre, top	zt	0.8
z axis extreme fibre, bottom	zb	-1.4
Shape code identifier	Type	28
n	n	1.0
Wt	Wt	3.0
Wb	Wb	3.0
H	H	2.2
Wc	Wc	3.5
Tc1	Tc1	0.5
Tc2	Tc2	0.3
Hm	Hm	0.0
Tt	Tt	0.3
Tb	Tb	0.3
nt	nt	1.0
nb	nb	1.0
nc	nc	1.0
ni	ni	0.0
ne	ne	0.0
Element type	elementType	"3D Thick Beam"
Reinforcement	reinforcement	None

Assignment to Lines:

17;21;22;23;27

Attribute: 8 Title: Pier horizontal (Section 3: B x H = 6000 x 1000 (RSS D=1 B=6))
Sub Type = Line Geometric
Assigned in: Analysis 2 (Base analysis); Analysis 1

Property	Symbol	Value
Cross sectional area	A	6.0
Second moment of area about y axis	Iyy	0.5
Second moment of area about z axis	Izz	18.0
Product moment of area	Iyz	0.0
Torsional constant	J	1.8
Eccentricity in local z direction, relative to specified origin	ez0	0.0
Eccentricity in local y direction, relative to specified origin	ey0	0.0
Eccentricity in local z direction, relative to beam centroid	ez	0.0
Eccentricity in local y direction, relative to beam centroid	ey	0.0
Wagner constant 1st moment of square radius about y (Iyr)	Iyr	0.0
Wagner constant 1st moment of square radius about z (Izr)	Izr	0.0
Wagner constant 4th moment of area about origin (Irr)	Irr	100.3
Wagner constant 2nd moment of warping about origin (Iwr)	Iwr	0.0
Effective shear area in local z direction	Asz	5.0
Effective shear area in local y direction	Asy	5.0
Plastic area	Ap	6.0
Plastic modulus for bending about y	Zpy	1.5
Plastic modulus for bending about z	Zpz	9.0
Plastic neutral axis, distance from centroid along y axis	yp	0.0
Plastic neutral axis, distance from centroid along z axis	zp	0.0
Plastic torsional section modulus	Zpt	4.0
Warping torsional constant about shear centre	Cw	1.3
Shear centre about y axis	yo	0.0
Shear centre about z axis	zo	0.0
Monosymmetry constant about y	betay	0.0
Monosymmetry constant about z	betaz	0.0
Radius of gyration about y axis	ky	0.3
Radius of gyration about z axis	kz	1.7
y axis extreme fibre, top	yt	3.0
y axis extreme fibre, bottom	yb	-3.0
z axis extreme fibre, top	zt	0.5
z axis extreme fibre, bottom	zb	-0.5
Shape code identifier	Type	1
Breadth of this section	B	6.0
Depth of this section	D	1.0
Element type	elementType	"3D Thick Beam"
Reinforcement	reinforcement	None

Assignment to Lines:
2T11I3;13T16

7.3 Tapered beams

Attribute: 1 Title: Superstructure - tapering:R (Section 2: H = 5.20 m (CBoxSingleCell D=5.2 Wt=3 Wb=3 Tt=0.25 Tb=0.25)/ Section 1: H = 2.20 m (CBoxSingleCell D=2.2 Wt=3 Wb=3 Tt=0.25 Tb=0.25))

