

Post-Processing

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1. Introduction

Post-processing results requires 3 steps:

1.1. Result file edition

Work and disk space, errors warnings, matrix, ...
Reactions,...

1.2. Graphical drawings of results

- Isovalues
- vectors
- Animations
- Deformed shape,...

1.3. Evolution curves

Time function curves,...

No sense in linear static except for the "ASEF transient"

2. Editing results file *.res

2.1. Introduction

The file *_**nn.res** describes computation course. It contains :

- Finite element model characteristics (number of nodes, of elements, ...)
- Workspace, disk space, available space ;
- Errors and warnings ;
- Results.

2.2. Looking for errors and warnings

%%%Xnn-RRRRRR : text :

X :	E for error A for warning
Nn :	number of message
RRRRRR :	concerned routine
Text :	text of message.

Remarks :

- An Error corresponds also to a software stops.
- A warning informs that an anomaly has been detected and has to be interpreted (for ex. : absence of density, thermal conductivity, ...).

2.3. Matrix

Check gap between greater and smaller term of diagonal.

2.4. Pivots

Check null or negative pivots.

Examples : Due to negative Young modulus, thickness, areas or inertia, Poisson ration greater than $\frac{1}{2} \rightarrow$ error.

2.5. Resultants and reactions, structure dimensions

Check structure dimensions : length (element rods, beams), surface (shells, element planes...), volume, mass, gravity centre.

2.6. Work space and disk space

2.6.1. Work space

ESTIMATED WORKSPACE SIZES REQUIRED BY THIS PROBLEM

PROCESSING OF LOADS	3918	WORDS
MATRIX CONDENSATION	7225	
BACK SUBSTITUTION	13764	
PRINTOUT OF RESULTS	1810	

Greater value is 13764 which is very smaller than SAM_ZONE value (1000000).

A word is written in 8 octets, so 1000000 are 8 Mo.

-vi samrc.ini

SAM_ZONE 2000000.

2.6.2. Disk space

INDICATION ABOUT DISK SPACE STORAGE REQUIREMENTS

UNIT	FILE	NUMBER OF 1024-BYTES BLOCKS
18	/disk1/user/nom_as.u18	63
1	/disk1/user/nom_as.w01	3
3	/disk1/user/nom_as.w03	17
4	/disk1/user/nom.u04	95
8	/disk1/user/nom_as.w08	16
9	/disk1/user/nom.u09	2
11	/disk1/user/nom.u11	18
13	/disk1/user/nom.u13	4
14	/disk1/user/nom_as.w14	3
52	/disk1/user/nom.u52	72

SUMMARY OF DISK SPACE USAGE:

DISK	NUMBER OF 1024- BYTES BLOCKS		
	TOTAL	FREE	ALLOCATED BY SAMCEF
/disk1	8273920	2402784	> 293 OK

3. Graphical Post-processing

3.1. Post-processing files

- Model constituting results support: *file.sdb*,
- Results files : *file_nn.des*, *file_nn.fac*

nn corresponds to initial of executed module : **mt** for SAMCEF Thermal, **as** for ASEF module, **dy** for Dynam, ...

The files results can be formatted with “copie” software.

3.2. Post-processing running

To run post-processing, user can choose between:

- Dialogue box : Add Modules/Baconpost/RUN
- Keyboard command : Samcef bp nom n 1
- Keyboard command : Samcef ba nom n 1

3.2.1. Run by Bacon Post : **samcef bp name n 1**

Question : «Name of module? » **as**

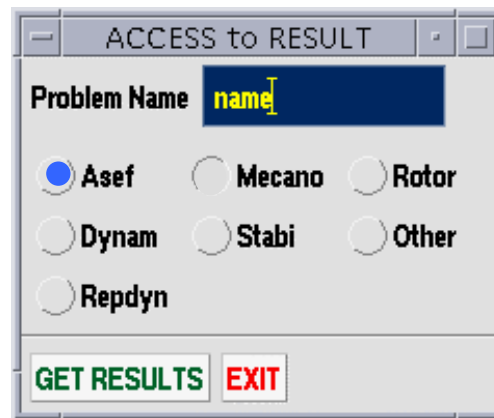
Menu Mode	Keyboard Command
Access to data base file : .sdb	
/File/Open File Name : file_name	.DOC DB « file_name»

3.2.2. Run through Bacon : **samcef ba name n 1**

3.2.2.1. Data base : .sdb

Menu Mode	Keyboard Command
Access to data base file : .sdb	
/File/Open File Name : file_name	.DOC DB « file_name»

3.2.2.2. Nodes and elements : .fac, .des



	<i>Access to results from ASEF</i>
ASSIGN FAC "name" UNITE 22	

In same session, it is possible to post-process 2 different models :

```
ASSI FAC « file_name1_nn » UNITE 20
ASSI FAC « file_name2_nn » UNITE 22
.DES UNIT 20                      (post-processing of model 1)
...
.DES UNIT 22                      (post-processing of model 2)
```


