

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

FAKULTA STAVEBNÍ

KATEDRA OCELOVÝCH A DŘEVĚNÝCH KONSTRUKCÍ

PŘÍLOHY

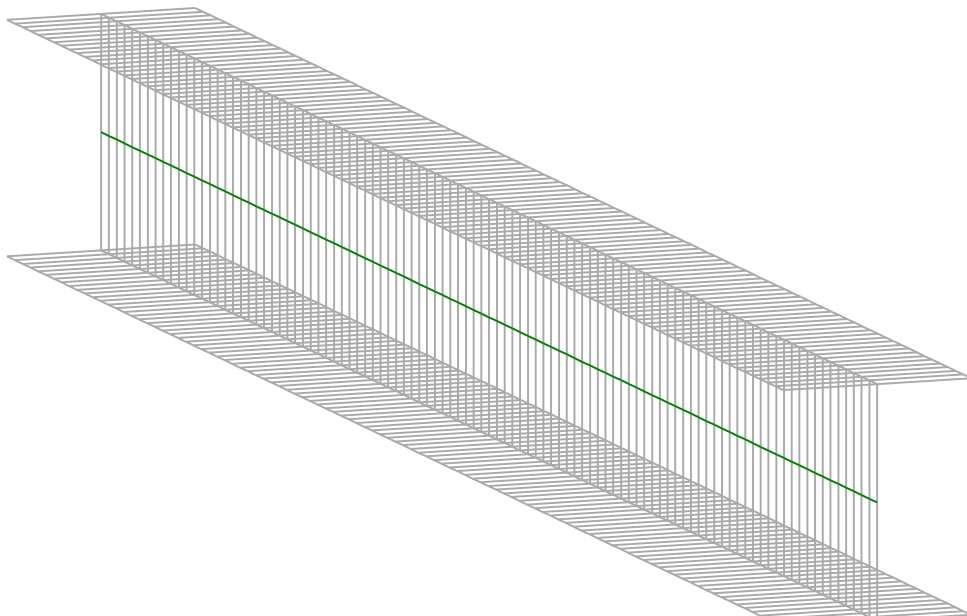
2024

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***LTB**eamN*

v 1.0.4

CALCULATION SHEET



I - PARAMETERS

I.1 - General parameters

Projected total length :	L = 3.4 m
Initial discretization of the beam :	$n_{el} = 100$ elements

I.2 - Material

Name :	Steel
Young modulus :	E = 210000 MPa
Shear modulus :	G = 80769 MPa
Poisson factor :	$\nu = 0.3$
Density :	$\rho = 7850 \text{ kg/m}^3$

I.3 - Sections

Alignment of sections :	Top
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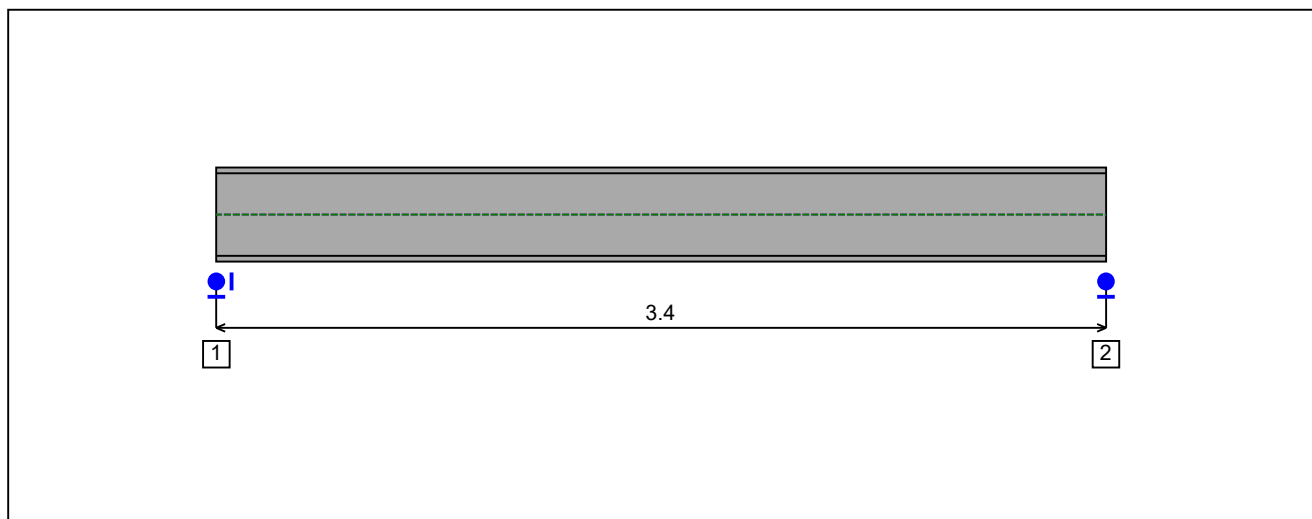


Figure 1 : Profile in long with section numbers.

- Section No. 1 : HEB 360

Abscissa from the left end of the beam : $x = 0$ m

Type : In catalogue (OTUA)

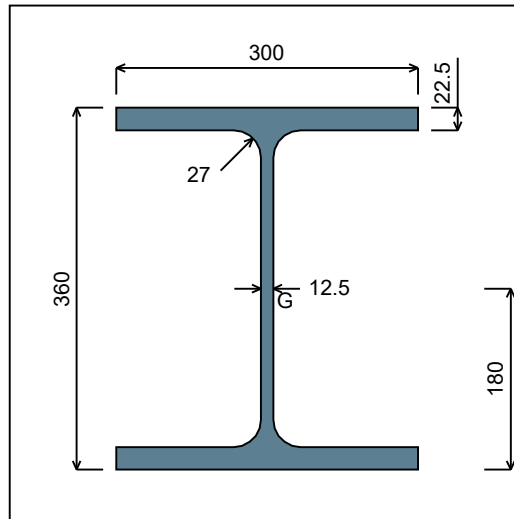


Figure 2 : Section No. 1 (HEB 360).

Main geometrical properties :

z_S	= 0 cm
z_G	= 18 cm
I_y	= 43193 cm ⁴
I_z	= 10141 cm ⁴
I_t	= 296.31 cm ⁴ (Villette)
I_w	= 2.888E+6 cm ⁶

Other geometrical properties :

A	= 180.63 cm ²	
$A_{v,y}$	= 135 cm ²	$A_{v,z}$ = 60.6 cm ²
$W_{el,y,sup}$	= 2399.6 cm ³	
$W_{el,y,inf}$	= 2399.6 cm ³	$W_{el,z}$ = 676.08 cm ³
$W_{pl,y}$	= 2683 cm ³	$W_{pl,z}$ = 1032.5 cm ³

Stiffness relaxations :

θ	: Continuous
v'	: Continuous
θ'	: Continuous
w'	: Continuous

- Section No. 2 : HEB 360

Abscissa from the left end of the beam :

$x = 3.4 \text{ m}$

Type :

In catalogue (OTUA)

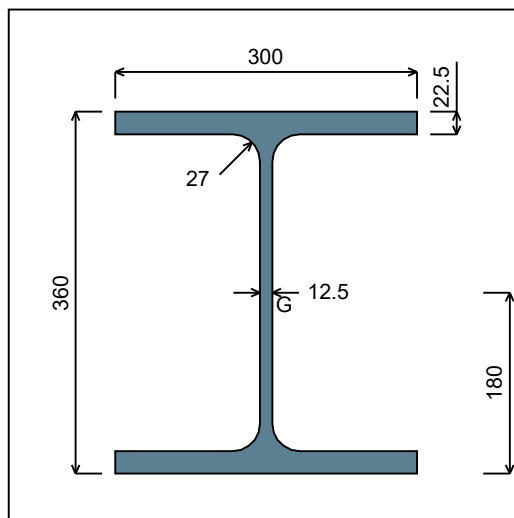


Figure 3 : Section No. 2 (HEB 360).

Main geometrical properties :

z_S	= 0 cm
z_G	= 18 cm
I_y	= 43193 cm ⁴
I_z	= 10141 cm ⁴
I_t	= 296.31 cm ⁴ (Villette)
I_w	= 2.888E+6 cm ⁶

Other geometrical properties :

A	= 180.63 cm ²	
$A_{v,y}$	= 135 cm ²	$A_{v,z}$ = 60.6 cm ²
$W_{el,y,sup}$	= 2399.6 cm ³	
$W_{el,y,inf}$	= 2399.6 cm ³	$W_{el,z}$ = 676.08 cm ³
$W_{pl,y}$	= 2683 cm ³	$W_{pl,z}$ = 1032.5 cm ³

Stiffness relaxations :

θ	: Continuous
v'	: Continuous
θ'	: Continuous
w'	: Continuous

I.4 - Lateral restraints

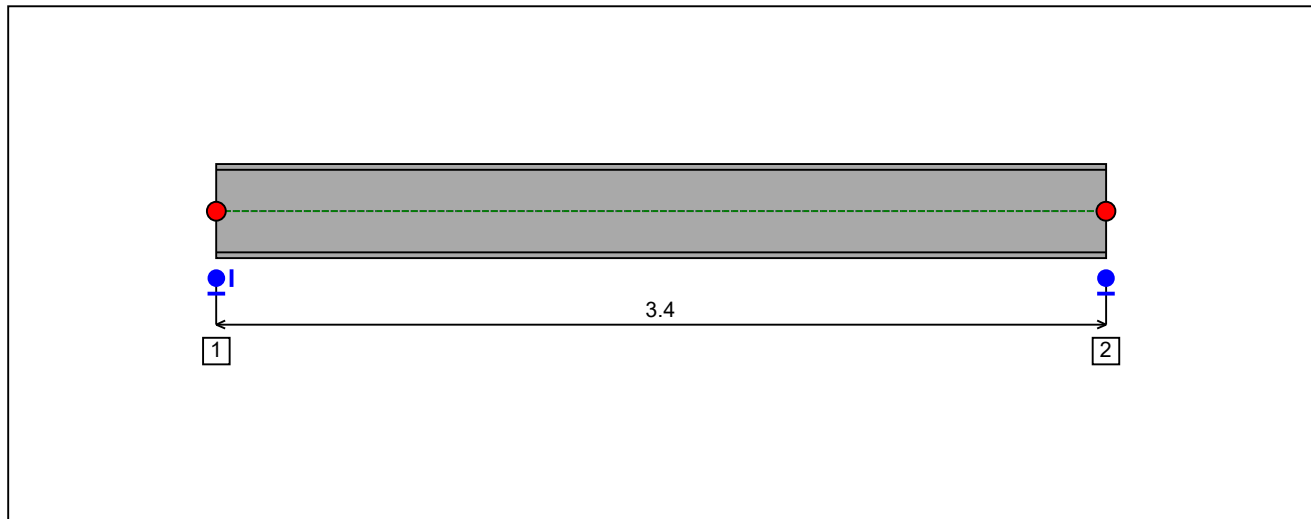


Figure 4 : Profile in long with restraint numbers.

- Restraint No. 1 :

Type : Ponctual

Abscissa from the left end of the beam : $x = 0$ m

Vertical position from the shear centre : $z = 0$ cm

Restraint conditions :

- v : Fixed
- θ : Fixed
- v' : Free
- θ' : Free

- Restraint No. 2 :

Type : Ponctual

Abscissa from the left end of the beam : $x = 3.4$ m

Vertical position from the shear centre : $z = 0$ cm

Restraint conditions :

- v : Fixed
- θ : Fixed
- v' : Free
- θ' : Free

1.5 - Supports

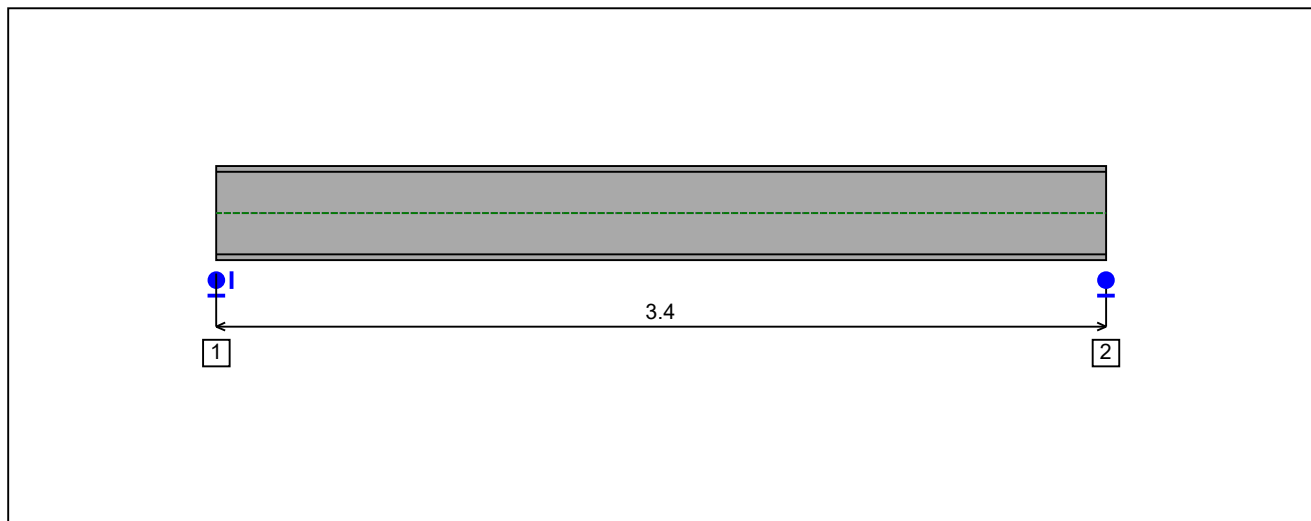


Figure 5 : Profile in long with support numbers.