Sub Type = Line Geometric

Assigned in: Analysis 2 (Base analysis); Analysis 1

Property	Symbol	End 1	End 2
Cross sectional area	A	10.1	7.4
Second moment of area about y axis	Iyy	39.7	5.0
Second moment of area about z axis	Izz	92.6	71.8
Product moment of area	Iyz	0.0	0.0
Torsional constant	J	52.8	10.5
Eccentricity in local z direction, relative to specified origin	ez0	0.0	0.0
Eccentricity in local y direction, relative to specified origin	ey0	0.0	0.0
Eccentricity in local z direction, relative to beam centroid	ez	0.0	0.0
Eccentricity in local y direction, relative to beam centroid	ey	0.0	0.0
Wagner constant 1st moment of square radius about y (Iyr)	Iyr	34.0	22.8
Wagner constant 1st moment of square radius about z (Izr)	Izr	0.0	0.0
Wagner constant 4th moment of area about origin (Irr)	Irr	2426.4	1469.5
Wagner constant 2nd moment of warping about origin (Iwr)	Iwr	0.0	0.0
Effective shear area in local z direction	Asz	3.9	1.3
Effective shear area in local y direction	Asy	4.5	5.0
Plastic area	Ap	10.1	7.4
Plastic modulus for bending about y	Zpy	17.9	5.0
Plastic modulus for bending about z	Zpz	27.7	20.2
Plastic neutral axis, distance from centroid along y axis	yp	0.0	0.0
Plastic neutral axis, distance from centroid along z axis	zp	0.7	0.5
Plastic torsional section modulus	Zpt	24.0	10.6
Warping torsional constant about shear centre	Cw	29.0	10.0
Shear centre about y axis	yo	0.0	0.0
Shear centre about z axis	zo	-0.3	-0.3
Monosymmetry constant about y	betay	1.4	5.2
Monosymmetry constant about z	betaz	0.0	0.0
Radius of gyration about y axis	ky	2.0	0.8
Radius of gyration about z axis	kz	3.0	3.1
y axis extreme fibre, top	yt	6.5	6.5
y axis extreme fibre, bottom	yb	-6.5	-6.5
z axis extreme fibre, top	zt	2.1	0.8
z axis extreme fibre, bottom	zb	-3.1	-1.4
Shape code identifier	Type	28	28
n	n	1.0	1.0
Wt	Wt	3.0	3.0
Wb	Wb	3.0	3.0
H	H	5.2	2.2
Wc	Wc	3.5	3.5
Tc1	Tc1	0.5	0.5
Tc2	Tc2	0.3	0.3
Hm	Hm	0.0	0.0
Tt	Tt	0.3	0.3
Tb	Tb	0.3	0.3
nt	nt	1.0	1.0
nb	nb	1.0	1.0
nc	nc	1.0	1.0
ni	ni	0.0	0.0
ne	ne	0.0	0.0
Element type	elementType	"3D Thick Beam"	"3D Thick Beam"
Vertical alignment eccentricity	vAlign	0.0	0.0
Horizontal alignment eccentricity	hAlign	0.0	0.0
Section to which others are aligned	alignToRow	0	0
Vertical alignment type	vAlignType	"CenterToCenter"	"CenterToCenter"
Horizontal alignment type	hAlignType	"CenterToCenter"	"CenterToCenter"
Interpolation method	interpMethod	"Enhanced"	"Enhanced"
Reinforcement	reinforcement	None	None

Assignment to Lines:

20;26

Attribute: 3 Title: Superstructure - tapering:L (Section 1: H = 2.20 m (CBoxSingleCell D=2.2 Wt=3 Wb=3 Tt=0.25 Tb=0.25)/ Section 2: H = 5.20 m (CBoxSingleCell D=5.2 Wt=3 Wb=3 Tt=0.25 Tb=0.25))

Sub Type = Line Geometric

Assigned in: Analysis 2 (Base analysis)

