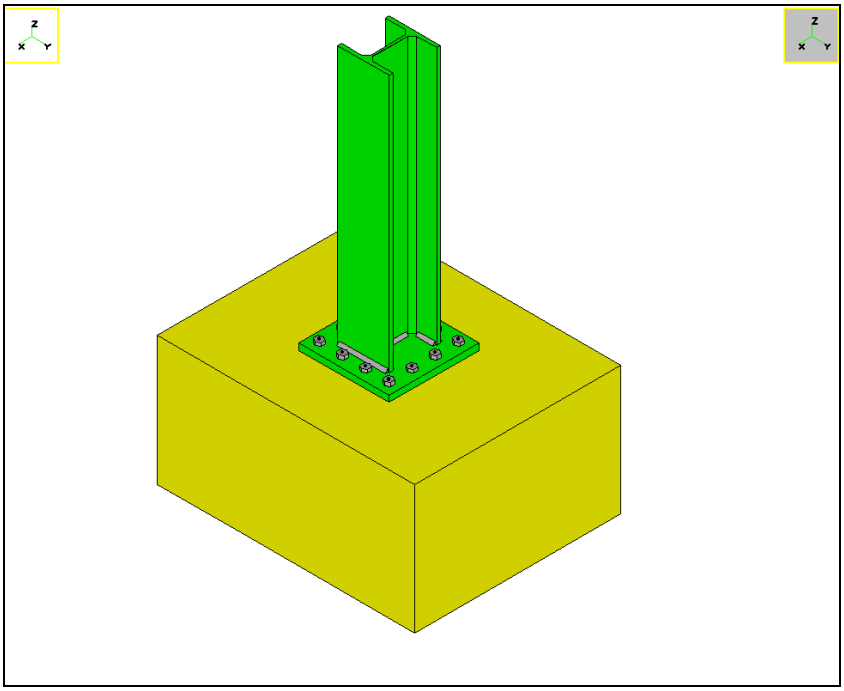
Paolo Rugarli

Connection Study Environment

Tutorial 1: base joint



http://www.castaliaweb.com - http://www.steelchecks.com
Via Pinturicchio, 24
20133 Milan - Italy
staff@castaliaweb.com

Referring to CSE Version 4.40
Rev.8 November, 23, 2011

Keywords:

steel connections, steel joints, welds, bolts, software, checks, verification, base plate, bending, compression, no tension, bearing, steel, yield, stress, strain, bolted connections, welded connections, anchors, slip resistant, plates, cleats, constraint, clamp, column, stiffener, fem analysis, fem models, fea, plate element, thickness, stress map, CSE, Castalia srl, steelchecks.com, castaliaweb.com, C.S.E.

Parole chiave:

connessioni acciaio, collegamenti acciaio, saldature, bullonature, bulloni, software, verifiche, piastra di base, flessione, compressione, no-tension, contrasto, supporto, acciaio, snervamento, sforzo, deformazione, connessioni bullonate, connessioni saldate, ancoraggi, unioni ad attrito, piastre, vincoli, incastro, colonna, irrigidimento, analisi fem, modelli fem, elemento piastra, spessore, mappa di sforzo, CSE, Castalia srl, steelchecks.com, castaliaweb.com, C.S.E.

1 INTRODUCTION

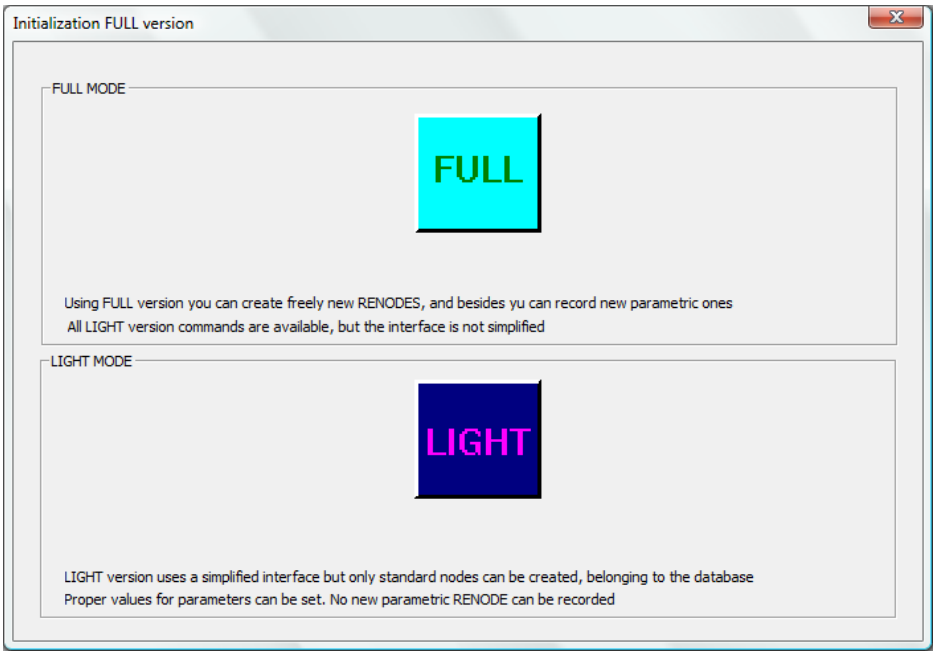
This tutorial is a tool to start the understanding of how CSE works. No special efforts to have realistic force values have been made, however this will explain several features of the program. By following this tutorial you will be able to:

- Create a dummy fem model to study a column base connection
- Assign the materials and cross-section to the fem elements
- Search members
- Search jnodes
- Add a base plate, a constraint block, a weld layout and a bolt layout
- Set the checks to be performed
- Have a look at results both FEM and non FEM, at the listing.
- Change some component to modify the initial guess for the real-node.
- Have a look at the bearing surface, fem model, block tearing results.

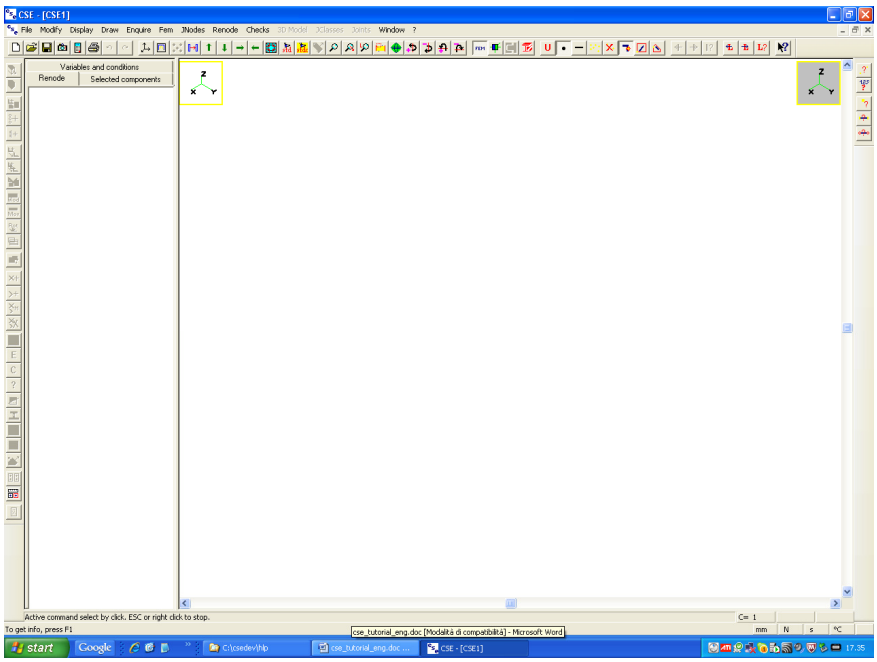
This tutorial is some like 70 pages long because we have explained step by step anything with images, however it takes very few minutes to actually do these things.

N.B. this tutorial refers to CSE version reported on the first page of this document. If you are using a newer version, keep in mind that some dialog or commands may be different, although the logic of the program has remained the same. If you find some differences, see the up-to-date PDF guide or the context sensitive help for information.

2 BASE JOINT



In the initial dialog box, choose the full mode (complete, with no limitations).



Initial window content: blank.

2.1 STEP 1: GETTING THE NODE

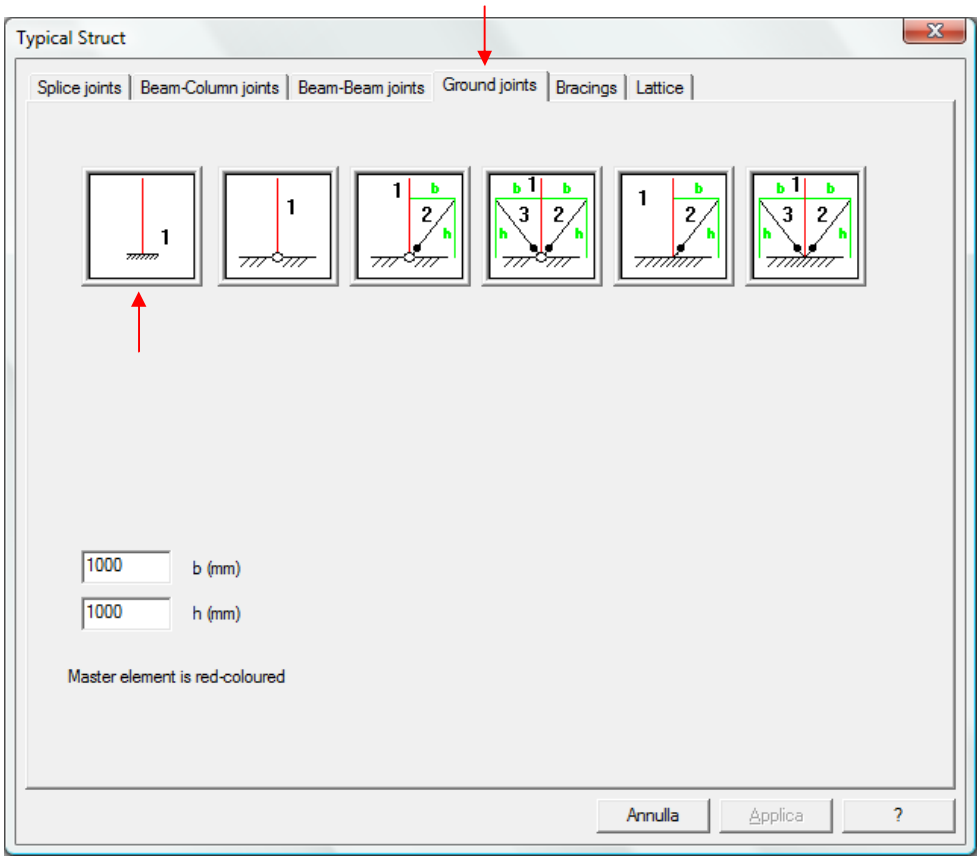
2.1.1 Choosing node type

Activate right window by clicking left inside it.

Execute the command

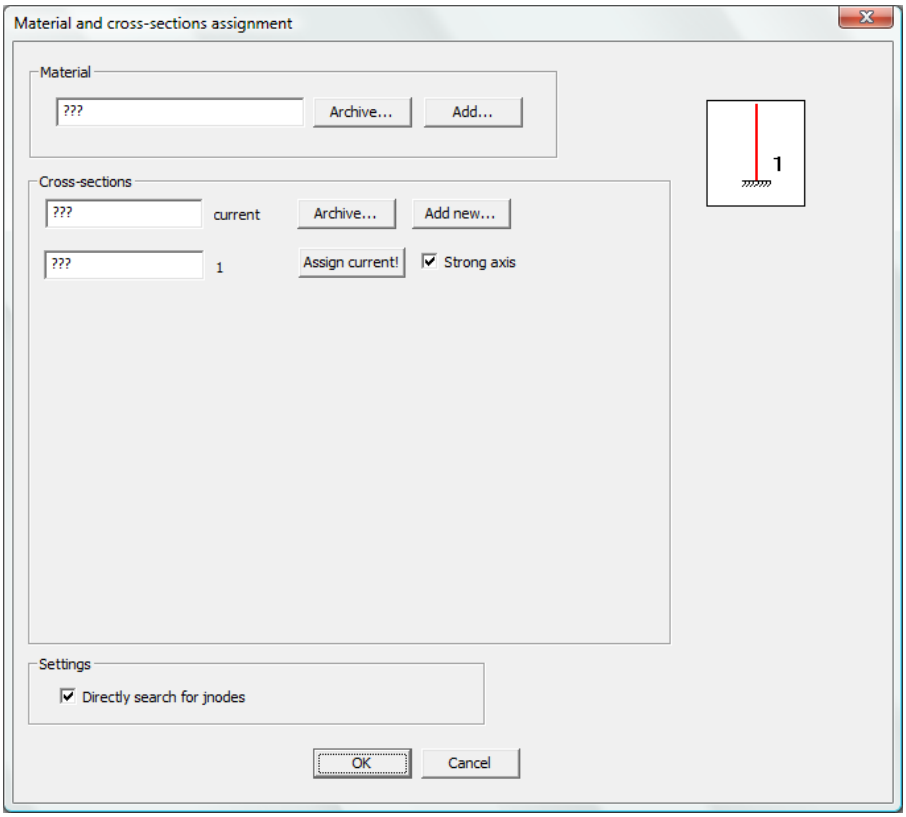
FEM-Elements-Typical nodes.

The following dialog box will be opened.



Choose the pane "ground joints", click inside the first image (from the left).

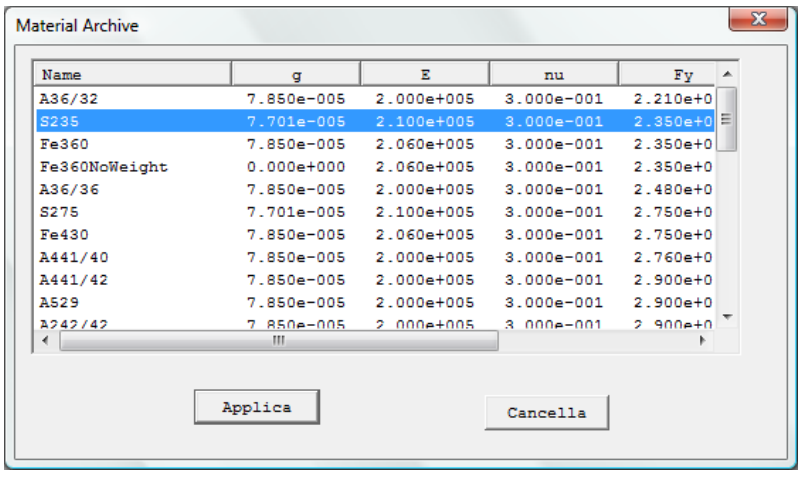
You will get the following dialog box:



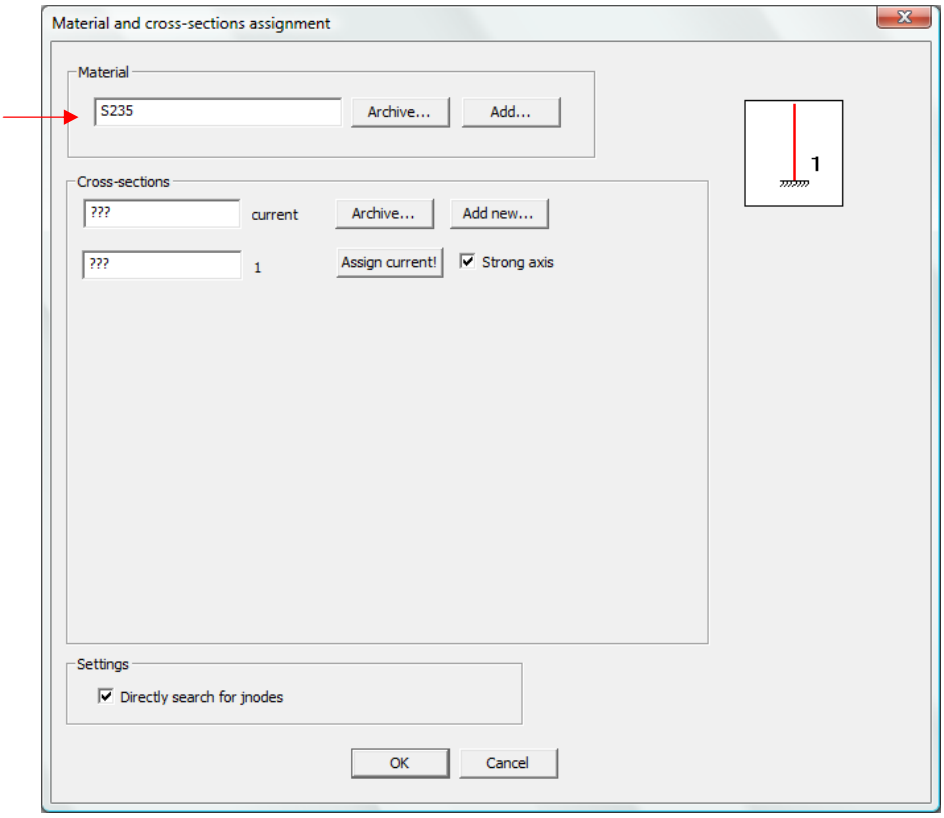
2.1.2 Assigning material

Use the button “Archive” in the box called “Material” in order to assign a material to the member, choosing it from the archive. It is also possible to add a new material with the button “Add”.

Press “Archive” and then choose the desired material by selecting the appropriate row and pressing the button "Applica (Apply)" in the following dialog box:



Chosen material has been applied.

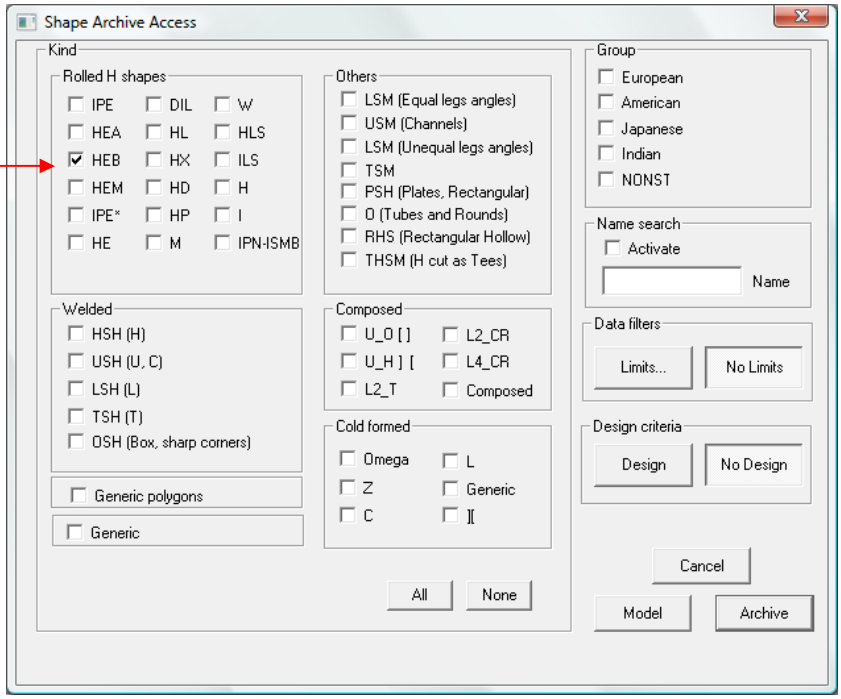


If you are using the demo the button "Archive" automatically applies the material S235.

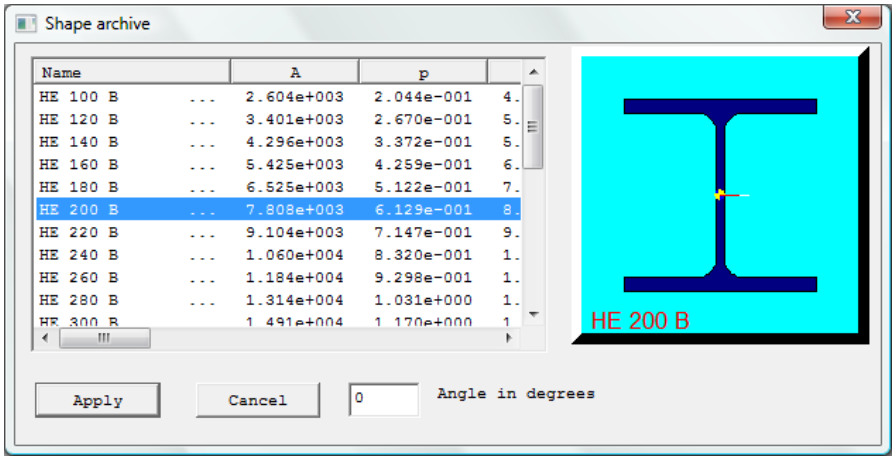
In this case there is just one member. It there are two or more members, with the "Typical node" tool all the members have the same material. It is possible to define different materials with the standard fem commands.

2.1.3 Assigning cross-section

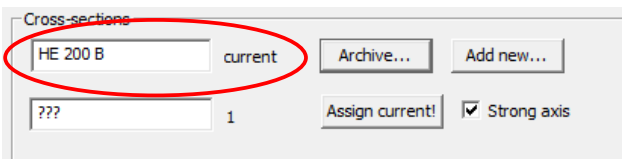
As for the material, it is possible to add new cross-sections or choose them from the archive. Press "Archive" in the "Cross-sections" box to browse the archive.



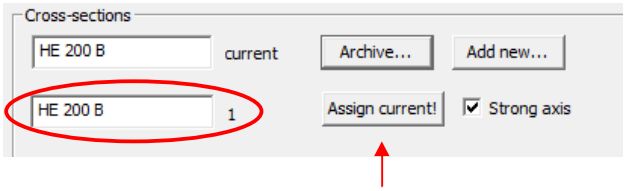
Select HEB check box and then "Archive" to filter HEB kind among all the available cross-sections. Then choose the section HEB200 by selecting the appropriate row, and press the “Apply” button.



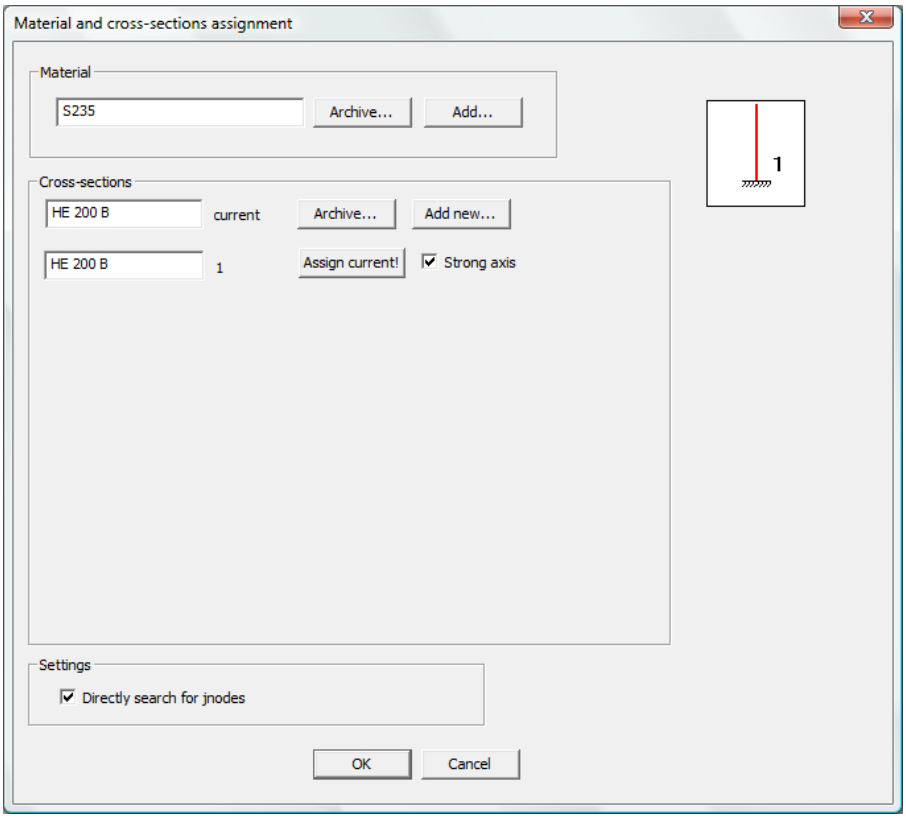
The chosen shape will appear in the box called “current”.



Current shape can now be applied to member 1, the only member in this node, with the "Assign current!" button on the left of member 1 box.



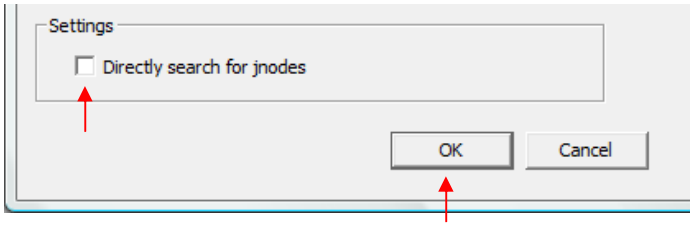
If there are two or more members, click each "Assign current!" button to assign current section to each member. Change the current cross-section before assign it to define different shapes for the members.



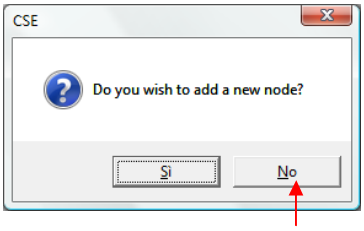
It is possible to apply a rotation of 90° to the member removing the tick from "Strong axis" box. In some nodes, not in this case, it is possible to define hinges for the slaves with proper tick boxes.

Pressing OK with the tick on "Directly search for jnodes", members and jnodes would be automatically searched and the resulting 3D renode would be automatically shown.

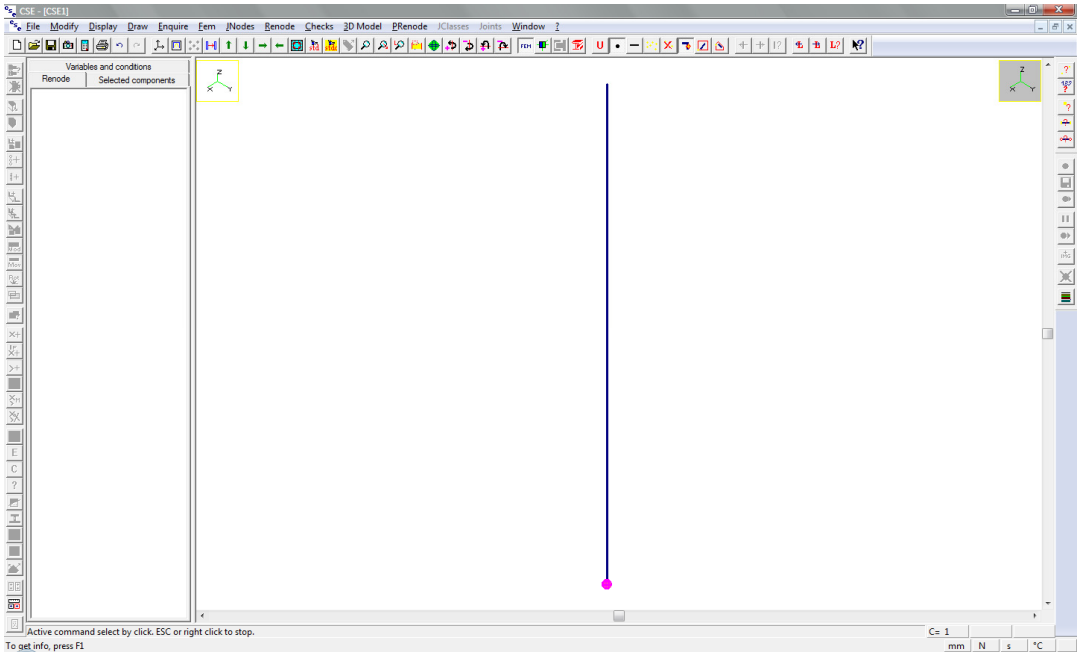
Remove that tick to see and understand step by step what could be done automatically (steps 2, 3 and 4 of this tutorial).



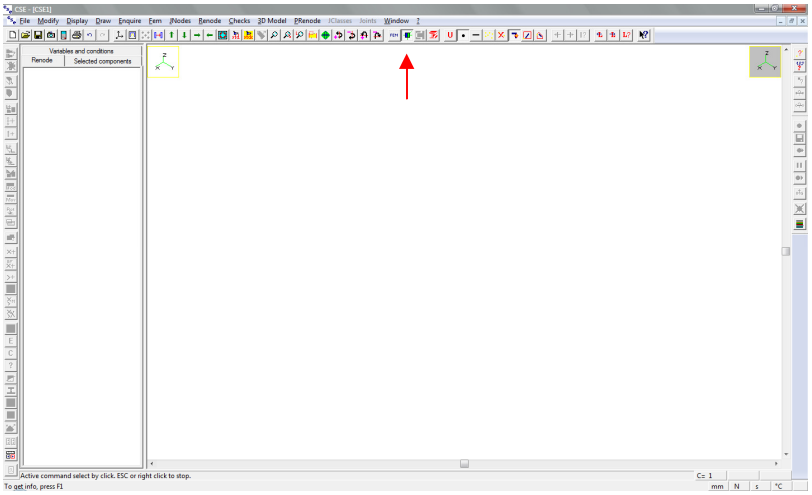
Choose “No” in the following dialog box. If you choose “Si” (Yes), will be opened the “Typical nodes” dialog box and it will be possible to select another kind of node, define its properties, and so on.



A fem model of the defined node has been automatically created.



Switch to jnode view with the command **Display – Jnode** (use the associated button ).

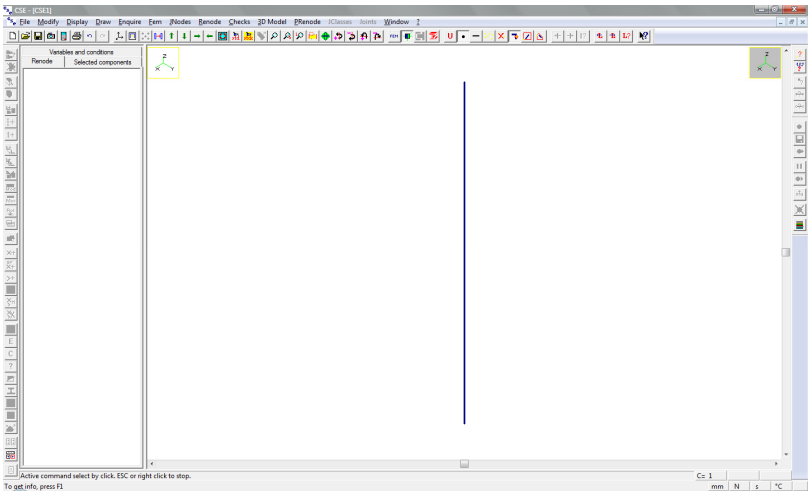


The view is now empy.

2.2 STEP 2: SEARCHING MEMBERS

To move to connection design you now have to detect which members are present in the fem model. To do that just execute the command:

FEM-Search members!



Members (only one in this case) appear in the jnode view. In general, structural members do not coincide with finite elements: for example, a single member can be divided into 2, 3 or n finite elements.

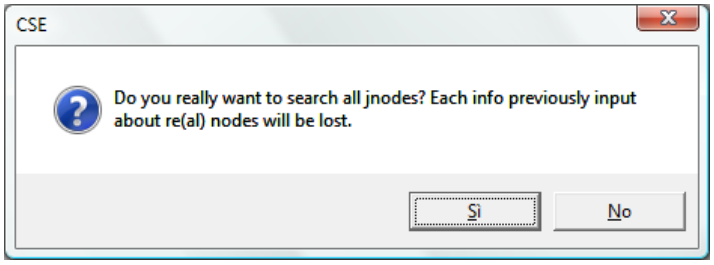
2.3 STEP 3: SEARCHING JNODES

Now that members have been found, you need to find different "jnodes" that is what will next get a true, real node (renode). The program scans the member model and finds how many equal and how many different jnodes there are in the model. Then each jnode will be marked and you will be able to select it in order to work on it.

To search jnodes just execute the command:

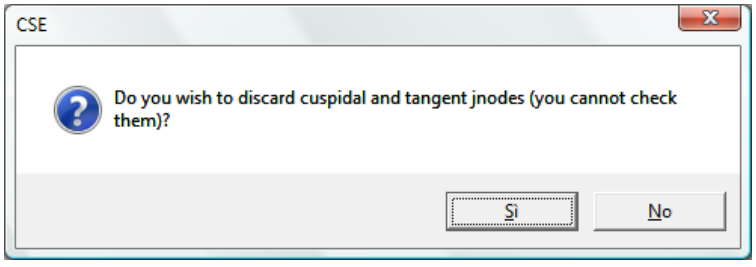
JNODE-Search jnodes!

and answer "yes" to the following question:



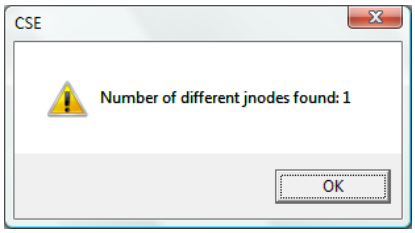
As no real nodes info has been defined you won't lose anything. Jnode search is usually done once for all in a model. Before beginning to add RENODES, you will check that the JNODES found are correct. This depends also on how the fem model has been prepared.

The following dialog appears:



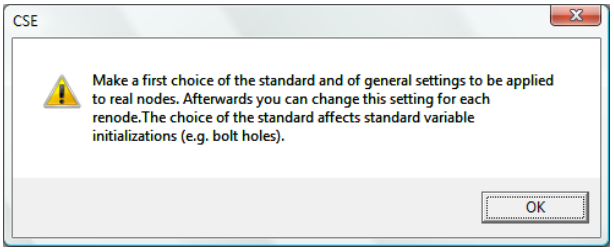
It is possible to discard cuspidal and tangent jnodes from the search (these jnodes cannot be computed).

You will get the following message after command execution:

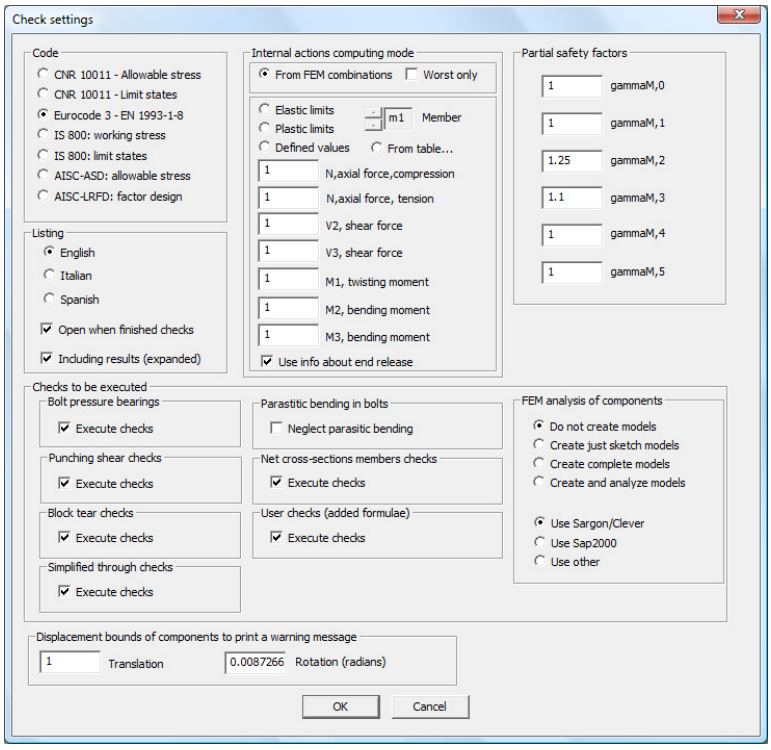


This means that in this model there is just one jnode, the ground node (simple jnode, a member alone attached to ground).

