

RESULTS COMPARISON

CDS-SectionDesigner / Cubus-Fagus

ANALYSIS 1 – Reinforced Concrete

CUBUS-FAGUS

**Analyse des contraintes sous effort**

Sollicitations

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		0	50.0	0				-

Paramètres d'analyse "ELU" Norme: Eurocode EN

Contraintes et dilatations extrêmes

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.124	0.652	-1.53	-21.435	1.76
C1	C40/50	0.12	0.304	3.17	0.	1.76
P1	B500B	0.04	0.525	0.79	157.119	1.15
P6	B500B	0.817	0.077	1.12	223.23	1.15

Contraintes calculées dans la section homogène (matériau linéaire)

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.124	0.652	-11.212
C1	1.	0.12	0.304	9.43

État au dernier pas d'itération

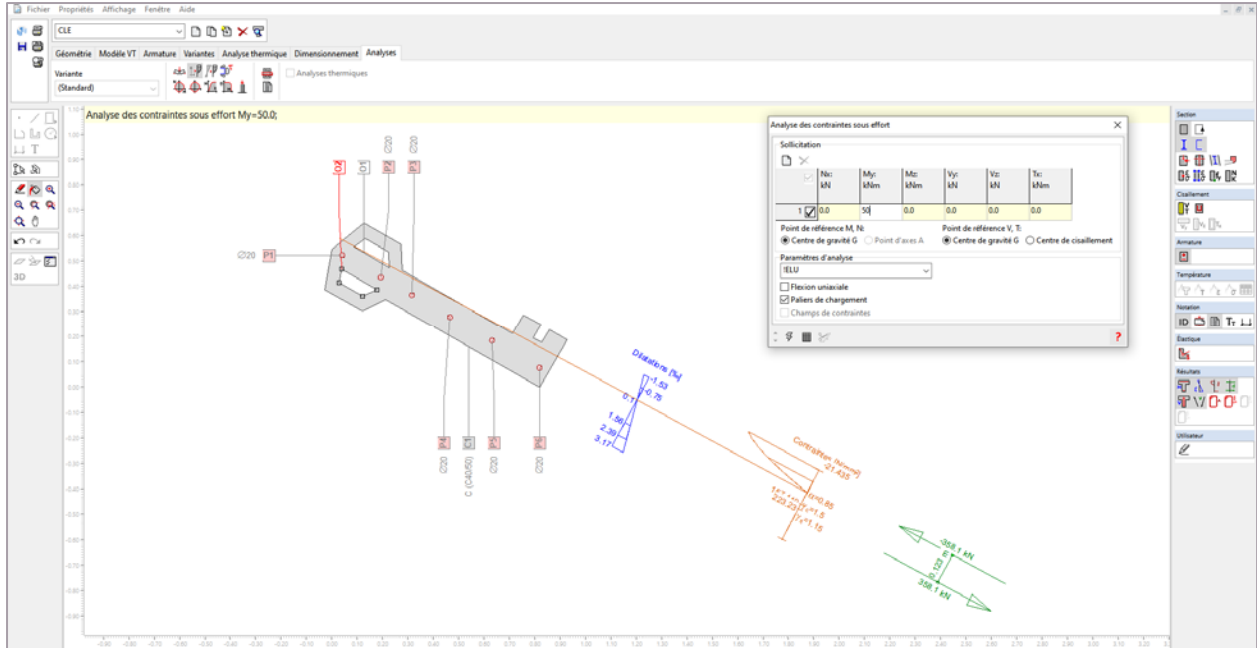
Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
0.	50.	0.	0.81	13.4	7.3	46.87	3724.44	0.5

Efforts internes comme un couple de forces :

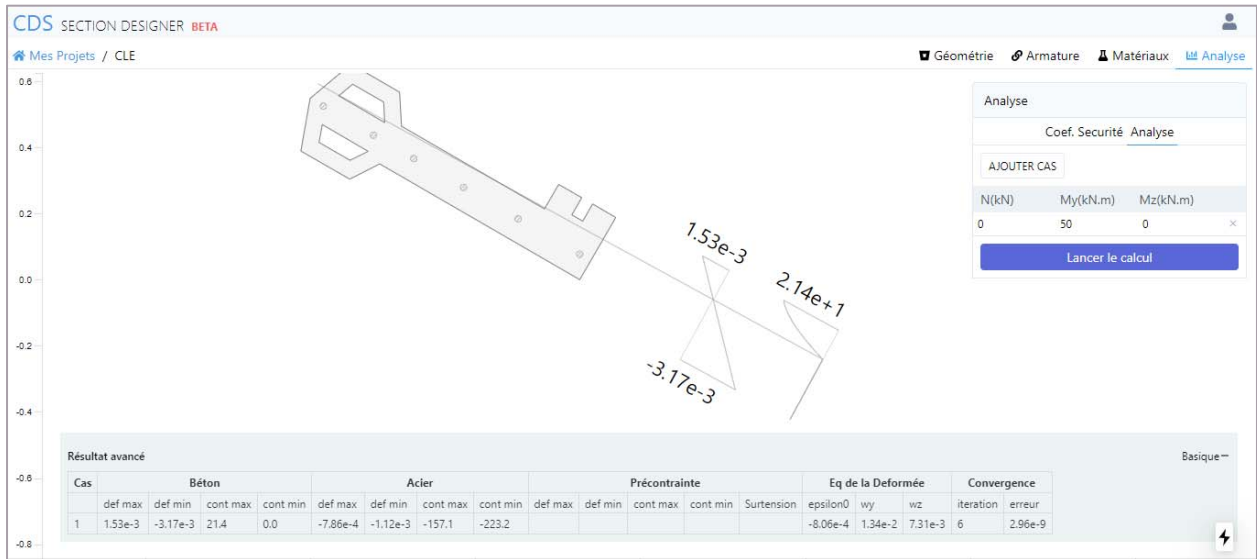
	Efforts intérieurs de traction et compression			Moments		Valeurs géométriques			
	Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]	z	Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-358.1	0.	-358.1	M <sub>c</sub> =	-40.2	z <sub>c</sub> =	0.112	x <sub>c</sub> =	0.1
Tract. F <sub>s</sub> =	0.	358.1	358.1	M <sub>s</sub> =	-3.7	z <sub>s</sub> =	0.01	d =	0.163
N =			0.	M =	-43.9	z =	0.123	x/d =	0.61

Calcul des fissures

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	0.81	0.81	0
Curvature about Y ( $e^{-3}$ )	13.4	13.4	0
Curvature about Z ( $e^{-3}$ )	7.3	7.3	0
Stress - Concrete (MPa)	-21.4	-21.4	0
Stress Rebar – Steel Min (MPa)	157.1	157.2	0
Stress Rebar – Steel Max (MPa)	223.2	223.2	0

ANALYSIS 2 – Reinforced Concrete

CUBUS-FAGUS

**Analyse des contraintes sous effort**

Sollicitations

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		0	0	-80.0				

Paramètres d'analyse "ELU" Norme: Eurocode EN

Contraintes et dilatations extrêmes

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.12	0.304	-2.68	-22.667	1.76
C1	C40/50	0.124	0.652	5.	0.	1.76
P6	B500B	0.817	0.077	0.99	198.17	1.15
P1	B500B	0.04	0.525	1.17	234.494	1.15

Contraintes calculées dans la section homogène (matériau linéaire)

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.12	0.304	-9.427
C1	1.	0.124	0.652	6.85

État au dernier pas d'itération

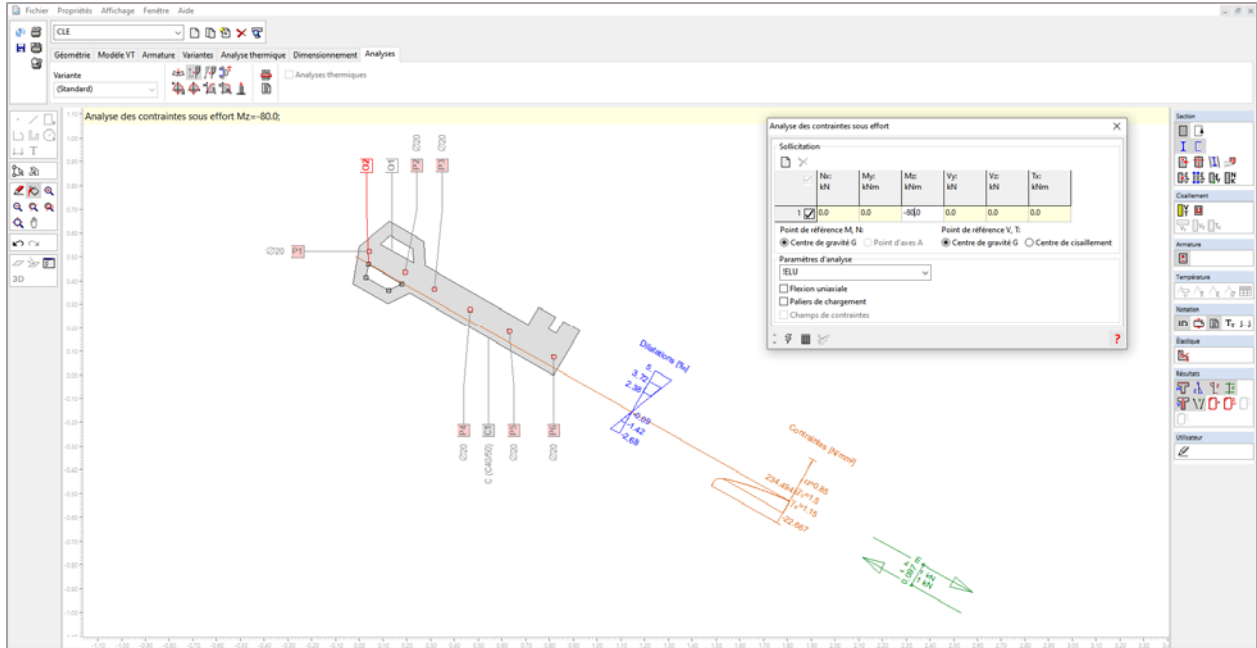
Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
0.	0.	-80.	1.32	-21.9	-12.4	28.2	0.09	6451.49