Property	Symbol	End 1	End 2
Cross sectional area	A	7.4	10.1
Second moment of area about y axis	Iyy	5.0	39.7
Second moment of area about z axis	Izz	71.8	92.6
Product moment of area	Iyz	0.0	0.0
Torsional constant	J	10.5	52.8
Eccentricity in local z direction, relative to specified origin	ez0	0.0	0.0
Eccentricity in local y direction, relative to specified origin	ey0	0.0	0.0
Eccentricity in local z direction, relative to beam centroid	ez	0.0	0.0
Eccentricity in local y direction, relative to beam centroid	ey	0.0	0.0
Wagner constant 1st moment of square radius about y (Iyr)	Iyr	22.8	34.0
Wagner constant 1st moment of square radius about z (Izr)	Izr	0.0	0.0
Wagner constant 4th moment of area about origin (Irr)	Irr	1469.5	2426.4
Wagner constant 2nd moment of warping about origin (Iwr)	Iwr	0.0	0.0
Effective shear area in local z direction	Asz	1.3	3.9
Effective shear area in local y direction	Asy	5.0	4.5
Plastic area	Ap	7.4	10.1
Plastic modulus for bending about y	Zpy	5.0	17.9
Plastic modulus for bending about z	Zpz	20.2	27.7
Plastic neutral axis, distance from centroid along y axis	yp	0.0	0.0
Plastic neutral axis, distance from centroid along z axis	zp	0.5	0.7
Plastic torsional section modulus	Zpt	10.6	24.0
Warping torsional constant about shear centre	Cw	10.0	29.0
Shear centre about y axis	yo	0.0	0.0
Shear centre about z axis	zo	-0.3	-0.3
Monosymmetry constant about y	betay	5.2	1.4
Monosymmetry constant about z	betaz	0.0	0.0
Radius of gyration about y axis	ky	0.8	2.0
Radius of gyration about z axis	kz	3.1	3.0
y axis extreme fibre, top	yt	6.5	6.5
y axis extreme fibre, bottom	yb	-6.5	-6.5
z axis extreme fibre, top	zt	0.8	2.1
z axis extreme fibre, bottom	zb	-1.4	-3.1
Shape code identifier	Type	28	28
n	n	1.0	1.0
Wt	Wt	3.0	3.0
Wb	Wb	3.0	3.0
H	H	2.2	5.2
Wc	Wc	3.5	3.5
Tc1	Tc1	0.5	0.5
Tc2	Tc2	0.3	0.3
Hm	Hm	0.0	0.0
Tt	Tt	0.3	0.3
Tb	Tb	0.3	0.3
nt	nt	1.0	1.0
nb	nb	1.0	1.0
nc	nc	1.0	1.0
ni	ni	0.0	0.0
ne	ne	0.0	0.0
Element type	elementType	"3D Thick Beam"	"3D Thick Beam"
Vertical alignment eccentricity	vAlign	0.0	0.0
Horizontal alignment eccentricity	hAlign	0.0	0.0
Section to which others are aligned	alignToRow	0	0
Vertical alignment type	vAlignType	"CenterToCenter"	"CenterToCenter"
Horizontal alignment type	hAlignType	"CenterToCenter"	"CenterToCenter"
Interpolation method	interpMethod	"Enhanced"	"Enhanced"
Reinforcement	reinforcement	None	None

Assignment to Lines:

18;24

8. Isotropic material

Attribute: 2 Title: Concrete (fck = 35MPa Quartzite | Concrete | EN1992-2:2005)
Sub Type = Isotropic Material
Assigned in: Analysis 2 (Base analysis); Analysis 1

Property	Symbol	Value
Young's modulus	E	34077100.0
Poisson's ratio	nu	0.2
Density	rho	2.5
Coefficient of thermal expansion	alpha	0.0
Characteristic cylinder strength	fck	35000.0

Loadcase ID: 9 Title: Surfacing
Assignment to Lines:
1T27
Loadcase ID: 10 Title: Stage 1
Assignment to Lines:
1T27

9. Support

Attribute: 1Title: Mid support
Sub Type = Structural Support
Assigned in: Analysis 2 (Base analysis); Analysis 1

Property	Symbol	Value
Translation in X	U	"R"
Translation in Y	V	"R"
Translation in Z	W	"R"
Rotation about X	THX	"R"
Rotation about Y	THY	"R"
Rotation about Z	THZ	"R"
Torsional warping	Torsion	"F"
Moment about hinge	L1	"F"
Pore pressure	pore	"C"

Assignment to Points:
1T4

Attribute: 2 Title: End support
Sub Type = Structural Support

Property	Symbol	Value
Translation in X	U	"F"
Translation in Y	V	"R"
Translation in Z	W	"R"
Rotation about X	THX	"R"
Rotation about Y	THY	"F"
Rotation about Z	THZ	"F"
Torsional warping	Torsion	"F"
Moment about hinge	L1	"F"
Pore pressure	pore	"C"