3.3. Available results

3.3.1. Results type by support

- By nodes
 - Scalar : Temperature
 - Vector : Displacement, speed
- By elements
 - Scalar : Mean equivalent stress
 - Vector : Thermal flux
 - Tensor : mean stress, mean strain
- By node/by element
 - Scalar : Extrapolated equivalent stress
 - Tensor : Extrapolated stress, extrapolated strain

3.3.2. Result Codes

Results are stored in a dictionary file (code);

Convention for code numbering

- Nodal results (119 < 271)
 - Displacements
 - Reactions
- Element results
 - 1xxx Results by node by element
 - 3xxx Mean results by element
 - y3xx Scalar values
 - y4xx Tensorial values
 - y5xx Vectorial values

Example 1411 3d stress tensor (volume)
 1431 2d stress tensor (shell)

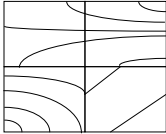
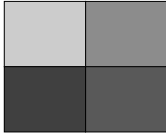
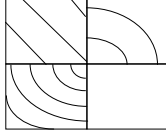
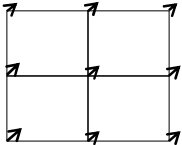
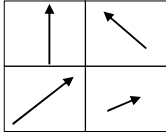
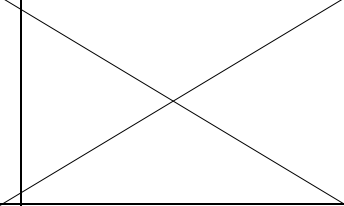
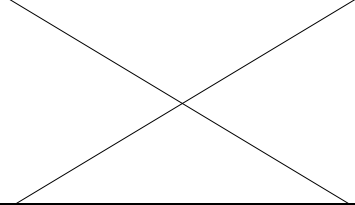
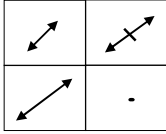

3.3.3. References

Convention for reference numbering

- To load a result:

.DES CODE xxx REF r n			
r: reference			
4	Load case	8	Time step
6	Vibration mode	9	Rigid body mode
7	Buckling mode		

	VALUE/ NODE	VALUE/ ELEMENT	VALUE/ NODE/ELEMENT
SCALAR	<ul style="list-style-type: none"> Temperature Component of displacement 	<ul style="list-style-type: none"> Von Mises 310 	<ul style="list-style-type: none"> Extrapolated Von Mises Extrapolated tensor component
VECTOR	<ul style="list-style-type: none"> Displacement Speed Acceleration 	-	-
TENSOR	-	<ul style="list-style-type: none"> Mean stress tensor Mean strain tensor Upper skin extrapolated stress tensor Lower skin extrapolated stress tensor 	<ul style="list-style-type: none"> Extrapolated stress tensor Extrapolated strain tensor Upper skin extrapolated stress tensor Lower skin extrapolated stress tensor

	Value/Node	Value/Element	Value/Node/Element
Scalar			
Vector			
Tensor			

4. Results codes for stresses, moments

Code format is constituted of 4 figures :

- code 1*** : value per node and per element
- code 3*** : mean by element
- code 9*** : time function result (constant by element)

- code *3** : scalar
- code *4** : tensor
- code *5** : vector

Last figures depend on physical quantity (for example : 1320, 3320 and 9320 are relative to equivalent plastic strain)

Default storage made by ASEF module

Elements	Tensors M,S,I	Efforts and moments	Normal stress	Strain
Volumes	*411	*411		
Shells	*431 *435 *436	*437 (effort) *438 (moment)		*445 *446
Beams		*439	*440	
Rods		*439	*440	

5. Results printing in *.res .SAI IMPRESS

5.1. Nodes results printing

Displacement, residues, forces printing, ...

Case MENU	Keyboard Command
Pre-processing/Exec params/ Node / Node/Impression/ Displacement / Point/ Click point 50	.SAI IMPRESS POINT 50 <i>Other choice: Node, Line, Group</i>

5.2. Element results printing

To print Von Mises stresses for elements with attribute 15

Case MENU	Keyboard Command
Pre-processing/Exec params/ Structur. Elements / Impression / Volumes/ Stress/ Von Mises Stress / Attribute/ Creation / Attribute Number : 15	.SAI IMPRESS ATTR 15 STYPE 1310 <i>Other choice: Element, Group</i>

5.3. Element Results on the whole structure

To print equivalent Von Mises stress for all the elements.

