ZZZZ110 - Validation of the command PROJ_CHAMP/ELEM (in 2D and telegraphic)

Summarized:

This benchmark makes it possible to validate command PROJ_CHAMP/ELEM in the following cases:

Projection of a field of temperature (modelizations A and B):

- Projection of a mesh $2D$ on another mesh $2D$
- Projection of a mesh $2D$ on a telegraphic mesh $1D$
- Projection of a telegraphic $1D$ mesh on a mesh $2D$
- Projection of a mesh $2D\ axis$ on a solid $3D$

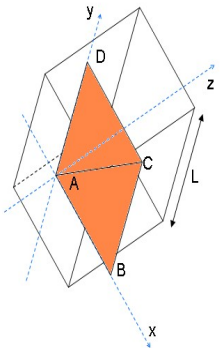
Projection of a stress field (modelizations A and B):

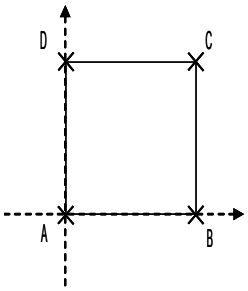
- Projection of a mesh $2D\ axis$ on a solid $3D$
- Projection of a mesh $3D$ on a solid $3D$

1 Problem of reference

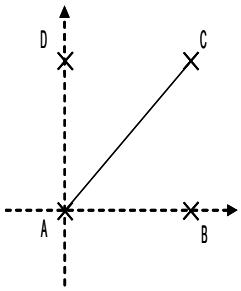
1.1 Modelization A

1.1.1 Geometry

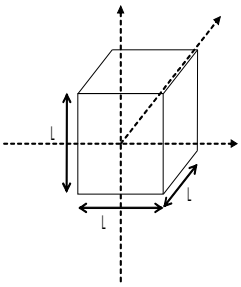




Carre1/carre2



AC



cube1

Coordinated of the points (m) :

$A:(0.,0.)$
$B:(1.,0.)$
$C:(0.,0.)$
$D:(0.,1.)$

Geometry of the cube:

Center: $(0.,0.,-0.5)$
Side: $L=1$

Mesh group:

$carre1$ surface A,B,C,D
$carre2$ surface A,B,C,D
AC segment AC
$cube1$ Properties

1.1.2 volume of the material

Without object

1.1.3 Boundary conditions and loadings

Without Reference solution

1.2 object

1.2.1 Method of calculating

Computation of the reference for the field of temperature

the field which one projects of a model on the other is an analytical field of temperature whose evolution is the following one:

$$T = 3. + X + Y$$

The reference solution is identical to the analytical field project.

Computation of the reference for the field of stress

the purpose is to carry out a change of reference, after having carried out a projection of a stress field known on a mesh towards a mesh 3D.

Transition of a cylindrical coordinate system (XOY) towards a cartesian coordinate system $3\mathrm{D}$ (XYZ).

The stress field (N/m^2) in the axisymmetric reference (axis OY) is the following:

- $SIXX = 2$
- $SIYY = y$
- $SIZZ = 1$
- $SIXY = 0.$

The stress field in the cartesian coordinate system ($3\mathrm{D}$) is obtained while carrying out:

- A projection of the tensor of the stresses evaluated on the maillagesur $2\mathrm{D}$ *axis* mesh 3D.
- Change of reference of the tensor of the stresses $[\sigma_{3\mathrm{D}}]=[P][\sigma_{cyl}][P]^T$ or $[P]$ represents the matrix of change of reference.

The numerical results are the following:

NOEUD	X	Y	Z	$SIXX$	$SIYY$	$SIZZ$
N258	-1/3	-1/3	1/6	1.5.1.5		1/6
N33	-1/3	0.	1.	2.	1.	1.
N108	0.	1/2	2/3	1.	2.	2/3.

