# HOW TO RUN AN EXAMPLE OF COUPLING BETWEEN FDS AND SAFIR

## 1. SPECIFIC FILES YOU NEED TO RUN AN FDS-SAFIR ANALYSIS

- The **modified executable of FDS (FDS_SAFIR.exe)** able to produce the transfer file (i.e. the file that contains temperatures and intensities calculated by FDS). This executable of FDS differs from the "official" one downloadable from the website http://www.fire.nist.gov/fds/.
- A **2012 version (or later) of SAFIR (either SAFIR2012_32.exe for 32bit OS or SAFIR2012_64.exe for 64bit OS)** that includes all routines necessary to perform thermal analyses on the basis of FDS data.

## 2. EXAMPLE

### A) COMPARTMENT MODELLED IN FDS

GEOMETRY

The compartment 6 x 6 x 3 $m^3$: The floor, the ceiling and one perimetral wall are modelled whereas the others 3 walls are openings.

MATERIALS

The floor, ceiling and wall are made of concrete whose thermal material properties are derived from the EN1992-1-2.

LOCALISED FIRE

A localised fire 1 x 1 $m^2$ with constant HRR = 1000 $kW/m^2$ is located at x = 4.5 m, y = 3 m and z = 0 m.

**NOTE**: that in the following figure no structural elements across the compartment is modelled in FDS.

### B) STRUCTURE MODELLED IN SAFIR

GEOMETRY

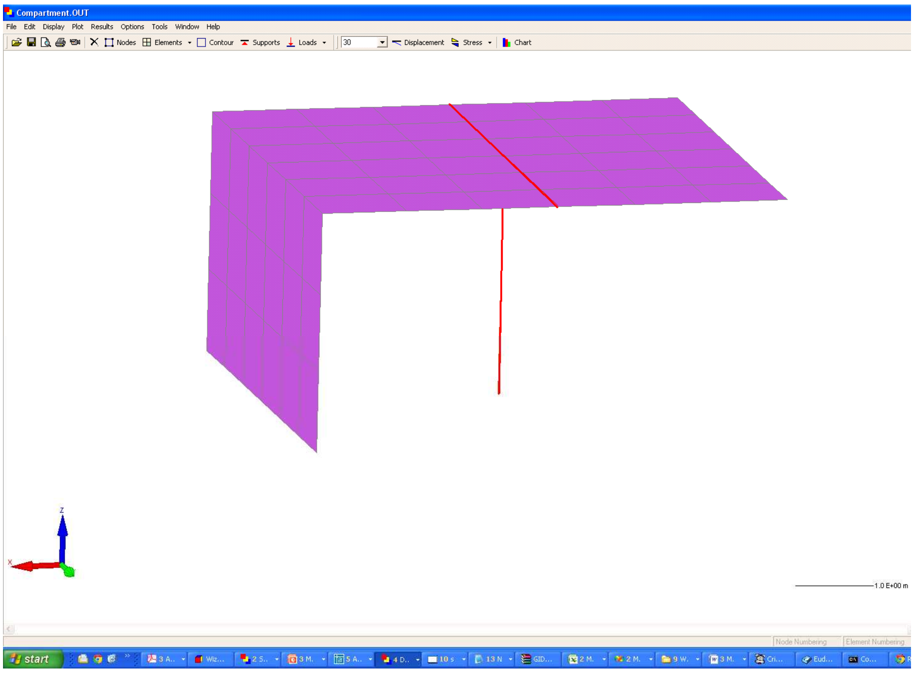
The ceiling and the wall are also modelled in SAFIR by means of shell elements. The ceiling and the wall differ from the thickness (150 mm for the ceiling and 200 mm for the wall). Thus, they are two shell element types.

Moreover, a composite beam made of a HE400B profile and a concrete slab of 150 mm, as well as a column made of a steel tube (diameter 300 mm and thickness 10 mm), are modelled with beam elements.

MATERIALS

The slab, and wall are made of concrete whose thermal and mechanical material properties are derived from the EN1992-1-2 and EN1992-1-1, respectively.

The beam and the tube are made of steel the thermal and mechanical material properties of which are derived from the EN1993-1-2.




## 3. HOW TO RUN FDS AND CREATE THE TRANSFER FILE

- The executable FDS_SAFIR.exe provided to you in the folder FDS_Files has to be in the same folder as the input file .fds used to simulate the scenario in FDS.
- The input file of FDS .fds can be written in a text editor following the standard syntax of FDS. However, as this executable of FDS differs from the official one, additional commands have to be written in order to ask FDS to create the transfer file as an output. Basically, there are two commands specifically conceived for this purpose and implemented in the modified version of FDS:

```
--------------------------------------------------------
&HEAD CHID='Localised_Fire', TITLE='Localised_Fire'/

&MESH XB=0.0,6.0,0.0,6.0,0.0,3.0, IJK =24,24,12 /

&RADI NUMBER_RADIATION_ANGLES=64/
```

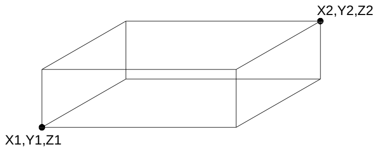
```
&MISC NOISE=.FALSE. /

&FDStoSAFIR      STATUS=.TRUE.,T_BEGIN=1.,      T_END=601.      DT=30.,
XB=0.0,6.0,0.0,6.0,0.0,3.0, ORIENTATION=-1,1,-2,2,-3,3 /

&PointtoSAFIR XYZ= 4.5 3.0 2.80 /

&TIME T_END=601. DT=5.0 /


-------------CONCRETE CEILING--------------------

&MATL ID = 'concrete'
      EMISSIVITY = 0.7
      DENSITY = 2300.
      CONDUCTIVITY_RAMP = 'k_ramp'
      SPECIFIC_HEAT_RAMP = 'c_ramp' /

---------SILICEOUS CONCRETE AND UPPER LIMIT FOR CONDUCTIVITY EN1992-1-
2---------

&RAMP ID='k_ramp', T=20.,  F=1.9514 /
&RAMP ID='k_ramp', T=100., F=1.7656 /
&RAMP ID='k_ramp', T=200., F=1.5526 /
&RAMP ID='k_ramp', T=300., F=1.3610 /
&RAMP ID='k_ramp', T=400., F=1.1908 /
&RAMP ID='k_ramp', T=500., F=1.0420 /
&RAMP ID='k_ramp', T=600., F=0.9146 /
&RAMP ID='k_ramp', T=700., F=0.8086 /
&RAMP ID='k_ramp', T=800., F=0.7240 /
&RAMP ID='k_ramp', T=900., F=0.6608 /
&RAMP ID='k_ramp', T=1000., F=0.6190 /
&RAMP ID='k_ramp', T=1100., F=0.5986 /
&RAMP ID='k_ramp', T=1200., F=0.5996 /

----------3% MOISTURE CONTENT EN1992-1-2------------

&RAMP ID='c_ramp', T=20.,   F=0.900 /
&RAMP ID='c_ramp', T=100.,  F=0.900 /
&RAMP ID='c_ramp', T=115.,  F=2.020 /
&RAMP ID='c_ramp', T=200.,  F=1.000 /
&RAMP ID='c_ramp', T=400.,  F=1.100 /
&RAMP ID='c_ramp', T=1200., F=1.100 /

----------SURF ID------------

&SURF ID = 'ceil_floor'
      MATL_ID = 'concrete'
      THICKNESS = 0.15 /

&SURF ID = 'wall'
      MATL_ID = 'concrete'
      THICKNESS = 0.20 /

------------ WALLS ----------------
&OBST XB=6.0,6.0,0.0,6.0,0.0,3.0,SURF_ID='wall' /
&OBST XB=0.0,6.0,0.0,6.0,0.0,0.0,SURF_ID='ceil_floor' /
&OBST XB=0.0,6.0,0.0,6.0,3.0,3.0,SURF_ID='ceil_floor' /
```

```
&VENT MB='XMIN',SURF_ID='OPEN' /
&VENT MB='YMIN',SURF_ID='OPEN' /
&VENT MB='YMAX',SURF_ID='OPEN' /

----------------SQUARE FIRE---------------------

&SURF ID = 'fire'
      HRRPUA = 2000.0 /

&VENT XB=4.0,5.0,2.5,3.5,0.0,0.0, SURF_ID='fire'

&DEVC XYZ=2.0,3.0,3.0, QUANTITY='WALL TEMPERATURE', IOR=-3, ID='wall'
/
&DEVC XYZ=6.0,3.0,1.5, QUANTITY='WALL TEMPERATURE', IOR=-1, ID='wall'
/

&TAIL /
```

1) FDStoSAFIR:

it allows recording at the centre of each cell of the compartment (or a subdomain of it) modelled in FDS temperature, convection coefficient and radiant intensities. In the given example

```
&FDStoSAFIR   STATUS=.TRUE.,T_BEGIN=1.,   T_END=601.   DT=30.,
XB=0.0,6.0,0.0,6.0,0.0,3.0, ORIENTATION=-1,1,-2,2,-3,3 /
```

| **COMMAND** | **DEFINITION** | |
|---|---|---|
| STATUS | ACTIVATION OF THE INTERFACE | DEFAULT VALUE .FALSE. |
| T_BEGIN | TIME AT WHICH THE WRITING OF DATA IN THE TRANSFER FILE STARTS [s] | - |
| T_END | TIME AT WHICH THE WRITING OF DATA IN THE TRANSFER FILE FINISHES [s] | - |
| DT | TIME STEP OF THE WRITING OF DATA IN THE TRANSFER FILE [s] | - |
| XB | DIMENSIONS OF THE DOMAIN WHERE TO RECORD DATA | X1,X2,Y1,Y2,Z1,Z2<br>6 VALUES IN m<br> |
| ORIENTATION | IF THE FLUX IS REQUIRED IN SOME POINT OF THE DOMAIN BY MEANS OF THE PointtoSAFIR COMMAND, IT GIVES THE ORIENTATION OF THE NORMAL TO SURFACE OF THE RECORDED FLUXES | -1,1,-2,2,-3,3<br>6 DIRECTIONS<br><br>(1 IS PARALLEL TO THE x-AXIS, 2 TO y-AXIS AND 3 TO THE z-AXIS) |

2) `PointtoSAFIR`

it allows recording at one point of the compartment modelled in FDS temperature, convection coefficient and fluxes whose normal to surface has orientation according to what specified in `ORIENTATION` in the `FDStoSAFIR` command.

An example of syntax

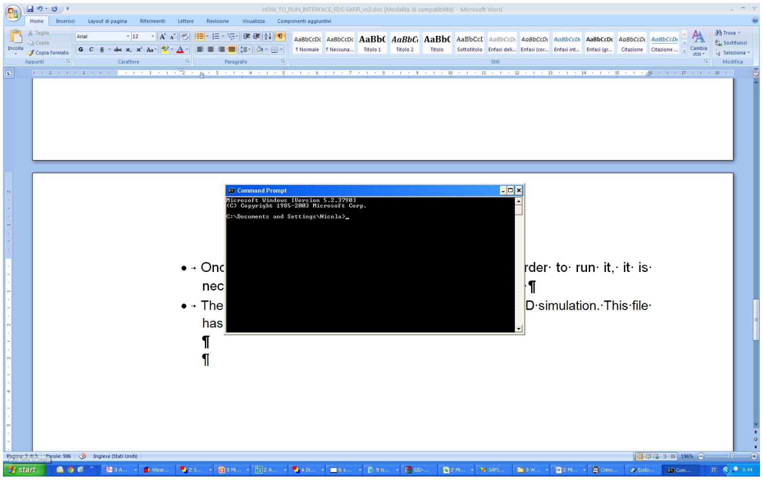
```
&PointtoSAFIR  XYZ= 4.5 3.0 2.80 /
```

| **COMMAND** | **DEFINITION** | |
|---|---|---|
| XYZ | COORDINATES OF THE POINT | X,Y,Z<br>3 VALUES IN m<br><br>On the basis of the example given previously for FDStoSAFIR, the transfer file will contain temperature, convection coefficient and flux of normal parallel to the x-axis and pointing toward -x of the centre of cell where the point of coordinates XYZ= 4.5 3.0 2.80 is contained. |

- The number of radiant intensity to be written in the transfer file is given by the standard FDS command `RADI NUMBER_RADIATION_ANGLES`. The following table provides the number to be assigned to the `NUMBER_RADIATION_ANGLES` in order to get a certain number of radiant intensities in transfer file.

| NUMBER_RADIATION_ANGLES | RESULTING NUMBER OF INTENSITIES |
|---|---|
| 12 | 16 |
| 24 | 24 |
| 30 | 32 |
| 36 | 40 |
| 48 | 48 |
| 52 | 56 |
| 56 | 64 |
| 64 | 72 |
| 80 | 80 |
| 86 | 88 |
| 90 | 96 |
| 100 | 104 |

- Once the .fds input file for FDS is written, in order to run it, it is necessary to open a Command prompt window




  and to go in folder where the executable FDS_SAFIR.exe is located along with the .fds input file. Then, type `fds_safir name_input_file.fds` and FDS will start to run.
- Once the FDS simulation is finished check with SMOKEVIEW the results of the simulation. Double click on the .smv file created in the same folder.
- Finally, the **transfer file** has been produced in the same folder where the executable and the input file of FDS are located. This file has extension .Fts and it has to be renamed to `cfd_trilin.txt` in order to be successfully used as input for the SAFIR thermal analyses.