Case MENU	Commande CLAVIER
/Pre-Processing/Exec Params /Structure/Impression/ code number : 1310 Creation	.SAI IMPRESS STRUCTURE STYPE 1*** or 3***

6. Storage for graphical post-processing .SAI ARCHIVE

Results Storage in file .u18

6.1. Storage of nodal results on a structure part

Case MENU	Keyboard Command
Pre-processing/Exec params/ Node / Node/Storage/ Von Mises/ Node / Creation/ Click on node 3 / Accept	.SAI ARCHIV NOEUD 3 STYPE 1310 Other choice : Node, Point, Line, Group

6.2. Storage of element results on a structure part

Case MENU	Keyboard Command
Pre-processing/Exec params/ Structur. Elements / Archive /Volumes / Stress /Von Mises Stress/ Group /creation/ Click on group 12 in the box /OK/Accept/Exit	.SAI ARCHIV GROUPE 12 STYPE 3310

6.3. Storage of element results on the whole structure

To store or to des-activate storage (if STYPE <0) in the .u18 unit, stresses to be post-processed with **.DES** in order to be drawn on the structure.

Case MENU	Keyboard Command
/ Pre-processing /Exec Params/Structure/Storage/ code number : 1310 Creation	.SAI ARCHIV STRUCTURE STYPE 1*** ou 3*** <i>If -1310 is introduced, code 1310 will not be stored.</i>

Remarks :

If the storage has been omitted in the first ASEF computation, it is possible to recover omitted result without running ASEF but only FAC module.

Example :

Code 1310 in a fist ASEF computation is not requested. Database is called toto.sdb. The data file test_as.u18 contains all the results at Gauss Points.

Run BACON : **samcef ba test n 1**

Recover model toto : bacon>.DOC DB « toto.sdb »

Add missing command : .SAI ARCHIVE STRUC STYPE 1310

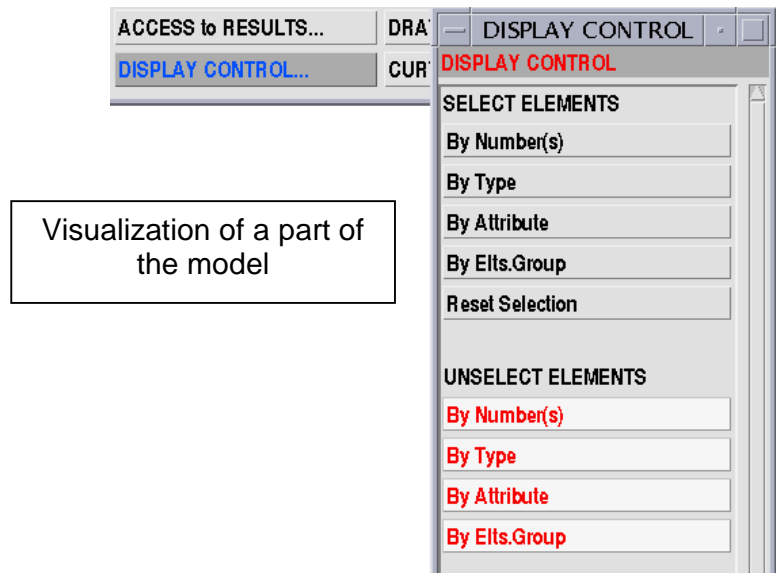
Create test.sam and test.sdb file : **.FIN** and after **.STOP**

Run *FAC* : **samcef fa test n 2** → Finally, test_as.fac and test_as.des files contain code 1310.

7. Access to results

7.1. Selection

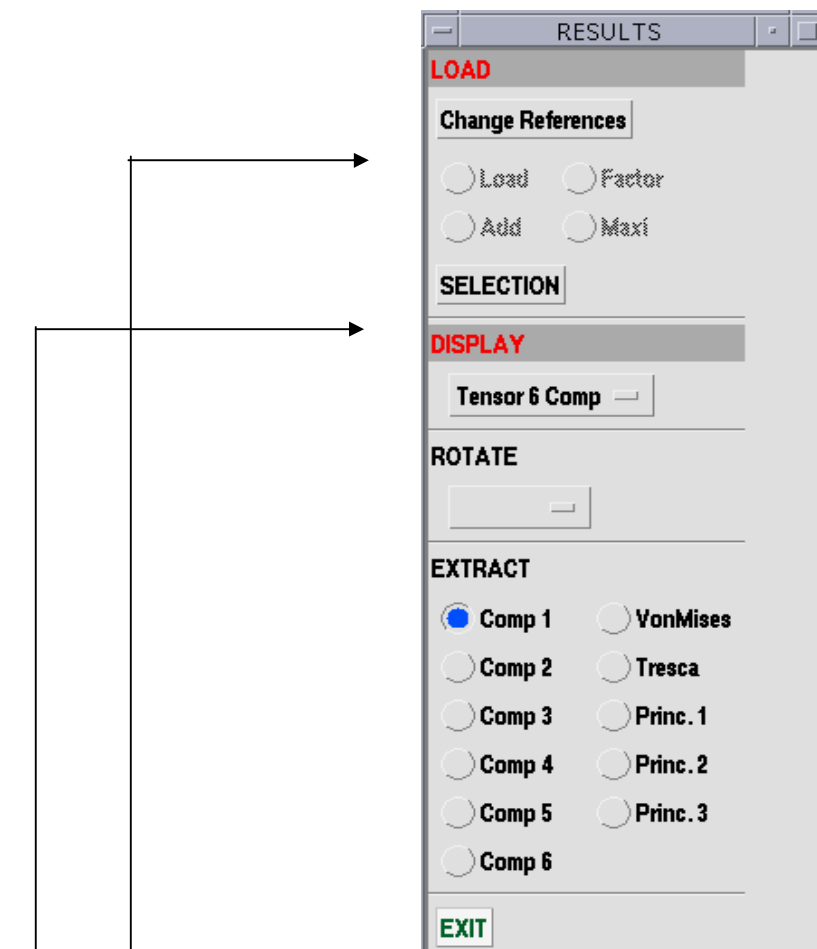
7.1.1. Selection of the mesh to post-process



