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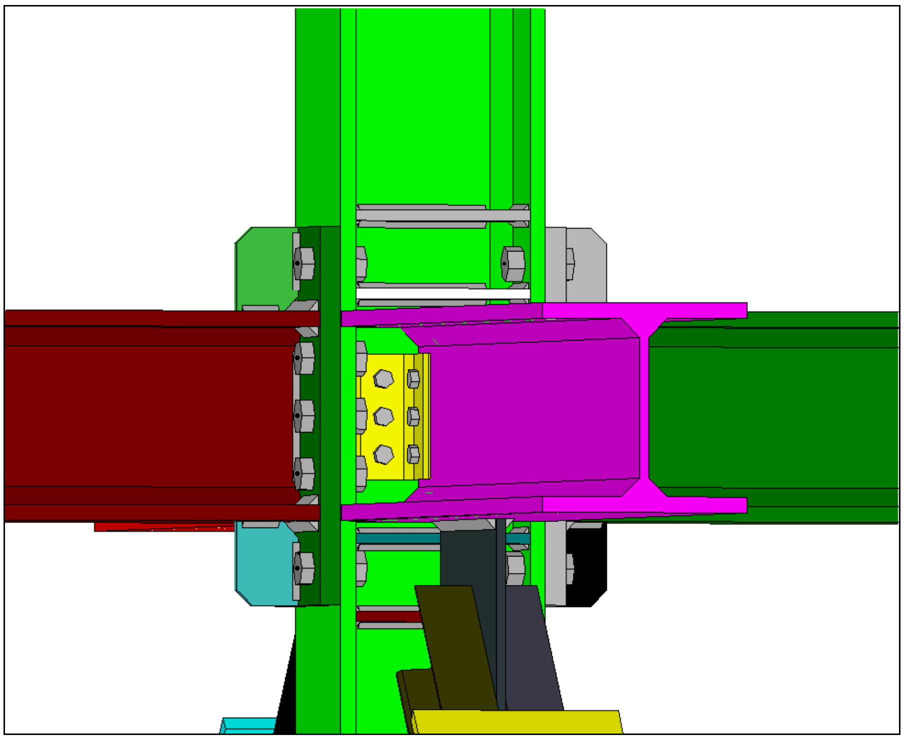
C.S.E.

Connection Study Environment

Tutorial 3: building a multiple-members renode. Part 3



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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. This tutorial (part 3 of tutorial 3) is aimed at teaching base commands relative to renode construction. The start point is the end of tutorial 003b (part 2 of tutorial 3).

By following this tutorial you will be able to:

- Build up a complex renode adding plates, angles, bolts and welds
- Apply cuts, bevels, shorten and lengthen members
- Understand computing options of bolt layouts and of members and components
- Understand how to use the left side panes
- Understand how to add new variables
- Understand how to add user-defined checks
- Export a DXF to be processed by other CAD programs

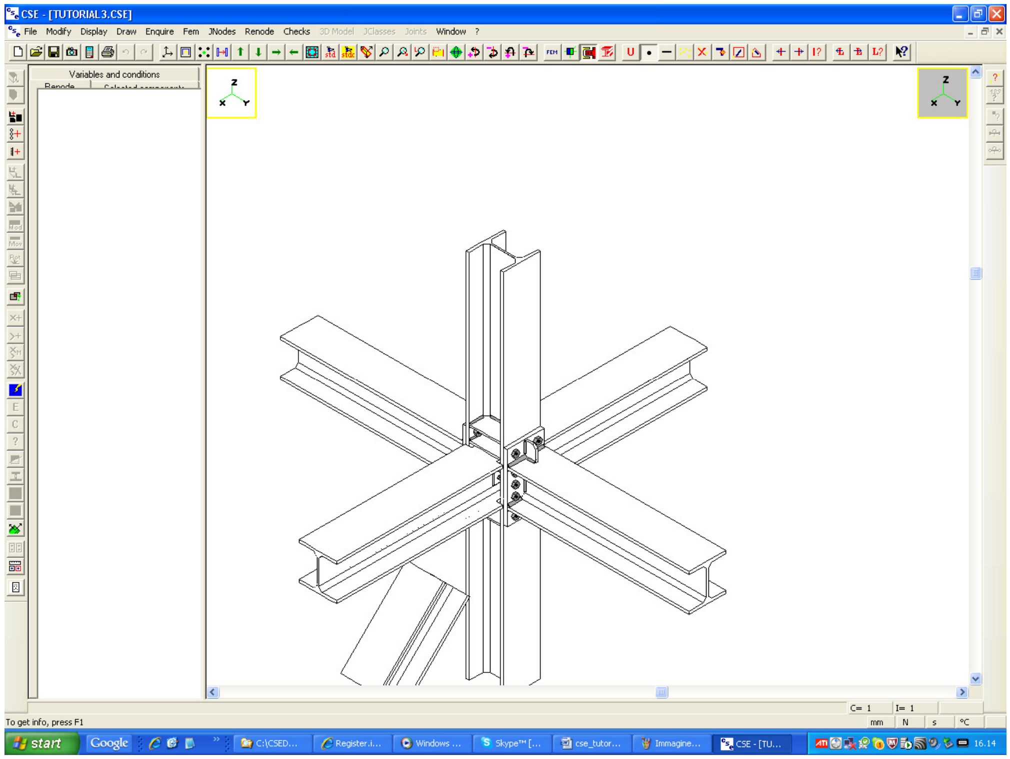
Running the checks and discussing results will be done in another tutorial.

This tutorial is some like 26 pages long because we have explained step by step anything with images, however it takes very few minutes to actually do these things.

This is the third part of a set of 4 parts. In this part we will join the diagonals.

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.

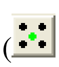
2 HOW TO BUILD A MULTIPLE MEMBERS RENODE

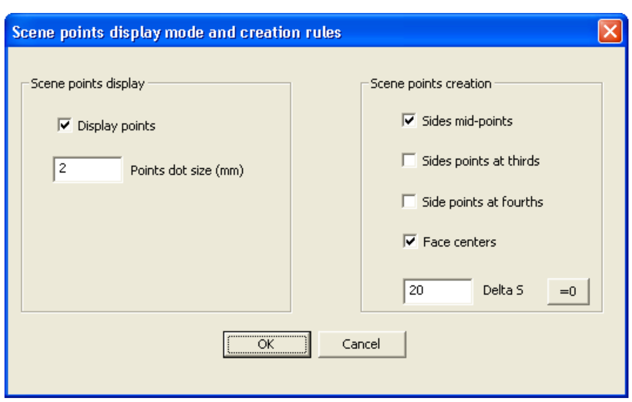


Initial windows content: renode view at the end of tutorial 003b.

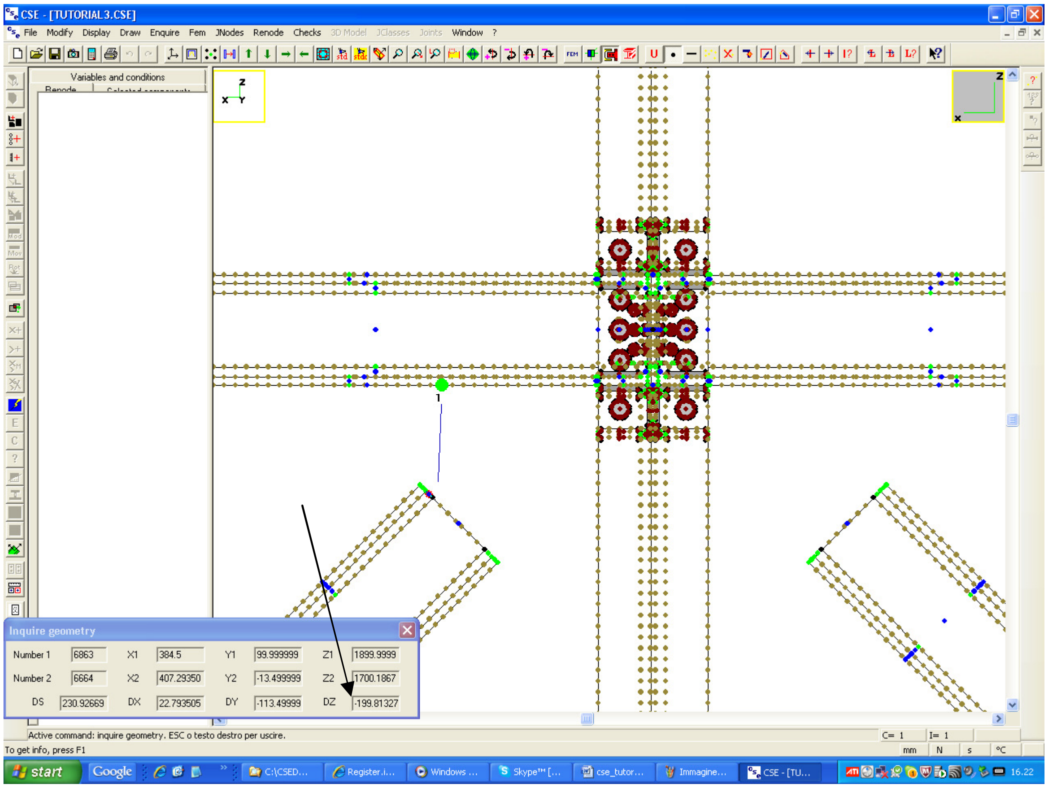
2.1 STEP 5: JOINING THE DIAGONAL ELEMENTS

2.1.1 Add a plate joined to +X beam

First of all we will add a plate to the +X beam. To do that we first have to understand which sizes will have this plate. So execute the **Display-Scene points** command ( button in the main bar) and choose to see the scene points adding points at 20 mm distance (**Delta S**), like this:

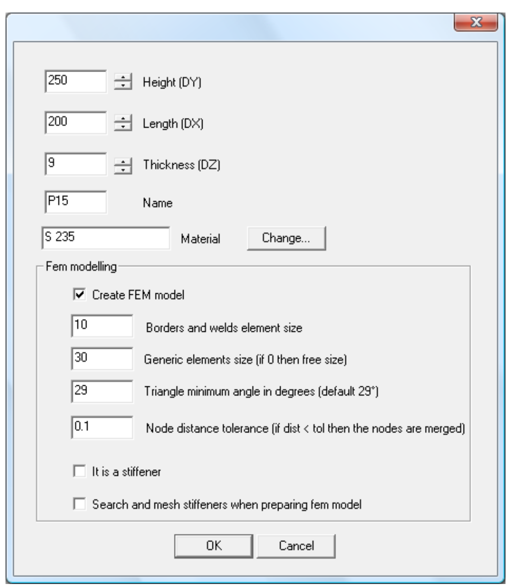


Then choose a +Y view and using the **Enquire-Geometry** command (button in the right bar) have a look at the scene understanding the sizes:

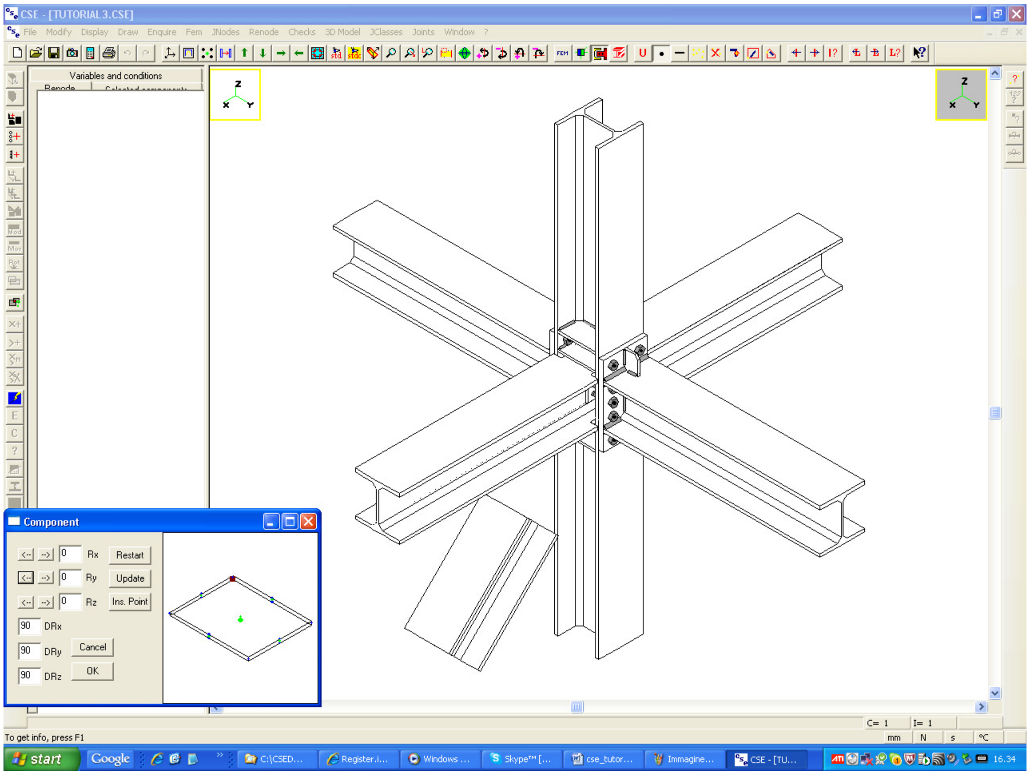


To exit from **Enquire-Geometry** click right. Re-execute the **Display-Scene points** command to avoid the points display and to reduce the scene points number (reset 0 in the **Delta S** edit box).