## 4. HOW TO RUN A THERMAL ANALYSIS IN SAFIR WITH DATA PROVIDED BY FDS

- The procedure follows the same steps needed to run in SAFIR a scenario of a localised fire by employing the Hasemi model.
- The cfd_trilin.txt file must be located in the same folder where the thermal input file is located.

### A) WRITE THE MECHANICAL INPUT FILE

- The first step is write the input file (in this example Compartment.in) needed to run the mechanical analysis (it is a Safir_Structural_3D problem type).It will be used in the thermal analysis in order to identify the position of the structural points in the compartment.

  Note that two types of beam elements and two types of shell elements are included in the present example.

  Moreover, all structural elements at the boundaries (slab and wall in particular) are located in correspondence to their centreline axes, which means that they surely outside the CFD domain. Also the nodeline of the composite beam is at the level of the slab centreline.

  The mechanical input file must be located in the same folder where the thermal input file is located.

```
-------------------------------------------------------
LOCALISED FIRE - MECHANICAL FILE

     NNODE   84
      NDIM    3
   NDDLMAX    7
EVERY_NODE    0
         FROM 1  TO 42 STEP    1 NDDL    6
         FROM 43 TO 49 STEP    1 NDDL    7
         FROM 50 TO 70 STEP    1 NDDL    6
         FROM 71 TO 73 STEP    1 NDDL    7
         FROM 74 TO 82 STEP    1 NDDL    1
     FROM 83 TO 84 STEP    1 NDDL    0
  END_NDDL
   STATIC   PURE_NR
     NLOAD    1
   OBLIQUE    0
  COMEBACK 1.0e-5
 RENUMGEO 1
      NMAT    4
  ELEMENTS
   BEAM    9     2
   NG 2
   NFIBER    414
   SHELL     54     2
   NGTHICK    3
   NGAREA     2
   NREBARS    2
  END_ELEM
     NODES
        NODE    1       6.100    0.000    -0.075
        NODE    2       6.100    1.000    -0.075
        NODE    3       6.100    2.000    -0.075
        NODE    4       6.100    3.000    -0.075
        NODE    5       6.100    4.000    -0.075
        NODE    6       6.100    5.000    -0.075
        NODE    7       6.100    6.000    -0.075
        NODE    8       6.100    0.000    1.000
        NODE    9       6.100    1.000    1.000
        NODE    10      6.100    2.000    1.000
        NODE    11      6.100    3.000    1.000
        NODE    12      6.100    4.000    1.000
        NODE    13      6.100    5.000    1.000
        NODE    14      6.100    6.000    1.000
        NODE    15      6.100    0.000    2.000
        NODE    16      6.100    1.000    2.000
        NODE    17      6.100    2.000    2.000
        NODE    18      6.100    3.000    2.000
        NODE    19      6.100    4.000    2.000
        NODE    20      6.100    5.000    2.000
        NODE    21      6.100    6.000    2.000
        NODE    22      6.100    0.000    3.075
        NODE    23      6.100    1.000    3.075
        NODE    24      6.100    2.000    3.075
        NODE    25      6.100    3.000    3.075
        NODE    26      6.100    4.000    3.075
        NODE    27      6.100    5.000    3.075
        NODE    28      6.100    6.000    3.075
        NODE    29      5.000    0.000    3.075
        NODE    30      5.000    1.000    3.075
        NODE    31      5.000    2.000    3.075
        NODE    32      5.000    3.000    3.075
        NODE    33      5.000    4.000    3.075
        NODE    34      5.000    5.000    3.075
        NODE    35      5.000    6.000    3.075
        NODE    36      4.000    0.000    3.075
        NODE    37      4.000    1.000    3.075
        NODE    38      4.000    2.000    3.075
        NODE    39      4.000    3.000    3.075
        NODE    40      4.000    4.000    3.075
        NODE    41      4.000    5.000    3.075
        NODE    42      4.000    6.000    3.075
        NODE    43      3.000    0.000    3.075
        NODE    44      3.000    1.000    3.075
```

```
        NODE     45       3.000    2.000    3.075
        NODE     46       3.000    3.000    3.075
        NODE     47       3.000    4.000    3.075
        NODE     48       3.000    5.000    3.075
        NODE     49       3.000    6.000    3.075
        NODE     50       2.000    0.000    3.075
        NODE     51       2.000    1.000    3.075
        NODE     52       2.000    2.000    3.075
        NODE     53       2.000    3.000    3.075
        NODE     54       2.000    4.000    3.075
        NODE     55       2.000    5.000    3.075
        NODE     56       2.000    6.000    3.075
        NODE     57       1.000    0.000    3.075
        NODE     58       1.000    1.000    3.075
        NODE     59       1.000    2.000    3.075
        NODE     60       1.000    3.000    3.075
        NODE     61       1.000    4.000    3.075
        NODE     62       1.000    5.000    3.075
        NODE     63       1.000    6.000    3.075
        NODE     64       0.000    0.000    3.075
        NODE     65       0.000    1.000    3.075
        NODE     66       0.000    2.000    3.075
        NODE     67       0.000    3.000    3.075
        NODE     68       0.000    4.000    3.075
        NODE     69       0.000    5.000    3.075
        NODE     70       0.000    6.000    3.075
        NODE     71       3.000    3.000    2.000
        NODE     72       3.000    3.000    1.000
        NODE     73       3.000    3.000    -0.075
        NODE     74       3.000    3.000    2.5375
        NODE     75       3.000    3.000    1.500
        NODE     76       3.000    3.000    0.500
        NODE     77       3.000    0.500    3.075
        NODE     78       3.000    1.500    3.075
        NODE     79       3.000    2.500    3.075
        NODE     80       3.000    3.500    3.075
        NODE     81       3.000    4.500    3.075
        NODE     82       3.000    5.500    3.075
        NODE     83       3.000    6.100    4.000
        NODE     84       3.100    3.000    -0.100
 FIXATIONS
        BLOCK    1        F0       F0       F0       NO       NO       NO       NO
        BLOCK    2        F0       NO       F0       NO       NO       NO       NO
        BLOCK    3        F0       NO       F0       NO       NO       NO       NO
        BLOCK    4        F0       NO       F0       NO       NO       NO       NO
        BLOCK    5        F0       NO       F0       NO       NO       NO       NO
        BLOCK    6        F0       NO       F0       NO       NO       NO       NO
        BLOCK    7        F0       NO       F0       NO       NO       NO       NO
        BLOCK    64       F0       F0       F0       NO       NO       NO       NO
        BLOCK    65       F0       NO       F0       NO       NO       NO       NO
        BLOCK    66       F0       NO       F0       NO       NO       NO       NO
        BLOCK    67       F0       NO       F0       NO       NO       NO       NO
        BLOCK    68       F0       NO       F0       NO       NO       NO       NO
        BLOCK    69       F0       NO       F0       NO       NO       NO       NO
        BLOCK    70       F0       NO       F0       NO       NO       NO       NO
        BLOCK    73       F0       F0       F0       F0       F0       F0       F0
   END_FIX
 NODOFBEAM
beam1.tem
TRANSLATE    1    1
TRANSLATE    2    3
END_TRANS
column.tem
TRANSLATE    1    1
END_TRANS
      ELEM   1    43   77    44    83     1
      ELEM   2    44   78    45    83     1
      ELEM   3    45   79    46    83     1
      ELEM   4    46   80    47    83     1
      ELEM   5    47   81    48    83     1
      ELEM   6    48   82    49    83     1
      ELEM   7    46   74    71    84     2
      ELEM   8    71   75    72    84     2
      ELEM   9    72   76    73    84     2
NODOFSHELL
wall.tsh
```

```
TRANSLATE    1    2
 TRANSLATE    2    4
END_TRANS
```

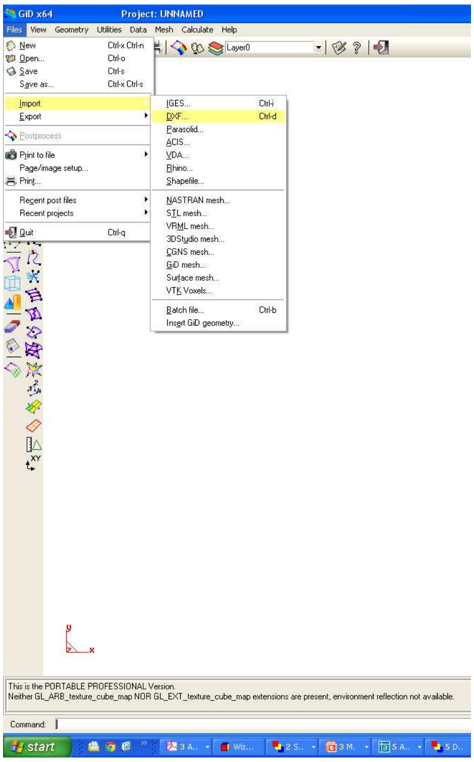
**slab.tsh**

```
TRANSLATE    1    2
 TRANSLATE    2    4
END_TRANS
    ELEM1       1       2       9       8   1
        ELEM    2       2       3       10      9   1
        ELEM    3       3       4       11      10  1
        ELEM    4       4       5       12      11  1
        ELEM    5       5       6       13      12  1
        ELEM    6       6       7       14      13  1
        ELEM    7       8       9       16      15  1
        ELEM    8       9       10      17      16  1
        ELEM    9       10      11      18      17  1
        ELEM    10      11      12      19      18      1
        ELEM    11      12      13      20      19      1
        ELEM    12      13      14      21      20      1
        ELEM    13      15      16      23      22      1
        ELEM    14      16      17      24      23      1
        ELEM    15      17      18      25      24      1
        ELEM    16      18      19      26      25      1
        ELEM    17      19      20      27      26      1
        ELEM    18      20      21      28      27      1
        ELEM    19      22      23      30      29      2
        ELEM    20      23      24      31      30      2
        ELEM    21      24      25      32      31      2
        ELEM    22      25      26      33      32      2
        ELEM    23      26      27      34      33      2
        ELEM    24      27      28      35      34      2
        ELEM    25      29      30      37      36      2
        ELEM    26      30      31      38      37      2
        ELEM    27      31      32      39      38      2
        ELEM    28      32      33      40      39      2
        ELEM    29      33      34      41      40      2
        ELEM    30      34      35      42      41      2
        ELEM    31      36      37      44      43      2
        ELEM    32      37      38      45      44      2
        ELEM    33      38      39      46      45      2
        ELEM    34      39      40      47      46      2
        ELEM    35      40      41      48      47      2
        ELEM    36      41      42      49      48      2
        ELEM    37      43      44      51      50      2
        ELEM    38      44      45      52      51      2
        ELEM    39      45      46      53      52      2
        ELEM    40      46      47      54      53      2
        ELEM    41      47      48      55      54      2
        ELEM    42      48      49      56      55      2
        ELEM    43      50      51      58      57      2
        ELEM    44      51      52      59      58      2
        ELEM    45      52      53      60      59      2
        ELEM    46      53      54      61      60      2
        ELEM    47      54      55      62      61      2
        ELEM    48      55      56      63      62      2
        ELEM    49      57      58      65      64      2
        ELEM    50      58      59      66      65      2
        ELEM    51      59      60      67      66      2
        ELEM    52      60      61      68      67      2
        ELEM    53      61      62      69      68      2
        ELEM    54      62      63      70      69      2
PRECISION 1.0e-3
     LOADS
  FUNCTION        FLOAD
   DISTRSH      19 0.000000 0.000000 -5310.000000
   GDISTRSH     54 0.000000 0.000000 -5310.000000  1
  END_LOAD
 MATERIALS
STEELEC3EN
           2.10e+11   3.00e-01   3.55e+08  1200.   0.
SILCONC2D
            3.00e-01   3.00e+07   3.00e+06 0.
INSULATION
STEELEC2
           2.06e+11   3.00e-01   5.00e+08  1200.   0.
   TIME
```

```
        1.0     600.0
    ENDTIME
      EPSTH
IMPRESSION
 TIMEPRINT
        30.0    600.0
END_TIMEPR
PRINTREACT
    PRINTMN
    PRINTFHE
    PRINTDEPL
```

