SAFIR® training session – level 1
Johns Hopkins University, Baltimore

Example: 2D thermal analysis of a beam

"Steel IPE 300 profile heated on 3 sides"

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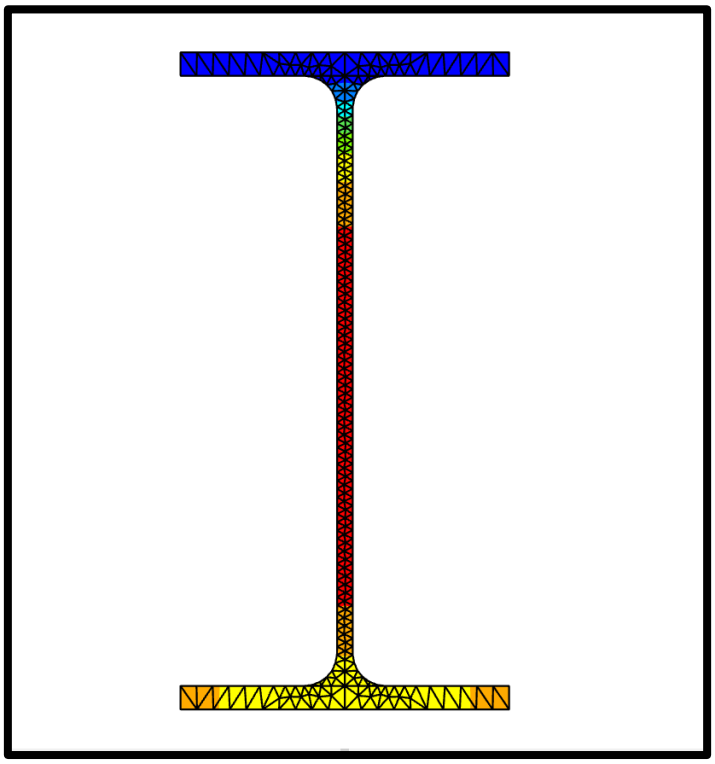


1. General description

This example deals with a 2D thermal analysis of a steel beam profile.

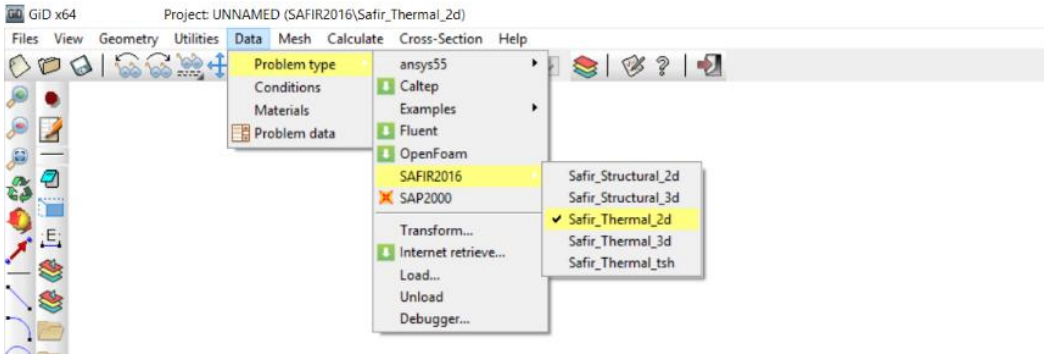
General data:

- Section IPE 300
- Material model from Eurocode 3 part 1-2
- Exposed to ISO fire on 3 sides
- In contact with atmosphere at 20°C on the upper side

The section file will be used for a subsequent 3D structural analysis. Therefore, it will also include a torsional analysis.