Now the following message appears:

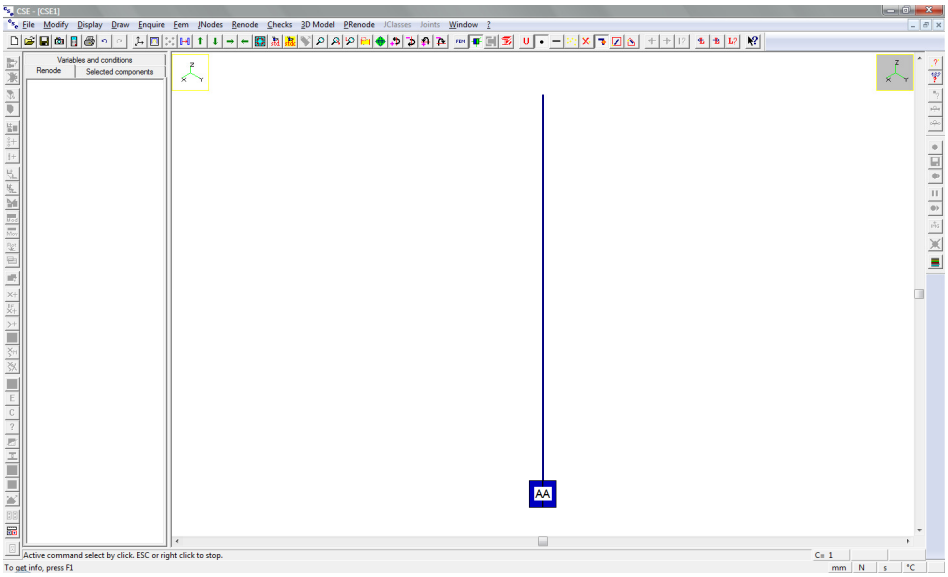


asking to make a first choice about the standard you are going to use. This settings will be applied to all renodes (here just one) as initialisation. Afterwards you will be able to assign different settings (e.g. about the checks to be done) to each different renode. So the following dialog appears:



Choose Eurocode 3 and leave all other defaults, we will change them later..

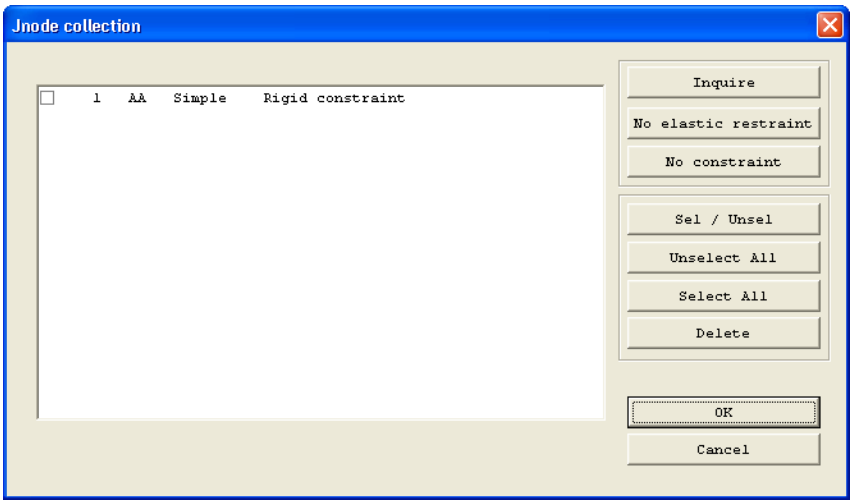
In jnode view you get the following, where AA is the only jnode found in this model.



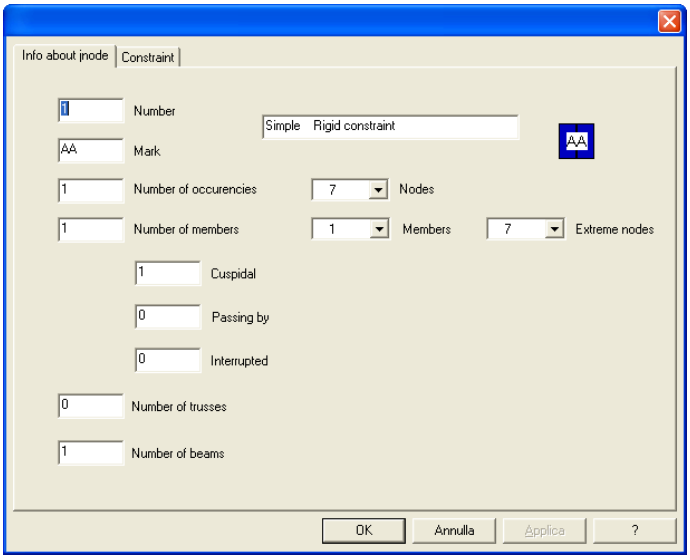
You can now get some info about the jnode found. Execute the command

JNODE-Edit...

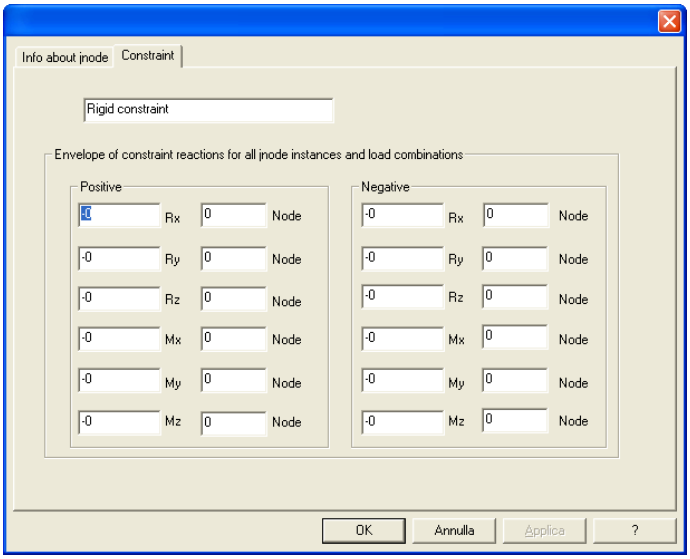
and get the following dialog:



Select the appropriate row and then "Inquire", you get the following



and clicking to "Constraint" the following:



The first dialog tells how many jnodes "AA" there are in the model, and which fem model nodes, members, and elements the jnode is using. The second dialog is blank as this fem model has been prepared inside CSE and is not coming from a true fem analysis.

Press OK and then Cancel to exit from both dialogs, including "Jnode Collection" dialog.

You can now wish to examine a listing for all jnodes found. This helps to understand if the fem model has been prepared correctly, and is an important tool to pre-study future RENODES.

Now save the model executing the command **File-Save**, and specify a name, for instance TUT1.CSE.

Execute the command

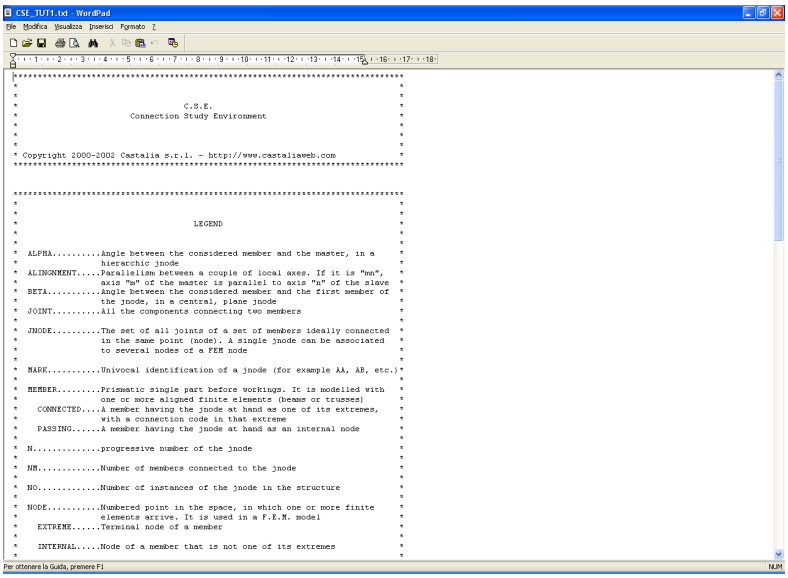
JNODES-Create listing!

you will get a message telling you that the stress file is missing: it's ok as we are not coming from a true fem analysis.

Now execute the command

JNODES-Open listing!

You will get a file with useful preliminary info about JNODES topology and categorization.



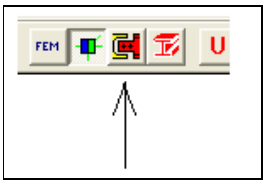
In particular you will get the following info:

```
*******************************************************************************
*                                                                             *
*                          JNODE     1       MARK    AA                       *
*                                                                             *
*******************************************************************************

GLOBAL TYPOLOGY OF THE JNODE: SIMPLE CONSTRAINT

NODES ASSOCIATED TO THIS JNODE: TOTAL 1
    7

MEMBERS IN THE JNODE: TOTAL 1
    1

   CONSTRAINT - KIND= FIXED     SHAPE=HE 200 B

RIGID CONSTRAINT
```

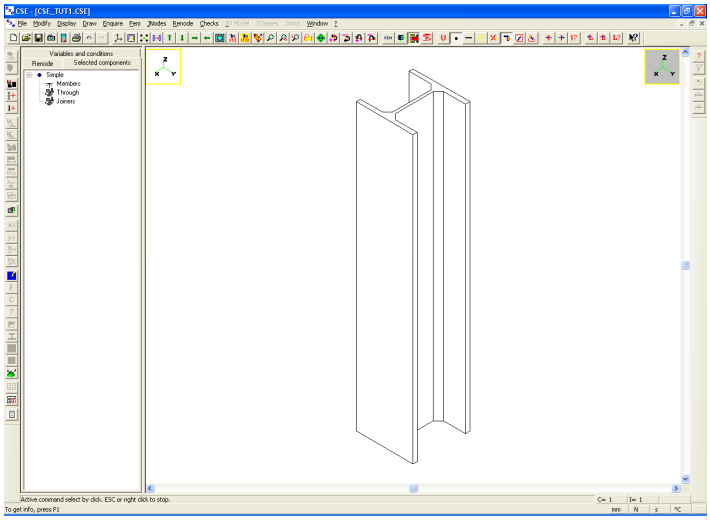
2.4 STEP 4: SELECTING THE PROPER JNODE

We are sure that jnodes are correct, we can move forward to select one of them to transform it into a REal NODE. Left click with mouse over the square "AA" in the graphic pane: it gets yellow. This means you have selected a jnode (all *instances* of that jnode will be selected, here there is just one *instance*. In a true fem model there can be tens of different instances of the same jnode).

Since there is just one jnode selected the switch to real node is possible. The following button in the main toolbar is active now:



By pressing it you will get into the 3D environment where RENODES are built up, checked, and studied. You will see what follows:



Note that the left window is not empty anymore: it gives you info about the components selected, the components present in the renode, and the variables and conditions present in the model.
Note that clicking the member it gets selected (blue) and that the "Selected components" sub-pane in the left window is upgraded. Clicking and re-clicking you select and unselect.

2.5 STEP 5: CONSTRUCTION OF THE REAL NODE

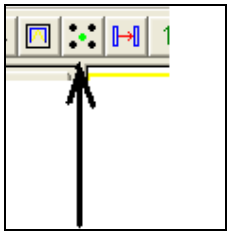
N.B. in this tutorial the renode will be manually build step by step, but it is also possible to apply one of the available parametric renodes of the archive that apply to the current renode. The command is Renode - Assign Prenode

2.5.1 Addition of cleats

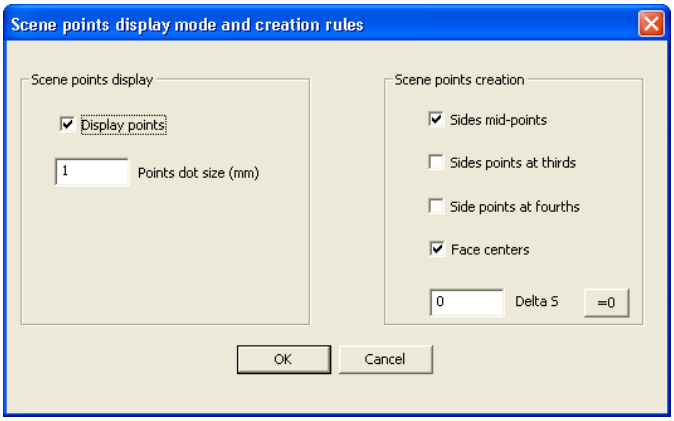
Let's first add a plate centred on the member bottom cross section centroid.

To make addition easier, let's ask to see the scene points, and particularly the face centres. Once you've understood how the program works you won't need to see the points each time, but just in particular cases.

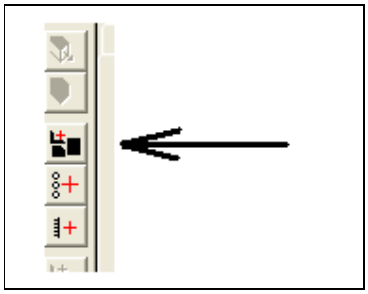
Press the following button in the main bar:



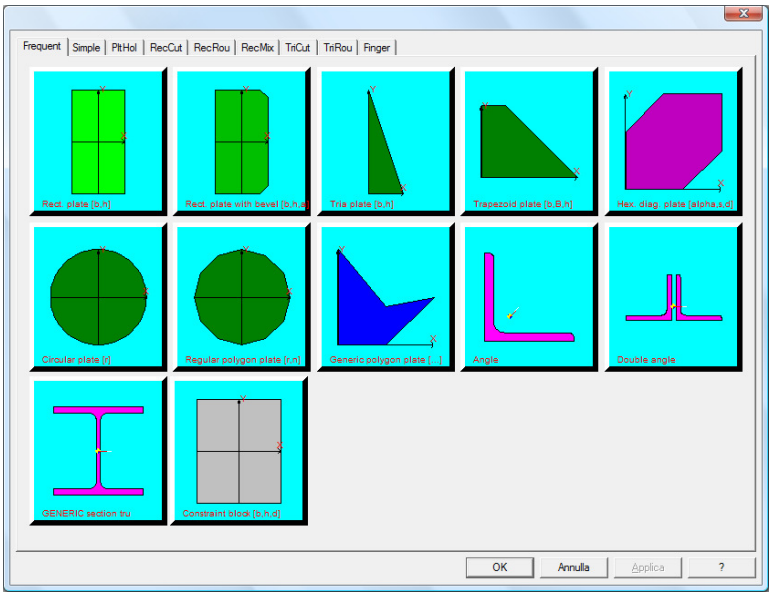
Now choose to see the scene-points by placing a tick in the Display Points check box. Press ok.



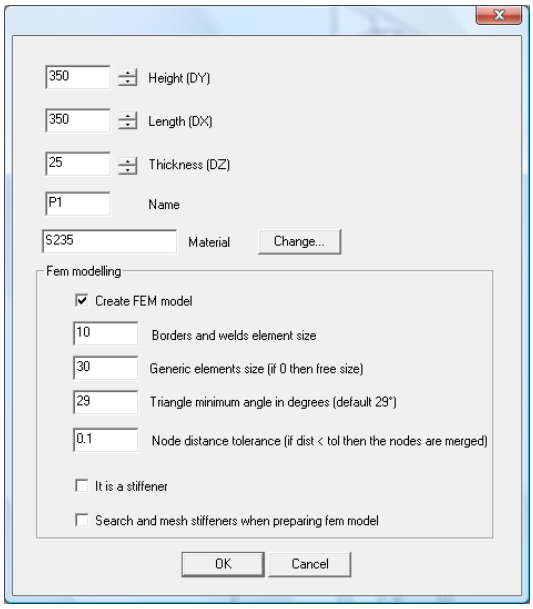
Press the "Addition of a through" button in the left toolbar. The button is used frequently:



The following property sheet appears:



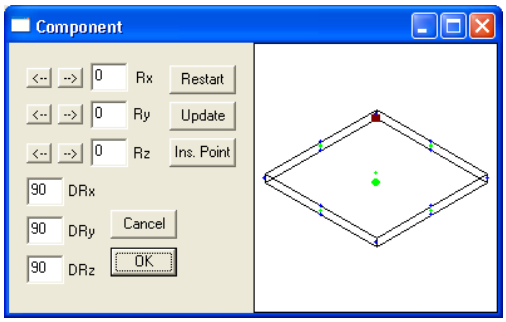
Now press the button corresponding to the rectangular plate (top left); the following dialog appears:



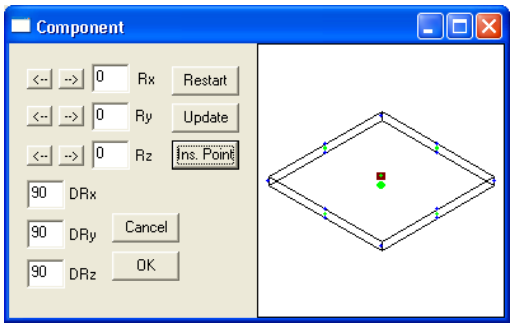
N.B. in latest versions, default values have been changed: angle is 18.9° and tolerance is 0.5mm.

Choose the plate sizes as shown in the picture. Also place a tick in the Create FEM model check box in order to specify that the FEM model of this component should be created. Leave the default values for the mesh size and features.

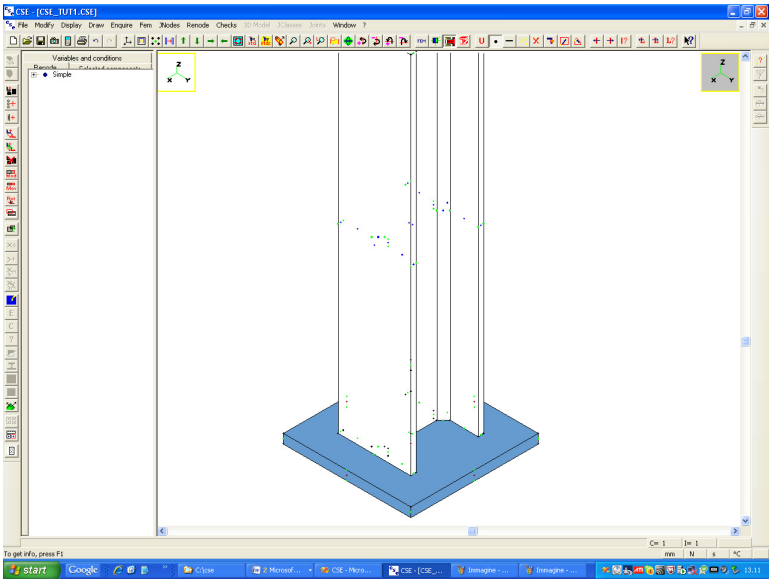
Now the following dialog appears



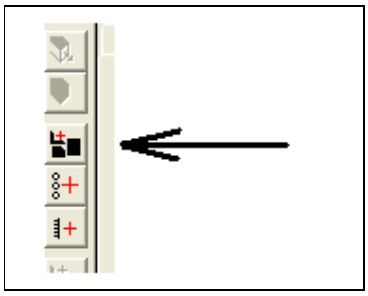
Press the Ins. Point button and select the top face center. This point will get red.



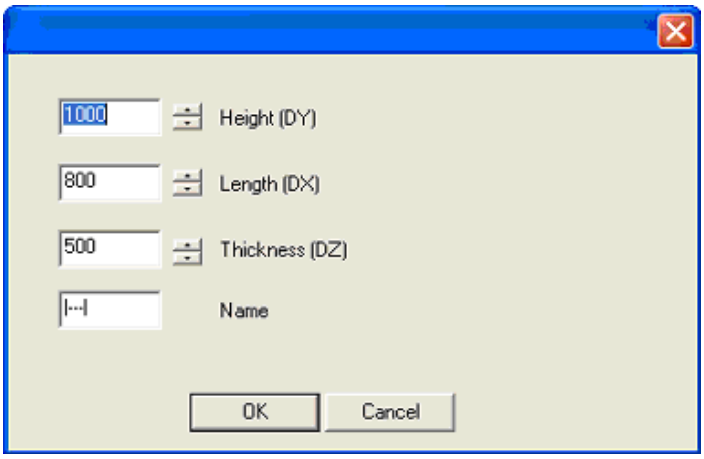
This point will be the insertion point of the object. Now press OK and click the bottom face center of the member. The plate will be placed so that its insertion point will match the point chosen. Orientation will be the same.



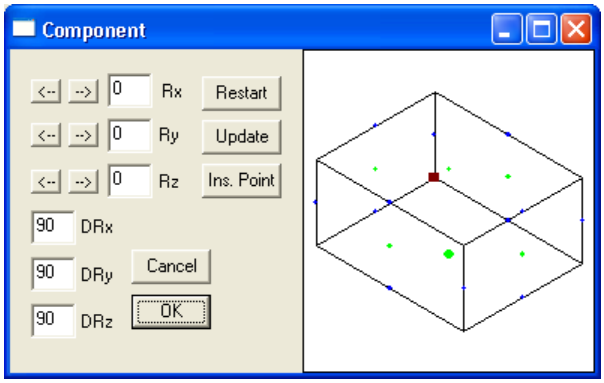
Now since this is a "ground" renode, we must add a "constraint block" as place holder for the ground. Click again the Add through button.



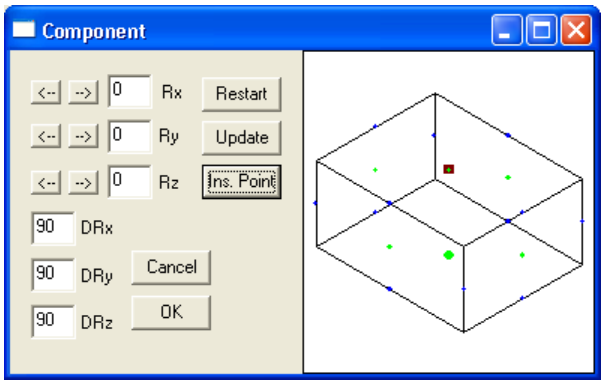
And choose the last button (constraint block, bottom right). You will get the following dialog:



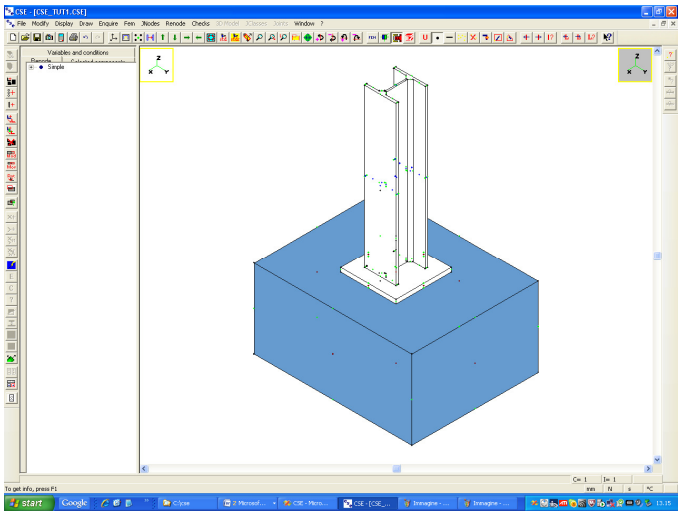
Leave all default values and click OK. You'll get what follows:



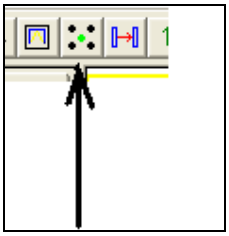
Now click Ins. Point and choose as insertion point the top-face center. In this way:



Now press OK and, in the scene, click over the added plate bottom face center, you'll get the following:



You can now hide the scene points. Press once more the button



in the main tool bar. Remove the tick from the Display Points check box. Press ok. Scene points disappear.

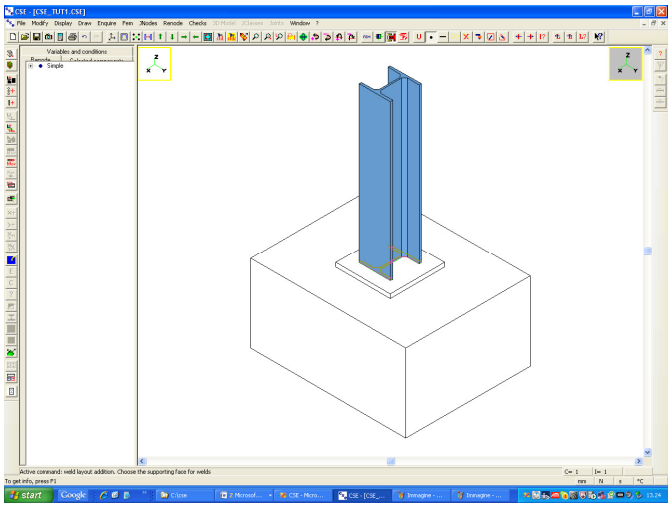
2.5.2 Addition of joiners

Let's first add the weld which joins the column to the plate. Unselect all but the column. To unselect all press the following button in the main toolbar:

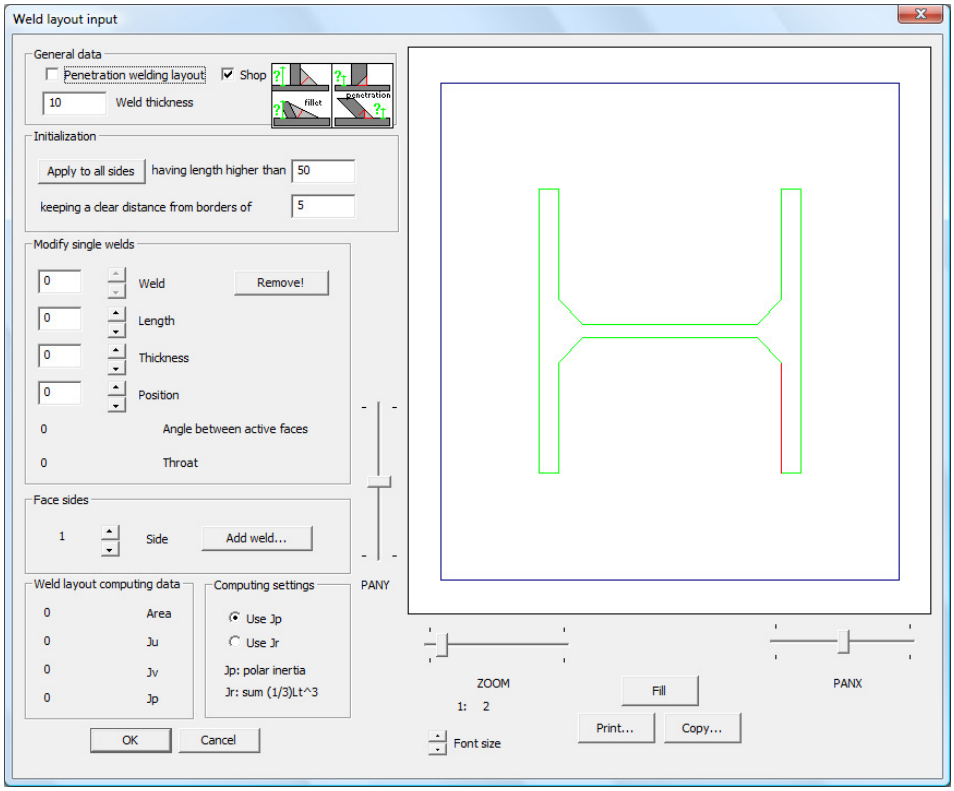
now click over the column so that it gets blue. You have selected it. Preliminary selection is not needed but helps as clickable faces, in the next command, will only be those of objects selected.

Now press this button in the left toolbar, which stands for "Add weld layout":

Moving the mouse you now see that faces are continuously being selected. Choose the bottom column face, as shown, and click the mouse left button.



You'll get into this dialog:

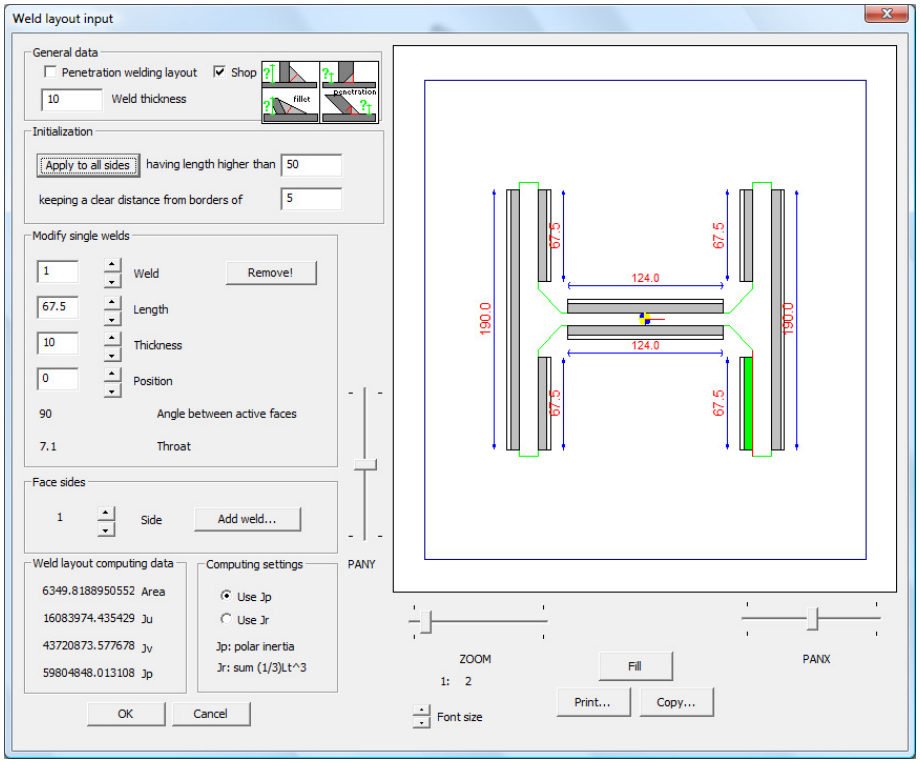


Choose the weld thickness, for instance 10 (mm, as we are using default units).

Do NOT tick “penetration welding layout” in order to use fillet welds.

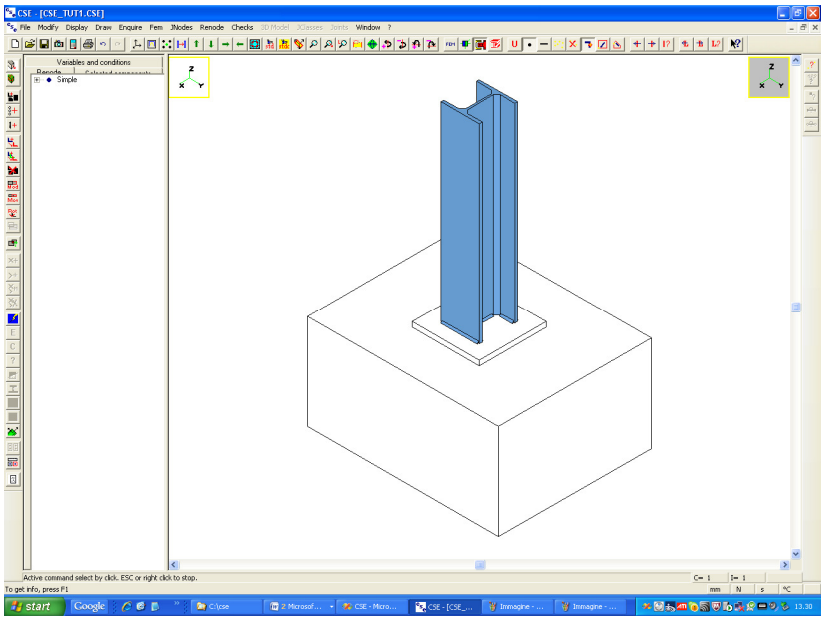
Torsion can be computed with Jp (polar inertia) or with Jr (sum of $1/3*Lt^3$)

In order to add quickly the welds, press the Apply to all sides button. You will get the following:



If you would have to modify some weld thickness you would choose the weld by clicking the Weld top and bottom arrows. The chosen weld is the green one. Notice that the Throat read only datum is coherent with the thickness you've specified. Play a bit with the ZOOM and PAN slide controls. Pressing the Copy button you get the image of the weld into the clipboard. You can then paste where you wish. Also notice that the weld layout global computing data have been computed.

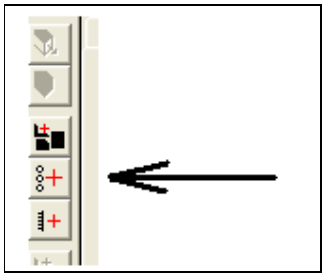
Press OK to add the weld. You will see what follows:



Now let's add the bolts joining the base plate to the constraint block. Unselect all objects by pressing

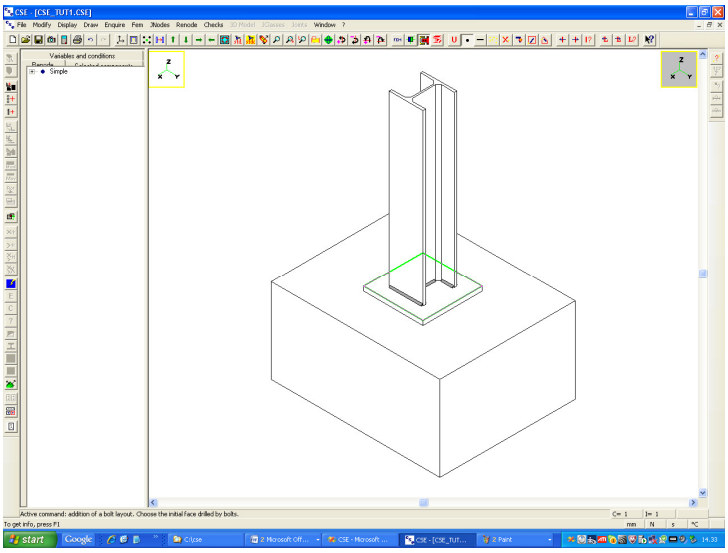
in the main tool bar.

