



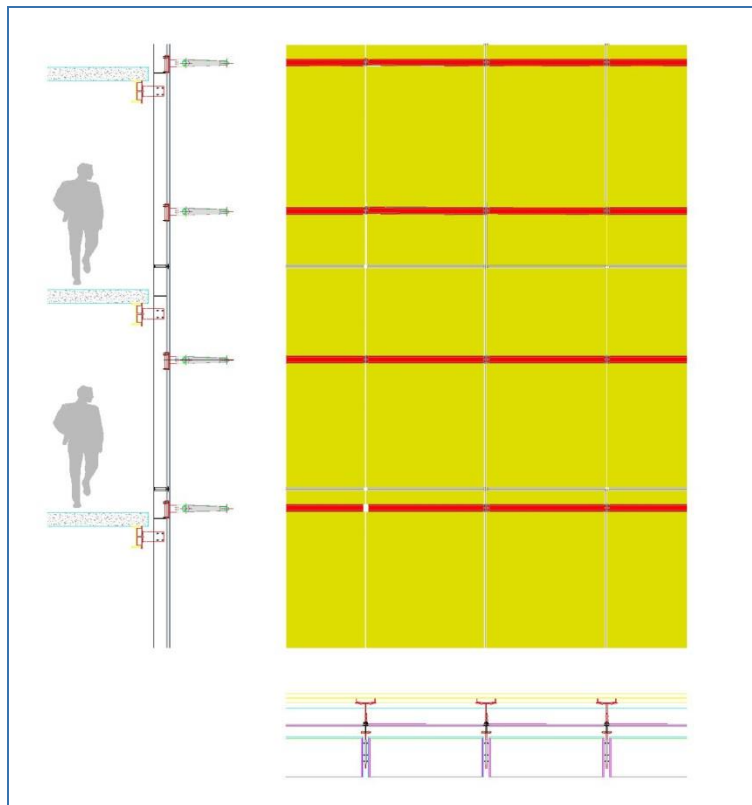
CivilFEMTM
powered by MarcTM

Curtain Wall Framing Anchor Castellana77

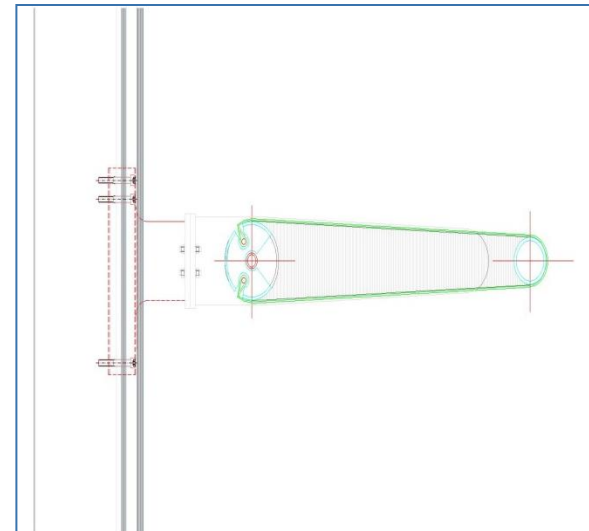
FERGA

Curtain Wall Framing Anchor

The curtain wall consists of a grid of vertical and horizontal crossbars with a floor to floor glass panel connected by steel connections.



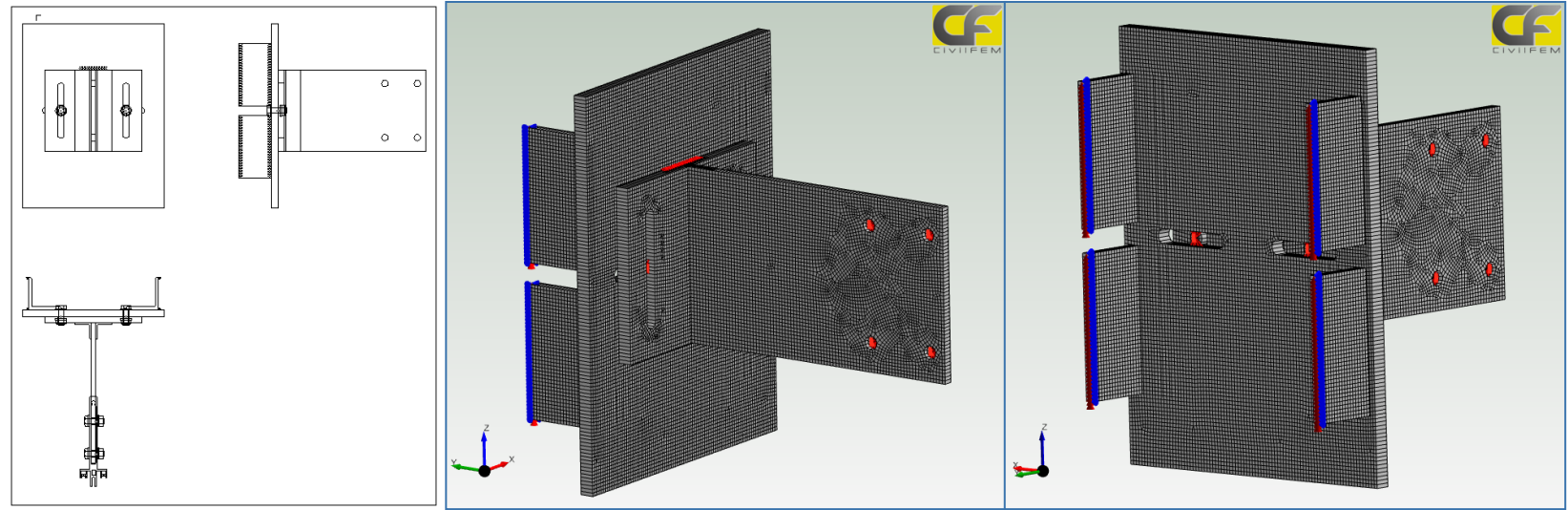
On the outside of the glass facade, horizontal sunscreen slats are arranged.