2. Create a project in 2D for Thermal Analysis

From the pull down menu select:
Data -> Problem type -> SAFIR2016 -> Safir_Thermal_2d



To save the project select (or use icons on the left):
Files->Save or or [Ctrl + s]

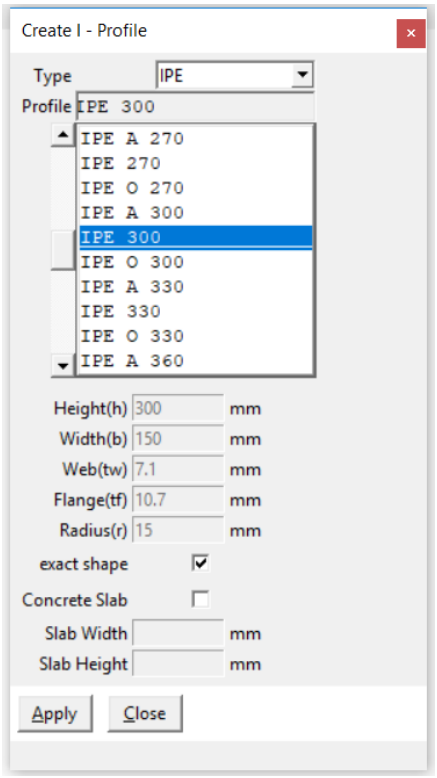
Enter a file name, e.g.: ***IPE300***
GiD creates a directory with the name ***IPE300.gid***
GiD creates a number of system files in this directory.
When you start the SAFIR calculation the Safir . IN, .OUT and .TEM files will be created in this directory.

Note: the project's name cannot contain spaces or special characters. Regarding the names of the files, SAFIR is not case sensitive.

3. Create the geometry in the xy-plane

From the pull down menu select:
Cross-Section->I-Profile

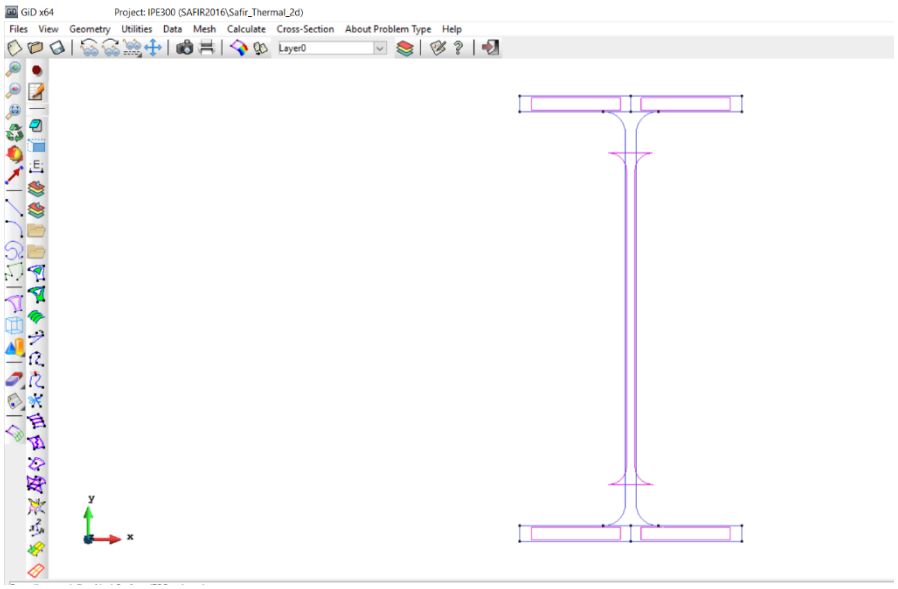
Select ***IPE*** as type, ***IPE 300*** as Profile, tick ***exact shape***.
Click on ***Apply***



Note: GiD-Safir will create an IPE300 profile. The center of this profile will be automatically centered on the 0,0 point of the xy-plan.

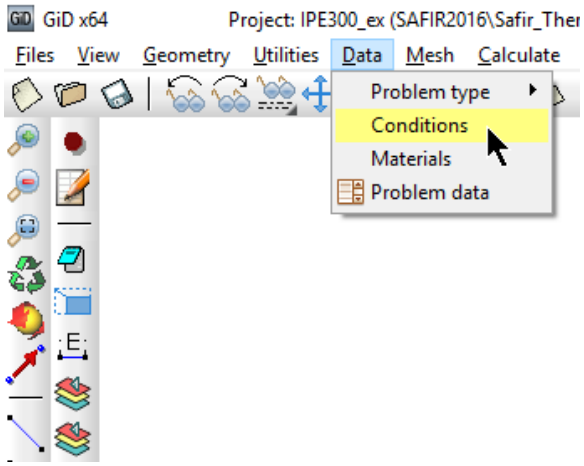
GiD displays this profile.