Press the Add bolt layout button:

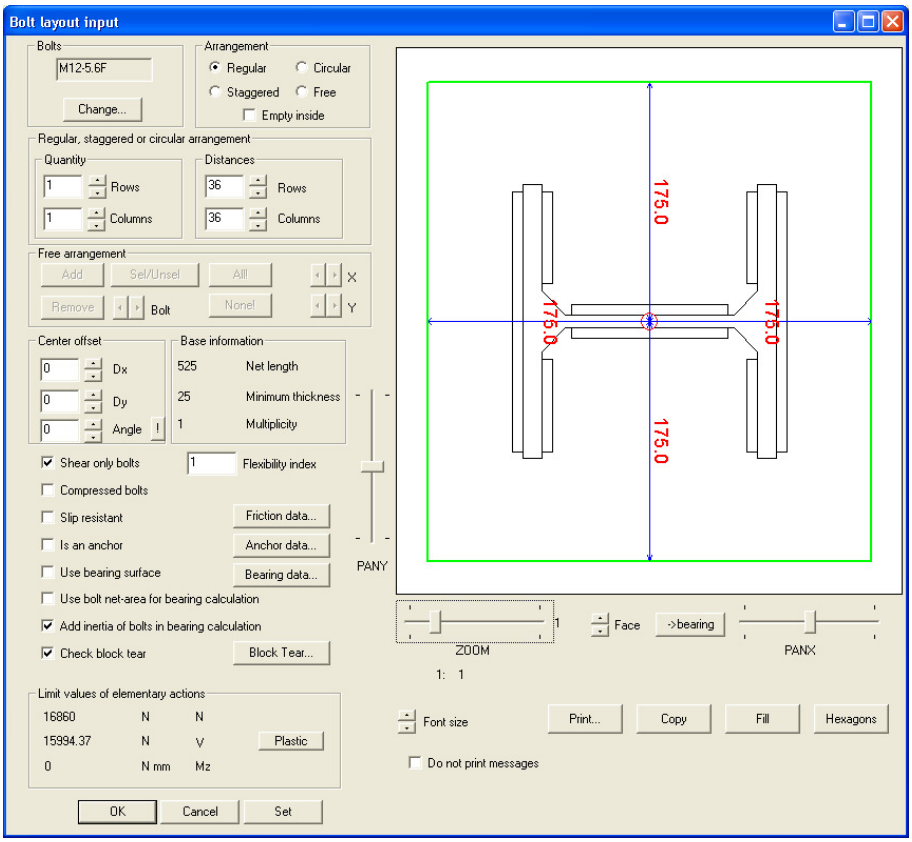


Moving the mouse you'll notice you are selecting faces.

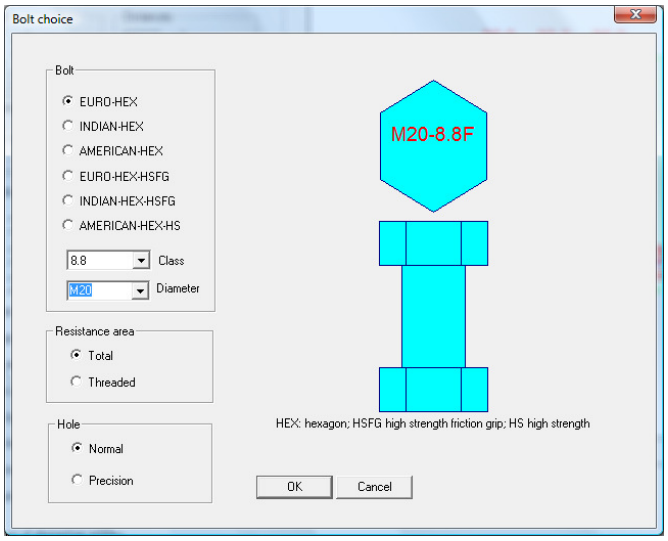
Now select the top face of the added plate.



Bolts will drill into that face to connect the plate to the constraint block. As soon as you click left choosing the top face you get into this dialog:

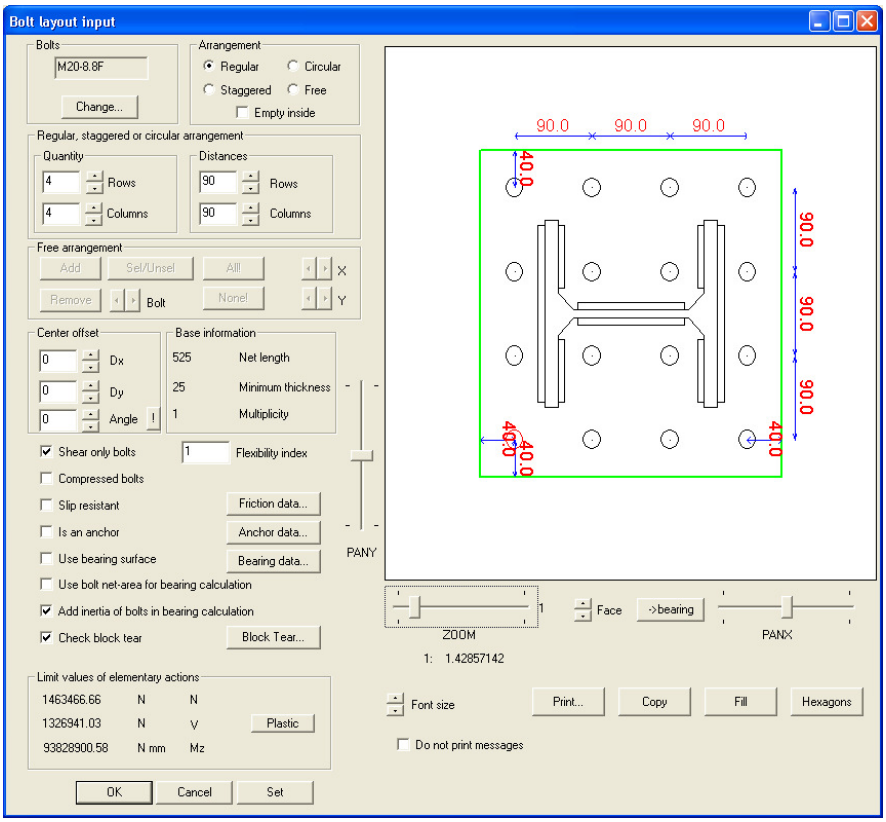


First of all choose the typical bolt. All bolts will be the same. Press **Change** in the Bolts frame. You get the following dialog:

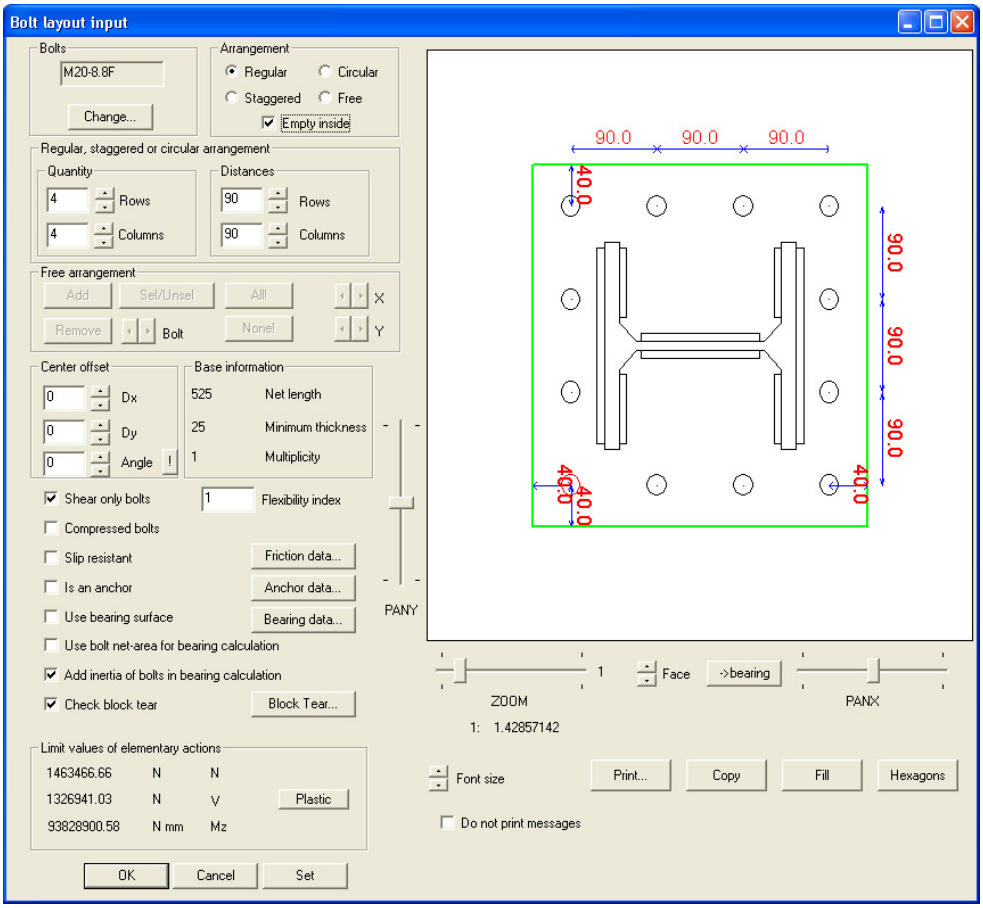


Keeping EURO-HEX selected, choose the steel grade 8.8 and the bolt diameter M20 (mm). Then leave the default Total resistance area, and Normal hole. Press OK. You are back in the previous dialog, but now the bolt is M20-8.8.

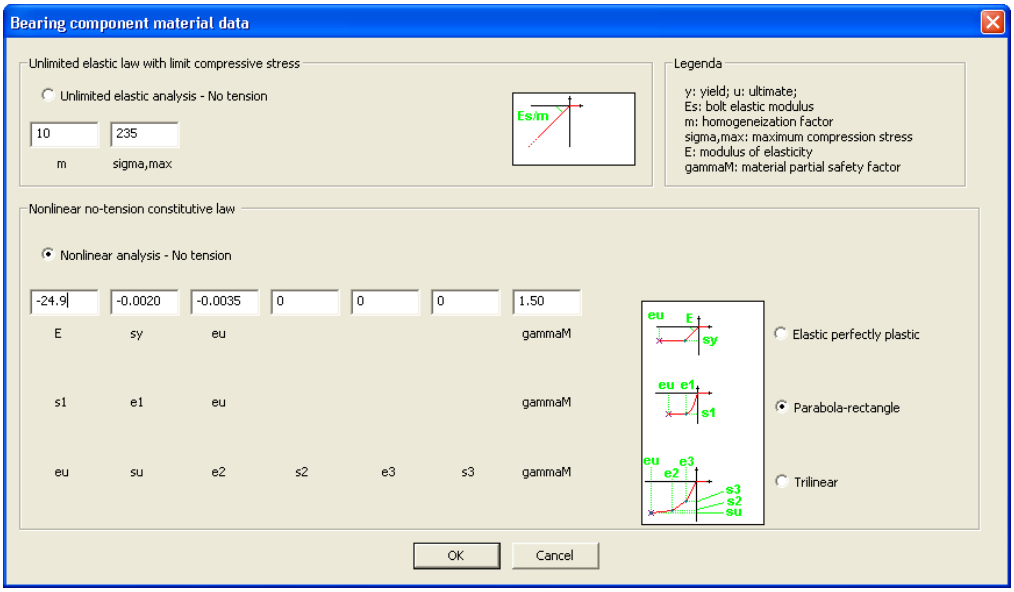
Now choose 4 rows and 4 columns, and 90mm as distance between cols and rows. You get the following:



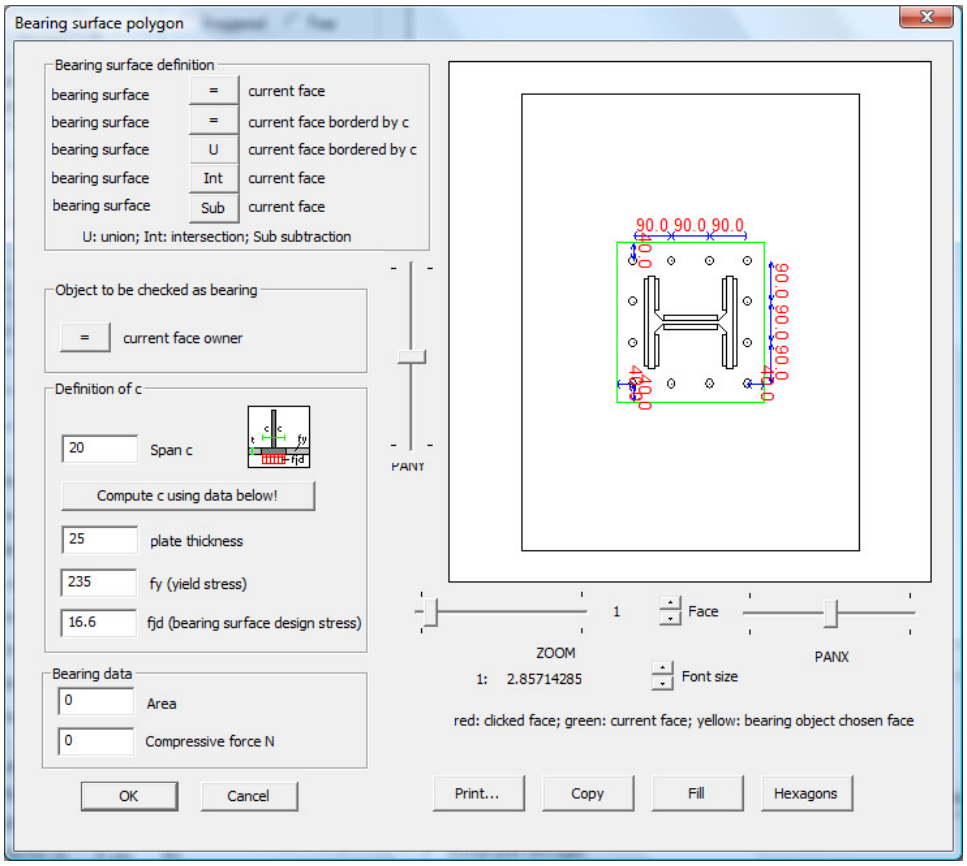
Now place a tick in the check box "Empty inside", you'll get the following:



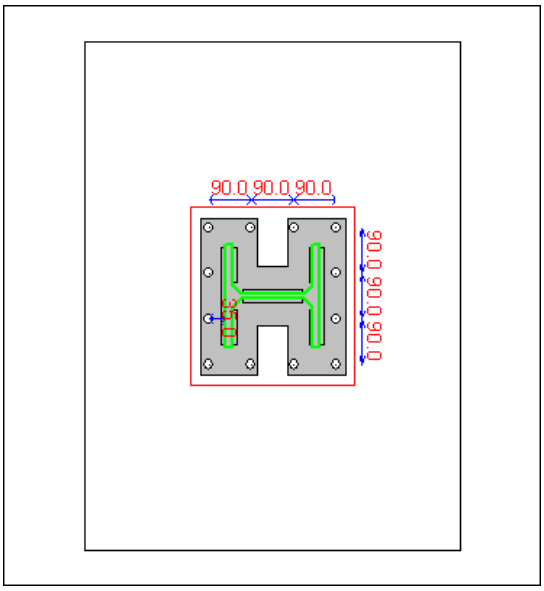
We must now choose how bolt layout works. As it is expected that bending will occur, and that a bearing surface will help in getting the pressures, we remove the tick from the check box "**Shear only bolts**", and so the bending stiffness will be considered, and then place a tick in the check box "**Use bearing surface**". Afterwards we must define the constitutive law of the bearing. Here the bearing is a concrete block, modelled via the constraint block. Press the button **Bearing data**. You get inside this dialog:



We choose a non linear no-tension law, parabola-rectangle. The ultimate compressive force f_{ck} is 24.9N/mm^2 (concrete C25/30), the safety material factor is 1.5. The yield strain is -0.002 the ultimate strain is -0.0035 (please note the minus signs). These data define how the bearing material is going to behave. By definition this is no-tension material. The constitutive law depends on the situation and mechanical model for the bearing material. Also, these data will be used to check the maximum computed compressive stress over the bearing against the ultimate stress (which is 24.9/1.5). Press OK and get back to main dialog. Now we must define two more things: the contact area assumed in computation and the object that will be considered as the bearing object. To do that press the button "**->bearing**". You get into this dialog:

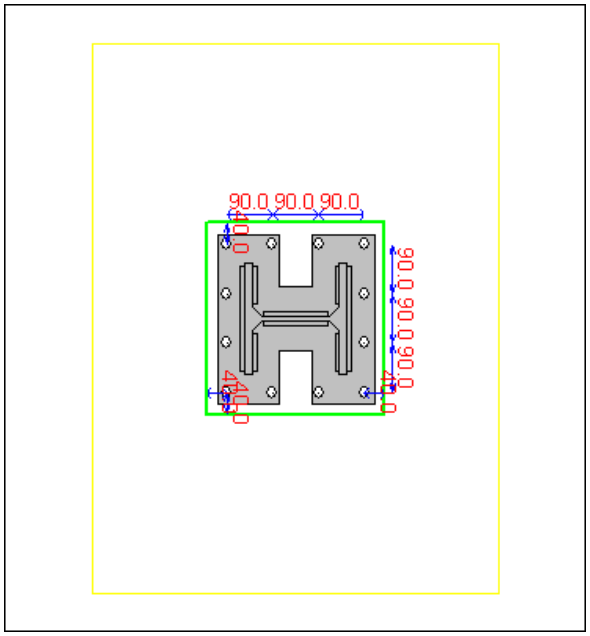


Bearing surface (or surfaces) is defined by using available faces. If we assume that the plate is relatively flexible, we can consider just an area around the HEB200 face. We can add a border "c" to this face in order to get this as bearing surface. To compute "c" we specify the design stress of the concrete (which is 24.9/1.5=16.6), the yield stress of the steel (235), and the plate thickness (25), then press "**Compute c using data below!**". These implements Eurocode 3, part 1-8, specific rules to get the reacting part of the plate. We get that c is 54mm. Now use the **Face** top arrow until the face of HEB200 gets green. This means we have selected this face. Then press the button "**bearing surface = current face bordered by c**", and you get the following image:



So we will use this surface as bearing surface for the bolt layout. The bearing surface will only react in compression.

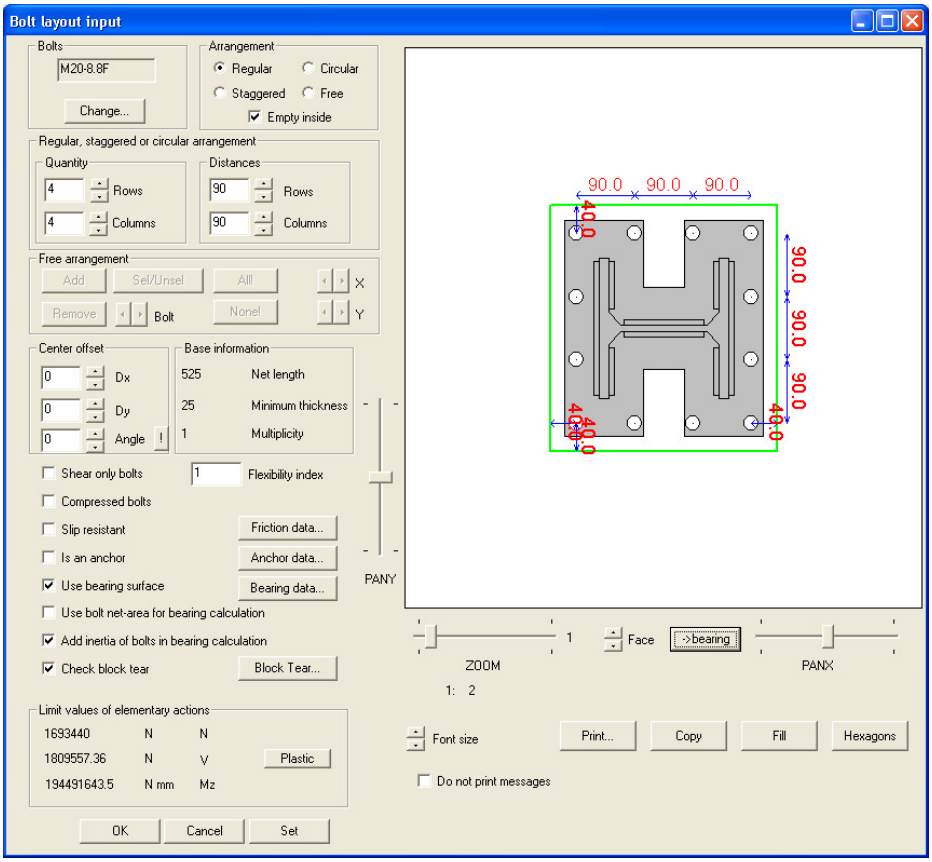
Now we must explain to the program which object will be considered (and checked) as bearing object. Click the Face arrows until the constraint-block face gets green. Then press the button "**= current face owner**" to specify that the constraint block will be the object to which the bearing pressure check will be connected.



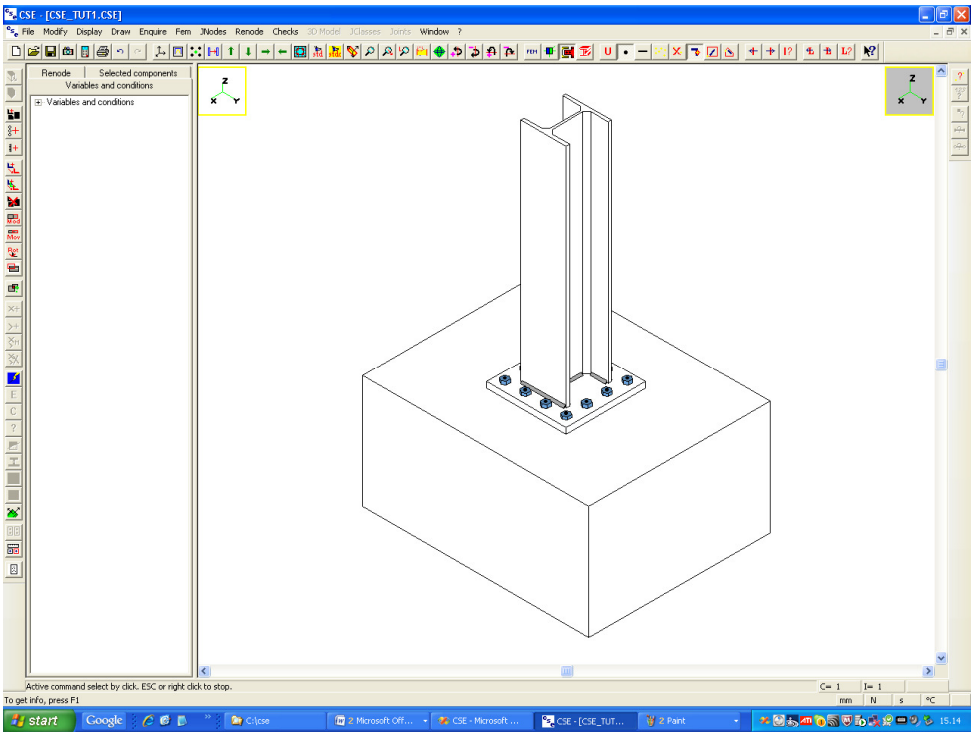
As you will notice clicking over the Face arrows, the face chosen as bearing object will be shown yellow. We have defined both the bearing surface and the bearing object for the bolt layout. Please note that this is needed only when using bolt layouts that use the bearing surface concept.

Press OK and go back to main bolt dialog.

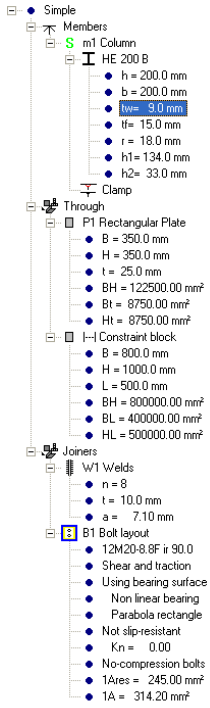
If you wish to check bolt traction against an anchor limit value, then place a tick in the "Is an anchor" check box. You will then have to specify the limit shear stress and the computing bolt equivalent length. As this is just an introduction we just keep the bolt as already defined leaving all default values. The dialog will be like this:



Press OK, you will see what follows:



The connection is ready. Please have a look at the left panes. You will see that the Renode pane embeds all components:



You can copy and paste both the right and the left window content. Just activate the window you need and then press this button in the main bar:

Then paste the image where you need. This previous image has been got in this way. Have a look at the Variables and Conditions pane. You will see that a number of pre-defined variables have been added for your possible needs.

Let's check if the renode is well posed. Execute the command Renode-Check coherence (you will have to activate the right window by clicking inside it). Once the command is executed you get the following message:

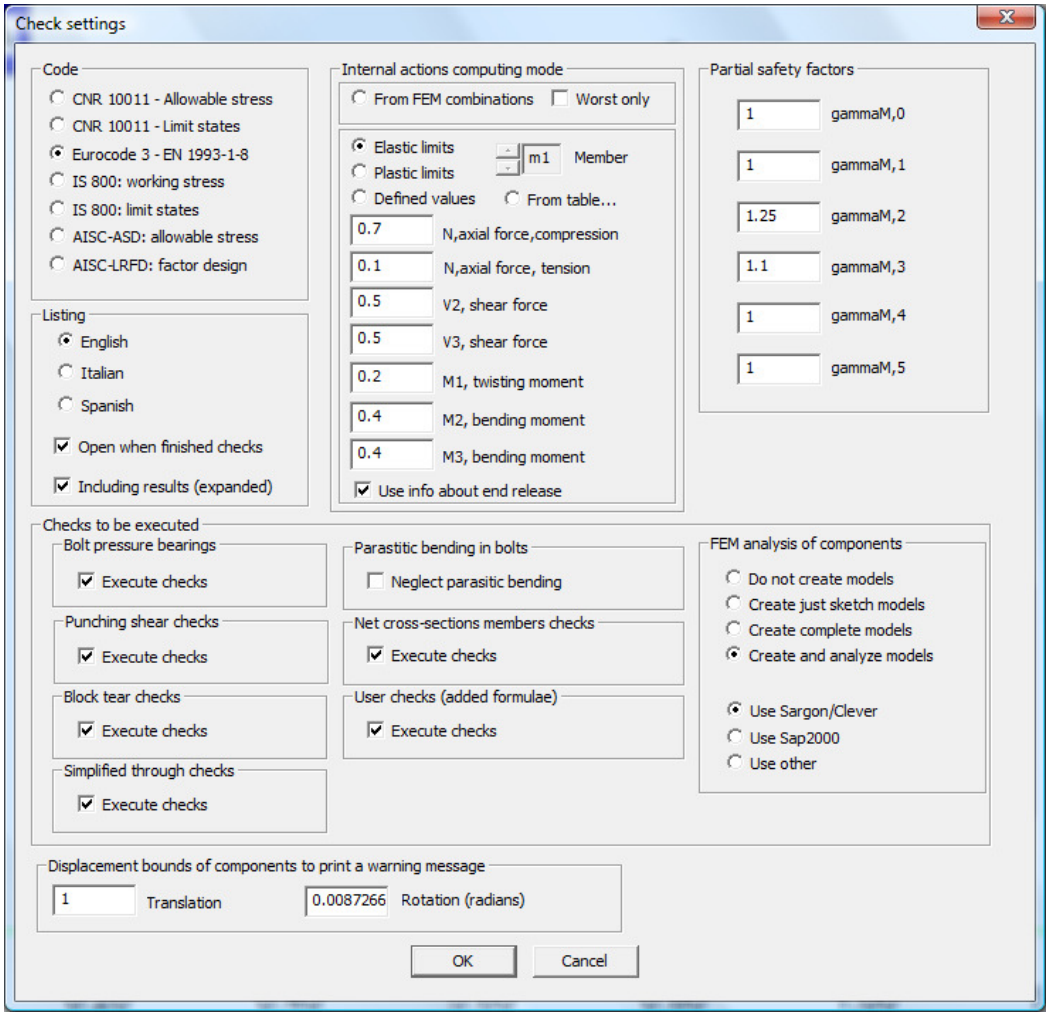
This is the "logic" of the real node. You go from member "m1" to the constraint block passing through W1, P1, and B1.
We are ready to check the connection.

2.6 STEP 6: SETTING CHECKS

Before executing the checks, let us specify how we want them to be done (we now choose the settings that initially have left as default values). Execute the command **Checks-Set**. You get a dialog like that following.

The standard has already been chosen, Eurocode 3. This is a limit state standard. Now choose the language of the listing and if the listing will be automatically open at the end of checks.

Since we have not a true fem model we must choose as "Internal actions computing mode", "Elastic limits", "Plastic limits", “Defined Values” or combinations imported “From table”. Choose elastic limits for instance. Then specify the multiplier of internal actions for each component. Here we assume 0.7 for compressive axial force, 0.1 for tensile axial force, 0.5 for shears, 0.2 for twist, 0.4 for bending. You can specify the number you want. This will generate 24 notional load combinations. 6 for positive internal forces, one by one. Six more for negative internal forces. Next 12 will be a mix of N, M_2, M_3, i.e. axial force and bending moments.



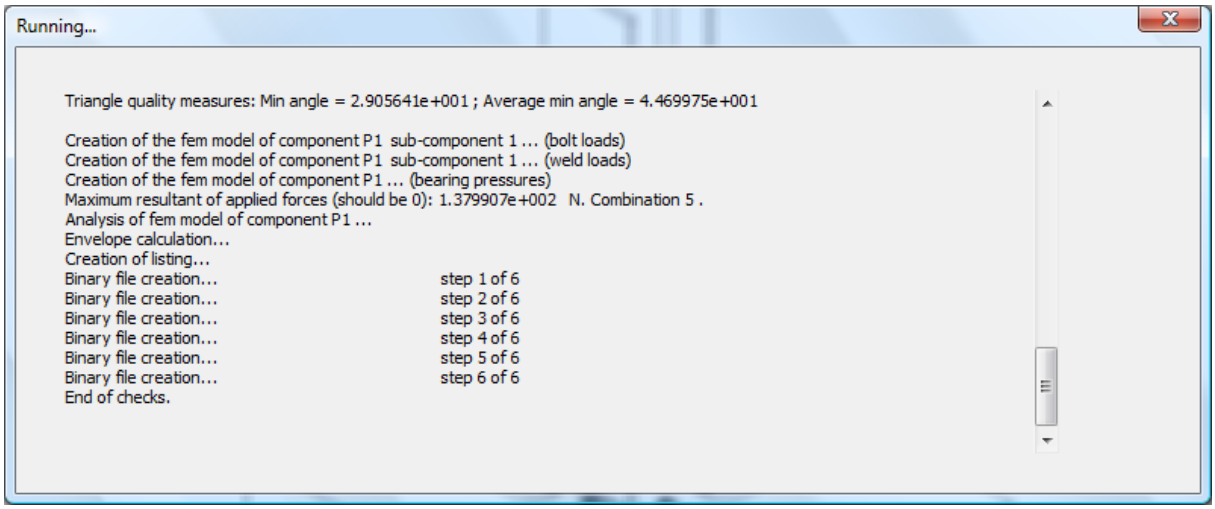
Leave all the remaining data as default suggests. Just ask "**Create and analyse models**" in order to get the fem model of the plate to be solved. Choose **Sargon/Clever**, i.e. the embedded solver, as solving tool.

Press **ok**.

2.7 STEP 7: EXECUTING CHECKS

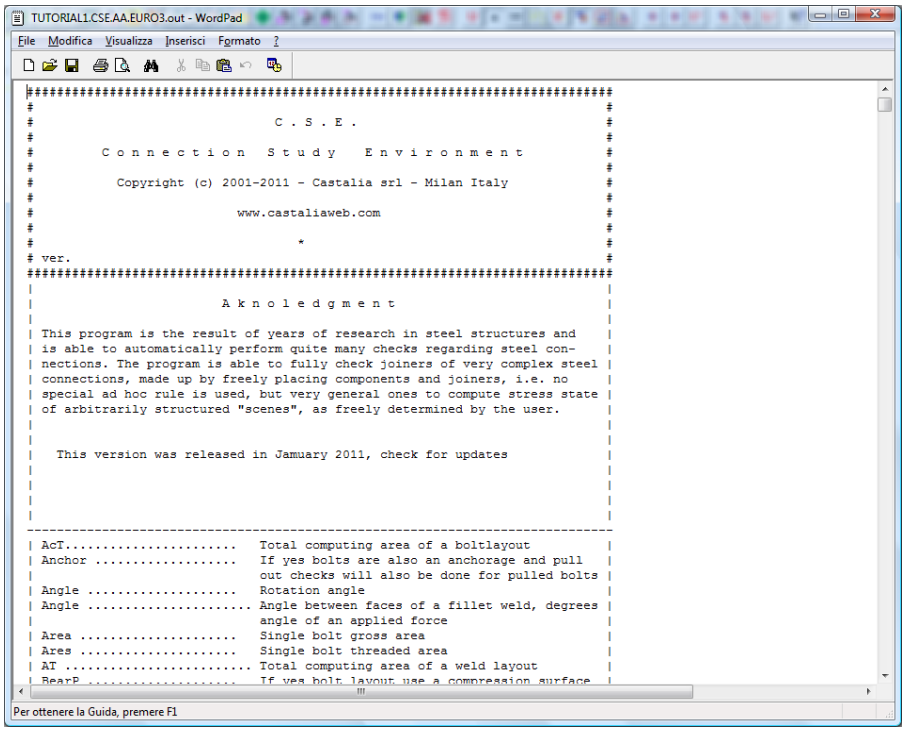
To execute the checks press the following button

in the left toolbar.



The window above will appear, it is a log window explaining what happens. At the end just close it by clicking over the red-background cross.