Assigned in: Analysis 2 (Base analysis)
Assignment to Points:
17;24
Assigned in: Analysis 1 (Stage 6)
Assignment to Points:
17
Assigned in: Analysis 1 (Stage 7)
Assignment to Points:
24

10. Activation

Attribute: 1 Title: Deactivate

Sub Type = Deactivate

Property	Symbol	Value
Percentage of internal forces to be redistributed	percent	100.0
Stiffness reduction factor	stfscl	0.0
Process constraint equations	createConstr	true
Constraint equation type	constrEquType	"none"
Increments	ninc	1
Basic Deactivation Options	deactType	"activeMesh"
Redistribution of Internal Forces	deactRedist	"number of increments"

Analysis: Analysis 1 (Stage 1)
Assignment to Lines:
17;18;20T24;26;27

Attribute: 1 Title: Activate

Sub Type = Activate

Property	Symbol	Value
Process constraint equations	createConstr	true
Constraint equation type	constrEquType	"tangent"
Increments	ninc	1

Analysis: Analysis 1 (Stage 2)
Assignment to Lines:
20

Analysis: Analysis 1 (Stage 3)
Assignment to Lines:
18;24

Analysis: Analysis 1 (Stage 4)
Assignment to Lines:
21;26

Analysis: Analysis 1 (Stage 5)
Assignment to Lines:
17;23

Analysis: Analysis 1 (Stage6)
Assignment to Lines:
27

Analysis: Analysis 1 (Stage 7)
Assignment to Lines:
22

11. Search Area

Attribute: 2 Title: Superstructure

Sub Type = Search Area

Assignment to Lines:
17T27

12. Body load

Attribute: 11 Title: Dead weight 1

Sub Type = Body Force Load

Property	Symbol	Value
Linear acceleration in X	AccX	0.0
Linear acceleration in Y	AccY	0.0
Linear acceleration in Z	AccZ	-10.0
Angular velocity about X axis	AngVelX	0.0
Angular velocity about Y axis	AngVelY	0.0
Angular velocity about Z axis	AngVelZ	0.0
Angular acceleration about X axis	AngAccX	0.0
Angular acceleration about Y axis	AngAccY	0.0
Angular acceleration about Z axis	AngAccZ	0.0
Linear acceleration In X fluid phase	lnFlAccX	0.0
Linear acceleration In Y fluid phase	lnFlAccY	0.0
Linear acceleration In Z fluid phase	lnFlAccZ	-10.0

Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
22
Loadcase ID: 4136 Title: Stage 6 Factor = 1.0
Loadcase ID: 4138 Title: Dead weight (stage 6) Factor = 1.0
Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
27
Loadcase ID: 4133 Title: Stage 5 Factor = 1.0
Loadcase ID: 4135 Title: Dead weight (stage 5) Factor = 1.0
Loadcase ID: 4136 Title: Stage 6 Factor = 1.0
Loadcase ID: 4138 Title: Dead weight (stage 6) Factor = 1.0
Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
17;23
Loadcase ID: 16 Title: Stage 4 Factor = 1.0
Loadcase ID: 4132 Title: Dead weight (stage 4) Factor = 1.0
Loadcase ID: 4133 Title: Stage 5 Factor = 1.0
Loadcase ID: 4135 Title: Dead weight (stage 5) Factor = 1.0
Loadcase ID: 4136 Title: Stage 6 Factor = 1.0
Loadcase ID: 4138 Title: Dead weight (stage 6) Factor = 1.0
Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
21;26
Loadcase ID: 12 Title: Stage 3 Factor = 1.0
Loadcase ID: 15 Title: Dead weight (stage 3) Factor = 1.0
Loadcase ID: 16 Title: Stage 4 Factor = 1.0
Loadcase ID: 4132 Title: Dead weight (stage 4) Factor = 1.0
Loadcase ID: 4133 Title: Stage 5 Factor = 1.0
Loadcase ID: 4135 Title: Dead weight (stage 5) Factor = 1.0
Loadcase ID: 4136 Title: Stage 6 Factor = 1.0
Loadcase ID: 4138 Title: Dead weight (stage 6) Factor = 1.0
Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
18;24