The command .DES is used to select a part of the model.

	<i>Select element by numbers</i>
.DES MAILLES I J K	
	<i>Select elements through attribute</i>
.DES ATTRIBUTE ...	
	<i>Group selection</i>
.DES GROUP "name"	
	<i>Topologic type selection</i>
.DES MAILLES TRIANGLE .DES MAILLES BEAM .DES MAILLES VOLUME .DES MAILLES ROD .DES MAILLES RESSORT	
	<i>Remove elements</i>
.DES SUPPRIME i j k .DES SUPPRIME GROUPDES SUPPRIME BEAM	
	<i>Select element with a box</i>
GRAP COUPE ZI zi ZS zs XI xi YI yi XS xs YS ys	
	<i>Select elements with attached nodes</i>
.DES NODES i j k	
	<i>Back to all Attributes element /ALL</i>
.DES ATTRIBUTE .DES MAILLES	

7.1.2. Selection of the results.



Convention for reference numbering

➤ To load a result:

.DES CODE xxx REF r n

r: reference

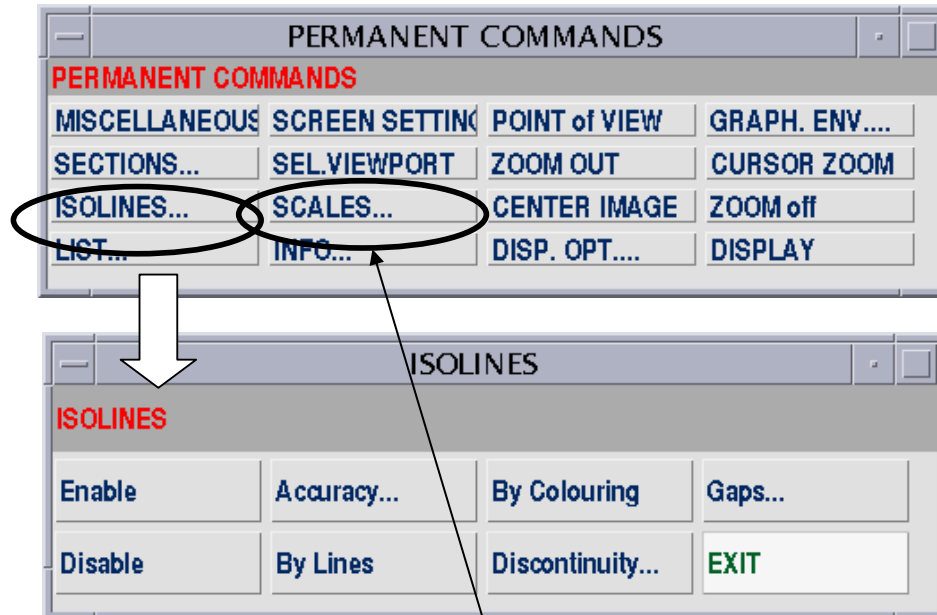
4	Load case	8	Time step
6	Vibration mode	9	Rigid body mode
7	Buckling mode		

		<i>Load case choice and then result selection</i>
CODE	REFE	
		<i>Result extreme values list</i>
LIST	VMIN VMAX	
		<i>Sorted list of 15 values by decreasing order (TRI 1)</i>
LIST	15 TRI 1	
		<i>Listing file (Permanent Command./List/Listing File)</i>
MODE	TRACE "name"	
MODE	TRACE 0	
		<i>List of reactions</i>
.DES	CODE 221	
LIST	REACTION	

7.2. Display of results

7.2.1. Scalars

Linked to nodes: Isovalues
 Linked to nodes in its element Discontinuous Isovalues
 Linked to elements Uniform color in element