The blue lines represent the contour of the section, while the pink lines represent the surfaces delimited by the blue lines. For instance, blue lines are used to assign thermal boundary conditions to the contour of a cross-section, while the pink surfaces are used to assign thermal properties to an area of the cross-section.

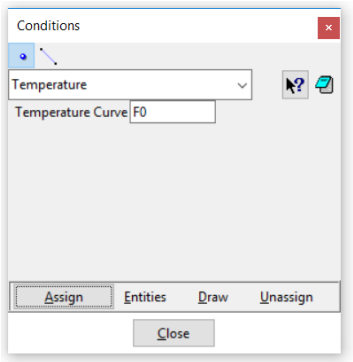


4. Assign the thermal boundary conditions

In GiD, from the pull down menu select:
Data->Conditions

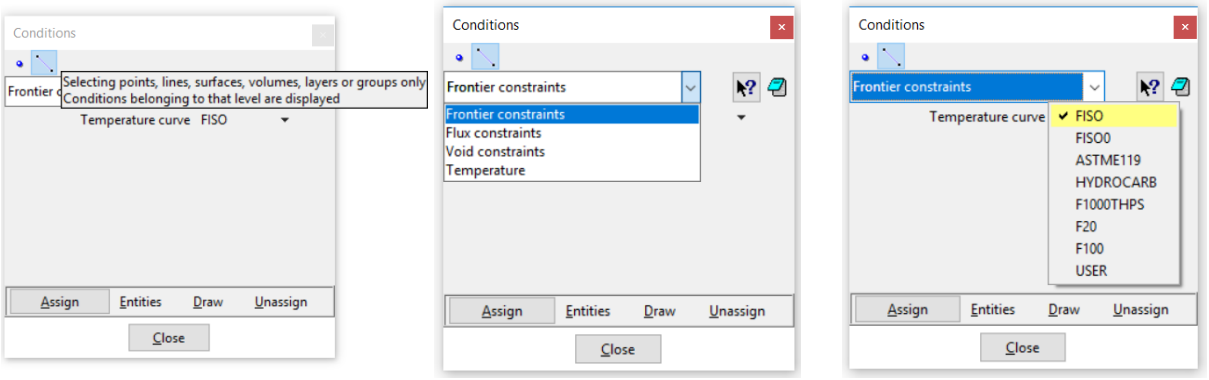


This window appears in GiD:

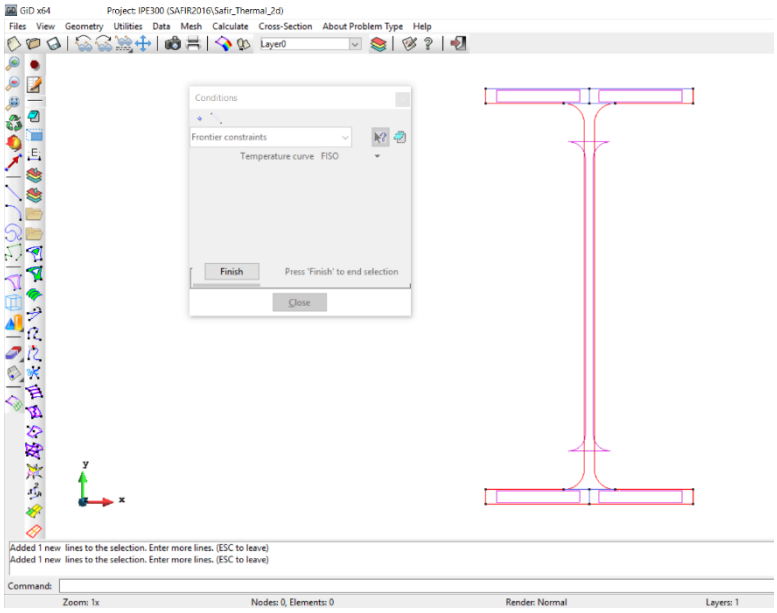


Select the  button (“Line”). On the first pull down list, select: ***Frontier constraints***

Different time-temperature curves are predefined. Select ***FISO*** for the ISO 834 fire curve.