Efforts internes comme un couple de forces :

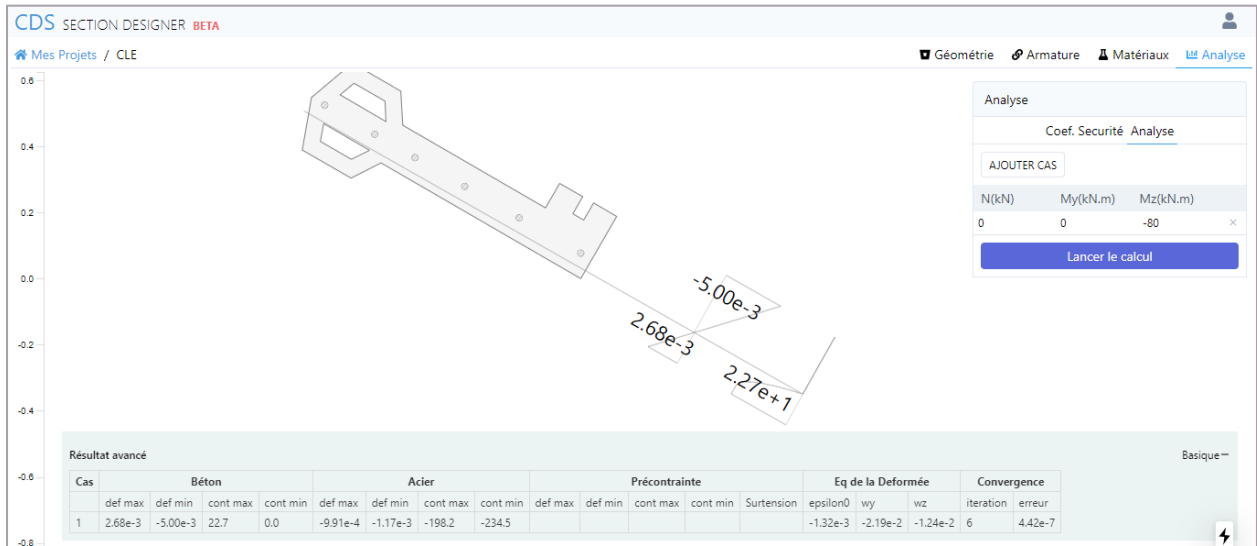
	Efforts intérieurs de traction et compression			Moments		z	Valeurs géométriques		
	Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]		Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-405.1	0.	-405.1	M <sub>c</sub> =	-43.2	z <sub>c</sub> =	0.107	x <sub>c</sub> =	0.106
Tract. F <sub>s</sub> =	0.	405.1	405.1	M <sub>s</sub> =	3.8	z <sub>s</sub> =	-0.009	d =	0.168
N =			0.	M =	-39.4	z =	0.097	x/d =	0.63

Calcul des fissures

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	1.32	1.32	0
Curvature about Y ( $e^{-3}$ )	-21.9	-21.9	0
Curvature about Z ( $e^{-3}$ )	-12.4	-12.4	0
Stress - Concrete (MPa)	-22.7	-22.7	0
Stress Rebar – Steel Min (MPa)	198.2	198.2	0
Stress Rebar – Steel Max (MPa)	234.5	234.5	0

ANALYSIS 3 – Reinforced Concrete

CUBUS-FAGUS

**Analyse des contraintes sous effort**

**Sollicitations**

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	IELU		0	60.0	-20.0				

Paramètres d'analyse "IELU" Norme: Eurocode EN

**Contraintes et dilatations extrêmes**

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.124	0.652	-1.6	-21.741	1.76
C1	C40/50	0.12	0.304	3.02	0.	1.76
P1	B500B	0.04	0.525	0.66	132.033	1.15
P6	B500B	0.817	0.077	1.2	239.734	1.15

**Contraintes calculées dans la section homogène (matériau linéaire)**

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.124	0.652	-11.742
C1	1.	0.12	0.304	8.96

**État au dernier pas d'itération**

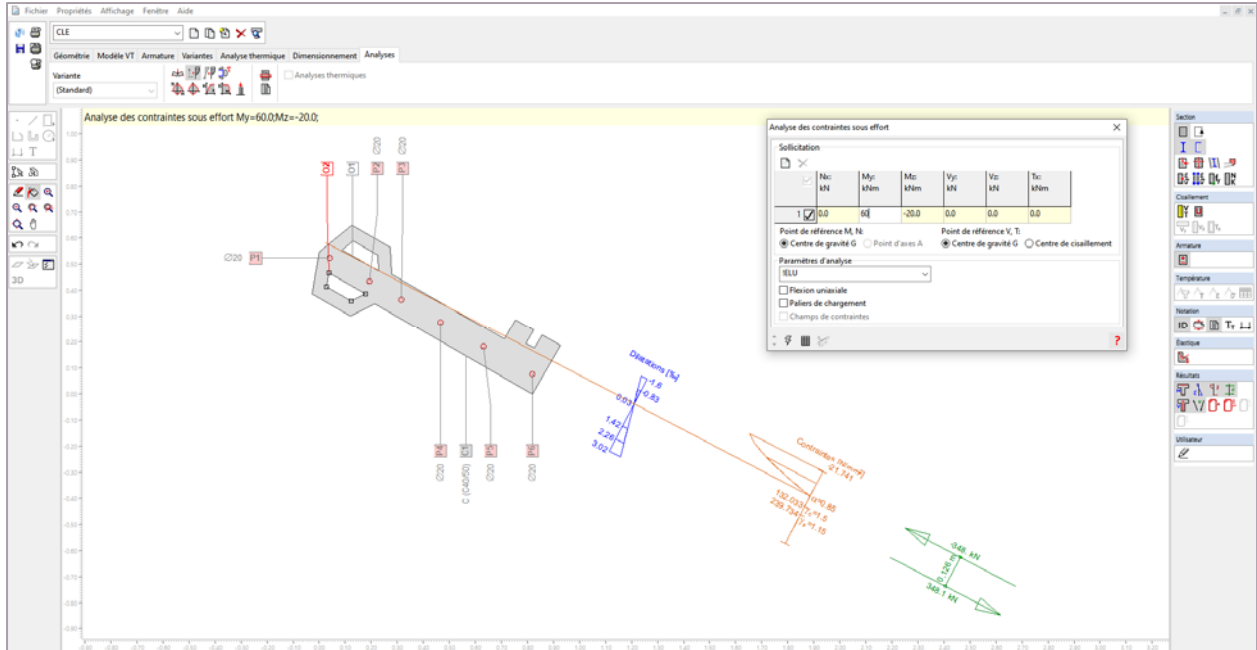
Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
0.	60.	-20.	0.79	13.2	6.9	47.53	4548.05	2893.55