- Support No. 1 :

Abscissa from the left end of the beam : $x = 0$ m

Support conditions :

u : Fixed
w : Fixed
w' : Free

- Support No. 2 :

Abscissa from the left end of the beam : $x = 3.4$ m

Support conditions :

u : Free
w : Fixed
w' : Free

I.6 - Loads

Type of loading :

External

The weight of the beam is not taken into account.

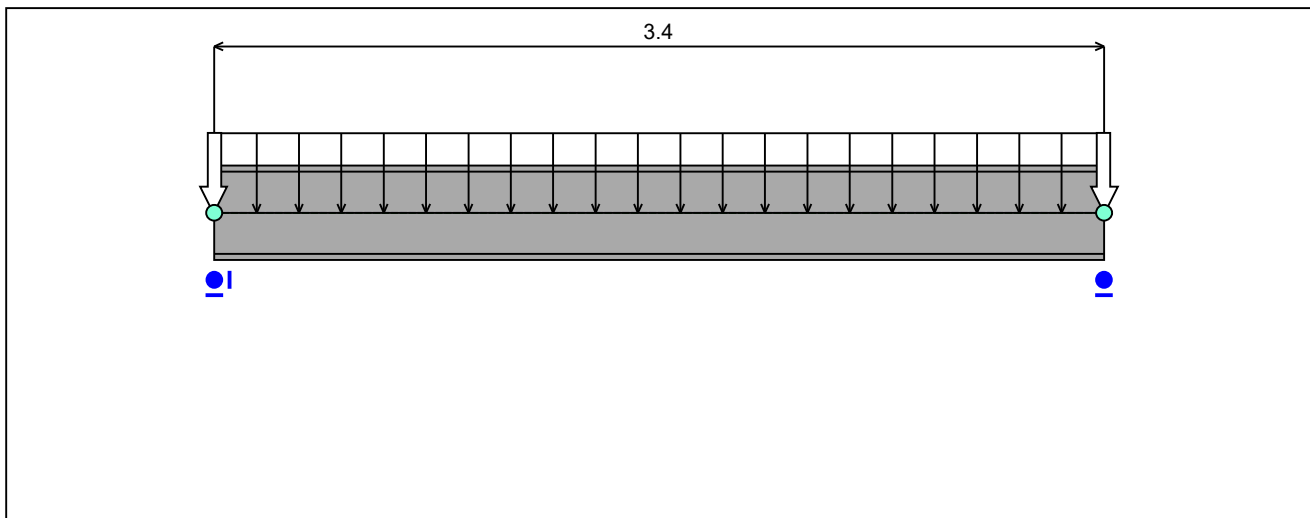


Figure 6 : Profile in long with loads.

- Concentrated loads :

No load has been defined.

- Distributed loads :

Table 1 : Distributed loads.

x_1 (m)	$z_1^{(*)}$ (cm)	$q_{x,1}$ (kN/m)	$q_{z,1}$ (kN/m)	x_2 (m)	$z_2^{(*)}$ (cm)	$q_{x,2}$ (kN/m)	$q_{z,2}$ (kN/m)	Active
0	0	0	-0.474	3.4	0	0	-0.474	Yes

(*) Vertical position from the shear centre

II - RESULTS OF 2D GLOBAL ANALYSIS

II.1 - Sign conventions

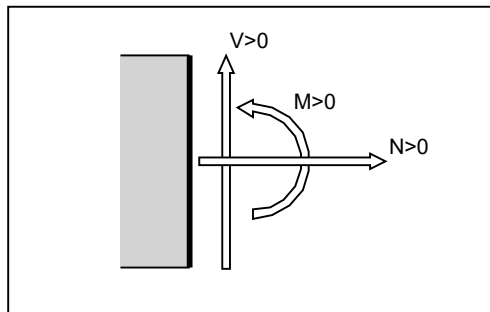


Figure 7 : Sign conventions.

$N > 0$: for tension normal force

$M > 0$: when the upper fiber is compressed

$w > 0$: upward displacement

M, N, V solicitations in a section are actions of the right side on the left side.

II.2 - Support reactions

- Support No. 1 :

Horizontal :	$F_h = 0 \text{ kN}$
Vertical :	$F_v = 0.8058 \text{ kN}$
Moment :	$M = 0 \text{ kN.m}$

- Support No. 2 :

Horizontal :	$F_h = 0 \text{ kN}$
Vertical :	$F_v = 0.8058 \text{ kN}$
Moment :	$M = 0 \text{ kN.m}$

II.3 - Diagrams of internal forces in global coordinates

1st order elastic analysis

In-plane buckling analysis :

Not applicable

$|M|_{\max} = 0.6849 \text{ kN.m}$ ($x = 1.7 \text{ m}$)

$|V|_{\max} = 0.8058 \text{ kN}$ ($x = 0 \text{ m}$)

$|N|_{\max} = 0 \text{ kN}$ ($x = 0 \text{ m}$)

$|w|_{\max} = 9.093\text{E-}4 \text{ cm}$ ($x = 1.7 \text{ m}$)

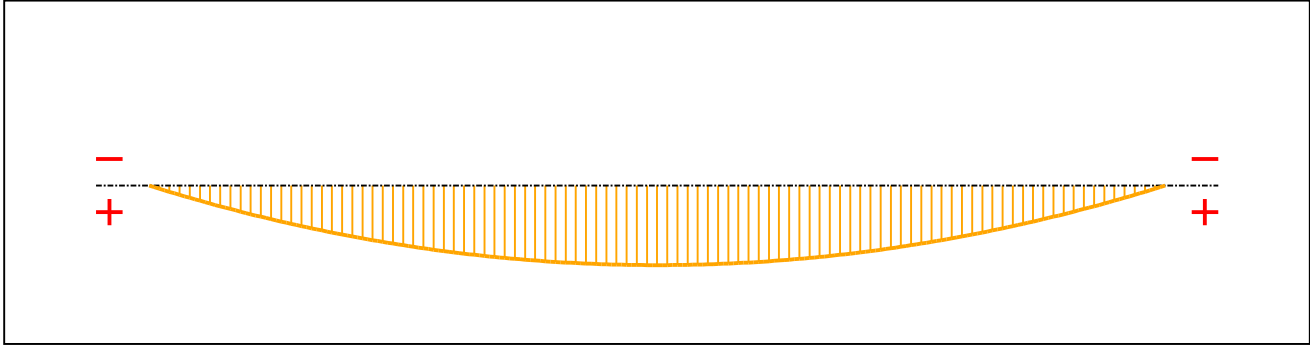


Figure 8 : Moment diagram.

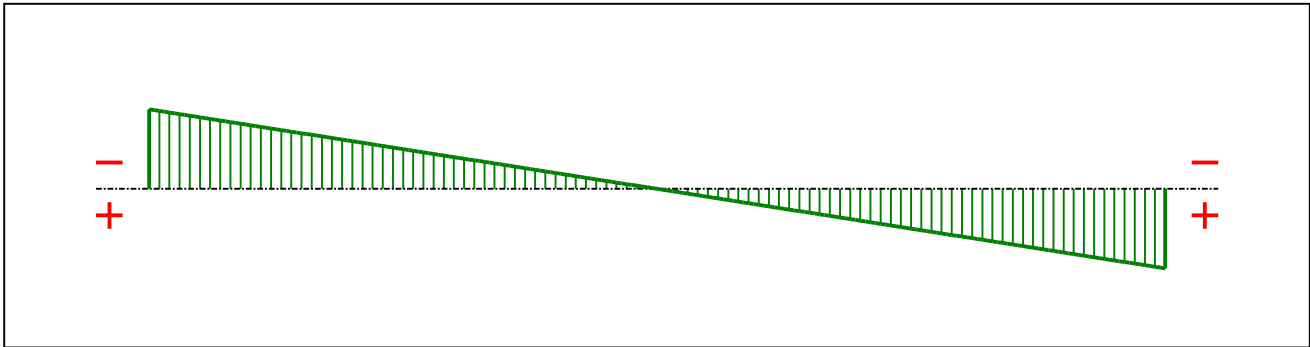


Figure 9 : Shear force diagram.

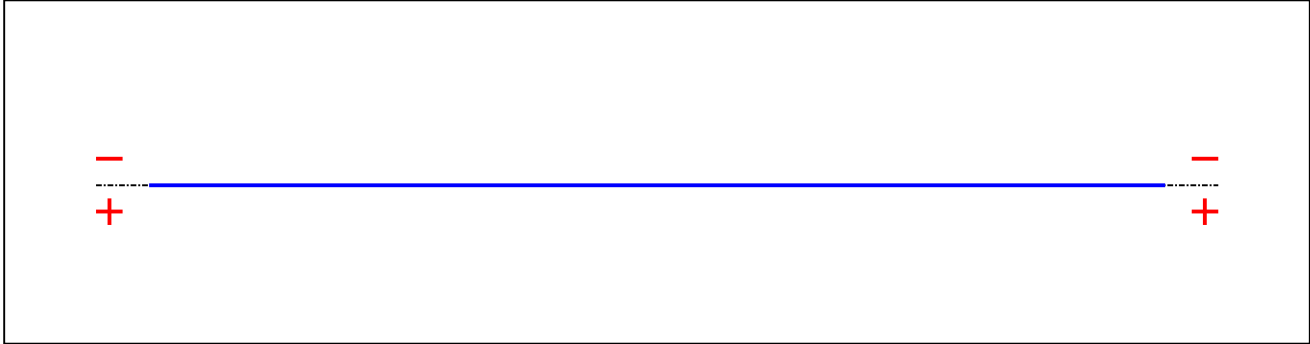


Figure 10 : Axial force diagram.

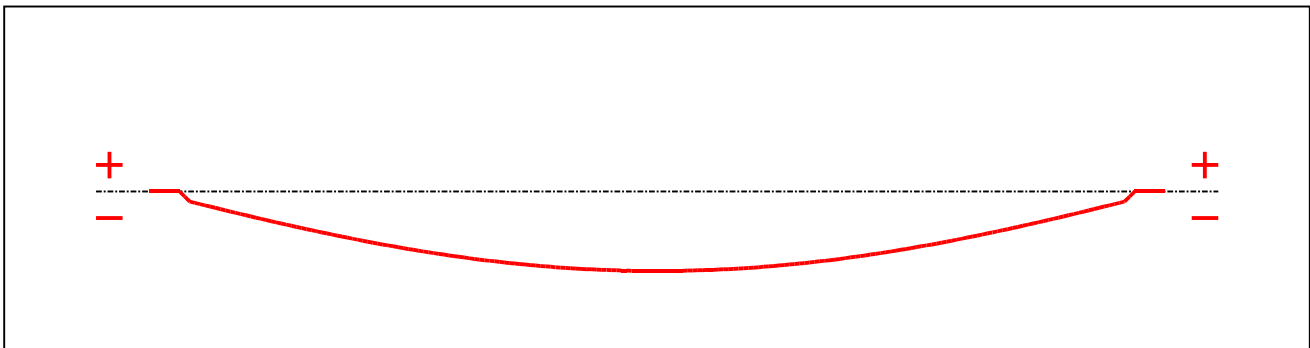


Figure 11 : Deflection.