Loadcase ID: 11 Title: Stage 2 Factor = 1.0
Loadcase ID: 12 Title: Stage 3 Factor = 1.0
Loadcase ID: 15 Title: Dead weight (stage 3) Factor = 1.0
Loadcase ID: 16 Title: Stage 4 Factor = 1.0
Loadcase ID: 4132 Title: Dead weight (stage 4) Factor = 1.0
Loadcase ID: 4133 Title: Stage 5 Factor = 1.0
Loadcase ID: 4135 Title: Dead weight (stage 5) Factor = 1.0
Loadcase ID: 4136 Title: Stage 6 Factor = 1.0
Loadcase ID: 4138 Title: Dead weight (stage 6) Factor = 1.0
Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
20
Loadcase ID: 10 Title: Stage 1 Factor = 1.0
Loadcase ID: 11 Title: Stage 2 Factor = 1.0
Loadcase ID: 12 Title: Stage 3 Factor = 1.0
Loadcase ID: 15 Title: Dead weight (stage 3) Factor = 1.0
Loadcase ID: 16 Title: Stage 4 Factor = 1.0
Loadcase ID: 4132 Title: Dead weight (stage 4) Factor = 1.0
Loadcase ID: 4133 Title: Stage 5 Factor = 1.0
Loadcase ID: 4135 Title: Dead weight (stage 5) Factor = 1.0
Loadcase ID: 4136 Title: Stage 6 Factor = 1.0
Loadcase ID: 4138 Title: Dead weight (stage 6) Factor = 1.0
Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
1T16;19;25

13. Global distributed

Attribute: 12 Title: Dead weight 2

Sub Type = Global Distributed Load

Property	Symbol	Value
Attribute type	type	"Length"
X Direction	WX	0.0
Y Direction	WY	0.0
Z Direction	WZ	-12.0
Moment about X axis	MX	0.0
Moment about Y axis	MY	0.0
Moment about Z axis	MZ	0.0
Moment about hinge nodes	Hinge	0.0
Pore pressure flux	pwp	0.0
Keep global	keepGlobal	false

Loadcase ID: 4139 Title: Stage 7 Factor = 1.0
Loadcase ID: 4141 Title: Dead weight (stage 7) Factor = 1.0
Loadcase ID: 4142 Title: Longterm Factor = 1.0
Assignment to Lines:
17T27

Attribute: 13 Title: Surfacing

Sub Type = Global Distributed Load

Property	Symbol	Value
Attribute type	type	"Length"
X Direction	WX	0.0
Y Direction	WY	0.0
Z Direction	WZ	-29.0
Moment about X axis	MX	0.0
Moment about Y axis	MY	0.0
Moment about Z axis	MZ	0.0
Moment about hinge nodes	Hinge	0.0
Pore pressure flux	pwp	0.0
Keep global	keepGlobal	false

Loadcase ID: 9 Title: Surfacing Factor = 1.0
Assignment to Lines:
17T27

14. Prestress

General	Value	Units
Design code	EN1992-1-1:2004 / 2014 Eurocode 2	
Initial tendon force	5000.0	kN
Tendon area	5050.0	mm²
Modulus of elasticity for tendon	195000000.0	kN/m²
Jacking	Jacking from both ends	None
Slip at end 1	0.0	m
Jack angle at end 1	0.0	deg
Slip at end 2	0.0	m
Jack angle at end 2	0.0	deg
Installation losses	**Value**	**Units**
Unintentional angular displacement	0.0	rad/m
Duct friction coefficient	0.2	
Post-installation losses	**Value**	**Units**
Tensile strength of prestressing steel	1860.0	N/mm²
Characteristic 0.1% proof-stress of prestressing steel, fp0.1k	1675.0	N/mm²
Relaxation class	Class 2	
Relaxation loss at 1000hrs	2.5	%