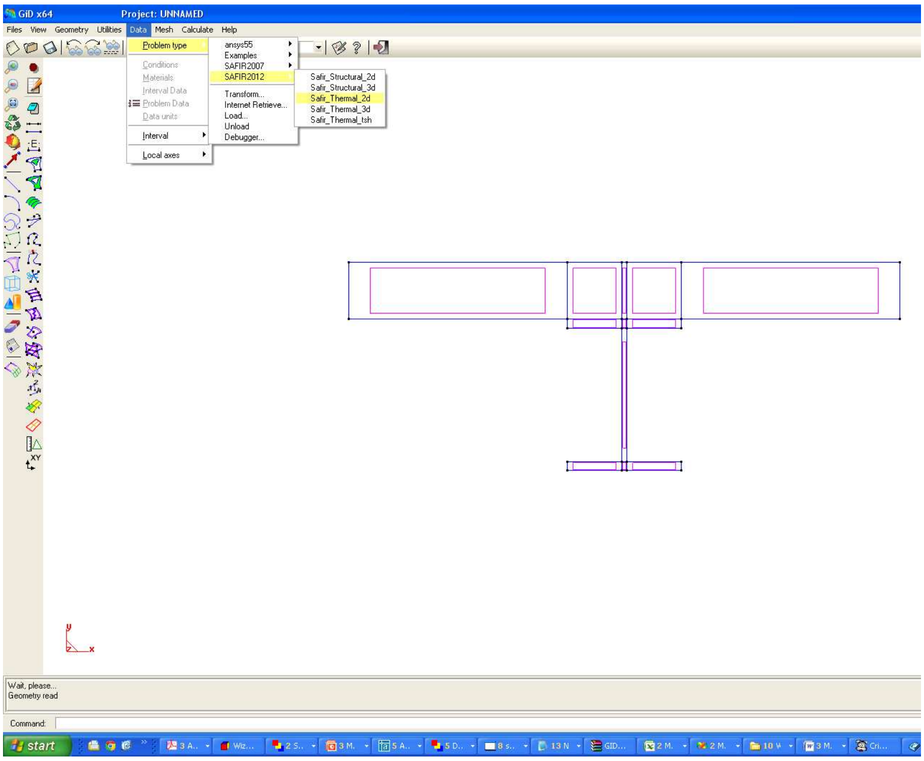
## B) CREATE THE THERMAL INPUT IN GiD FILES AND RUN THERMAL ANALYSIS

- If you use GiD new GiD - SAFIR interface files have been developed to include the option to run thermal analyses that exploit CFD data.
  In order to speed up the process .dxf files which contain the **section layout** of both beam elements are already provided to you in the folder DXF_Files.

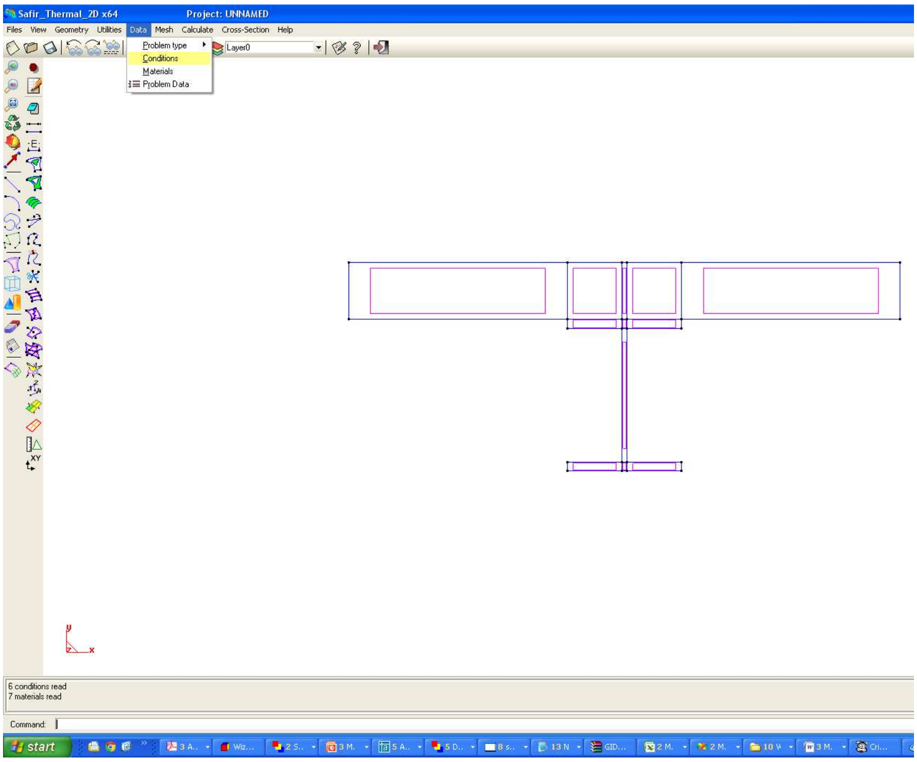


**COMPOSITE BEAM**

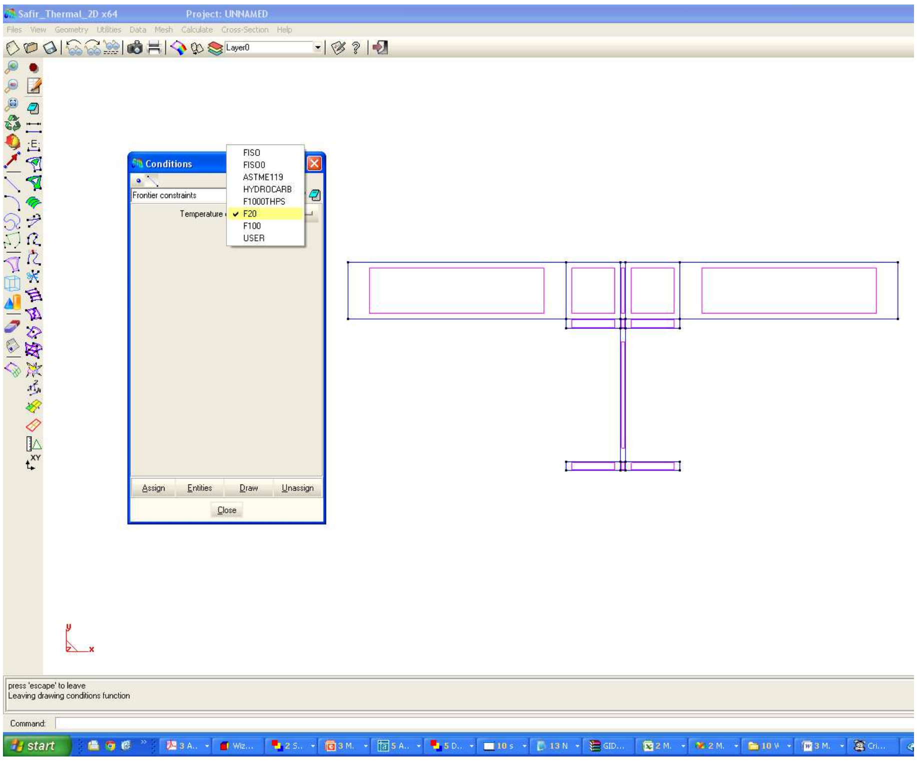
Select the **Problem type** -> Safir_Thermal_2D in the new SAFIR 2012 GiD - SAFIR interface

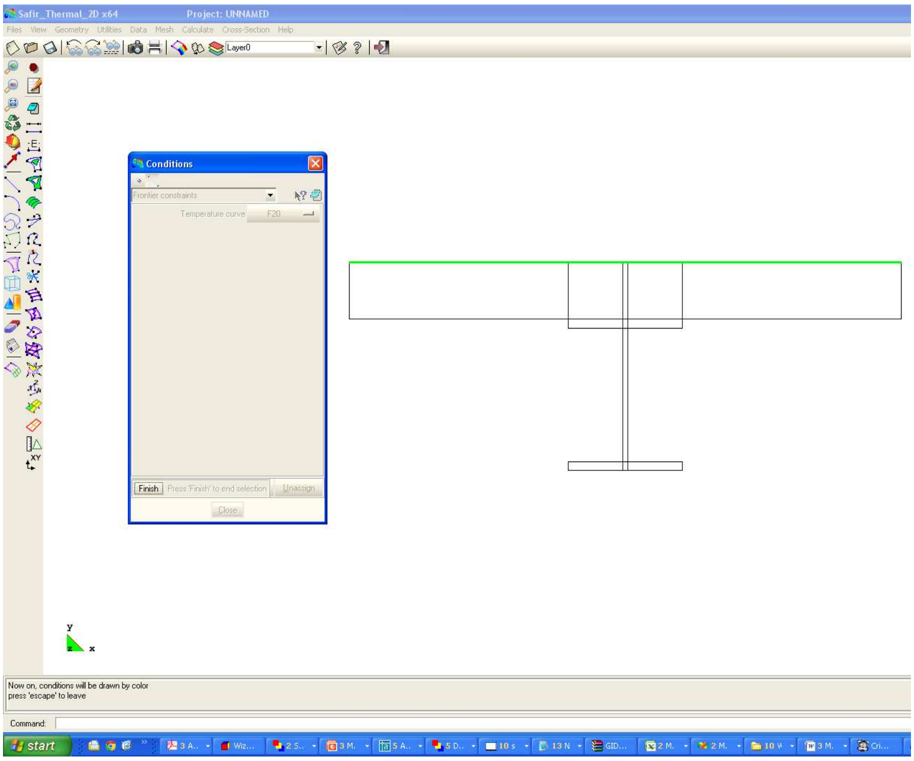


Assign the Boundary **Conditions** to the section

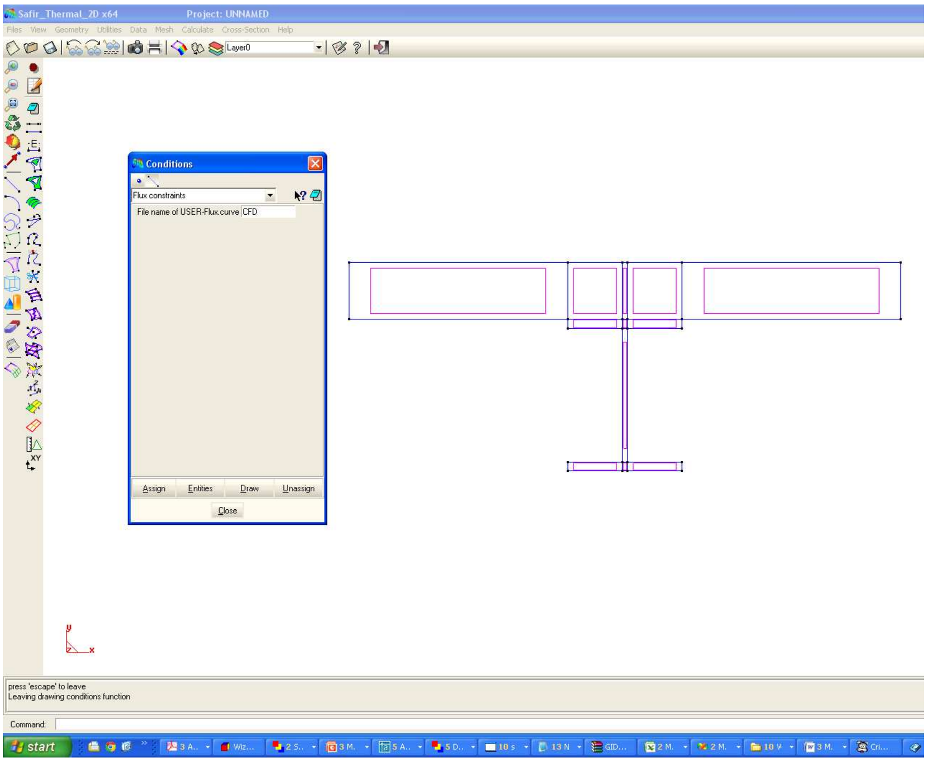


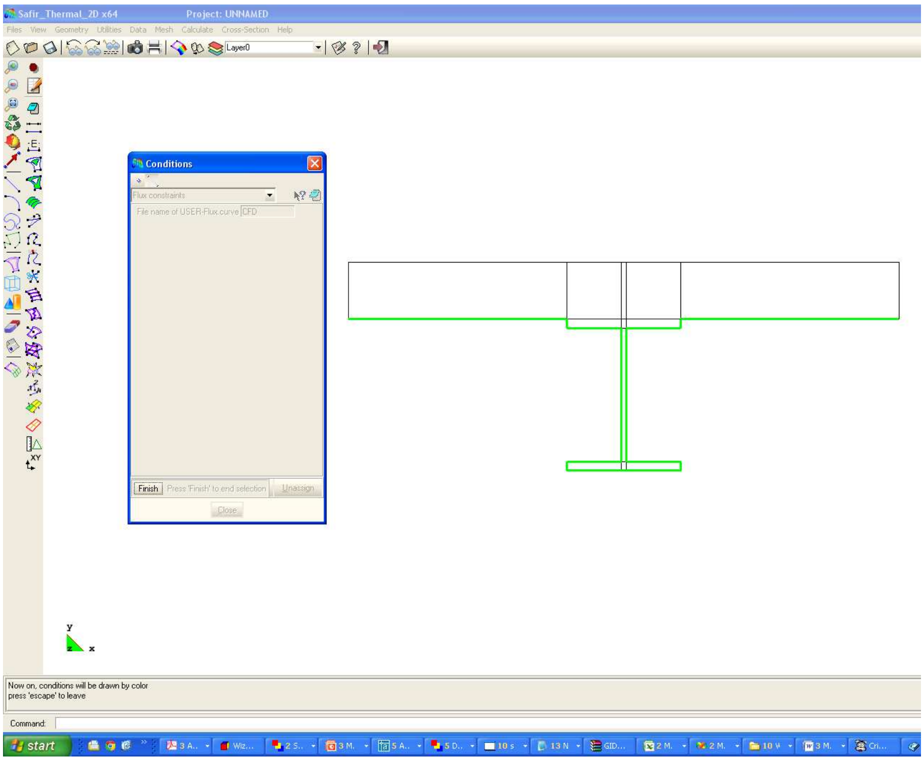
Assign **Frontier condition F20** to the top of the slab