**Efforts internes comme un couple de forces :**

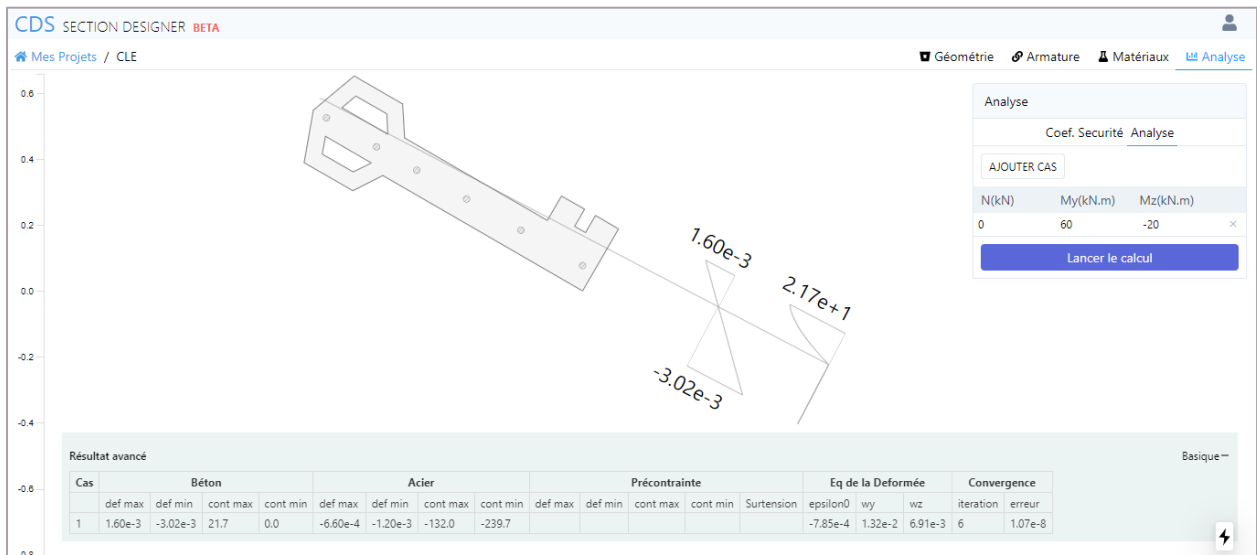
	Efforts intérieurs de traction et compression			Moments		z	Valeurs géométriques		
	Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]		Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-348.	0.	-348.	M <sub>c</sub> =	-39.8	z <sub>c</sub> =	0.114	x <sub>c</sub> =	0.107
Tract. F <sub>s</sub> =	0.	348.1	348.1	M <sub>s</sub> =	-4.1	z <sub>s</sub> =	0.012	d =	0.172
N =			0.	M =	-43.9	z =	0.126	x/d =	0.62

Calcul des fissures

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	0.79	0.79	0.0
Curvature about Y ( $e^{-3}$ )	13.2	13.2	0.0
Curvature about Z ( $e^{-3}$ )	6.9	6.9	0.0
Stress - Concrete (MPa)	-21.7	-21.8	-0.5
Stress Rebar – Steel Min (MPa)	132	132	0.0
Stress Rebar – Steel Max (MPa)	239.7	239.7	0.0

ANALYSIS 4 – Reinforced Concrete

CUBUS-FAGUS

**Analyse des contraintes sous effort**

Sollicitations

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		-200.0	-40.0	-20.0				-

Paramètres d'analyse "!ELU" Norme: Eurocode EN

Contraintes et dilatations extrêmes

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.12	0.304	-2.27	-22.667	1.76
C1	C40/50	0.124	0.652	4.53	0.	1.76
P6	B500B	0.817	0.077	0.3	60.608	1.15
P1	B500B	0.04	0.525	1.22	244.518	1.15

Contraintes calculées dans la section homogène (matériau linéaire)

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.12	0.304	-11.109
C1	1.	0.124	0.652	9.474

État au dernier pas d'itération

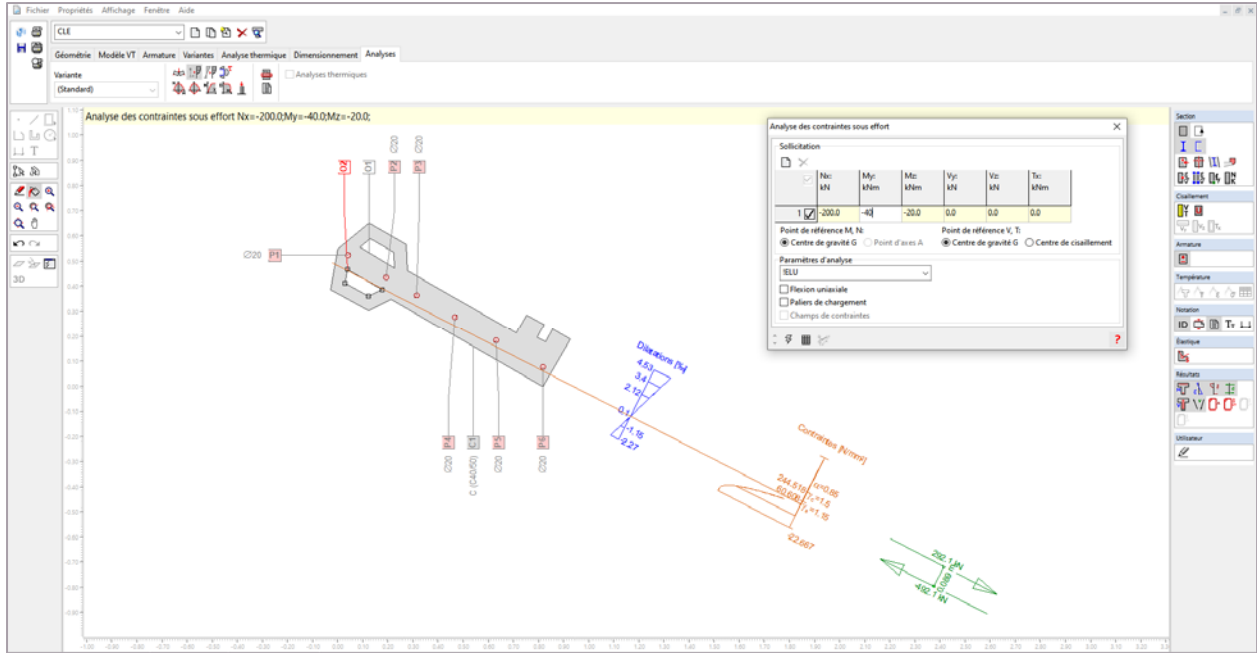
Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
-199.9	-40.	-20.	0.98	-19.4	-10.0	204885.04	2057.8	1994.81

Efforts internes comme un couple de forces :

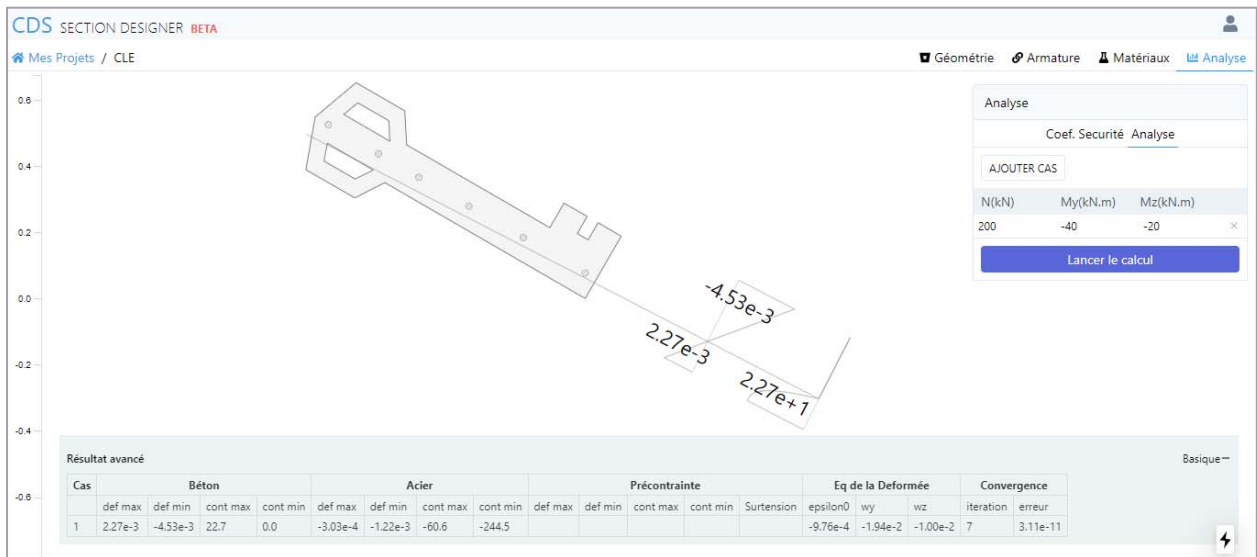
Efforts intérieurs de traction et compression			Moments		Valeurs géométriques				
	Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]	z	Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-492.1	0.	-492.1	M <sub>c</sub> =	-45.7	z <sub>c</sub> =	0.093	x <sub>c</sub> =	0.104
Tract. F <sub>s</sub> =	0.	292.1	292.1	M <sub>s</sub> =	1.	z <sub>s</sub> =	-0.004	d =	0.152
N =			-199.9	M =	-44.7	z =	0.089	x/d =	0.68

Calcul des fissures

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	0.98	0.98	0.0
Curvature about Y ( $e^{-3}$ )	-19.4	-19.4	0.0
Curvature about Z ( $e^{-3}$ )	-10	-10	0.0
Stress - Concrete (MPa)	-22.7	-22.6	0.4
Stress Rebar – Steel Min (MPa)	60.6	60.6	0.0
Stress Rebar – Steel Max (MPa)	244.5	244.6	0.0



ANALYSIS 5 – Reinforced Concrete

CUBUS-FAGUS

**Analyse des contraintes sous effort**

**Sollicitations**

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	IELU		10.0	0	-20.0				-

Paramètres d'analyse "IELU" Norme: Eurocode EN

**Contraintes et dilatations extrêmes**

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.12	0.304	-0.46	-9.279	1.76
C1	C40/50	0.124	0.652	1.07	0.	1.76
P6	B500B	0.817	0.077	0.21	41.753	1.15
P1	B500B	0.04	0.525	0.32	63.023	1.15