Curtain Wall Framing Anchor

In this study, CivilFEM powered by Marc is used to calculate the connection between the glass curtain wall and the slab.

We need to check that the steel strength is not exceeded anywhere in the metallic bond. In order to check this, we perform a static analysis using *contacts* and the *tying* utility between the elements of the union.



We have to model the plates, screws and welding present in the steel connection.

Curtain Wall Framing Anchor Description

Entities of the model

Name	Type
150x180	Shell
150x260	Shell

Default group

Name	Type
Perno B	Beam
Carga3	Beam
Carga2	Beam
Perno A	Beam
Carga4	Beam
Carga1	Beam

Placa 1

Name	Type
Placa1A	Shell

Angular

Name	Type
L2B	Shell
L3B	Shell
L1B	Shell
L4B	Shell
L3A	Shell
L2A	Shell
L1A	Shell
L4A	Shell

Refuerzo

Name	Type
ref1	Shell
ref2	Shell

Plates are modeled as **shell** structural elements with different thicknesses. The screws have been modeled as **beam** elements connecting with the shell by the **tying** utility. In order to simulate the welding we use **springs** with a stiffness of $K=2.1 \cdot 10^5$ MPa in the three directions X, Y and Z.

Properties

S 275	S 275
Name	S 275
Type	Structural steel
E	210000 [N/mm ²]
v	0.3
ρ	7.85e-09 [tn/mm ³]
G	80769.2 [N/mm ²]
α	1.2e-05 [1/ΔK]
Act. time	0 day
Deact. time	36500 day
Steel type	Non austenitic
<input checked="" type="checkbox"/> Thickness	(3)
<input checked="" type="checkbox"/> Design σ-ε diagram	
<input checked="" type="checkbox"/> Code properties	
<input checked="" type="checkbox"/> Damping	

Parameter list

P...	Parameter type	Unit type	C.	Formula	Value	Unit
s...	Real number	Length			0.003	m
sL	Real number	Length		sP1/1.3333...	0.00225	m
e...	Real number	Length			0.012	m
e...	Real number	Length			0.008	m
s...	Real number	Length		eP1*5+eT1*	0.004	m

+ Add X Remove ↑ Move up ↓ Move down ↓ Order alphabetically

Default group

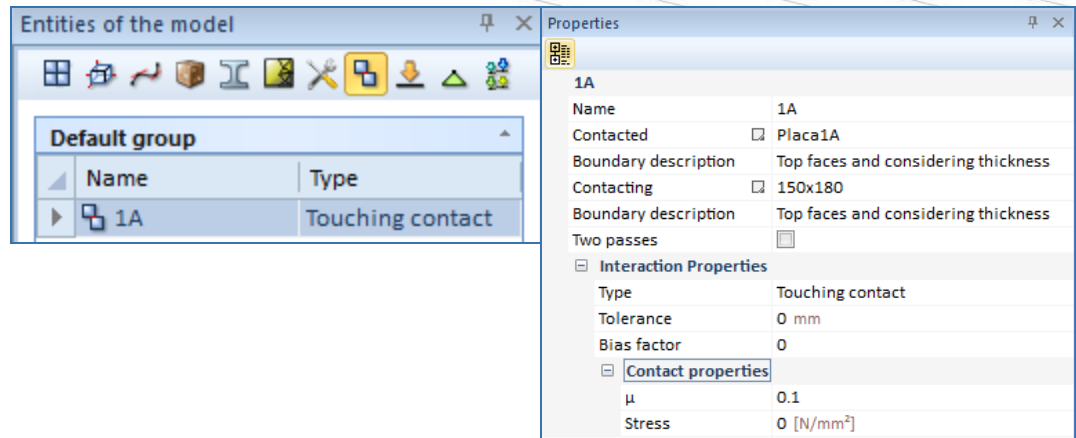
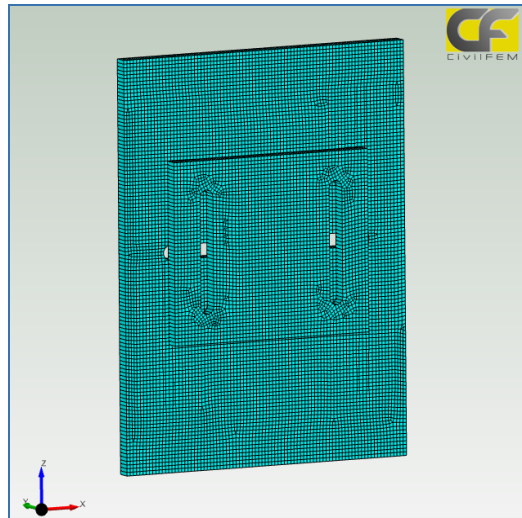
Name	Type
Central	Spring
L1	Spring
L2	Spring
L3	Spring
L4	Spring
L5	Spring
L6	Spring
L7	Spring
L8	Spring
R1	Spring
R2	Spring
R3	Spring
R4	Spring
R5	Spring
R6	Spring
R7	Spring
R8	Spring
carga 1	Tying
carga 2	Tying
carga 3	Tying
carga 4	Tying
P1	Tying
P2	Tying
T1	Tying
T2	Tying