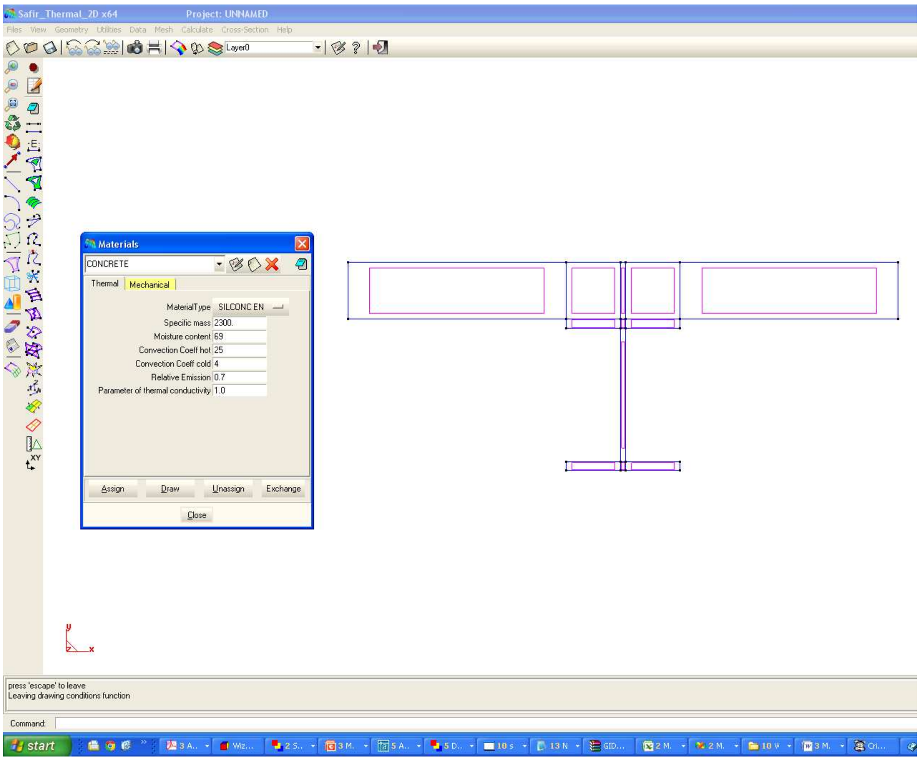



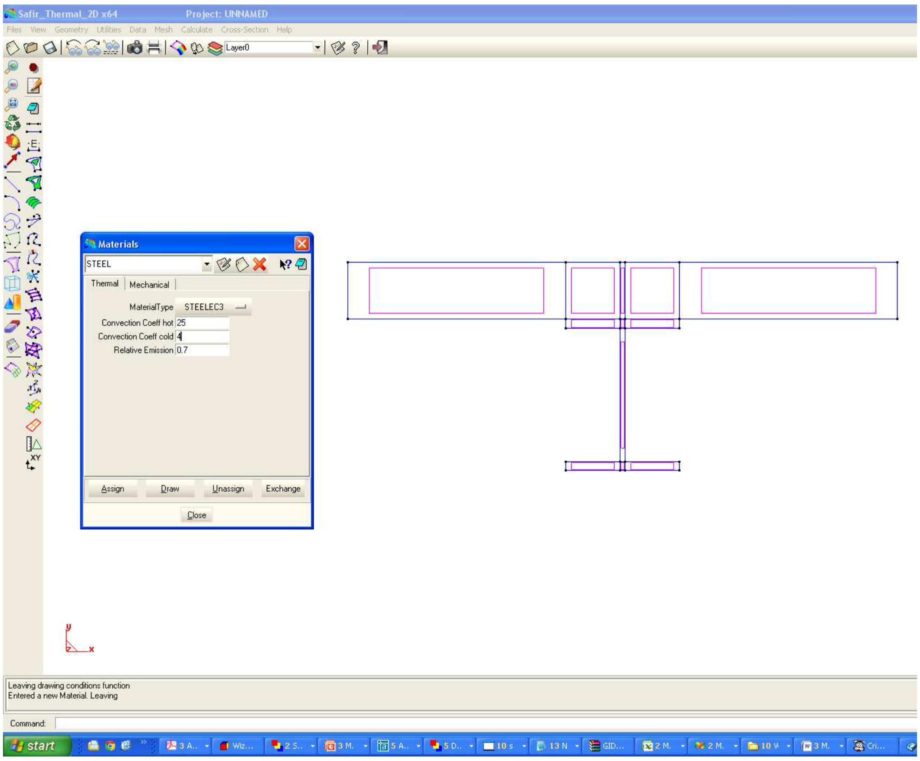
**Assign CFD flux constraints** to the bottom side of the slab and to the beam by writing in the cell "File name of USER-Flux curve" **CFD**.



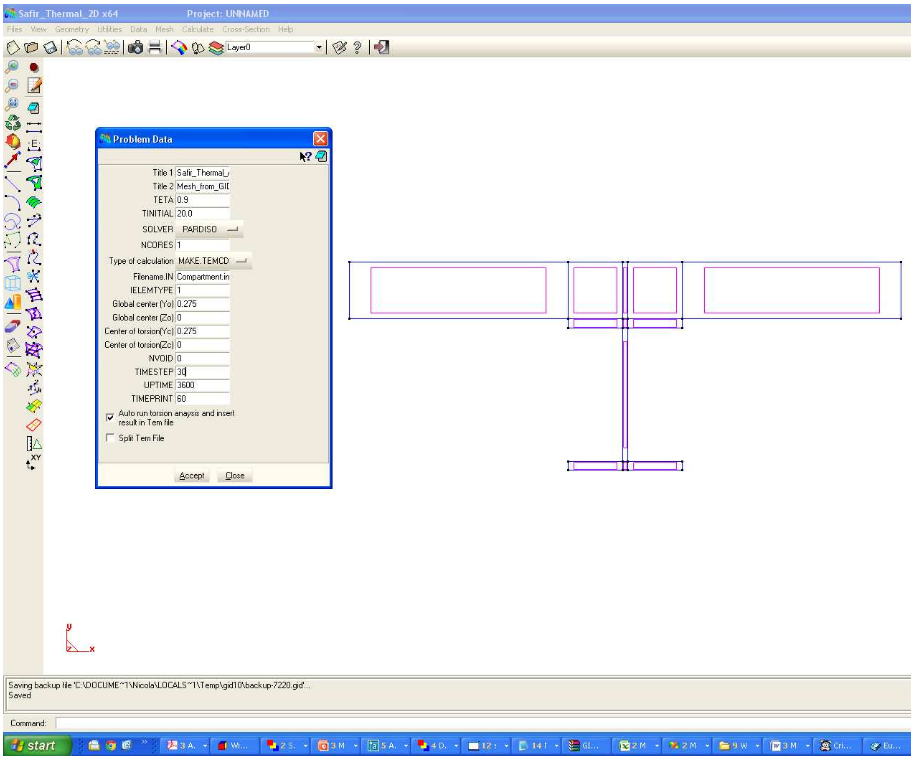



**Assign material properties.** In order to be consistent with material properties given in the FDS model for the concrete slab, assign the same material with same values.



**Define Problem Data.** Choose MAKE.TEMCD in order to run a thermal analysis that relies on CFD data. Insert the file name of the mechanical input file Compartment.in and make sure that IELEMTYPE corresponds to the right one in the mechanical file (in this example = 1). Move the nodeline of the beam to the slab centerline. Tick Auto run torsion in order to perform torsion analysis as well. **Generate Mesh.**

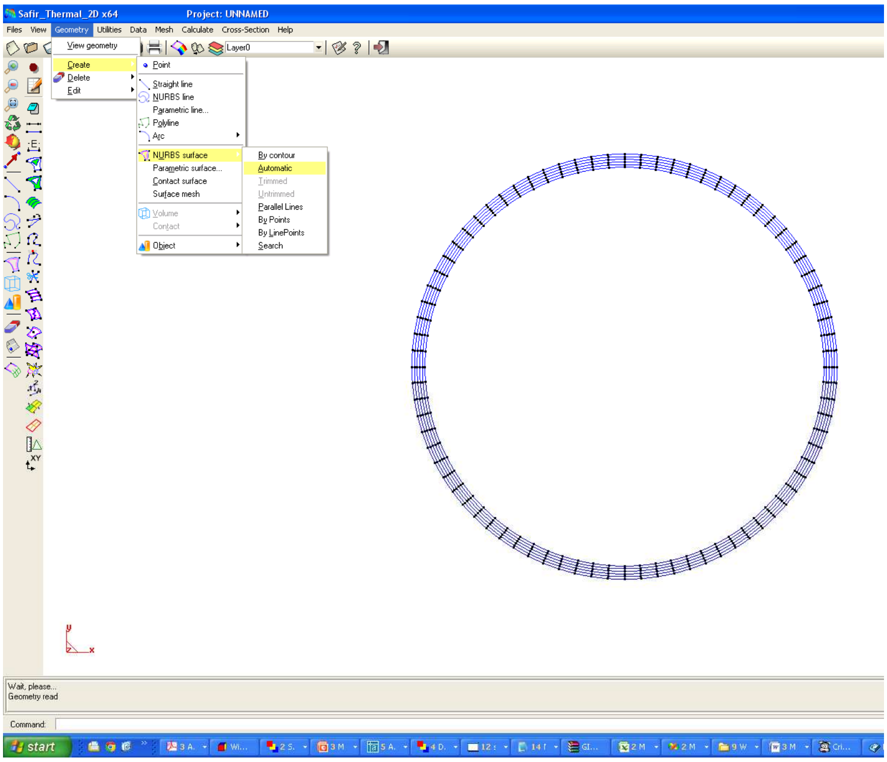



**Generate Mesh.**

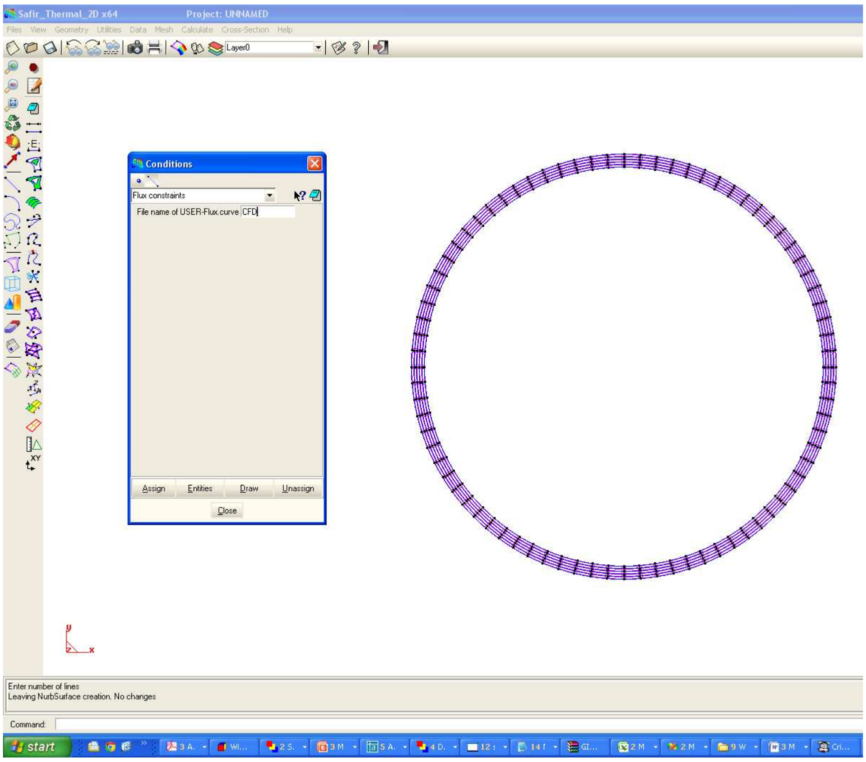
**Before running the thermal analysis make sure that the transfer file cfd_trilin.txt and the mechanical input file Compartment.in be in the same folder of the thermal input file.**
**Run the thermal analysis.**