Table 2 : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
0	0	-	-0.8058	0	0
0.017	0	-0.8058	-0.7977	0.0136	0
0.034	0	-0.7977	-0.7897	0.0271	0
0.051	0	-0.7897	-0.7816	0.0405	0
0.068	0	-0.7816	-0.7736	0.0537	0
0.085	0	-0.7736	-0.7655	0.0668	0
0.102	0	-0.7655	-0.7575	0.0797	0
0.119	0	-0.7575	-0.7494	0.0925	-5.801E-4
0.136	0	-0.7494	-0.7413	0.1052	-0.0012
0.153	0	-0.7413	-0.7333	0.1177	-0.0013
0.17	0	-0.7333	-0.7252	0.1301	-0.0014
0.187	0	-0.7252	-0.7172	0.1424	-0.0016
0.204	0	-0.7172	-0.7091	0.1545	-0.0017
0.221	0	-0.7091	-0.701	0.1665	-0.0019
0.238	0	-0.701	-0.693	0.1784	-0.002
0.255	0	-0.693	-0.6849	0.1901	-0.0022
0.272	0	-0.6849	-0.6769	0.2016	-0.0023
0.289	0	-0.6769	-0.6688	0.2131	-0.0024
0.306	0	-0.6688	-0.6608	0.2244	-0.0026
0.323	0	-0.6608	-0.6527	0.2355	-0.0027
0.34	0	-0.6527	-0.6446	0.2466	-0.0029
0.357	0	-0.6446	-0.6366	0.2575	-0.003
0.374	0	-0.6366	-0.6285	0.2682	-0.0031
0.391	0	-0.6285	-0.6205	0.2788	-0.0033
0.408	0	-0.6205	-0.6124	0.2893	-0.0034
0.425	0	-0.6124	-0.6043	0.2997	-0.0035
0.442	0	-0.6043	-0.5963	0.3099	-0.0037
0.459	0	-0.5963	-0.5882	0.3199	-0.0038
0.476	0	-0.5882	-0.5802	0.3299	-0.0039
0.493	0	-0.5802	-0.5721	0.3397	-0.0041
0.51	0	-0.5721	-0.5641	0.3493	-0.0042
0.527	0	-0.5641	-0.556	0.3588	-0.0043
0.544	0	-0.556	-0.5479	0.3682	-0.0044
0.561	0	-0.5479	-0.5399	0.3775	-0.0046
0.578	0	-0.5399	-0.5318	0.3866	-0.0047

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
0.595	0	-0.5318	-0.5238	0.3955	-0.0048
0.612	0	-0.5238	-0.5157	0.4044	-0.0049
0.629	0	-0.5157	-0.5077	0.4131	-0.005
0.646	0	-0.5077	-0.4996	0.4216	-0.0052
0.663	0	-0.4996	-0.4915	0.4301	-0.0053
0.68	0	-0.4915	-0.4835	0.4384	-0.0054
0.697	0	-0.4835	-0.4754	0.4465	-0.0055
0.714	0	-0.4754	-0.4674	0.4545	-0.0056
0.731	0	-0.4674	-0.4593	0.4624	-0.0057
0.748	0	-0.4593	-0.4512	0.4701	-0.0058
0.765	0	-0.4512	-0.4432	0.4777	-0.006
0.782	0	-0.4432	-0.4351	0.4852	-0.0061
0.799	0	-0.4351	-0.4271	0.4925	-0.0062
0.816	0	-0.4271	-0.419	0.4997	-0.0063
0.833	0	-0.419	-0.411	0.5068	-0.0064
0.85	0	-0.411	-0.4029	0.5137	-0.0065
0.867	0	-0.4029	-0.3948	0.5205	-0.0066
0.884	0	-0.3948	-0.3868	0.5271	-0.0067
0.901	0	-0.3868	-0.3787	0.5336	-0.0068
0.918	0	-0.3787	-0.3707	0.54	-0.0069
0.935	0	-0.3707	-0.3626	0.5462	-0.007
0.952	0	-0.3626	-0.3546	0.5523	-0.007
0.969	0	-0.3546	-0.3465	0.5583	-0.0071
0.986	0	-0.3465	-0.3384	0.5641	-0.0072
1.003	0	-0.3384	-0.3304	0.5698	-0.0073
1.02	0	-0.3304	-0.3223	0.5753	-0.0074
1.037	0	-0.3223	-0.3143	0.5808	-0.0075
1.054	0	-0.3143	-0.3062	0.586	-0.0076
1.071	0	-0.3062	-0.2981	0.5912	-0.0076
1.088	0	-0.2981	-0.2901	0.5962	-0.0077
1.105	0	-0.2901	-0.282	0.601	-0.0078
1.122	0	-0.282	-0.274	0.6058	-0.0079
1.139	0	-0.274	-0.2659	0.6103	-0.0079
1.156	0	-0.2659	-0.2579	0.6148	-0.008
1.173	0	-0.2579	-0.2498	0.6191	-0.0081

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
1.19	0	-0.2498	-0.2417	0.6233	-0.0081
1.207	0	-0.2417	-0.2337	0.6273	-0.0082
1.224	0	-0.2337	-0.2256	0.6312	-0.0082
1.241	0	-0.2256	-0.2176	0.635	-0.0083
1.258	0	-0.2176	-0.2095	0.6386	-0.0084
1.275	0	-0.2095	-0.2014	0.6421	-0.0084
1.292	0	-0.2014	-0.1934	0.6455	-0.0085
1.309	0	-0.1934	-0.1853	0.6487	-0.0085
1.326	0	-0.1853	-0.1773	0.6518	-0.0086
1.343	0	-0.1773	-0.1692	0.6547	-0.0086
1.36	0	-0.1692	-0.1612	0.6575	-0.0087
1.377	0	-0.1612	-0.1531	0.6602	-0.0087
1.394	0	-0.1531	-0.145	0.6627	-0.0087
1.411	0	-0.145	-0.137	0.6651	-0.0088
1.428	0	-0.137	-0.1289	0.6674	-0.0088
1.445	0	-0.1289	-0.1209	0.6695	-0.0088
1.462	0	-0.1209	-0.1128	0.6715	-0.0089
1.479	0	-0.1128	-0.1048	0.6734	-0.0089
1.496	0	-0.1048	-0.0967	0.6751	-0.0089
1.513	0	-0.0967	-0.0886	0.6766	-0.009
1.53	0	-0.0886	-0.0806	0.6781	-0.009
1.547	0	-0.0806	-0.0725	0.6794	-0.009
1.564	0	-0.0725	-0.0645	0.6805	-0.009
1.581	0	-0.0645	-0.0564	0.6816	-0.009
1.598	0	-0.0564	-0.0483	0.6825	-0.0091
1.615	0	-0.0483	-0.0403	0.6832	-0.0091
1.632	0	-0.0403	-0.0322	0.6838	-0.0091
1.649	0	-0.0322	-0.0242	0.6843	-0.0091
1.666	0	-0.0242	-0.0161	0.6847	-0.0091
1.683	0	-0.0161	-0.0081	0.6849	-0.0091
1.7	0	-0.0081	0	0.6849	-0.0091
1.717	0	0	0.0081	0.6849	-0.0091
1.734	0	0.0081	0.0161	0.6847	-0.0091
1.751	0	0.0161	0.0242	0.6843	-0.0091
1.768	0	0.0242	0.0322	0.6838	-0.0091

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
1.785	0	0.0322	0.0403	0.6832	-0.0091
1.802	0	0.0403	0.0483	0.6825	-0.0091
1.819	0	0.0483	0.0564	0.6816	-0.009
1.836	0	0.0564	0.0645	0.6805	-0.009
1.853	0	0.0645	0.0725	0.6794	-0.009
1.87	0	0.0725	0.0806	0.6781	-0.009
1.887	0	0.0806	0.0886	0.6766	-0.009
1.904	0	0.0886	0.0967	0.6751	-0.0089
1.921	0	0.0967	0.1048	0.6734	-0.0089
1.938	0	0.1048	0.1128	0.6715	-0.0089
1.955	0	0.1128	0.1209	0.6695	-0.0088
1.972	0	0.1209	0.1289	0.6674	-0.0088
1.989	0	0.1289	0.137	0.6651	-0.0088
2.006	0	0.137	0.145	0.6627	-0.0087
2.023	0	0.145	0.1531	0.6602	-0.0087
2.04	0	0.1531	0.1612	0.6575	-0.0087
2.057	0	0.1612	0.1692	0.6547	-0.0086
2.074	0	0.1692	0.1773	0.6518	-0.0086
2.091	0	0.1773	0.1853	0.6487	-0.0085
2.108	0	0.1853	0.1934	0.6455	-0.0085
2.125	0	0.1934	0.2014	0.6421	-0.0084
2.142	0	0.2014	0.2095	0.6386	-0.0084
2.159	0	0.2095	0.2176	0.635	-0.0083
2.176	0	0.2176	0.2256	0.6312	-0.0082
2.193	0	0.2256	0.2337	0.6273	-0.0082
2.21	0	0.2337	0.2417	0.6233	-0.0081
2.227	0	0.2417	0.2498	0.6191	-0.0081
2.244	0	0.2498	0.2579	0.6148	-0.008
2.261	0	0.2579	0.2659	0.6103	-0.0079
2.278	0	0.2659	0.274	0.6058	-0.0079
2.295	0	0.274	0.282	0.601	-0.0078
2.312	0	0.282	0.2901	0.5962	-0.0077
2.329	0	0.2901	0.2981	0.5912	-0.0076
2.346	0	0.2981	0.3062	0.586	-0.0076
2.363	0	0.3062	0.3143	0.5808	-0.0075

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
2.38	0	0.3143	0.3223	0.5753	-0.0074
2.397	0	0.3223	0.3304	0.5698	-0.0073
2.414	0	0.3304	0.3384	0.5641	-0.0072
2.431	0	0.3384	0.3465	0.5583	-0.0071
2.448	0	0.3465	0.3546	0.5523	-0.007
2.465	0	0.3546	0.3626	0.5462	-0.007
2.482	0	0.3626	0.3707	0.54	-0.0069
2.499	0	0.3707	0.3787	0.5336	-0.0068
2.516	0	0.3787	0.3868	0.5271	-0.0067
2.533	0	0.3868	0.3948	0.5205	-0.0066
2.55	0	0.3948	0.4029	0.5137	-0.0065
2.567	0	0.4029	0.411	0.5068	-0.0064
2.584	0	0.411	0.419	0.4997	-0.0063
2.601	0	0.419	0.4271	0.4925	-0.0062
2.618	0	0.4271	0.4351	0.4852	-0.0061
2.635	0	0.4351	0.4432	0.4777	-0.006
2.652	0	0.4432	0.4512	0.4701	-0.0058
2.669	0	0.4512	0.4593	0.4624	-0.0057
2.686	0	0.4593	0.4674	0.4545	-0.0056
2.703	0	0.4674	0.4754	0.4465	-0.0055
2.72	0	0.4754	0.4835	0.4384	-0.0054
2.737	0	0.4835	0.4915	0.4301	-0.0053
2.754	0	0.4915	0.4996	0.4216	-0.0052
2.771	0	0.4996	0.5077	0.4131	-0.005
2.788	0	0.5077	0.5157	0.4044	-0.0049
2.805	0	0.5157	0.5238	0.3955	-0.0048
2.822	0	0.5238	0.5318	0.3866	-0.0047
2.839	0	0.5318	0.5399	0.3775	-0.0046
2.856	0	0.5399	0.5479	0.3682	-0.0044
2.873	0	0.5479	0.556	0.3588	-0.0043
2.89	0	0.556	0.5641	0.3493	-0.0042
2.907	0	0.5641	0.5721	0.3397	-0.0041
2.924	0	0.5721	0.5802	0.3299	-0.0039
2.941	0	0.5802	0.5882	0.3199	-0.0038
2.958	0	0.5882	0.5963	0.3099	-0.0037

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
2.975	0	0.5963	0.6043	0.2997	-0.0035
2.992	0	0.6043	0.6124	0.2893	-0.0034
3.009	0	0.6124	0.6205	0.2788	-0.0033
3.026	0	0.6205	0.6285	0.2682	-0.0031
3.043	0	0.6285	0.6366	0.2575	-0.003
3.06	0	0.6366	0.6446	0.2466	-0.0029
3.077	0	0.6446	0.6527	0.2355	-0.0027
3.094	0	0.6527	0.6608	0.2244	-0.0026
3.111	0	0.6608	0.6688	0.2131	-0.0024
3.128	0	0.6688	0.6769	0.2016	-0.0023
3.145	0	0.6769	0.6849	0.1901	-0.0022
3.162	0	0.6849	0.693	0.1784	-0.002
3.179	0	0.693	0.701	0.1665	-0.0019
3.196	0	0.701	0.7091	0.1545	-0.0017
3.213	0	0.7091	0.7172	0.1424	-0.0016
3.23	0	0.7172	0.7252	0.1301	-0.0014
3.247	0	0.7252	0.7333	0.1177	-0.0013
3.264	0	0.7333	0.7413	0.1052	-0.0012
3.281	0	0.7413	0.7494	0.0925	-5.801E-4
3.298	0	0.7494	0.7575	0.0797	0
3.315	0	0.7575	0.7655	0.0668	0
3.332	0	0.7655	0.7736	0.0537	0
3.349	0	0.7736	0.7816	0.0405	0
3.366	0	0.7816	0.7897	0.0271	0
3.383	0	0.7897	0.7977	0.0136	0
3.4	0	0.7977	-	0	0

III - LTB CALCULATION

Requested number of modes : 1

Blocked moment diagram : No

Blocked axial force diagram : No

III.1 - LTB modes

Table 3 : LTB modes.

Mode	λ_{cr}	$M_{max,cr}$ [kN.m]	$x(M_{max})$ [m]	$N_{max,cr}$ [kN]	$x(N_{max})$ [m]
1	6223.1	4262.4	1.7	0	1.7

III.2 - Mode shapes

- Mode 1

Table 4 : Mode 1.