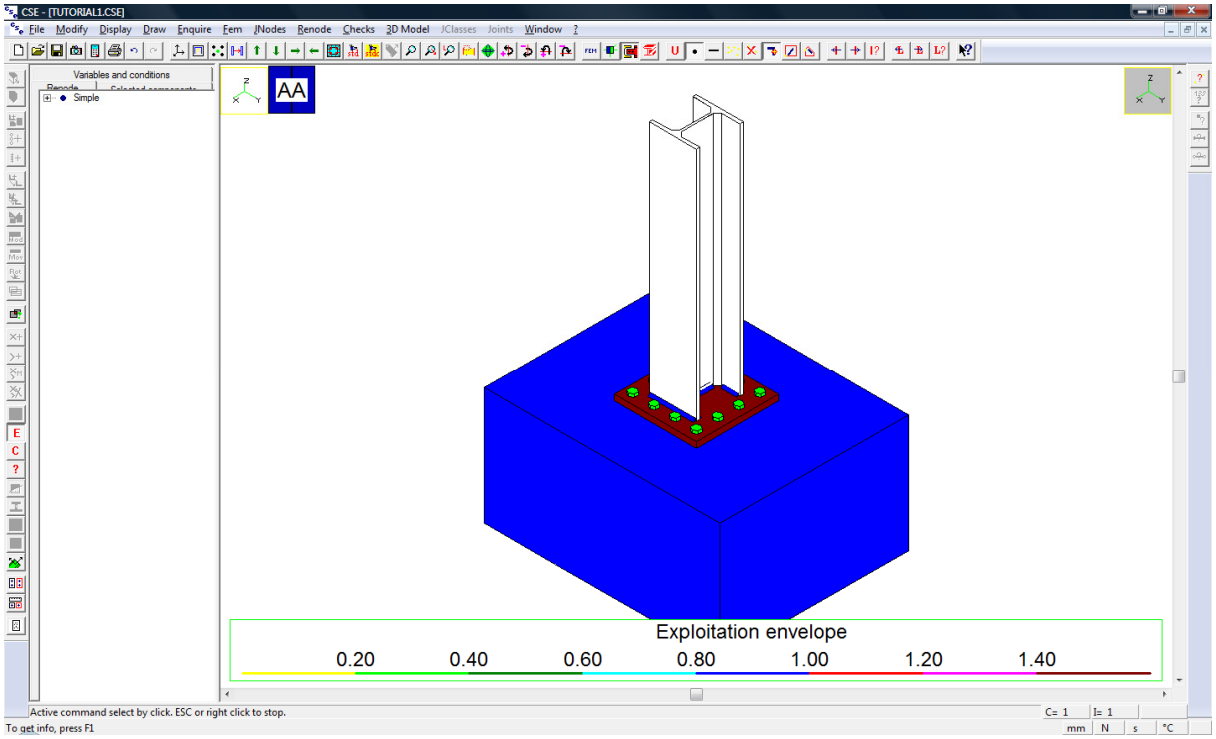
The output file has been automatically opened. You will find it as a whole in a next section. Have a look at the file if you wish, then minimize or close the output file window.



2.8 STEP 8: EXAMINING RESULTS

First of all press the red E button in the left toolbar.

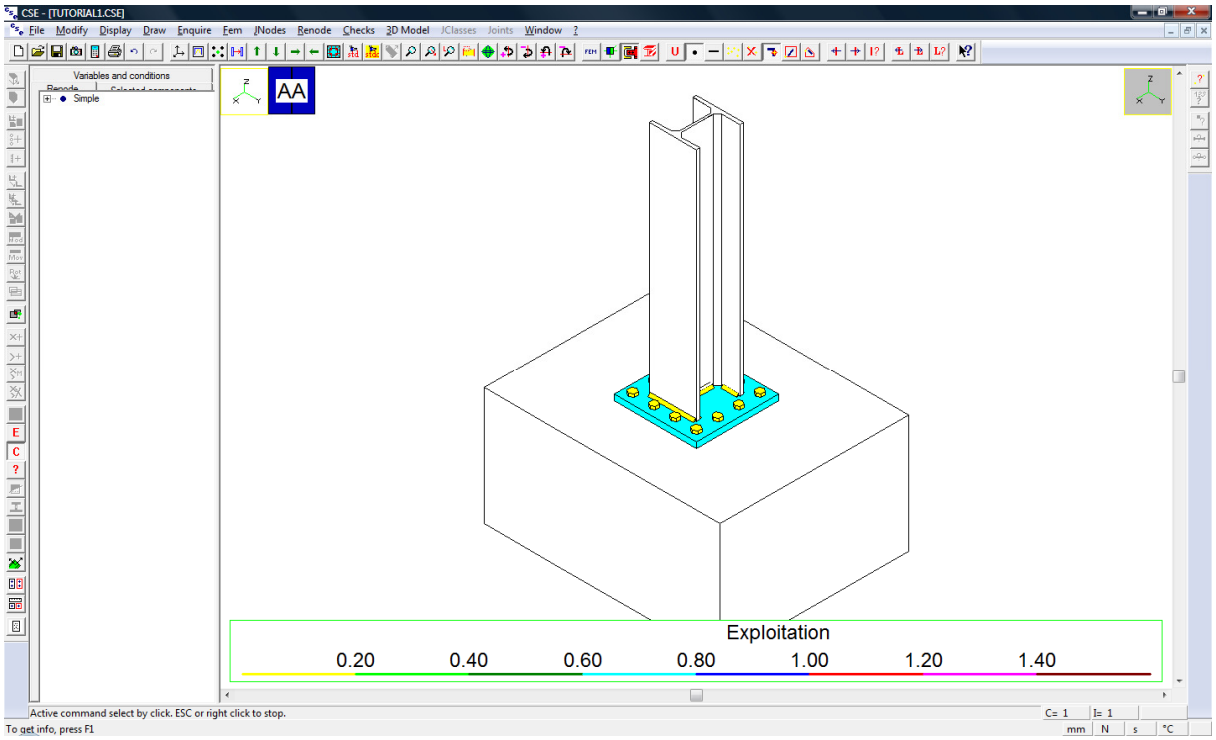
You will see a colour map with the envelope exploitations.



The base plate is not checked.

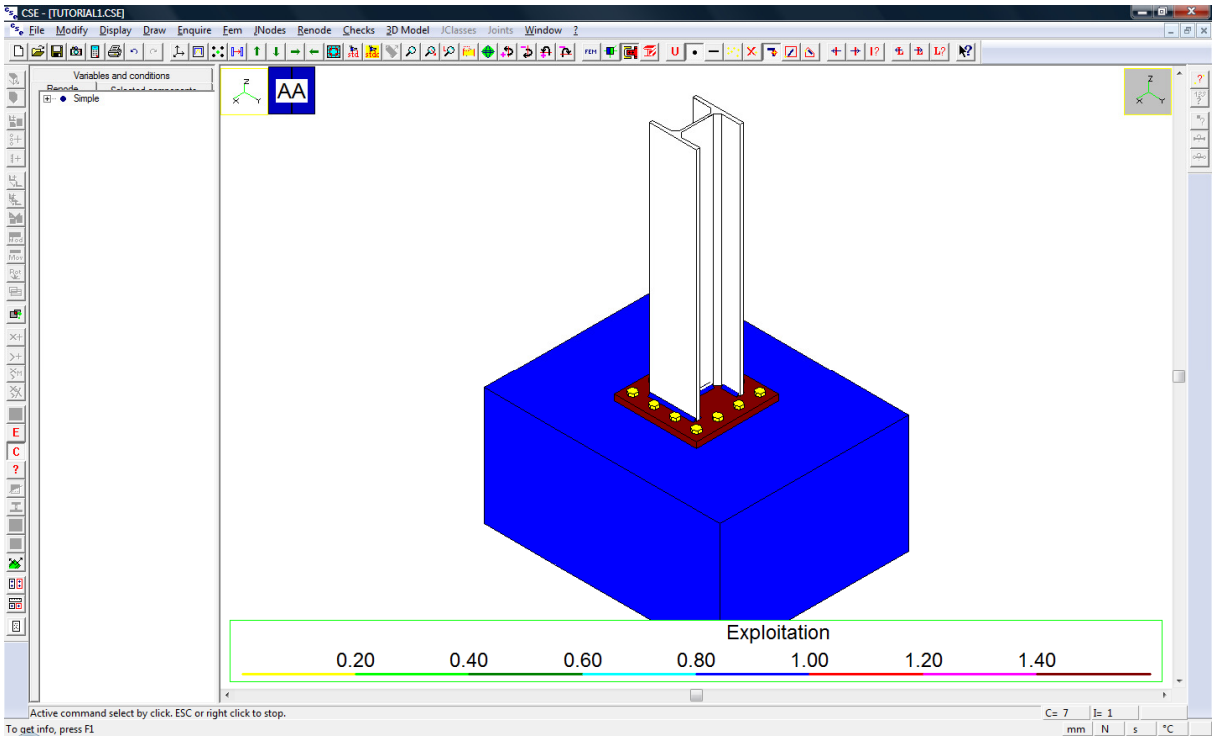
To understand why, let us see the exploitations in all 24 combinations. Press the button with a red C in the left toolbar (Combination):

You will see exploitations in the first combination:



This is the element in traction (0.1 times the elastic force). Note that the constraint block is not loaded by any pressure. By pressing the button  in the main toolbar you move to the following combinations. You notice it in the status bar at the bottom of the CSE window.

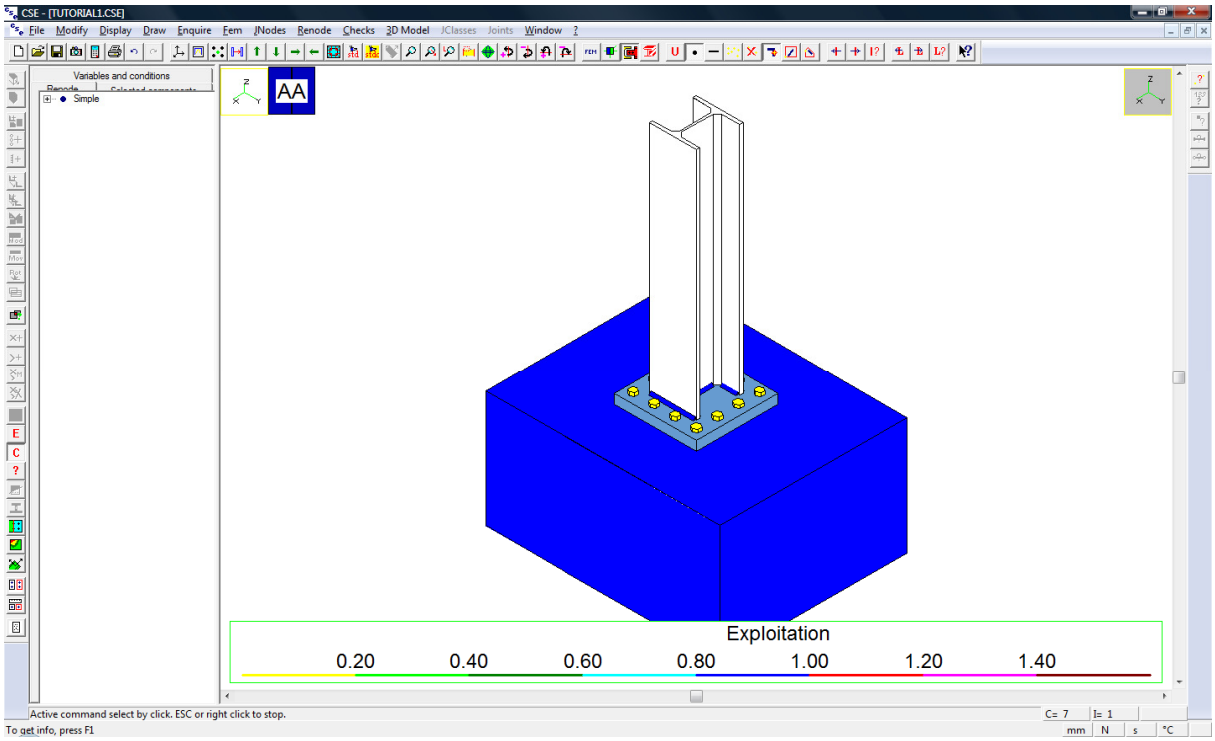
Move to combination 7 (element in compression).



Here the column is compressed. Note that bolt exploitation is quite low, and that constraint block exploitation due to bearing compression is comprised between 0.8 and 1.0.

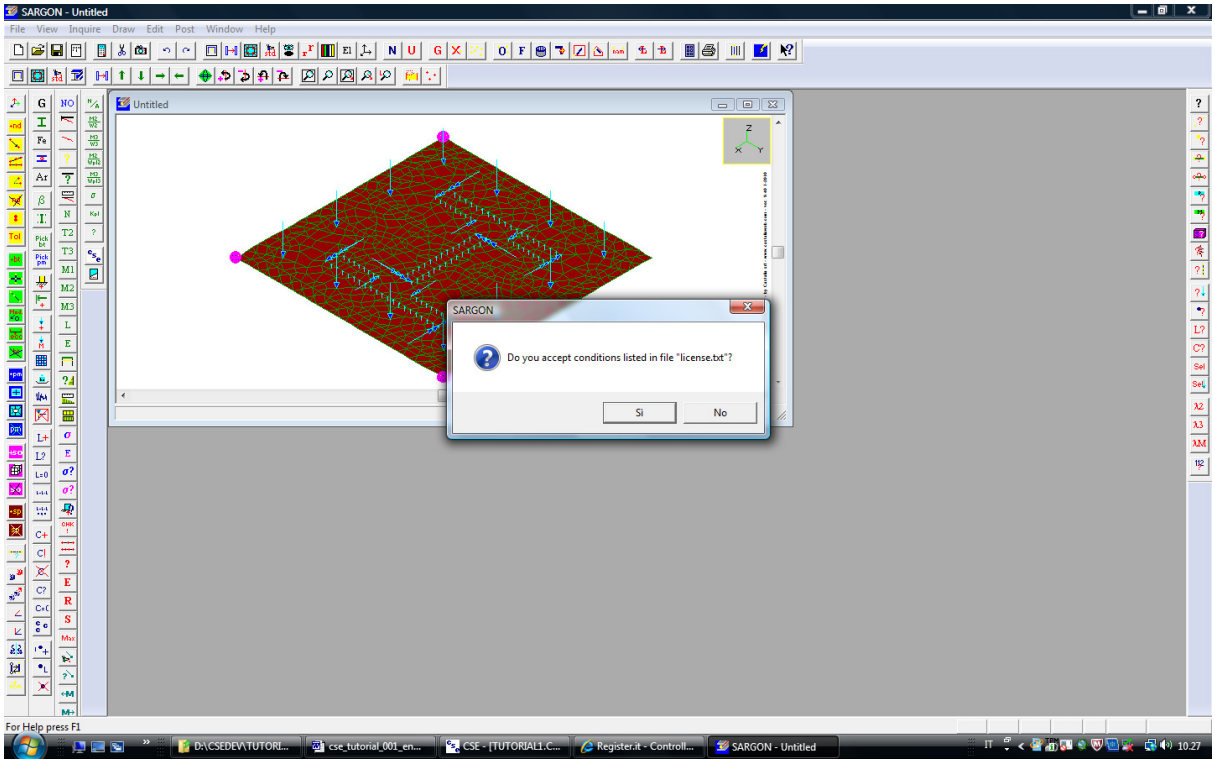
To have exact values just press the button  in the left toolbar: moving the mouse you will get the exploitation values for that combination, for all objects you need. To exit click right.

Let's have a look at the fem checks for the base plate in combination 7. Click over the base plate so that it gets blue (see next picture). Now this is the only component selected.



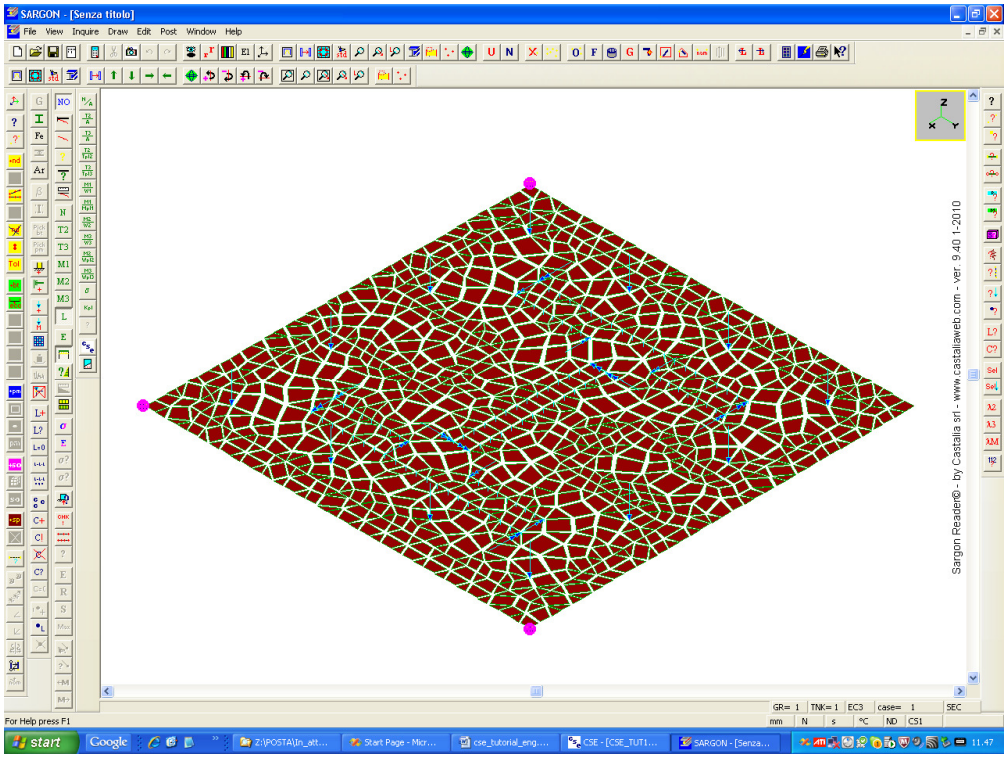
Just press the button  in the left toolbar. This starts Sargon Reader to have a look at the FEM model created and solved for the base plate.

Now you get the following window:

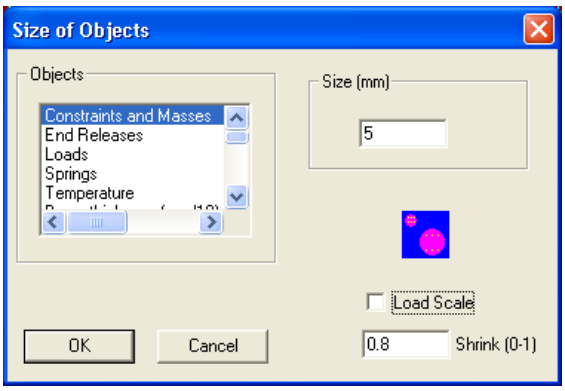


Answer "yes" to the question.

Maximize the model window and use the mouse wheel to zoom in. You see the fem model of the base plate:

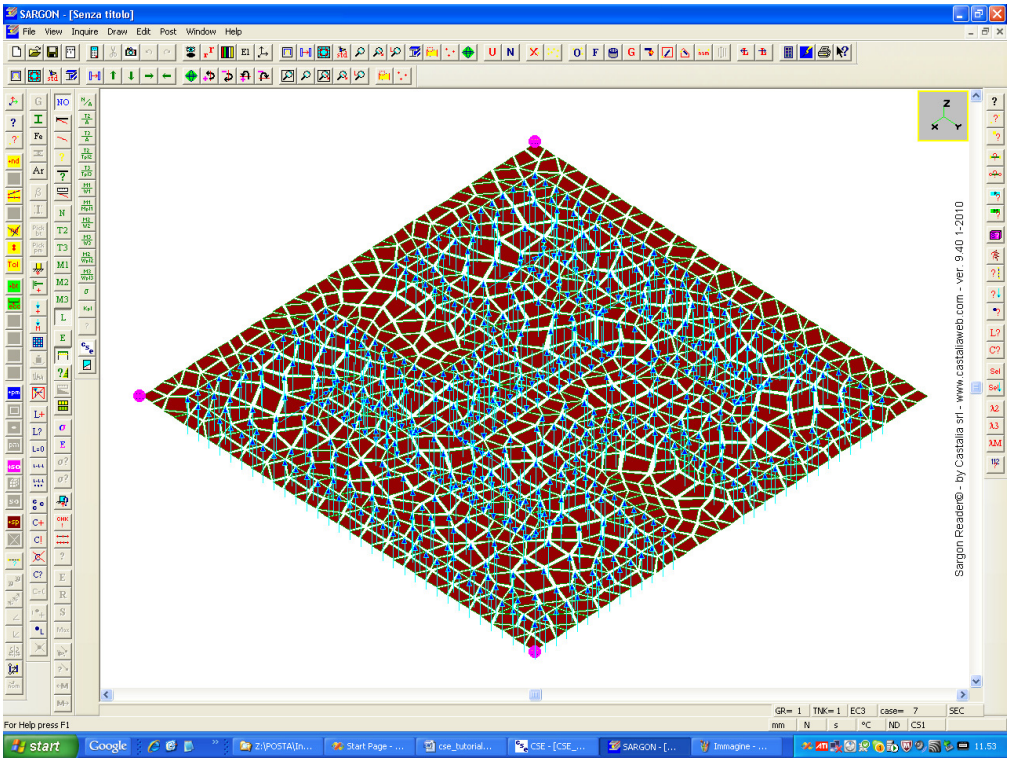


To have a clear look at the forces applied press the  button in the main toolbar, and remove the tick from the Load scale check box:



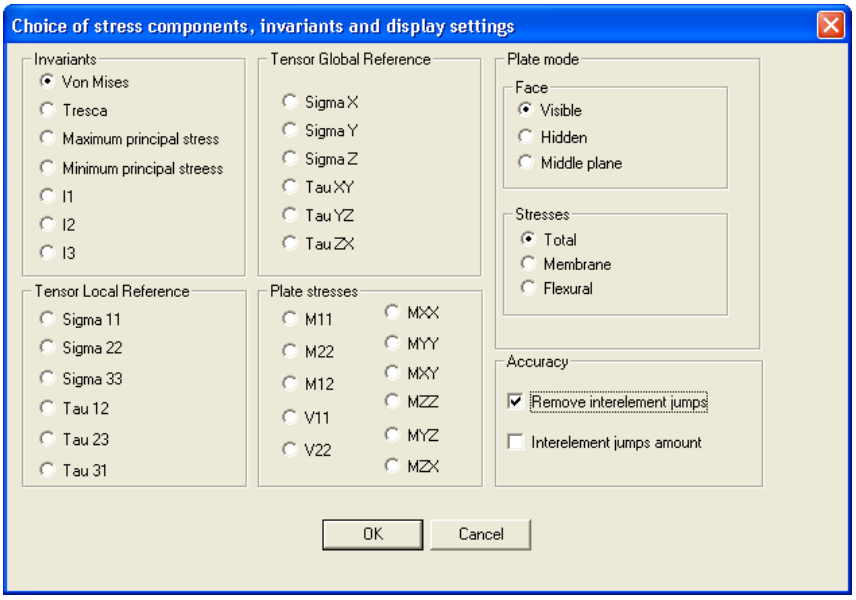
Press **OK** and then look at the unscaled forces applied to the model.

Move to load case 7 (column compression) using this button  : you will notice that the bearing surface is loaded and the outside region is not loaded. This is exactly what we have asked for.



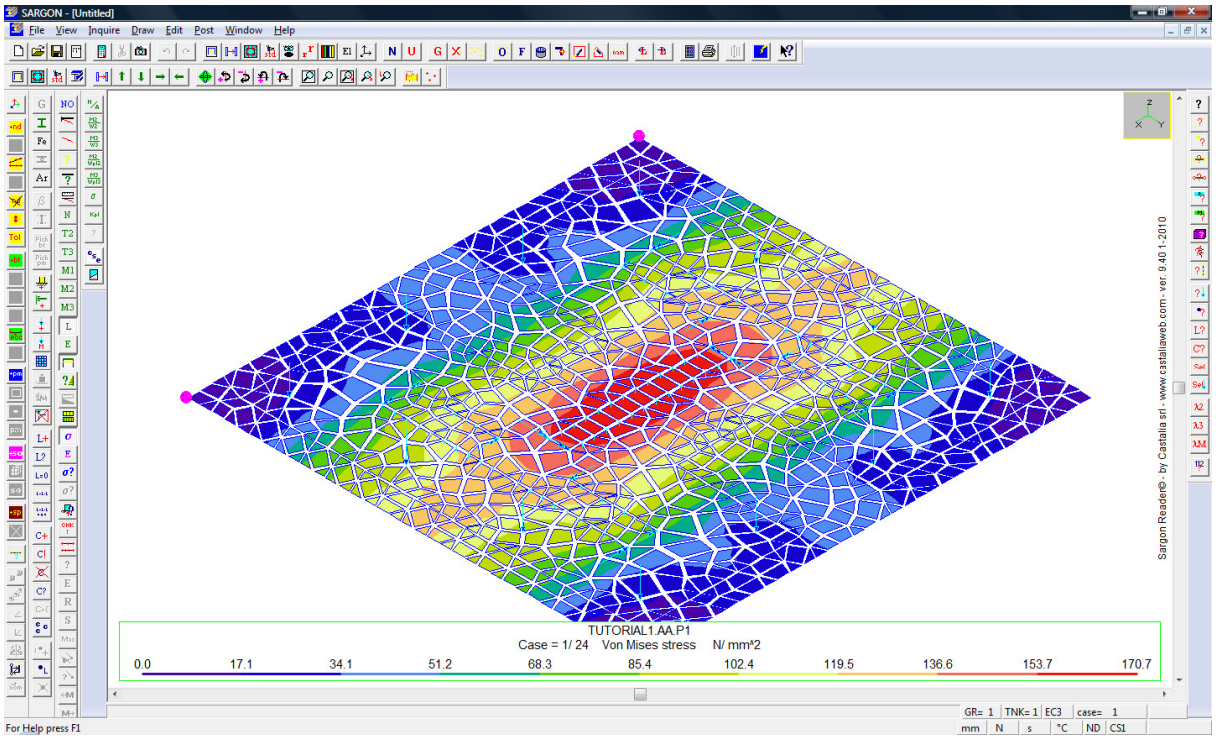
Get back to load case 1 using  .

Now let's have a look at Von Mises stresses. Press this button in the third toolbar from the extreme left  , a dialog appears. Choose as follows the ticks in the check boxes:



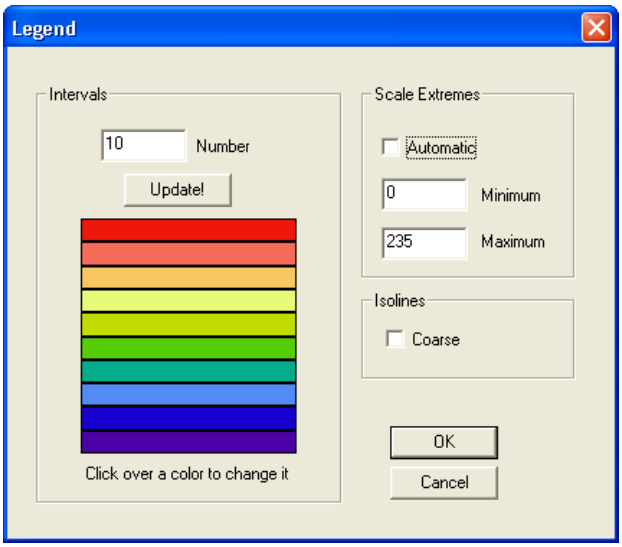
And press OK.

Now you see the Von Mises map in the first load (i.e. the first combination of CSE).

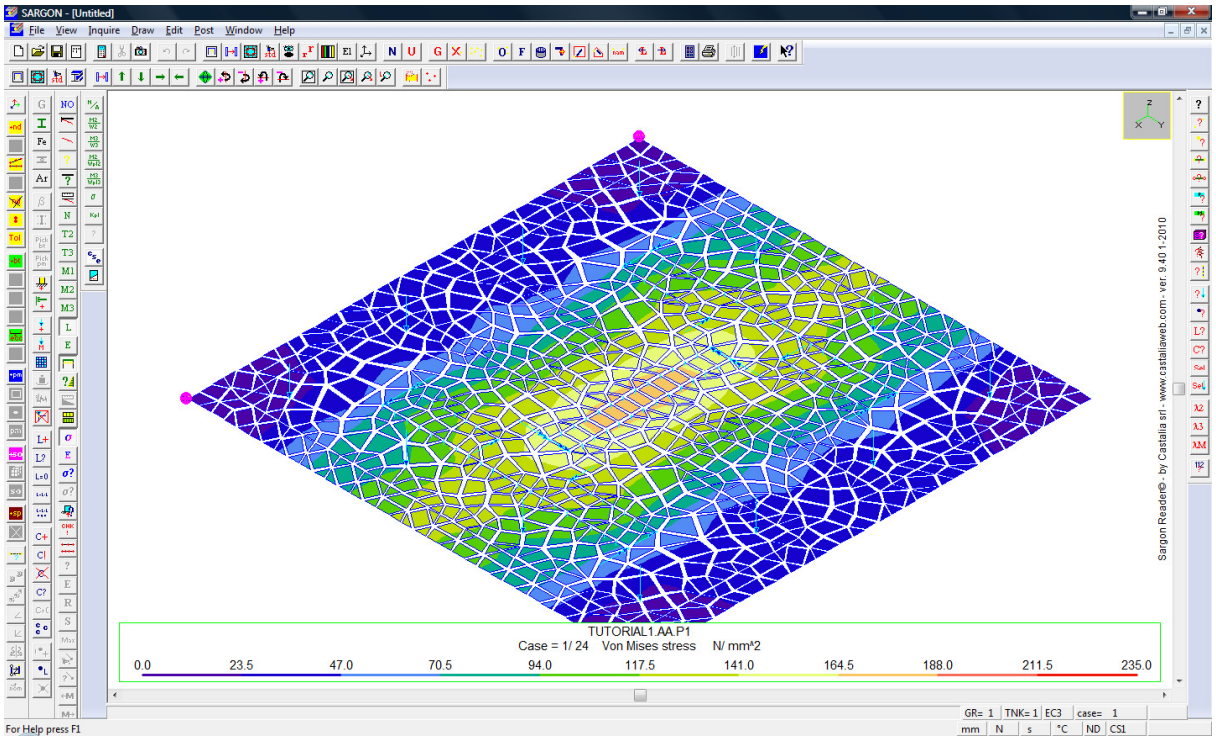


To better understand the stress levels, set as maximum stress the yield stress in the stress scale.

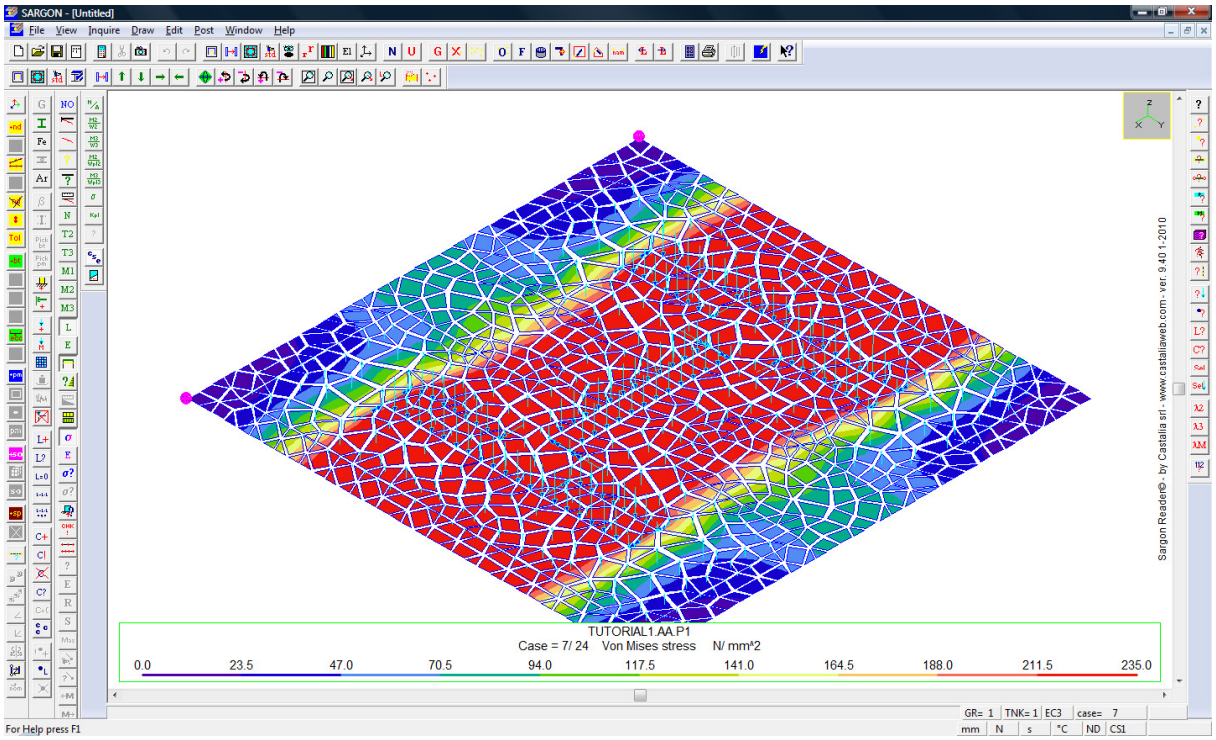
Execute Post-Legend command, remove the tick from Automatic and set as maximum 235 ([N/mmq] as you are using default units).



Now you get what follows:

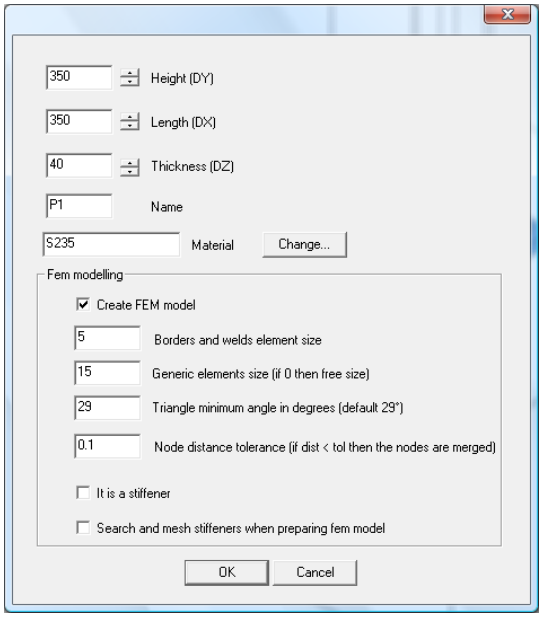


The plate is OK in this load case 1 (column pulled by 0.1 times its elastic limit). Switch to combi 7 by using the same button  you already know in the main bar. You see what follows:



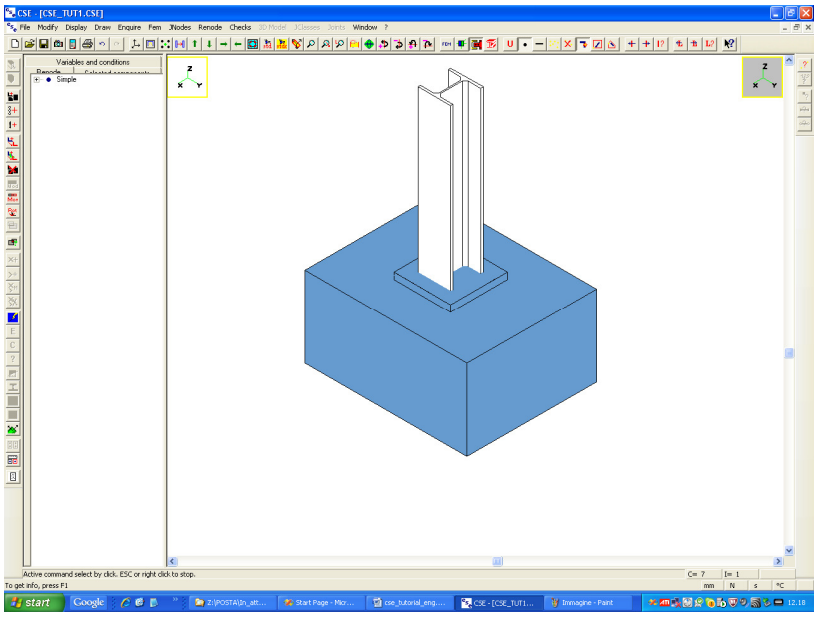
We will then change the plate to a higher thickness and also change the weld that highly exploited (0.973 < 1).