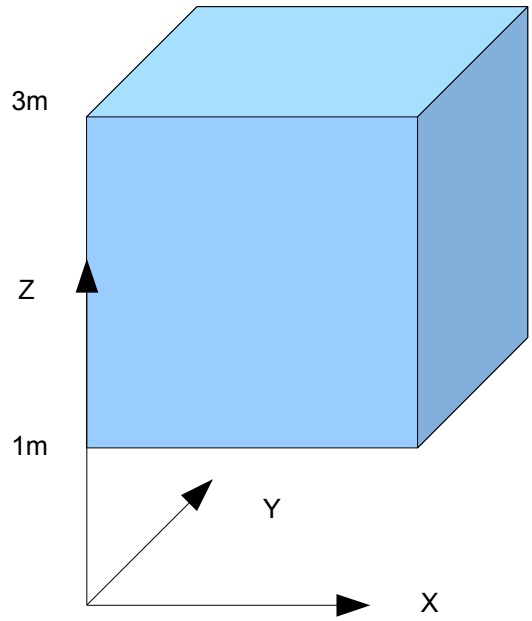
1.2.2 Results of Standard

reference of projection	Not	Standard $(°C)$	Quantity
$carre1 \rightarrow carre2$	A	$TEMP$	3
	B	$TEMP$	4
	C	$TEMP$	5
	$N364$	$TEMP$	4.66
$carre2 \rightarrow carre1$	A	$TEMP$	3
	B	$TEMP$	4
	C	$TEMP$	5
	$N355$	$TEMP$	3.75
$carre2 \rightarrow AC$	A	$TEMP$	3
	C	$TEMP$	5
	$N356$	$TEMP$	4
$AC \rightarrow carre2$	A	$TEMP$	3
	B	$TEMP$	4
$carre2 \rightarrow cube1$	C	$TEMP$	5
	$N363$	$TEMP$	3.33
	$N341$	$TEMP$	3.69371

Reference of projection	Not	Quantity (N/m^2)	Reference
$carre2 \rightarrow cube1$	$N258$	$SIXX$	1.5
	$N258$	$SIYY$	1.5
	$N258$	$SIZZ$	0.16
	$N33$	$SIXX$	2
	$N33$	$SIYY$	1
	$N33$	$SIZZ$	1
	$N108$	$SIXX$	1
	$N108$	$SIYY$	2
	$N108$	$SIZZ$	0.66

1.3 Modelization B

1.3.1 Geometry



Cube on side: $L=2$

1.3.2 Properties of the material

- $E=2\ N/m^2$
- $\nu=0.$

1.3.3 Boundary conditions and loadings

imposed Displacements

- plane $z=1\text{m}$ $DX=0.=DY=0.=DZ=0.$
- Reference solution $z=3\,m$ $DZ=2.\text{m}$

1.4 plane

1.4.1 Méthode de calcul

the Poisson's ratio is null $\nu = 0$ what gives us

$$\sigma_{xx} = \sigma_{yy} = \sigma_{xy} = \sigma_{xz} = \sigma_{yz} = 0$$

$$\sigma_{zz} = E\,\epsilon = E\frac{DZ}{L}$$

1.4.2 Results of reference

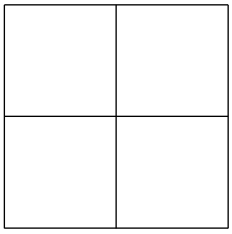
$SIZZ = 2\ N/m^2$ In any point of the cube

2 Modelization A

2.1 Characteristic

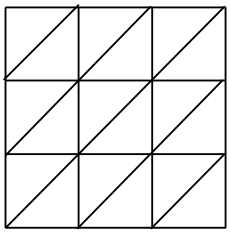
Modelization PLANE for *carre1* :

Many nodes	9			
Number of meshes	4	Are:		
			QUAD8	4



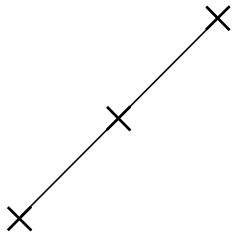
Modelization PLANE for *carre2* :

Many nodes	16			
Number of meshes	18	Are:		
			TRIA3	18



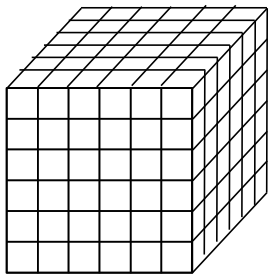
Modelization COQUE_PLAN for *AC* :

Many nodes	3			
Number of meshes	1	Are:		
			SEG3	1



Modelization 3D for *cube1* :