Mode	λ_{cr}	$M_{max,cr}$ [kN.m]	$x(M_{max})$ [m]	$N_{max,cr}$ [kN]	$x(N_{max})$ [m]
1	6223.1	4262.4	1.7	0	1.7

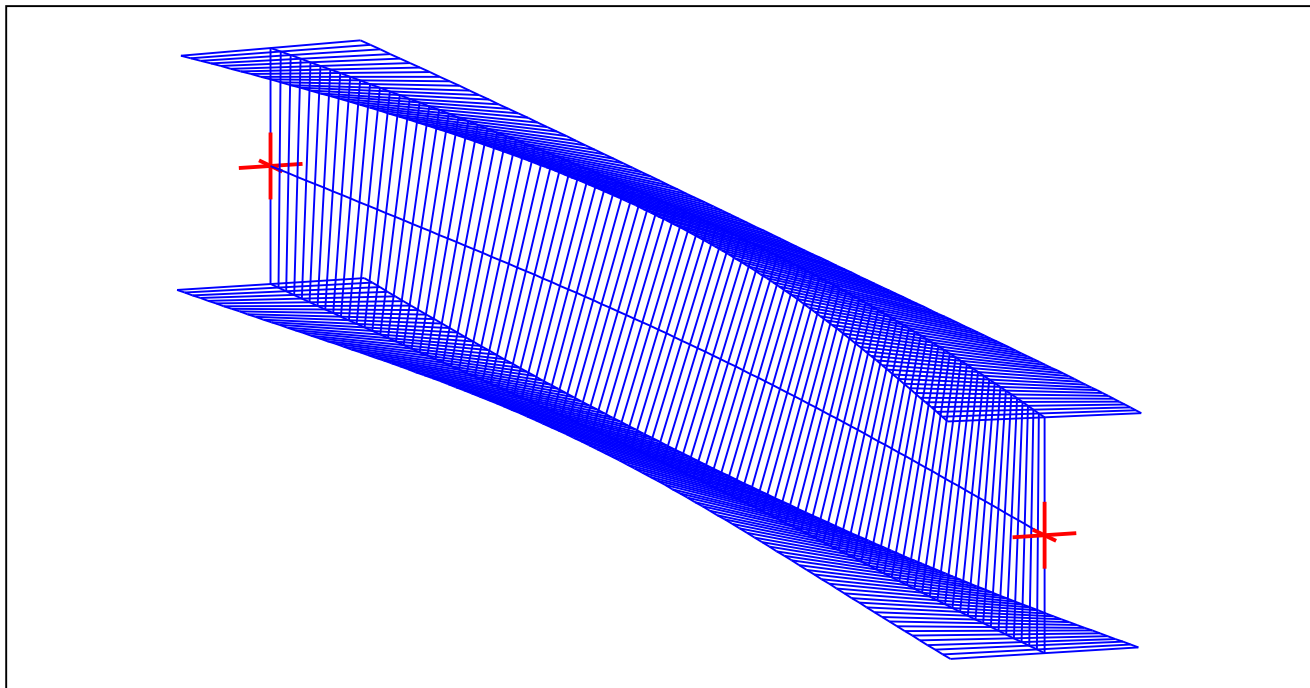


Figure 12 : Mode shape in 3D (Mode 1).

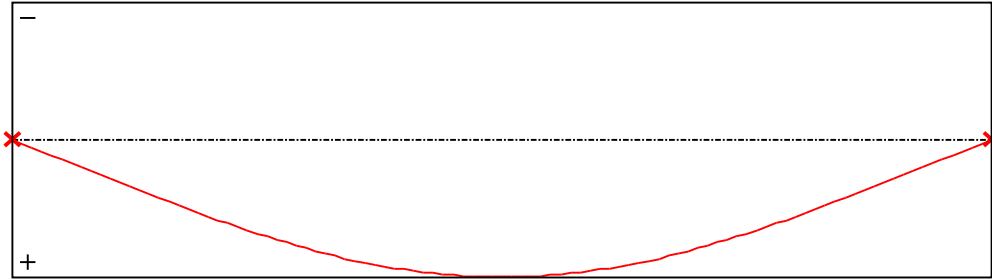


Figure 13 : Lateral displacement component of the shear centre (Mode 1).

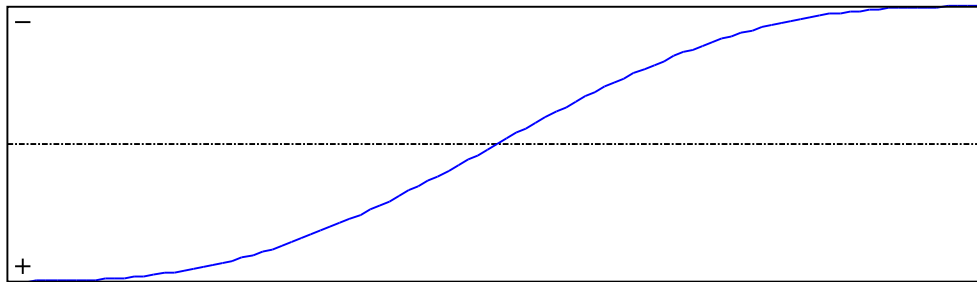


Figure 14 : Rotation in lateral flexure component of the shear centre (Mode 1).

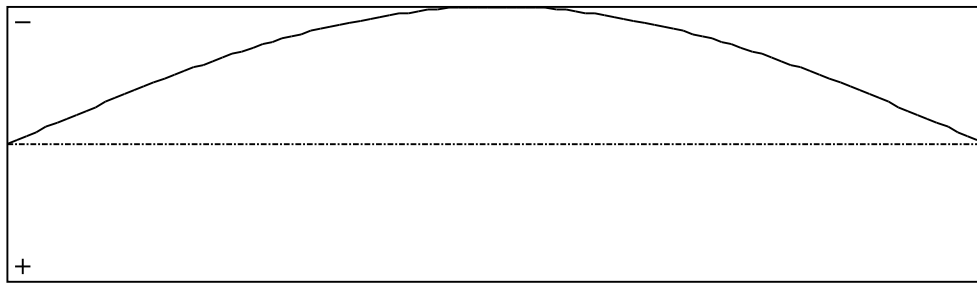


Figure 15 : Longitudinal rotation (torsion) component of the shear centre (Mode 1).

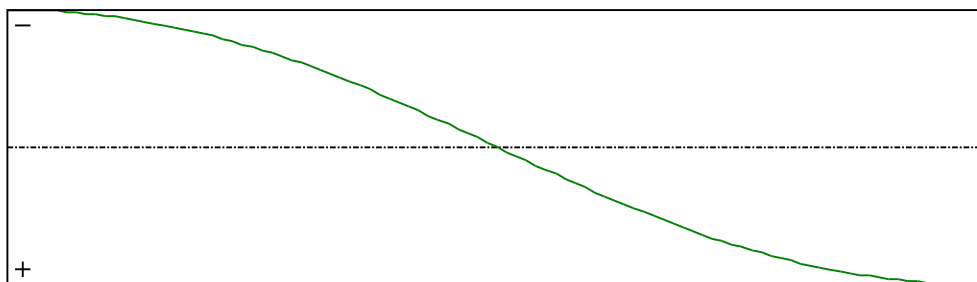


Figure 16 : Warping component of the shear centre (Mode 1).

Table 5 : Mode 1.

x [m]	v [cm]	v' [rd]	θ [rd]	θ' [rd/m]
0	-1.053E-22	0.0084	-7.472E-22	-0.0444
0.034	0.0287	0.0084	-0.0015	-0.0444
0.068	0.0574	0.0084	-0.003	-0.0444
0.102	0.0862	0.0084	-0.0045	-0.0443
0.136	0.1149	0.0084	-0.006	-0.0441
0.17	0.1435	0.0084	-0.0075	-0.044
0.204	0.1722	0.0084	-0.009	-0.0437
0.238	0.2008	0.0084	-0.0105	-0.0435
0.272	0.2293	0.0084	-0.012	-0.0432
0.306	0.2578	0.0084	-0.0134	-0.0429
0.34	0.2861	0.0083	-0.0149	-0.0425
0.374	0.3144	0.0083	-0.0163	-0.0421
0.408	0.3425	0.0082	-0.0178	-0.0417
0.442	0.3704	0.0082	-0.0192	-0.0412
0.476	0.3981	0.0081	-0.0206	-0.0407
0.51	0.4256	0.0081	-0.0219	-0.0401
0.544	0.4528	0.008	-0.0233	-0.0395
0.578	0.4798	0.0079	-0.0246	-0.0389
0.612	0.5064	0.0078	-0.0259	-0.0382
0.646	0.5327	0.0077	-0.0272	-0.0375
0.68	0.5586	0.0076	-0.0285	-0.0367
0.714	0.5841	0.0074	-0.0297	-0.036
0.748	0.6092	0.0073	-0.0309	-0.0351
0.782	0.6337	0.0071	-0.0321	-0.0343
0.816	0.6578	0.007	-0.0333	-0.0334
0.85	0.6813	0.0068	-0.0344	-0.0324
0.884	0.7042	0.0066	-0.0355	-0.0314
0.918	0.7264	0.0065	-0.0365	-0.0304
0.952	0.7481	0.0063	-0.0375	-0.0294
0.986	0.769	0.0061	-0.0385	-0.0283
1.02	0.7892	0.0058	-0.0394	-0.0272
1.054	0.8087	0.0056	-0.0404	-0.0261
1.088	0.8273	0.0054	-0.0412	-0.0249
1.122	0.8452	0.0051	-0.042	-0.0237
1.156	0.8622	0.0049	-0.0428	-0.0224

Table 5 (Next) : Mode 1.

x [m]	v [cm]	v' [rd]	θ [rd]	θ' [rd/m]
1.19	0.8783	0.0046	-0.0436	-0.0212
1.224	0.8935	0.0043	-0.0443	-0.0199
1.258	0.9078	0.0041	-0.0449	-0.0186
1.292	0.9212	0.0038	-0.0455	-0.0172
1.326	0.9335	0.0035	-0.0461	-0.0159
1.36	0.9449	0.0032	-0.0466	-0.0145
1.394	0.9552	0.0029	-0.0471	-0.0131
1.428	0.9645	0.0026	-0.0475	-0.0117
1.462	0.9728	0.0023	-0.0479	-0.0103
1.496	0.98	0.002	-0.0482	-0.0088
1.53	0.9861	0.0016	-0.0485	-0.0074
1.564	0.9911	0.0013	-0.0487	-0.0059
1.598	0.995	9.847E-4	-0.0489	-0.0044
1.632	0.9978	6.575E-4	-0.049	-0.003
1.666	0.9994	3.29E-4	-0.0491	-0.0015
1.7	1	2.164E-9	-0.0491	-1.251E-8
1.734	0.9994	-3.29E-4	-0.0491	0.0015
1.768	0.9978	-6.575E-4	-0.049	0.003
1.802	0.995	-9.847E-4	-0.0489	0.0044
1.836	0.9911	-0.0013	-0.0487	0.0059
1.87	0.9861	-0.0016	-0.0485	0.0074
1.904	0.98	-0.002	-0.0482	0.0088
1.938	0.9728	-0.0023	-0.0479	0.0103
1.972	0.9645	-0.0026	-0.0475	0.0117
2.006	0.9552	-0.0029	-0.0471	0.0131
2.04	0.9449	-0.0032	-0.0466	0.0145
2.074	0.9335	-0.0035	-0.0461	0.0159
2.108	0.9212	-0.0038	-0.0455	0.0172
2.142	0.9078	-0.0041	-0.0449	0.0186
2.176	0.8935	-0.0043	-0.0443	0.0199
2.21	0.8783	-0.0046	-0.0436	0.0212
2.244	0.8622	-0.0049	-0.0428	0.0224
2.278	0.8452	-0.0051	-0.042	0.0237
2.312	0.8273	-0.0054	-0.0412	0.0249
2.346	0.8087	-0.0056	-0.0404	0.0261

Table 5 (Next) : Mode 1.

x [m]	v [cm]	v' [rd]	θ [rd]	θ' [rd/m]
2.38	0.7892	-0.0058	-0.0394	0.0272
2.414	0.769	-0.0061	-0.0385	0.0283
2.448	0.7481	-0.0063	-0.0375	0.0294
2.482	0.7264	-0.0065	-0.0365	0.0304
2.516	0.7042	-0.0066	-0.0355	0.0314
2.55	0.6813	-0.0068	-0.0344	0.0324
2.584	0.6578	-0.007	-0.0333	0.0334
2.618	0.6337	-0.0071	-0.0321	0.0343
2.652	0.6092	-0.0073	-0.0309	0.0351
2.686	0.5841	-0.0074	-0.0297	0.036
2.72	0.5586	-0.0076	-0.0285	0.0367
2.754	0.5327	-0.0077	-0.0272	0.0375
2.788	0.5064	-0.0078	-0.0259	0.0382
2.822	0.4798	-0.0079	-0.0246	0.0389
2.856	0.4528	-0.008	-0.0233	0.0395
2.89	0.4256	-0.0081	-0.0219	0.0401
2.924	0.3981	-0.0081	-0.0206	0.0407
2.958	0.3704	-0.0082	-0.0192	0.0412
2.992	0.3425	-0.0082	-0.0178	0.0417
3.026	0.3144	-0.0083	-0.0163	0.0421
3.06	0.2861	-0.0083	-0.0149	0.0425
3.094	0.2578	-0.0084	-0.0134	0.0429
3.128	0.2293	-0.0084	-0.012	0.0432
3.162	0.2008	-0.0084	-0.0105	0.0435
3.196	0.1722	-0.0084	-0.009	0.0437
3.23	0.1435	-0.0084	-0.0075	0.044
3.264	0.1149	-0.0084	-0.006	0.0441
3.298	0.0862	-0.0084	-0.0045	0.0443
3.332	0.0574	-0.0084	-0.003	0.0444
3.366	0.0287	-0.0084	-0.0015	0.0444
3.4	-1.673E-22	-0.0084	-4.202E-22	0.0444

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WARNING !