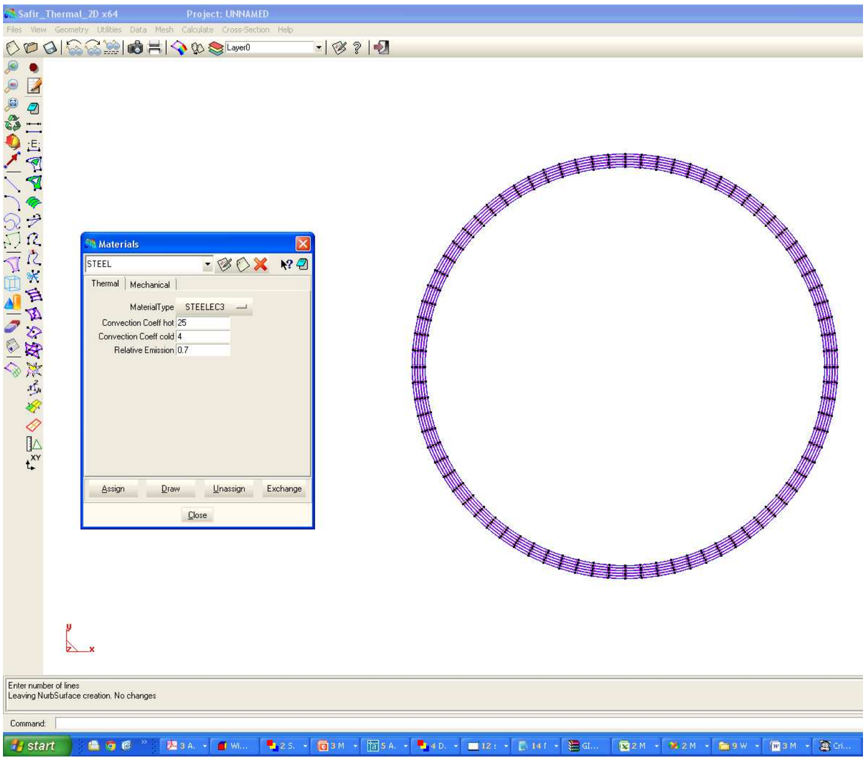
## COLUMN TUBE

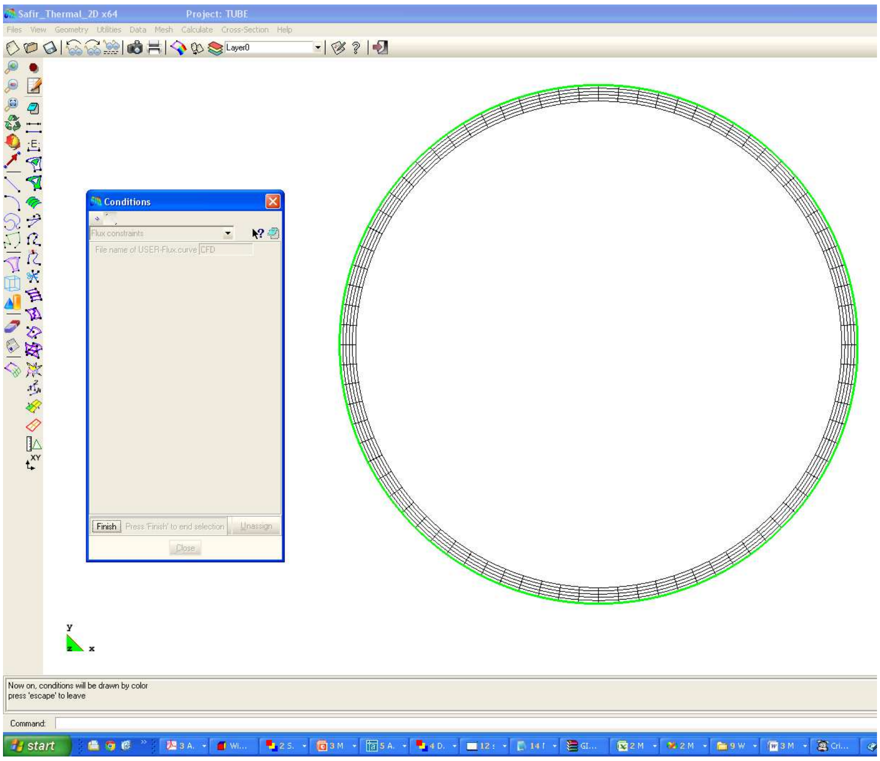
Import the tube.dxf file and create surfaces.



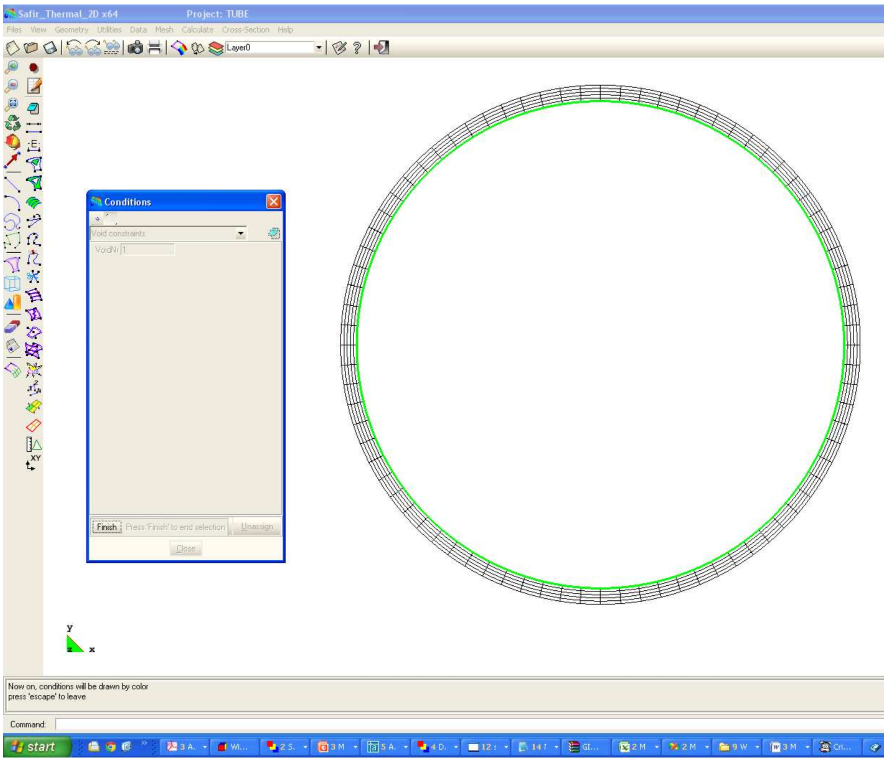
**Assign CFD flux constraints** to outer side of the tube by writing in the cell "File name of USER-Flux curve" **CFD**.



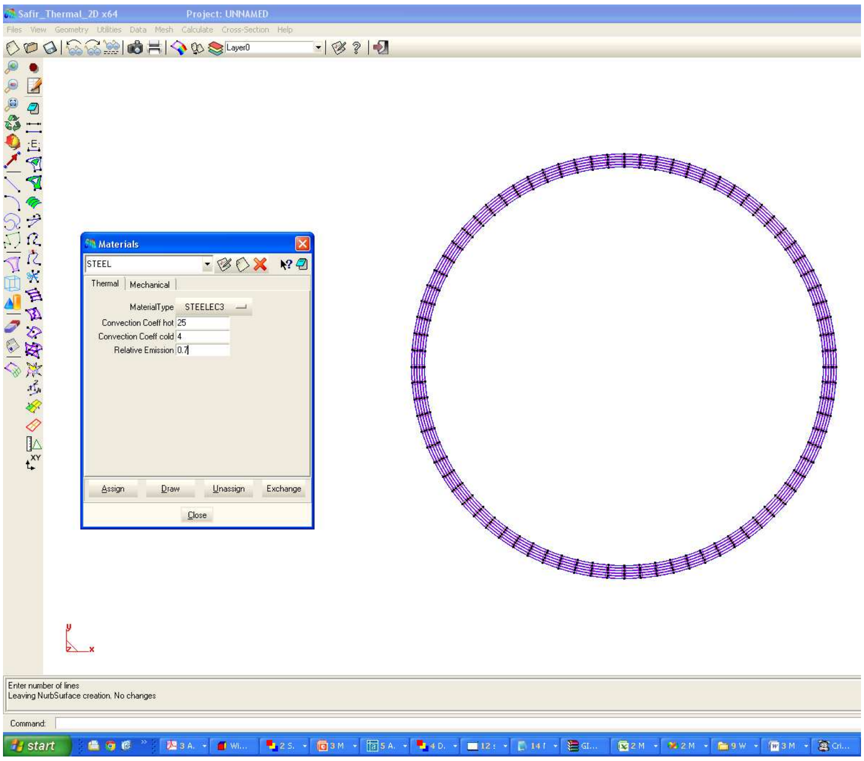

Safir_Thermal_2D x64 Project: UNNAMED
Materials
STEEL
Thermal
Mechanical
MaterialType STEELEC3
Convection Coeff hot 25
Convection Coeff cold 4
Relative Emission 0.7
Assign
Draw
Unassign
Exchange
Close
Enter number of lines
Leaving NurbSurface creation. No changes
Command:


Safir_Thermal_2D x64 Project: TUBE
Conditions
Flux constraints
File name of USER-Flux curve CFD
Finish
Press 'Finish' to end selection
Unassign
Close
Now on, conditions will be drawn by color
press 'escape' to leave
Command:

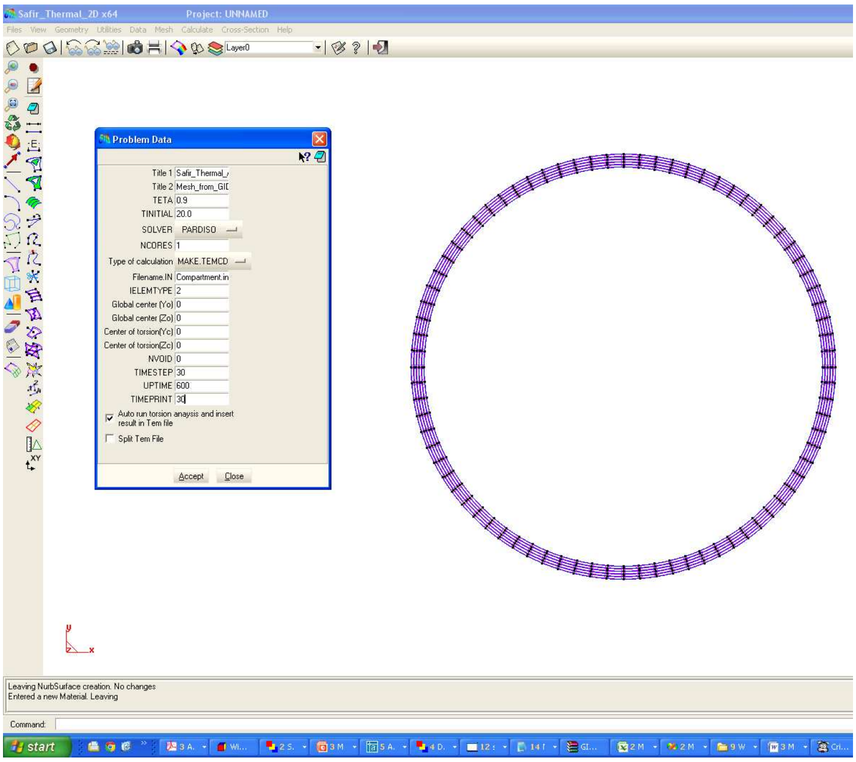
**Assign VOID constraints** to the inner side of the tube by writing in the cell "File name of USER-Flux curve" **CFD**.