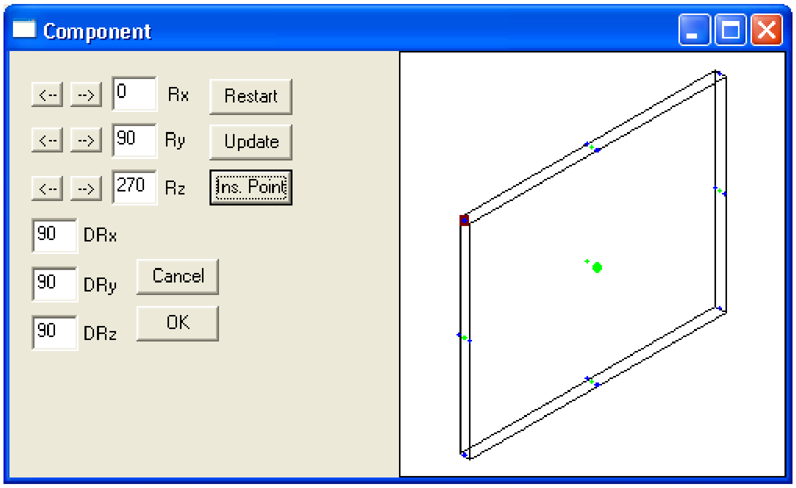
So a 250x200 mm plate will be ok. Now change view. Choose an isometric view and execute the command **Renode-Components-Add through** (button in the left bar), and then choose **Rectangular plate**. You are now here



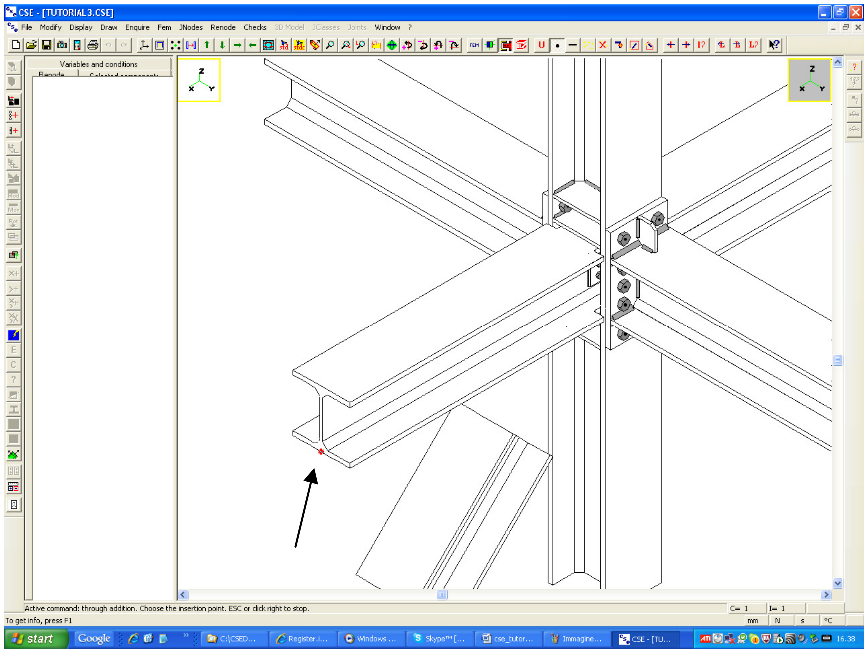
Choose 250, 200 and 9 mm for the plate sizes (as the diagonal web thickness is 9mm), as shown. Place a tick in the "**Create FEM model**" check box, so that, when required, the fem model of this plate we are in for adding will be created. You can later change this option, if you wish. Press **OK**. You are here:



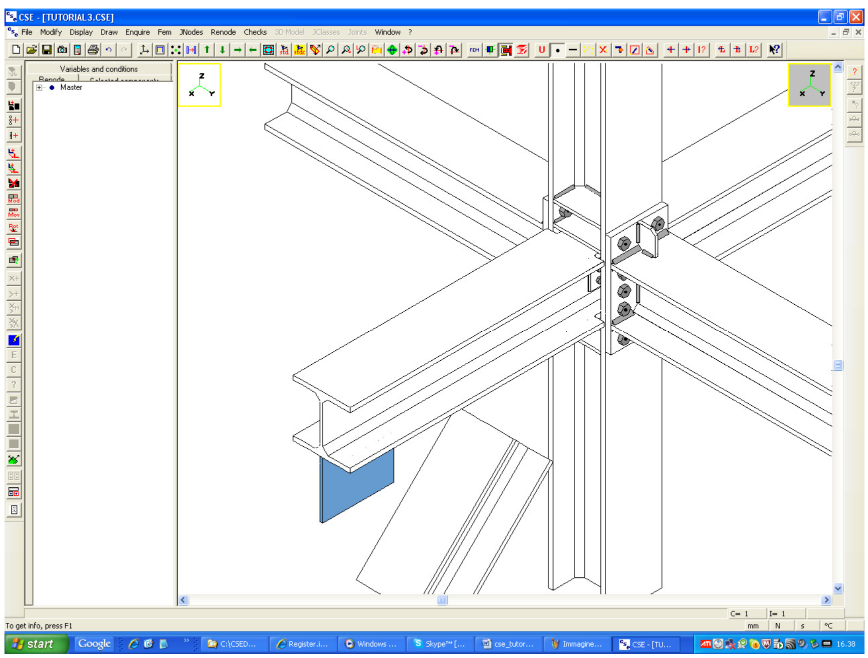
Click once the right arrow in the Ry row, and once the left arrow in the Rz row,; then choose your insertion point, like this:



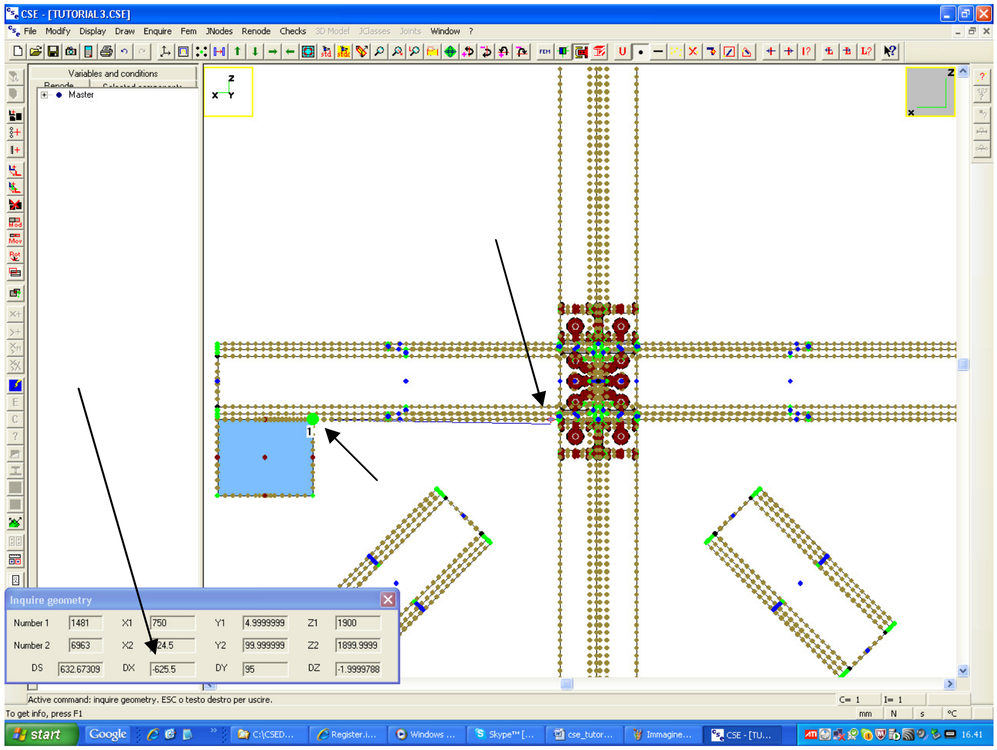
This point is at the mid of the thickness: be sure not to click extremities. You can also enlarge the window to better see what you are doing. Press **OK**. Now choose this poin in the scene (help yourself with the mouse wheel):

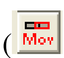


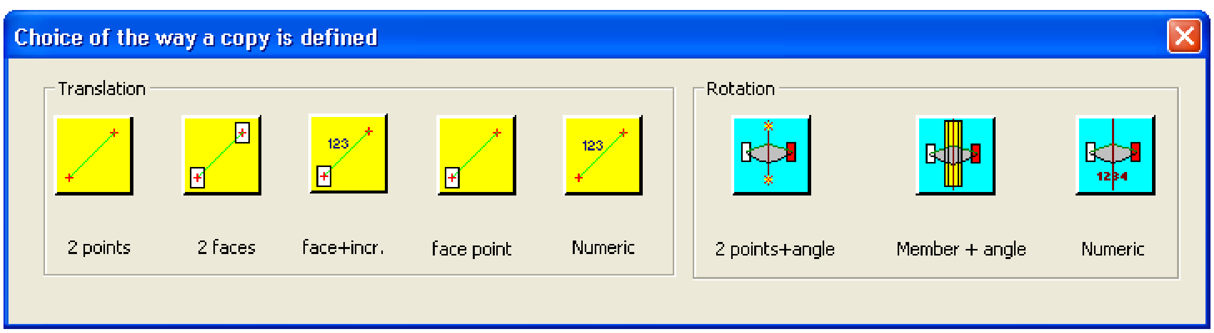
Now you see the plate positioned in this way:



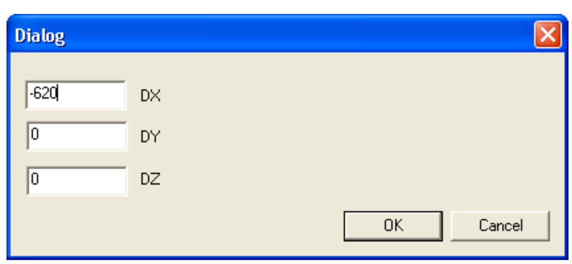
We now have to understand how much it must be shifted in -X direction. To do that choose a +Y view, make more points visible (**Display-Scene points** as previously done) and use the **Enquire-Geometry** command.



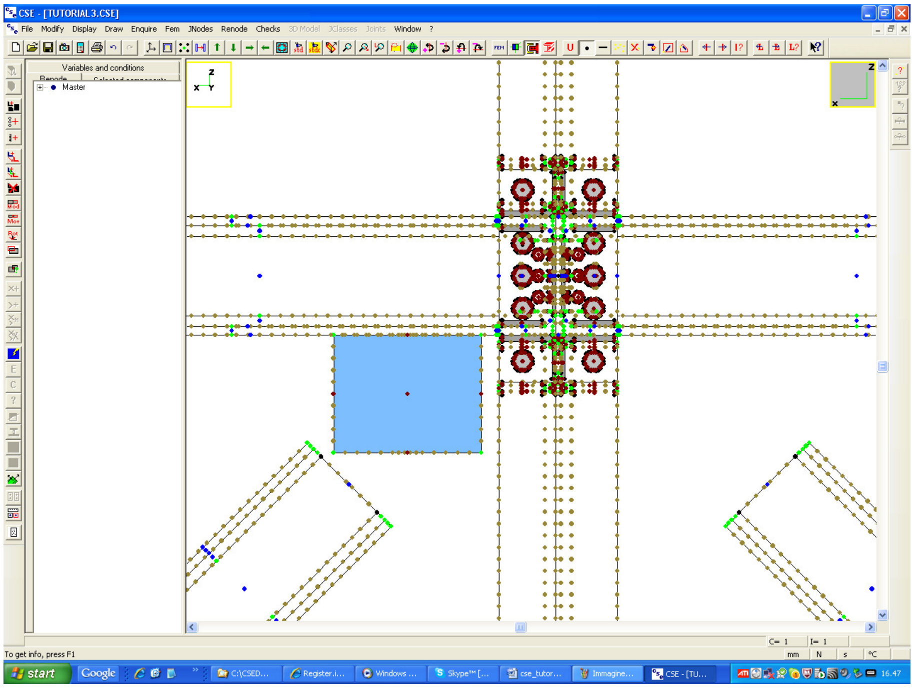
Apparently a -620 Dx will put the plate in a correct position. As the plate is the only object selected, and we are going to move it, we must not change selection. Execute the **Renode-Shift** command ( button in the left bar), and choose the yellow "Numeric" mode:



Enter -620 as dx.