**Contraintes calculées dans la section homogène (matériau linéaire)**

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.12	0.304	-2.296
C1	1.	0.124	0.652	1.773

**État au dernier pas d'itération**

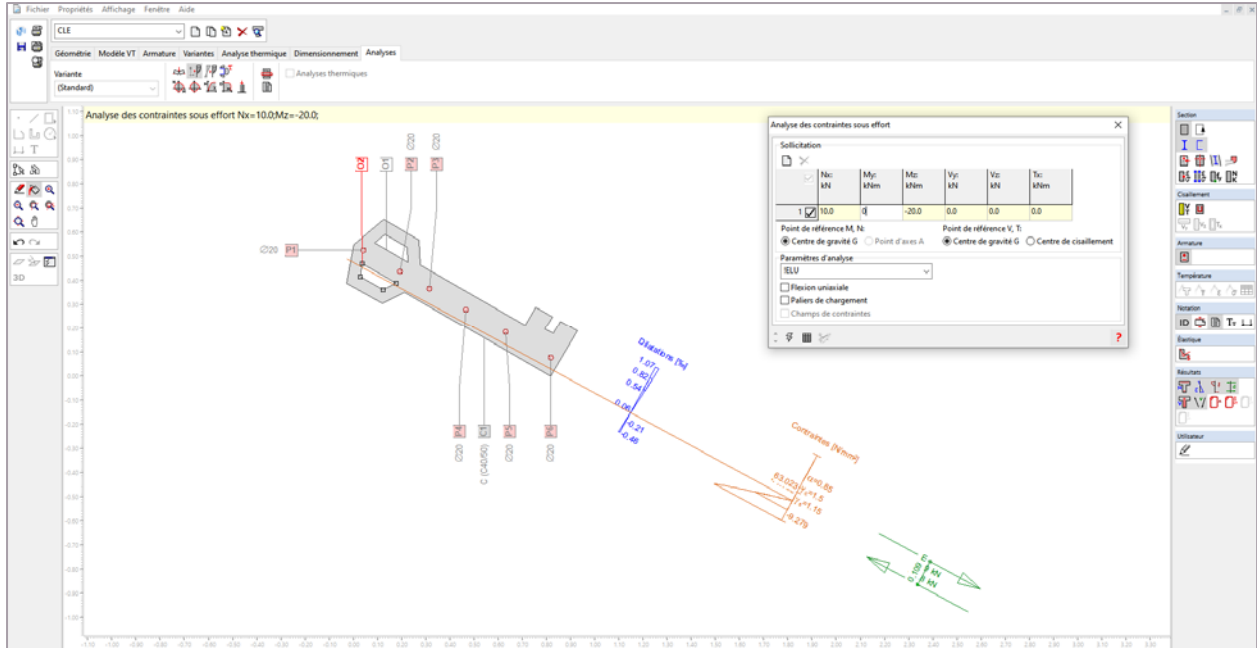
Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
10.	0.	-20.	0.31	-4.4	-2.4	32418.63	0.05	8357.79

**Efforts internes comme un couple de forces :**

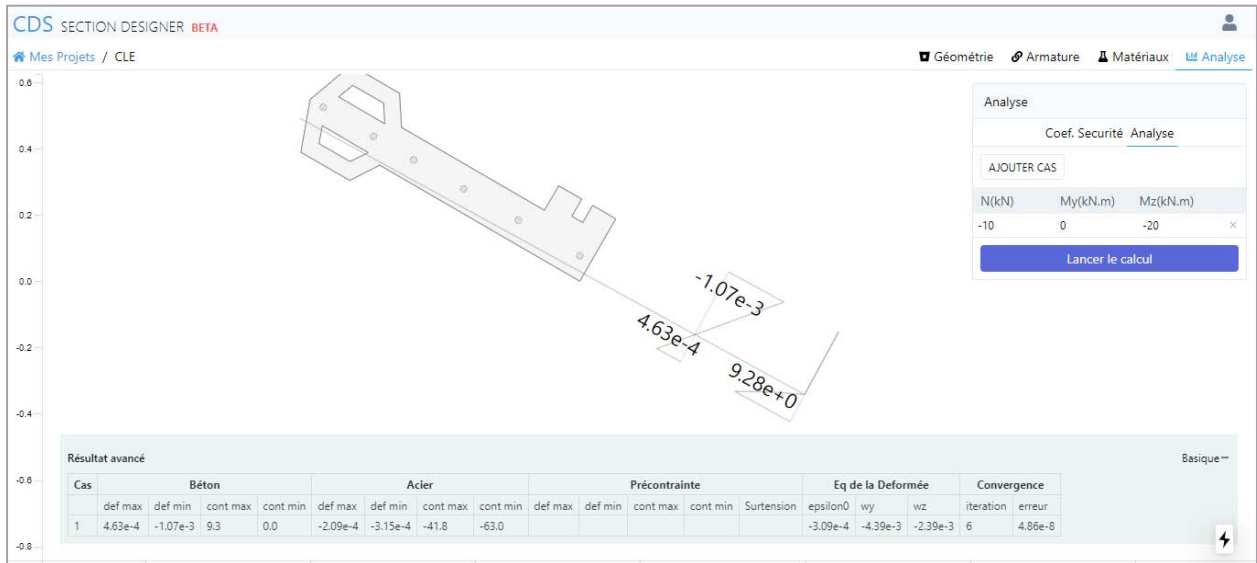
	Efforts intérieurs de traction et compression			Moments			Valeurs géométriques		
	Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]	z	Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-88.8	0.	-88.8	M <sub>c</sub> =	-10.4	z <sub>c</sub> =	0.117	x <sub>c</sub> =	0.093
Tract. F <sub>s</sub> =	0.	98.9	98.9	M <sub>s</sub> =	0.8	z <sub>s</sub> =	-0.008	d =	0.163
N =			10.	M =	-9.6	z =	0.109	x/d =	0.57

Calcul des fissures

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	0.31	0.31	0.0
Curvature about Y ( $e^{-3}$ )	-4.4	-4.4	0.0
Curvature about Z ( $e^{-3}$ )	-2.4	-2.4	0.0
Stress - Concrete (MPa)	-9.3	-9.3	0.0
Stress Rebar – Steel Min (MPa)	41.8	41.7	0.2
Stress Rebar – Steel Max (MPa)	63	63	0.0

ANALYSIS 6 – Prestressed Concrete – Unbonded PT

CUBUS-FAGUS

**Analyse des contraintes sous effort**

Sollicitations

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		0	20.0	0				-

Paramètres d'analyse "ELU" Norme: Eurocode EN

Contraintes et dilatations extrêmes

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.124	0.652	-0.79	-14.409	1.76
C1	C40/50	0.12	0.304	0.92	0.	1.76
P1	B500B	0.04	0.525	0.06	11.412	1.15
P6	B500B	0.817	0.077	0.13	25.489	1.15
PP1	S1500/1670	0.188	0.585	1.	195.	1.15

Contraintes calculées dans la section homogène (matériau linéaire)

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.124	0.652	-10.803
C1	1.	0.12	0.304	5.723

État au dernier pas d'itération

Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
0.	20.	0.	0.04	4.9	2.7	714.82	4091.88	5.69

Forces de précontrainte P(t=0) au début du chargement

N <sub>p</sub> [kN]	M <sub>yp</sub> [kNm]	M <sub>zp</sub> [kNm]
-382.7	10.4	19.5

Efforts internes comme un couple de forces :