The following software may be used for working out technical solutions during preparatory engineering studies.

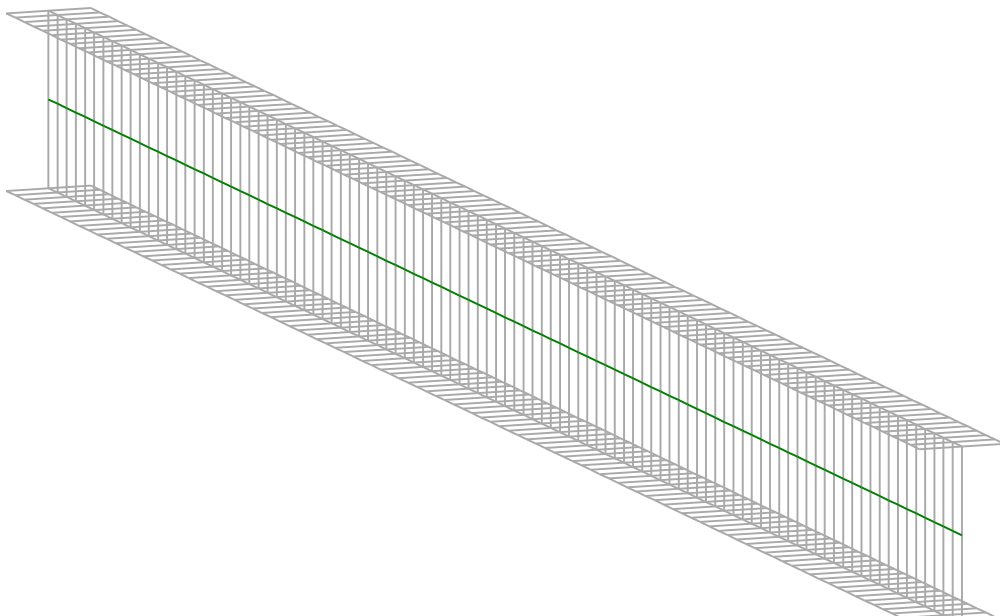
Because of the complexity of the calculations involved, the software is only for users who are able to make themselves an accurate idea of its possibilities, its limitations and adequacy to the various practical applications. The user will use it under his own responsibilities at his own risk.

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LTBeamN

v 1.0.4

CALCULATION SHEET



I - PARAMETERS

I.1 - General parameters

Projected total length :	$L = 4 \text{ m}$
Initial discretization of the beam :	$n_{el} = 100 \text{ elements}$

I.2 - Material

Name :	Steel
Young modulus :	$E = 210000 \text{ MPa}$
Shear modulus :	$G = 80769 \text{ MPa}$
Poisson factor :	$\nu = 0.3$
Density :	$\rho = 7850 \text{ kg/m}^3$

I.3 - Sections

Alignment of sections :	Top
-------------------------	-----

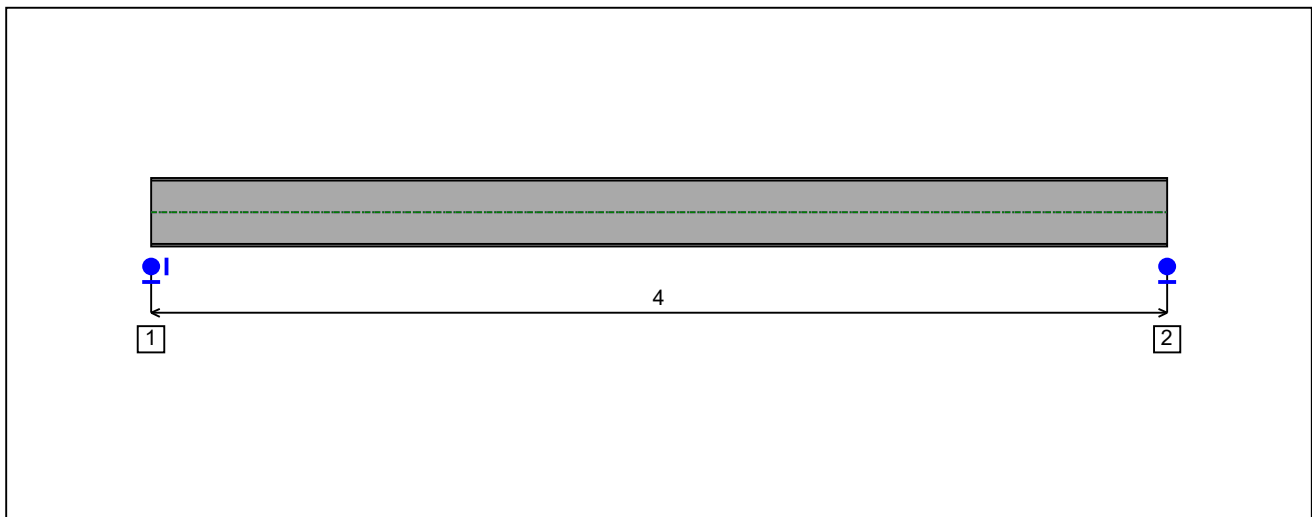


Figure 1 : Profile in long with section numbers.

- Section No. 1 : IPE 270

Abscissa from the left end of the beam : $x = 0$ m

Type : In catalogue (OTUA)

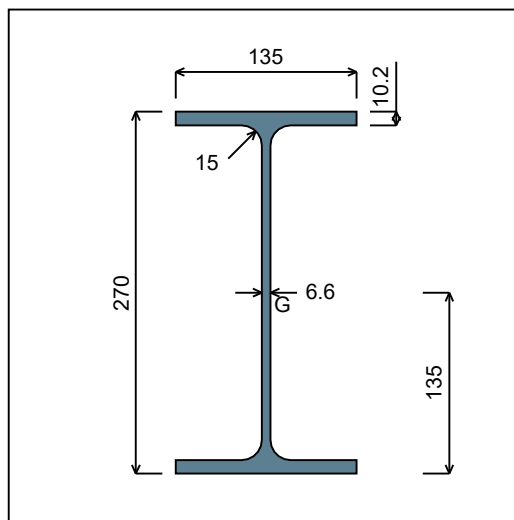


Figure 2 : Section No. 1 (IPE 270).

Main geometrical properties :

- $z_S = 0$ cm
- $z_G = 13.5$ cm
- $I_y = 5789.8$ cm⁴
- $I_z = 419.87$ cm⁴
- $I_t = 15.73$ cm⁴ (Villette)
- $I_w = 70849$ cm⁶

Other geometrical properties :

- | | |
|---|------------------------------------|
| $A = 45.95$ cm ² | |
| $A_{v,y} = 27.54$ cm ² | $A_{v,z} = 22.14$ cm ² |
| $W_{el,y,sup} = 428.87$ cm ³ | |
| $W_{el,y,inf} = 428.87$ cm ³ | $W_{el,z} = 62.2$ cm ³ |
| $W_{pl,y} = 484$ cm ³ | $W_{pl,z} = 96.95$ cm ³ |

Stiffness relaxations :

- θ : Continuous
- v' : Continuous
- θ' : Continuous
- w' : Continuous

- Section No. 2 : IPE 270

Abscissa from the left end of the beam :

$x = 4 \text{ m}$

Type :

In catalogue (OTUA)

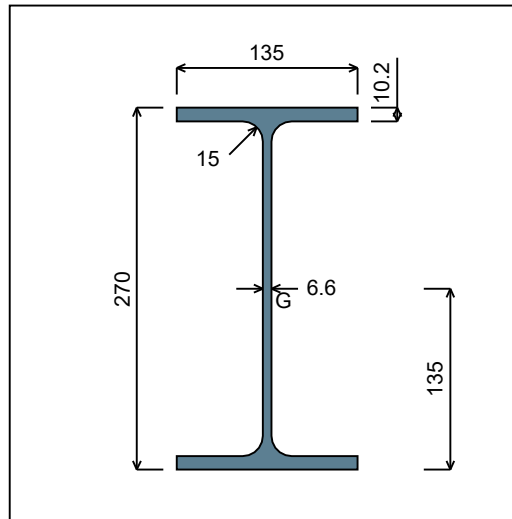


Figure 3 : Section No. 2 (IPE 270).

Main geometrical properties :

- $z_S = 0 \text{ cm}$
- $z_G = 13.5 \text{ cm}$
- $I_y = 5789.8 \text{ cm}^4$
- $I_z = 419.87 \text{ cm}^4$
- $I_t = 15.73 \text{ cm}^4$ (Villette)
- $I_w = 70849 \text{ cm}^6$

Other geometrical properties :

- | | |
|--------------------------------------|---------------------------------|
| $A = 45.95 \text{ cm}^2$ | |
| $A_{v,y} = 27.54 \text{ cm}^2$ | $A_{v,z} = 22.14 \text{ cm}^2$ |
| $W_{el,y,sup} = 428.87 \text{ cm}^3$ | |
| $W_{el,y,inf} = 428.87 \text{ cm}^3$ | $W_{el,z} = 62.2 \text{ cm}^3$ |
| $W_{pl,y} = 484 \text{ cm}^3$ | $W_{pl,z} = 96.95 \text{ cm}^3$ |

Stiffness relaxations :

- θ : Continuous
- v' : Continuous
- θ' : Continuous
- w' : Continuous

I.4 - Lateral restraints

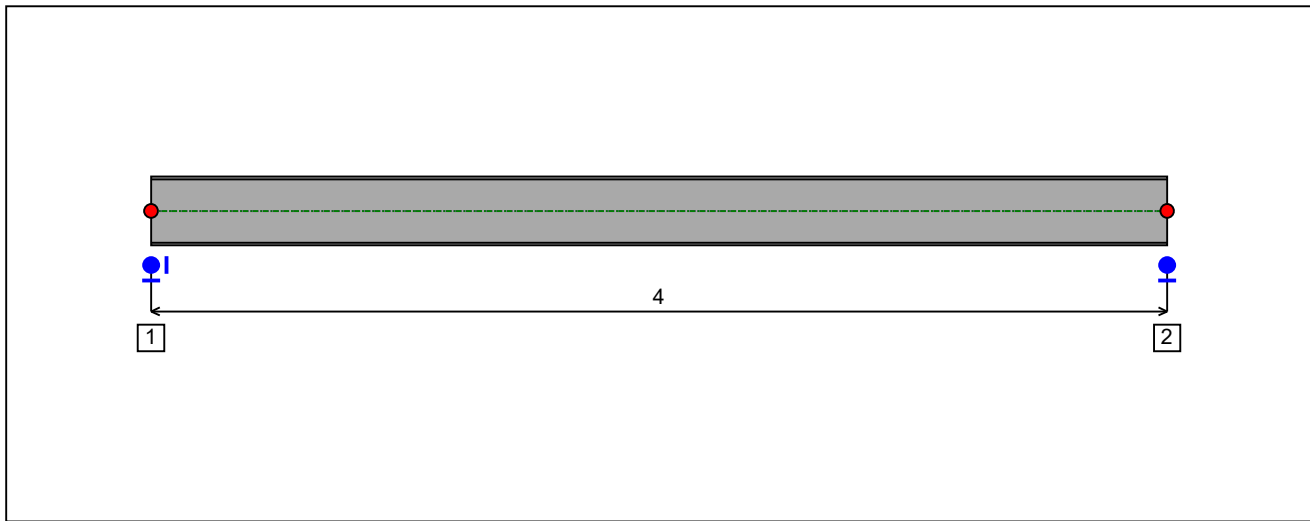


Figure 4 : Profile in long with restraint numbers.

- Restraint No. 1 :

Type : Ponctual

Abscissa from the left end of the beam : $x = 0$ m

Vertical position from the shear centre : $z = 0$ cm

Restraint conditions :

- v : Fixed
- θ : Fixed
- v' : Free
- θ' : Free

- Restraint No. 2 :

Type : Ponctual

Abscissa from the left end of the beam : $x = 4$ m

Vertical position from the shear centre : $z = 0$ cm

Restraint conditions :

- v : Fixed
- θ : Fixed
- v' : Free
- θ' : Free

1.5 - Supports

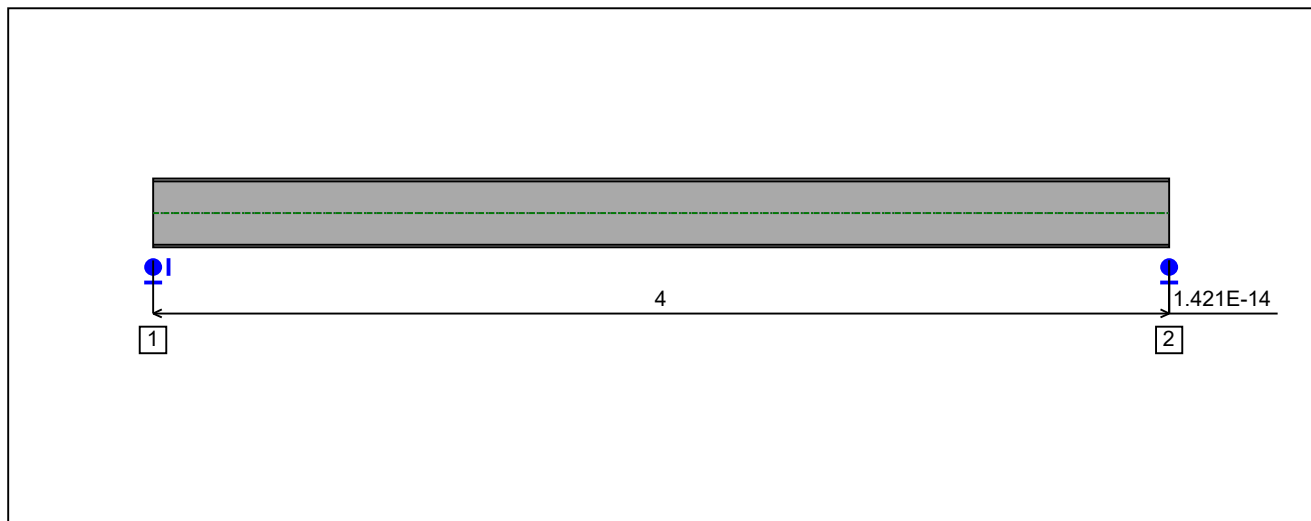


Figure 5 : Profile in long with support numbers.