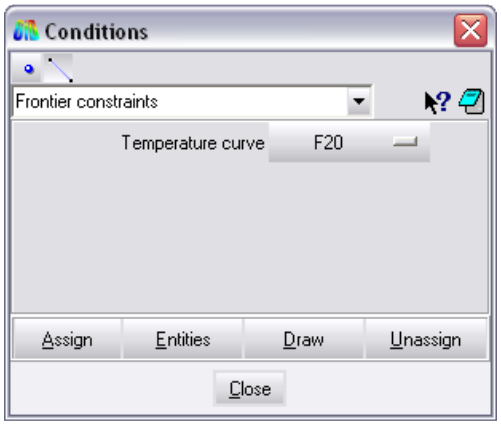


Click on the ***Assign*** button and assign it to profile lines as shown below.

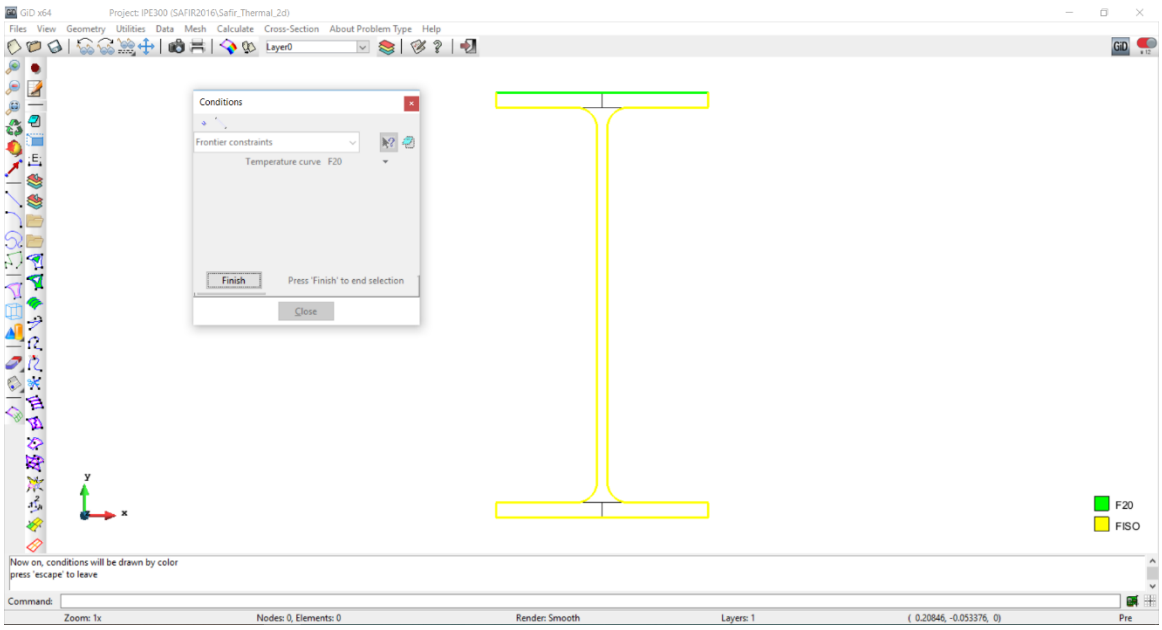


Press ***[Esc]*** or click on ***Finish*** to confirm
Select ***DRAW->Colors*** in the Conditions dialog box to display the frontier constraints
Press ***[Esc]*** or click on ***Finish*** to leave this view mode

Then select ***F20*** as temperature curve



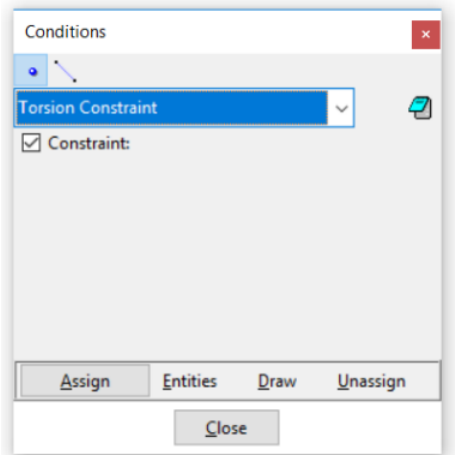
And assign it to the upper line of the profile, as shown below:



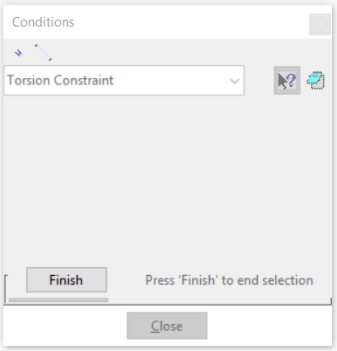
5. Assign a torsion constraint (for the torsional analysis)

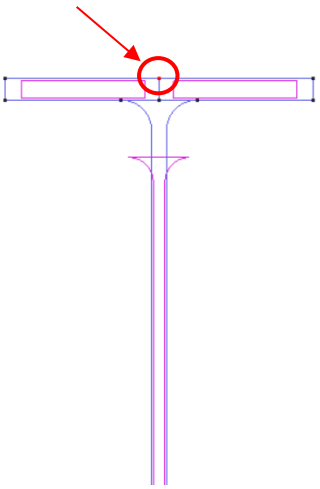
In GiD, from the pull down menu select:
Data->Conditions

Select the  button
On the pull down list: ***Torsion constraints***
Tick the box ***Constraint*** (only in GiD problem types versions prior to 1.4)



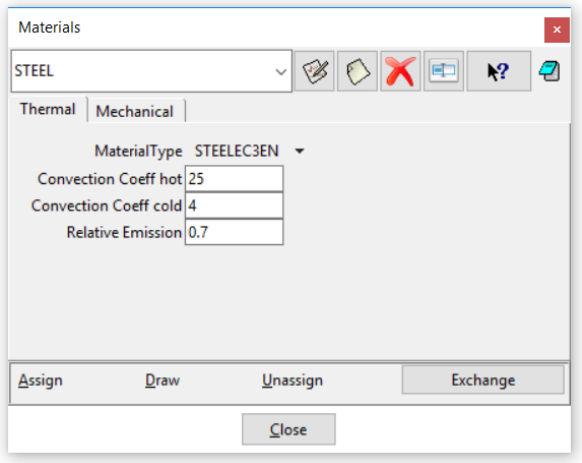
Select the node on the vertical axis of symmetry of the steel profile. Validate with ***Finish***.



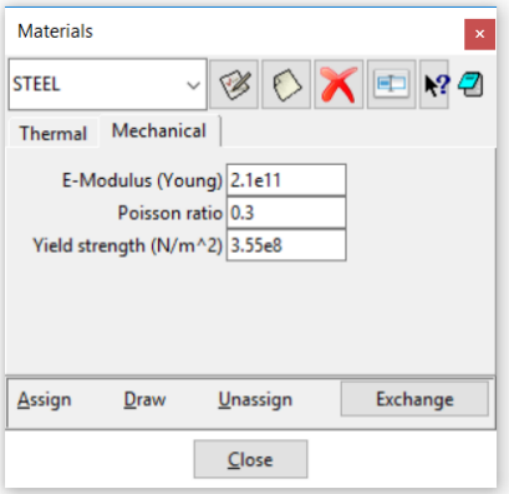


6. Assign the materials

From the pull down menu select:
Data->Materials
Select ***STEEL*** from the dialog box pull down list
The ***Thermal*** tab is active.
Then select:
STEELEC3EN as Material Type
A Convection Coeff hot of ***25***
A Convection Coeff cold of ***4***
A Relative Emission of ***0.7***