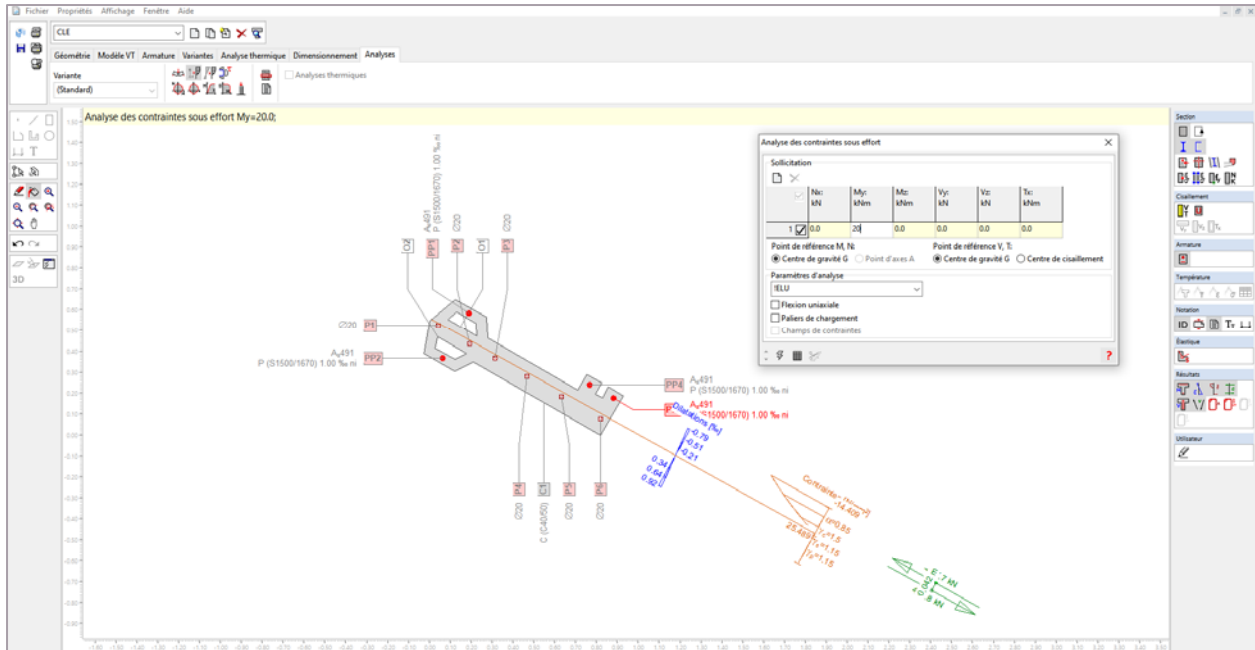
	Efforts intérieurs de traction et compression			Moments		z	Valeurs géométriques		
	Sct princ. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]		Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-417.7	0.	-417.7	M <sub>c</sub> =	-35.7	z <sub>c</sub> =	0.085	x <sub>c</sub> =	0.142
Tract. F <sub>s</sub> =	0.	417.8	417.8	M <sub>s</sub> =	18.2	z <sub>s</sub> =	-0.044	d =	0.192
N =			0.	M =	-17.5	z =	0.042	x/d =	0.74

Calcul des fissures

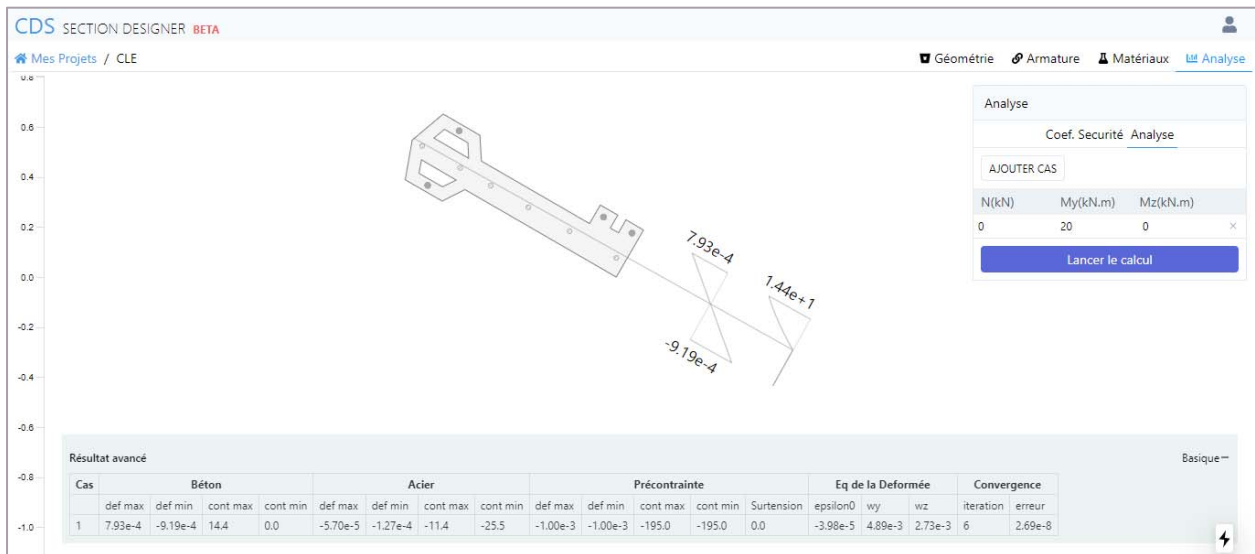
Points de résultat

Formule / Résultat	Nom	Max	Min	Unité
σ(PP1(0.086,0.436))	σ <sub>PT</sub>	195.	195.	N/mm <sup>2</sup>
Δσ((0.423,0.315))	Δσ <sub>PT</sub>	0.	0.	N/mm <sup>2</sup>

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	0.04	0.04	0.0
Curvature about Y ( $e^{-3}$ )	4.9	4.9	0.0
Curvature about Z ( $e^{-3}$ )	2.7	2.7	0.0
Stress - Concrete (MPa)	-14.4	-14.4	0.0
Stress - Steel Min (MPa)	11.4	11.4	0.0
Stress - Steel Max (MPa)	25.5	25.5	0.0
Stress - PT Min (MPa)	195	195	0.0
Stress - PT Max (MPa)	195	195	0.0

ANALYSIS 7– Prestressed Concrete – Unbonded PT

CUBUS-FAGUS

**Analyse des contraintes sous effort**

Sollicitations

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		0	20.0	20.0				-

Paramètres d'analyse "ELU" Norme: Eurocode EN

Contraintes et dilatations extrêmes

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.124	0.652	-1.11	-18.207	1.76
C1	C40/50	-0.028	0.389	1.66	0.	1.76
P6	B500B	0.817	0.077	0.27	53.9	1.15
P3	B500B	0.314	0.366	0.28	56.006	1.15
PP1	S1500/1670	0.188	0.585	1.	195.	1.15

Contraintes calculées dans la section homogène (matériau linéaire)

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.124	0.652	-12.515
C1	1.	-0.028	0.389	7.846

État au dernier pas d'itération

Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
0.1	20.	20.	0.19	7.9	4.6	444.08	2532.08	4376.25

Forces de précontrainte P(t=0) au début du chargement

N <sub>p</sub> [kN]	M <sub>yp</sub> [kNm]	M <sub>zp</sub> [kNm]
-382.7	10.4	19.5

Efforts internes comme un couple de forces :

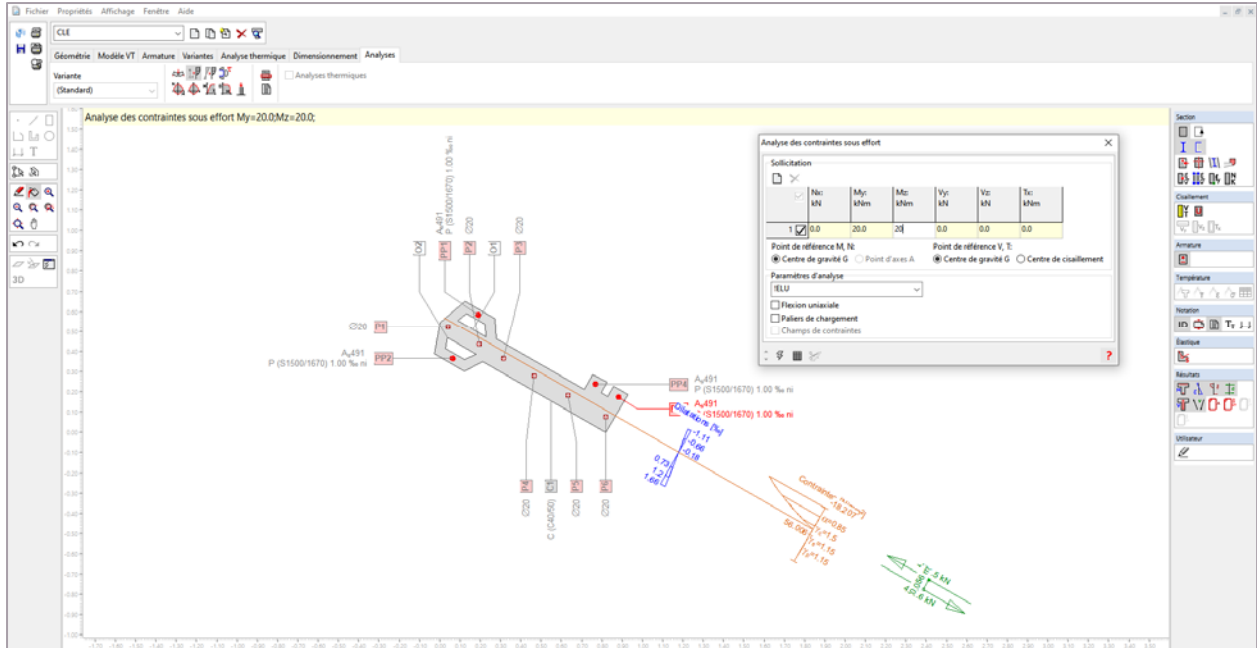
	Efforts intérieurs de traction et compression			Moments		z	Valeurs géométriques		
	Sct princ. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]		Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-486.5	0.	-486.5	M <sub>c</sub> =	-45.1	z <sub>c</sub> =	0.093	x <sub>c</sub> =	0.122
Tract. F <sub>s</sub> =	0.	486.6	486.6	M <sub>s</sub> =	17.8	z <sub>s</sub> =	-0.037	d =	0.179
N =			0.1	M =	-27.3	z =	0.056	x/d =	0.68