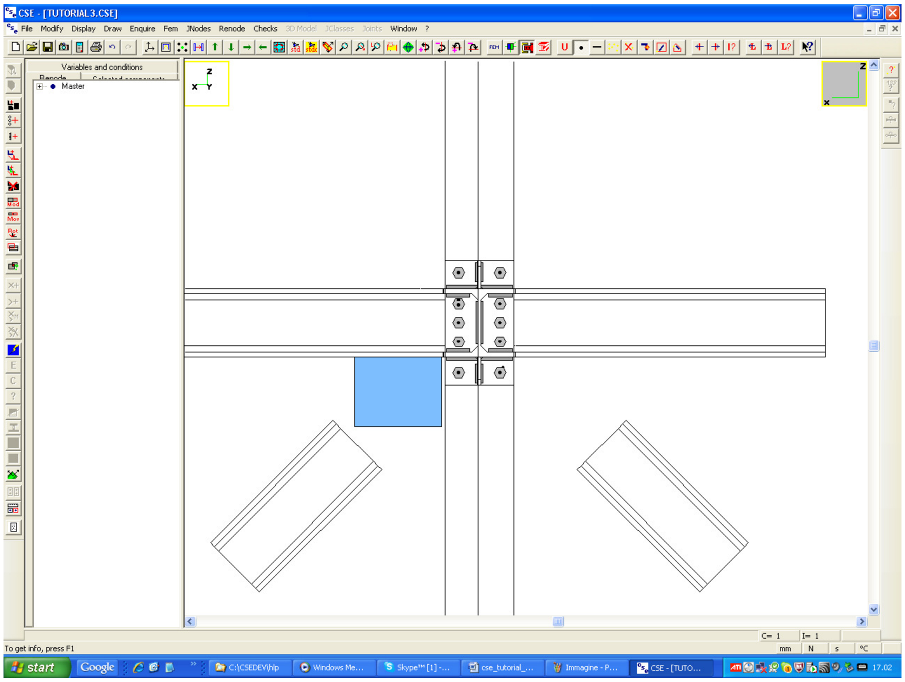


Press OK. You now see the plate here:

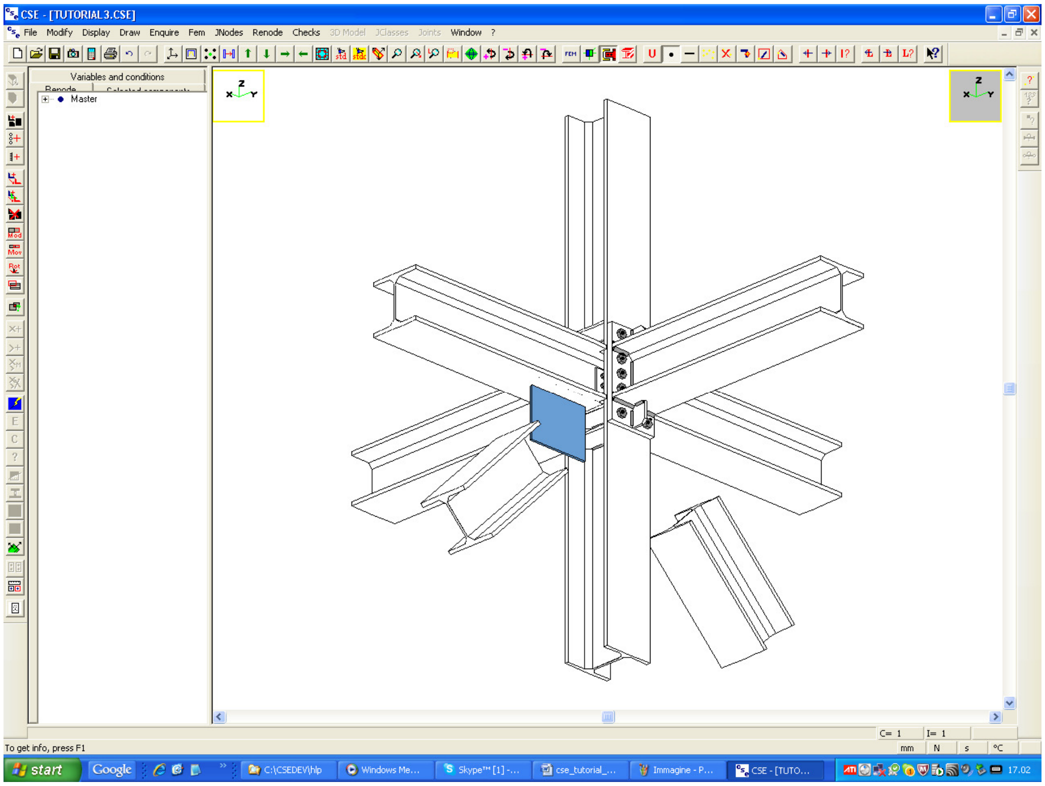


Maybe a slight move more in the -DX direction could help.

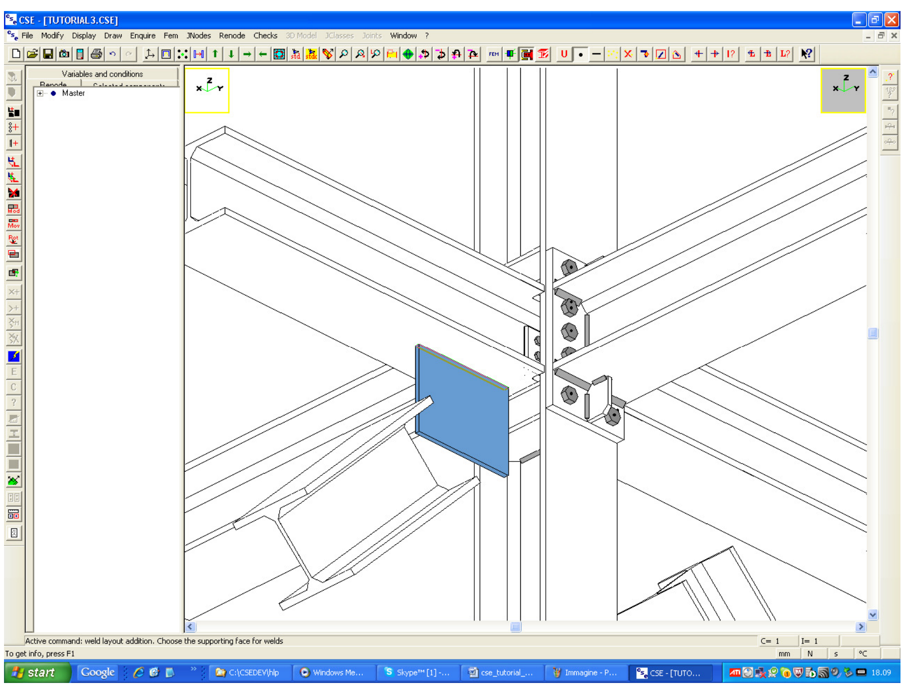
Using the Enquire-Geometry command we can see that there is a 30mm gap with the column (and the stiffeners), so we can move 20 mm more in -DX direction. Remove the scene points display. Remove the +20 in the **Delta S** field (**Display-Scene points** command). You see:



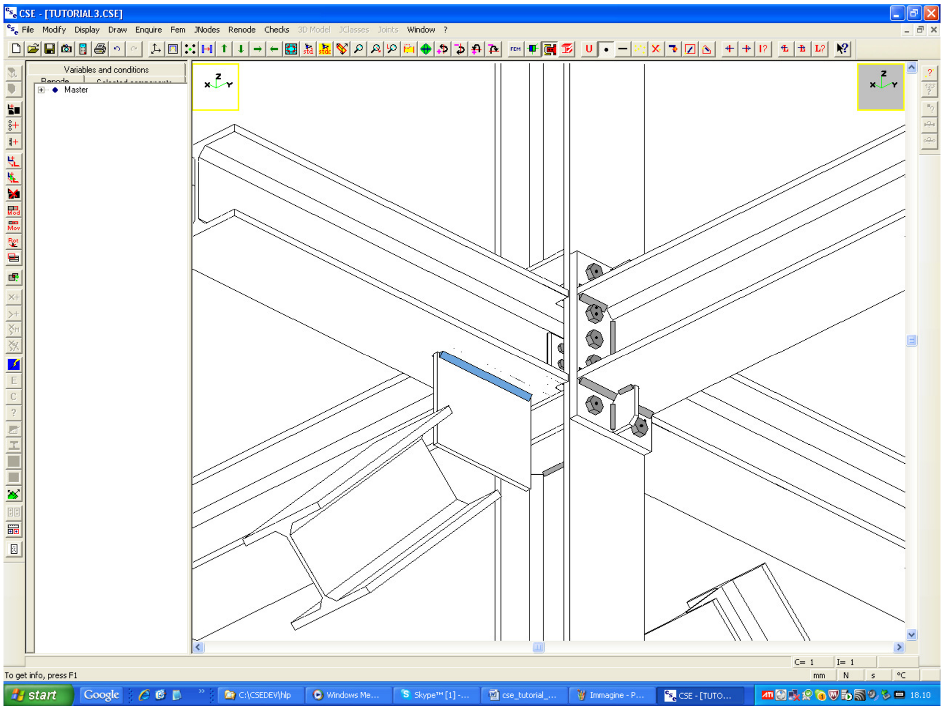
Now choose a Isometric view and then change the view slightly down using the  button in the main bar. See connection from below, like this:



Execute the **Renode-Components-Add weld layout** command (button in the left bar), and choose the face of the plate in contact with the beam:



Use the **Apply to all sides** button in the weld layout addition dialog to apply to fillet welds, 10mm thick, like this:

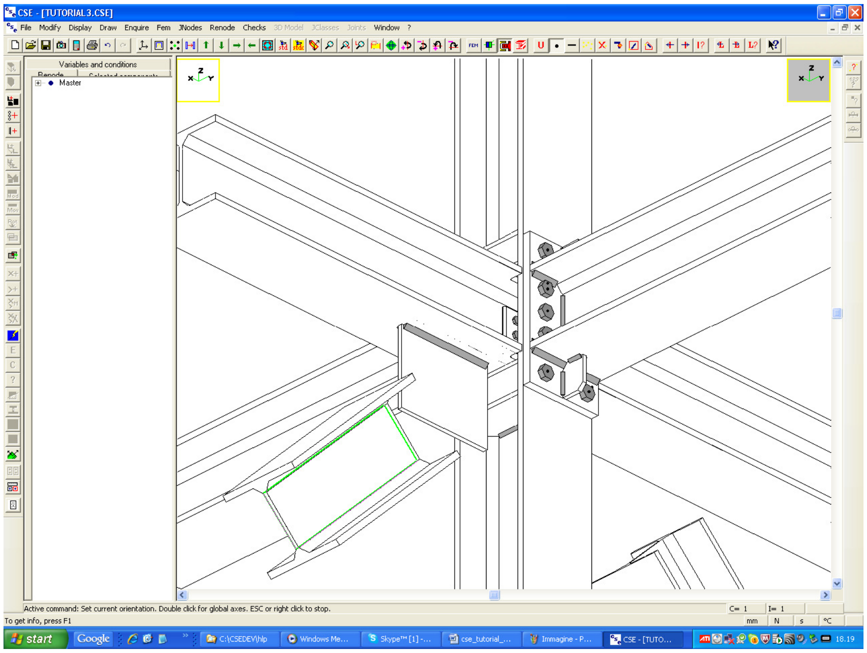


The plate is connected to the beam.

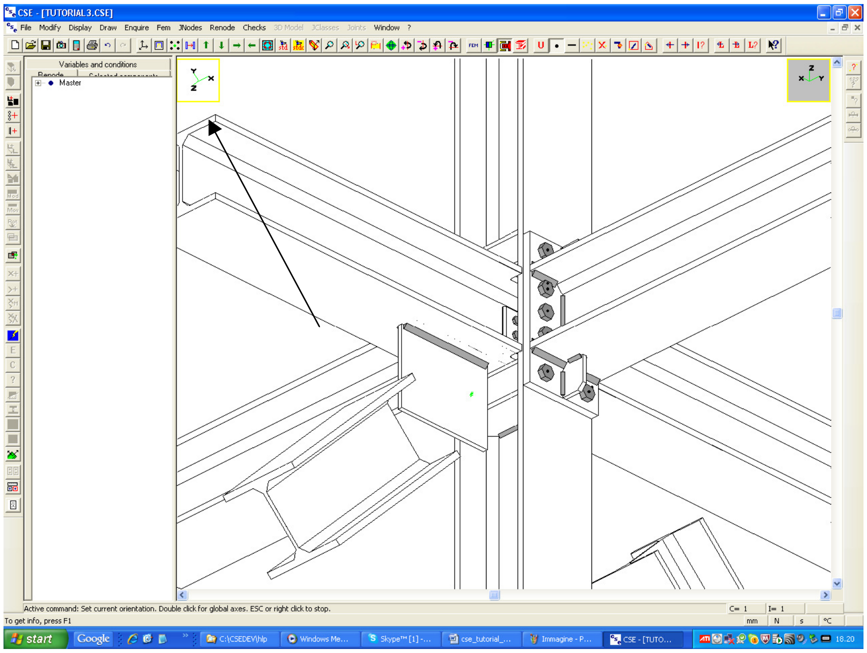
Please note that this connection cannot work properly for high diagonal force values, as the force transferred by the diagonal will flow into bolts connecting the X beam to the column. So these bolts will have to work twice, once for the beam and once for the diagonals: we shall see this when executing checks, as *CSE correctly will keep into account this feature of the connection we are preparing*. This example, which has been set up for demo purposes, will show that CSE is capable of detecting this weakness in the connection design and to compute components accordingly.