- Support No. 1 :

Abscissa from the left end of the beam : $x = 0$ m

Support conditions :

u : Fixed
w : Fixed
w' : Free

- Support No. 2 :

Abscissa from the left end of the beam : $x = 4$ m

Support conditions :

u : Free
w : Fixed
w' : Free

I.6 - Loads

Type of loading :

External

The weight of the beam is not taken into account.

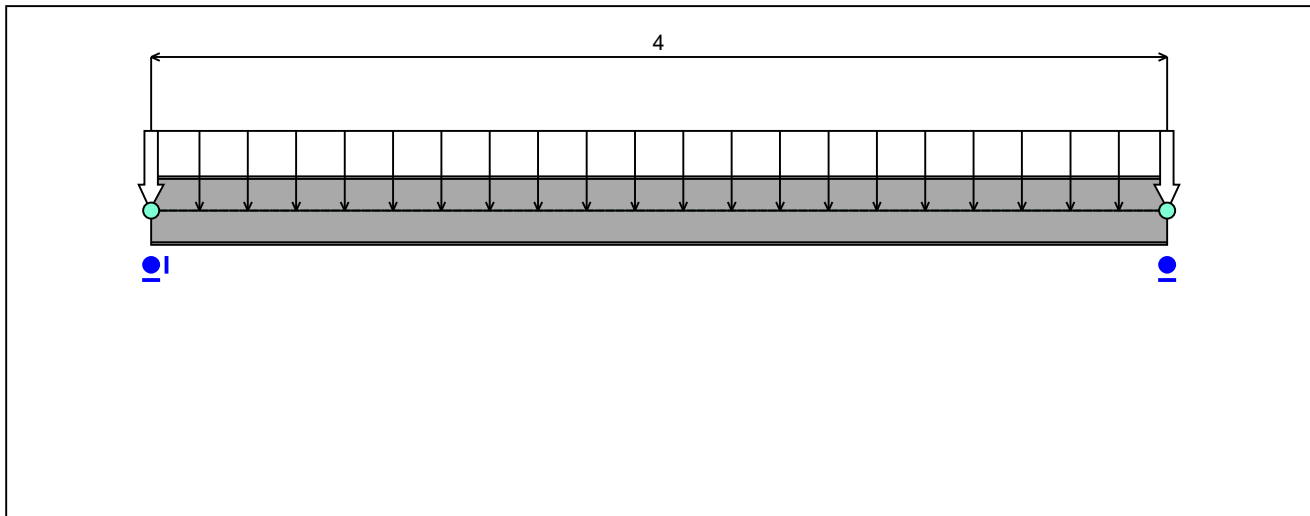


Figure 6 : Profile in long with loads.

- Concentrated loads :

No load has been defined.

- Distributed loads :

Table 1 : Distributed loads.

x_1 (m)	$z_1^{(*)}$ (cm)	$q_{x,1}$ (kN/m)	$q_{z,1}$ (kN/m)	x_2 (m)	$z_2^{(*)}$ (cm)	$q_{x,2}$ (kN/m)	$q_{z,2}$ (kN/m)	Active
0	0	0	-3.5	4	0	0	-3.5	Yes

(*) Vertical position from the shear centre

II - RESULTS OF 2D GLOBAL ANALYSIS

II.1 - Sign conventions

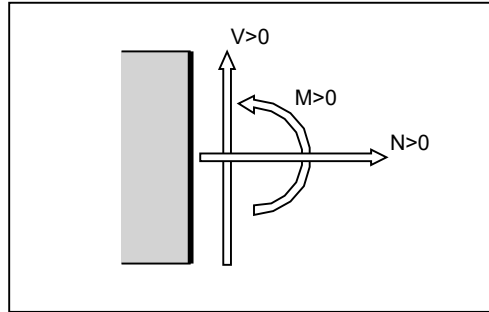


Figure 7 : Sign conventions.

- N > 0 : for tension normal force
- M > 0 : when the upper fiber is compressed
- w > 0 : upward displacement

M, N, V solicitations in a section are actions of the right side on the left side.

II.2 - Support reactions

- Support No. 1 :

- Horizontal : $F_h = 0 \text{ kN}$
- Vertical : $F_v = 7 \text{ kN}$
- Moment : $M = 0 \text{ kN.m}$

- Support No. 2 :

- Horizontal : $F_h = 0 \text{ kN}$
- Vertical : $F_v = 7 \text{ kN}$
- Moment : $M = 0 \text{ kN.m}$

II.3 - Diagrams of internal forces in global coordinates

1st order elastic analysis

In-plane buckling analysis : Not applicable

- $|M|_{\max} = 7 \text{ kN.m (x = 2 m)}$
- $|V|_{\max} = 7 \text{ kN (x = 4 m)}$
- $|N|_{\max} = 0 \text{ kN (x = 0 m)}$
- $|w|_{\max} = 0.096 \text{ cm (x = 2 m)}$

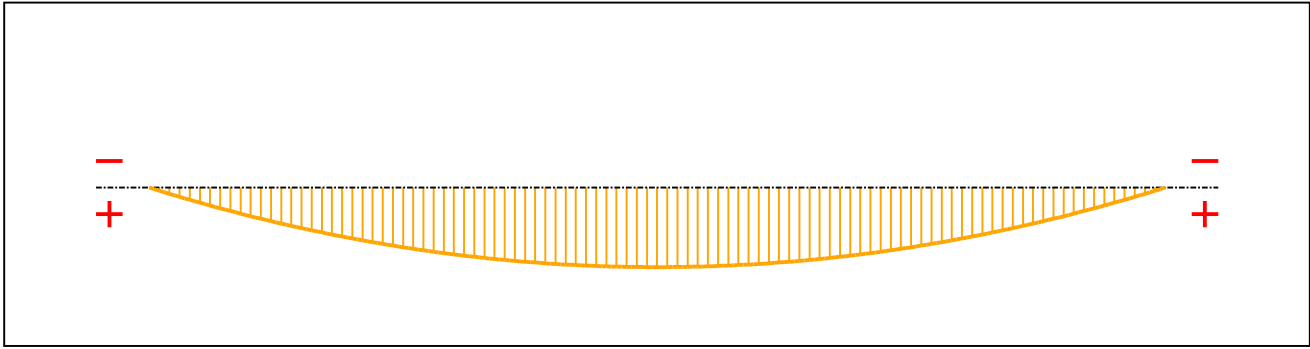


Figure 8 : Moment diagram.

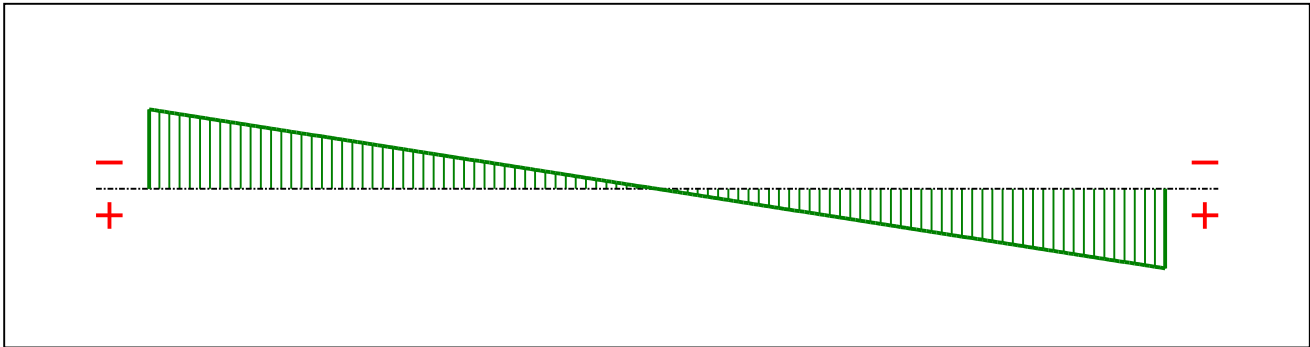


Figure 9 : Shear force diagram.

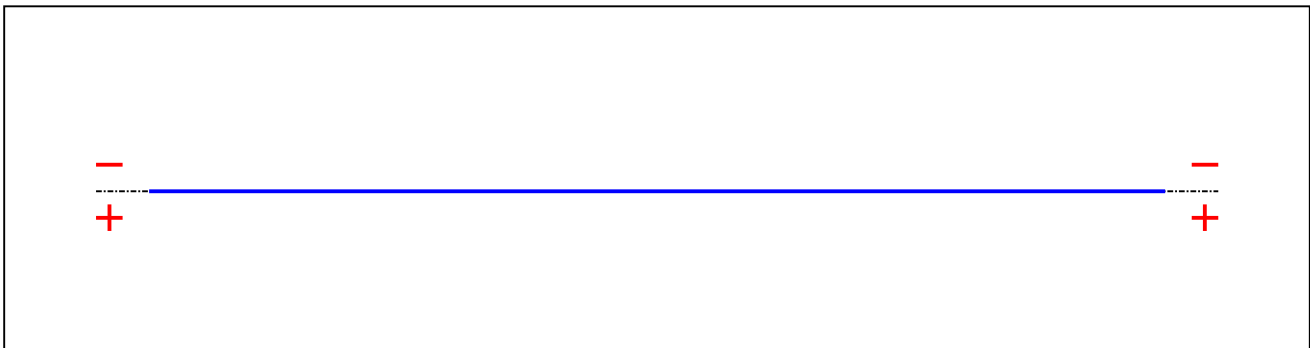


Figure 10 : Axial force diagram.

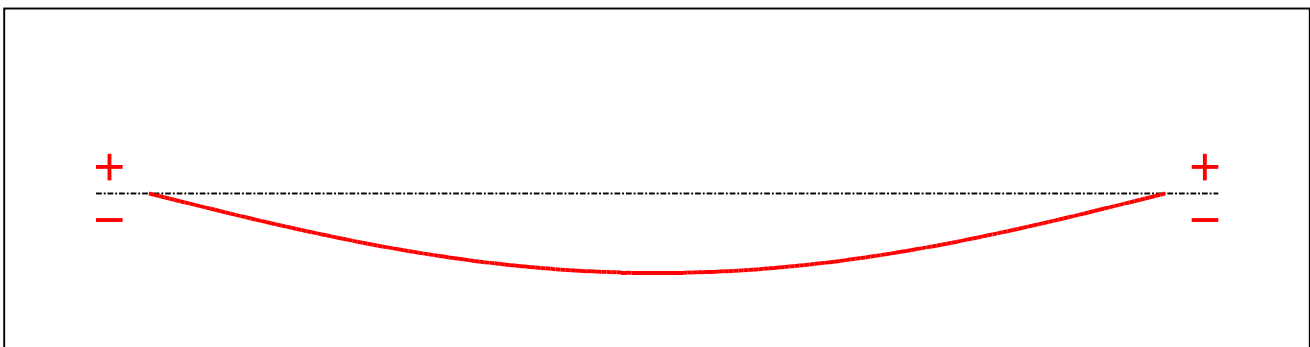


Figure 11 : Deflection.