14.1 Tendon 1:Left

Attribute: 1 Title: Tendon 1:L assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 3 → Longterm)
Assignment to Lines:
18T20

Segment type	X	Y	Z
Start	-20.0	2.8	18.7
Straight	0.0	2.8	19.6
Straight	20.0	2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corner

14.2 Tendon 1:Right

Attribute: 2 Title: Tendon 1:R assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 3 → Longterm)
Assignment to Lines:
18T20

Segment type	X	Y	Z
Start	-20.0	-2.8	18.7
Straight	0.0	-2.8	19.6
Straight	20.0	-2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corner

14.3 Tendon 2:Left

Attribute: 3 Title: Tendon 2:L assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 4 → Longterm)
Assignment to Lines:
24T26

Segment type	X	Y	Z
Start	60.0	2.8	18.7
Straight	80.0	2.8	19.6
Straight	100.0	2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corner

14.4 Tendon 2:Right

Attribute: 4 Title: Tendon 2:R assignment 1
Sub Type = Search Area Analysis: Analsysis 1 (Stage 4 → Longterm)
Assignment to Lines:
24T26

Segment type	X	Y	Z
Start	60.0	-2.8	18.7
Straight	80.0	-2.8	19.6
Straight	100.0	-2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corner

14.5 Tendon 3:Left

Attribute: 5 Title: Tendon 3:L assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 5 → Longterm)
Assignment to Lines:
17T21

Segment type	X	Y	Z
Start	-40.0	2.8	18.7
Straight	0.0	2.8	19.9
Straight	36.0	2.8	18.9

Minimum radius = 60.0
Smoothing type: Cut corner

14.6 Tendon 3:Right

Attribute: 8 Title: Tendon 4:R assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 5 → Longterm)
Assignment to Lines:
23T27

Segment type	X	Y	Z
Start	-40.0	-2.8	18.7
Straight	0.0	-2.8	19.9
Straight	36.0	-2.8	18.9

Minimum radius = 60.0
Smoothing type: Cut corner

14.7 Tendon 4:Left

Attribute: 7 Title: Tendon 4 :L assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 6 → Longterm)
Assignment to Lines:
23T27

Segment type	X	Y	Z
Start	44.0	2.8	18.9
Straight	80.0	2.8	19.9
Straight	120.0	2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corner

14.8 Tendon 4:Right

Attribute: 8 Title: Tendon 4:R assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 6 → Longterm)
Assignment to Lines:
23T27

Segment type	X	Y	Z
Start	44.0	-2.8	18.9
Straight	80.0	-2.8	19.9
Straight	120.0	-2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corner

14.9 Tendon 5:Left

Attribute: 9 Title: Tendon 5:L assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 7 → Longterm)
Assignment to Lines:
21T23

Segment type	X	Y	Z
Start	20.0	2.8	18.7
Straight	60.0	2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corner

14.10 Tendon 5:Right

Attribute: 10 Title: Tendon 5:R assignment 1
Sub Type = Search Area
Analysis: Analsysis 1 (Stage 7 → Longterm)
Assignment to Lines:
21T23

Segment type	X	Y	Z
Start	20.0	-2.8	18.7
Straight	60.0	-2.8	18.7

Minimum radius = 60.0
Smoothing type: Cut corne

15. Direct Method Influence

Attribute: 1 Title: Inf1 – Beam (Fx, Fy, Fz, Mx, My)
Sub Type = Direct method influence
Assignment to Points:
1T24
Assignment to Lines:
1T27

Attribute: 6 Title: Inf2 – Reaction (FX, FY, FZ, MX, MY)
Sub Type = Direct method influence
Assignment to Points:
1T4;17;24

16. Load groups: traffic

Load groups : Eurocode Load Modell 1 (LM1)
Type: Tandem axle
Axle load - lane 1: 300 kN
Axle load - lane 2: 200 kN
Axel load - lane 3: 100 kN