<i>Iso-values curves quality drawing (Enable/disable + accuracy)</i>	
ISO n (n = 1 to 6, suppressed by ISO 0)	
	<i>By Node/Element results (discontinuity)</i>
DISC 1	
	<i>Coloring or not space between lines</i>
PEINT 0	
	<i>Modifying isovalues scale graduation</i>
VMIN CURSOR	
VMIN .4 VMAX 2 PAS .1	

Parameter ISO : 1 smoothening -> non uniform color by element
 0 mean value for element (3***)
 Parameter DISCO 1 gaps of values through element limits are displayed.
 0 mean value of extrapolated values (1***)

7.2.2. Vectors

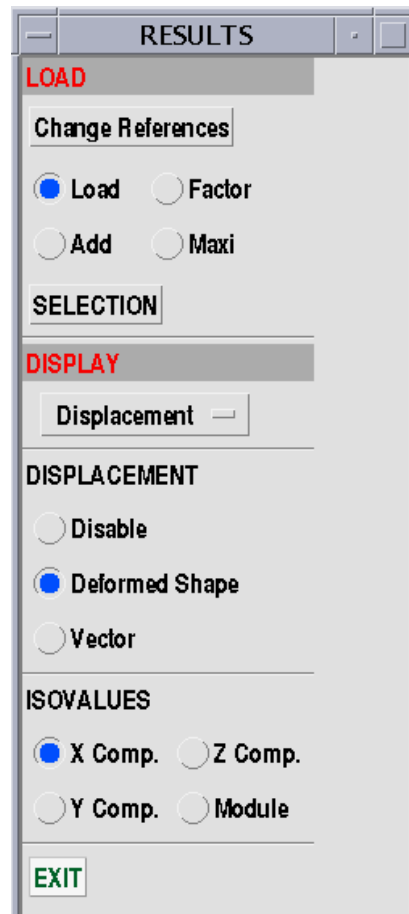
At nodes: (Speeds, rotations,...) Arrows at nodes.
 At elements: (Thermal Flux) Arrows at element center.

8. Displacements

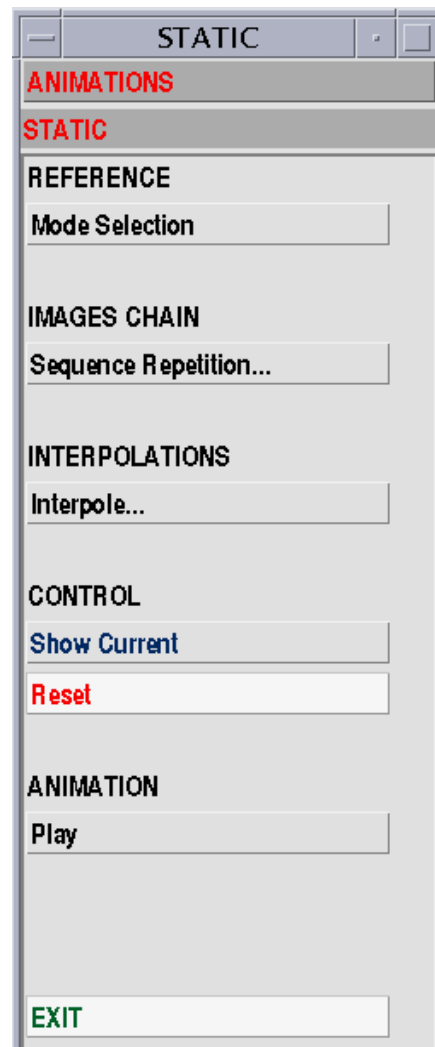
8.1. Deformed shape

Maxi Displacement = 5% of structure size is set by default to allow users to see the deflection.

8.2. Manipulations



<i>Deformed shape scale 1 = real deformation</i>	
DEFO 1	
<i>Representation in vectors</i>	
VECT DEPL	
<i>Representation in scalars</i>	
COMP 1 DEPL	
MODU DEPL	



		<i>Animation</i>
ANIM VI		

9. Stresses

The screenshot shows a software interface titled "RESULTS". It contains several sections for configuring stress results:

- LOAD**: A section header.
- Change References**: A button.
- Four radio buttons: ☐ Load, ☐ Factor, ☐ Add, and ☐ Maxi.
- SELECTION**: A section header.
- DISPLAY**: A section header.
- A dropdown menu showing "Tensor 6 Comp".
- ROTATE**: A section header.
- A dropdown menu.
- EXTRACT**: A section header.
- Two columns of radio buttons:
 - Left column: ☒ Comp 1, ☐ Comp 2, ☐ Comp 3, ☐ Comp 4, ☐ Comp 5, ☐ Comp 6.
 - Right column: ☐ VonMises, ☐ Tresca, ☐ Princ. 1, ☐ Princ. 2, ☐ Princ. 3.
- EXIT**: A green button at the bottom.