Table 2 : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
0	0	-	-7	0	0
0.02	0	-7	-6.93	0.1393	-0.0153
0.04	0	-6.93	-6.86	0.2772	-0.0307
0.06	0	-6.86	-6.79	0.4137	-0.046
0.08	0	-6.79	-6.72	0.5488	-0.0614
0.1	0	-6.72	-6.65	0.6825	-0.0767
0.12	0	-6.65	-6.58	0.8148	-0.092
0.14	0	-6.58	-6.51	0.9457	-0.1072
0.16	0	-6.51	-6.44	1.075	-0.1224
0.18	0	-6.44	-6.37	1.203	-0.1376
0.2	0	-6.37	-6.3	1.33	-0.1528
0.22	0	-6.3	-6.23	1.455	-0.1679
0.24	0	-6.23	-6.16	1.579	-0.1829
0.26	0	-6.16	-6.09	1.702	-0.1979
0.28	0	-6.09	-6.02	1.823	-0.2129
0.3	0	-6.02	-5.95	1.943	-0.2278
0.32	0	-5.95	-5.88	2.061	-0.2426
0.34	0	-5.88	-5.81	2.178	-0.2573
0.36	0	-5.81	-5.74	2.293	-0.2721
0.38	0	-5.74	-5.67	2.407	-0.2866
0.4	0	-5.67	-5.6	2.52	-0.3012
0.42	0	-5.6	-5.53	2.631	-0.3156
0.44	0	-5.53	-5.46	2.741	-0.33
0.46	0	-5.46	-5.39	2.85	-0.3443
0.48	0	-5.39	-5.32	2.957	-0.3585
0.5	0	-5.32	-5.25	3.063	-0.3725
0.52	0	-5.25	-5.18	3.167	-0.3866
0.54	0	-5.18	-5.11	3.27	-0.4004
0.56	0	-5.11	-5.04	3.371	-0.4142
0.58	0	-5.04	-4.97	3.471	-0.4278
0.6	0	-4.97	-4.9	3.57	-0.4414
0.62	0	-4.9	-4.83	3.667	-0.4548
0.64	0	-4.83	-4.76	3.763	-0.4681
0.66	0	-4.76	-4.69	3.858	-0.4813
0.68	0	-4.69	-4.62	3.951	-0.4944

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
0.7	0	-4.62	-4.55	4.043	-0.5072
0.72	0	-4.55	-4.48	4.133	-0.5201
0.74	0	-4.48	-4.41	4.222	-0.5327
0.76	0	-4.41	-4.34	4.309	-0.5453
0.78	0	-4.34	-4.27	4.395	-0.5576
0.8	0	-4.27	-4.2	4.48	-0.5699
0.82	0	-4.2	-4.13	4.563	-0.5819
0.84	0	-4.13	-4.06	4.645	-0.5939
0.86	0	-4.06	-3.99	4.726	-0.6056
0.88	0	-3.99	-3.92	4.805	-0.6173
0.9	0	-3.92	-3.85	4.883	-0.6287
0.92	0	-3.85	-3.78	4.959	-0.6401
0.94	0	-3.78	-3.71	5.034	-0.6512
0.96	0	-3.71	-3.64	5.107	-0.6622
0.98	0	-3.64	-3.57	5.179	-0.6729
1	0	-3.57	-3.5	5.25	-0.6837
1.02	0	-3.5	-3.43	5.319	-0.6941
1.04	0	-3.43	-3.36	5.387	-0.7044
1.06	0	-3.36	-3.29	5.454	-0.7145
1.08	0	-3.29	-3.22	5.519	-0.7245
1.1	0	-3.22	-3.15	5.583	-0.7342
1.12	0	-3.15	-3.08	5.645	-0.7438
1.14	0	-3.08	-3.01	5.706	-0.7531
1.16	0	-3.01	-2.94	5.765	-0.7624
1.18	0	-2.94	-2.87	5.823	-0.7713
1.2	0	-2.87	-2.8	5.88	-0.7802
1.22	0	-2.8	-2.73	5.935	-0.7888
1.24	0	-2.73	-2.66	5.989	-0.7973
1.26	0	-2.66	-2.59	6.042	-0.8054
1.28	0	-2.59	-2.52	6.093	-0.8135
1.3	0	-2.52	-2.45	6.143	-0.8213
1.32	0	-2.45	-2.38	6.191	-0.829
1.34	0	-2.38	-2.31	6.238	-0.8363
1.36	0	-2.31	-2.24	6.283	-0.8436
1.38	0	-2.24	-2.17	6.327	-0.8506

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
1.4	0	-2.17	-2.1	6.37	-0.8575
1.42	0	-2.1	-2.03	6.411	-0.864
1.44	0	-2.03	-1.96	6.451	-0.8705
1.46	0	-1.96	-1.89	6.49	-0.8765
1.48	0	-1.89	-1.82	6.527	-0.8826
1.5	0	-1.82	-1.75	6.563	-0.8882
1.52	0	-1.75	-1.68	6.597	-0.8939
1.54	0	-1.68	-1.61	6.63	-0.8991
1.56	0	-1.61	-1.54	6.661	-0.9043
1.58	0	-1.54	-1.47	6.691	-0.909
1.6	0	-1.47	-1.4	6.72	-0.9138
1.62	0	-1.4	-1.33	6.747	-0.9181
1.64	0	-1.33	-1.26	6.773	-0.9224
1.66	0	-1.26	-1.19	6.798	-0.9263
1.68	0	-1.19	-1.12	6.821	-0.9302
1.7	0	-1.12	-1.05	6.843	-0.9336
1.72	0	-1.05	-0.98	6.863	-0.937
1.74	0	-0.98	-0.91	6.882	-0.94
1.76	0	-0.91	-0.84	6.899	-0.943
1.78	0	-0.84	-0.77	6.915	-0.9455
1.8	0	-0.77	-0.7	6.93	-0.948
1.82	0	-0.7	-0.63	6.943	-0.9501
1.84	0	-0.63	-0.56	6.955	-0.9522
1.86	0	-0.56	-0.49	6.966	-0.9538
1.88	0	-0.49	-0.42	6.975	-0.9554
1.9	0	-0.42	-0.35	6.983	-0.9566
1.92	0	-0.35	-0.28	6.989	-0.9577
1.94	0	-0.28	-0.21	6.994	-0.9584
1.96	0	-0.21	-0.14	6.997	-0.9591
1.98	0	-0.14	-0.07	6.999	-0.9593
2	0	-0.07	0	7	-0.9595
2.02	0	0	0.07	6.999	-0.9593
2.04	0	0.07	0.14	6.997	-0.9591
2.06	0	0.14	0.21	6.994	-0.9584
2.08	0	0.21	0.28	6.989	-0.9577

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
2.1	0	0.28	0.35	6.983	-0.9566
2.12	0	0.35	0.42	6.975	-0.9554
2.14	0	0.42	0.49	6.966	-0.9538
2.16	0	0.49	0.56	6.955	-0.9522
2.18	0	0.56	0.63	6.943	-0.9501
2.2	0	0.63	0.7	6.93	-0.948
2.22	0	0.7	0.77	6.915	-0.9455
2.24	0	0.77	0.84	6.899	-0.943
2.26	0	0.84	0.91	6.882	-0.94
2.28	0	0.91	0.98	6.863	-0.937
2.3	0	0.98	1.05	6.843	-0.9336
2.32	0	1.05	1.12	6.821	-0.9302
2.34	0	1.12	1.19	6.798	-0.9263
2.36	0	1.19	1.26	6.773	-0.9224
2.38	0	1.26	1.33	6.747	-0.9181
2.4	0	1.33	1.4	6.72	-0.9138
2.42	0	1.4	1.47	6.691	-0.909
2.44	0	1.47	1.54	6.661	-0.9043
2.46	0	1.54	1.61	6.63	-0.8991
2.48	0	1.61	1.68	6.597	-0.8939
2.5	0	1.68	1.75	6.563	-0.8882
2.52	0	1.75	1.82	6.527	-0.8826
2.54	0	1.82	1.89	6.49	-0.8765
2.56	0	1.89	1.96	6.451	-0.8705
2.58	0	1.96	2.03	6.411	-0.864
2.6	0	2.03	2.1	6.37	-0.8575
2.62	0	2.1	2.17	6.327	-0.8506
2.64	0	2.17	2.24	6.283	-0.8436
2.66	0	2.24	2.31	6.238	-0.8363
2.68	0	2.31	2.38	6.191	-0.829
2.7	0	2.38	2.45	6.143	-0.8213
2.72	0	2.45	2.52	6.093	-0.8135
2.74	0	2.52	2.59	6.042	-0.8054
2.76	0	2.59	2.66	5.989	-0.7973
2.78	0	2.66	2.73	5.935	-0.7888

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
2.8	0	2.73	2.8	5.88	-0.7802
2.82	0	2.8	2.87	5.823	-0.7713
2.84	0	2.87	2.94	5.765	-0.7624
2.86	0	2.94	3.01	5.706	-0.7531
2.88	0	3.01	3.08	5.645	-0.7438
2.9	0	3.08	3.15	5.583	-0.7342
2.92	0	3.15	3.22	5.519	-0.7245
2.94	0	3.22	3.29	5.454	-0.7145
2.96	0	3.29	3.36	5.387	-0.7044
2.98	0	3.36	3.43	5.319	-0.6941
3	0	3.43	3.5	5.25	-0.6837
3.02	0	3.5	3.57	5.179	-0.6729
3.04	0	3.57	3.64	5.107	-0.6622
3.06	0	3.64	3.71	5.034	-0.6512
3.08	0	3.71	3.78	4.959	-0.6401
3.1	0	3.78	3.85	4.883	-0.6287
3.12	0	3.85	3.92	4.805	-0.6173
3.14	0	3.92	3.99	4.726	-0.6056
3.16	0	3.99	4.06	4.645	-0.5939
3.18	0	4.06	4.13	4.563	-0.5819
3.2	0	4.13	4.2	4.48	-0.5699
3.22	0	4.2	4.27	4.395	-0.5576
3.24	0	4.27	4.34	4.309	-0.5453
3.26	0	4.34	4.41	4.222	-0.5327
3.28	0	4.41	4.48	4.133	-0.5201
3.3	0	4.48	4.55	4.043	-0.5072
3.32	0	4.55	4.62	3.951	-0.4944
3.34	0	4.62	4.69	3.858	-0.4813
3.36	0	4.69	4.76	3.763	-0.4681
3.38	0	4.76	4.83	3.667	-0.4548
3.4	0	4.83	4.9	3.57	-0.4414
3.42	0	4.9	4.97	3.471	-0.4278
3.44	0	4.97	5.04	3.371	-0.4142
3.46	0	5.04	5.11	3.27	-0.4004
3.48	0	5.11	5.18	3.167	-0.3866

Table 2 (Next) : Results of 2D global analysis.

x(m)	N(kN)	V(L)(kN)	V(R)(kN)	M(kN.m)	w (mm)
3.5	0	5.18	5.25	3.063	-0.3725
3.52	0	5.25	5.32	2.957	-0.3585
3.54	0	5.32	5.39	2.85	-0.3443
3.56	0	5.39	5.46	2.741	-0.33
3.58	0	5.46	5.53	2.631	-0.3156
3.6	0	5.53	5.6	2.52	-0.3012
3.62	0	5.6	5.67	2.407	-0.2866
3.64	0	5.67	5.74	2.293	-0.2721
3.66	0	5.74	5.81	2.178	-0.2573
3.68	0	5.81	5.88	2.061	-0.2426
3.7	0	5.88	5.95	1.943	-0.2278
3.72	0	5.95	6.02	1.823	-0.2129
3.74	0	6.02	6.09	1.702	-0.1979
3.76	0	6.09	6.16	1.579	-0.1829
3.78	0	6.16	6.23	1.455	-0.1679
3.8	0	6.23	6.3	1.33	-0.1528
3.82	0	6.3	6.37	1.203	-0.1376
3.84	0	6.37	6.44	1.075	-0.1224
3.86	0	6.44	6.51	0.9457	-0.1072
3.88	0	6.51	6.58	0.8148	-0.092
3.9	0	6.58	6.65	0.6825	-0.0767
3.92	0	6.65	6.72	0.5488	-0.0614
3.94	0	6.72	6.79	0.4137	-0.046
3.96	0	6.79	6.86	0.2772	-0.0307
3.98	0	6.86	6.93	0.1393	-0.0153
4	0	6.93	-	0	0

III - LTB CALCULATION

Requested number of modes : 1
 Blocked moment diagram : No
 Blocked axial force diagram : No

III.1 - LTB modes

Table 3 : LTB modes.

Mode	λ_{cr}	$M_{max,cr}$ [kN.m]	$x(M_{max})$ [m]	$N_{max,cr}$ [kN]	$x(N_{max})$ [m]
1	17.63	123.42	2	0	2

III.2 - Mode shapes

- Mode 1

Table 4 : Mode 1.