Lane load
Surface load - lane 1: 9.0 kPa
Surface load - remaining: 2.5 kPa

Load groups : Eurocode Load Modell 2 (LM2)
Type: Single axle
Axle load: 360 kN

Load groups : Fatigue modell 3 (UTM3)
Type: Quadruple axel
Axle load: 120 kN

17. VLO Analysis

Type: VLO – LM1 ~ Characteristic
Representative values : Charateristic
Design code : EN 1991-2 Sweden 2011
Load groups : LM1
Longitudinal increment : 0.25 m
Transverse increment : 0.50 m
Vehicule direction : Both
Kerbs : L28, L29
UDL alfa factor : 0.8, 1, 1 , 1, 1
TS alfa factor : 0.9, 0.9,0
Influence attributes :
Inf1 – Beam (Fx, Fy, Fz, Mx, My)
Inf2 – Reaction (FX, FY, FZ, MX, MY)

Type: VLO – LM2 ~ Characteristic
Representative values : Charateristic
Design code : EN 1991-2 Sweden 2011
Load groups : LM2
Longitudinal increment : 0.25 m
Transverse increment : 0.50 m
Vehicule direction : Both
Kerbs : L28, L29
UDL alfa factor : 0.8, 1, 1 , 1, 1
TS alfa factor : 0.9, 0.9,0
Influence attributes :
Inf1 – Beam (Fx, Fy, Fz, Mx, My)
Inf2 – Reaction (FX, FY, FZ, MX, MY)

Type: VLO – UTM3 ~ CharacteristicRepresentative values : Charateristic
Design code : EN 1991-2 Sweden 2011
Load groups : UTM3
Longitudinal increment : 0.25 m
Transverse increment : 0.50 m
Vehicule direction : Both
Kerbs : L28, L29
Minimum width vehicule : 2.0 m
Maximum width vehicle : 2.0 m
Influence attributes :
Inf1 – Beam (Fx, Fy, Fz, Mx, My)

Type: VLO – EG A ~ Characteristic

Representative values : Charateristic
Design code : EN 1991-2 Sweden 2011
Load groups : Complementary load modell
Dynamic amplification : 25 %
Load model value A : 180 kN
Load model value B : 300 kN
Load modell valute q : 5 kN/m
Lane vehicule factor most onerous lane : 1.0
Lane vehicule factor second lane : 0.8
Type vehicules : a
Longitudinal increment : 0.25 m
Transverse increment : 0.50 m
Vehicule direction : Both
Kerbs : L28, L29
Minimum width vehicule : 2.0 m
Maximum width vehicle : 2.0 m
Influence attributes :
Inf1 – Beam (Fx, Fy, Fz, Mx, My)
Inf2 – Reaction (FX, FY, FZ, MX, MY)

Type: VLO – EG B ~ Characteristic
Representative values : Charateristic
Design code : EN 1991-2 Sweden 2011
Load groups : Complementary load modell
Dynamic amplification : 25 %
Load model value A : 180 kN
Load model value B : 300 kN
Load modell valute q : 5 kN/m
Lane vehicule factor most onerous lane : 1.0
Lane vehicule factor second lane : 0.8
Type vehicules : b, c, d, e, f, g,h,I,j,k,l,m,n,o
Longitudinal increment : 0.25 m
Transverse increment : 0.50 m
Vehicule direction : Both
Kerbs : L28. L28
Minimum width vehicule : 2.0 m
Maximum width vehicle : 2.0 m
Influence attributes :
Inf1 – Beam (Fx, Fy, Fz, Mx, My)
Inf2 – Reaction (FX, FY, FZ, MX, MY)

18. Smart combination

Loadcase ID: 4144 Title: ULS-PERM
Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Title	Type		
17	33		1.0	0.2	Dead weight (stage 7)
9	0		1.0	0.0	Surfacing

Loadcase ID: 12384 Title: ULS-VAR
Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Title	Type		
12378	0		1.03	0.47	TRAFFIC (Max)
12379	0		1.03	0.47	TRAFFIC (Min)