Exit from Sargon Reader by clicking over the red-background white cross. In CSE un-press the red button "C" in left toolbar. The plate is already selected. Click the "Mod" button in the left toolbar to modify the plate. You get the plate data dialog. Change the thickness to 40mm and decrease the mesh size to 5 and 15, in this way:

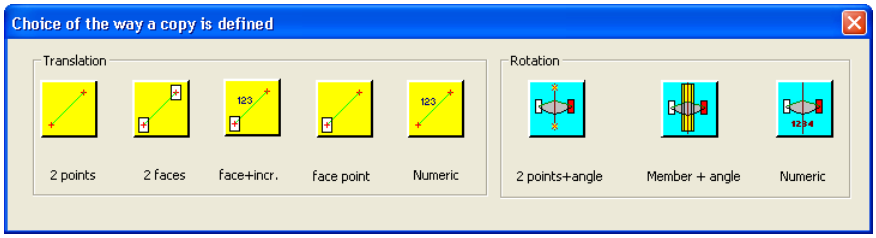


We decrease the element size to have a finer fem model (we will explain why later).

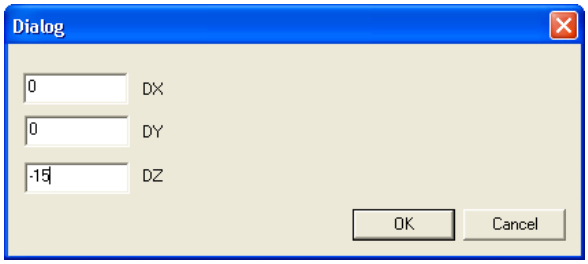
Press OK and notice that due to plate thickness change the connections have been lost. We will just move objects to re-establish connection (i.e. tangent conditions). The plate is already selected. Click over the constraint block to select also it.



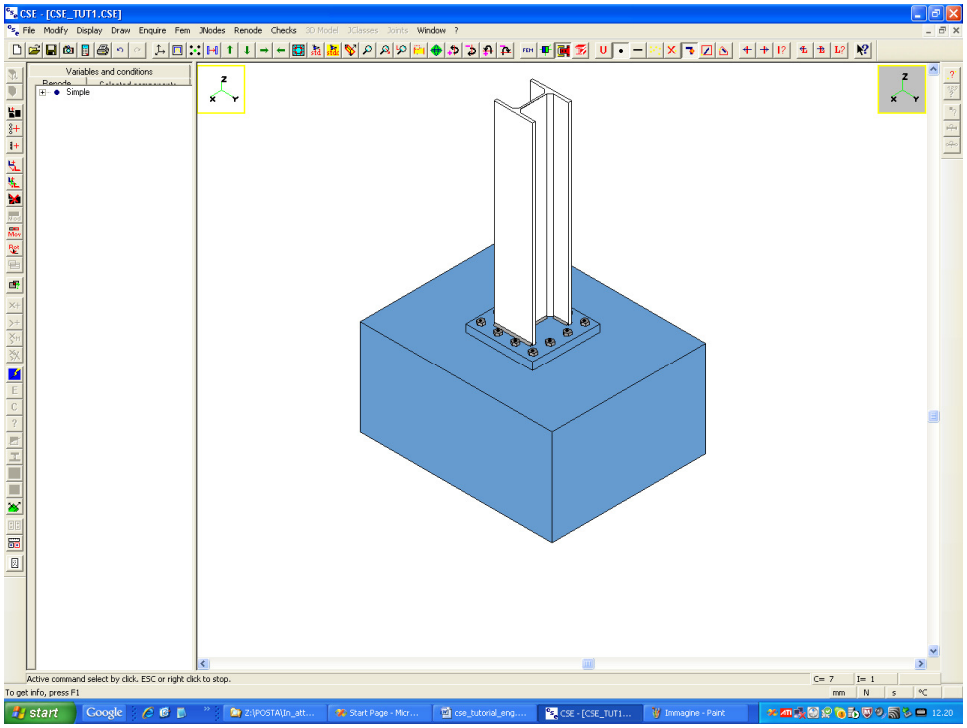
Now press the "Mov" button in the left toolbar, the following dialog appears:



Press yellow "Numeric". And then specify -15 for DZ.



Press OK and see now that the scene is ok.

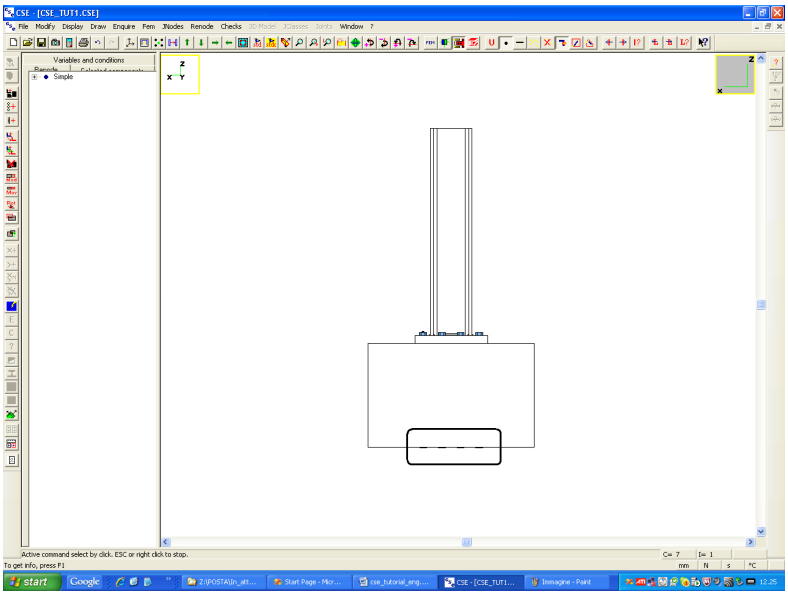


However, since the bolt length has changed (due to the increase in plate thickness) we have to inform the program by just re-editing and saving the bolt layout. You can notice this thing in two ways.

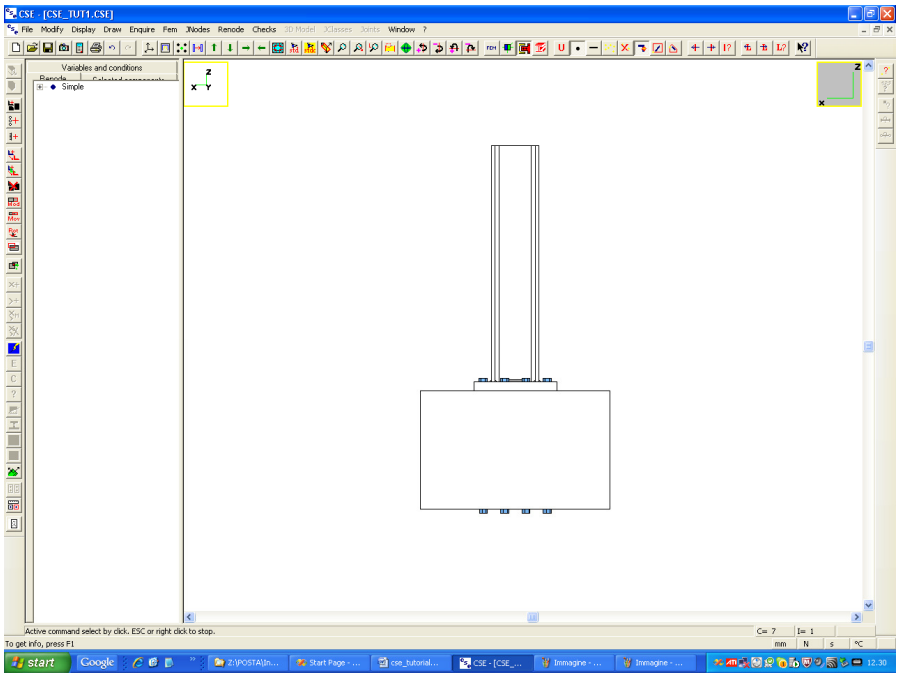
1) Execute the command Renode-Check coherence. You get the following message:

Once you press OK you see that the bolt layout is the only component selected.

2) Choose a +Y view and see the RENODE in this way. To do that press the  button in the main toolbar and choose +Y. You see that the nuts are not out of the constraint block but embedded into it. This means the bolt length has to be updated. This is quite easy to do as the bolt-heads are correctly in contact with the upper constraint-block face, so just the nuts have to be updated. The bolt layout is already selected, so we can re-edit it.



Press the "Mod" button in the left toolbar. You get into the bolt layout dialog, just press OK without doing nothing, you will now see what follows

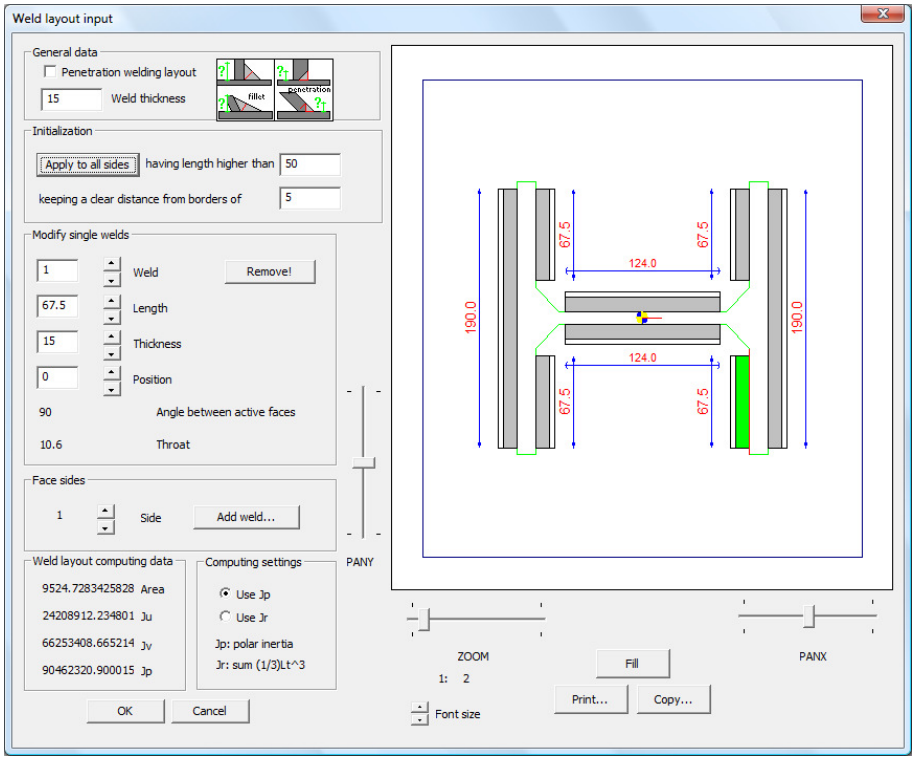


The nuts are correctly positioned. Re-execute Check-coherence command and see that all is now ok:

Change the view to an isometric view (press the std button in the main toolbar and choose ISO).

We now - as an exercise - change the weld to improve its exploitation which is high. Unselect all (in the main bar) and select the weld layout. Now press the "Mod" button in the left toolbar. You get into the weld layout dialog.

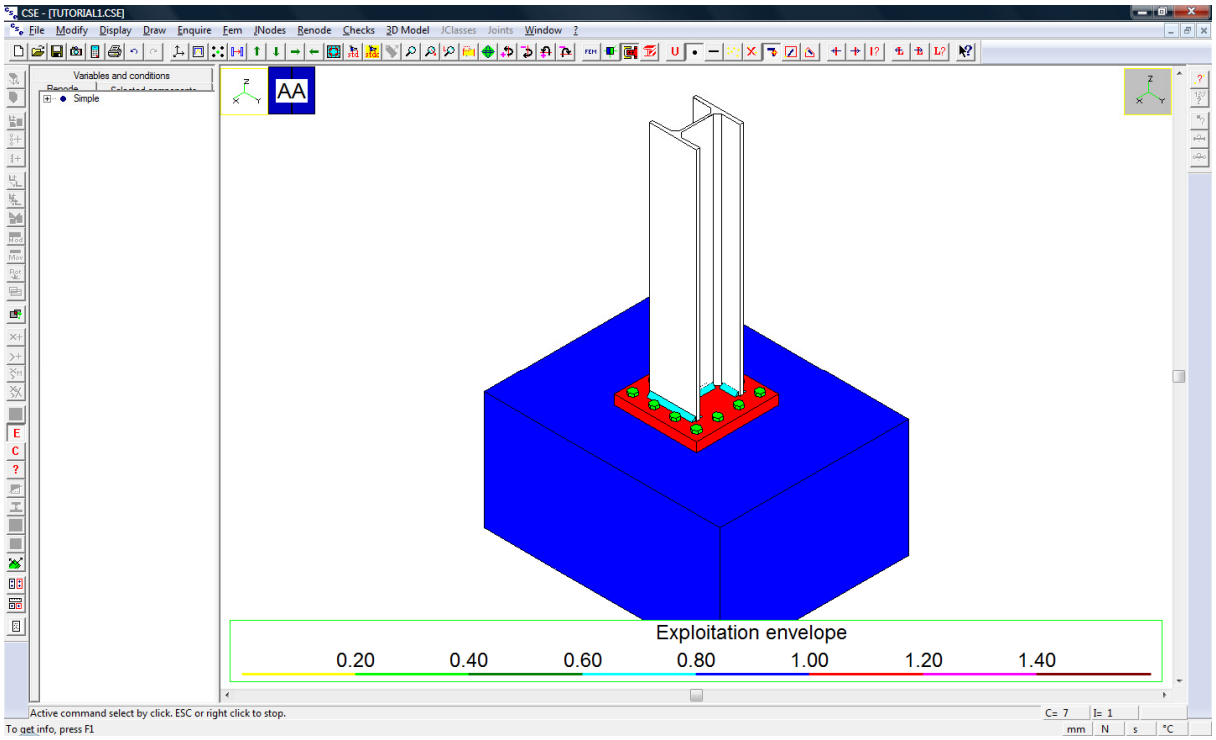
Increase the thickness to 15 and then press Apply to all sides leaving 50mm and 5mm as parameters. You get the following:



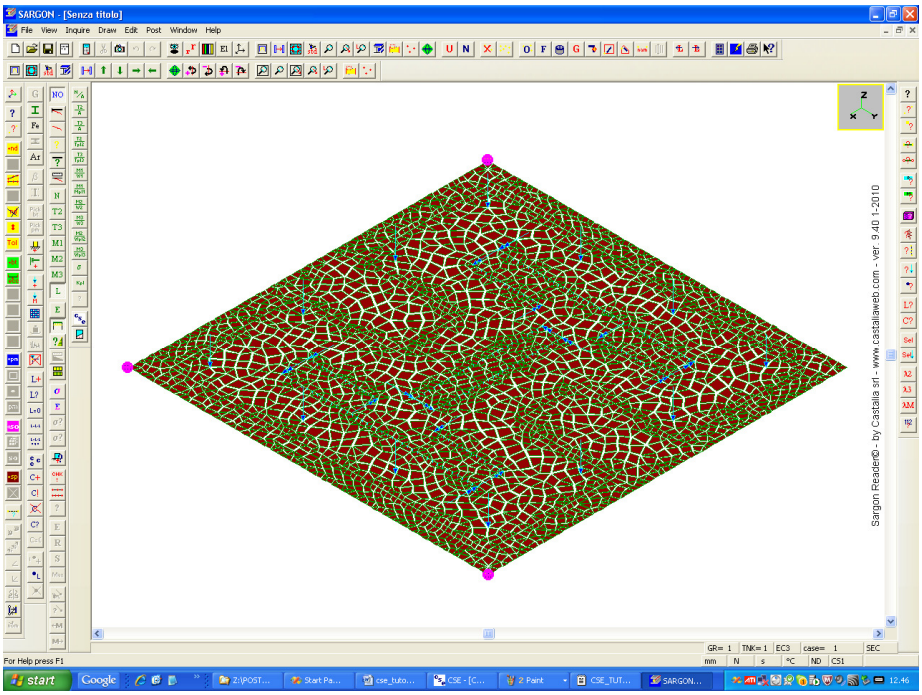
Press OK and notice that the weld layout has been changed.

Re-execute the checks ( ) in the left toolbar. As the mesh size has been halved the time necessary to create the mesh will increase. Just wait until the procedure ends. The model will now have some like 17,000 dofs (the previous had 5,556 dofs).

When finished close the output dialog and close the notepad window. Press the red E button in the left toolbar and look at envelope exploitations:

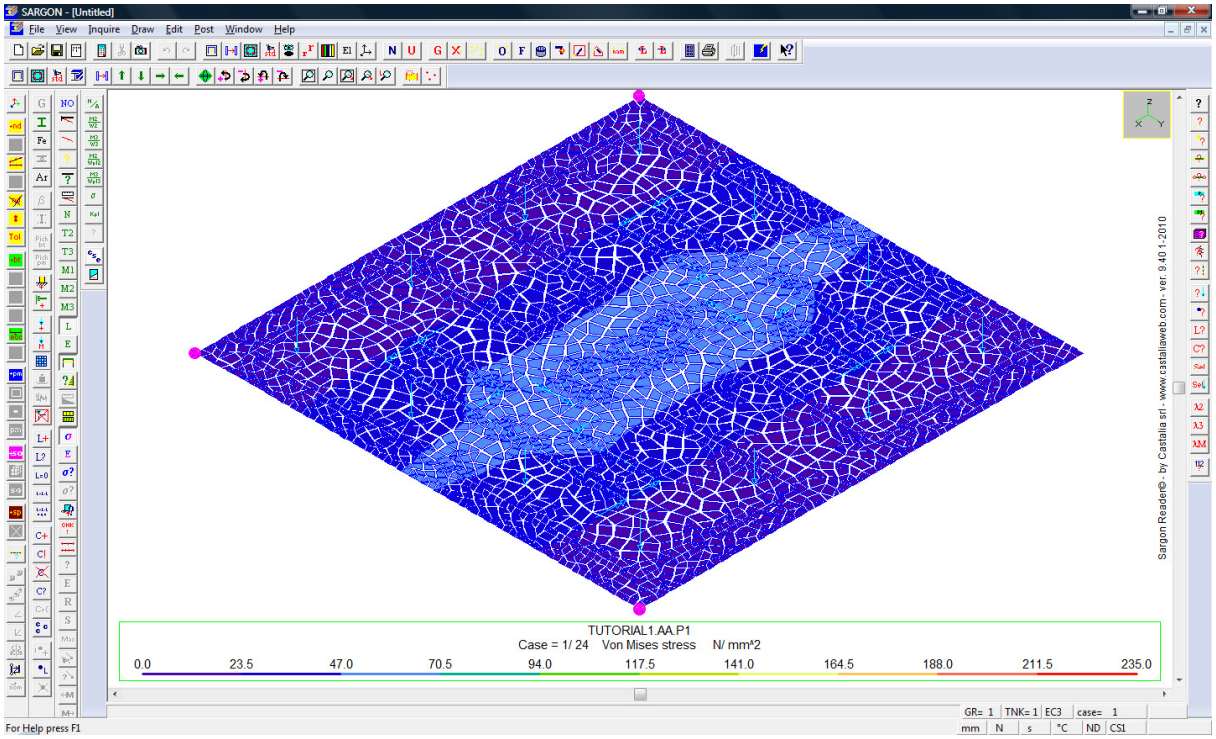


The weld is now exploited at a lower level, and once more checked, while the plate is still not (1-1.2 range, a lower range than before, but still un-checked). However we would like to have a look at the fem result to decide if the plate can be accepted or not. Select the plate by clicking over it and press the  button in the left toolbar. Get into Sargon Reader and zoom in to have a look at the model.

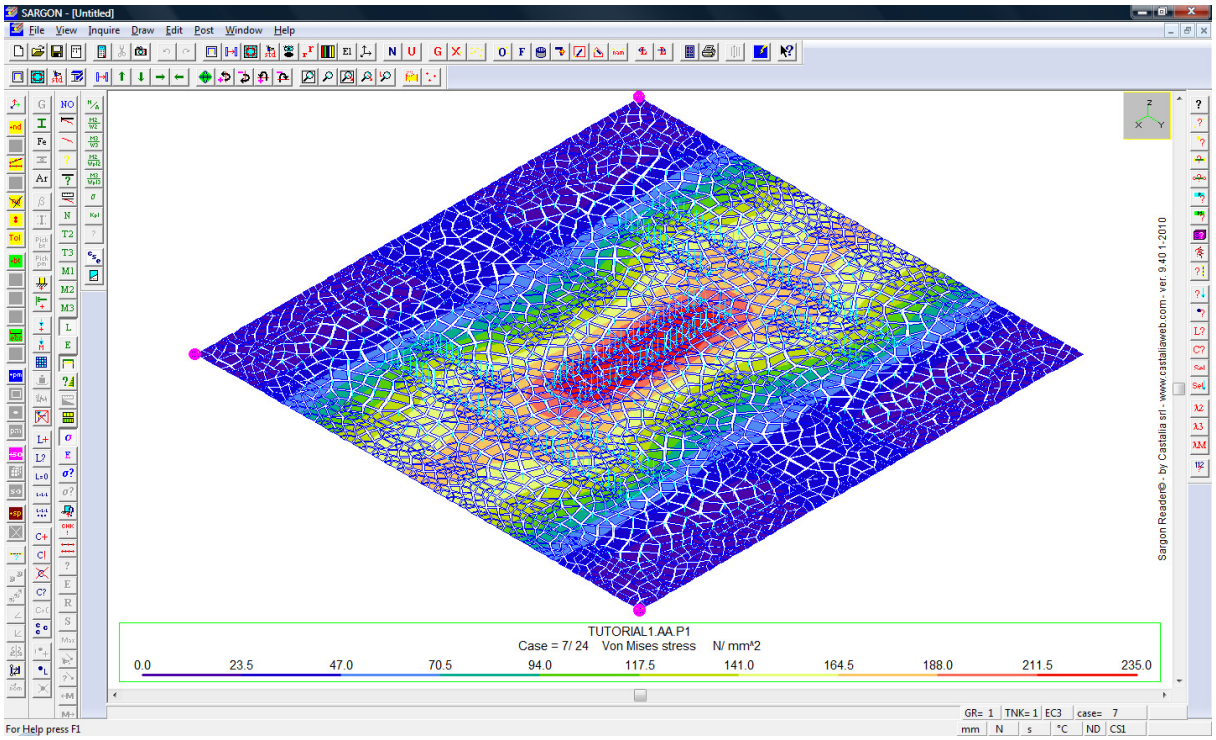


The model is more refined. Now choose the stress button () in the left toolbar, as already explained. Choose Remove interelement jumps and press OK. You see the Von Mises stress map in

the current (1) load case. This is the column pulled. Set the legend min and max values as already explained and you see the following map:



Now look at the next 5 combinations, the stresses are always low. So it is the compression in the column to produce the high stress. See now load case 7: this is the compression. You see that the stress map is as follows (we have removed the loads by using View-Objects command, and removed the tick from "Loads", and set the plate elements shrink to 1 by pressing  button in the main bar and setting 1 as shrink):

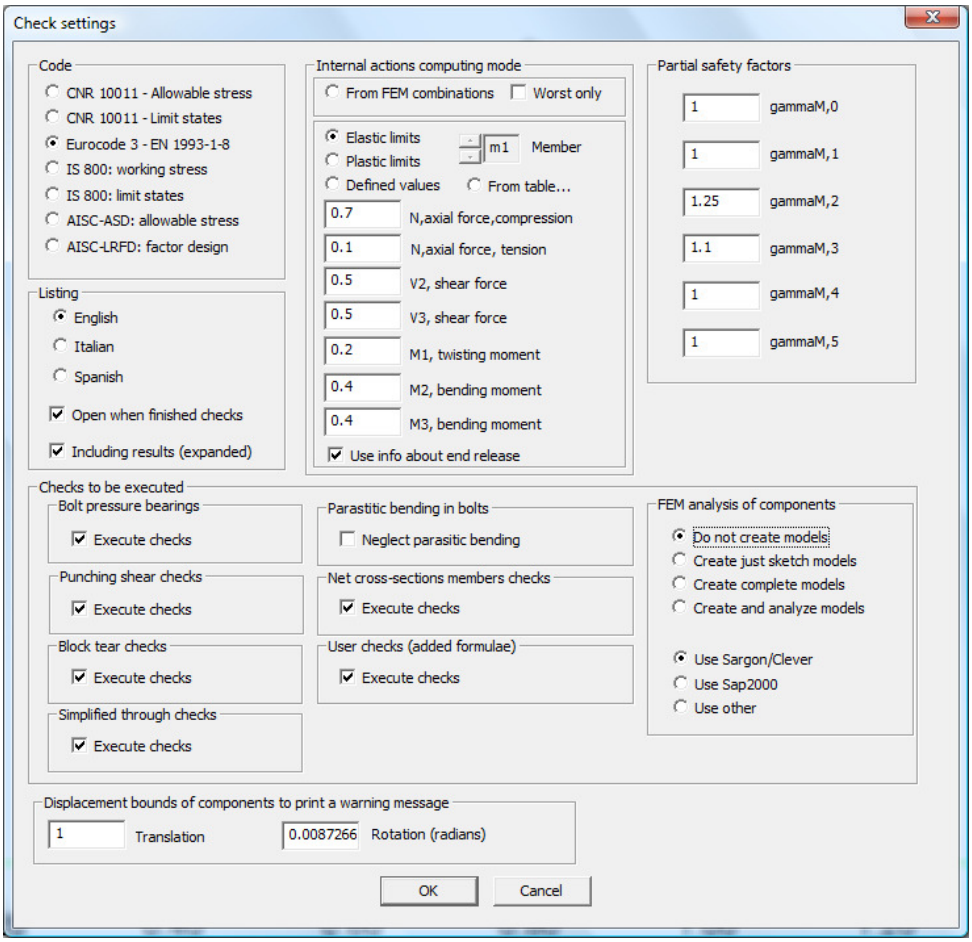


Although there is an area where the Von Mises stress is higher than 235MPa, we would probably accept this plate element, as the plasticization occurs in a limited region under the column web.

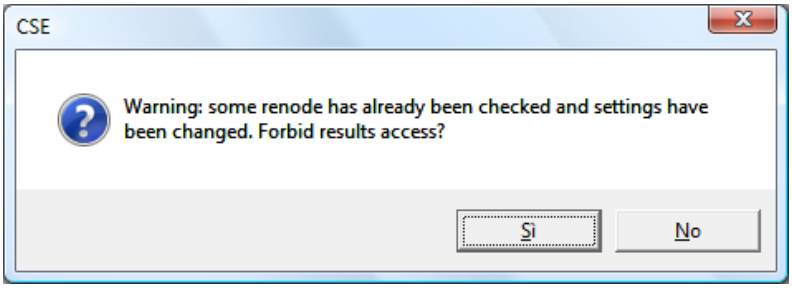
So we can re-execute the checks avoiding to use fem results to determine plate exploitation: we will keep the fem model results to show that our choice is due to good reasons. Otherwise we could increase once more the thickness or add stiffeners to better distribute the pressures. Let's see how to re-execute the checks avoiding to keep into account the fem model results for this plate. As this is the only component we have checked via fem, we could avoid fem model creation, at all.

Close Sargon Reader and go back to CSE.

Execute **Checks-Set** and choose do not create models in the "FEM Analysis of components" group.

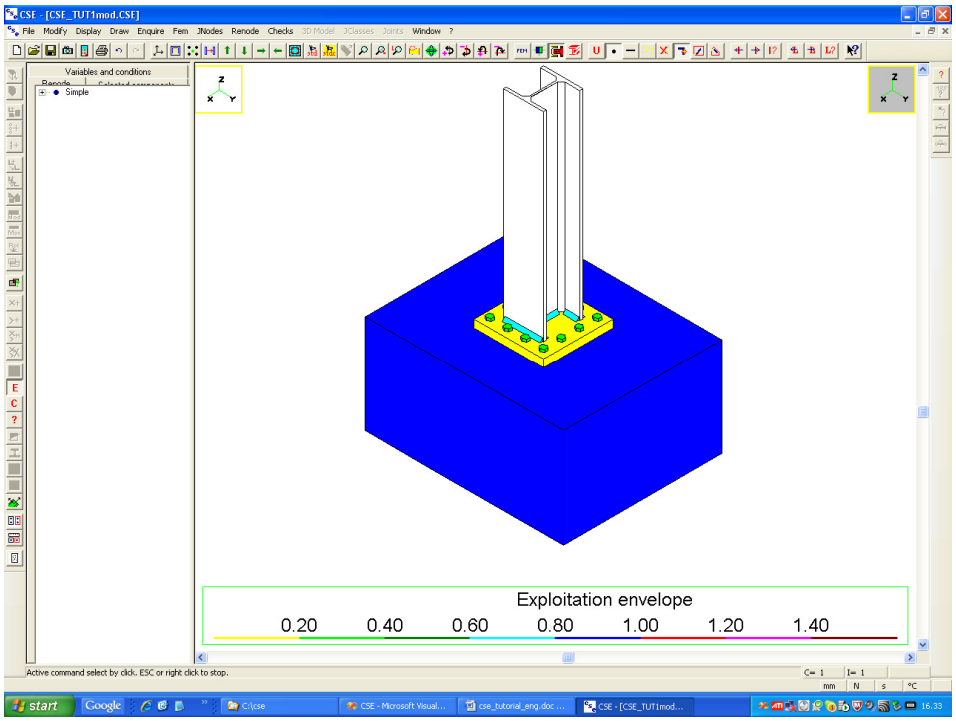


Press OK and answer yes to the following question (Sì=Yes):

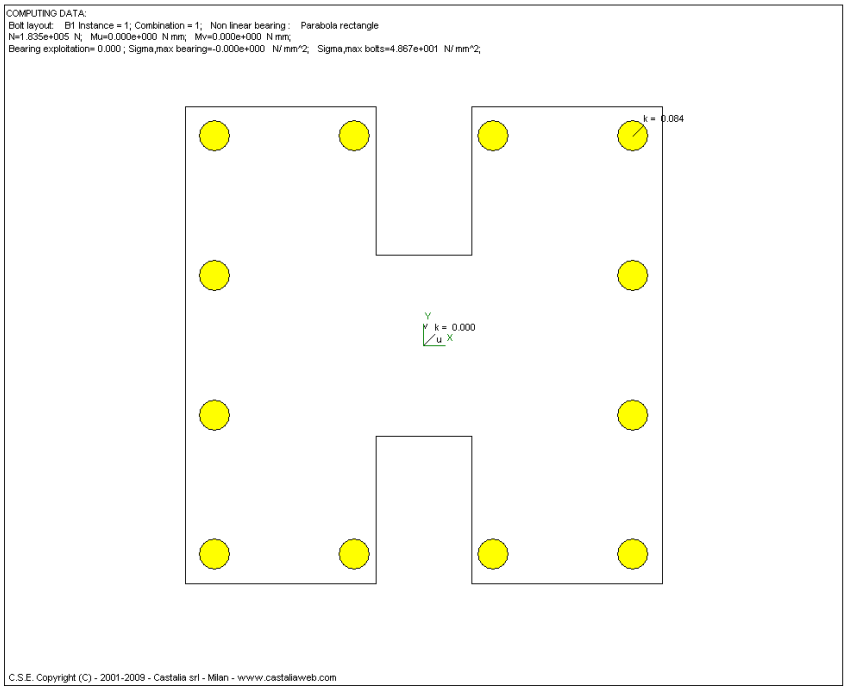


Exit from the Envelope command by pressing back the red "E" in the left toolbar. Now re-run checks.

At the end close the output windows and press once more the red "E". You see what follows:



Every component is checked. The plate has been previously studied via fem Let's have a look at the constraint block checks. Here what matters is the pressure over the block. Exit from the "E" command and select the bolts by clicking over them. Now press the  button in the left toolbar.