Mode	λ_{cr}	$M_{max,cr}$ [kN.m]	$x(M_{max})$ [m]	$N_{max,cr}$ [kN]	$x(N_{max})$ [m]
1	17.63	123.42	2	0	2

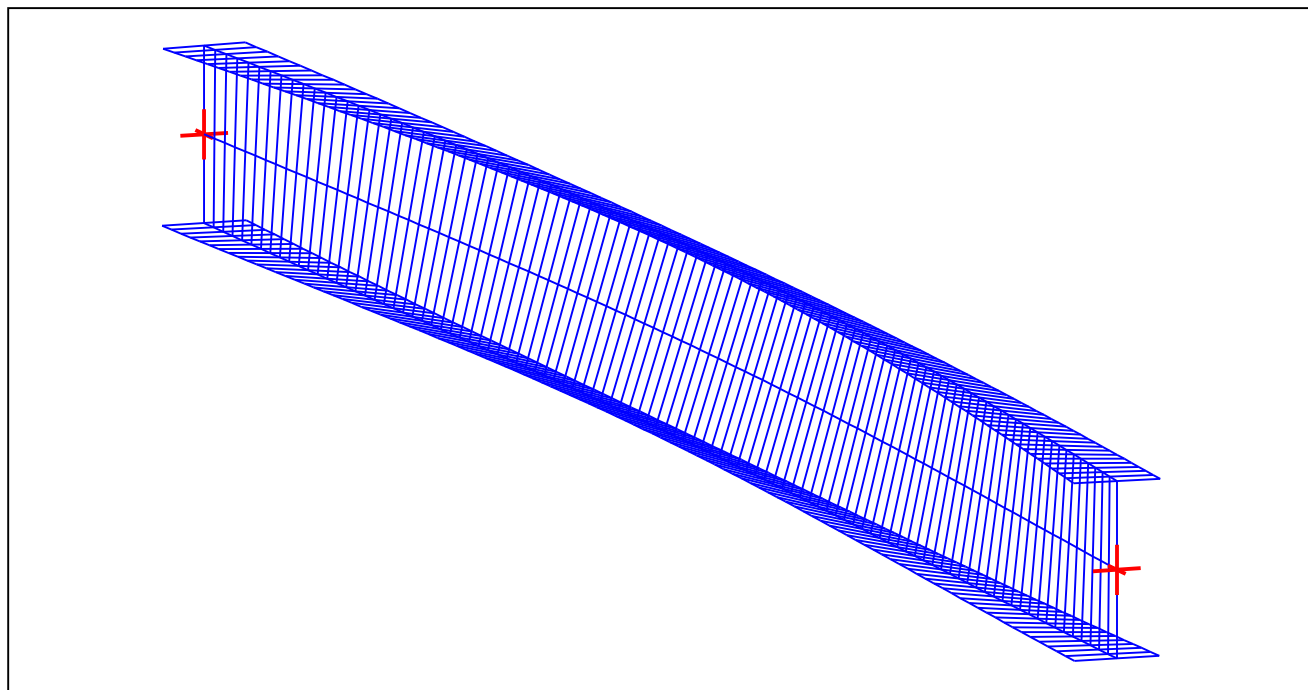


Figure 12 : Mode shape in 3D (Mode 1).

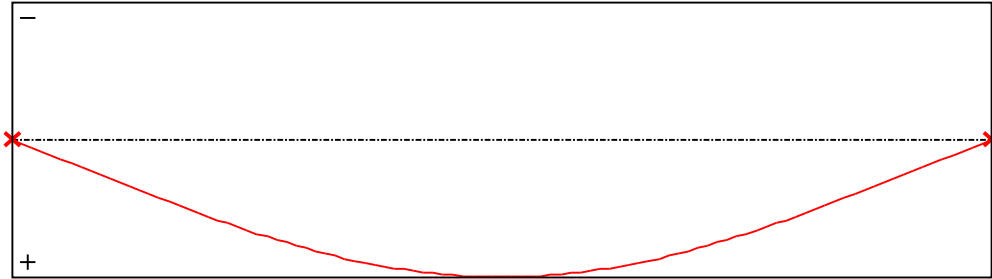


Figure 13 : Lateral displacement component of the shear centre (Mode 1).

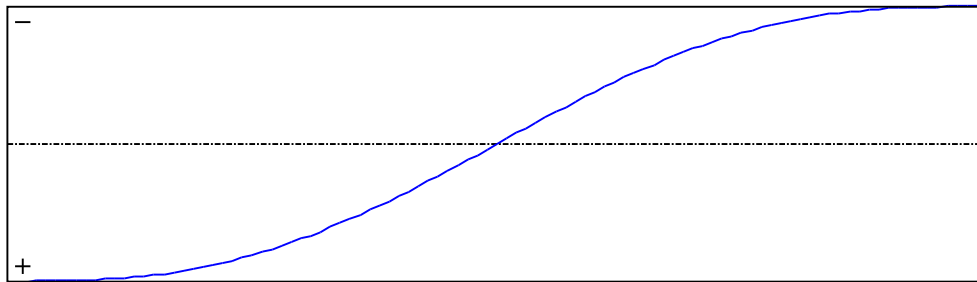


Figure 14 : Rotation in lateral flexure component of the shear centre (Mode 1).

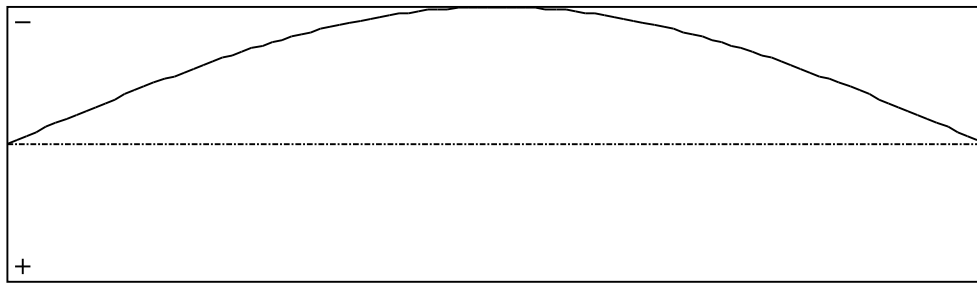


Figure 15 : Longitudinal rotation (torsion) component of the shear centre (Mode 1).

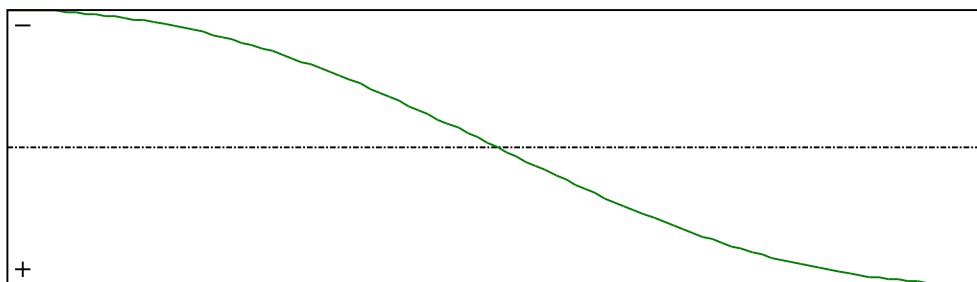


Figure 16 : Warping component of the shear centre (Mode 1).

Table 5 : Mode 1.

x [m]	v [cm]	v' [rd]	θ [rd]	θ' [rd/m]
0	1.884E-27	0.0072	5.71E-27	-0.0381
0.04	0.0287	0.0072	-0.0015	-0.0381
0.08	0.0574	0.0072	-0.003	-0.0381
0.12	0.0861	0.0072	-0.0046	-0.038
0.16	0.1148	0.0072	-0.0061	-0.0379
0.2	0.1434	0.0072	-0.0076	-0.0377
0.24	0.1721	0.0072	-0.0091	-0.0376
0.28	0.2006	0.0071	-0.0106	-0.0374
0.32	0.2292	0.0071	-0.0121	-0.0371
0.36	0.2576	0.0071	-0.0136	-0.0369
0.4	0.2859	0.0071	-0.015	-0.0366
0.44	0.3141	0.007	-0.0165	-0.0363
0.48	0.3422	0.007	-0.0179	-0.0359
0.52	0.3701	0.007	-0.0194	-0.0355
0.56	0.3978	0.0069	-0.0208	-0.0351
0.6	0.4253	0.0068	-0.0222	-0.0346
0.64	0.4525	0.0068	-0.0236	-0.0341
0.68	0.4795	0.0067	-0.0249	-0.0336
0.72	0.5061	0.0066	-0.0262	-0.0331
0.76	0.5324	0.0065	-0.0276	-0.0325
0.8	0.5583	0.0064	-0.0288	-0.0319
0.84	0.5838	0.0063	-0.0301	-0.0312
0.88	0.6088	0.0062	-0.0313	-0.0305
0.92	0.6334	0.0061	-0.0325	-0.0298
0.96	0.6574	0.0059	-0.0337	-0.029
1	0.6809	0.0058	-0.0349	-0.0282
1.04	0.7038	0.0057	-0.036	-0.0274
1.08	0.7261	0.0055	-0.0371	-0.0266
1.12	0.7478	0.0053	-0.0381	-0.0257
1.16	0.7687	0.0051	-0.0391	-0.0247
1.2	0.7889	0.005	-0.0401	-0.0238
1.24	0.8084	0.0048	-0.041	-0.0228
1.28	0.8271	0.0046	-0.0419	-0.0218
1.32	0.845	0.0044	-0.0428	-0.0208
1.36	0.862	0.0041	-0.0436	-0.0197

Table 5 (Next) : Mode 1.

x [m]	v [cm]	v' [rd]	θ [rd]	θ' [rd/m]
1.4	0.8781	0.0039	-0.0443	-0.0186
1.44	0.8934	0.0037	-0.0451	-0.0175
1.48	0.9077	0.0035	-0.0457	-0.0163
1.52	0.921	0.0032	-0.0464	-0.0152
1.56	0.9334	0.003	-0.0469	-0.014
1.6	0.9448	0.0027	-0.0475	-0.0128
1.64	0.9552	0.0025	-0.048	-0.0116
1.68	0.9645	0.0022	-0.0484	-0.0103
1.72	0.9727	0.0019	-0.0488	-0.0091
1.76	0.9799	0.0017	-0.0491	-0.0078
1.8	0.986	0.0014	-0.0494	-0.0065
1.84	0.9911	0.0011	-0.0496	-0.0052
1.88	0.995	8.385E-4	-0.0498	-0.0039
1.92	0.9978	5.599E-4	-0.05	-0.0026
1.96	0.9994	2.802E-4	-0.05	-0.0013
2	1	4.49E-11	-0.0501	-3.163E-10
2.04	0.9994	-2.802E-4	-0.05	0.0013
2.08	0.9978	-5.599E-4	-0.05	0.0026
2.12	0.995	-8.385E-4	-0.0498	0.0039
2.16	0.9911	-0.0011	-0.0496	0.0052
2.2	0.986	-0.0014	-0.0494	0.0065
2.24	0.9799	-0.0017	-0.0491	0.0078
2.28	0.9727	-0.0019	-0.0488	0.0091
2.32	0.9645	-0.0022	-0.0484	0.0103
2.36	0.9552	-0.0025	-0.048	0.0116
2.4	0.9448	-0.0027	-0.0475	0.0128
2.44	0.9334	-0.003	-0.0469	0.014
2.48	0.921	-0.0032	-0.0464	0.0152
2.52	0.9077	-0.0035	-0.0457	0.0163
2.56	0.8934	-0.0037	-0.0451	0.0175
2.6	0.8781	-0.0039	-0.0443	0.0186
2.64	0.862	-0.0041	-0.0436	0.0197
2.68	0.845	-0.0044	-0.0428	0.0208
2.72	0.8271	-0.0046	-0.0419	0.0218
2.76	0.8084	-0.0048	-0.041	0.0228

Table 5 (Next) : Mode 1.

x [m]	v [cm]	v' [rd]	θ [rd]	θ' [rd/m]
2.8	0.7889	-0.005	-0.0401	0.0238
2.84	0.7687	-0.0051	-0.0391	0.0247
2.88	0.7478	-0.0053	-0.0381	0.0257
2.92	0.7261	-0.0055	-0.0371	0.0266
2.96	0.7038	-0.0057	-0.036	0.0274
3	0.6809	-0.0058	-0.0349	0.0282
3.04	0.6574	-0.0059	-0.0337	0.029
3.08	0.6334	-0.0061	-0.0325	0.0298
3.12	0.6088	-0.0062	-0.0313	0.0305
3.16	0.5838	-0.0063	-0.0301	0.0312
3.2	0.5583	-0.0064	-0.0288	0.0319
3.24	0.5324	-0.0065	-0.0276	0.0325
3.28	0.5061	-0.0066	-0.0262	0.0331
3.32	0.4795	-0.0067	-0.0249	0.0336
3.36	0.4525	-0.0068	-0.0236	0.0341
3.4	0.4253	-0.0068	-0.0222	0.0346
3.44	0.3978	-0.0069	-0.0208	0.0351
3.48	0.3701	-0.007	-0.0194	0.0355
3.52	0.3422	-0.007	-0.0179	0.0359
3.56	0.3141	-0.007	-0.0165	0.0363
3.6	0.2859	-0.0071	-0.015	0.0366
3.64	0.2576	-0.0071	-0.0136	0.0369
3.68	0.2292	-0.0071	-0.0121	0.0371
3.72	0.2006	-0.0071	-0.0106	0.0374
3.76	0.1721	-0.0072	-0.0091	0.0376
3.8	0.1434	-0.0072	-0.0076	0.0377
3.84	0.1148	-0.0072	-0.0061	0.0379
3.88	0.0861	-0.0072	-0.0046	0.038
3.92	0.0574	-0.0072	-0.003	0.0381
3.96	0.0287	-0.0072	-0.0015	0.0381
4	-2.995E-27	-0.0072	-1.25E-26	0.0381

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WARNING !

The following software may be used for working out technical solutions during preparatory engineering studies.

Because of the complexity of the calculations involved, the software is only for users who are able to make themselves an accurate idea of its possibilities, its limitations and adequacy to the various practical applications. The user will use it under his own responsibilities at his own risk.

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