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USER'S MANUAL FOR SAFIR 2022

A COMPUTER PROGRAM FOR ANALYSIS OF STRUCTURES SUBJECTED TO FIRE

Part 4: torsion analyses

by

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1. General concept

A torsion analysis is typically performed for its results to be used as properties of a 3D BEAM finite element.

The torsion analysis must be performed on the same cross-section and with the same discretisation as the one used for the thermal analysis in the section, see Part 2.

The names of both input files must be consistent:

- ✓ The name of the input file for the thermal analysis would be, for example "*name.in*". The thermal analysis with SAFIR will generate the file "*name.tem*".
- ✓ The name of the input file for the torsion analysis must then be "*name-t.in*" and the torsion analysis with SAFIR will generate the file "*name-t.tor*".

These two files will describe the properties of this section type.

If the thermal analysis is made in a section that is heated by a localised fire such as LOCAFI, HASEMI, TRAFIR, CFD or GOZONE, the file "*name.in*" will generate several "*.tem*" files with names that look like, for example, "*b00015_1.tem*",…., "*b00025_2.tem*".
The file of the torsion analysis "*name-t.tor*" must then be renamed as "*b00015_1-t.tor*".

2. Description and format of the ".IN" file for torsional analysis

The format of this file is very similar to the format of the thermal analysis. It will thus be referred to Part 2 of this user's manual, except when there is a difference.

SERIES 1: COMMENTS

Same as part 2

SERIES 2: QUANTITY OF NODES

Same as part 2

SERIES 3: QUANTITY OF DIMENSIONS

1 card

`NDIM`, *ndim*

- `NDIM`
  Command.
- *ndim* = 2 for torsion analyses

SERIES 4: DEGREES OF FREEDOM

1 card

`NDOFMAX`, *ndofmax*

- `NDOFMAX`
  Command.
- *Ndofmax* = 1 for torsion analyses

SERIES 5: TORSION

1 card

`TORSION`

Command.

SERIES 6: QUANTITY OF MATERIALS

See Series 10 in part 2

SERIES 7: ELEMENTS

See Series 11 in part 2

Note that *nvoid* must be set to 0 in a torsion analysis

SERIES 8: NODES

See Series 12 in part 2

SERIES 9: TORSIONAL CENTRE

See Series 13 in part 2

SERIES 10: SUPPORTS AND IMPOSED DISPLACEMENTS

See Series 14 in part 2

Note that at least one node must be blocked with the function “F0”.

SERIES 11: SOLID ELEMENTS

See Series 15 in part 2

SERIES 12: SYMMETRIES

See Series 18 in part 2

Note that the command “YSYM” cannot be used here as torsion properties are de facto for 3D BEAM finite elements.

SERIES 13: PRECISION

See Series 19 in part 2

SERIES 14: MATERIALS

A. 1 card

`MATERIALS`

Command.

Material description sub-series. One sub-series entered for each *nmat* material type

a) 1 card

`CMAT`

Name of the material, `CMAT` is one of the material names given hereafter.

Valid material names must be distinguished in two groups:

- Group 1: `INSULATION, USER1, USER2, USER3, USER4, USER5, SFRM_PROBA, C_GYPSUM, X_GYPSUM`
- Group 2: Any other material name

b) 1 card

The content of this card b) depends on the group of the material introduced in card a).

- If the name belongs to group 1, the line is blank because these materials don't have any stiffness.
- If the name belongs to group 2, the material used by SAFIR will be `ELASTIC`, no matter the name that is given here and two parameters are given.
  - *paracold(1,nm)* = Young's modulus.
  - paracold*(2,nm)* = Poisson's ratio.

SERIES 15 (optional) OUT OF BALANCE FORCES

`PRINTFHE`,*Tstart*

- `PRINTFHE`

  Writes the out of balance warping loads at the nodes before the system of equation is solved by SAFIR. This command is used only for debugging problems, not for usual calculations

- *Tstart*

  Time (in seconds). Any value equal or greater than 1.