9.1. Mean stresses

- One value for each element obtained with Gauss points values ;
- Stored as tensors or scalars. Codes 3xxx (Example code 3411)

9.2. Extrapolated stresses

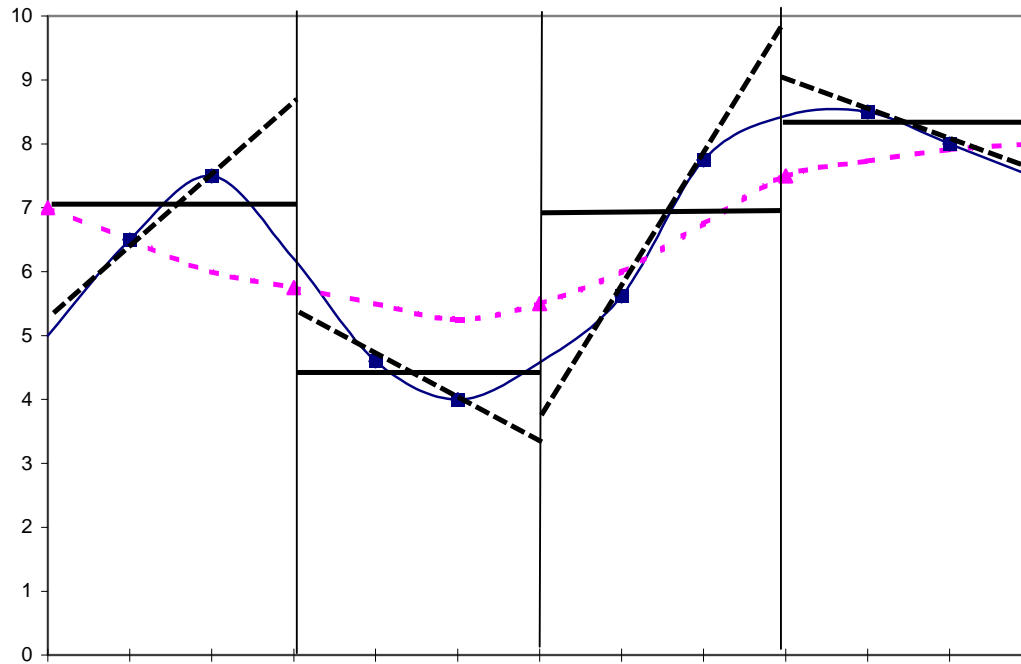
- One value for each node in an element, obtained from extrapolated Gauss points values ;
- Stored as tensors. Codes 1xxx (Example code 1411)





9.3. Tensors and scalars

<i>Beams values</i>	
CODE 1439	
REDU i (i=1 to 6 for N,Ty,Tz,Mtorsion,Mfy,Mfz)	
<i>Stress tensors</i>	
CODE 3411 COMP i TENSOR	
CODE 3411 COMP i TENSOR PRINC ;VISUALISE	
CODE 1411 VONMISES ;VISUALISE	
<i>Permanent Commands / ISOLINES /Gaps</i>	
ECART 1 (Vmin-Vmax)	
ECART 2 (Vmaxnode*(Vmax-Vmin)node/ Vmaxstructure*(Vmax-Vmin)Structure)	
ECART 3 (Vmaxnode)	

- For shell elements, tensors and their components are defined in local axes
- ECART is not valid value at boundaries of different materials.
- Tensor 6 components: σ_x , σ_y , σ_z , τ_{xy} , τ_{yz} , τ_{zx} . (i=1 to 6).
- Tensor 3 components: σ_x , σ_y , τ_{xy} . (i=1,2,4).
- Principal stresses tensor 6 components: σ_1 , σ_2 , σ_3 , Pressure = - ($\sigma_1 + \sigma_2 + \sigma_3$)/3.
Numbered in order i = 1,2,3,5.
- Principal stresses 3 components : σ_1 , σ_2 , τ_{max} , Pression = - ($\sigma_1 + \sigma_2$)/3.
Numbered in order i = 1,2,4,5.