The material used is Fe275 according Eurocode 3.

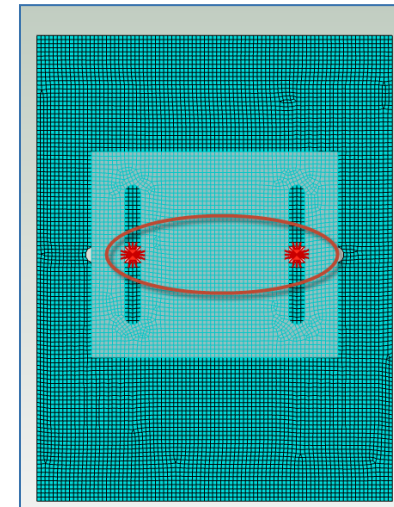
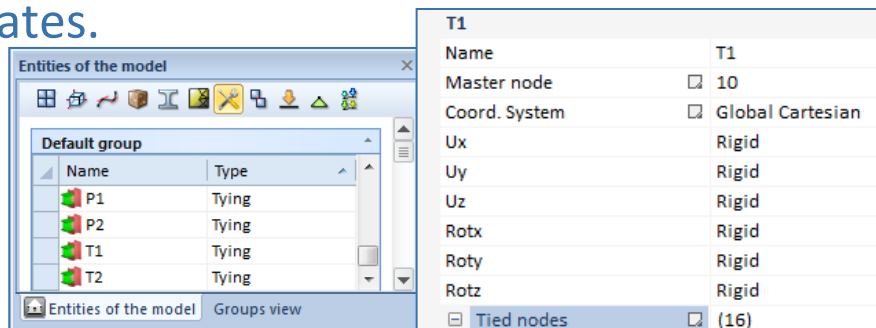
To define the shell thickness and the size of the mesh, some parameters have been created.

Curtain Wall Framing Anchor Description

We define a **touching contact** between the main plates.