2.1.2 Add a][trunk to bridge the gap between the plate and the diagonal

To add a][trunk bridging the gap between the plate and the diagonal, we need a special CS, that of the diagonal. *Unselect all* (so all faces will be available in next command). Execute the command Current orientation by pressing the  button in the main bar. Now click a face of the diagonal we are joining

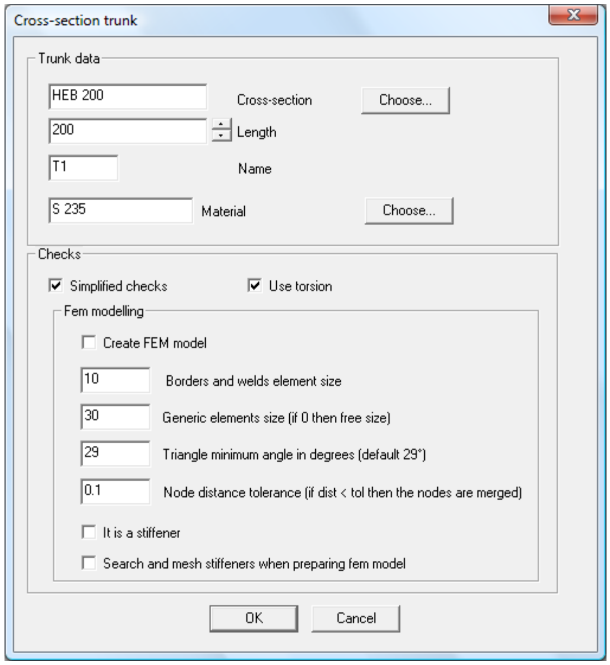


and click right to exit from the command. The axes shown in the top left corner of the window have changed:

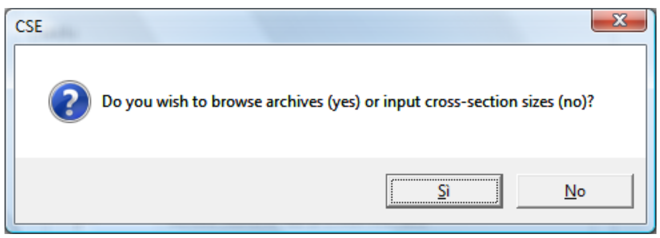


These are the axes of the selected object. These axes will be used now to position the trunk in the scene, so the diagonal direction will be available.

Choose the **Renode-Components-Add through** command (in the left bar), and then choose "Cross-section trunk". You get here:

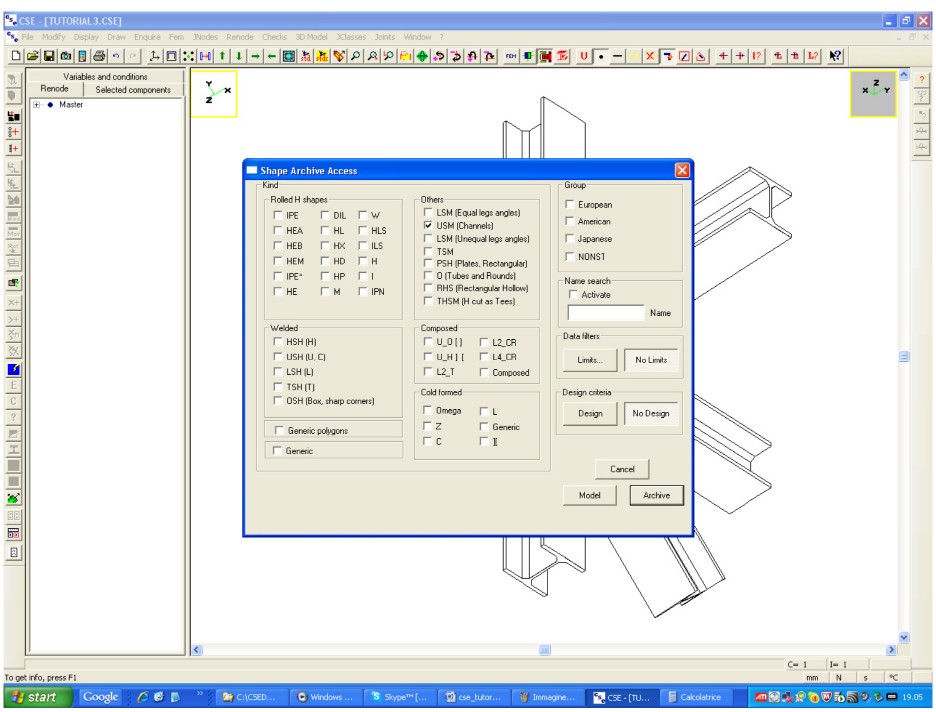


Choose "**Choose**" button and you get here:



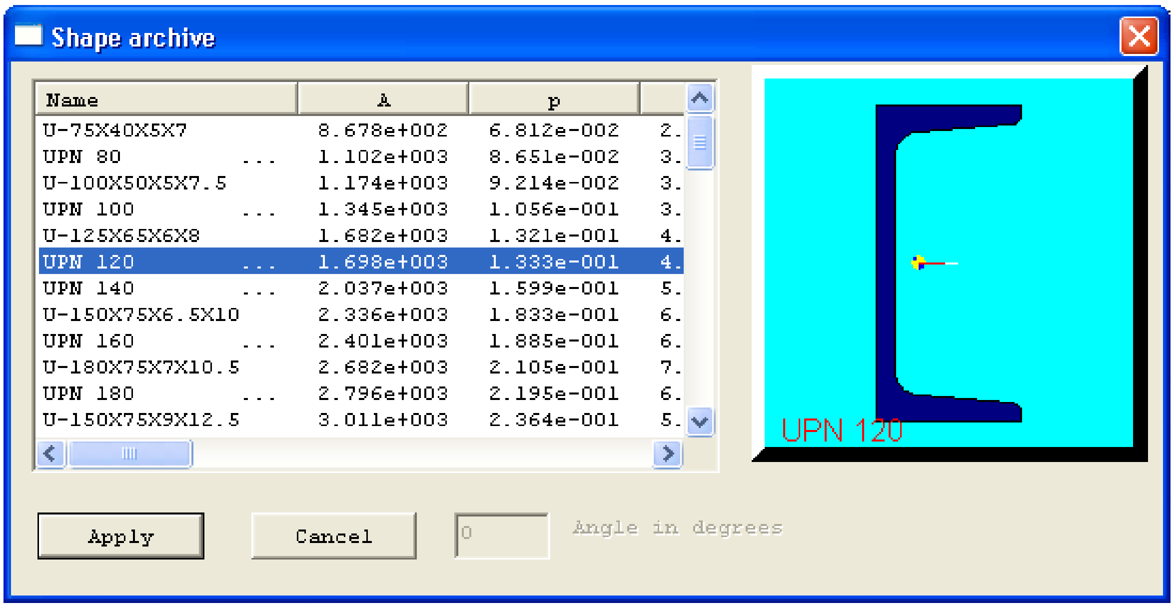
Click “Si” (Yes) to choose a shape from CSE archive (new shapes can be added by clicking “No”).

The following dialog appears:

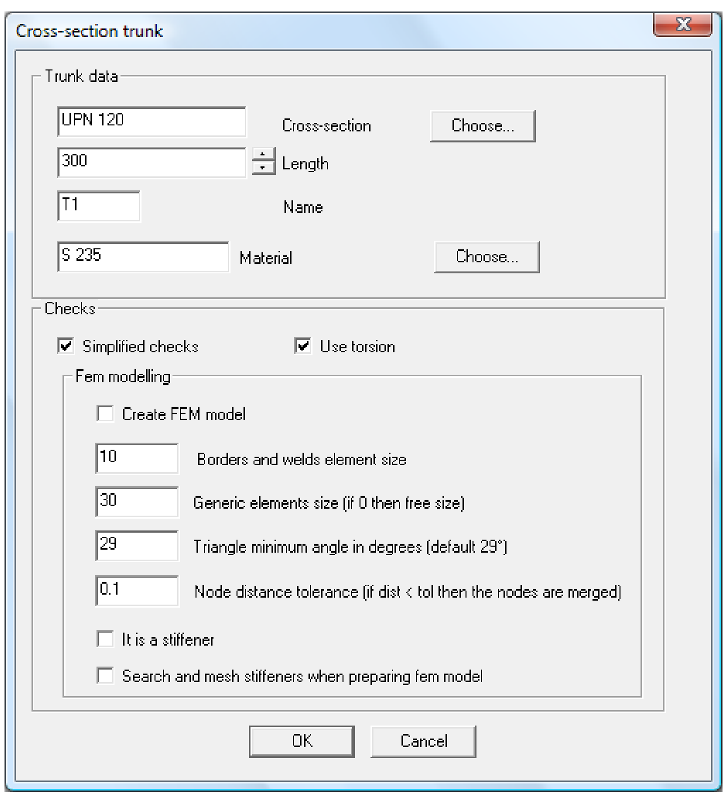


Place a tick in the "Usm channel" check box and press "Archive". We are looking among the] cross-sections in the archive (more than 13,000 shapes available: the archive can be upgraded using our program Shape And Material Brisk Archive).

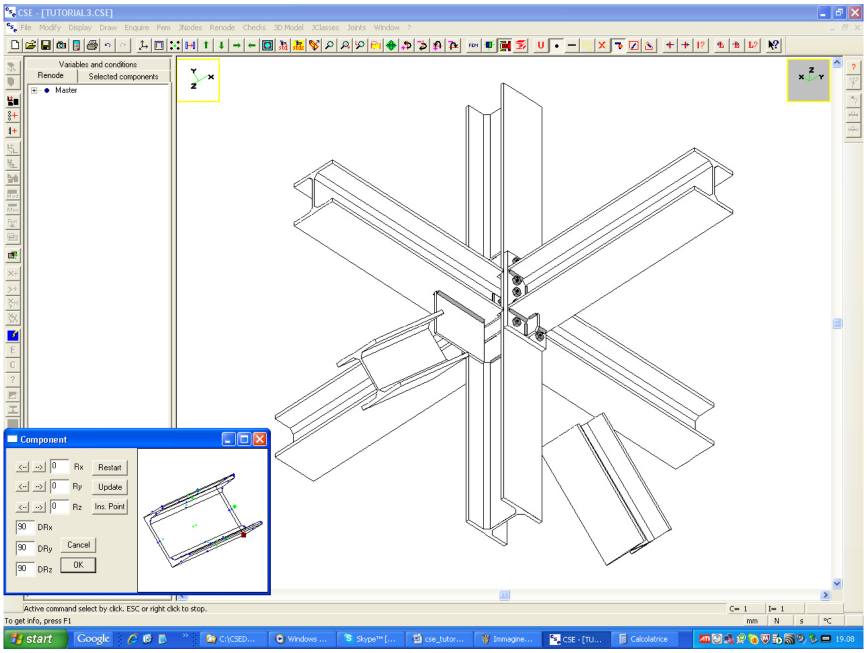
Browse through the sections and choose UPN120



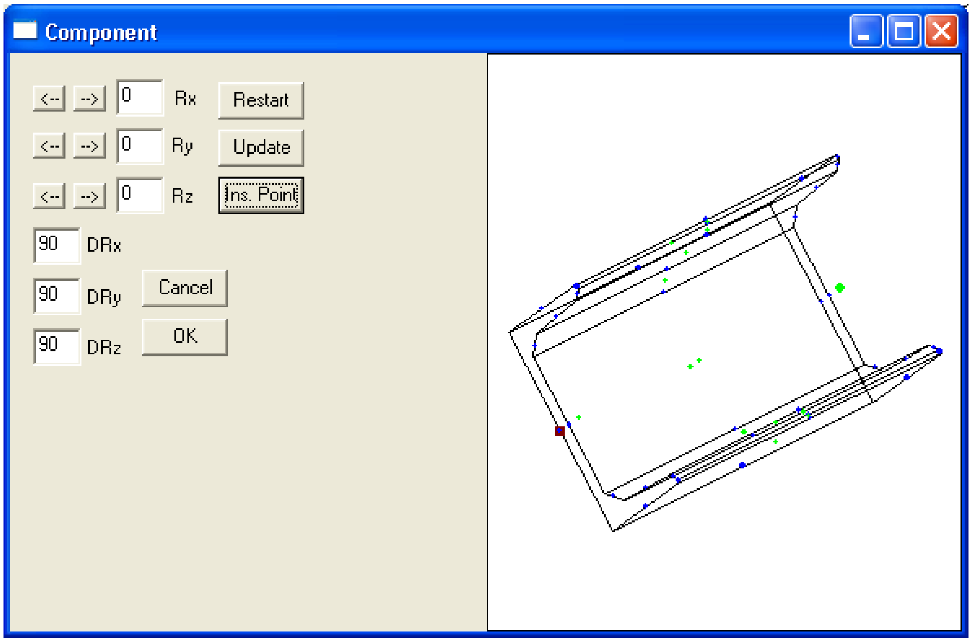
Press the **Apply** button, you are back here, but now the name of the cross section to use has changed. Input 300 for the Length edit box. Press **OK**.