9.3.1. Mean Stresses, extrapolated, smoothened, ...



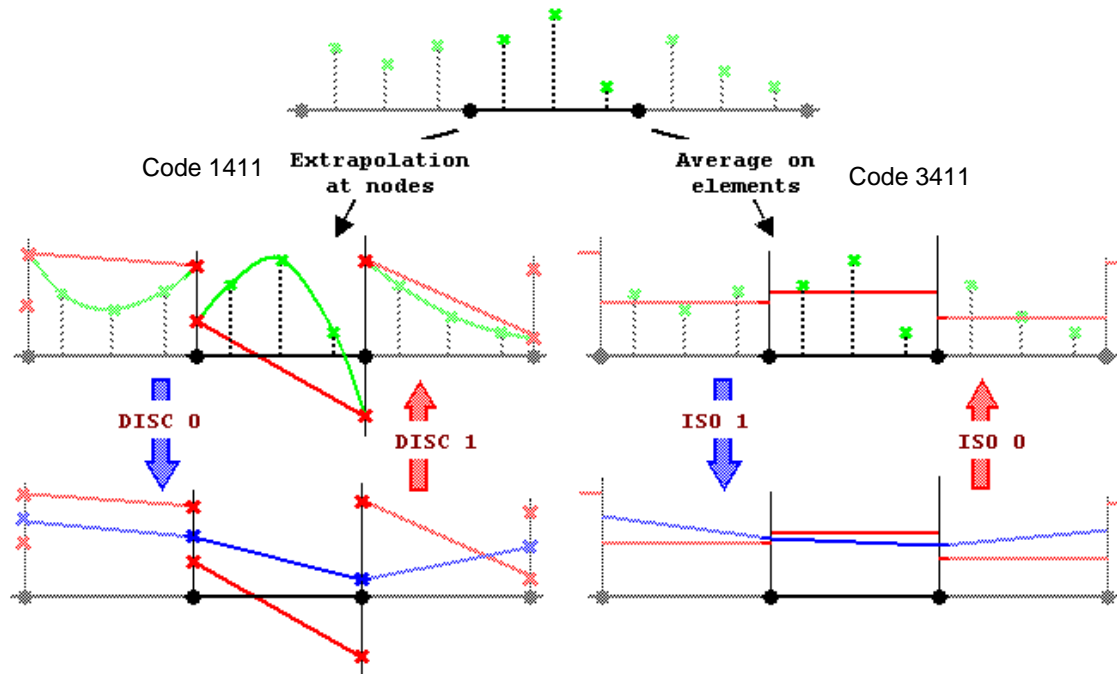
-  Gauss Points Stresses (Store in the u18 file)
-  Mean Stress by element (mean of stress at Gauss points) Code 3411
-  Extrapolated stress by element (projection of Gauss points stresses, at nodes for each element) Code 1411
-  Smoothened mean stress (best curve between points corresponding to here-above mean stresses)

9.3.2. **DISCO** and **ISO** Parameters

Two parameters : DISCO and ISO

DISCO : To smooth extrapolated element values. Assumes the continuity of the nodal values.

ISO : To transform element average values in nodal values. Assumes the continuity of the nodal values



DISCO 0 : Average of the nodal values
DISCO 1 : No continuity – Default

ISO 1 : Average of the nodal value
ISO 0 : No continuity - Default

9.3.3. Example: Plane stresses (.HYP MEMBRANE BIDIM)

Except for basics results (1411 and 163), ASEF do not store the other results. If you want to post process these results, you have to add the command :

.SAI ARCHIVE STRUCT STYPE 1412 1494 1498 3310 1310 3411

<i>Mean VonMises : each element is painted with an unique colour</i>	
CODE 3310	
<i>Von Mises stresses computed at Gauss points and extrapolated at nodes</i>	
CODE 1310	
<i>Elastic limit Criterion (Stress limit = XT entered value in .MAT</i>	
CODE 1494	
<i>Strain limit criterion tensor (Strain = DT entered value in .MAT)</i>	
CODE 1498	
<i>Stresses tensor extrapolated to nodes from Gauss points values: σ_x, σ_y, τ_{xy}.</i>	
CODE 1411 VONMISES	
<i>Mean stresses tensor at element computed from Gauss points(We obtained the code 3310)</i>	
CODE 3411 VONMISES ;VISUALISE	
<i>Domain by domain smoothened stresses tensor.</i>	
CODE 1412 VONMISES ;VISUALISE	
<i>Other tensor component choices</i>	
CODE xxxxx COMP i	
CODE xxxxx COMP i TENSOR PRINC	
CODE xxxxx TRESCA	

9.3.4. The errors estimators

This error estimator is activated, in the **FAC** program by the [.ALGO ERRC 1](#) command. Smoothed stresses can be visualized in post processing (code **1412** in command

.DES). Two measures of the error are also accessible:

an **dimensionless error** calculated on each element (code **3102** of command **.DES**):

a **relative stress error** evaluated on each element (code **3103** of command **.DES**): (average error on stress)

optimal size for the elements to obtain a predefined error (code **3104** of command **.DES**).

The global relative error in the energetic norm (global value of code **3103**) is also printed on the drawing of codes **1412**, **3102**, **3103** and **3104**.

