SSNV171 – Intercomparison of behaviors MONOCRISTAL AND POLYCRISTAL

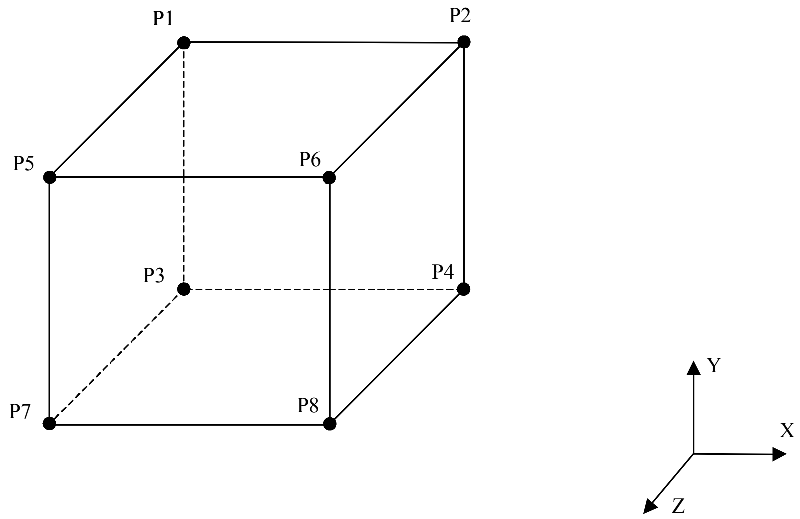
Summarized:

The purpose of this test is validating behaviors MONOCRISTAL and POLYCRISTAL by intercomparison, in a particular situation: only one grain for the MONOCRISTAL and only one phase for the POLYCRISTAL. The treated geometry is a cube (situation of material point), and crystal is not parallel to the axes of coordinates. 3 modelizations make it possible to test:

- behaviors MONOCRISTAL (clarifies), POLYCRISTAL (explicit) and MONOCRISTAL (implicit)
- behaviors MONOCRISTAL (clarifies), POLYCRISTAL (explicit) and MONOCRISTAL (implicit) for different parameters, and the post-processing of Weibull.

1 Problem of reference

1.1 Geometry



One defines an element $MA1$, containing the nodes $P1$ $P2$ $P3$ $P4$ $P5$ $P6$, $P7$ and $P8$.

1.2 Material properties

Modulus Young: $E=145200 MPa$

Poisson's ratio: $\nu=0.3$

Modelization b:
MONO_VISC1
$N=10$
$K=40$
$C=1$

MONO_ISOT1
$R_0=75.5$
$B=19.34$
$Q=9.77$
$H=0$

MONO_CINE1
$D=36.68$
the selected directional sense is the same one as that of the modelization A $(30,0,0)$.

Modelization C:
MONO_VISC1
$N=10$
$K=40$

$C=10$

MONO_ISOT1

$R_0=75.5$

$B=19.34$

$Q=9.77$

$H=0$

MONO_CINE1

$D=36.68$

WEIBULL with :

$M=24.$

VOLU_REFE=1.E-3

SIGM_REFE=2630.

In this modelization, one makes tests with Polycrystal and of the directional senses partly defined in the local coordinate system $(15.,0.,0.)$ and partly in the total reference $(15.,0.,0.)$

1.3 Boundary conditions and loadings

The node is outside the field of definition with a right profile of the EXCLU type node: $P4$	$DX=DY=0$
The node is outside the field of definition with a right profile of the EXCLU type node: $P8$	$DX=DY=DZ=0$
Nodes $P2$ and $P6$	: $DX=0$
Nodes $P1$ $P3$, $P5$ and $P7$	: $FX=35$ (- 35 in the modelization C)

the loading is increasing. $FX=0$ at time 0. and varies linearly and is worth $FX=35$ at time 1. The computation is carried out until time 1.5.