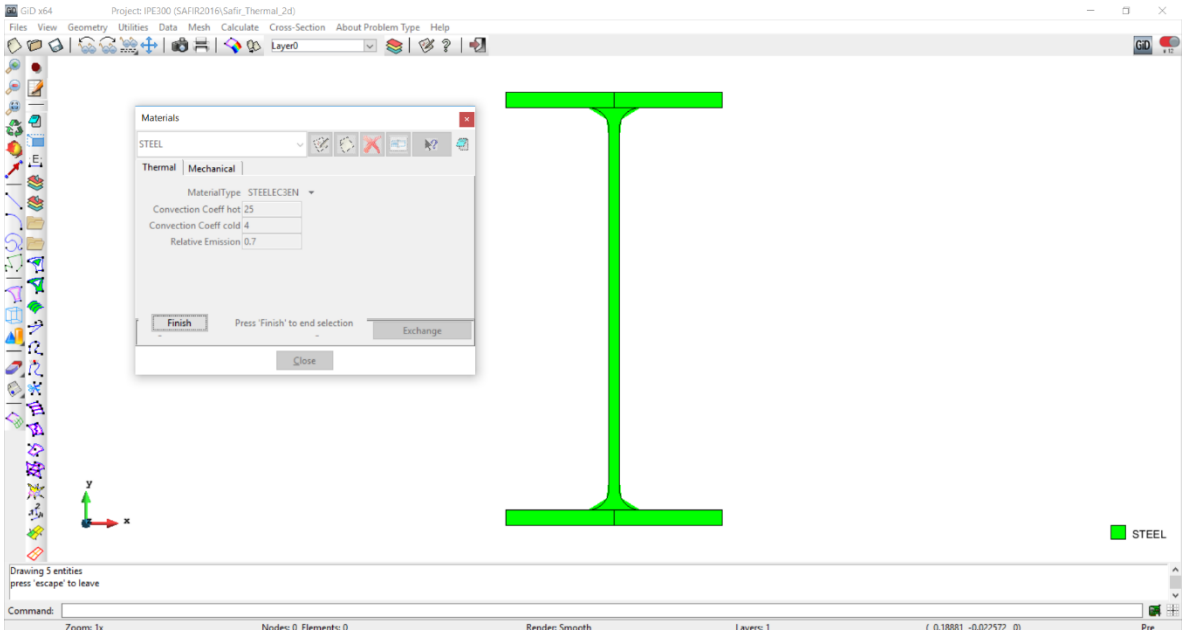


Then select the ***Mechanical*** tab. Input:
A Young modulus of ***210 000 MPa***
A Poison ratio of ***0.3***
A Yield strength of ***355 MPa***



Click on ***Assign-> Surfaces*** and assign it to the IPE300 surface
Press ***[Esc]*** or ***Finish*** to confirm.

Select ***DRAW->all materials*** in the Material dialog box to display Materials
Press ***[Esc]*** or ***Finish*** to leave



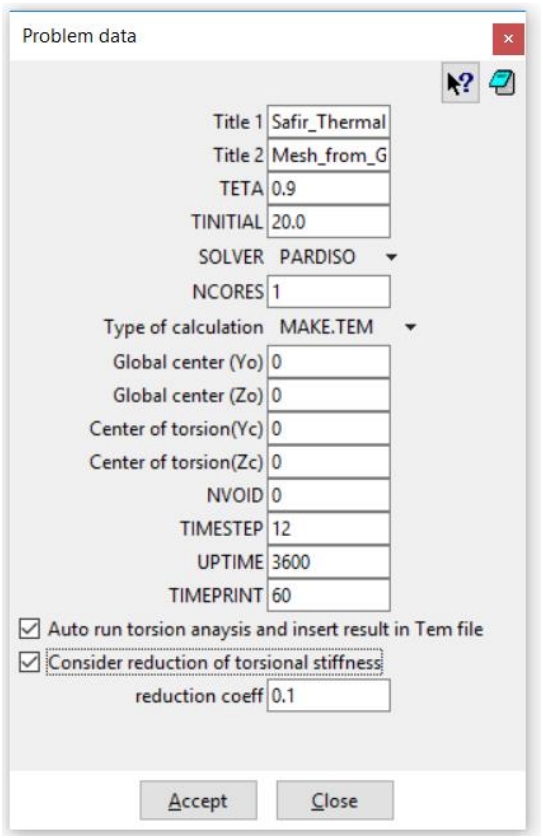
7. Assign the general data

From the pull down menu select:
Data->Problem Data

In the Problem Data dialog mask enter:
TIMESTEP, UPTIME, TIMEPRINT as needed
Do not forget to tick the box ***Autorun Torsion Analysis***
Also tick the box ***Consider reduction of torsional stiffness*** and leave the value as 0.1