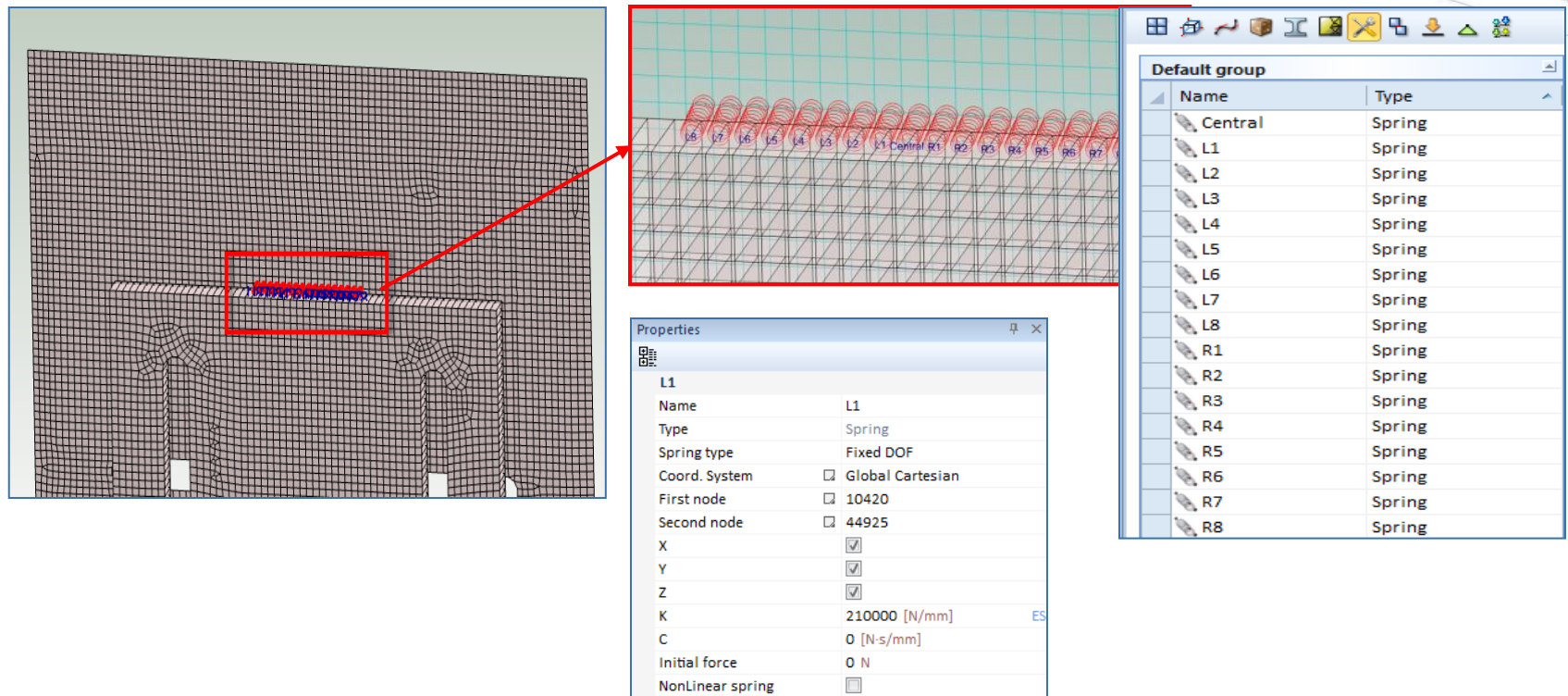


We also use Tying connections to simulate the connection between the screws and the plates.



Curtain Wall Framing Anchor Description

We can model the welding at the upper plate by using springs with a stiffness of $K=2.1 \cdot 10^5$ MPa in the three directions X, Y and Z.



The image displays a finite element model of a curtain wall framing anchor. A red box highlights the spring locations, and a red arrow points to a detailed view of the springs. A properties window and a default group list are also shown.

Properties

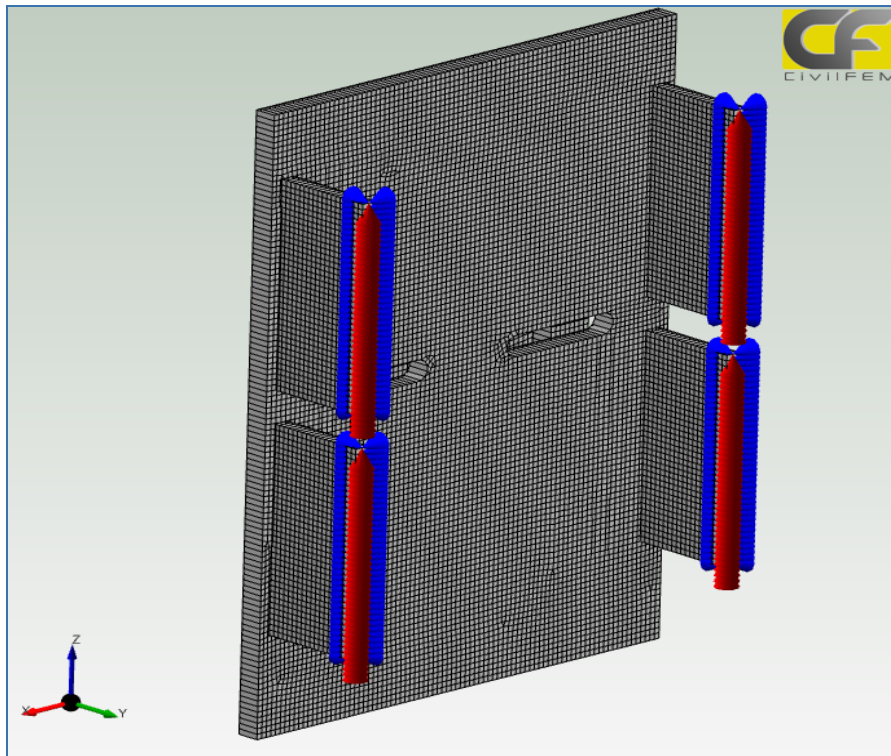
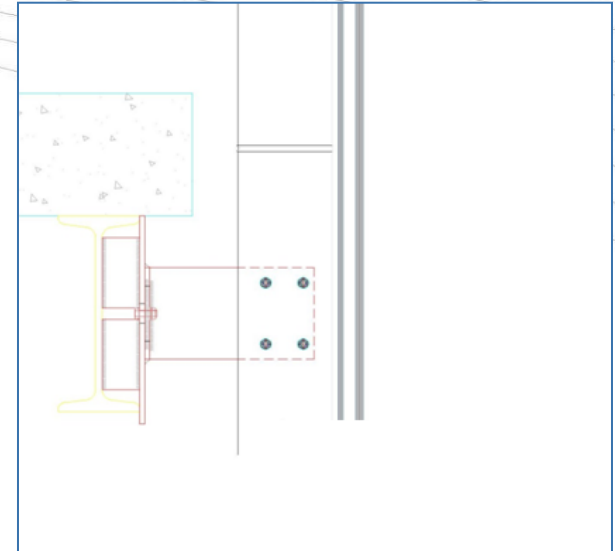
Name	L1
Type	Spring
Spring type	Fixed DOF
Coord. System	<input type="checkbox"/> Global Cartesian
First node	<input type="checkbox"/> 10420
Second node	<input type="checkbox"/> 44925
X	<input checked="" type="checkbox"/>
Y	<input checked="" type="checkbox"/>
Z	<input checked="" type="checkbox"/>
K	210000 [N/mm] ES
C	0 [N-s/mm]
Initial force	0 N
NonLinear spring	<input type="checkbox"/>