Calcul des fissures

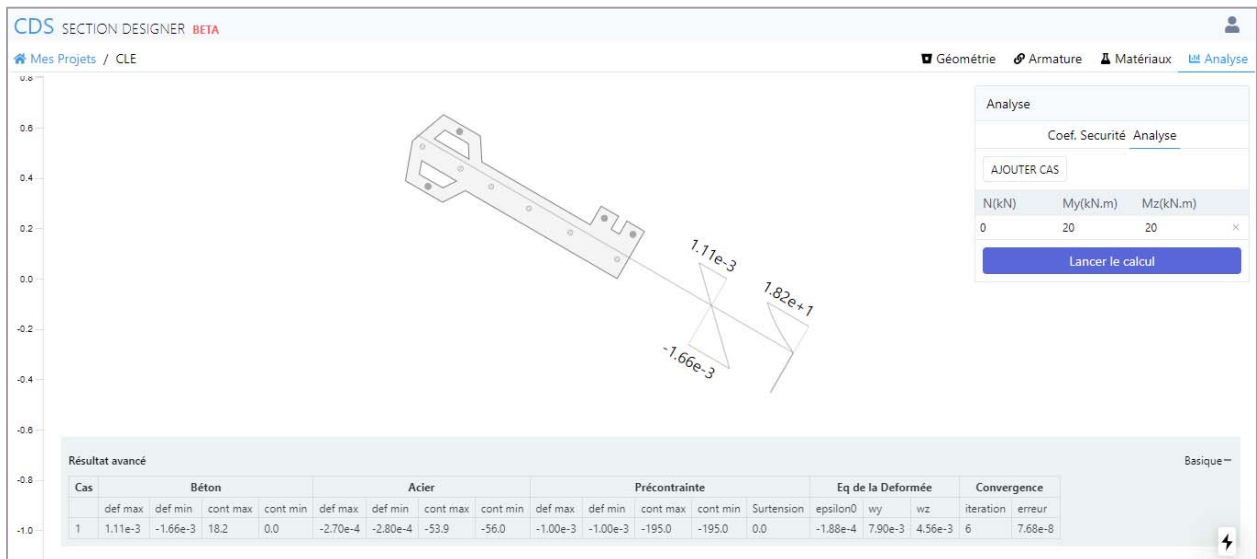
Points de résultat

Formule / Résultat	Nom	Max	Min	Unité
σ(PP1(0.084,0.431))	σ <sub>PT</sub>	195.	195.	N/mm <sup>2</sup>
Δσ((0.423,0.315))	Δσ <sub>PT</sub>	0.	0.	N/mm <sup>2</sup>

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner




## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	0.19	0.19	0.0
Curvature about Y ( $e^{-3}$ )	7.9	7.9	0.0
Curvature about Z ( $e^{-3}$ )	4.6	4.6	0.0
Stress - Concrete (MPa)	-18.2	-18.2	0.0
Stress - Steel Min (MPa)	53.9	53.9	0.0
Stress - Steel Max (MPa)	56	56	0.0
Stress - PT Min (MPa)	195	195	0.0
Stress - PT Max (MPa)	195	195	0.0

**ANALYSIS 8– Prestressed Concrete – Bonded PT**

CUBUS-FAGUS

 Analyse des contraintes sous effort



**Sollicitations**

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		0	30.0	30.0				-

Paramètres d'analyse "!ELU" Norme: Eurocode EN

**Contraintes et dilatations extrêmes**

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.124	0.652	-0.81	-14.58	1.76
C1	C40/50	0.12	0.304	0.95	0.	1.76
P1	B500B	0.04	0.525	0.06	11.214	1.15
P6	B500B	0.817	0.077	0.22	44.01	1.15
PP1	S1500/1670	0.188	0.585	0.36	70.001	1.15
PP2	S1500/1670	0.062	0.367	1.79	348.845	1.15

**Contraintes calculées dans la section homogène (matériau linéaire)**

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.124	0.652	-15.614
C1	1.	0.12	0.304	11.144

**État au dernier pas d'itération**

Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
0.1	30.	30.	0.08	5.0	2.7	1146.12	5984.14	11203.09

**Forces de précontrainte P(t=0) au début du chargement**

N <sub>p</sub> [kN]	M <sub>yp</sub> [kNm]	M <sub>zp</sub> [kNm]
-382.7	10.4	19.5

**Efforts internes comme un couple de forces :**

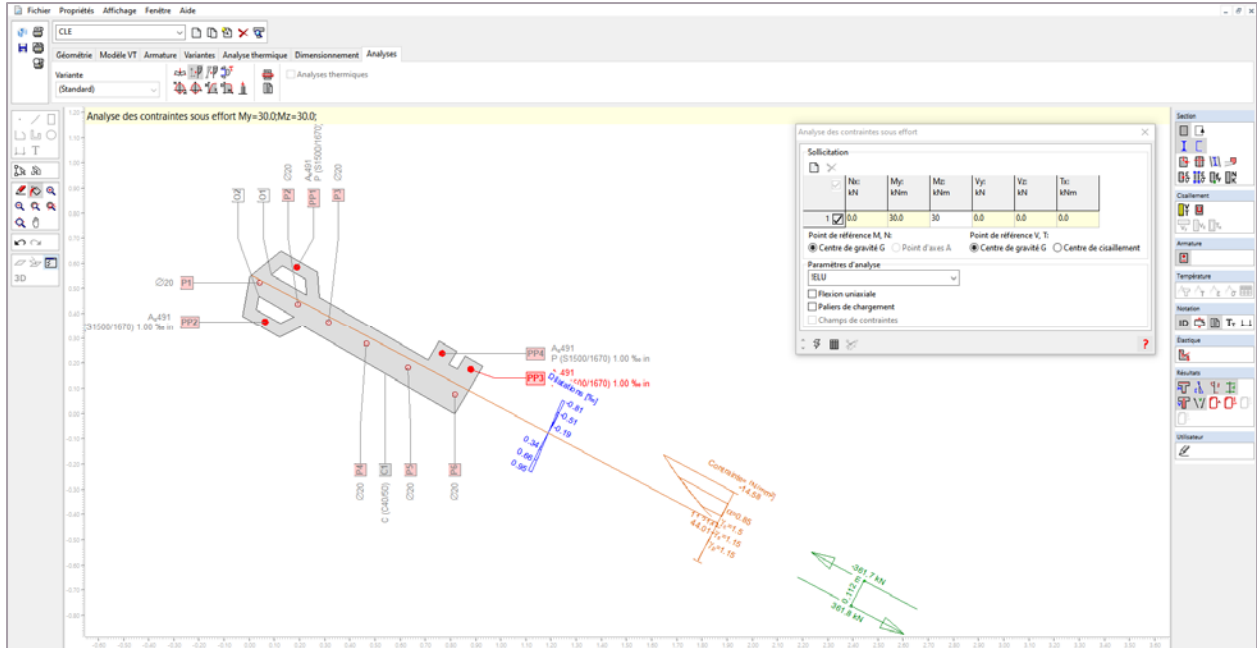
Efforts intérieurs de traction et compression			Moments		Valeurs géométriques				
Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]	z	Unité [m]	x, d	Unité [m]	
Compr. F <sub>c</sub> =	-361.7	0.	-361.7	M <sub>c</sub> =	-32.9	z <sub>c</sub> =	0.091	x <sub>c</sub> =	0.142
Tract. F <sub>s</sub> =	0.	361.8	361.8	M <sub>s</sub> =	-7.7	z <sub>s</sub> =	0.021	d =	0.178
N =			0.1	M =	-40.6	z =	0.112	x/d =	0.8

Calcul des fissures

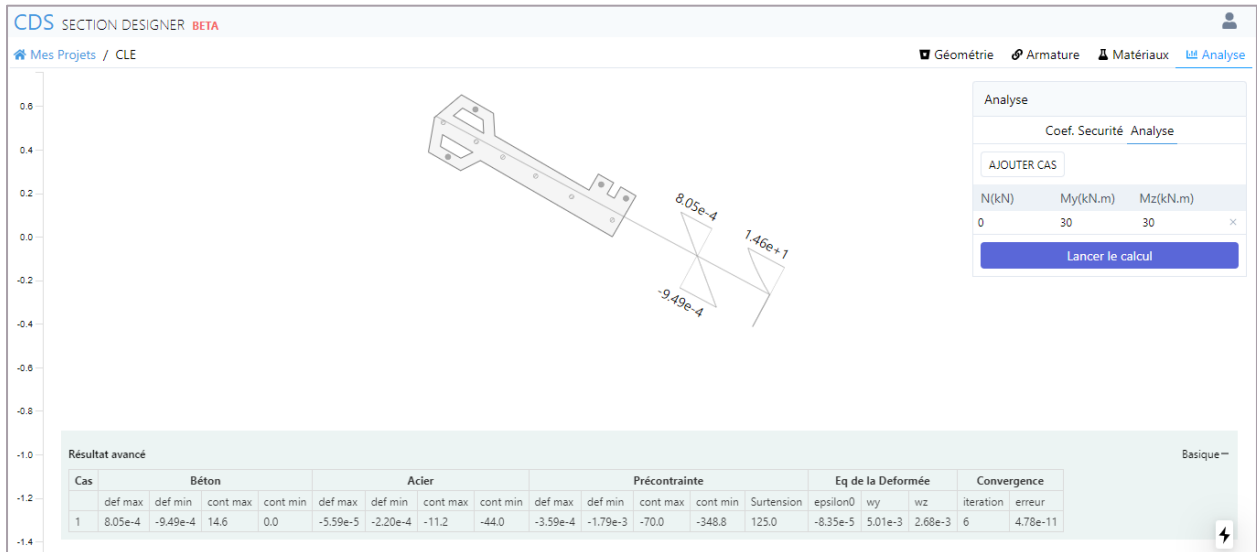
**Points de résultat**

Formule / Résultat	Nom	Max	Min	Unité
σ(PP2(0.08,0.191))	σ <sub>PT</sub>	511.767	511.767	N/mm <sup>2</sup>
Δσ((0.423,0.315))	Δσ <sub>PT</sub>	0.	0.	N/mm <sup>2</sup>