2 Reference solution

2.1 Method of calculating

This test proceeds by intercomparison: behaviors MONOCRISTAL (for only one grain) on the one hand, and POLYCRISTAL on the other hand must give the same results. The selected reference is the solution provided by MONOCRISTAL EXPLICITE.

3 Modelization B

3.1 Characteristic of the mesh

Many nodes: 8.
Modelization 3D : 1 quadratic volume element: HEXA8.
The structure contains only one grain (voluminal fraction equal to 1) and the selected directional sense is $(30,0,0)$.

3.2 Quantities tested and results

In this modelization one compares the values obtained with model POLYCRISTAL into explicit with the model MONOCRISTAL into explicit and model MONOCRISTAL into implicit. The values of reference are those obtained with the explicit MONOCRISTAL.

Results of the MONOCRISTAL into explicit (non regression) :

Identification	Reference
σ_{xx} of SIEF_ELGA	-210
ε_{xx} of EPSI_ELGA	-0.0018909
ε_{yy} of EPSI_ELGA	0.000502667
ε_{yy} of EPSP_ELGA	0.00006878285

Results of the MONOCRISTAL into implicit:

Identification	Reference
σ_{xx} of SIEF_ELGA	-210
ε_{xx} of EPSI_ELGA	-0.0018909
ε_{yy} of EPSI_ELGA	0.000502667
ε_{yy} of EPSP_ELGA	0.00006878285

Results of the POLYCRISTAL :

Identification	Reference
σ_{xx} of SIEF_ELGA	-210
ε_{xx} of EPSI_ELGA	-0.0018909
ε_{yy} of EPSI_ELGA	0.000502667
ε_{yy} of EPSP_ELGA	0.00006878285

4 Modelization C

4.1 Characteristic of the mesh

Many nodes: 8.
Modelization 3D : 1 quadratic volume element: HEXA8.

4.2 Quantities tested and results

the structure contains only one grain (voluminal fraction equal to 1) and the selected directional sense is $(30,0,0)$.

The goal of this modelization is the comparison between the values of the stress fields and strains obtained with the behavior MONOCRISTAL into implicit and explicit, and behavior POLYCRISTAL (by testing the directional senses partly well informed in the total reference under AFFE_CARA_ELEM and partly well informed in the local coordinate system under DEFI_COMPOR). One validates moreover the local variable $V43$ which is the total cumulated plastic strain of the monocrystal, and the post-processing of BEREMIN (WEIBULL).

MONOCRISTAL into explicit (non regression):

Identification	*Aster*
σ_{xx} of SIEF_ELGA	-209.99
ε_{xx} of EPSI_ELGA	1.88738425E-03
ε_{yy} of EPSI_ELGA	-5.021232E-04
ε_{yy} of EPSP_ELGA	-6.823915E-05
V_{43} of VARI_ELGA	4.813675E-04

MONOCRISTAL into implicit:

Identification	Reference
σ_{xx} of SIEF_ELGA	-209.99
ε_{xx} of EPSI_ELGA	1.88738425E-03
ε_{yy} of EPSI_ELGA	-5.021232E-04
ε_{yy} of EPSP_ELGA	-6.823915E-05
V_{43} of VARI_ELGA	4.813675E-04
SIGMA_WEIBULL	278.61

POLYCRISTAL with directional senses partly in the total reference and partly in the local coordinate system:

Identification	Reference
σ_{xx} of SIEF_ELGA	-209.99
ε_{xx} of EPSI_ELGA	1.88738425E-03
ε_{yy} of EPSI_ELGA	-5.021232E-04
ε_{yy} of EPSP_ELGA	-6.823915E-05
V_{43} of VARI_ELGA	4.813675E-04

SIGMA_WEIBULL	278.61

5 Summary of the results

the results got with implicit integration are in concord with the reference solution (explicit monocrystal). In the same way, the results got with behavior POLYCRISTAL are in conformity (in the case of one only phase) with those obtained with MONOCRISTAL.