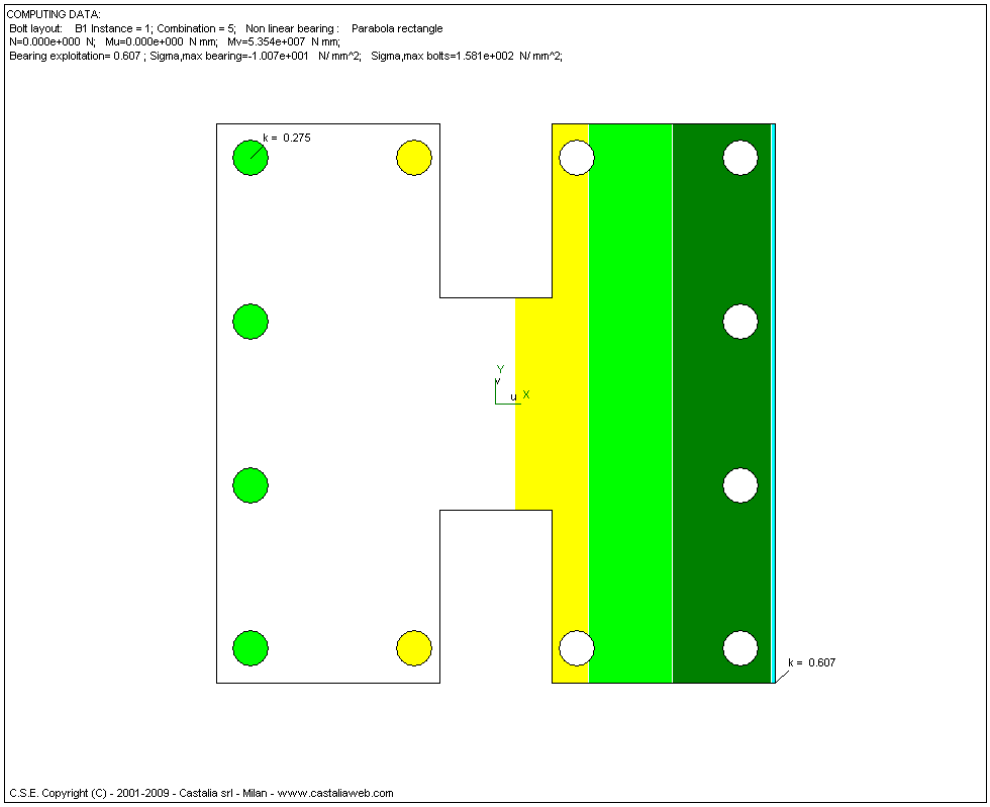


You see what happens in the first combination. The combinations have been built up using the following rule (just use "el", elastic, instead of "pl", plastic):

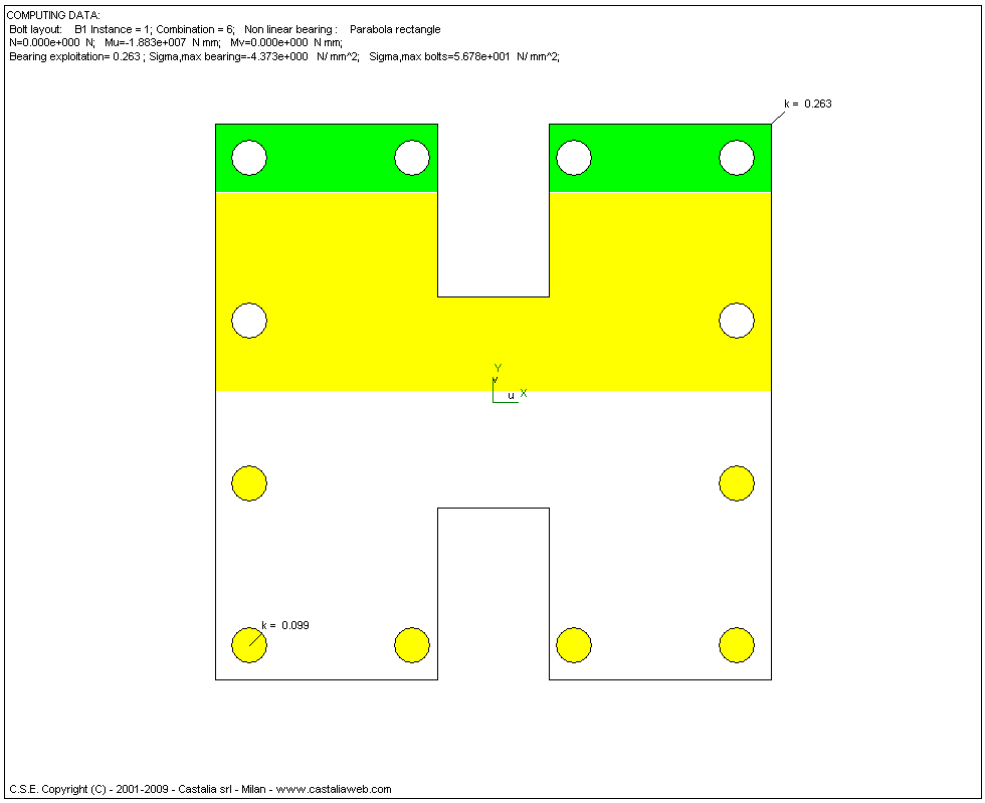
$k_{Np} \cdot N_{pl}$	$k_{V2} \cdot V_{2pl}$	$k_{V3} \cdot V_{3pl}$	$k_{M1} \cdot M_{1pl}$	$k_{M2} \cdot M_{2pl}$	$k_{M3} \cdot M_{3pl}$
$-k_{Nm} \cdot N_{pl}$	$-k_{V2} \cdot V_{2pl}$	$-k_{V3} \cdot V_{3pl}$	$-k_{M1} \cdot M_{1pl}$	$-k_{M2} \cdot M_{2pl}$	$-k_{M3} \cdot M_{3pl}$
$0.5k_{Np} \cdot N_{pl} + 0.5k_{M2} \cdot M_{2pl}$	$0.5k_{Np} \cdot N_{pl} - 0.5k_{M2} \cdot M_{2pl}$	$0.5k_{Np} \cdot N_{pl} + 0.5k_{M3} \cdot M_{3pl}$	$0.5k_{Np} \cdot N_{pl} - 0.5k_{M2} \cdot M_{2pl}$	$-0.5k_{Nm} \cdot N_{pl} + 0.5k_{M2} \cdot M_{2pl}$	$-0.5k_{Nm} \cdot N_{pl} - 0.5k_{M2} \cdot M_{2pl}$
$-0.5k_{Nm} \cdot N_{pl} + 0.5k_{M3} \cdot M_{3pl}$	$-0.5k_{Nm} \cdot N_{pl} - 0.5k_{M2} \cdot M_{2pl}$	$0.5k_{M2} \cdot M_{2pl} + 0.5k_{M3} \cdot M_{3pl}$	$0.5k_{M2} \cdot M_{2pl} - 0.5k_{M3} \cdot M_{3pl}$	$-0.5k_{M2} \cdot M_{2pl} + 0.5k_{M3} \cdot M_{3pl}$	$-0.5k_{M2} \cdot M_{2pl} - 0.5k_{M3} \cdot M_{3pl}$

Read the table from left to right and from up to down: each table cell is one of the 24 combinations. So the first is column pulled. Just bolts react.

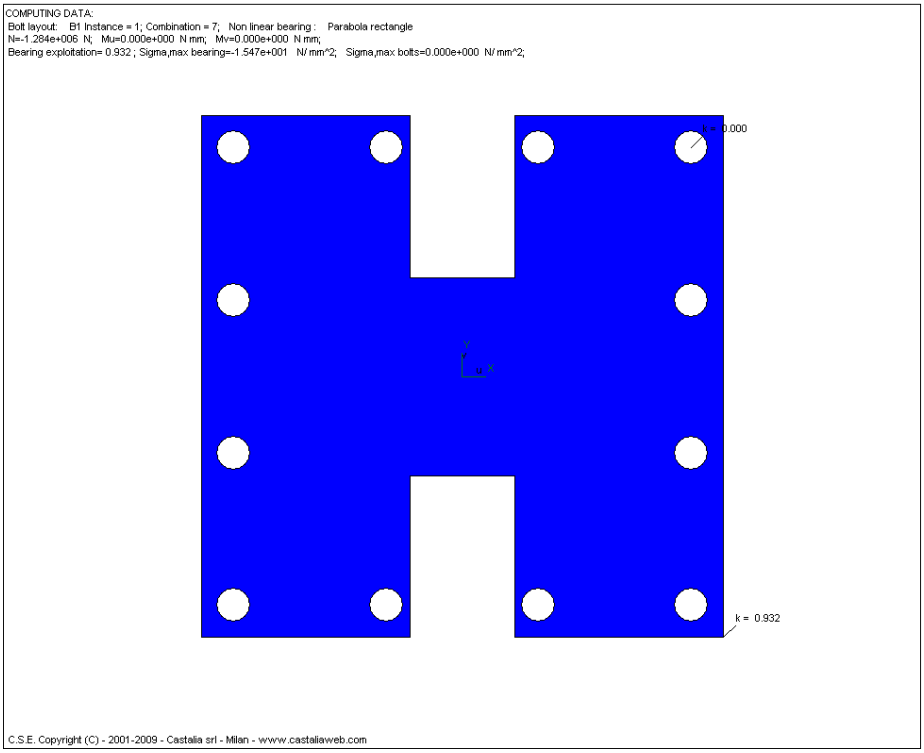
Now browse the combinations using the button in the main bar. Here is combi 5 (strong axis bending):



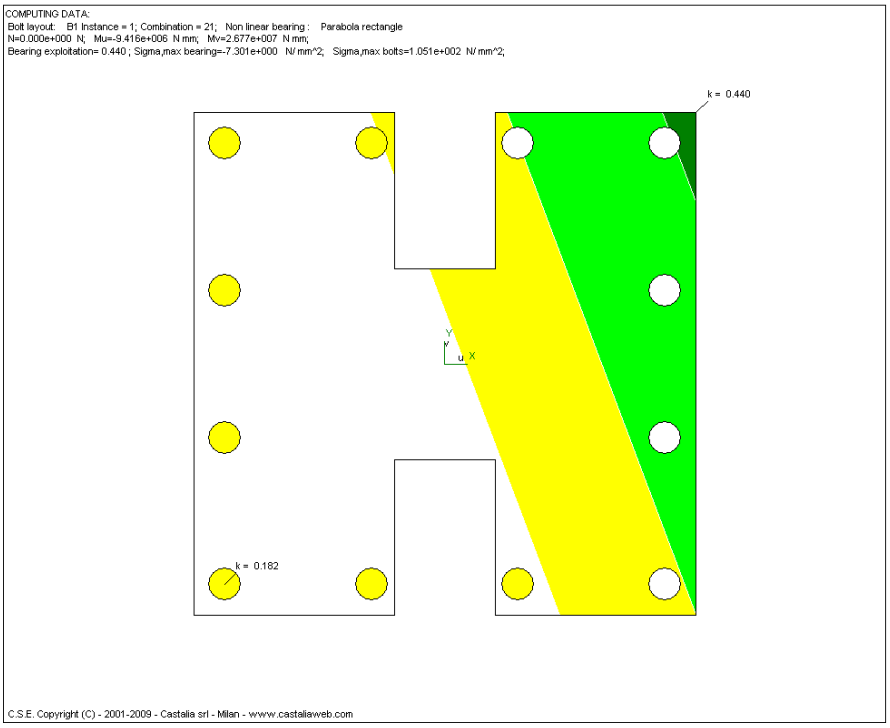
Here combi 6 (bending M3, weak axis bending)



Here is combi 7 (compression only):



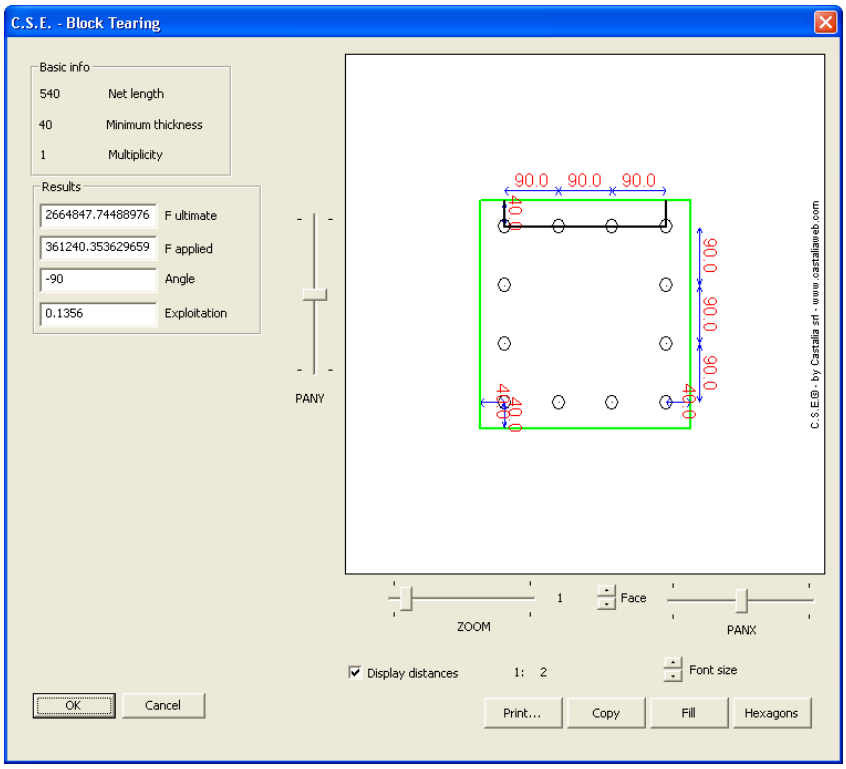
And here is combi 21 (i.e. $0.5k_{M2} \cdot M_{2el} + 0.5k_{M3} \cdot M_{3el} = 0.2 \cdot M_{2el} + 0.2 \cdot M_{3el}$)



As we can see from these pictures, the no-tension compressive field over the bearing surface is correctly computed. The bolts in tension are drawn in colour, the compressed bolts do not react (this was a choice of ours in the bolt layout properties, see the "Compressed bolts" check-box).

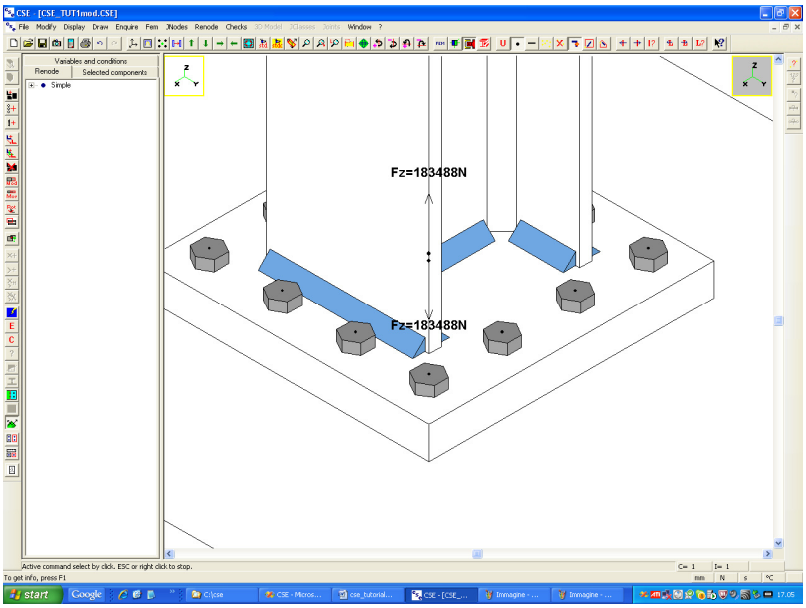
Notice that these pictures can be copied and pasted (use the button in the main toolbar to copy to clipboard).

Now let's see the block tearing checks. Un-press the button in the left toolbar. Select just the base plate. Move to combination 2, as that is the worst for the component. This is shear V_{2el} times 0.5. Once you have selected just the base plate and you have positioned yourself in the 2nd combination (use these buttons in the main toolbar), execute the command to see block tearing checks results, i.e., press this button in the left toolbar . You will get the following dialog:

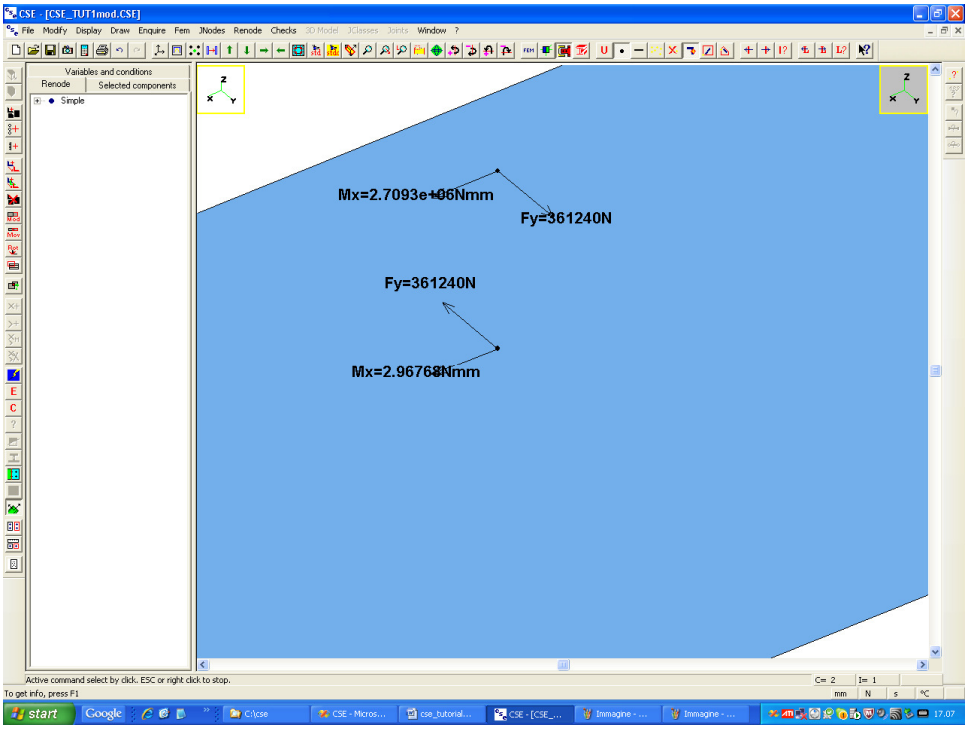


Note that the elastic shear has been computed as 722480N (2x200mmx15mmx235MPa/√3=814062N, 10% higher, Eurocode 3 uses a slightly different formula to compute limit shear, as shear 3 uses part of the flange area), and that 0.5x722840=361240N. The block shear check assume - on the safe side - that all bolts pull in vertical direction creating the shear+tensile rupture shown in the picture. This is the worst possible path. Exploitation is quite low.

Now let's have a look at the forces exchanged by the components. Click Cancel to close the dialog box. Position in the first load case (). Select just the weld. Press the  button and see the forces exchanged by the weld layout, noting that here the vectors overlap (a strong zoom can show it):



Now move to combination 2:



The shear 2 at the base of the column (we have seen it is equal to 361,240N), when moved at the second weld extreme gives rise to a moment equal to 2,709,300Nmm, that is 361,240x7.5mm, which is half the actual weld thickness). In CSE every parasitic moment is kept into account.

By changing the object selection and load combinations you will be able to assess all the forces exchanged by components for checking purposes.

2.9 REMARKS ABOUT FEM MODEL ANALYSIS OF THE PLATE

Opening the first FEM model, the least refined one, we have not checked that the constraint reactions are low. This is an important check, as the models of components should be self-balanced, and constraint reactions must be low. If a constraint reaction is high, it can perturb the results. Note that this is not true for members fem models, which are not self balanced (constraint reactions are internal forces in members at a given distance from theoretical node point), but only for cleats. Typically decreasing the element size will result in lower constraint reactions, as the model gets more precise. Also interelement jumps of stresses will decrease, so a check to see what happens with a finer mesh is always a good thing, if the component is important. Although computing time increase, well, it is all automatic, so there is not too much a problem.

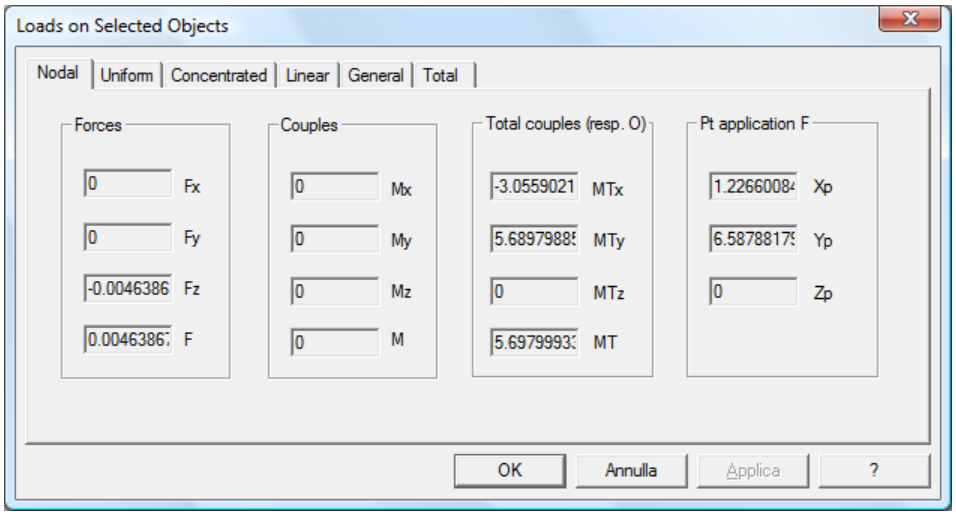
To see the forces globally applied to a model in Sargon Reader we can do in this way (we are going to do the check on the second fem model).

1) Select all nodes by pressing the Select All button in the main toolbar ().

2) Execute the command **Inquire-Selected objects-Loads**

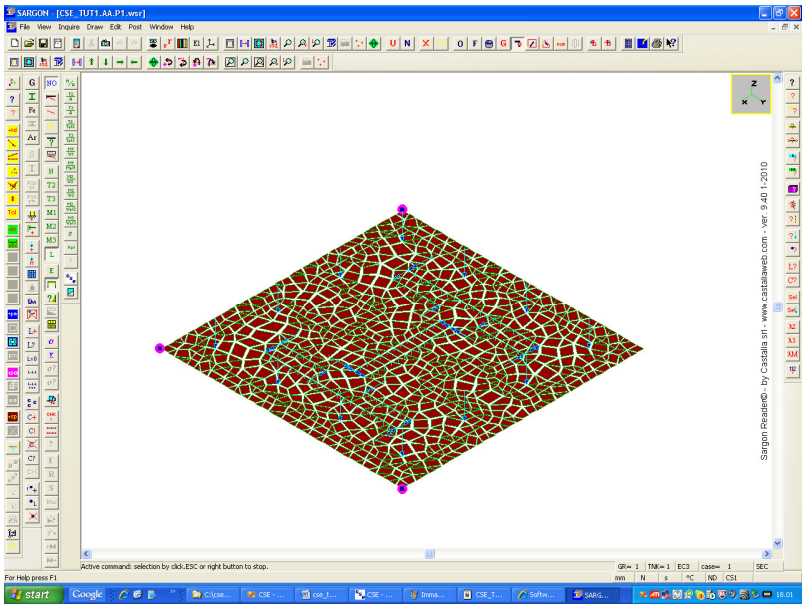
3) Choose the load case you want (load case 1, for example)

4) Choose the **Total** pane, you get the following (for combination 1):

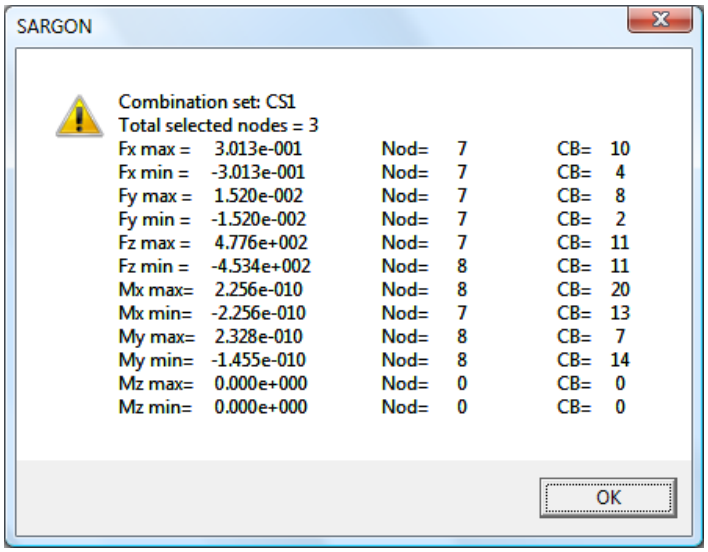


This is the resultant of all the nodal forces applied to all the selected nodes. Notice that the resultant is quite low. Also notice that the point of application of resultant is near, i.e. not at an infinite point. This means that not only the force resultant is low, but also the moment.

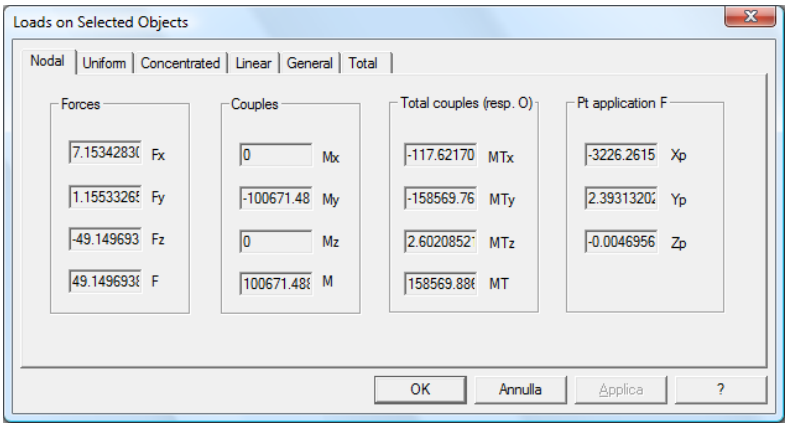
Now usually a self balanced load model has no relevant constraint reactions. To inquire envelope reactions unselect all nodes by pressing the  button in the main toolbar , and then select the three constrained nodes by clicking over them. The constrained nodes are those with the magenta circle applied. If selected also a blue square appears (see next picture).



Now execute the command Post-Reactions-Envelope of envelope, you get the following:



So there is a node (node 7) which has a maximum reaction of 477,6N in combination 11 (corresponding to pure -M2 applied to column, negative strong axis bending). This reaction is not high, but can be usually decreased by improving fem model refinement. Let's see the resultant of applied loads in load case 11 (there is a one to one relationship between loads and combinations in CSE-prepared component fem models). It's what follows in the next image (you must previously select all nodes, as done before). The global resultant of applied loads is not 0, it is very low, however, some like 49N. This out of balance is due to the neutral axis of bending which cuts the finite elements, giving rise to an approximation in nodal forces. By decreasing the overall mesh size (not only the border and welds mesh size), it usually gets lower. Notice that the application point is farther than for combi 1 (where no neutral axis exist).



2.10 THE LISTING

Here is the listing of second computation (the one including fem analysis and thicker plate).

```
################################################################################
#                                                                              #
#                              C . S . E .                                     #
#                                                                              #
#        C o n n e c t i o n   S t u d y   E n v i r o n m e n t               #
#                                                                              #
#          Copyright (c) 2001-2011 - Castalia srl - Milan Italy                #
#                                                                              #
#                           www.castaliaweb.com                                #
#                                                                              #
#                                  *                                           #
# ver.                                                                         #
################################################################################
|                                                                              |
|                        A k n o l e d g m e n t                               |
|                                                                              |
| This program is the result of years of research in steel structures and      |
| is able to automatically perform quite many checks regarding steel con-      |
| nections. The program is able to fully check joiners of very complex steel   |
| connections, made up by freely placing components and joiners, i.e. no       |
| special ad hoc rule is used, but very general ones to compute stress state   |
| of arbitrarily structured "scenes", as freely determined by the user.        |
|                                                                              |
|                                                                              |
|   This version was released in Jamuary 2011, check for updates              |
|                                                                              |
|                                                                              |
|                                                                              |
|                                                                              |
--------------------------------------------------------------------------------
| AcT.......................   Total computing area of a boltlayout           |
| Anchor ...................   If yes bolts are also an anchorage and pull    |
|                              out checks will also be done for pulled bolts   |
| Angle ....................   Rotation angle                                 |
| Angle ..................... Angle between faces of a fillet weld, degrees  |
|                              angle of an applied force                       |
| Area .....................   Single bolt gross area                         |
| Ares .....................   Single bolt threaded area                      |
| AT ......................... Total computing area of a weld layout          |
| BearP ....................   If yes bolt layout use a compression surface   |
|                              to resist bending and compression               |
| beta ..................... Principal axes (u,v) angle relative to local    |
|                              axes (x, y) in a weldlayout                     |
| BLT ....................... Execute block shear checks for this boltlayout|
| Bolt ...................... Bolt number in a boltlayout                     |
| Bolt layout ..............  A set of identical bolts joining the same      |
|                              components. The "extremes" are the thicknesses|
|                              joined. The "resistant sections" are the inter|
|                              faces between thicknesses.                      |
| Cause ..................... Cause of exploitation                          |
|                              In fillet weld: formula used (3: simplified)    |
| Cdx ......................   Offset x from position in local CS             |
| Cdy ......................   Offset y from position in local CS             |
| Check ....................   The user check number                         |
| Class ....................   Bolt class                                    |
| Combi ..................... Load combination number                        |
| Computing area ...........   Area if full=yes Ares if full=no             |
| Compr ....................   If yes bolts will be also in compression  if   |
|                              not bolt will only be in tension                |
| CS .......................   Coordinate system                             |
| Dc .......................   Distance between columns                      |
| di .......................   Bolt i distance from boltlayout center        |
| Dia ......................   Bolt Diameter                                 |
```

Dia H	Bolt hole diameter
Dr	Distance between rows
E	Young's modulus
e1, e2, e3	Strains in different constitutive law points
eu	Ultimate strain
Expl	Exploitation index, if < 1 check is passed if > 1 check is not passed
Ext.	Extreme number of a bolt or boltlayout. If n thicknesses are joined, for each thickness an "extreme" of bolt/boltlayout is present. The total number of extremes is n.
Ext	Extreme of a fillet weld
Fa,dB	Pull out design force of a single bolt
Fa,dT	Pull out design force of a bolt layout
Fi	Hole coefficient
Flex	Flexibility index
force	Force per unit length of fillet weld
Force A	Applied force
Force U	Ultimate force
Fp,C	v. Nini
F,t	The shear force acting over a bolt due to the applied torque at a given resistant section
Full	If yes gross area will be used in bolt shear checks. If not threaded area will be used
fu,o	Ultimate stress of a component in contact with a bolt
FX	Force x active over a joiner extreme in global CS (X,Y, Z)
FY	Force y active over a joiner extreme in global CS (X, Y, Z)
fub	Ultimate bolt stress
Fu,t	The shear force acting over a bolt in u direction due to a torque Mt
Fv,t	The shear force acting over a bolt in v direction due to a torque Mt
fy,o	Yield stress of a component in contact with a bolt
FZ	Force z active over a joiner extreme in global CS (X, Y, Z)
gammaM	Bearing surface material safety factor: it divides ultimate stress
gM0	Partial safety factor (Eurocode)
gM1	Partial safety factor (Eurocode)
gM2	Partial safety factor (Eurocode)
gM3	Partial safety factor (Eurocode)
gM4	Partial safety factor (Eurocode)
gM5	Partial safety factor (Eurocode)
Id	Component identifier
Incl	inclination of a fillet weld relative to local x axis, degrees = atan[(y2-y1)/(x2-x1)]
InnerC	Boolean flag to mark as inner or not a bolt in row direction
InnerR	Boolean flag to mark as inner or not a bolt in column direction
Inst	Instance of a renode in the structure at hand
Ju	Sum(i){ vi ^ 2} - principal axis u second moment of bolts area normalized to bolt area
Ju	Second area moment of throat areas relative to weld layout principal axis u
JustSh	If the bolts are loaded just by shear
Jv	Sum(i){ ui ^ 2} - principal axis v second moment of bolts area normalized to bolt area
Jv	Second area moment of throat areas relative to weld layout principal axis v
Jp	Sum(i){ di ^ 2} - polar second area moment normalized to bolt area
Jp	Polar area moment of throat areas relative to weld layou center
Jx	Sum(i){ yi^2 } - axis x second moment of bolts area normalized to bolt area
Jxy	Sum(i){xi * yi} - centrifigal second moment of bolts area normalized to bolt area
Jy	Sum(i){ xi^2 } - axis y second moment of bolts area normalized to bolt area
Kn	Preload factor: Fp,C= Kn * fub * Ares
Len	Fillet weld length
Leq	Anchorage equivalent length
m	m = Es / Ebear where Es is bolt Young's modulus, and Ebear is bearing surface Young's modulus (homogenization factor,elastic check)
MB	Couple in a bolt at a given section, resultant of MuB and MvB
MtT	Total torque in a bolt layout at a given section
MtT	Total torque in a weld layout at a given section
Mu	Slip coefficient
MuB	Couple acting in a bolt at a given section, in bolt layout principal axis u direction
MuT	Total couple acting in a bolt layout at a given section in layout principal axis u dir.
MuT	Total couple acting in a weld layout at a given section in layout principal axis u dir.
MvB	Couple acting in a bolt at a given section, in bolt layout principal axis v direction
MvT	Total couple acting in a bolt layout at a given section in layout principal axis v dir.
MvT	Total couple acting in a weld layout at a given section in layout principal axis v dir.
MX	Couple x active over a joiner extreme in global CS (X, Y, Z)
MY	Couple y active over a joiner extreme in global CS (X, Y, Z)

MZ	Couple z active over a joiner extreme in global CS (X, Y, Z)
NB	Axial force in a bolt (tensile if > 0)
Nbo	Number of bolts in a boltlayout
Nco	Number of columns in a boltlayout
Nini	Initial pre load of bolt (tensile force, > 0)
Ni,Mu	Axial force in bolt i due to bending Mu
Ni,Mv	Axial force in bolt i due to bending Mv
Nlim	Single bolt limit axial force
nPer	Normal stress acting over fillet weld throat
Nro	Number of rows of a boltlayout
NT	Total axial force in a bolt layout (tensile if > 0), at a given bolt layout section
NT	Total axial force in a weld layout (tensile if > 0), at a given weld layout section
NTB	Total axial force (NB + Nini)
Nwe	Number of welds in a weld layout
Obj	Component identifier
Pangle	Principal axes (u,v) angle relative to local axes (x,y)
Precision	The bolt hole is a "precision" hole
Pt	Point number of the polygon used as bearing surface
Sec	Resisting section number of a bolt: here slip and resistance are checksd
s1, s2, s3	Stresses in different constitutive law points > 0 tensile < 0 compressive
Safety	Slip safety factor
Sec	Number of resisting sections
Sigma	Computed hole beraing stress
SigmaM	Maximum design hole bearing stress
SlipR.	If yes bolt layout should be slip resistant and slip checks will be done for shear
su	Ultimate stress
Sum(i)	Sum as "i" ranges from 1 to the number of sub components in a layout
sy	Yield stress
Tau	Adherence shear stress
TB	Shear force in a bolt at a given section, resultant of TuB and TvB
Thick	Thickness of the component joined by a fillet welds weld layout
Throat	Throat height of a fillet weld, the one used in computing fillet weld area
tPar	Shear stress parallel to fillet weld length, acting over fillet weld throat
tPer	Shear stress perpendicular to fillet weld length, acting over fillet weld throat
TuB	Shear force in a bolt at a given section, in bolt layout principal axis u direction
TuT	Total shear force in a bolt layout at a given section in layout principal axis u direction
TuT	Total shear force in a weld layout at a given section in layout principal axis u direction
TvB	Shear force in a bolt at a given section, in bolt layout principal axis v direction
TvT	Total shear force in a bolt layout at a given section in layout principal axis v direction
TvT	Total shear force in a weld layout at a given section in layout principal axis v direction
u	u coordinate of a point
ui	Bolt i u coordinate in boltlayout principal CS
Units	Measure units
v	v coordinate of a point
vi	Bolt i v coordinate in boltlayout principal CS
vL	Left hand value of user's check
Vlim	Single bolt limit shear if just one resisting section is used
VmaxB	Max slip shear of a single bolt in a single resistant section
VmaxT	Max slip shear of a bolt layout in a single resistant section
vR	Right hand value of user's check
x	Bolt x coordinate in local CS
x1	x coordinate of the first extreme of a fillet weld, in local CS
x2	x coordinate of the second extreme of a fillet weld, in local CS
xc	x coordinate of the center of a weldlayout in local CS
xc	Boltlayout center x coordinate in local CS
xi	Bolt i x coordinate in local CS
y	Bolt y coordinate in local CS
y1	y coordinate of the first extreme of a fillet weld, in local CS
y2	y coordinate of the second extreme of a fillet weld, in local CS
yc	Boltlayout center y coordinate in local CS
yc	y coordinate of the center of a weldlayout in local CS
yi	Bolt i y coordinate in local CS
Weld	Single weld number in a weld layout
Weld layout	A set of welds joining two components
WTi	For a bolt F,t = Mt / WTi WTi = Jp / di if di=0 WTi = 1.e12
WTui	For a bolt Fu,t = Mt / WTui WTui = Jp / vi if vi=0 WTui = 1.e12
WTvi	For a bolt Fv,t = Mt / WTvi WTvi = Jp / ui if ui=0 WTvi = 1.e12
Wui	For a bolt Ni,Mu = Mu / Wui Wui = Ju / vi if vi=0 Wui = 1.e12
Wvi	For a bolt Ni,Mv = Mv / Wvi Wvi = Jv / ui if ui=0 Wvi = 1.e12
-?-	Section number or user check number

AA

UNKNOWNS = 4 EQUATIONS = 4 HYPERCONNECTIVITY = 0

Units

Length   Force   Temperature   Time
 mm   N   °C   s

****
Norm settings
****

Eurocode 3 EN 1993
gM0 =   1.000
gM1 =   1.000
gM2 =   1.250
gM3 =   1.100
gM4 =   1.000
gM5 =   1.000

Comb. from el. limits.Member m 1 Factors: Np-> 0.100 Nm-> 0.700 V2-> 0.500 V3-> 0.500 M1-> 0.200 M2-> 0.400 M3-> 0.400

Bolt bearings pressure checks has been executed.