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	0.08	0.08	0.0
Curvature about Y ( $e^{-3}$ )	5.0	5.0	0.0
Curvature about Z ( $e^{-3}$ )	2.7	2.7	0.0
Stress - Concrete (MPa)	-14.6	-14.6	0.0
Stress – Steel Min (MPa)	11.2	11.2	0.0
Stress – Steel Max (MPa)	44.0	44.0	0.0
Stress – PT Min (MPa)	70.0	70.0	0.0
Stress – PT Max (MPa)	348.8	348.9	0.0



ANALYSIS 9– Prestressed Concrete – Bonded PT

CUBUS-FAGUS

**Analyse des contraintes sous effort**

Sollicitations

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		0	-30.0	30.0				-

Paramètres d'analyse "!ELU" Norme: Eurocode EN

Contraintes et dilatations extrêmes

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.926	0.188	-0.17	-3.707	1.76
C1	C40/50	-0.028	0.389	-0.01	-0.159	1.76
P6	B500B	0.817	0.077	-0.14	-27.632	1.15
P1	B500B	0.04	0.525	-0.03	-6.876	1.15
PP3	S1500/1670	0.88	0.176	0.84	163.664	1.15
PP2	S1500/1670	0.062	0.367	0.98	190.68	1.15

Contraintes calculées dans la section homogène (matériau linéaire)

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.926	0.188	-5.049
C1	1.	-0.028	0.389	0.364

État au dernier pas d'itération

Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
0.	-30.	30.	-0.09	0.1	0.2	311.61	287373.9	154796.78

Forces de précontrainte P(t=0) au début du chargement

N <sub>p</sub> [kN]	M <sub>yp</sub> [kNm]	M <sub>zp</sub> [kNm]
-382.7	10.4	19.5

Efforts internes comme un couple de forces :

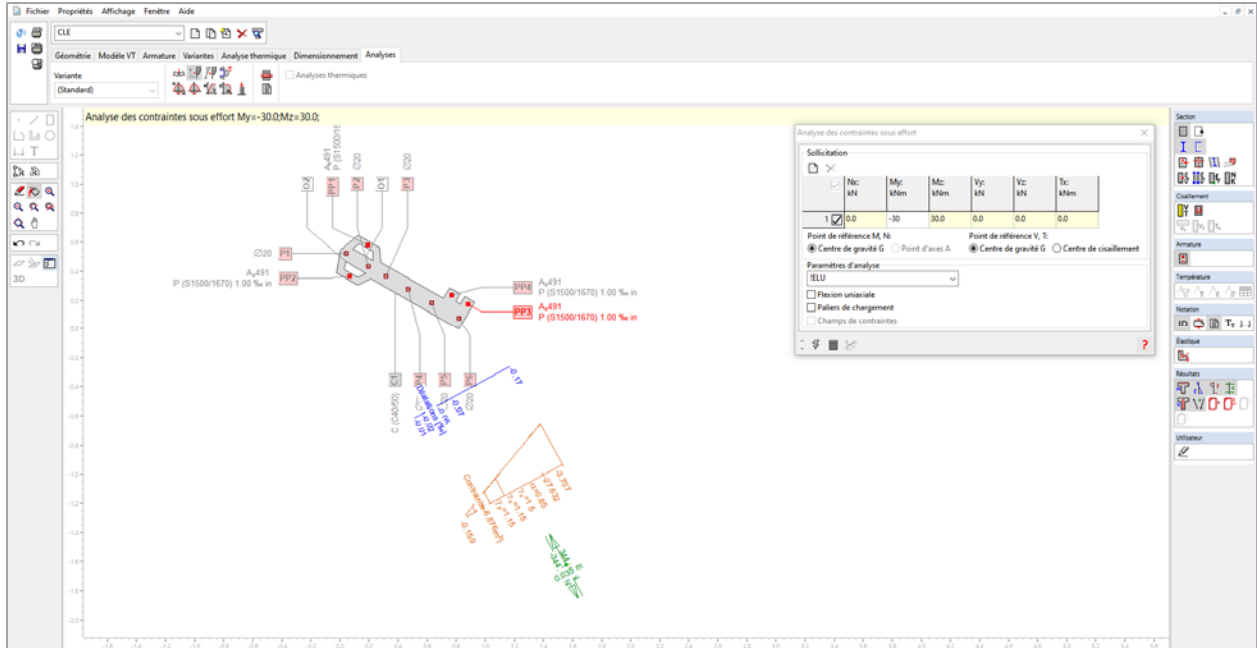
Efforts intérieurs de traction et compression			Moments		Valeurs géométriques				
Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]	z	Unité [m]	x, d	Unité [m]	
Compr. F <sub>c</sub> =	-313.1	-31.6	-344.7	M <sub>c</sub> =	-26.5	z <sub>c</sub> =	0.077	x <sub>c</sub> =	0.
Tract. F <sub>s</sub> =	0.	344.6	344.6	M <sub>s</sub> =	14.4	z <sub>s</sub> =	-0.042	d =	0.745
N =			0.	M =	-12.2	z =	0.035	x/d =	1.

Calcul des fissures

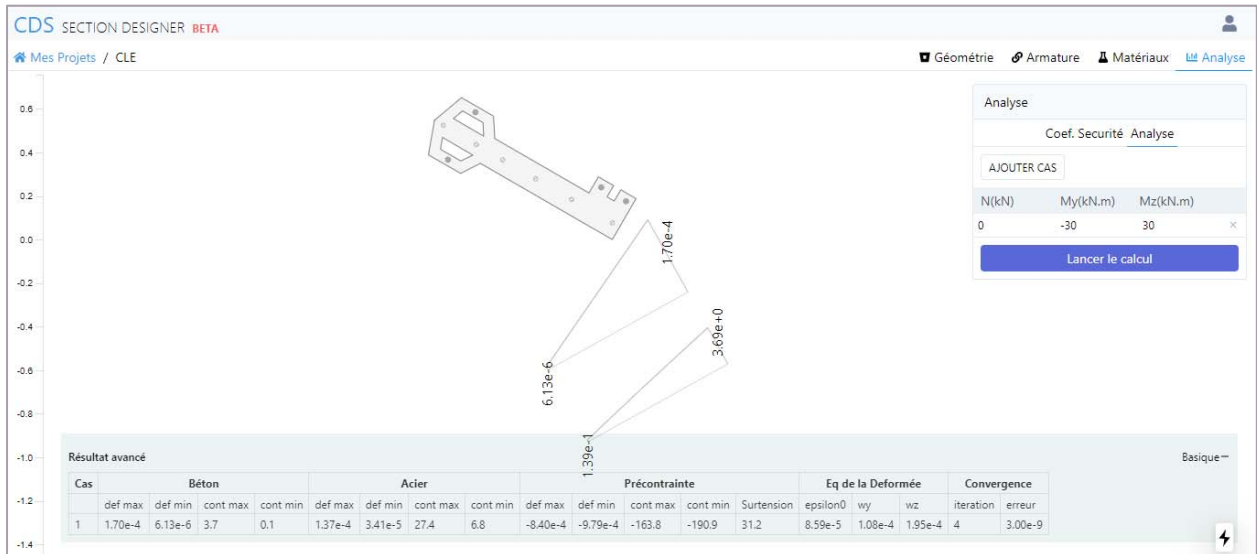
Points de résultat

Formule / Résultat	Nom	Max	Min	Unité
σ <sub>(PP1(0.074,0.236))</sub>	σ <sub>PT</sub>	192.904	192.904	N/mm <sup>2</sup>
Δσ <sub>((0.423,0.315))</sub>	Δσ <sub>PT</sub>	0.	0.	N/mm <sup>2</sup>

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	-0.09	-0.09	0.0
Curvature about Y ( $e^{-3}$ )	0.1	0.1	0.0
Curvature about Z ( $e^{-3}$ )	0.2	0.2	0.0
Stress - Concrete (MPa)	-3.7	-3.7	0.0
Stress - Steel Min (MPa)	-27.4	-27.6	-0.7
Stress - Steel Max (MPa)	-6.8	-6.9	-1.4
Stress - PT Min (MPa)	163.8	163.7	0.1
Stress - PT Max (MPa)	190.9	190.7	0.1