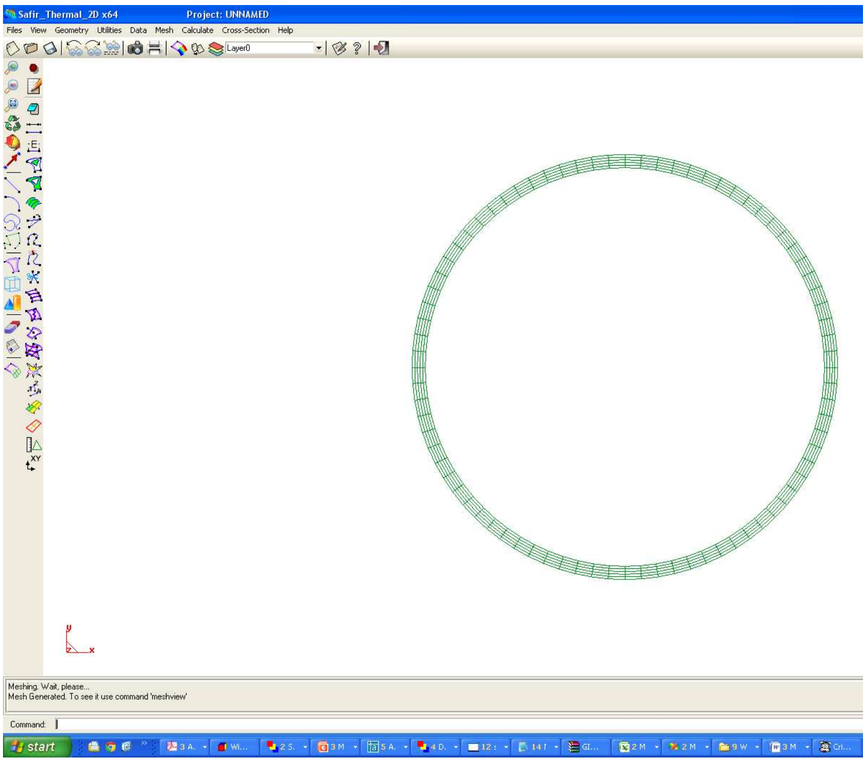

**Assign material properties** of the steel tube.



**Define Problem Data.** Choose MAKE.TEMCD in order to run a thermal analysis with CFD data. Insert the file name of the mechanical input file Compartment.in and make sure that IELEMTYPE corresponds to the right one in the mechanical file (in this example = 2). Tick Auto run torsion in order to perform torsion analysis as well.



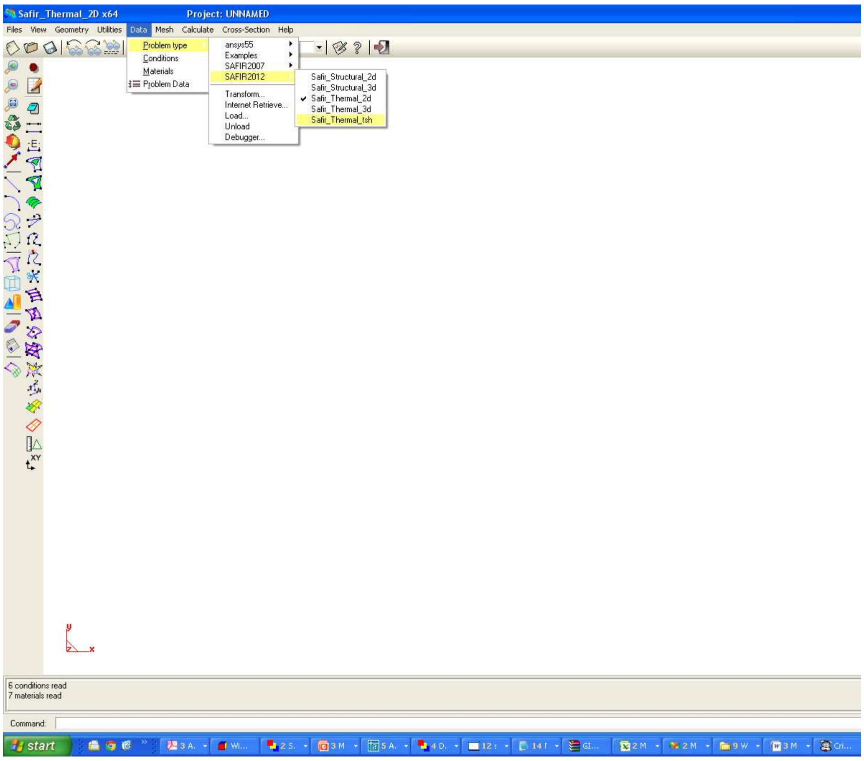

**Generate mesh.**



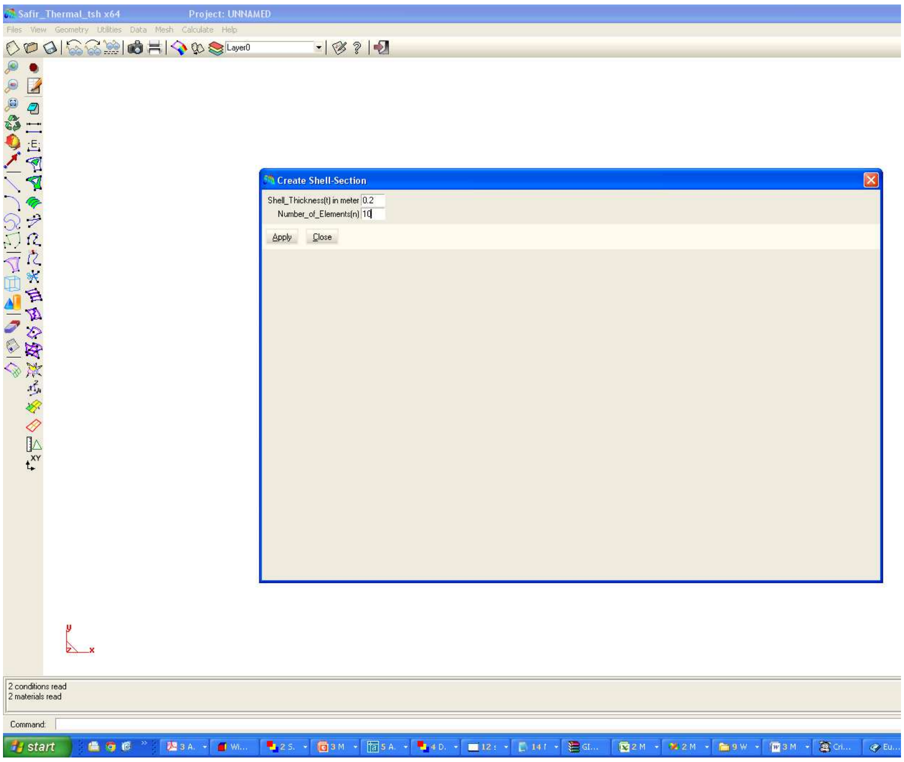
**Before running the thermal analysis make sure that the transfer file cfd_trilin.txt and the mechanical input file Compartment.in be in the same folder of the thermal input file.**
**Run the thermal analysis.**

**WALL ELEMENT**

Select the **Problem type** -> Safir_Thermal_tsh in the new SAFIR 2012 GiD - SAFIR interface.

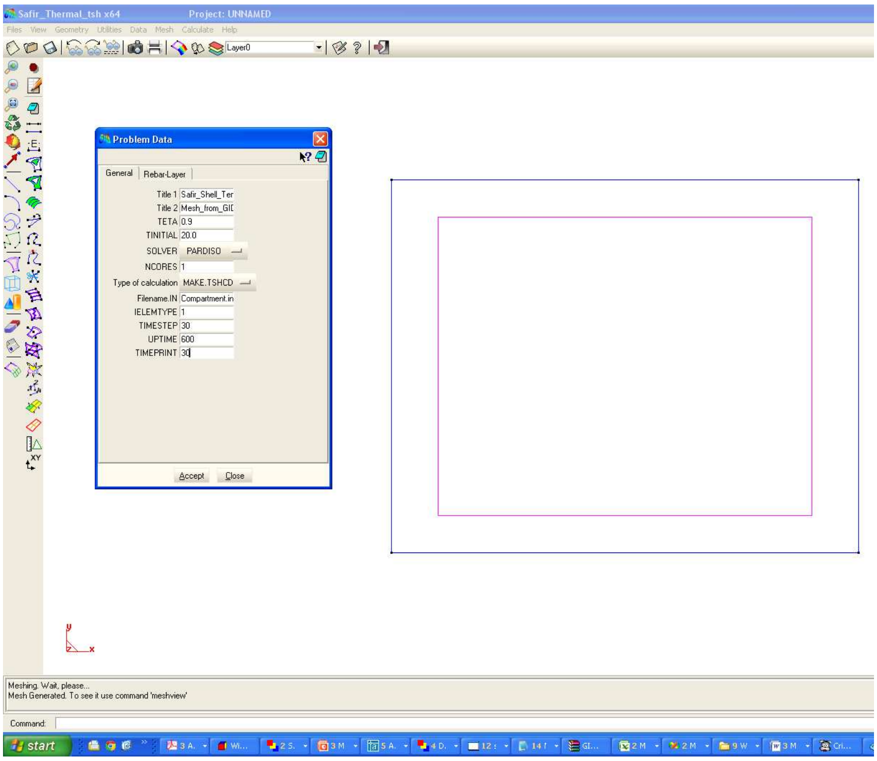


**Insert Thickness (0.2 m) and Number of elements.**

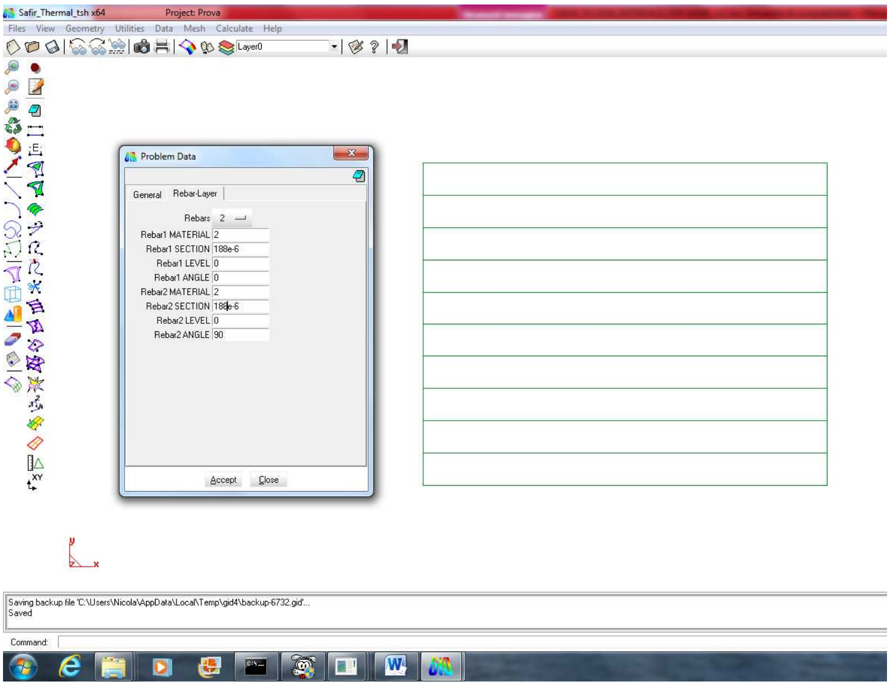



**NOTE:** The same way to assign Boundary **Conditions** (Frontier F20 top and Flux CFD bottom) and **Materials** (same concrete properties) as for the composite beam applies.

**Define Problem Data.** Choose MAKE.TEMSH in order to run a thermal analysis with CFD data. Make sure that IELEMTYPE (in this example = 1) corresponds to the right one in the mechanical file.




Assign the rebar properties.




**Before running the thermal analysis make sure that the transfer file cfd_trilin.txt and the mechanical input file Compartment.in be in the same folder of the thermal input file.**
**Run the thermal analysis.**

**SLAB ELEMENT**

The same way as to create the wall thermal input file but thickness 0.15 m and IELEMTYPE = 2 in Problem Data.

## 5. PREPARING WHAT NEEDED TO RUN THE MECHANICAL ANALYSIS

In each folder created by GiD for the 4 structural type elements there are the files created by the thermal analyses needed to run the mechanical analysis. These files have .tem extension in the case of beam elements and .tsh in the case of shell elements. They are progressively numbered on the basis of the element number. However, they are not ready to be used yet because in .tem files information about torsion is missing, whilst in .tsh files what is missing is the information about thickness and rebars of the shell.

**BEAM ELEMENT**

For beam elements it is necessary to open the .T0R in the relevant folder and copy all lines from **w** to **GJ= value** in the first .tem relative to the beam element type. For, instance for the composite beam:

> Open HE400B-1.T0R
>
> Copy all lines from **w** to **GJ= value** in the file **b0001_1.tem** right before the line where CFD is written. Leave one blank lines before **w** and after **GJ= value.** Save the file.

In an analogously way it is done for the tube column, but the .tem file right now is called **b0007_1.tem** because the first element of the column tube corresponds to the 7th beam element in the mechanical input file.

```
        w
   -0.006088    0.008049    0.681235
   -0.004009    0.054313    0.649576
   -0.000137    0.066699    0.595848
    0.004201    0.070054    0.539879
    0.008670    0.071006    0.482701
    0.013178    0.071364    0.425265
    0.017715    0.072087    0.367744
    0.022337    0.073486    0.309547
    0.027176    0.082995    0.252360
    0.033910    0.114857    0.174100
    0.010368    0.008003    0.640691
    0.011732    0.035019    0.637178
    0.014328    0.043358    0.592813
....................................
.......lines missing................
....................................
    0.020381   -0.068818   -0.121187
    0.031447   -0.133572   -0.009203
    0.029637   -0.132234   -0.022787
    0.027860   -0.130001   -0.036301
    0.026121   -0.126886   -0.049831
    0.024427   -0.122910   -0.063415
    0.022796   -0.118152   -0.077117
    0.021245   -0.112738   -0.090843
    0.019775   -0.106804   -0.104711
    0.018390   -0.100521   -0.118780
    0.017097   -0.094137   -0.133111
 According to the principle of virtual works,
     GJ=  0.15195E+08
```

### SHELL ELEMENT

The info regarding the thickness and the rebars of shell elements are included in the 04_wall-1.dat and 05_slab-1.dat created during thermal analysis and you can find it in the relevant GiD folders.