9.3.5. Gauss points values

It is possible to dispose of stresses calculated at Gauss points by using **POSTFAC** module. This module reads *_as.u18 datafile.

samcef po <nom-de-fichier> n 1

Identifier of the last module : as

.TERM

.FAC 18

.STR NOCAS ICODE IU33 *see here-above parameter signification*

.<Sélection d'éléments, Return = tous>

-> LISTING OF STRESSES ELEMENT BY ELEMENT

=====

COMMAND OPTIONS:

NOCAS= 0 (loadcase number)

ICODE= 0 (Code to be treated, 0 = All the codes)

IU33 = 0 (unit for interlam. stresses)

<ENTER LIST OF ELEMENTS TO BE SELECTED>

ELEMENT= 1 PLY= 1

Code 1411 (record 4)

GP= 1	-5.934E+05	-1.696E+06	-4.309E+06	3.930E+05	-1.481E+06	-2.934E+05
GP= 2	1.197E+05	1.994E+05	-3.094E+05	-1.053E+05	-4.484E+05	7.863E+04
GP= 3	5.592E+05	8.275E+05	4.309E+06	3.930E+05	-1.674E+06	2.433E+05
GP= 4	-1.172E+05	-1.209E+06	3.094E+05	-1.053E+05	-3.969E+05	-6.520E+04
GP= 5	-5.934E+05	-1.696E+06	-4.309E+06	-3.930E+05	-1.481E+06	2.934E+05
GP= 6	1.197E+05	1.994E+05	-3.094E+05	1.053E+05	-4.484E+05	-7.863E+04
GP= 7	5.592E+05	8.275E+05	4.309E+06	-3.930E+05	-1.674E+06	-2.433E+05
GP= 8	-1.172E+05	-1.209E+06	3.094E+05	1.053E+05	-3.969E+05	6.520E+04

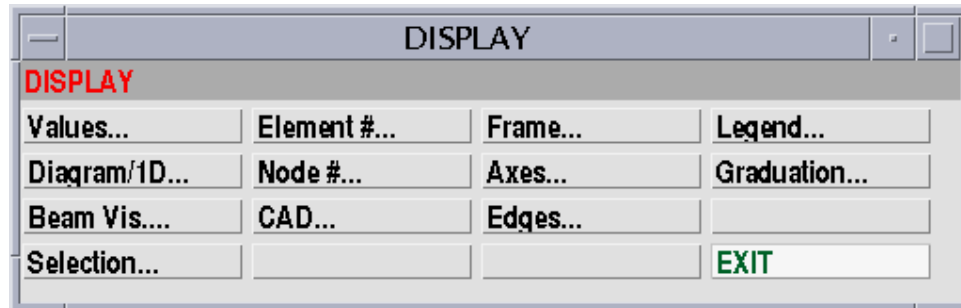
Code 1310 (record 4)

GP= 1	4.270E+06
GP= 2	9.380E+05
GP= 3	4.709E+06
GP= 4	1.536E+06
GP= 5	4.270E+06
GP= 6	9.380E+05
GP= 7	4.709E+06
GP= 8	1.536E+06

.STOP

9.4. Display, combination of load cases

9.4.1. Display Options



	<i>No display of comments</i>
GRAP LEGENDE 0	
	<i>No display of frame</i>
GRAP CADRE 0	
	<i>No display of isovalues scale</i>
GRAP GRADUATION 0	
	<i>Values displayed on nodes or elements</i>
AFFICHAGE 1	
	<i>Diagram activated on 1-D elements</i>
V1D	
	<i>No display of diagram on 1-D elements</i>
VID 0	
	<i>Display of the profiles for beams (VP 1 = equivalent rectangular section)</i>
VP 2	

9.4.2. Graphical Environment



<i>Characters Size (1 large size to 4 small size)</i>	
GRAP TCA 1	
<i>Characters colors</i>	
GRAP CGA i	
<i>Line style (Dotted line)</i>	
GRAP GL 1 (0,1 or 2)	
<i>Colors Palet</i>	
PALET ROUGE	
PALET ISO	
PALET 2 (Blue to red)	
PALET 3 (Red to blue)	
<i>Element Color according to attribute number(or l= color number)</i>	
GRAP CP 0	

9.4.3. Combining results

9.4.3.1. Load cases combination

<i>Displacement obtained 2 x Load case 1 + 3 x Load case 2</i>
.DES CODE 163 REFE 4 1 FACT 2 CODE 163 REFE 4 2 FACT 3 ADDITION MODU DEPLA ;VI

9.4.3.2. Combining results

<i>Numerical relation between stresses σ_x and σ_y</i>
.DES CODE 1411 COMPONENT 1 MEMOIRE 1 COMPONENT 2 MEMOIRE 2 OPERATION "SQRT(\$1*\$2+\$2*\$2+((\$1-\$2)*(\$1-\$2))/2)"

10. Graphical output

To send the content of the screen to the printer you have to :

1. Define the printer queue : **setenv SAM_PLOTQUEUE**NAME <>
2. Activate the picking inside BACON : **PICK ACTIVE**
3. Display and activate the command : **PLOT PRINT**

11. Comments or title introduction

Command **Title** or case **Title** in *preprocessing menu*.

Exercises :

- Post process the results on exercise 7, 8, 9, 11 and 13:
- Displacements, deformed shape;
- Display values on nodes, on elements;
- Display stresses tensors, von mises stresses
- Modify graduation scales,
- Check validity of stresses using gaps (ECART parameter)