Default group

Name	Type
Central	Spring
L1	Spring
L2	Spring
L3	Spring
L4	Spring
L5	Spring
L6	Spring
L7	Spring
L8	Spring
R1	Spring
R2	Spring
R3	Spring
R4	Spring
R5	Spring
R6	Spring
R7	Spring
R8	Spring

Boundary Conditions

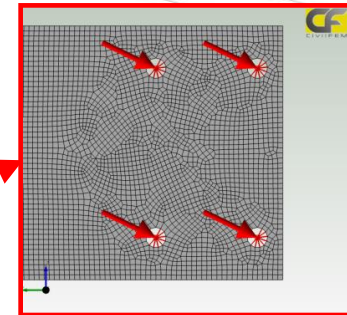
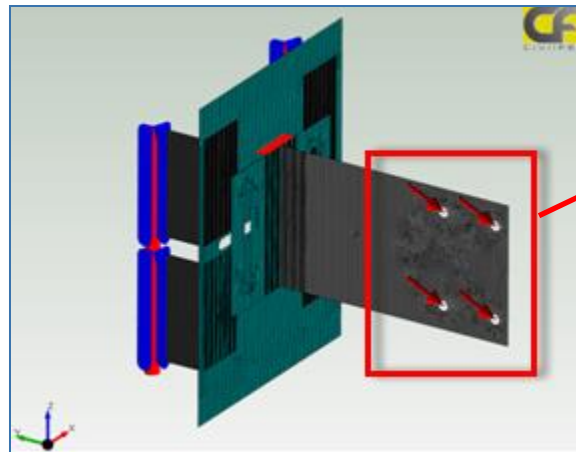
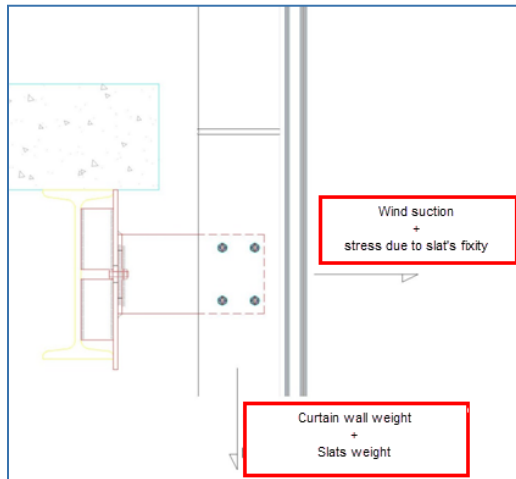
To define the **Boundary Conditions** (bond between steel plate and floor beams), all displacements and rotations around the Z axis are restrained in the contact lines between the plates and the floor beams.



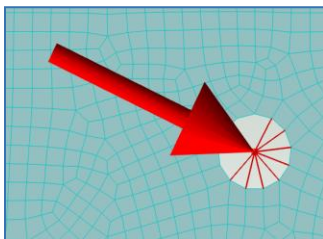
Empotramiento	
Name	Empotramiento
<input type="checkbox"/> Boundary c...	<input checked="" type="checkbox"/> (4)
L2	
Name	L2
Boundary c...	Boundary conditio...
Structur...	<input checked="" type="checkbox"/> L2A
Coord. S...	<input checked="" type="checkbox"/> Global Cartesian
Constrain m...	<input checked="" type="checkbox"/>
Constrain m...	<input checked="" type="checkbox"/>
Constrain m...	<input checked="" type="checkbox"/>
Constrain r...	<input type="checkbox"/>
Constrain r...	<input type="checkbox"/>
Constrain r...	<input checked="" type="checkbox"/>
Line	<input checked="" type="checkbox"/> \$Curve (75)

Loads

The main loads are self weight (vertical loads) and wind (horizontal loads) and are applied to the fixing screws.



Punctual forces are applied at the beam node simulating the screws. We use the Tying connection to distribute the punctual forces between the nodes of the plate hole.