Loadcase ID: 12386 Title: ULS
Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Title	Type		
4144	0		1.0	0.0	ULS-PERM (Max)
4145	0		1.0	0.0	ULS-PERM (Min)
12382	0		1.0	0.35	PT (Max)
12383	0		1.0	0.35	PT (Min)
12384	0		0.0	1.0	ULS-VAR (Max)
12385	0		0.0	1.0	ULS-VAR (Min)

Loadcase ID: 12388 Title: SLS-PERM
Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Title	Type		
17	33		1.0	0.0	Dead weight (stage 7)
9	0		0.9	0.2	Surfacing

Loadcase ID: 12390 Title: SLS-K-VAR

Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Type		
12378	0	0.75	0.25	TRAFFIC (Max)
12379	0	0.75	0.25	TRAFFIC (Min)

Loadcase ID: 12392 Title: SLS-F-VAR

Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Type		
12378	0	0.0	0.75	TRAFFIC (Max)
12379	0	0.0	0.75	TRAFFIC (Min)

Loadcase ID: 12394 Title: SLS-K

Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Type		
12388	0	1.0	0.0	SLS-PERM (Max)
12389	0	1.0	0.0	SLS-PERM (Min)
12382	0	1.0	0.0	PT (Max)
12383	0	1.0	0.0	PT (Min)
12390	0	0.0	1.0	SLS-K-VAR (Max)
12391	0	0.0	1.0	SLS-K-VAR (Min)

Loadcase ID: 12396 Title: SLS-F

Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Factor	Type		
12388	0	1.0	0.0	SLS-PERM (Max)
12389	0	1.0	0.0	SLS-PERM (Min)
12382	0	1.0	0.0	PT (Max)
12383	0	1.0	0.0	PT (Min)
12392	0	0.0	1.0	SLS-F-VAR (Max)
12393	0	0.0	1.0	SLS-F-VAR (Min)

Loadcase ID: 12398 Title: SLS-Q

Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Title	Type		
17	33	1.0	0.0	Dead weight (stage 7)
9	0	1.0	0.0	Surfacing
19	33	1.0	0.0	Prestress (longterm)

Loadcase ID: 12402 Title: FAT

Sub Type: Smart Combination
Loadcases to consider: All
Variable Loadcases: All

Loadcase File Factor	Results Permanent Variable Title	Type		
17	33	1.0	0.0	Dead weight (stage 7)
9	0	1.0	0.0	Surfacing
19	33	1.0	0.0	Prestress (longterm)
12400	0	1.0	0.0	UTM 3 (Max)
12401	0	1.0	0.0	UTM 3 (Min)

19. Envelopes

Loadcase ID: 12378 Title: TRAFFIC

Sub Type: Envelope

Loadcase File	Results Title	Type
8260	0	EG A - Beam ~ Characteristic (Max)
8261	0	EG A- Beam ~ Characteristic (Min)
8262	0	EG A Reaction ~ Characteristic (Max)
8263	0	EG A - Reaction ~ Characteristic (Min)
12374	0	EG B - Beam ~ Characteristic (Max)
12375	0	EG B - Beam ~ Characteristic (Min)
12376	0	EG B Reaction ~ Characteristic (Max)
12377	0	EG B - Reaction ~ Characteristic (Min)
4128	0	LM1 - Beam ~ Characteristic (Max)
4129	0	LM1 - Beam ~ Characteristic (Min)
4130	0	LM1 - Reaction ~ Characteristic (Max)
4131	0	LM1 - Reaction ~ Characteristic (Min)
4132	0	LM2 - Beam ~ Characteristic (Max)
4133	0	LM2 - Beam ~ Characteristic (Min)
4134	0	LM2 - Reaction ~ Characteristic (Max)
4135	0	LM2 - Reaction ~ Characteristic (Min)

Loadcase ID: 12382 Title: PT

Sub Type: Envelope

Loadcase File	Results Title	Type
16	33	Prestress (stage 7)
18	33	Prestredd (longterm)