Block tearing checks, as provided by the program, has been executed.

Members net cross-sections checks, as provided by the program has been executed.

Simplified components checks, as provided by the program has been executed.

User checks, as provided by the user, have been executed.

Parasitic bending taken into account in bolt checks

Combination number: 24

****
Components description
****

Member   m1   HE 200 B   S235
Rectangular plate   P1 H=350 mm B=350 mm t=40 mm S235
Support |---|
Joiner W1 - nw=8 Fillet Welds-Shop-Jp - Multeplicity 2 (weld layout)
Joiner B1 - 12M20-8.8F ir 90.0 - Multeplicity 2 (bolt layout)

****
Joints topology
****

CHAIN 1   m1 *(W1)*P1:(B1):|---|

Boltlayouts general data

Id	Nbo	Nro	Nco	Angle	Dc	Dr	Cdx	Cdy	Kind	JustSh	Compr	Anchor	SlipR	BearP	BLT	Flex
B1	12	4	4	0.00	9.000e+001	9.000e+001	0.000e+000	0.000e+000	grid s	not	not	not	not	yes	yes	1.00

Boltlayouts computational properties

Id	xc	yc	AcT	Jx	Jy	Jxy	Ju	Jv	Pangle	Jp
B1	0.000e+000	0.000e+000	3.770e+003	1.539e+005	1.539e+005	0.000e+000	1.539e+005	1.539e+005	0.000e+000	3.078e+005

Boltlayouts bolt properties

Id	Class	Dia	Dia H	Sec	Full	Precision	Area	Ares	Vlim	Nlim	Nini
B1	8.8	20.0	22.0	1	yes	not	3.142e+002	2.450e+002	1.206e+005	1.411e+005	0.000e+000

Bearing surface bolt layouts

B1   nonlinear computation

parabola-rectangle   sl= -2.490e+001   el = -2.000e-003   eu = -3.500e-003 gammaM =   1.500

FULL
Pt = 1   u = 1.540e+002   v = -1.540e+002
Pt = 2   u = 1.540e+002   v = 1.540e+002
Pt = 3   u = 3.100e+001   v = 1.540e+002
Pt = 4   u = 3.100e+001   v = 5.850e+001
Pt = 5   u = -3.100e+001   v = 5.850e+001
Pt = 6   u = -3.100e+001   v = 1.540e+002
Pt = 7   u = -1.540e+002   v = 1.540e+002

Pt = 8 u = -1.540e+002 v = -1.540e+002
Pt = 9 u = -3.100e+001 v = -1.540e+002
Pt = 10 u = -3.100e+001 v = -5.850e+001
Pt = 11 u = 3.100e+001 v = -5.850e+001
Pt = 12 u = 3.100e+001 v = -1.540e+002

Boltlayouts single bolts position and moduli

Id	Bolt	x	y	AcT	WTui	WTvi	WTi	Wui	Wvi
B1	1	-1.350e+002	-1.350e+002	3.770e+003	2.280e+003	-2.280e+003	1.612e+003	-1.140e+003	1.140e+003
B1	2	-4.500e+001	-1.350e+002	3.770e+003	2.280e+003	-6.840e+003	2.163e+003	-1.140e+003	3.420e+003
B1	3	4.500e+001	-1.350e+002	3.770e+003	2.280e+003	6.840e+003	2.163e+003	-1.140e+003	-3.420e+003
B1	4	1.350e+002	-1.350e+002	3.770e+003	2.280e+003	2.280e+003	1.612e+003	-1.140e+003	-1.140e+003
B1	5	-1.350e+002	-4.500e+001	3.770e+003	6.840e+003	-2.280e+003	2.163e+003	-3.420e+003	1.140e+003
B1	6	1.350e+002	-4.500e+001	3.770e+003	6.840e+003	2.280e+003	2.163e+003	-3.420e+003	-1.140e+003
B1	7	-1.350e+002	4.500e+001	3.770e+003	-6.840e+003	-2.280e+003	2.163e+003	3.420e+003	1.140e+003
B1	8	1.350e+002	4.500e+001	3.770e+003	-6.840e+003	2.280e+003	2.163e+003	3.420e+003	-1.140e+003
B1	9	-1.350e+002	1.350e+002	3.770e+003	-2.280e+003	-2.280e+003	1.612e+003	1.140e+003	1.140e+003
B1	10	-4.500e+001	1.350e+002	3.770e+003	-2.280e+003	-6.840e+003	2.163e+003	1.140e+003	3.420e+003
B1	11	4.500e+001	1.350e+002	3.770e+003	-2.280e+003	6.840e+003	2.163e+003	1.140e+003	-3.420e+003
B1	12	1.350e+002	1.350e+002	3.770e+003	-2.280e+003	2.280e+003	1.612e+003	1.140e+003	-1.140e+003

Bolt distances and objects joined at different extremes

Id	Bolt	Ext.	InnerC	InnerR	Obj	Distance	fy,o	fu,o
B1	1	1	not	not	P1	4.000e+001	2.350e+002	3.600e+002
B1	1	2	not	not	|---|	2.650e+002	2.350e+002	3.600e+002
B1	2	1	yes	not	P1	4.000e+001	2.350e+002	3.600e+002
B1	2	2	yes	not	|---|	2.650e+002	2.350e+002	3.600e+002
B1	3	1	yes	not	P1	4.000e+001	2.350e+002	3.600e+002
B1	3	2	yes	not	|---|	2.650e+002	2.350e+002	3.600e+002
B1	4	1	not	not	P1	4.000e+001	2.350e+002	3.600e+002
B1	4	2	not	not	|---|	2.650e+002	2.350e+002	3.600e+002
B1	5	1	not	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	5	2	not	yes	|---|	2.650e+002	2.350e+002	3.600e+002
B1	6	1	yes	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	6	2	yes	yes	|---|	2.650e+002	2.350e+002	3.600e+002
B1	7	1	yes	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	7	2	yes	yes	|---|	2.650e+002	2.350e+002	3.600e+002
B1	8	1	not	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	8	2	not	yes	|---|	2.650e+002	2.350e+002	3.600e+002
B1	9	1	not	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	9	2	not	yes	|---|	2.650e+002	2.350e+002	3.600e+002
B1	10	1	yes	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	10	2	yes	yes	|---|	2.650e+002	2.350e+002	3.600e+002
B1	11	1	yes	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	11	2	yes	yes	|---|	2.650e+002	2.350e+002	3.600e+002
B1	12	1	not	yes	P1	4.000e+001	2.350e+002	3.600e+002
B1	12	2	not	yes	|---|	2.650e+002	2.350e+002	3.600e+002

Weldlayouts general data

Id	Nwe
W1	8

Weldlayouts computational properties

Id	xc	yc	beta	AT	Ju	Jv	Jp
W1	-9.167e-015	-1.528e-015	-3.214e-016	9.525e+003	2.421e+007	6.625e+007	9.046e+007

Weldlayouts: single welds position

Id	Weld	Len	Thick	Throat	Angle	x1	y1	x2	y2	Incl.
W1	1	6.750e+001	1.500e+001	1.061e+001	9.000e+001	7.970e+001	-2.750e+001	7.970e+001	-9.500e+001	-9.000e+001
W1	2	1.240e+002	1.500e+001	1.061e+001	9.000e+001	-6.200e+001	-9.803e+000	6.200e+001	-9.803e+000	0.000e+000
W1	3	6.750e+001	1.500e+001	1.061e+001	9.000e+001	-7.970e+001	-9.500e+001	-7.970e+001	-2.750e+001	9.000e+001
W1	4	1.900e+002	1.500e+001	1.061e+001	9.000e+001	-1.053e+002	9.500e+001	-1.053e+002	-9.500e+001	-9.000e+001
W1	5	6.750e+001	1.500e+001	1.061e+001	9.000e+001	-7.970e+001	2.750e+001	-7.970e+001	9.500e+001	9.000e+001
W1	6	1.240e+002	1.500e+001	1.061e+001	9.000e+001	6.200e+001	9.803e+000	-6.200e+001	9.803e+000	1.800e+002
W1	7	6.750e+001	1.500e+001	1.061e+001	9.000e+001	7.970e+001	9.500e+001	7.970e+001	2.750e+001	-9.000e+001

W1	8	1.900e+002	1.500e+001	1.061e+001	9.000e+001	1.053e+002	-9.500e+001	1.053e+002	9.500e+001	9.000e+001

Users's defined variables

User checks description

****
Beginning of automatic checks
****

Users's preconditions check

Check	Description	vL	vR	Expl

Forces acting over bolt layouts at different extremes, global system
---

Id	Inst	Combi	Ext	Fx	Fy	Fz	Mx	My	Mz
B1	1	1	1	0.0000e+000	0.0000e+000	1.8349e+005	0.0000e+000	0.0000e+000	0.0000e+000
B1	1	1	2	0.0000e+000	0.0000e+000	-1.8349e+005	0.0000e+000	0.0000e+000	0.0000e+000
B1	1	2	1	0.0000e+000	3.6124e+005	0.0000e+000	-7.2248e+006	0.0000e+000	0.0000e+000
B1	1	2	2	0.0000e+000	-3.6124e+005	0.0000e+000	1.8062e+007	0.0000e+000	0.0000e+000
B1	1	3	1	-1.6844e+005	0.0000e+000	0.0000e+000	0.0000e+000	-3.3689e+006	0.0000e+000
B1	1	3	2	1.6844e+005	0.0000e+000	0.0000e+000	0.0000e+000	8.4222e+006	0.0000e+000
B1	1	4	1	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	1.0724e+006
B1	1	4	2	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	-1.0724e+006
B1	1	5	1	2.1309e-003	0.0000e+000	0.0000e+000	0.0000e+000	5.3544e+007	0.0000e+000
B1	1	5	2	-2.1309e-003	0.0000e+000	0.0000e+000	0.0000e+000	-5.3544e+007	0.0000e+000
B1	1	6	1	0.0000e+000	1.6201e-002	0.0000e+000	-1.8832e+007	0.0000e+000	0.0000e+000
B1	1	6	2	0.0000e+000	-1.6201e-002	0.0000e+000	1.8832e+007	0.0000e+000	0.0000e+000
B1	1	7	1	0.0000e+000	0.0000e+000	-1.2844e+006	0.0000e+000	0.0000e+000	0.0000e+000
B1	1	7	2	0.0000e+000	0.0000e+000	1.2844e+006	0.0000e+000	0.0000e+000	0.0000e+000
B1	1	8	1	0.0000e+000	-3.6124e+005	0.0000e+000	7.2248e+006	0.0000e+000	0.0000e+000
B1	1	8	2	0.0000e+000	3.6124e+005	0.0000e+000	-1.8062e+007	0.0000e+000	0.0000e+000
B1	1	9	1	1.6844e+005	0.0000e+000	0.0000e+000	0.0000e+000	3.3689e+006	0.0000e+000
B1	1	9	2	-1.6844e+005	0.0000e+000	0.0000e+000	0.0000e+000	-8.4222e+006	0.0000e+000
B1	1	10	1	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	-1.0724e+006
B1	1	10	2	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	1.0724e+006
B1	1	11	1	-2.1309e-003	0.0000e+000	0.0000e+000	0.0000e+000	-5.3544e+007	0.0000e+000
B1	1	11	2	2.1309e-003	0.0000e+000	0.0000e+000	0.0000e+000	5.3544e+007	0.0000e+000
B1	1	12	1	0.0000e+000	-1.6201e-002	0.0000e+000	1.8832e+007	0.0000e+000	0.0000e+000
B1	1	12	2	0.0000e+000	1.6201e-002	0.0000e+000	-1.8832e+007	0.0000e+000	0.0000e+000
B1	1	13	1	1.0654e-003	0.0000e+000	9.1744e+004	0.0000e+000	2.6772e+007	0.0000e+000
B1	1	13	2	-1.0654e-003	0.0000e+000	-9.1744e+004	0.0000e+000	-2.6772e+007	0.0000e+000
B1	1	14	1	-1.0654e-003	0.0000e+000	9.1744e+004	0.0000e+000	-2.6772e+007	0.0000e+000
B1	1	14	2	1.0654e-003	0.0000e+000	-9.1744e+004	0.0000e+000	2.6772e+007	0.0000e+000
B1	1	15	1	0.0000e+000	8.1007e-003	9.1744e+004	-9.4160e+006	0.0000e+000	0.0000e+000
B1	1	15	2	0.0000e+000	-8.1007e-003	-9.1744e+004	9.4160e+006	0.0000e+000	0.0000e+000
B1	1	16	1	0.0000e+000	-8.1007e-003	9.1744e+004	9.4160e+006	0.0000e+000	0.0000e+000
B1	1	16	2	0.0000e+000	8.1007e-003	-9.1744e+004	-9.4160e+006	0.0000e+000	0.0000e+000
B1	1	17	1	1.0654e-003	0.0000e+000	-6.4221e+005	0.0000e+000	2.6772e+007	0.0000e+000
B1	1	17	2	-1.0654e-003	0.0000e+000	6.4221e+005	0.0000e+000	-2.6772e+007	0.0000e+000
B1	1	18	1	-1.0654e-003	0.0000e+000	-6.4221e+005	0.0000e+000	-2.6772e+007	0.0000e+000
B1	1	18	2	1.0654e-003	0.0000e+000	6.4221e+005	0.0000e+000	2.6772e+007	0.0000e+000
B1	1	19	1	0.0000e+000	8.1007e-003	-6.4221e+005	-9.4160e+006	0.0000e+000	0.0000e+000
B1	1	19	2	0.0000e+000	-8.1007e-003	6.4221e+005	9.4160e+006	0.0000e+000	0.0000e+000
B1	1	20	1	0.0000e+000	-8.1007e-003	-6.4221e+005	9.4160e+006	0.0000e+000	0.0000e+000
B1	1	20	2	0.0000e+000	8.1007e-003	6.4221e+005	-9.4160e+006	0.0000e+000	0.0000e+000
B1	1	21	1	1.0654e-003	8.1007e-003	0.0000e+000	-9.4160e+006	2.6772e+007	0.0000e+000
B1	1	21	2	-1.0654e-003	-8.1007e-003	0.0000e+000	9.4160e+006	-2.6772e+007	0.0000e+000
B1	1	22	1	1.0654e-003	-8.1007e-003	0.0000e+000	9.4160e+006	2.6772e+007	0.0000e+000
B1	1	22	2	-1.0654e-003	8.1007e-003	0.0000e+000	-9.4160e+006	-2.6772e+007	0.0000e+000
B1	1	23	1	-1.0654e-003	8.1007e-003	0.0000e+000	-9.4160e+006	-2.6772e+007	0.0000e+000
B1	1	23	2	1.0654e-003	-8.1007e-003	0.0000e+000	9.4160e+006	2.6772e+007	0.0000e+000
B1	1	24	1	-1.0654e-003	-8.1007e-003	0.0000e+000	9.4160e+006	-2.6772e+007	0.0000e+000

B1	1	24	2	1.0654e-003	8.1007e-003	0.0000e+000	-9.4160e+006	2.6772e+007	0.0000e+000

Overall internal actions over Bolt Layouts

Id	Inst	Combi	Sec	NT	TuT	TvT	MtT	MuT	MvT
B1	1	1	1	1.8349e+005	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000
B1	1	2	1	0.0000e+000	0.0000e+000	3.6124e+005	0.0000e+000	-1.4450e+007	0.0000e+000
B1	1	3	1	0.0000e+000	-1.6844e+005	0.0000e+000	0.0000e+000	0.0000e+000	-6.7377e+006
B1	1	4	1	0.0000e+000	0.0000e+000	0.0000e+000	1.0724e+006	0.0000e+000	0.0000e+000
B1	1	5	1	0.0000e+000	2.1309e-003	0.0000e+000	0.0000e+000	0.0000e+000	5.3544e+007
B1	1	6	1	0.0000e+000	0.0000e+000	1.6201e-002	0.0000e+000	-1.8832e+007	0.0000e+000
B1	1	7	1	-1.2844e+006	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000	0.0000e+000
B1	1	8	1	0.0000e+000	0.0000e+000	-3.6124e+005	0.0000e+000	1.4450e+007	0.0000e+000
B1	1	9	1	0.0000e+000	1.6844e+005	0.0000e+000	0.0000e+000	0.0000e+000	6.7377e+006
B1	1	10	1	0.0000e+000	0.0000e+000	0.0000e+000	-1.0724e+006	0.0000e+000	0.0000e+000
B1	1	11	1	0.0000e+000	-2.1309e-003	0.0000e+000	0.0000e+000	0.0000e+000	-5.3544e+007
B1	1	12	1	0.0000e+000	0.0000e+000	-1.6201e-002	0.0000e+000	1.8832e+007	0.0000e+000
B1	1	13	1	9.1744e+004	1.0654e-003	0.0000e+000	0.0000e+000	0.0000e+000	2.6772e+007
B1	1	14	1	9.1744e+004	-1.0654e-003	0.0000e+000	0.0000e+000	0.0000e+000	-2.6772e+007
B1	1	15	1	9.1744e+004	0.0000e+000	8.1007e-003	0.0000e+000	-9.4160e+006	0.0000e+000
B1	1	16	1	9.1744e+004	0.0000e+000	-8.1007e-003	0.0000e+000	9.4160e+006	0.0000e+000
B1	1	17	1	-6.4221e+005	1.0654e-003	0.0000e+000	0.0000e+000	0.0000e+000	2.6772e+007
B1	1	18	1	-6.4221e+005	-1.0654e-003	0.0000e+000	0.0000e+000	0.0000e+000	-2.6772e+007
B1	1	19	1	-6.4221e+005	0.0000e+000	8.1007e-003	0.0000e+000	-9.4160e+006	0.0000e+000
B1	1	20	1	-6.4221e+005	0.0000e+000	-8.1007e-003	0.0000e+000	9.4160e+006	0.0000e+000
B1	1	21	1	0.0000e+000	1.0654e-003	8.1007e-003	0.0000e+000	-9.4160e+006	2.6772e+007
B1	1	22	1	0.0000e+000	1.0654e-003	-8.1007e-003	0.0000e+000	9.4160e+006	2.6772e+007
B1	1	23	1	0.0000e+000	-1.0654e-003	8.1007e-003	0.0000e+000	-9.4160e+006	-2.6772e+007
B1	1	24	1	0.0000e+000	-1.0654e-003	-8.1007e-003	0.0000e+000	9.4160e+006	-2.6772e+007

Internal actions in bolts at different planes, exploitations

Inst	Combi	Name	Bolt	-?-	NB	NTB	TuB	TvB	TB	MuB	MvB	MB	Expl	cause
1	1	B1	1	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	2	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	3	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	4	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	5	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	6	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	7	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	8	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	9	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	10	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	11	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	1	B1	12	1	1.529e+004	1.529e+004	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.108	resis
1	2	B1	1	1	1.366e+004	1.366e+004	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322	resis
1	2	B1	2	1	1.366e+004	1.366e+004	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322	resis
1	2	B1	3	1	1.366e+004	1.366e+004	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322	resis
1	2	B1	4	1	1.366e+004	1.366e+004	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322	resis
1	2	B1	5	1	4.961e+003	4.961e+003	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.278	resis
1	2	B1	6	1	4.961e+003	4.961e+003	0.000e+000	3.010e+004	3.010e+004	2.415e+003	2.235e-012	2.415e+003	0.278	resis
1	2	B1	7	1	0.000e+000	0.000e+000	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.253	resis
1	2	B1	8	1	0.000e+000	0.000e+000	0.000e+000	3.010e+004	3.010e+004	2.415e+003	2.235e-012	2.415e+003	0.253	resis

1	2	B1	9	1	0.000e+000	0.000e+000	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003
0.253 resis												
1	2	B1	10	1	0.000e+000	0.000e+000	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003
0.253 resis												
1	2	B1	11	1	0.000e+000	0.000e+000	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003
0.253 resis												
1	2	B1	12	1	0.000e+000	0.000e+000	0.000e+000	3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003
0.253 resis												
1	3	B1	1	1	0.000e+000	0.000e+000	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.118 resis												
1	3	B1	2	1	0.000e+000	0.000e+000	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.118 resis												
1	3	B1	3	1	2.460e+003	2.460e+003	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.130 resis												
1	3	B1	4	1	6.139e+003	6.139e+003	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.149 resis												
1	3	B1	5	1	0.000e+000	0.000e+000	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.118 resis												
1	3	B1	6	1	6.139e+003	6.139e+003	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.149 resis												
1	3	B1	7	1	0.000e+000	0.000e+000	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.118 resis												
1	3	B1	8	1	6.139e+003	6.139e+003	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.149 resis												
1	3	B1	9	1	0.000e+000	0.000e+000	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.118 resis												
1	3	B1	10	1	0.000e+000	0.000e+000	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.118 resis												
1	3	B1	11	1	2.460e+003	2.460e+003	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.130 resis												
1	3	B1	12	1	6.139e+003	6.139e+003	-1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003
0.149 resis												
1	4	B1	1	1	0.000e+000	0.000e+000	4.703e+002	-4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000
0.006 resis												
1	4	B1	2	1	0.000e+000	0.000e+000	4.703e+002	-1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	3	1	0.000e+000	0.000e+000	4.703e+002	1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	4	1	0.000e+000	0.000e+000	4.703e+002	4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000
0.006 resis												
1	4	B1	5	1	0.000e+000	0.000e+000	1.568e+002	-4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	6	1	0.000e+000	0.000e+000	1.568e+002	4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	7	1	0.000e+000	0.000e+000	-1.568e+002	-4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	8	1	0.000e+000	0.000e+000	-1.568e+002	4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	9	1	0.000e+000	0.000e+000	-4.703e+002	-4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000
0.006 resis												
1	4	B1	10	1	0.000e+000	0.000e+000	-4.703e+002	-1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	11	1	0.000e+000	0.000e+000	-4.703e+002	1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000
0.004 resis												
1	4	B1	12	1	0.000e+000	0.000e+000	-4.703e+002	4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000
0.006 resis												
1	5	B1	1	1	4.968e+004	4.968e+004	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	5	B1	2	1	1.888e+004	1.888e+004	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.153 resis												
1	5	B1	3	1	0.000e+000	0.000e+000	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	5	B1	4	1	0.000e+000	0.000e+000	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	5	B1	5	1	4.968e+004	4.968e+004	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	5	B1	6	1	0.000e+000	0.000e+000	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	5	B1	7	1	4.968e+004	4.968e+004	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	5	B1	8	1	0.000e+000	0.000e+000	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	5	B1	9	1	4.968e+004	4.968e+004	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	5	B1	10	1	1.888e+004	1.888e+004	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.153 resis												
1	5	B1	11	1	0.000e+000	0.000e+000	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	5	B1	12	1	0.000e+000	0.000e+000	1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	6	B1	1	1	1.784e+004	1.784e+004	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.133 resis												
1	6	B1	2	1	1.784e+004	1.784e+004	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.133 resis												
1	6	B1	3	1	1.784e+004	1.784e+004	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.133 resis												
1	6	B1	4	1	1.784e+004	1.784e+004	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.133 resis												
1	6	B1	5	1	6.444e+003	6.444e+003	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.053 resis												
1	6	B1	6	1	6.444e+003	6.444e+003	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.053 resis												
1	6	B1	7	1	0.000e+000	0.000e+000	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	6	B1	8	1	0.000e+000	0.000e+000	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	6	B1	9	1	0.000e+000	0.000e+000	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	6	B1	10	1	0.000e+000	0.000e+000	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												

1	6	B1	11	1	0.000e+000	0.000e+000	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003	0.007 resis
1	6	B1	12	1	0.000e+000	0.000e+000	0.000e+000	1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003	0.007 resis
1	7	B1	1	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000
1	7	B1	2	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000
1	7	B1	3	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000
1	7	B1	4	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000
1	7	B1	5	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000
1	7	B1	6	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000
1	7	B1	7	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	3.576e-011	3.576e-011	0.000 resis
1	7	B1	8	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	3.576e-011	3.576e-011	0.000 resis
1	7	B1	9	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	3.576e-011	3.576e-011	0.000 resis
1	7	B1	10	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	3.576e-011	3.576e-011	0.000 resis
1	7	B1	11	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	3.576e-011	3.576e-011	0.000 resis
1	7	B1	12	1	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	0.000e+000	3.576e-011	3.576e-011	0.000 resis
1	8	B1	1	1	0.000e+000	0.000e+000	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.253 resis
1	8	B1	2	1	0.000e+000	0.000e+000	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.253 resis
1	8	B1	3	1	0.000e+000	0.000e+000	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.253 resis
1	8	B1	4	1	0.000e+000	0.000e+000	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.253 resis
1	8	B1	5	1	0.000e+000	0.000e+000	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.253 resis
1	8	B1	6	1	0.000e+000	0.000e+000	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.253 resis
1	8	B1	7	1	4.961e+003	4.961e+003	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.278 resis
1	8	B1	8	1	4.961e+003	4.961e+003	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.278 resis
1	8	B1	9	1	1.366e+004	1.366e+004	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322 resis
1	8	B1	10	1	1.366e+004	1.366e+004	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322 resis
1	8	B1	11	1	1.366e+004	1.366e+004	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322 resis
1	8	B1	12	1	1.366e+004	1.366e+004	0.000e+000	-3.010e+004	3.010e+004	2.415e+003	0.000e+000	2.415e+003	0.322 resis
1	9	B1	1	1	6.139e+003	6.139e+003	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.149 resis
1	9	B1	2	1	2.460e+003	2.460e+003	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.130 resis
1	9	B1	3	1	0.000e+000	0.000e+000	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.118 resis
1	9	B1	4	1	0.000e+000	0.000e+000	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.118 resis
1	9	B1	5	1	6.139e+003	6.139e+003	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.149 resis
1	9	B1	6	1	0.000e+000	0.000e+000	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.118 resis
1	9	B1	7	1	6.139e+003	6.139e+003	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.149 resis
1	9	B1	8	1	0.000e+000	0.000e+000	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.118 resis
1	9	B1	9	1	6.139e+003	6.139e+003	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.149 resis
1	9	B1	10	1	2.460e+003	2.460e+003	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.130 resis
1	9	B1	11	1	0.000e+000	0.000e+000	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.118 resis
1	9	B1	12	1	0.000e+000	0.000e+000	1.404e+004	0.000e+000	1.404e+004	0.000e+000	1.022e+003	1.022e+003	0.118 resis
1	10	B1	1	1	0.000e+000	0.000e+000	-4.703e+002	4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000	0.006 resis
1	10	B1	2	1	0.000e+000	0.000e+000	-4.703e+002	1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	3	1	0.000e+000	0.000e+000	-4.703e+002	-1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	4	1	0.000e+000	0.000e+000	-4.703e+002	-4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000	0.006 resis
1	10	B1	5	1	0.000e+000	0.000e+000	-1.568e+002	4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	6	1	0.000e+000	0.000e+000	-1.568e+002	-4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	7	1	0.000e+000	0.000e+000	1.568e+002	4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	8	1	0.000e+000	0.000e+000	1.568e+002	-4.703e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	9	1	0.000e+000	0.000e+000	4.703e+002	4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000	0.006 resis
1	10	B1	10	1	0.000e+000	0.000e+000	4.703e+002	1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	11	1	0.000e+000	0.000e+000	4.703e+002	-1.568e+002	4.958e+002	0.000e+000	0.000e+000	0.000e+000	0.004 resis
1	10	B1	12	1	0.000e+000	0.000e+000	4.703e+002	-4.703e+002	6.652e+002	0.000e+000	0.000e+000	0.000e+000	0.006 resis

1	11	B1	1	1	0.000e+000	0.000e+000	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	11	B1	2	1	0.000e+000	0.000e+000	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	11	B1	3	1	1.888e+004	1.888e+004	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.153 resis												
1	11	B1	4	1	4.968e+004	4.968e+004	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	11	B1	5	1	0.000e+000	0.000e+000	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	11	B1	6	1	4.968e+004	4.968e+004	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	11	B1	7	1	0.000e+000	0.000e+000	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	11	B1	8	1	4.968e+004	4.968e+004	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	11	B1	9	1	0.000e+000	0.000e+000	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	11	B1	10	1	0.000e+000	0.000e+000	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.019 resis												
1	11	B1	11	1	1.888e+004	1.888e+004	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.153 resis												
1	11	B1	12	1	4.968e+004	4.968e+004	-1.776e-004	0.000e+000	1.776e-004	0.000e+000	8.557e+003	8.557e+003
0.371 resis												
1	12	B1	1	1	0.000e+000	0.000e+000	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	12	B1	2	1	0.000e+000	0.000e+000	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	12	B1	3	1	0.000e+000	0.000e+000	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	12	B1	4	1	0.000e+000	0.000e+000	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	8.941e-012	3.165e+003
0.007 resis												
1	12	B1	5	1	0.000e+000	0.000e+000	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	12	B1	6	1	0.000e+000	0.000e+000	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.007 resis												
1	12	B1	7	1	6.444e+003	6.444e+003	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.053 resis												
1	12	B1	8	1	6.444e+003	6.444e+003	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.053 resis												
1	12	B1	9	1	1.784e+004	1.784e+004	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.133 resis												
1	12	B1	10	1	1.784e+004	1.784e+004	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.133 resis												
1	12	B1	11	1	1.784e+004	1.784e+004	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	0.000e+000	3.165e+003
0.133 resis												
1	12	B1	12	1	1.784e+004	1.784e+004	0.000e+000	-1.350e-003	1.350e-003	3.165e+003	8.941e-012	3.165e+003
0.133 resis												
1	13	B1	1	1	3.172e+004	3.172e+004	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	13	B1	2	1	1.625e+004	1.625e+004	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.125 resis												
1	13	B1	3	1	7.758e+002	7.758e+002	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.015 resis												
1	13	B1	4	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	13	B1	5	1	3.172e+004	3.172e+004	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	13	B1	6	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	13	B1	7	1	3.172e+004	3.172e+004	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	13	B1	8	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	13	B1	9	1	3.172e+004	3.172e+004	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	13	B1	10	1	1.625e+004	1.625e+004	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.125 resis												
1	13	B1	11	1	7.758e+002	7.758e+002	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.015 resis												
1	13	B1	12	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	14	B1	1	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	14	B1	2	1	7.758e+002	7.758e+002	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.015 resis												
1	14	B1	3	1	1.625e+004	1.625e+004	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.125 resis												
1	14	B1	4	1	3.172e+004	3.172e+004	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	14	B1	5	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	14	B1	6	1	3.172e+004	3.172e+004	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	14	B1	7	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	14	B1	8	1	3.172e+004	3.172e+004	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	14	B1	9	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.009 resis												
1	14	B1	10	1	7.758e+002	7.758e+002	-8.879e-005	0.000e+000	8.879e-005	2.235e-012	4.297e+003	4.297e+003
0.015 resis												
1	14	B1	11	1	1.625e+004	1.625e+004	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.125 resis												
1	14	B1	12	1	3.172e+004	3.172e+004	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.297e+003	4.297e+003
0.234 resis												
1	15	B1	1	1	1.593e+004	1.593e+004	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												
1	15	B1	2	1	1.593e+004	1.593e+004	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												

1	15	B1	3	1	1.593e+004	1.593e+004	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												
1	15	B1	4	1	1.593e+004	1.593e+004	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												
1	15	B1	5	1	1.033e+004	1.033e+004	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.077 resis												
1	15	B1	6	1	1.033e+004	1.033e+004	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.077 resis												
1	15	B1	7	1	4.720e+003	4.720e+003	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.037 resis												
1	15	B1	8	1	4.720e+003	4.720e+003	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.037 resis												
1	15	B1	9	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	15	B1	10	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	15	B1	11	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	15	B1	12	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	16	B1	1	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	16	B1	2	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	16	B1	3	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	16	B1	4	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.003 resis												
1	16	B1	5	1	4.720e+003	4.720e+003	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.037 resis												
1	16	B1	6	1	4.720e+003	4.720e+003	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.037 resis												
1	16	B1	7	1	1.033e+004	1.033e+004	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.077 resis												
1	16	B1	8	1	1.033e+004	1.033e+004	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.077 resis												
1	16	B1	9	1	1.593e+004	1.593e+004	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												
1	16	B1	10	1	1.593e+004	1.593e+004	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												
1	16	B1	11	1	1.593e+004	1.593e+004	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												
1	16	B1	12	1	1.593e+004	1.593e+004	0.000e+000	-6.751e-004	6.751e-004	1.557e+003	0.000e+000	1.557e+003
0.116 resis												
1	17	B1	1	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	2	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	3	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	4	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	5	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	6	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	7	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	8	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	9	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	10	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	11	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	17	B1	12	1	0.000e+000	0.000e+000	8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	1	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	2	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	3	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	4	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	5	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	6	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	7	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	8	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	9	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	10	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	11	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	18	B1	12	1	0.000e+000	0.000e+000	-8.879e-005	0.000e+000	8.879e-005	0.000e+000	4.977e+003	4.977e+003
0.011 resis												
1	19	B1	1	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	2	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	3	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	4	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												