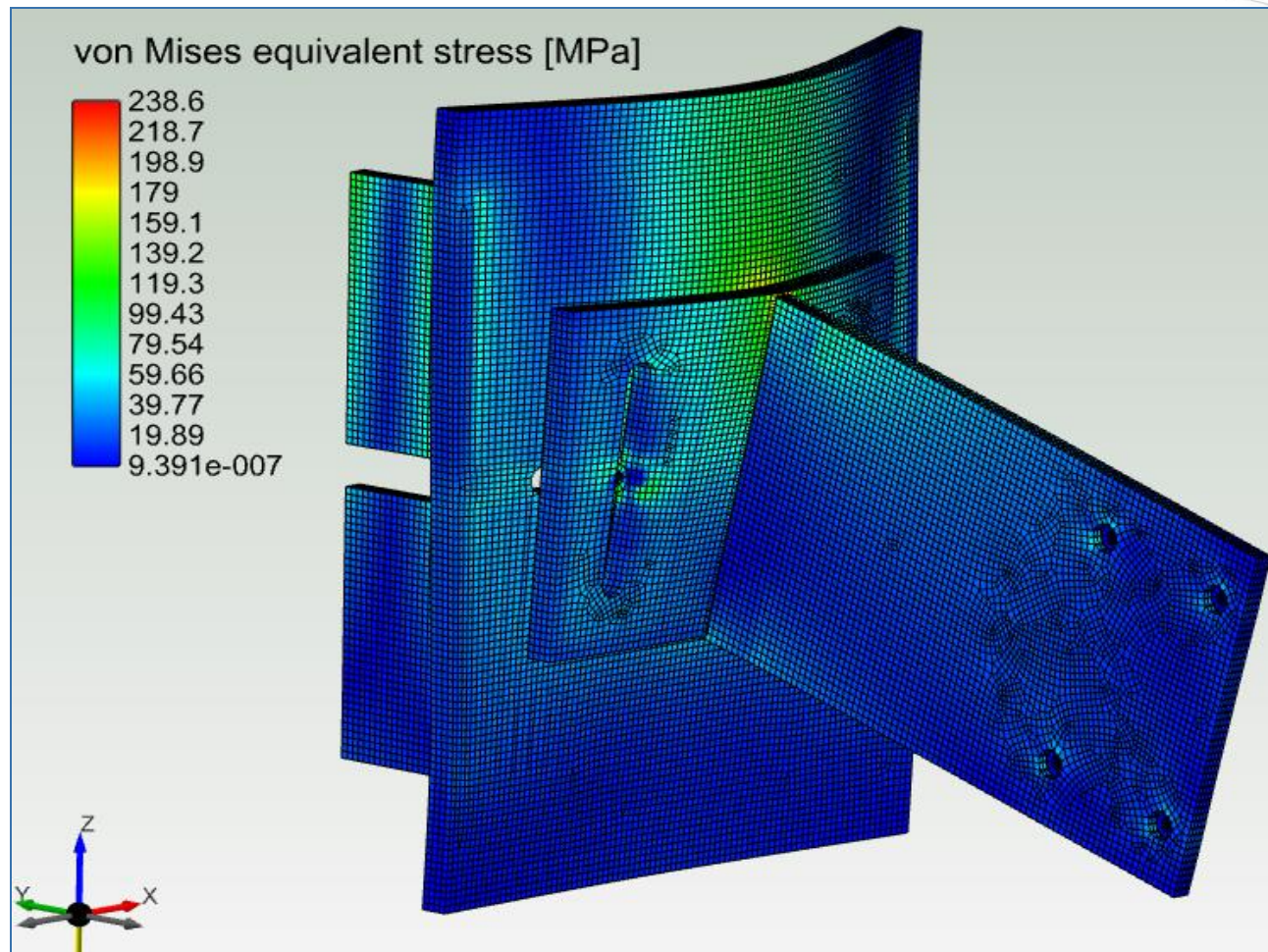


Default group	
Name	Type
Gravity	Constant accelerati...
Load V	Structural loads
Load H	Structural loads

Loads (4)	
Q1	
Name	Q1
Load type	Load on a point
Structural ele...	<input type="checkbox"/> Carga1
Coord. System	<input type="checkbox"/> Global Cartesian
Point	(0, -201, 60) mm
Direction	[0, 0, -1]
Load	1988.3 N 811/4;kp
Q2	
Name	Q2
Load type	Load on a point
Structural ele...	<input type="checkbox"/> Carga2
Coord. System	<input type="checkbox"/> Global Cartesian
Point	(0, -201, -40) mm
Direction	[0, 0, -1]
Load	1988.3 N 811/4;kp
Q3	
Name	Q3
Load type	Load on a point
Structural ele...	<input type="checkbox"/> Carga3
Coord. System	<input type="checkbox"/> Global Cartesian
Point	(0, -261, -40) mm
Direction	[0, 0, -1]
Load	1988.3 N 811/4;kp
Q4	
Name	Q4
Load type	Load on a point
Structural ele...	<input type="checkbox"/> Carga4
Coord. System	<input type="checkbox"/> Global Cartesian
Point	(0, -261, 60) mm
Direction	[0, 0, -1]
Load	1988.3 N 811/4;kp