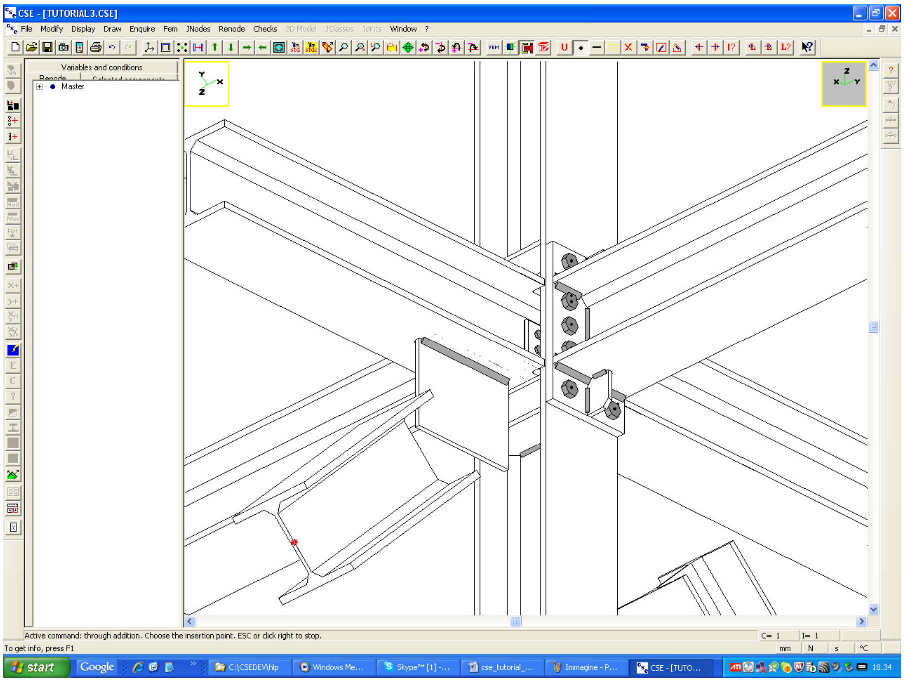
You are here.



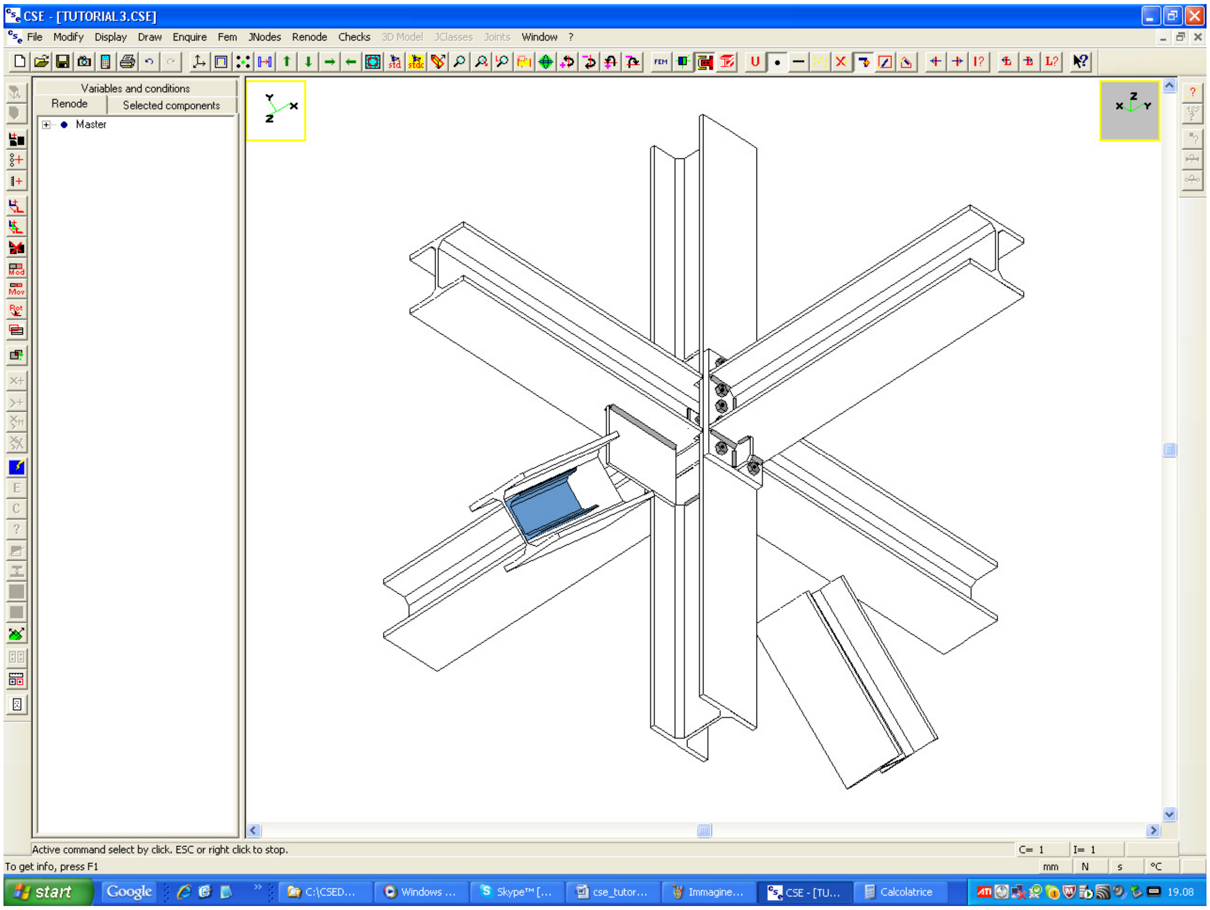
Notice that as we have changed the current orientation, the trunk is not anymore aligned with global axes, but with the local axes of the diagonal. The component we are going to add is already in the proper orientation. Select this point as insertion point (**Ins Point**):



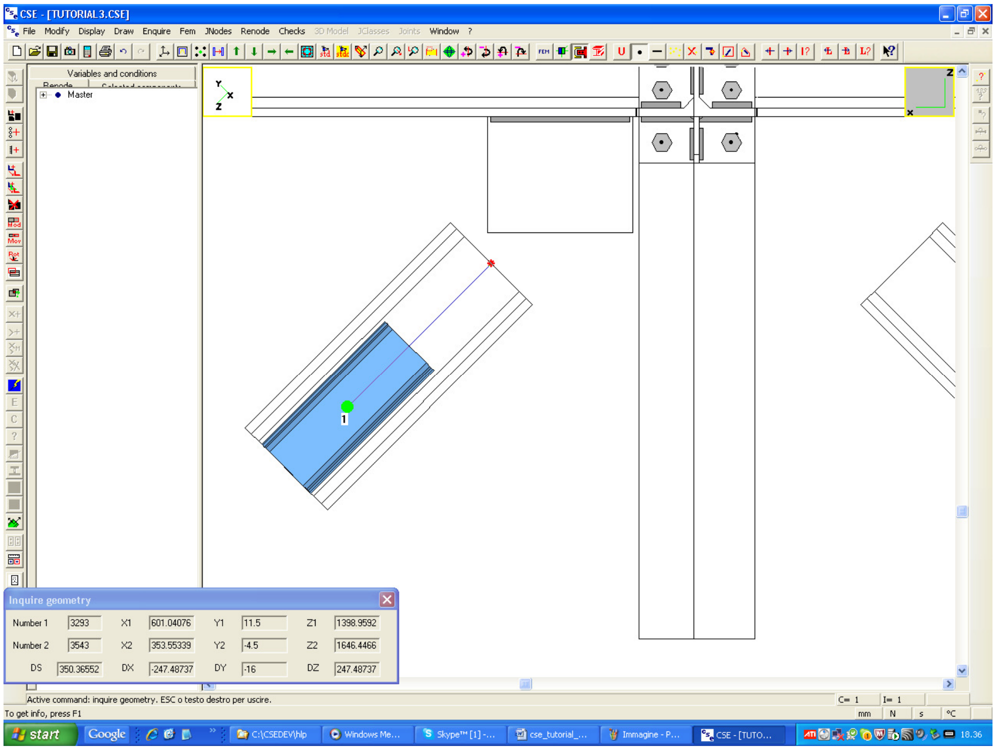
Press **OK** and then click in this point in the scene:



You will now see what follows:



Now to understand the correct shift choose a +Y view and execute the Enquire-Geometry command like this:

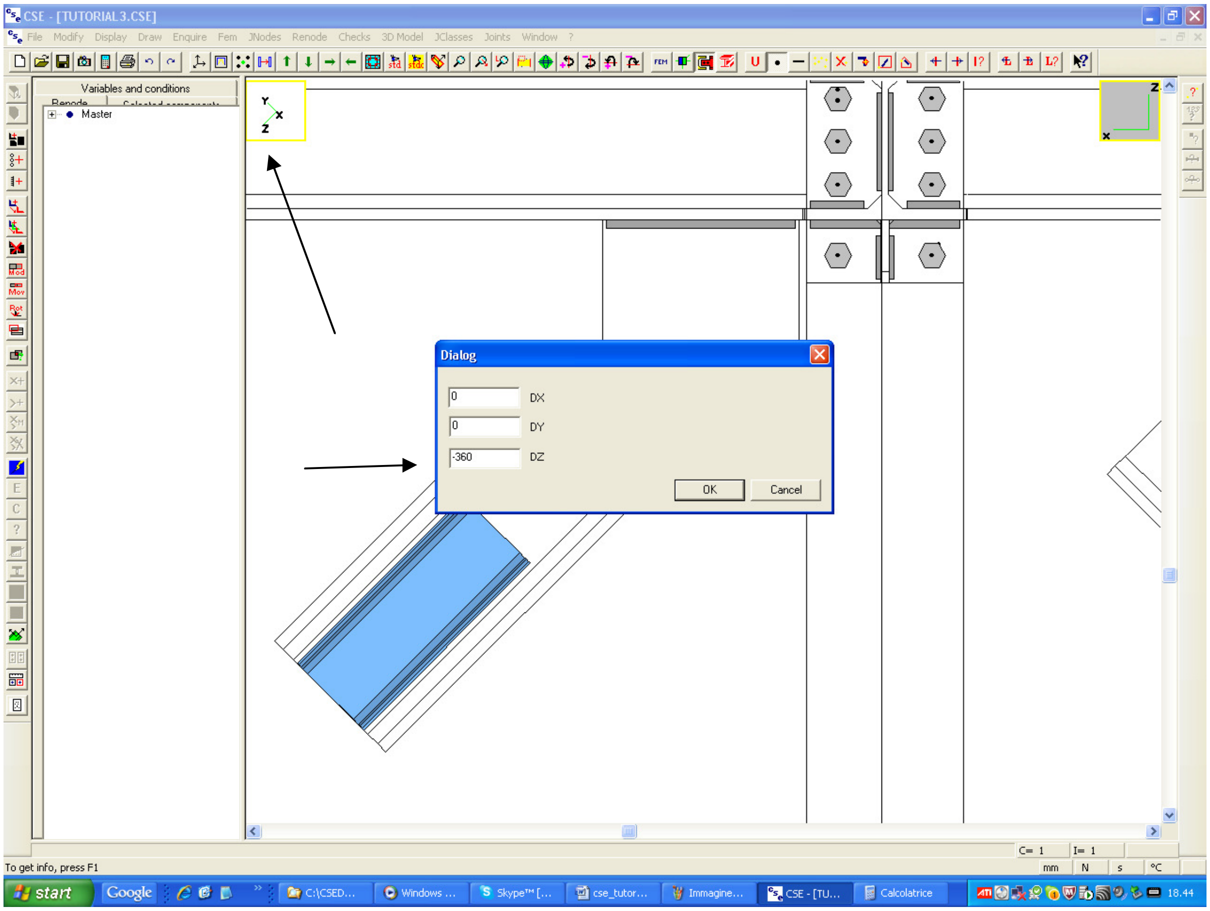


We go from mid trunk to diagonal end. In the window we read the DX and DZ to apply. They are:

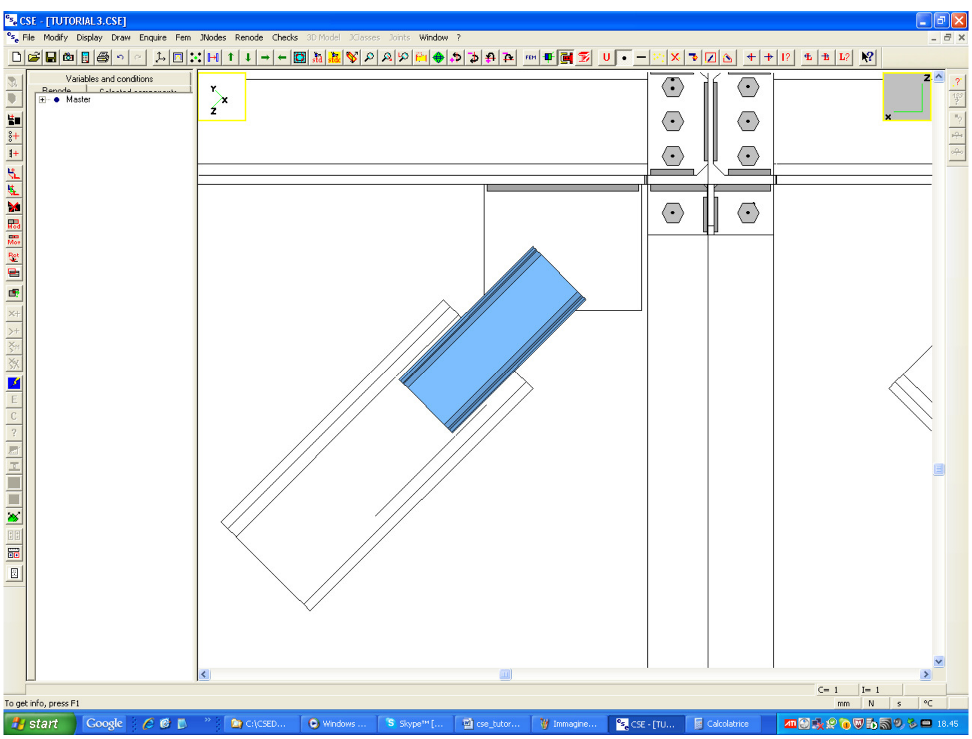
DX=-247.48

DZ=+247.48

Let's increase a bit, to 255. So execute the **Renode-Shift** command, yellow **numeric** mode and enter the shift vector components ***in the current orientation CS (DZ=255 x 1.41=360)***:

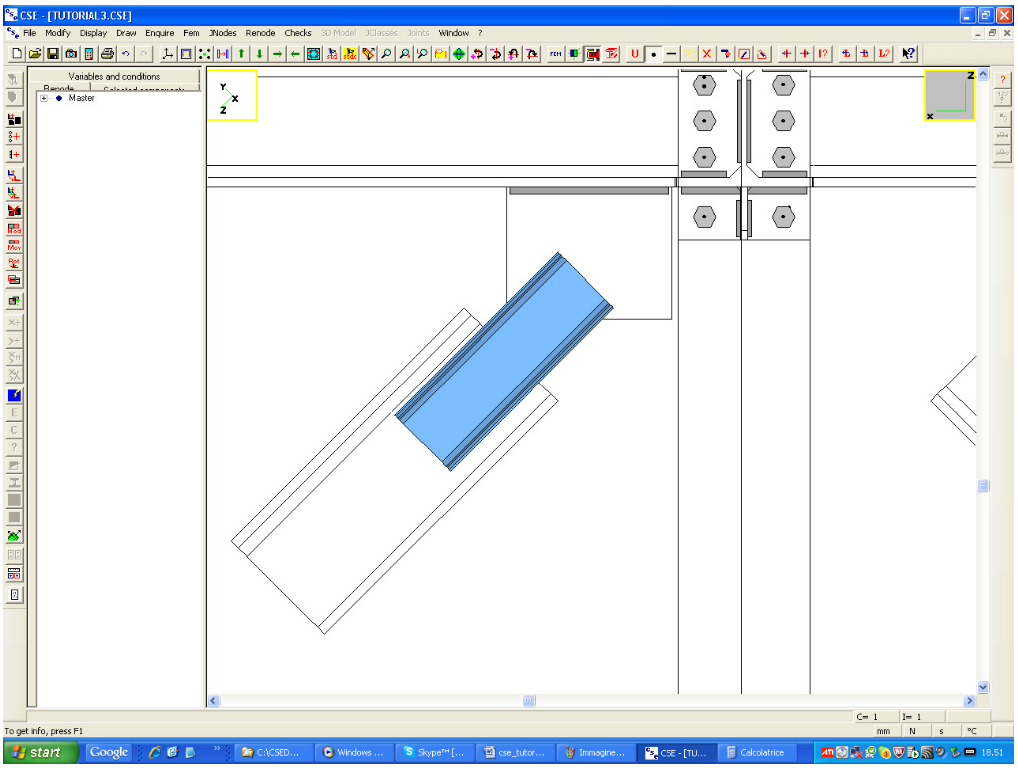


You will see what follows:

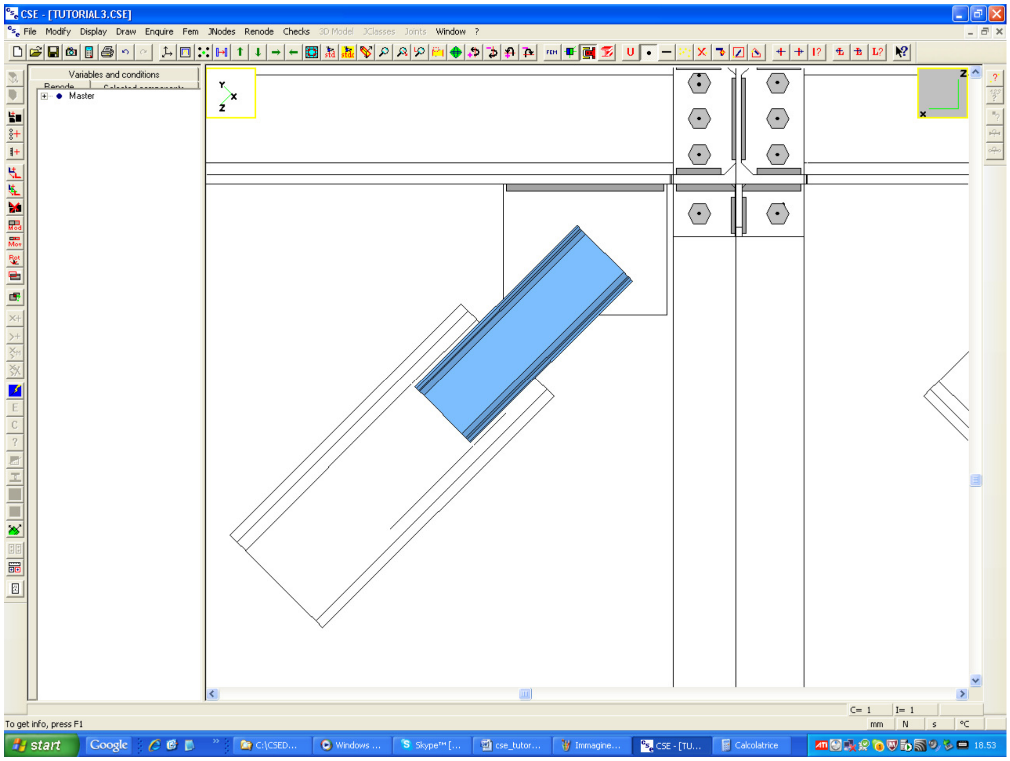


Please note that we could also have used global axes (and so enter DX=-255; DZ=+255) but to do so we would have previously changed the current orientation back to global axes, by executing once more the current orientation command (pressing the button in the main bar) and double clicking to say "back to global axes" to the program. However, since we are working at this diagonal we keep this current orientation as it is comfortable.

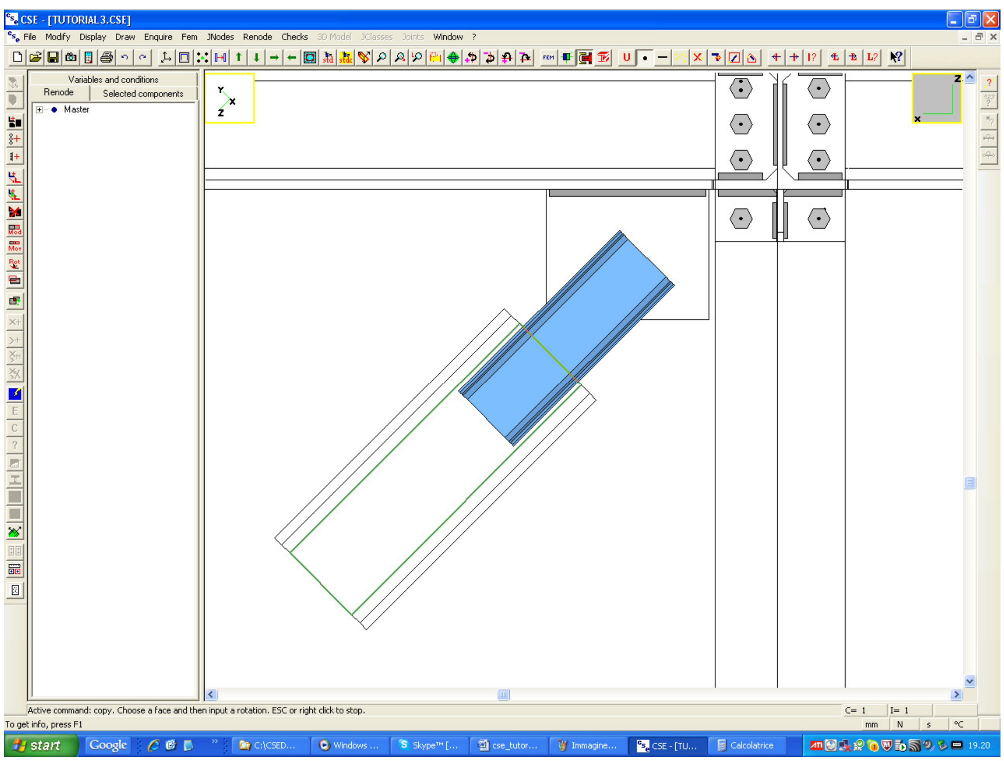
The object in place looks a bit too short. Execute the **Renode-Components-Modify** command (button in the left bar) and set the length from 300 to 350. You now see



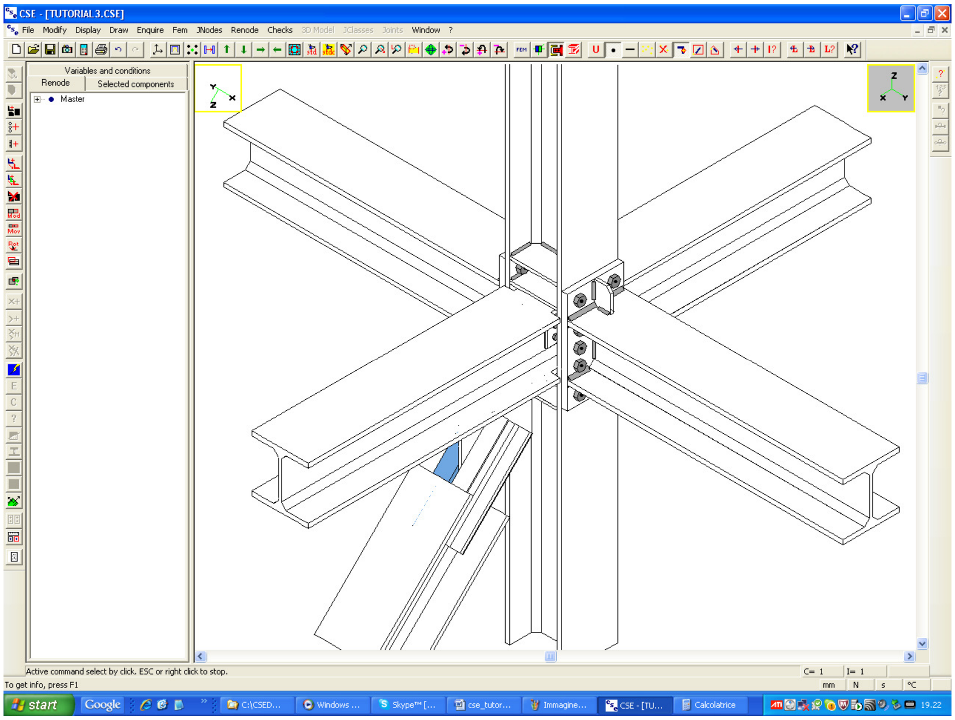
Now execute once more the **Renode-Shift** command, **numeric** yellow mode, and add a DZ -50 (in the current axes CS) to see now:



Now to have a double UPN execute the **Renode-Components-Copy** command with the **Member+angle** mode, and choose a face of the diagonal, like this:



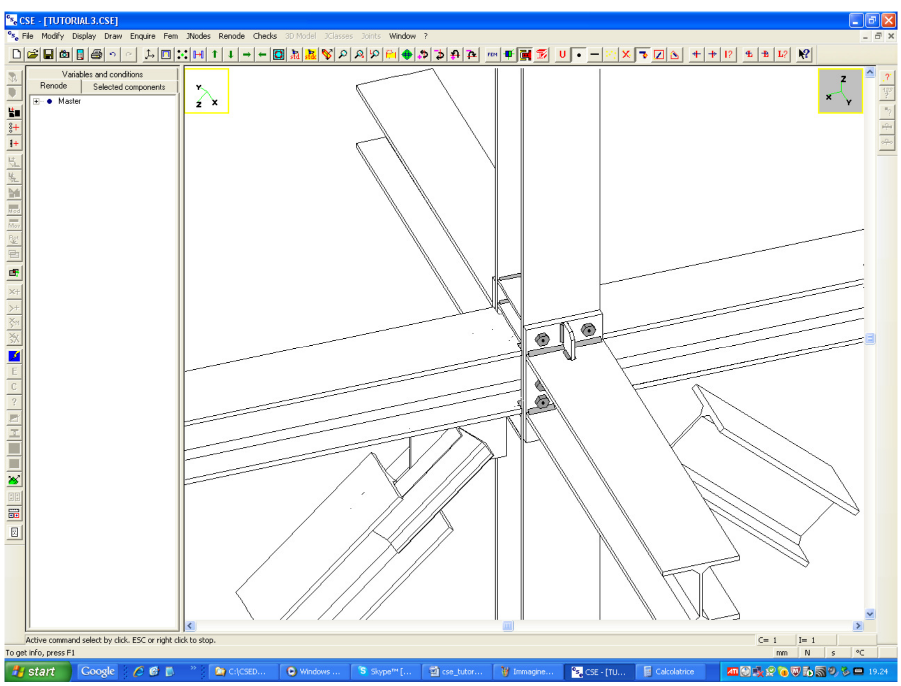
A new UPN trunk has been added in the correct position. Look at an ISO view. You see this:



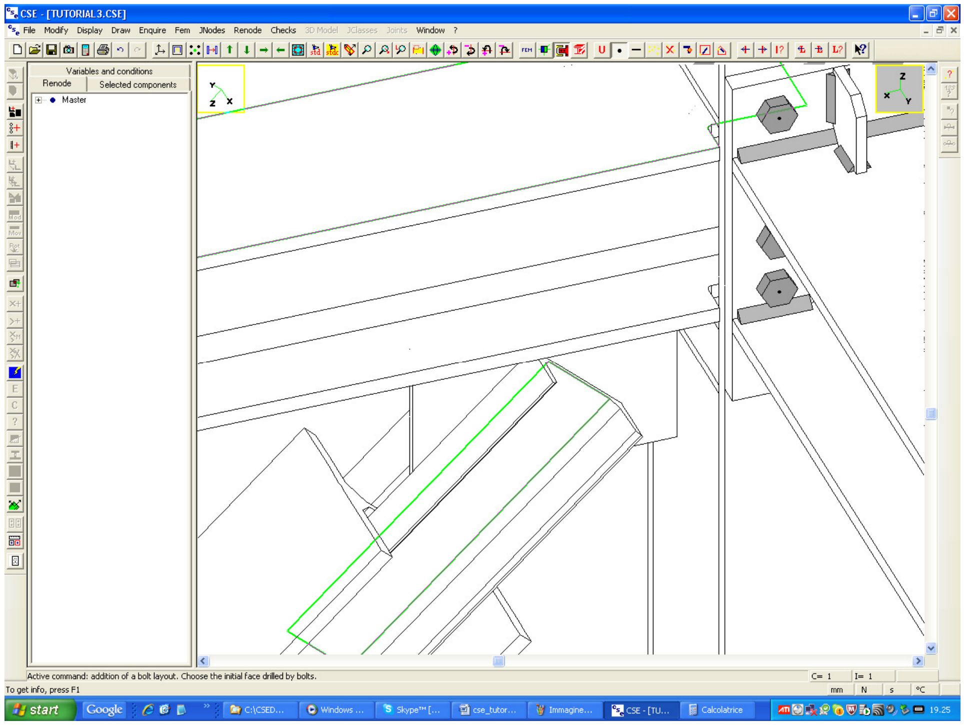
We are ready to add bolts. Unselect all.

2.1.3 Add bolts to connect the trunk to the plate

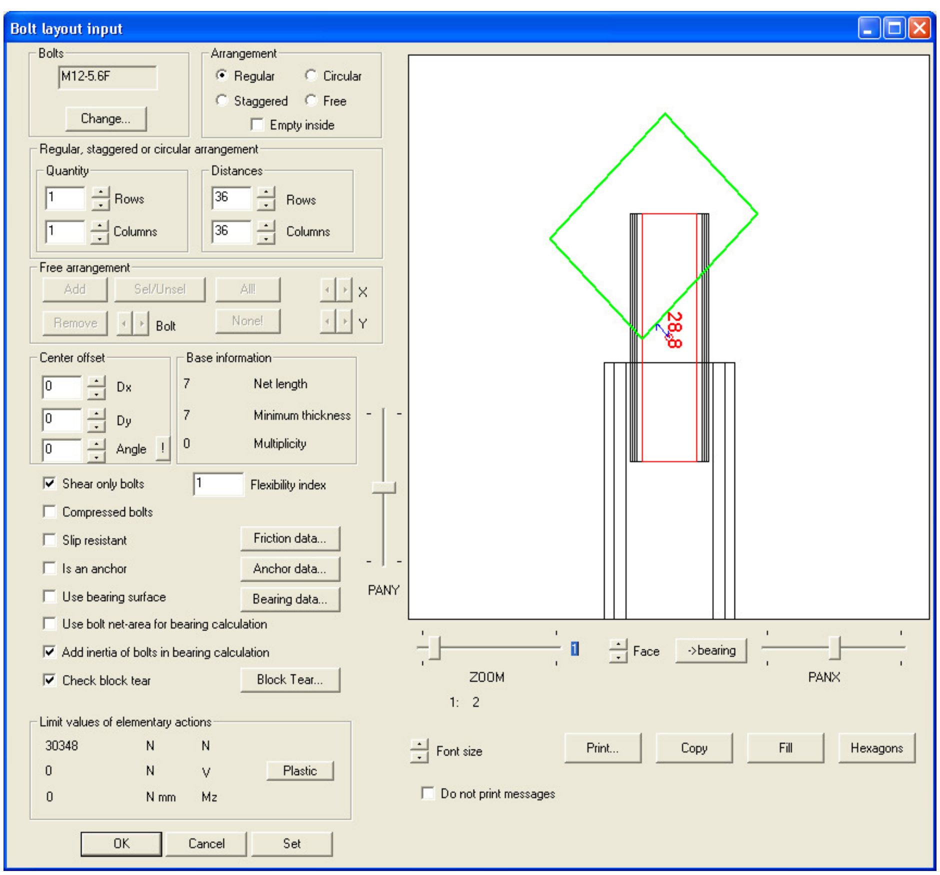
Choose an isometric view slightly rotated to this view, more or less (use the  button in the main bar):



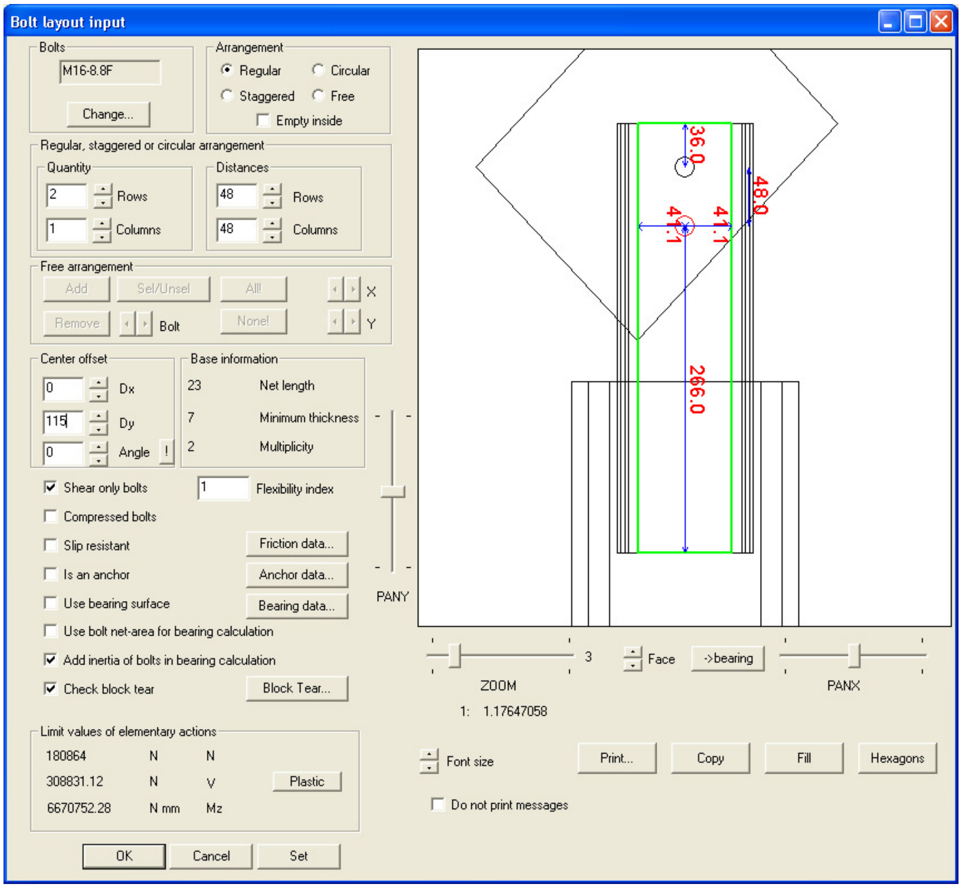
Now execute the command Renode-Components-Add bolt layout (button in the left bar), and click over the UPN outer face, like this:



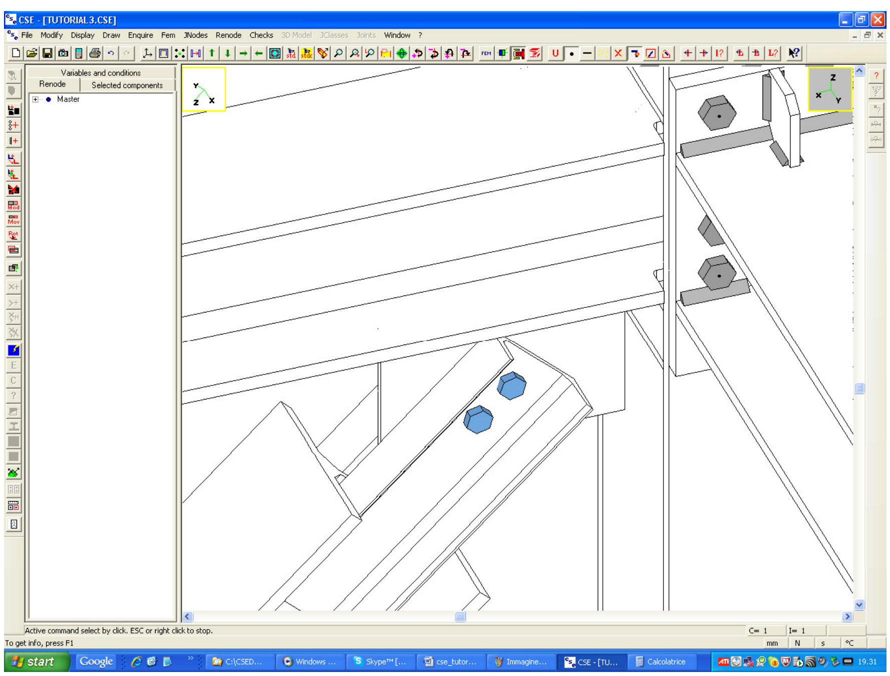
You see what follows:



Set the bolt M16 8.8. Choose two rows and enter data like this:

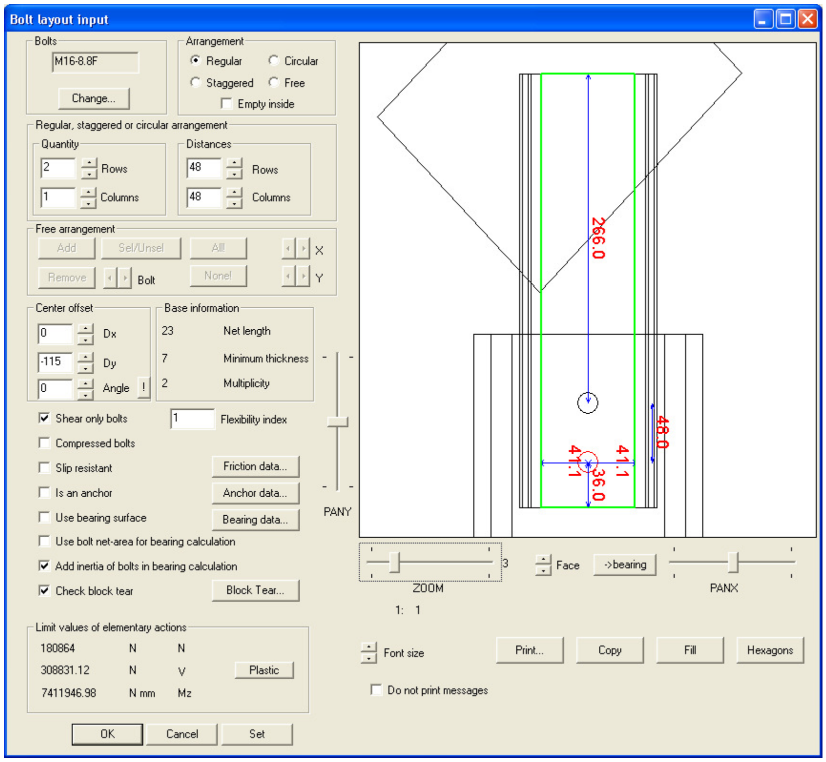


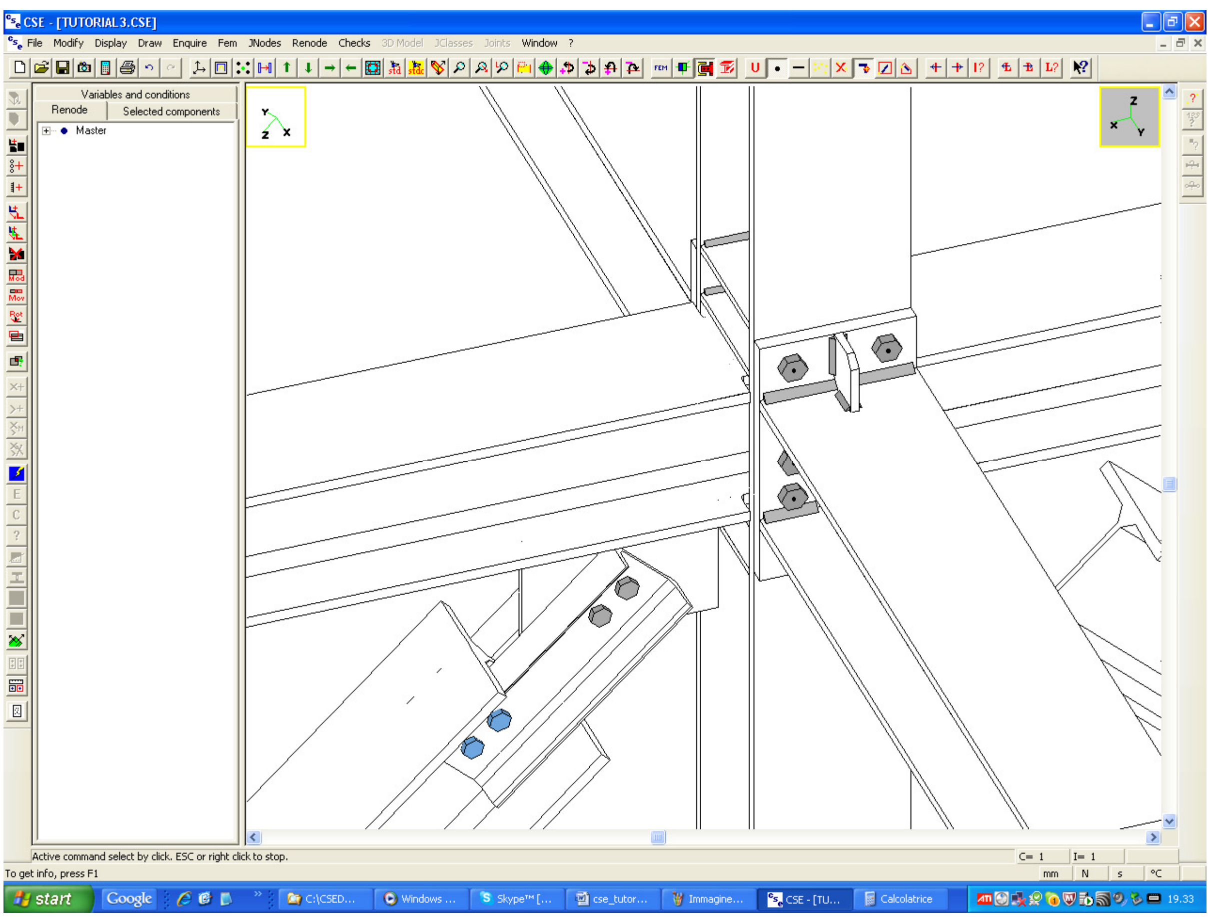
Moving the **Face** arrow keys notice that the distances from all face borders are OK. Press OK. You see now what follows:



Unselect the bolt layout just added.

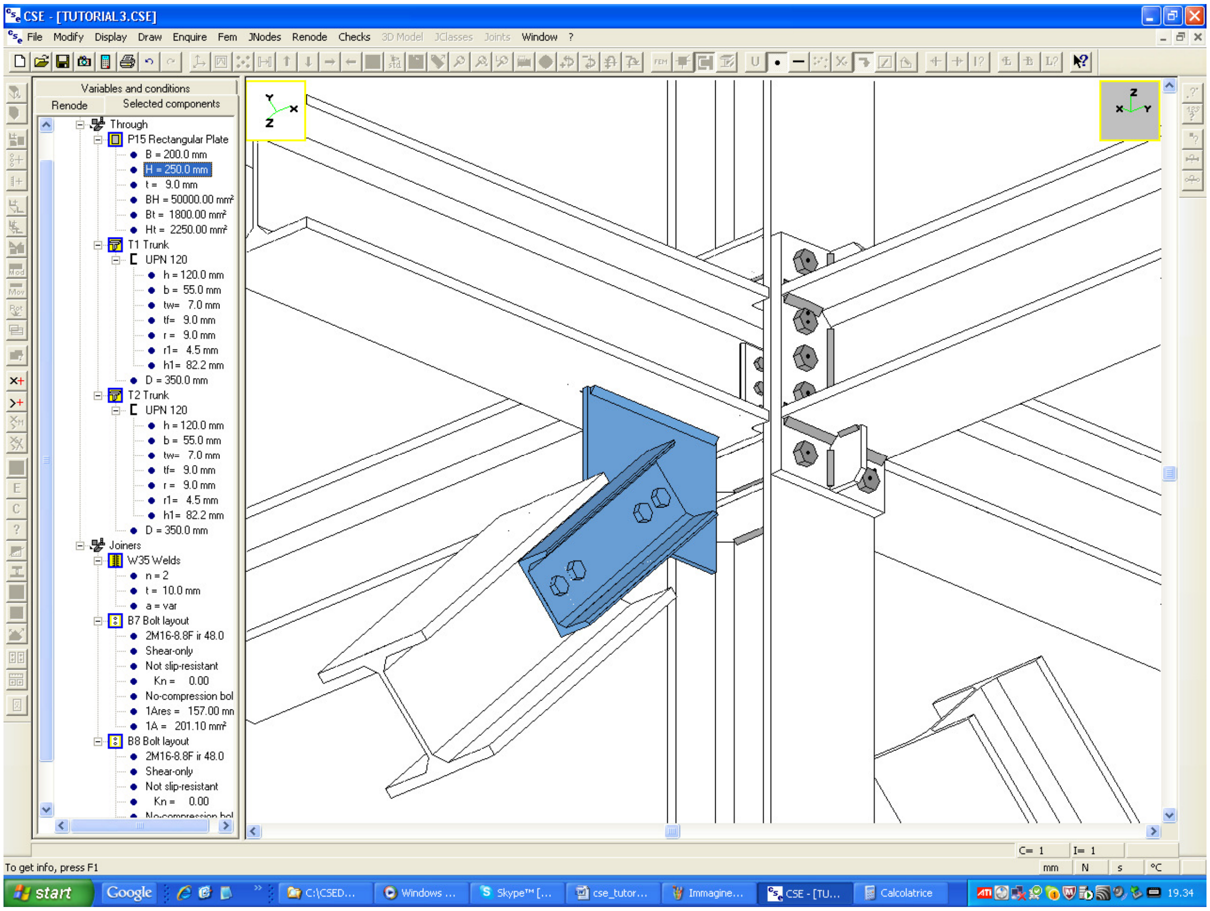
Now re-execute the command with the same face as before, but input data like this (-115 instead of +115):



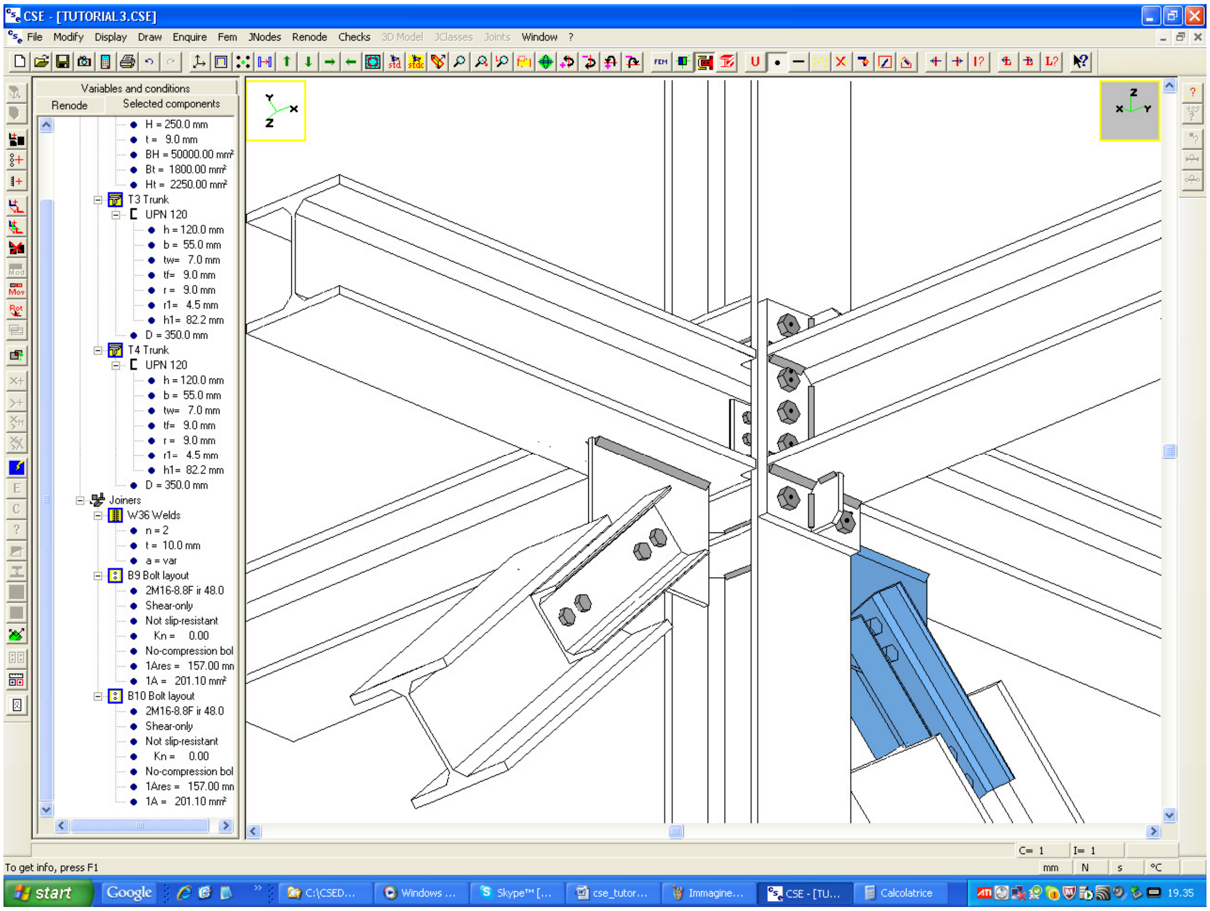


2.1.4 Copy the plate and the bolts to the -X beam and diagonal

Select the two trunks, and the two bolt layouts, the plate and its weld. Like this:



Execute the Renode-Components-Copy with the Member+angle option, choose a column face, leave 180 degrees. You get here:



That's it.

We are now ready to run the checks. This will be done in the 4th part of this tutorial.

To reset current orientation execute the command Current orientation ( button in the main bar) double click left to reset the current orientation to the global axes, and click right to exit from the command. The two triad of axes at the top of the window should give the same orientation.