The content of the file has to be copied in the first .tsh file created by the thermal analysis (**s0001_1.tsh** for the wall and **s0019_1.tsh** for the slab) before the line where CFD is written. Leave one blank line before and after the information of thickness and rebars.

```
THICKNESS   0.2
MATERIAL    1
  REBARS    2
MATERIAL    2
 SECTION    188e-6
   LEVEL    0.0
   ANGLE    0
MATERIAL    2
 SECTION    188e-6
   LEVEL    0.0
   ANGLE    90
```

## 6. HOW TO RUN THE MECHANICAL ANALYSIS

Change the name of the .tem and .tsh in the mechanical input file as follows. They correspond to the first .tem or .tsh of each beam or shell element type.

```
---------------------------------------------------------
LOCALISED FIRE - MECHANICAL FILE

     NNODE   84
      NDIM    3
   NDDLMAX    7
EVERY_NODE    0
         FROM 1  TO 42 STEP    1 NDDL    6
         FROM 43 TO 49 STEP    1 NDDL    7
         FROM 50 TO 70 STEP    1 NDDL    6
         FROM 71 TO 73 STEP    1 NDDL    7
         FROM 74 TO 82 STEP    1 NDDL    1
     FROM 83 TO 84 STEP    1 NDDL    0
  END_NDDL
   STATIC   PURE_NR
     NLOAD    1
   OBLIQUE    0
  COMEBACK 1.0e-5
 RENUMGEO 1
      NMAT    4
  ELEMENTS
   BEAM    9     2
   NG 2
   NFIBER    414
   SHELL     54     2
   NGTHICK    3
   NGAREA     2
   NREBARS    2
  END_ELEM
     NODES
        NODE     1       6.100    0.000    -0.075
        NODE     2       6.100    1.000    -0.075
        NODE     3       6.100    2.000    -0.075
        NODE     4       6.100    3.000    -0.075
        NODE     5       6.100    4.000    -0.075
        NODE     6       6.100    5.000    -0.075
        NODE     7       6.100    6.000    -0.075
        NODE     8       6.100    0.000    1.000
        NODE     9       6.100    1.000    1.000
        NODE     10      6.100    2.000    1.000
        NODE     11      6.100    3.000    1.000
```

```
        NODE     12       6.100    4.000    1.000
        NODE     13       6.100    5.000    1.000
        NODE     14       6.100    6.000    1.000
        NODE     15       6.100    0.000    2.000
        NODE     16       6.100    1.000    2.000
        NODE     17       6.100    2.000    2.000
        NODE     18       6.100    3.000    2.000
        NODE     19       6.100    4.000    2.000
        NODE     20       6.100    5.000    2.000
        NODE     21       6.100    6.000    2.000
        NODE     22       6.100    0.000    3.075
        NODE     23       6.100    1.000    3.075
        NODE     24       6.100    2.000    3.075
        NODE     25       6.100    3.000    3.075
        NODE     26       6.100    4.000    3.075
        NODE     27       6.100    5.000    3.075
        NODE     28       6.100    6.000    3.075
        NODE     29       5.000    0.000    3.075
        NODE     30       5.000    1.000    3.075
        NODE     31       5.000    2.000    3.075
        NODE     32       5.000    3.000    3.075
        NODE     33       5.000    4.000    3.075
        NODE     34       5.000    5.000    3.075
        NODE     35       5.000    6.000    3.075
        NODE     36       4.000    0.000    3.075
        NODE     37       4.000    1.000    3.075
        NODE     38       4.000    2.000    3.075
        NODE     39       4.000    3.000    3.075
        NODE     40       4.000    4.000    3.075
        NODE     41       4.000    5.000    3.075
        NODE     42       4.000    6.000    3.075
        NODE     43       3.000    0.000    3.075
        NODE     44       3.000    1.000    3.075
        NODE     45       3.000    2.000    3.075
        NODE     46       3.000    3.000    3.075
        NODE     47       3.000    4.000    3.075
        NODE     48       3.000    5.000    3.075
        NODE     49       3.000    6.000    3.075
        NODE     50       2.000    0.000    3.075
        NODE     51       2.000    1.000    3.075
        NODE     52       2.000    2.000    3.075
        NODE     53       2.000    3.000    3.075
        NODE     54       2.000    4.000    3.075
        NODE     55       2.000    5.000    3.075
        NODE     56       2.000    6.000    3.075
        NODE     57       1.000    0.000    3.075
        NODE     58       1.000    1.000    3.075
        NODE     59       1.000    2.000    3.075
        NODE     60       1.000    3.000    3.075
        NODE     61       1.000    4.000    3.075
        NODE     62       1.000    5.000    3.075
        NODE     63       1.000    6.000    3.075
        NODE     64       0.000    0.000    3.075
        NODE     65       0.000    1.000    3.075
        NODE     66       0.000    2.000    3.075
        NODE     67       0.000    3.000    3.075
        NODE     68       0.000    4.000    3.075
        NODE     69       0.000    5.000    3.075
        NODE     70       0.000    6.000    3.075
        NODE     71       3.000    3.000    2.000
        NODE     72       3.000    3.000    1.000
        NODE     73       3.000    3.000   -0.075
        NODE     74       3.000    3.000    2.5375
        NODE    75        3.000    3.000    1.500
        NODE     76       3.000    3.000    0.500
        NODE     77       3.000    0.500    3.075
        NODE     78       3.000    1.500    3.075
        NODE     79       3.000    2.500    3.075
        NODE     80       3.000    3.500    3.075
        NODE     81       3.000    4.500    3.075
        NODE     82       3.000    5.500    3.075
        NODE     83  3.000   6.100   4.000
        NODE     84  3.100   3.000  -0.100
FIXATIONS
        BLOCK    1        F0       F0       F0       NO       NO       NO       NO
        BLOCK    2        F0       NO       F0       NO       NO       NO       NO
```

```
        BLOCK   3       F0      NO      F0      NO      NO      NO      NO
        BLOCK   4       F0      NO      F0      NO      NO      NO      NO
        BLOCK   5       F0      NO      F0      NO      NO      NO      NO
        BLOCK   6       F0      NO      F0      NO      NO      NO      NO
        BLOCK   7       F0      NO      F0      NO      NO      NO      NO
        BLOCK   64      F0      F0      F0      NO      NO      NO      NO
        BLOCK   65      F0      NO      F0      NO      NO      NO      NO
        BLOCK   66      F0      NO      F0      NO      NO      NO      NO
        BLOCK   67      F0      NO      F0      NO      NO      NO      NO
        BLOCK   68      F0      NO      F0      NO      NO      NO      NO
        BLOCK   69      F0      NO      F0      NO      NO      NO      NO
        BLOCK   70      F0      NO      F0      NO      NO      NO      NO
        BLOCK   73      F0      F0      F0      F0      F0      F0      F0
   END_FIX
 NODOFBEAM
b0001_1.tem
TRANSLATE    1    1
TRANSLATE    2    3
END_TRANS
b0007_1.tem
TRANSLATE    1    1
END_TRANS
      ELEM   1    43   77    44    83     1
      ELEM   2    44   78    45    83     1
      ELEM   3    45   79    46    83     1
      ELEM   4    46   80    47    83     1
      ELEM   5    47   81    48    83     1
      ELEM   6    48   82    49    83     1
      ELEM   7    46   74    71    84     2
      ELEM   8    71   75    72    84     2
      ELEM   9    72   76    73    84     2
NODOFSHELL
s0001_1.tsh
TRANSLATE    1    2
 TRANSLATE    2    4
END_TRANS
s0019_1.tsh
TRANSLATE    1    2
 TRANSLATE    2    4
END_TRANS
    ELEM1       1       2       9       8   1
        ELEM    2       2       3       10      9   1
        ELEM    3       3       4       11      10  1
        ELEM    4       4       5       12      11  1
        ELEM    5       5       6       13      12  1
        ELEM    6       6       7       14      13  1
        ELEM    7       8       9       16      15  1
        ELEM    8       9       10      17      16  1
        ELEM    9       10      11      18      17  1
        ELEM    10      11      12      19      18      1
        ELEM    11      12      13      20      19      1
        ELEM    12      13      14      21      20      1
        ELEM    13      15      16      23      22      1
        ELEM    14      16      17      24      23      1
        ELEM    15      17      18      25      24      1
        ELEM    16      18      19      26      25      1
        ELEM    17      19      20      27      26      1
        ELEM    18      20      21      28      27      1
        ELEM    19      22      23      30      29      2
        ELEM    20      23      24      31      30      2
        ELEM    21      24      25      32      31      2
        ELEM    22      25      26      33      32      2
        ELEM    23      26      27      34      33      2
        ELEM    24      27      28      35      34      2
        ELEM    25      29      30      37      36      2
        ELEM    26      30      31      38      37      2
        ELEM    27      31      32      39      38      2
        ELEM    28      32      33      40      39      2
        ELEM    29      33      34      41      40      2
        ELEM    30      34      35      42      41      2
        ELEM    31      36      37      44      43      2
        ELEM    32      37      38      45      44      2
        ELEM    33      38      39      46      45      2
        ELEM    34      39      40      47      46      2
        ELEM    35      40      41      48      47      2
        ELEM    36      41      42      49      48      2
```

```
        ELEM    37      43      44      51      50      2
        ELEM    38      44      45      52      51      2
        ELEM    39      45      46      53      52      2
        ELEM    40      46      47      54      53      2
        ELEM    41      47      48      55      54      2
        ELEM    42      48      49      56      55      2
        ELEM    43      50      51      58      57      2
        ELEM    44      51      52      59      58      2
        ELEM    45      52      53      60      59      2
        ELEM    46      53      54      61      60      2
        ELEM    47      54      55      62      61      2
        ELEM    48      55      56      63      62      2
        ELEM    49      57      58      65      64      2
        ELEM    50      58      59      66      65      2
        ELEM    51      59      60      67      66      2
        ELEM    52      60      61      68      67      2
        ELEM    53      61      62      69      68      2
        ELEM    54      62      63      70      69      2
PRECISION 1.0e-3
     LOADS
  FUNCTION        FLOAD
   DISTRSH     19 0.000000 0.000000 -5310.000000
   GDISTRSH    54 0.000000 0.000000 -5310.000000  1
  END_LOAD
 MATERIALS
STEELEC3EN
           2.10e+11   3.00e-01   3.55e+08  1200.   0.
SILCONC2D
            3.00e-01   3.00e+07   3.00e+06 0.
INSULATION
STEELEC2
           2.06e+11   3.00e-01   5.00e+08  1200.   0.
   TIME
       1.0     600.0
   ENDTIME
     EPSTH
IMPRESSION
 TIMEPRINT
       30.0    600.0
END_TIMEPR
PRINTREACT
   PRINTMN
```

**Make sure that all .tem and .tsh files are in the same folder of the mechanical input file.**

**Run the mechanical analysis.**

## Example of transfer file.

```
NSTEPS / Number of time steps N in the CFD analysis
   3

TIMES next N lines each contains time value in s
    1.00
   31.00
   61.00

NF (0 implies no such points)
   3

XYZ_FLUXES
  0.500  0.500  0.500
  0.500  1.500  0.500
  0.500  2.500  0.500

NN
2

XYZ_NORMALS
 -1  1  0  0  0  0

NP
      27

XYZ_INTENSITIES
  0.500  0.500  0.500
  1.500  0.500  0.500
  2.500  0.500  0.500
  0.500  1.500  0.500
  1.500  1.500  0.500
  2.500  1.500  0.500
  0.500  2.500  0.500
  1.500  2.500  0.500
  2.500  2.500  0.500
  0.500  0.500  1.500
  1.500  0.500  1.500
  2.500  0.500  1.500
  0.500  1.500  1.500
  1.500  1.500  1.500
  2.500  1.500  1.500
  0.500  2.500  1.500
  1.500  2.500  1.500
  2.500  2.500  1.500
  0.500  0.500  2.500
  1.500  0.500  2.500
  2.500  0.500  2.500
  0.500  1.500  2.500
  1.500  1.500  2.500
  2.500  1.500  2.500
  0.500  2.500  2.500
  1.500  2.500  2.500
  2.500  2.500  2.500

NI
   8

XYZ_DIRECTIONS
  0.500  0.500  0.707
 -0.500  0.500  0.707
 -0.500 -0.500  0.707
  0.500 -0.500  0.707
  0.500  0.500 -0.707
 -0.500  0.500 -0.707
 -0.500 -0.500 -0.707
  0.500 -0.500 -0.707

TIME \time in s (real)
    1.00

FLUXES
 308.48  0.93    18504.20      418.74
 308.48  1.18    21134.32      418.74
 308.48  1.09    18504.20      418.74

INTENSITIES
 308.48  0.93     3585.63      133.29      133.29     5242.76     5242.76      133.29      133.29     9489.14
 294.88  1.26      823.76      133.29      133.29     1755.89     1755.89      133.29      133.29     6236.26
 294.88  0.78      271.38      133.29      133.29      633.88      633.88      133.29      133.29     3585.63
 308.48  1.18     4966.57      133.29      133.29     4966.57     8487.96      133.29      133.29     8487.96
 294.88  1.02     1514.23      133.29      133.29     1514.23     4609.83      133.29      133.29     4609.83
 294.88  0.77      513.05      133.29      133.29      513.05     2260.32      133.29      133.29     2260.32
 308.48  1.09     5242.76      133.29      133.29     3585.63     9489.14      133.29      133.29     5242.76
 294.88  0.86     1755.89      133.29      133.29      823.76     6236.26      133.29      133.29     1755.89
 294.88  0.41      633.88      133.29      133.29      271.38     3585.63      133.29      133.29      633.88
 308.48  1.33     4966.57      133.29      133.29     8487.96     4966.57      133.29      133.29     8487.96
```