1	19	B1	5	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	6	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	7	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	8	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	9	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	10	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	11	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	19	B1	12	1	0.000e+000	0.000e+000	0.000e+000	6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	1	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	2	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	3	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	4	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	1.788e-011	2.114e+003
0.005 resis												
1	20	B1	5	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	6	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	7	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	8	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	8.941e-012	2.114e+003
0.005 resis												
1	20	B1	9	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	10	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	8.941e-012	2.114e+003
0.005 resis												
1	20	B1	11	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	0.000e+000	2.114e+003
0.005 resis												
1	20	B1	12	1	0.000e+000	0.000e+000	0.000e+000	-6.751e-004	6.751e-004	2.114e+003	8.941e-012	2.114e+003
0.005 resis												
1	21	B1	1	1	3.302e+004	3.302e+004	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.244 resis												
1	21	B1	2	1	1.804e+004	1.804e+004	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.138 resis												
1	21	B1	3	1	3.069e+003	3.069e+003	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.032 resis												
1	21	B1	4	1	0.000e+000	0.000e+000	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	21	B1	5	1	2.736e+004	2.736e+004	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.204 resis												
1	21	B1	6	1	0.000e+000	0.000e+000	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	21	B1	7	1	2.171e+004	2.171e+004	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.164 resis												
1	21	B1	8	1	0.000e+000	0.000e+000	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	21	B1	9	1	1.605e+004	1.605e+004	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.124 resis												
1	21	B1	10	1	1.074e+003	1.074e+003	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.017 resis												
1	21	B1	11	1	0.000e+000	0.000e+000	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	21	B1	12	1	0.000e+000	0.000e+000	8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	22	B1	1	1	1.605e+004	1.605e+004	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.124 resis												
1	22	B1	2	1	1.074e+003	1.074e+003	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.017 resis												
1	22	B1	3	1	0.000e+000	0.000e+000	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	22	B1	4	1	0.000e+000	0.000e+000	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	22	B1	5	1	2.171e+004	2.171e+004	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.164 resis												
1	22	B1	6	1	0.000e+000	0.000e+000	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	22	B1	7	1	2.736e+004	2.736e+004	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.204 resis												
1	22	B1	8	1	0.000e+000	0.000e+000	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	22	B1	9	1	3.302e+004	3.302e+004	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.244 resis												
1	22	B1	10	1	1.804e+004	1.804e+004	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.138 resis												
1	22	B1	11	1	3.069e+003	3.069e+003	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.032 resis												
1	22	B1	12	1	0.000e+000	0.000e+000	8.879e-005	-6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	23	B1	1	1	0.000e+000	0.000e+000	-8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	23	B1	2	1	3.069e+003	3.069e+003	-8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.032 resis												
1	23	B1	3	1	1.804e+004	1.804e+004	-8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.138 resis												
1	23	B1	4	1	3.302e+004	3.302e+004	-8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.244 resis												
1	23	B1	5	1	0.000e+000	0.000e+000	-8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.010 resis												
1	23	B1	6	1	2.736e+004	2.736e+004	-8.879e-005	6.751e-004	6.809e-004	1.571e+003	4.160e+003	4.447e+003
0.204 resis												

```
    1    23    B1   7   1   0.000e+000   0.000e+000  -8.879e-005   6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    23    B1   8   1   2.171e+004   2.171e+004  -8.879e-005   6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.164 resis
    1    23    B1   9   1   0.000e+000   0.000e+000  -8.879e-005   6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    23    B1  10   1   0.000e+000   0.000e+000  -8.879e-005   6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    23    B1  11   1   1.074e+003   1.074e+003  -8.879e-005   6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.017 resis
    1    23    B1  12   1   1.605e+004   1.605e+004  -8.879e-005   6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.124 resis

    1    24    B1   1   1   0.000e+000   0.000e+000  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    24    B1   2   1   0.000e+000   0.000e+000  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    24    B1   3   1   1.074e+003   1.074e+003  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.017 resis
    1    24    B1   4   1   1.605e+004   1.605e+004  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.124 resis
    1    24    B1   5   1   0.000e+000   0.000e+000  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    24    B1   6   1   2.171e+004   2.171e+004  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.164 resis
    1    24    B1   7   1   0.000e+000   0.000e+000  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    24    B1   8   1   2.736e+004   2.736e+004  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.204 resis
    1    24    B1   9   1   0.000e+000   0.000e+000  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.010 resis
    1    24    B1  10   1   3.069e+003   3.069e+003  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.032 resis
    1    24    B1  11   1   1.804e+004   1.804e+004  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.138 resis
    1    24    B1  12   1   3.302e+004   3.302e+004  -8.879e-005  -6.751e-004  6.809e-004   1.571e+003  4.160e+003   4.447e+003
0.244 resis
```

Overall internal actions over Weld Layouts

Id	Inst	Combi	NT	TuT	TvT	MtT	MuT	MvT
W1	1	1	1.8349e+005	-0.0000e+000	-0.0000e+000	-0.0000e+000	-0.0000e+000	-0.0000e+000
W1	1	2	-0.0000e+000	-0.0000e+000	3.6124e+005	-0.0000e+000	-2.9677e+000	-0.0000e+000
W1	1	3	-0.0000e+000	-1.6844e+005	-0.0000e+000	-0.0000e+000	-0.0000e+000	3.1705e-001
W1	1	4	-0.0000e+000	-0.0000e+000	-0.0000e+000	1.0724e+006	-0.0000e+000	-0.0000e+000
W1	1	5	-0.0000e+000	2.0593e-003	-0.0000e+000	-0.0000e+000	-0.0000e+000	5.3544e+007
W1	1	6	-0.0000e+000	-0.0000e+000	1.5846e-002	-0.0000e+000	-1.8832e+007	-0.0000e+000
W1	1	7	-1.2844e+006	-0.0000e+000	-0.0000e+000	-0.0000e+000	-0.0000e+000	-0.0000e+000
W1	1	8	-0.0000e+000	-0.0000e+000	-3.6124e+005	-0.0000e+000	2.9677e+000	-0.0000e+000
W1	1	9	-0.0000e+000	1.6844e+005	-0.0000e+000	-0.0000e+000	-0.0000e+000	-3.1705e-001
W1	1	10	-0.0000e+000	-0.0000e+000	-0.0000e+000	-1.0724e+006	-0.0000e+000	-0.0000e+000
W1	1	11	-0.0000e+000	-2.0593e-003	-0.0000e+000	-0.0000e+000	-0.0000e+000	-5.3544e+007
W1	1	12	-0.0000e+000	-0.0000e+000	-1.5846e-002	-0.0000e+000	1.8832e+007	-0.0000e+000
W1	1	13	9.1744e+004	1.0297e-003	-0.0000e+000	-0.0000e+000	-0.0000e+000	2.6772e+007
W1	1	14	9.1744e+004	-1.0297e-003	-0.0000e+000	-0.0000e+000	-0.0000e+000	-2.6772e+007
W1	1	15	9.1744e+004	-0.0000e+000	7.9230e-003	-0.0000e+000	-9.4160e+006	-0.0000e+000
W1	1	16	9.1744e+004	-0.0000e+000	-7.9230e-003	-0.0000e+000	9.4160e+006	-0.0000e+000
W1	1	17	-6.4221e+005	1.0297e-003	-0.0000e+000	-0.0000e+000	-0.0000e+000	2.6772e+007
W1	1	18	-6.4221e+005	-1.0297e-003	-0.0000e+000	-0.0000e+000	-0.0000e+000	-2.6772e+007
W1	1	19	-6.4221e+005	-0.0000e+000	7.9230e-003	-0.0000e+000	-9.4160e+006	-0.0000e+000
W1	1	20	-6.4221e+005	-0.0000e+000	-7.9230e-003	-0.0000e+000	9.4160e+006	-0.0000e+000
W1	1	21	-0.0000e+000	1.0297e-003	7.9230e-003	-0.0000e+000	-9.4160e+006	2.6772e+007
W1	1	22	-0.0000e+000	1.0297e-003	-7.9230e-003	-0.0000e+000	9.4160e+006	2.6772e+007
W1	1	23	-0.0000e+000	-1.0297e-003	7.9230e-003	-0.0000e+000	-9.4160e+006	-2.6772e+007
W1	1	24	-0.0000e+000	-1.0297e-003	-7.9230e-003	-0.0000e+000	9.4160e+006	-2.6772e+007

Internal stresses in welds, exploitations

Inst	Combi	Name	Weld	nPer	tPar	tPer	force	Cause	Ext	Expl
1	1	W1	1	1.926e+001	0.000e+000	-0.000e+000	2.043e+002	2	1	0.093
1	1	W1	2	1.926e+001	0.000e+000	0.000e+000	2.043e+002	2	1	0.093
1	1	W1	3	1.926e+001	0.000e+000	0.000e+000	2.043e+002	2	1	0.093
1	1	W1	4	1.926e+001	0.000e+000	0.000e+000	2.043e+002	2	1	0.093
1	1	W1	5	1.926e+001	0.000e+000	0.000e+000	2.043e+002	2	1	0.093
1	1	W1	6	1.926e+001	0.000e+000	0.000e+000	2.043e+002	2	1	0.093

1	1	W1	7	1.926e+001	0.000e+000	0.000e+000	2.043e+002	2	1	0.093
1	1	W1	8	1.926e+001	-0.000e+000	0.000e+000	2.043e+002	2	1	0.093
1	2	W1	1	1.165e-005	-3.793e+001	2.322e-015	4.023e+002	2	2	0.182
1	2	W1	2	1.202e-006	2.128e-016	3.793e+001	4.023e+002	2	1	0.182
1	2	W1	3	1.165e-005	3.793e+001	2.322e-015	4.023e+002	2	1	0.182
1	2	W1	4	-1.165e-005	-3.793e+001	2.322e-015	4.023e+002	2	1	0.182
1	2	W1	5	-1.165e-005	3.793e+001	2.322e-015	4.023e+002	2	2	0.182
1	2	W1	6	-1.202e-006	4.645e-015	-3.793e+001	4.023e+002	2	1	0.182
1	2	W1	7	-1.165e-005	-3.793e+001	2.322e-015	4.023e+002	2	1	0.182
1	2	W1	8	1.165e-005	3.793e+001	2.322e-015	4.023e+002	2	1	0.182
1	3	W1	1	-3.814e-007	-1.083e-015	-1.768e+001	1.876e+002	2	1	0.085
1	3	W1	2	2.967e-007	-1.768e+001	9.922e-017	1.876e+002	2	1	0.085
1	3	W1	3	3.814e-007	-1.083e-015	1.768e+001	1.876e+002	2	1	0.085
1	3	W1	4	5.039e-007	-1.083e-015	-1.768e+001	1.876e+002	2	1	0.085
1	3	W1	5	3.814e-007	-1.083e-015	1.768e+001	1.876e+002	2	1	0.085
1	3	W1	6	-2.967e-007	1.768e+001	2.166e-015	1.876e+002	2	1	0.085
1	3	W1	7	-3.814e-007	-1.083e-015	-1.768e+001	1.876e+002	2	1	0.085
1	3	W1	8	-5.039e-007	-1.083e-015	1.768e+001	1.876e+002	2	1	0.085
1	4	W1	1	0.000e+000	-9.448e-001	1.126e+000	1.559e+001	2	2	0.007
1	4	W1	2	0.000e+000	1.162e-001	-7.350e-001	7.893e+000	2	1	0.004
1	4	W1	3	0.000e+000	-9.448e-001	-1.126e+000	1.559e+001	2	1	0.007
1	4	W1	4	-0.000e+000	1.248e+000	-1.126e+000	1.783e+001	2	1	0.008
1	4	W1	5	-0.000e+000	-9.448e-001	1.126e+000	1.559e+001	2	2	0.007
1	4	W1	6	-0.000e+000	1.162e-001	7.350e-001	7.893e+000	2	2	0.004
1	4	W1	7	0.000e+000	-9.448e-001	-1.126e+000	1.559e+001	2	1	0.007
1	4	W1	8	0.000e+000	1.248e+000	-1.126e+000	1.783e+001	2	1	0.008
1	5	W1	1	-6.441e+001	1.324e-023	2.162e-007	6.832e+002	2	1	0.310
1	5	W1	2	5.011e+001	2.162e-007	-1.213e-024	5.315e+002	2	1	0.241
1	5	W1	3	6.441e+001	1.324e-023	-2.162e-007	6.832e+002	2	1	0.310
1	5	W1	4	8.510e+001	1.324e-023	2.162e-007	9.027e+002	2	1	0.409
1	5	W1	5	6.441e+001	1.324e-023	-2.162e-007	6.832e+002	2	1	0.310
1	5	W1	6	5.011e+001	-2.162e-007	-2.648e-023	5.315e+002	2	2	0.241
1	5	W1	7	-6.441e+001	1.324e-023	2.162e-007	6.832e+002	2	1	0.310
1	5	W1	8	-8.510e+001	1.324e-023	-2.162e-007	9.027e+002	2	1	0.409
1	6	W1	1	7.390e+001	-1.664e-006	1.019e-022	7.838e+002	2	2	0.356
1	6	W1	2	7.626e+000	9.334e-024	1.664e-006	8.088e+001	2	1	0.037
1	6	W1	3	7.390e+001	1.664e-006	1.019e-022	7.838e+002	2	1	0.356
1	6	W1	4	-7.390e+001	-1.664e-006	1.019e-022	7.838e+002	2	1	0.356
1	6	W1	5	-7.390e+001	1.664e-006	1.019e-022	7.838e+002	2	2	0.356
1	6	W1	6	-7.626e+000	2.037e-022	-1.664e-006	8.088e+001	2	2	0.037
1	6	W1	7	-7.390e+001	-1.664e-006	1.019e-022	7.838e+002	2	1	0.356
1	6	W1	8	7.390e+001	1.664e-006	1.019e-022	7.838e+002	2	1	0.356
1	7	W1	1	-1.349e+002	0.000e+000	-0.000e+000	1.430e+003	2	1	0.649
1	7	W1	2	-1.349e+002	0.000e+000	0.000e+000	1.430e+003	2	1	0.649
1	7	W1	3	-1.349e+002	0.000e+000	0.000e+000	1.430e+003	2	1	0.649
1	7	W1	4	-1.349e+002	0.000e+000	0.000e+000	1.430e+003	2	1	0.649
1	7	W1	5	-1.349e+002	0.000e+000	0.000e+000	1.430e+003	2	1	0.649
1	7	W1	6	-1.349e+002	0.000e+000	0.000e+000	1.430e+003	2	1	0.649
1	7	W1	7	-1.349e+002	0.000e+000	0.000e+000	1.430e+003	2	1	0.649
1	7	W1	8	-1.349e+002	-0.000e+000	0.000e+000	1.430e+003	2	1	0.649
1	8	W1	1	-1.165e-005	3.793e+001	-2.322e-015	4.023e+002	2	2	0.182
1	8	W1	2	-1.202e-006	-2.128e-016	-3.793e+001	4.023e+002	2	1	0.182
1	8	W1	3	-1.165e-005	-3.793e+001	-2.322e-015	4.023e+002	2	1	0.182
1	8	W1	4	1.165e-005	3.793e+001	-2.322e-015	4.023e+002	2	1	0.182
1	8	W1	5	1.165e-005	-3.793e+001	-2.322e-015	4.023e+002	2	2	0.182
1	8	W1	6	1.202e-006	-4.645e-015	3.793e+001	4.023e+002	2	1	0.182
1	8	W1	7	1.165e-005	3.793e+001	-2.322e-015	4.023e+002	2	1	0.182
1	8	W1	8	-1.165e-005	-3.793e+001	-2.322e-015	4.023e+002	2	1	0.182
1	9	W1	1	3.814e-007	1.083e-015	1.768e+001	1.876e+002	2	1	0.085
1	9	W1	2	-2.967e-007	1.768e+001	-9.922e-017	1.876e+002	2	1	0.085
1	9	W1	3	-3.814e-007	1.083e-015	-1.768e+001	1.876e+002	2	1	0.085
1	9	W1	4	-5.039e-007	1.083e-015	1.768e+001	1.876e+002	2	1	0.085
1	9	W1	5	-3.814e-007	1.083e-015	-1.768e+001	1.876e+002	2	1	0.085
1	9	W1	6	2.967e-007	-1.768e+001	-2.166e-015	1.876e+002	2	1	0.085
1	9	W1	7	3.814e-007	1.083e-015	1.768e+001	1.876e+002	2	1	0.085
1	9	W1	8	5.039e-007	1.083e-015	-1.768e+001	1.876e+002	2	1	0.085
1	10	W1	1	0.000e+000	9.448e-001	-1.126e+000	1.559e+001	2	2	0.007
1	10	W1	2	0.000e+000	-1.162e-001	7.350e-001	7.893e+000	2	1	0.004
1	10	W1	3	0.000e+000	9.448e-001	1.126e+000	1.559e+001	2	1	0.007
1	10	W1	4	-0.000e+000	-1.248e+000	1.126e+000	1.783e+001	2	1	0.008
1	10	W1	5	-0.000e+000	9.448e-001	-1.126e+000	1.559e+001	2	2	0.007
1	10	W1	6	-0.000e+000	-1.162e-001	-7.350e-001	7.893e+000	2	2	0.004
1	10	W1	7	0.000e+000	9.448e-001	1.126e+000	1.559e+001	2	1	0.007
1	10	W1	8	0.000e+000	-1.248e+000	1.126e+000	1.783e+001	2	1	0.008
1	11	W1	1	6.441e+001	-1.324e-023	-2.162e-007	6.832e+002	2	1	0.310
1	11	W1	2	-5.011e+001	-2.162e-007	1.213e-024	5.315e+002	2	1	0.241
1	11	W1	3	-6.441e+001	-1.324e-023	2.162e-007	6.832e+002	2	1	0.310
1	11	W1	4	-8.510e+001	-1.324e-023	-2.162e-007	9.027e+002	2	1	0.409
1	11	W1	5	-6.441e+001	-1.324e-023	2.162e-007	6.832e+002	2	1	0.310
1	11	W1	6	-5.011e+001	2.162e-007	2.648e-023	5.315e+002	2	2	0.241
1	11	W1	7	6.441e+001	-1.324e-023	-2.162e-007	6.832e+002	2	1	0.310
1	11	W1	8	8.510e+001	-1.324e-023	2.162e-007	9.027e+002	2	1	0.409
1	12	W1	1	-7.390e+001	1.664e-006	-1.019e-022	7.838e+002	2	2	0.356
1	12	W1	2	-7.626e+000	-9.334e-024	-1.664e-006	8.088e+001	2	1	0.037
1	12	W1	3	-7.390e+001	-1.664e-006	-1.019e-022	7.838e+002	2	1	0.356
1	12	W1	4	7.390e+001	1.664e-006	-1.019e-022	7.838e+002	2	1	0.356
1	12	W1	5	7.390e+001	-1.664e-006	-1.019e-022	7.838e+002	2	2	0.356
1	12	W1	6	7.626e+000	-2.037e-022	1.664e-006	8.088e+001	2	2	0.037
1	12	W1	7	7.390e+001	1.664e-006	-1.019e-022	7.838e+002	2	1	0.356
1	12	W1	8	-7.390e+001	-1.664e-006	-1.019e-022	7.838e+002	2	1	0.356
1	13	W1	1	-2.257e+001	6.620e-024	1.081e-007	2.394e+002	2	1	0.109
1	13	W1	2	3.469e+001	1.081e-007	-6.065e-025	3.679e+002	2	1	0.167
1	13	W1	3	4.184e+001	6.620e-024	-1.081e-007	4.437e+002	2	1	0.201

1	13	W1	4	5.218e+001	6.620e-024	1.081e-007	5.535e+002	2	1	0.251
1	13	W1	5	4.184e+001	6.620e-024	-1.081e-007	4.437e+002	2	1	0.201
1	13	W1	6	3.469e+001	-1.081e-007	-1.324e-023	3.679e+002	2	2	0.167
1	13	W1	7	-2.257e+001	6.620e-024	1.081e-007	2.394e+002	2	1	0.109
1	13	W1	8	-3.292e+001	6.620e-024	-1.081e-007	3.492e+002	2	1	0.158
1	14	W1	1	4.184e+001	-6.620e-024	-1.081e-007	4.437e+002	2	1	0.201
1	14	W1	2	3.469e+001	-1.081e-007	6.065e-025	3.679e+002	2	2	0.167
1	14	W1	3	-2.257e+001	-6.620e-024	1.081e-007	2.394e+002	2	1	0.109
1	14	W1	4	-3.292e+001	-6.620e-024	-1.081e-007	3.492e+002	2	1	0.158
1	14	W1	5	-2.257e+001	-6.620e-024	1.081e-007	2.394e+002	2	1	0.109
1	14	W1	6	3.469e+001	1.081e-007	1.324e-023	3.679e+002	2	1	0.167
1	14	W1	7	4.184e+001	-6.620e-024	-1.081e-007	4.437e+002	2	1	0.201
1	14	W1	8	5.218e+001	-6.620e-024	1.081e-007	5.535e+002	2	1	0.251
1	15	W1	1	4.658e+001	-8.318e-007	5.094e-023	4.941e+002	2	2	0.224
1	15	W1	2	1.345e+001	4.667e-024	8.318e-007	1.426e+002	2	1	0.065
1	15	W1	3	4.658e+001	8.318e-007	5.094e-023	4.941e+002	2	1	0.224
1	15	W1	4	4.658e+001	-8.318e-007	5.094e-023	4.941e+002	2	2	0.224
1	15	W1	5	-2.732e+001	8.318e-007	5.094e-023	2.897e+002	2	2	0.131
1	15	W1	6	5.819e+000	1.019e-022	-8.318e-007	6.172e+001	2	1	0.028
1	15	W1	7	-2.732e+001	-8.318e-007	5.094e-023	2.897e+002	2	1	0.131
1	15	W1	8	4.658e+001	8.318e-007	5.094e-023	4.941e+002	2	1	0.224
1	16	W1	1	-2.732e+001	8.318e-007	-5.094e-023	2.897e+002	2	2	0.131
1	16	W1	2	5.819e+000	-4.667e-024	-8.318e-007	6.172e+001	2	1	0.028
1	16	W1	3	-2.732e+001	-8.318e-007	-5.094e-023	2.897e+002	2	1	0.131
1	16	W1	4	4.658e+001	8.318e-007	-5.094e-023	4.941e+002	2	1	0.224
1	16	W1	5	4.658e+001	-8.318e-007	-5.094e-023	4.941e+002	2	2	0.224
1	16	W1	6	1.345e+001	-1.019e-022	8.318e-007	1.426e+002	2	2	0.065
1	16	W1	7	4.658e+001	8.318e-007	-5.094e-023	4.941e+002	2	1	0.224
1	16	W1	8	4.658e+001	-8.318e-007	-5.094e-023	4.941e+002	2	2	0.224
1	17	W1	1	-9.963e+001	6.620e-024	1.081e-007	1.057e+003	2	1	0.479
1	17	W1	2	-9.248e+001	1.081e-007	-6.065e-025	9.809e+002	2	2	0.445
1	17	W1	3	-3.522e+001	6.620e-024	-1.081e-007	3.736e+002	2	1	0.169
1	17	W1	4	-2.487e+001	6.620e-024	1.081e-007	2.638e+002	2	1	0.120
1	17	W1	5	-3.522e+001	6.620e-024	-1.081e-007	3.736e+002	2	1	0.169
1	17	W1	6	-9.248e+001	-1.081e-007	-1.324e-023	9.809e+002	2	1	0.445
1	17	W1	7	-9.963e+001	6.620e-024	1.081e-007	1.057e+003	2	1	0.479
1	17	W1	8	-1.100e+002	6.620e-024	-1.081e-007	1.166e+003	2	1	0.529
1	18	W1	1	-3.522e+001	-6.620e-024	-1.081e-007	3.736e+002	2	1	0.169
1	18	W1	2	-9.248e+001	-1.081e-007	6.065e-025	9.809e+002	2	1	0.445
1	18	W1	3	-9.963e+001	-6.620e-024	1.081e-007	1.057e+003	2	1	0.479
1	18	W1	4	-1.100e+002	-6.620e-024	-1.081e-007	1.166e+003	2	1	0.529
1	18	W1	5	-9.963e+001	-6.620e-024	1.081e-007	1.057e+003	2	1	0.479
1	18	W1	6	-9.248e+001	1.081e-007	1.324e-023	9.809e+002	2	2	0.445
1	18	W1	7	-3.522e+001	-6.620e-024	-1.081e-007	3.736e+002	2	1	0.169
1	18	W1	8	-2.487e+001	-6.620e-024	1.081e-007	2.638e+002	2	1	0.120
1	19	W1	1	-5.673e+001	-8.318e-007	5.094e-023	6.017e+002	2	1	0.273
1	19	W1	2	-6.361e+001	4.667e-024	8.318e-007	6.747e+002	2	1	0.306
1	19	W1	3	-5.673e+001	8.318e-007	5.094e-023	6.017e+002	2	2	0.273
1	19	W1	4	-1.044e+002	-8.318e-007	5.094e-023	1.107e+003	2	1	0.502
1	19	W1	5	-1.044e+002	8.318e-007	5.094e-023	1.107e+003	2	2	0.502
1	19	W1	6	-7.124e+001	1.019e-022	-8.318e-007	7.556e+002	2	1	0.343
1	19	W1	7	-1.044e+002	-8.318e-007	5.094e-023	1.107e+003	2	1	0.502
1	19	W1	8	-1.044e+002	8.318e-007	5.094e-023	1.107e+003	2	2	0.502
1	20	W1	1	-1.044e+002	8.318e-007	-5.094e-023	1.107e+003	2	2	0.502
1	20	W1	2	-7.124e+001	-4.667e-024	-8.318e-007	7.556e+002	2	1	0.343
1	20	W1	3	-1.044e+002	-8.318e-007	-5.094e-023	1.107e+003	2	1	0.502
1	20	W1	4	-1.044e+002	8.318e-007	-5.094e-023	1.107e+003	2	2	0.502
1	20	W1	5	-5.673e+001	-8.318e-007	-5.094e-023	6.017e+002	2	1	0.273
1	20	W1	6	-6.361e+001	-1.019e-022	8.318e-007	6.747e+002	2	1	0.306
1	20	W1	7	-5.673e+001	8.318e-007	-5.094e-023	6.017e+002	2	2	0.273
1	20	W1	8	-1.044e+002	-8.318e-007	-5.094e-023	1.107e+003	2	1	0.502
1	21	W1	1	-2.151e+001	-8.318e-007	1.081e-007	2.281e+002	2	1	0.103
1	21	W1	2	2.887e+001	1.081e-007	8.318e-007	3.062e+002	2	1	0.139
1	21	W1	3	6.915e+001	8.318e-007	-1.081e-007	7.335e+002	2	1	0.333
1	21	W1	4	7.950e+001	-8.318e-007	1.081e-007	8.432e+002	2	2	0.383
1	21	W1	5	2.151e+001	8.318e-007	-1.081e-007	2.281e+002	2	1	0.103
1	21	W1	6	-2.887e+001	-1.081e-007	-8.318e-007	3.062e+002	2	1	0.139
1	21	W1	7	-6.915e+001	-8.318e-007	1.081e-007	7.335e+002	2	1	0.333
1	21	W1	8	-7.950e+001	8.318e-007	-1.081e-007	8.432e+002	2	2	0.383
1	22	W1	1	-6.915e+001	8.318e-007	1.081e-007	7.335e+002	2	2	0.333
1	22	W1	2	-2.887e+001	1.081e-007	-8.318e-007	3.062e+002	2	2	0.139
1	22	W1	3	2.151e+001	-8.318e-007	-1.081e-007	2.281e+002	2	2	0.103
1	22	W1	4	7.950e+001	8.318e-007	1.081e-007	8.432e+002	2	1	0.383
1	22	W1	5	6.915e+001	-8.318e-007	-1.081e-007	7.335e+002	2	2	0.333
1	22	W1	6	2.887e+001	-1.081e-007	8.318e-007	3.062e+002	2	2	0.139
1	22	W1	7	-2.151e+001	8.318e-007	1.081e-007	2.281e+002	2	2	0.103
1	22	W1	8	-7.950e+001	-8.318e-007	-1.081e-007	8.432e+002	2	1	0.383
1	23	W1	1	6.915e+001	-8.318e-007	-1.081e-007	7.335e+002	2	2	0.333
1	23	W1	2	2.887e+001	-1.081e-007	8.318e-007	3.062e+002	2	2	0.139
1	23	W1	3	-2.151e+001	8.318e-007	1.081e-007	2.281e+002	2	2	0.103
1	23	W1	4	-7.950e+001	-8.318e-007	-1.081e-007	8.432e+002	2	1	0.383
1	23	W1	5	-6.915e+001	8.318e-007	1.081e-007	7.335e+002	2	2	0.333
1	23	W1	6	-2.887e+001	1.081e-007	-8.318e-007	3.062e+002	2	2	0.139
1	23	W1	7	2.151e+001	-8.318e-007	-1.081e-007	2.281e+002	2	2	0.103
1	23	W1	8	7.950e+001	8.318e-007	1.081e-007	8.432e+002	2	1	0.383
1	24	W1	1	2.151e+001	8.318e-007	-1.081e-007	2.281e+002	2	1	0.103
1	24	W1	2	-2.887e+001	-1.081e-007	-8.318e-007	3.062e+002	2	1	0.139
1	24	W1	3	-6.915e+001	-8.318e-007	1.081e-007	7.335e+002	2	1	0.333
1	24	W1	4	-7.950e+001	8.318e-007	-1.081e-007	8.432e+002	2	2	0.383
1	24	W1	5	-2.151e+001	-8.318e-007	1.081e-007	2.281e+002	2	1	0.103
1	24	W1	6	2.887e+001	1.081e-007	8.318e-007	3.062e+002	2	1	0.139
1	24	W1	7	6.915e+001	8.318e-007	-1.081e-007	7.335e+002	2	1	0.333
1	24	W1	8	7.950e+001	-8.318e-007	1.081e-007	8.432e+002	2	2	0.383

Members whose maximum exploitation is due to bearing stresses
---

Inst	Combi	Name	Boltlay	Bolt	Extr.	Sigma	Sigma M	Expl

EMPTY LIST

Through whose maximum exploitation is due to bearing stresses
---

Inst	Combi	Name	Boltlay	Bolt	Extr.	Sigma	Sigma M	Expl

EMPTY LIST

Members whose maximum exploitation is due to punching shear

Inst	Combi	Name	Boltlay	Bolt	Extr.	Force	Force M	Expl

EMPTY LIST

Through whose maximum exploitation is due to punching shear

Inst	Combi	Name	Boltlay	Bolt	Extr.	Force	Force M	Expl

EMPTY LIST

Members whose relevant exploitation is due to block tearing checks
---

Inst	Combi	Name	Blayout	Angle	Force U	Force A	Expl

EMPTY LIST

Throughs whose relevant exploitation is due to block tearing checks
---

Inst	Combi	Name	Blayout	Angle	Force U	Force A	Expl

EMPTY LIST

Members whose relevant exploitation is due to being polygon bearings
---

Inst	Combi	Name	Blayout	Sigma,B	a	b	c	Expl

EMPTY LIST

Throughs whose relevant exploitation is due to being polygon bearings
---

Inst	Combi	Name	Blayout	Sigma,B	a	b	c	Expl
1	2	|---|	B1	-3.392e+000	2.522e-006	9.527e-007	3.140e-005	0.204
1	3	|---|	B1	-1.390e+000	2.522e-006	9.527e-007	3.140e-005	0.084
1	5	|---|	B1	-1.007e+001	2.522e-006	9.527e-007	3.140e-005	0.607
1	6	|---|	B1	-4.373e+000	2.522e-006	9.527e-007	3.140e-005	0.263
1	7	|---|	B1	-1.547e+001	2.522e-006	9.527e-007	3.140e-005	0.932
1	8	|---|	B1	-3.392e+000	2.522e-006	9.527e-007	3.140e-005	0.204
1	9	|---|	B1	-1.390e+000	2.522e-006	9.527e-007	3.140e-005	0.084
1	11	|---|	B1	-1.007e+001	2.522e-006	9.527e-007	3.140e-005	0.607
1	12	|---|	B1	-4.373e+000	2.522e-006	9.527e-007	3.140e-005	0.263
1	13	|---|	B1	-4.200e+000	2.522e-006	9.527e-007	3.140e-005	0.253
1	14	|---|	B1	-4.200e+000	2.522e-006	9.527e-007	3.140e-005	0.253
1	15	|---|	B1	-5.070e-001	2.522e-006	9.527e-007	3.140e-005	0.031
1	16	|---|	B1	-5.070e-001	2.522e-006	9.527e-007	3.140e-005	0.031
1	17	|---|	B1	-1.271e+001	2.522e-006	9.527e-007	3.140e-005	0.765
1	18	|---|	B1	-1.271e+001	2.522e-006	9.527e-007	3.140e-005	0.765
1	19	|---|	B1	-1.002e+001	2.522e-006	9.527e-007	3.140e-005	0.603
1	20	|---|	B1	-1.002e+001	2.522e-006	9.527e-007	3.140e-005	0.603
1	21	|---|	B1	-7.301e+000	2.522e-006	9.527e-007	3.140e-005	0.440
1	22	|---|	B1	-7.301e+000	2.522e-006	9.527e-007	3.140e-005	0.440
1	23	|---|	B1	-7.301e+000	2.522e-006	9.527e-007	3.140e-005	0.440
1	24	|---|	B1	-7.301e+000	2.522e-006	9.527e-007	3.140e-005	0.440

Members whose relevant exploitation is due to net sections check
---

Inst	Combi	Name	Sect	N	T2	T3	M1	M2	M3	fd	Expl

EMPTY LIST

Throughs whose worst exploitation is due to simplified "beam" resistance checks
---

Inst	Combi	Name	Sect	N	T2	T3	M1	M2	M3	Expl

EMPTY LIST

Members whose worst exploitation is due to fem resistance checks

---

Inst	Combi	Name	VM	fd	Expl

EMPTY LIST

Throughs whose worst exploitation is due to fem resistance checks

---

Inst	Combi	Name	VM	fd	Expl
1	1	P1	6.752e+001	2.350e+002	0.287
1	2	P1	7.130e+001	2.350e+002	0.303
1	3	P1	3.510e+001	2.350e+002	0.149
1	4	P1	2.385e+000	2.350e+002	0.010
1	5	P1	1.061e+002	2.350e+002	0.451
1	6	P1	4.798e+001	2.350e+002	0.204
1	7	P1	2.442e+002	2.350e+002	1.039 *
1	8	P1	7.507e+001	2.350e+002	0.319
1	9	P1	3.635e+001	2.350e+002	0.155
1	10	P1	2.385e+000	2.350e+002	0.010
1	11	P1	1.065e+002	2.350e+002	0.453
1	12	P1	4.838e+001	2.350e+002	0.206
1	13	P1	7.334e+001	2.350e+002	0.312
1	14	P1	7.362e+001	2.350e+002	0.313
1	15	P1	4.419e+001	2.350e+002	0.188
1	16	P1	4.417e+001	2.350e+002	0.188
1	17	P1	1.306e+002	2.350e+002	0.556
1	18	P1	1.308e+002	2.350e+002	0.557
1	19	P1	1.229e+002	2.350e+002	0.523
1	20	P1	1.237e+002	2.350e+002	0.526
1	21	P1	6.720e+001	2.350e+002	0.286
1	22	P1	6.751e+001	2.350e+002	0.287
1	23	P1	6.741e+001	2.350e+002	0.287
1	24	P1	6.706e+001	2.350e+002	0.285

Boltlayouts whose worst exploitation is due to user's checks

Inst	Combi	Name	Check	Description	vL	vR	Expl

EMPTY LIST

Weldlayouts whose worst exploitation is due to user's checks

Inst	Combi	Name	Check	Description	vL	vR	Expl

EMPTY LIST

Members whose worst exploitation is due to user's checks

Inst	Combi	Name	Check	Description	vL	vR	Expl

EMPTY LIST

Throughs whose worst exploitation is due to user's checks

Inst	Combi	Name	Check	Description	vL	vR	Expl

EMPTY LIST

Notional Displacement info

Maximum translation	Instance	Combination	Component
6.853e-002	1	7	m1

Maximum rotation	Instance	Combination	Component
1.904e-004	1	5	m1

****
End of automatic checks
****

