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*

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Flange(Radius	tf) 10.7 (r) 15	mm mm
exact sha Concrete Sla	pe 🔽	
Slab Wid Slab Heig	th ht	mm mm
Apply	Close	

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.

GiD x64	Project: IPE300 (SAFI	IR2016\Safir_Thermal_2d)	About Problem Tune Help		
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4. Assign the thermal boundary conditions

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



This window appears in GiD:

Conditions			×
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Temperature		~	k? 🕗
Temperature Curve	F0		
Assign	ntities	<u>D</u> raw	<u>U</u> nassign
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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.

Conditions	Conditions	Conditions
Frontier Conditions belonging to that level are displayed		Frontier constraints ✓ № 2
Temperature curve FISO 👻	Fronter constraints Flux constraints Void constraints Temperature	Temperature curve FISO ASTME119 HYDROCARB F1000THPS F20 F100 USER
Assign Entities Draw Unassign	Assign Entities Draw Unassign	Assign Entities Draw Unassign

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

GiD x64 Project IPE300 (S	AFIR2016\Safir_Thermal_2d)		
Files View Geometry Utilities Data	Mesh Calculate Cross-Section About Problem Type He	lp A L- CI	
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Zoom: 1x	Nodes: 0, Elements: 0	Render: Normal	Layers: 1

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

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Close				

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)

Conditions				×
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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

Materials			×
STEEL		~ 🧭 🐔	X 🗉 😽 🧧
Thermal	Mechanical		
	MaterialType STEE	LEC3EN 👻	
Conve	ction Coeff hot 25		
Convec	tion Coeff cold 4		
Re	lative Emission 0.7		
Assign	Draw	<u>U</u> nassign	Exchange
		<u>C</u> lose	

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

Materials			×
STEEL	`	- 🧭 🖒 🔰	🔨 💷 💦 🕗
Thermal	Mechanic	al	
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Yield str	ength (N/m	1^2) 3.55e8	
Assign	<u>D</u> raw	<u>U</u> nassign	Exchange
		<u>C</u> lose	

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.

Problem data	×
	k? 🕗
Title 1	Safir_Thermal
Title 2	Mesh_from_G
TETA	0.9
TINITIAL	20.0
SOLVER	PARDISO -
NCORES	1
Type of calculation	MAKE.TEM -
Global center (Yo)	0
Global center (Zo)	0
Center of torsion(Yc)	0
Center of torsion(Zc)	0
NVOID	0
TIMESTEP	12
UPTIME	3600
TIMEPRINT	60
Auto run torsion anaysis a	nd insert result in Tem file
Consider reduction of tors	ional stiffness
reduction coeff	0.1
reduction coeff	0.1
Accept	Close

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*

Mesh generation ×				
Enter size of elements to be generated				
0.0075	~			
Get meshing par	rameters from model			
OK	Cancel			
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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.

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Command:					# +
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Click on "Ok", save, and open the postprocessor Diamond to visualize the results.