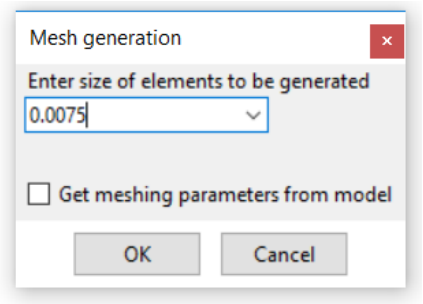
Click on the ***Accept*** data button

Note: The global center of coordinates (0,0) is by default positioned at the center of the steel profile. This position can be adjusted here to consider the relative position of the steel profile with respect to the rest of the structure in the structural model.

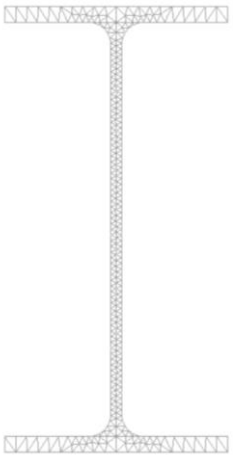


8. Create the mesh

Select ***Mesh->Generate mesh or use [Ctrl + g]***
Enter 0.0075 as size of elements to be generated
Validate with ***OK***



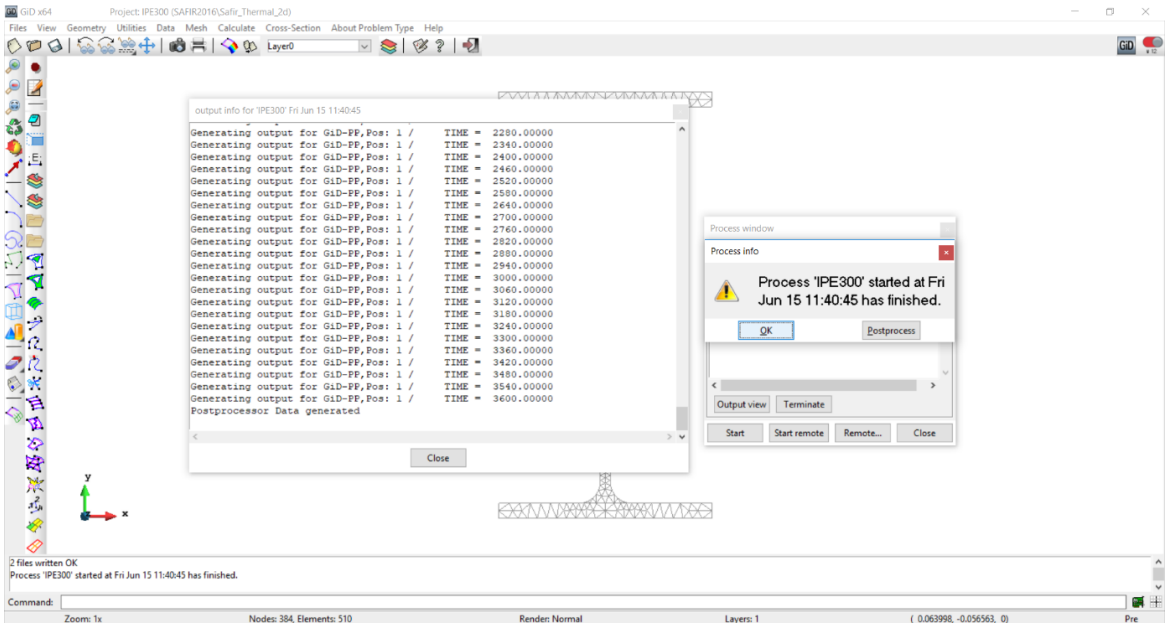
Click on ***View mesh*** to visualize the mesh



9. Start the calculation

From the pull down menu select:
Calculate->Calculate window
Click the ***Start*** button
Click the ***Output View*** button

GiD creates a .IN file in the project directory and starts the calculation.
In the output window you can see the calculation progress from SAFIR and the GiD interface program which generates GiD postprocessor files from the .OUT file.



Click on “Ok”, save, and open the postprocessor Diamond to visualize the results.