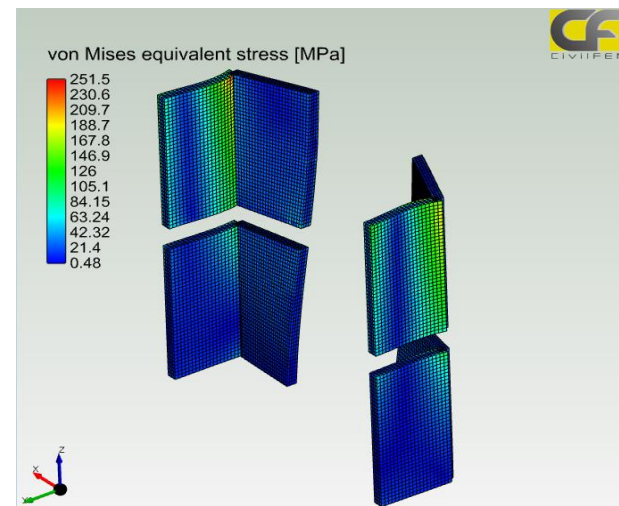
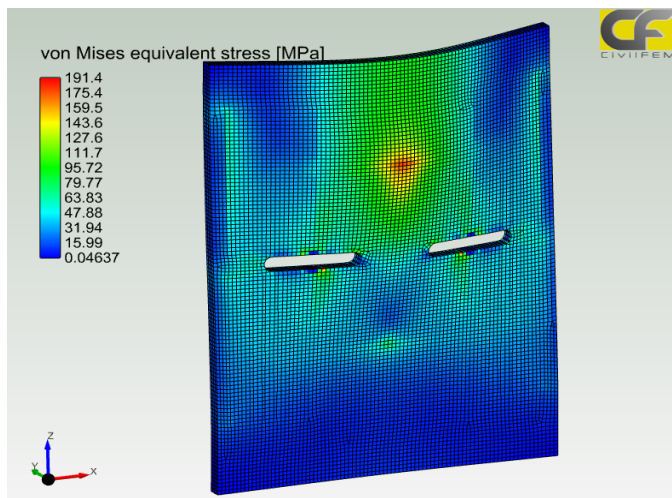
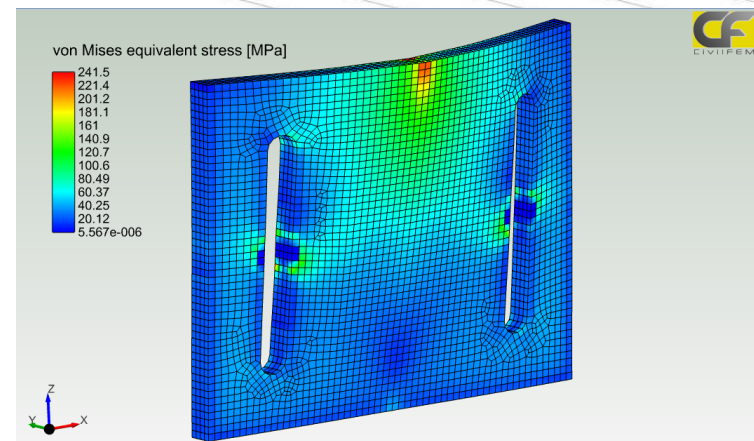
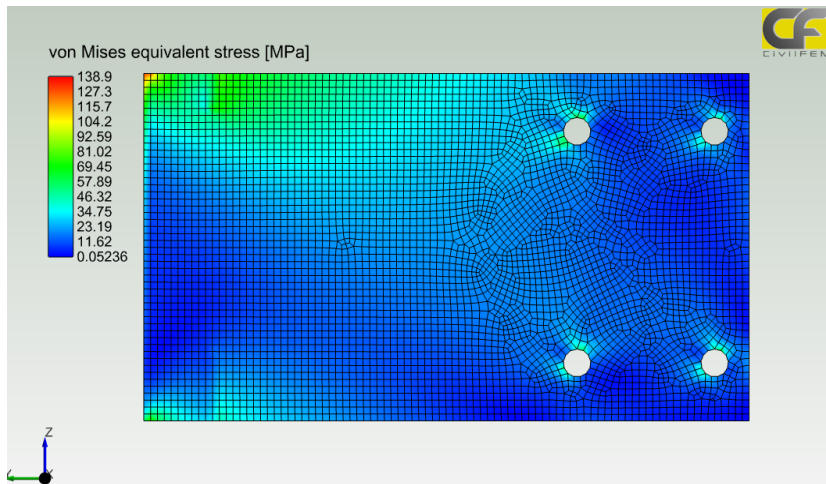
Analysis Results

In the figure below we can see the Von Mises equivalent stress on the deformed shape.