Many nodes	341			
Number of meshes	252	Are:		
			QUAD4	36
			HEXA8	216



2.2 Projection

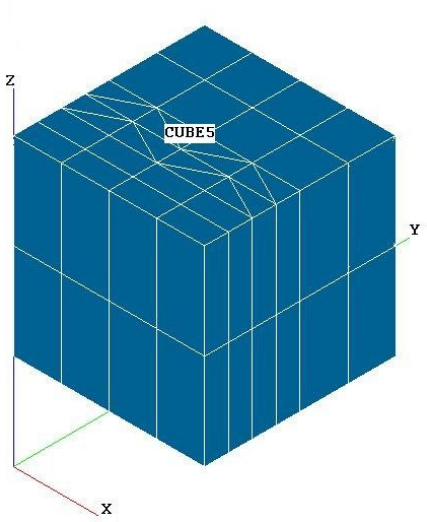
Results	Not	Quantity $(°C)$	Reference	Tolerance (%)
$carre1 \rightarrow carre2$	A	$TEMP$	3	0.1.0.1.0.1
	B	$TEMP$	4	
	C	$TEMP$	5	
	$N364$	$TEMP$	4.66	0.1.0.1.0.1
$carre2 \rightarrow carre1$	A	$TEMP$	3	
	B	$TEMP$	4	
	C	$TEMP$	5	0.1.0.1.0.1
	$N355$	$TEMP$	3.75	
$carre2 \rightarrow AC$	A	$TEMP$	3	
	C	$TEMP$	5	0.1.0.1.0.1
	$N356$	$TEMP$	4	
$AC \rightarrow carre2$	A	$TEMP$	3	
	B	$TEMP$	4	0.1.0.1.0.1
	C	$TEMP$	5	
	$N363$	$TEMP$	3.33	
$carre2 \rightarrow cube1$	$N341$	$TEMP$	3.69371	0.1

Projection	Not	Quantity (N/m^2)	Reference	Tolerance (%)
$carre2 \rightarrow cube1$	$N258$	$SIXX$	1.5	0.1.0.1.0.1
	$N258$	$SIYY$	1.5	
	$N258$	$SIZZ$	0.16	
	$N33$	$SIXX$	2	0.1.0.1.0.1
	$N33$	$SIYY$	1	
	$N33$	$SIZZ$	1	
	$N108$	$SIXX$	1	0.1.0.1.0.1
	$N108$	$SIYY$	2	
	$N108$	$SIZZ$	0.66	

3 Modelization B

3.1 Characteristic of the modelization B

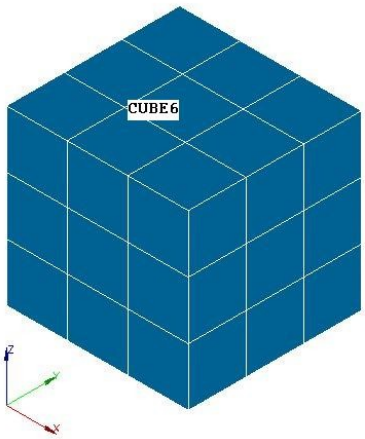
Mesh MA1:



Modelization 3D:

Many nodes	361		
Number of meshes	204	Are:	
		SEG2	38
		TRIA3	8
		QUAD4	28
		TETRA4	22
		TETRA10	22
		PENTA6	16
		PENTA15	16
		PYRAM5	14
		PYRAM13	14
		HEXA8	13
		HEXA20	13

Mesh MA2:



Modelization 3D:

Many nodes 64
Number of meshes 39 Are:

Urgent 3
SEG2 9
QUAD4 27

3.2 HEXA8

Projection	Results	Nets	Gauss point n°	Quantity (N/m^2)	Reference	Tolerance (%)
$MA1 \rightarrow MA2$	3.2	m3	1	$SIXX$	0.	0.1
		m3	1	$SIYY$	2.	1.
		M7	1	$SIXX$	0.	0.1
		M7	1	$SIYY$	2.	1.

4 Summary of the results

the got results are very satisfactory, they made it possible to check in the following situations:

The projection of a field of temperature:

- Projection of a mesh 2D on another mesh 2D
- Projection of a mesh 2D on a telegraphic mesh 1D
- Projection of a telegraphic 1D mesh on a mesh 2D
- Projection of a mesh 2D *axis* on a solid 3D

the projection of a stress field :

- Projection of a mesh 2D *axis* on a solid 3D
- Projection of a mesh 3D on a solid 3D