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 294.88 | 1.22 | 1514.23 | 133.29 | 133.29 | 4609.83 | 1514.23 | 133.29 | 133.29 | 4609.83 |
| 294.88 | 0.85 | 513.05 | 133.29 | 133.29 | 2260.32 | 513.05 | 133.29 | 133.29 | 2260.32 |
| 308.48 | 0.84 | 7728.44 | 133.29 | 133.29 | 7728.44 | 7728.44 | 133.29 | 133.29 | 7728.44 |
| 294.88 | 0.93 | 3585.63 | 133.29 | 133.29 | 3585.63 | 3585.63 | 133.29 | 133.29 | 3585.63 |
| 294.88 | 0.79 | 1537.24 | 133.29 | 133.29 | 1537.24 | 1537.24 | 133.29 | 133.29 | 1537.24 |
| 308.48 | 0.93 | 8487.96 | 133.29 | 133.29 | 4966.57 | 8487.96 | 133.29 | 133.29 | 4966.57 |
| 294.88 | 1.08 | 4609.83 | 133.29 | 133.29 | 1514.23 | 4609.83 | 133.29 | 133.29 | 1514.23 |
| 294.88 | 0.89 | 2260.32 | 133.29 | 133.29 | 513.05 | 2260.32 | 133.29 | 133.29 | 513.05 |
| 308.48 | 0.82 | 5242.76 | 133.29 | 133.29 | 9489.14 | 3585.63 | 133.29 | 133.29 | 5242.76 |
| 294.88 | 0.91 | 1755.89 | 133.29 | 133.29 | 6236.26 | 823.76 | 133.29 | 133.29 | 1755.89 |
| 294.88 | 0.82 | 633.88 | 133.29 | 133.29 | 3585.63 | 271.38 | 133.29 | 133.29 | 633.88 |
| 308.48 | 1.41 | 8487.96 | 133.29 | 133.29 | 8487.96 | 4966.57 | 133.29 | 133.29 | 4966.57 |
| 294.88 | 1.20 | 4609.83 | 133.29 | 133.29 | 4609.83 | 1514.23 | 133.29 | 133.29 | 1514.23 |
| 294.88 | 0.38 | 2260.32 | 133.29 | 133.29 | 2260.32 | 513.05 | 133.29 | 133.29 | 513.05 |
| 308.48 | 0.77 | 9489.14 | 133.29 | 133.29 | 5242.76 | 5242.76 | 133.29 | 133.29 | 3585.63 |
| 294.88 | 0.40 | 6236.26 | 133.29 | 133.29 | 1755.89 | 1755.89 | 133.29 | 133.29 | 823.76 |
| 294.88 | 0.00 | 3585.63 | 133.29 | 133.29 | 633.88 | 633.88 | 133.29 | 133.29 | 271.38 |

TIME \time in s (real)
31.00

FLUXES

| | | | |
|---|---|---|---|
| 346.75 | 4.82 | 18504.20 | 418.74 |
| 346.92 | 4.84 | 21134.32 | 418.74 |
| 346.75 | 4.82 | 18504.20 | 418.74 |

INTENSITIES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 346.75 | 4.82 | 3585.63 | 133.29 | 133.29 | 5242.76 | 5242.76 | 133.29 | 133.29 | 9489.14 |
| 337.38 | 3.77 | 823.76 | 133.29 | 133.29 | 1755.89 | 1755.89 | 133.29 | 133.29 | 6236.26 |
| 341.85 | 3.28 | 271.38 | 133.29 | 133.29 | 633.88 | 633.88 | 133.29 | 133.29 | 3585.63 |
| 346.92 | 4.84 | 4966.57 | 133.29 | 133.29 | 4966.57 | 8487.96 | 133.29 | 133.29 | 8487.96 |
| 337.03 | 3.66 | 1514.23 | 133.29 | 133.29 | 1514.23 | 4609.83 | 133.29 | 133.29 | 4609.83 |
| 341.44 | 2.69 | 513.05 | 133.29 | 133.29 | 513.05 | 2260.32 | 133.29 | 133.29 | 2260.32 |
| 346.75 | 4.82 | 5242.76 | 133.29 | 133.29 | 3585.63 | 9489.14 | 133.29 | 133.29 | 5242.76 |
| 337.38 | 3.77 | 1755.89 | 133.29 | 133.29 | 823.76 | 6236.26 | 133.29 | 133.29 | 1755.89 |
| 341.84 | 3.27 | 633.88 | 133.29 | 133.29 | 271.38 | 3585.63 | 133.29 | 133.29 | 633.88 |
| 355.44 | 4.35 | 4966.57 | 133.29 | 133.29 | 8487.96 | 4966.57 | 133.29 | 133.29 | 8487.96 |
| 350.43 | 3.45 | 1514.23 | 133.29 | 133.29 | 4609.83 | 1514.23 | 133.29 | 133.29 | 4609.83 |
| 351.96 | 4.41 | 513.05 | 133.29 | 133.29 | 2260.32 | 513.05 | 133.29 | 133.29 | 2260.32 |
| 356.05 | 4.54 | 7728.44 | 133.29 | 133.29 | 7728.44 | 7728.44 | 133.29 | 133.29 | 7728.44 |
| 350.35 | 3.71 | 3585.63 | 133.29 | 133.29 | 3585.63 | 3585.63 | 133.29 | 133.29 | 3585.63 |
| 352.41 | 4.25 | 1537.24 | 133.29 | 133.29 | 1537.24 | 1537.24 | 133.29 | 133.29 | 1537.24 |
| 355.44 | 4.35 | 8487.96 | 133.29 | 133.29 | 4966.57 | 8487.96 | 133.29 | 133.29 | 4966.57 |
| 350.43 | 3.45 | 4609.83 | 133.29 | 133.29 | 1514.23 | 4609.83 | 133.29 | 133.29 | 1514.23 |
| 351.95 | 4.41 | 2260.32 | 133.29 | 133.29 | 513.05 | 2260.32 | 133.29 | 133.29 | 513.05 |
| 365.42 | 4.35 | 5242.76 | 133.29 | 133.29 | 9489.14 | 3585.63 | 133.29 | 133.29 | 5242.76 |
| 358.98 | 4.33 | 1755.89 | 133.29 | 133.29 | 6236.26 | 823.76 | 133.29 | 133.29 | 1755.89 |
| 353.31 | 0.82 | 633.88 | 133.29 | 133.29 | 3585.63 | 271.38 | 133.29 | 133.29 | 633.88 |
| 366.14 | 4.27 | 8487.96 | 133.29 | 133.29 | 8487.96 | 4966.57 | 133.29 | 133.29 | 4966.57 |
| 359.85 | 4.25 | 4609.83 | 133.29 | 133.29 | 4609.83 | 1514.23 | 133.29 | 133.29 | 1514.23 |
| 354.15 | 0.82 | 2260.32 | 133.29 | 133.29 | 2260.32 | 513.05 | 133.29 | 133.29 | 513.05 |
| 365.43 | 4.35 | 9489.14 | 133.29 | 133.29 | 5242.76 | 5242.76 | 133.29 | 133.29 | 3585.63 |
| 358.98 | 4.33 | 6236.26 | 133.29 | 133.29 | 1755.89 | 1755.89 | 133.29 | 133.29 | 823.76 |
| 353.30 | 0.00 | 3585.63 | 133.29 | 133.29 | 633.88 | 633.88 | 133.29 | 133.29 | 271.38 |

TIME \time in s (real)
61.00

FLUXES

| | | | |
|---|---|---|---|
| 379.48 | 4.88 | 18504.20 | 418.74 |
| 380.13 | 4.89 | 21134.32 | 418.74 |
| 379.48 | 4.88 | 18504.20 | 418.74 |

INTENSITIES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 379.48 | 4.88 | 3585.63 | 133.29 | 133.29 | 5242.76 | 5242.76 | 133.29 | 133.29 | 9489.14 |
| 371.72 | 3.81 | 823.76 | 133.29 | 133.29 | 1755.89 | 1755.89 | 133.29 | 133.29 | 6236.26 |
| 375.89 | 3.74 | 271.38 | 133.29 | 133.29 | 633.88 | 633.88 | 133.29 | 133.29 | 3585.63 |
| 380.13 | 4.89 | 4966.57 | 133.29 | 133.29 | 4966.57 | 8487.96 | 133.29 | 133.29 | 8487.96 |
| 371.35 | 3.71 | 1514.23 | 133.29 | 133.29 | 1514.23 | 4609.83 | 133.29 | 133.29 | 4609.83 |
| 376.02 | 2.94 | 513.05 | 133.29 | 133.29 | 513.05 | 2260.32 | 133.29 | 133.29 | 2260.32 |
| 379.48 | 4.88 | 5242.76 | 133.29 | 133.29 | 3585.63 | 9489.14 | 133.29 | 133.29 | 5242.76 |
| 371.72 | 3.81 | 1755.89 | 133.29 | 133.29 | 823.76 | 6236.26 | 133.29 | 133.29 | 1755.89 |
| 375.89 | 3.72 | 633.88 | 133.29 | 133.29 | 271.38 | 3585.63 | 133.29 | 133.29 | 633.88 |
| 389.03 | 4.27 | 4966.57 | 133.29 | 133.29 | 8487.96 | 4966.57 | 133.29 | 133.29 | 8487.96 |
| 384.12 | 3.09 | 1514.23 | 133.29 | 133.29 | 4609.83 | 1514.23 | 133.29 | 133.29 | 4609.83 |
| 385.83 | 4.47 | 513.05 | 133.29 | 133.29 | 2260.32 | 513.05 | 133.29 | 133.29 | 2260.32 |
| 390.04 | 4.58 | 7728.44 | 133.29 | 133.29 | 7728.44 | 7728.44 | 133.29 | 133.29 | 7728.44 |
| 384.10 | 3.64 | 3585.63 | 133.29 | 133.29 | 3585.63 | 3585.63 | 133.29 | 133.29 | 3585.63 |
| 386.91 | 4.33 | 1537.24 | 133.29 | 133.29 | 1537.24 | 1537.24 | 133.29 | 133.29 | 1537.24 |
| 389.03 | 4.26 | 8487.96 | 133.29 | 133.29 | 4966.57 | 8487.96 | 133.29 | 133.29 | 4966.57 |
| 384.12 | 3.09 | 4609.83 | 133.29 | 133.29 | 1514.23 | 4609.83 | 133.29 | 133.29 | 1514.23 |
| 385.83 | 4.47 | 2260.32 | 133.29 | 133.29 | 513.05 | 2260.32 | 133.29 | 133.29 | 513.05 |
| 398.45 | 4.35 | 5242.76 | 133.29 | 133.29 | 9489.14 | 3585.63 | 133.29 | 133.29 | 5242.76 |
| 392.91 | 4.43 | 1755.89 | 133.29 | 133.29 | 6236.26 | 823.76 | 133.29 | 133.29 | 1755.89 |
| 387.73 | 0.50 | 633.88 | 133.29 | 133.29 | 3585.63 | 271.38 | 133.29 | 133.29 | 633.88 |
| 399.49 | 4.20 | 8487.96 | 133.29 | 133.29 | 8487.96 | 4966.57 | 133.29 | 133.29 | 4966.57 |
| 394.44 | 4.26 | 4609.83 | 133.29 | 133.29 | 4609.83 | 1514.23 | 133.29 | 133.29 | 1514.23 |
| 388.98 | 0.50 | 2260.32 | 133.29 | 133.29 | 2260.32 | 513.05 | 133.29 | 133.29 | 513.05 |
| 398.45 | 4.34 | 9489.14 | 133.29 | 133.29 | 5242.76 | 5242.76 | 133.29 | 133.29 | 3585.63 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **392.91** | **4.43** | **6236.26** | **133.29** | **133.29** | **1755.89** | **1755.89** | **133.29** | **133.29** | **823.76** |