Analysis Results

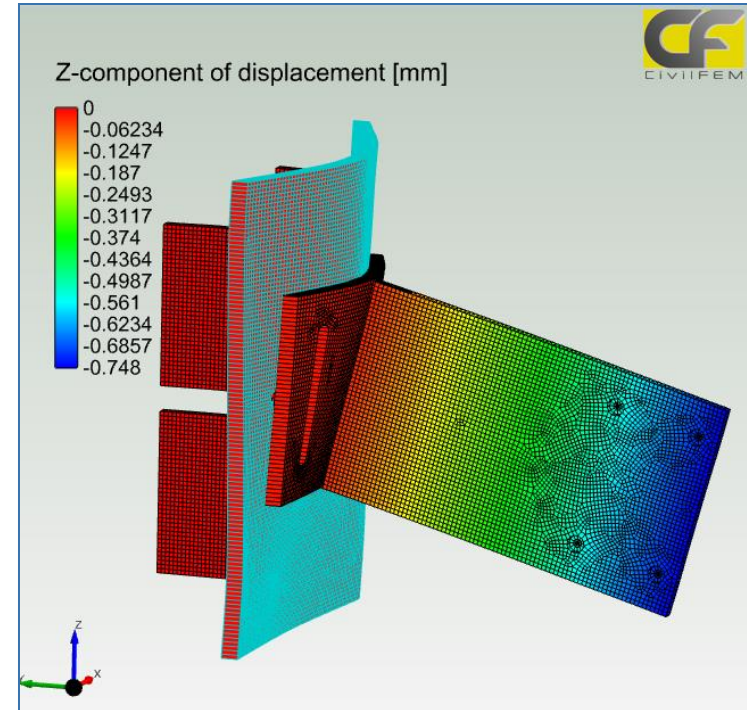
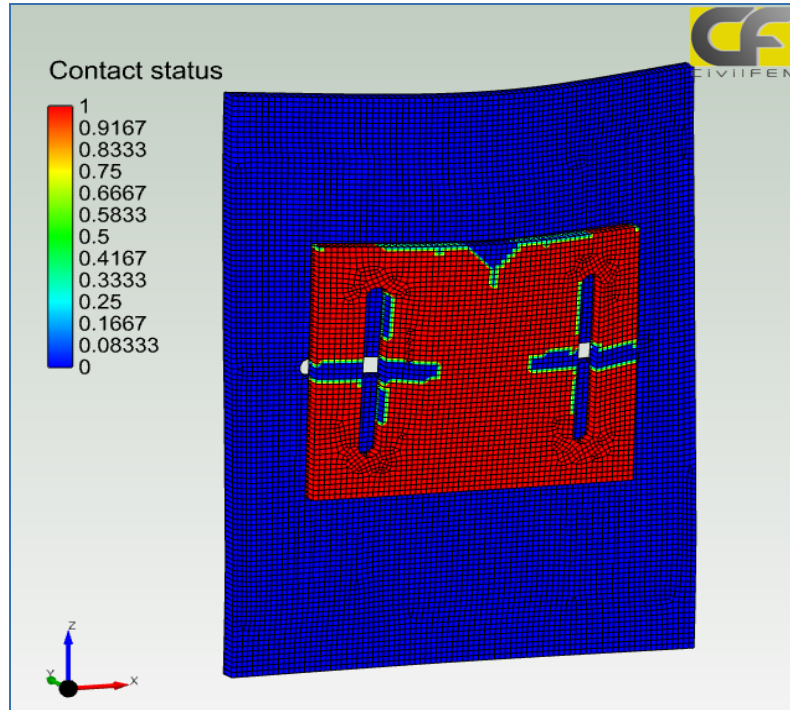
We can plot Von Mises stress in each plate separately



Analysis Results

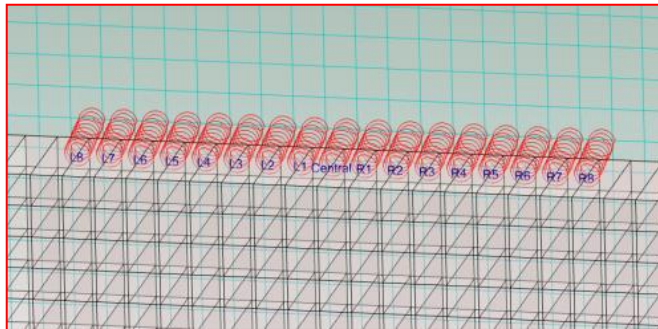
With CivilFEM, we can check the contact status between surfaces. Plate to plate contact is shown.

In the picture below, vertical displacement at the joint is shown.



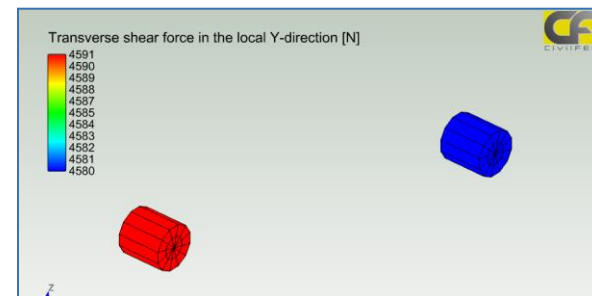
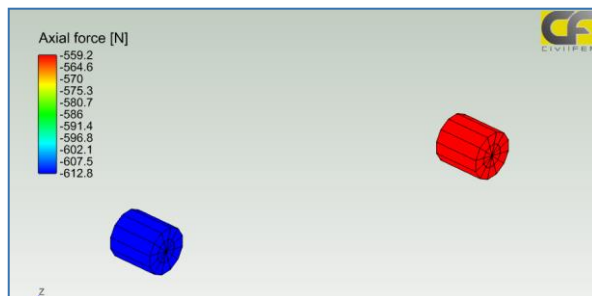
Analysis Results

The list below shows springs forces. Stresses on the welding can be derived from these results.



Spring	Node 1	Node 2	Fx	Fy	Fz
Central	10421	44924	0.002	1693.324	960.178
L1	10420	44925	-57.669	1191.625	813.182
L2	10419	44926	-60.718	883.785	749.507
L3	10418	44927	-53.659	649.153	714.064
L4	10417	44928	-43.841	462.627	701.682
L5	10416	44929	-32.056	336.822	708.341
L6	10415	44930	-18.199	262.398	735.234
L7	10414	44931	-0.880	237.768	791.481
L8	10413	44932	20.766	237.829	884.861
R1	10972	44923	57.676	1191.521	813.286
R2	10973	44922	60.730	883.547	749.714
R3	10974	44921	53.677	648.707	714.377
R4	10975	44920	43.870	461.765	702.099
R5	10976	44919	32.092	335.300	708.872
R6	10977	44918	18.247	260.155	735.889
R7	10978	44917	0.933	234.981	792.280
R8	10979	44916	-20.710	234.632	885.844

It is interesting to obtain the axial force and transverse shear force in the screws to check their resistance.





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