ANALYSIS 10– Prestressed Concrete – Bonded PT

CUBUS-FAGUS

📄 Analyse des contraintes sous effort

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**Sollicitations**

No	AP	P	Flexion et effort normal			Effort tranchant et torsion			Remarques
			N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	T [kNm]	
1	!ELU		200.0	-30.0	30.0				-

Paramètres d'analyse "ELU" Norme: Eurocode EN

**Contraintes et dilatations extrêmes**

Nom	Classe	y <sub>q</sub> [m]	z <sub>q</sub> [m]	ε [‰]	σ <sub>d</sub> [N/mm <sup>2</sup> ]	γ [-]
C1	C40/50	0.926	0.188	-0.14	-3.113	1.76
C1	C40/50	-0.028	0.389	0.07	0.	1.76
P6	B500B	0.817	0.077	-0.09	-18.22	1.15
P1	B500B	0.04	0.525	0.02	4.773	1.15
PP3	S1500/1670	0.88	0.176	0.87	170.078	1.15
PP2	S1500/1670	0.062	0.367	1.05	204.752	1.15

**Contraintes calculées dans la section homogène (matériau linéaire)**

Nom	Pondération	y <sub>q</sub> [m]	z <sub>q</sub> [m]	σ <sub>elas</sub> [N/mm <sup>2</sup> ]
C1	1.	0.926	0.188	-3.84
C1	1.	-0.028	0.389	1.573

**État au dernier pas d'itération**

Efforts intérieurs			Élongation et courbures			Rigidités		
N [kN]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [‰]	χ <sub>y</sub> [km <sup>-1</sup> ]	χ <sub>z</sub> [km <sup>-1</sup> ]	N/ε <sub>x</sub> [kN]	M <sub>y</sub> /χ <sub>y</sub> [kNm <sup>2</sup> ]	M <sub>z</sub> /χ <sub>z</sub> [kNm <sup>2</sup> ]
200.	-30.	30.	-0.03	0.2	0.3	5719485.07	148248.97	113368.53

**Forces de précontrainte P(t=0) au début du chargement**

N <sub>p</sub> [kN]	M <sub>yp</sub> [kNm]	M <sub>zp</sub> [kNm]
-382.7	10.4	19.5

**Efforts internes comme un couple de forces :**

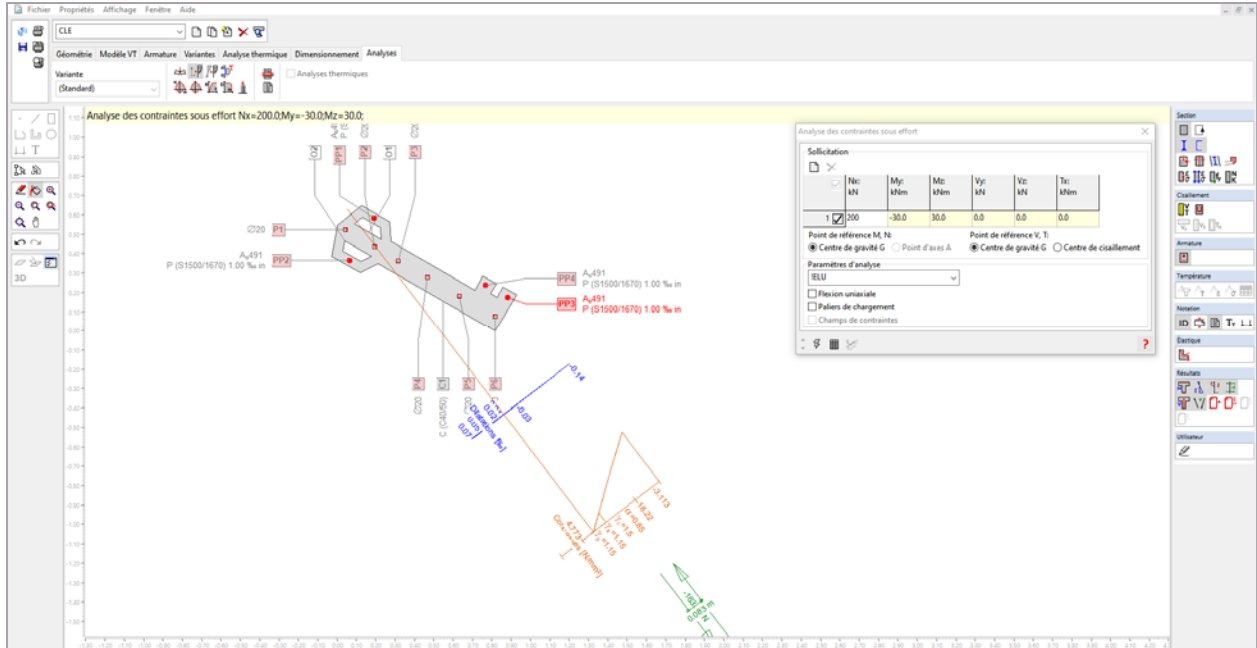
	Efforts intérieurs de traction et compression			Moments		Valeurs géométriques			
	Sct princip. [kN]	Armature [kN]	Somme [kN]	M	Unité [kNm]	z	Unité [m]	x, d	Unité [m]
Compr. F <sub>c</sub> =	-150.5	-13.2	-163.7	M <sub>c</sub> =	-20.2	z <sub>c</sub> =	0.123	x <sub>c</sub> =	0.427
Tract. F <sub>s</sub> =	0.	363.6	363.6	M <sub>s</sub> =	14.6	z <sub>s</sub> =	-0.04	d =	0.363
N =			200.	M =	-5.6	z =	0.083		

Calcul des fissures

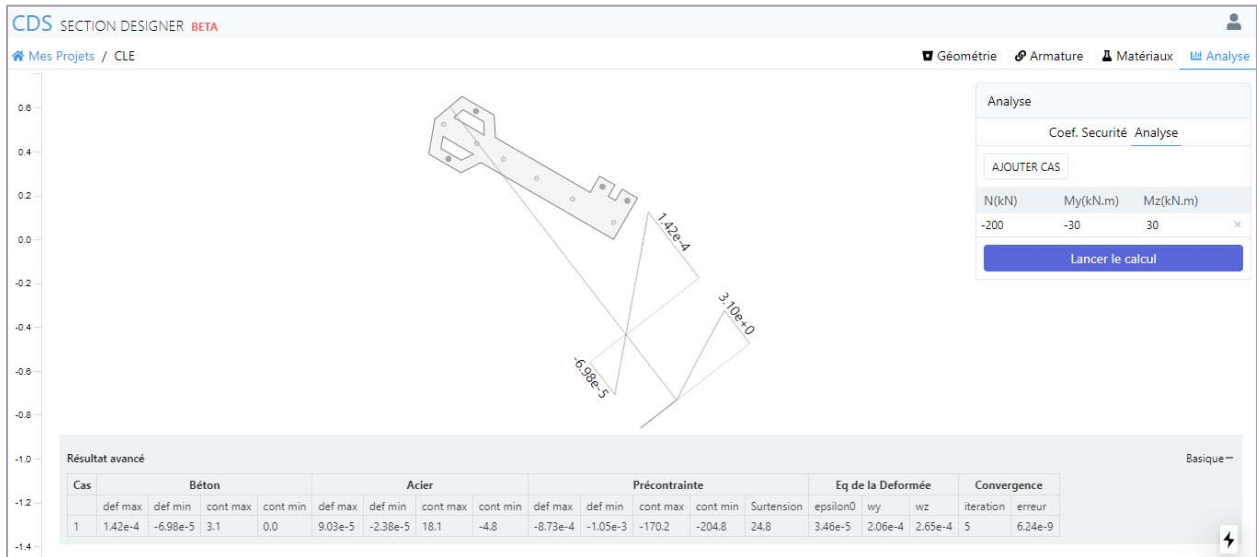
**Points de résultat**

Formule / Résultat	Nom	Max	Min	Unité
σ(PP2(0.162,0.06))	σ <sub>PT</sub>	211.705	211.705	N/mm <sup>2</sup>
Δσ((0.423,0.315))	Δσ <sub>PT</sub>	0.	0.	N/mm <sup>2</sup>

# TECHINCAL NOTE – UNSYMMETRICAL SECTION



## CDS-SectionDesigner



## Results comparison

	CDS-SectionDesigner	Fagus	Error (%)
Deformation at COG ( $e^{-3}$ )	-0.03	-0.03	0.0
Curvature about Y ( $e^{-3}$ )	0.2	0.2	0.0
Curvature about Z ( $e^{-3}$ )	0.3	0.3	0.0
Stress - Concrete (MPa)	-3.1	-3.1	0.0
Stress - Steel Min (MPa)	-18.1	-18.2	-0.5
Stress - Steel Max (MPa)	4.8	4.8	0.0
Stress - PT Min (MPa)	170.2	170.1	0.1
Stress - PT Max (MPa)	204.8	204.8	0.0