Modeling 3D_GRAD_EPSI

Summary:

This document describes for mechanical modeling 3D_GRAD_EPSI :

- degrees of freedom carried by the finite elements which support modeling,
- the related meshs supports,
- supported materials and loadings,
- options of calculations for the elementary matrices and the post treatments accessible to the user,
- nonlinear possibilities as well as the options of the breaking process if they exist.

Modeling 3D_GRAD_EPSI (Phenomenon: MECHANICS) corresponds to finite elements whose meshs supports are voluminal. This modeling enriches the finite elements 3D traditional by mechanics by adding degrees of freedom of generalized deformations making it possible to carry out nonlocal calculations, the regularization utilizing the gradient of the deformations (from where the name of modeling), for more details to see document [R5.04.02].

1 Discretization

1.1 Degrees of freedom

Modeling	Degrees of freedom (with each node top)
3D_GRAD_EPSI	DX : following displacement X DY : following displacement Y DZ : following displacement Z $EPXX$: generalized deformation XX $EPYY$: generalized deformation YY $EPZZ$: generalized deformation ZZ $EPXY$: generalized deformation XY $EPXZ$: generalized deformation XZ $EPYZ$: generalized deformation YZ

Degrees of freedom (with each node medium)
DX : following displacement X DY : following displacement Y DZ : following displacement Z

1.2 Mesh support of the matrices of rigidity

The meshs support of the finite elements can be quadratic tetrahedrons, pyramids, prisms or hexahedrons: displacements are interpolated with an order higher than the deformations generalized. One indicates in the column interpolation of the table following the couples of interpolation (displacements/generalized deformations). The elements are isoparametric.

Modeling	Mesh	Interpolation	Remarks
3D_GRAD_EPSI	TETRA10	Quadratic/linear	
3D_GRAD_EPSI	PYRAM13	Quadratic/linear	
3D_GRAD_EPSI	PENTA15	Serendip/bi-linear	
3D_GRAD_EPSI	HEXA20	Trilinear Serendip/	

1.3 Mesh support of the loadings

Modeling does not require a boundary condition specific to the generalized deformations (boundary condition natural), one thus uses for the meshs support of the loading modeling 3D (cf [U3.14.01]).

2 Significance of the symbols

•	corresponds to a functionality available
	corresponds to a functionality which could exist but noncurrently available
Name of CAS-test	corresponds to a test implementing the functionality

3 Supported materials

DEFI_MATERIAU	3D_GRAD_EPSI
% Behaviors elastic generals	
ELAS	SSNV157A
% Behaviors mechanical nonlinear generals	
ECRO_LINE	SSNV157A
BETON_ECRO_LINE	SSNV157D
MAZARS	SSNV157E

The case of the nonlinear operators is approached further.

4 Supported loadings

The loadings are to be affected on a modeling 3D, cf [§1.3].

5 Non-linear possibilities

This modeling has direction only into non-linear.

5.1 STAT_NON_LINE

BEHAVIOR	RELATION	3D_GRAD_EPSI
	ENDO_FRAGILE	SSNV157A
	ENDO_ISOT_BETON	SSNV157D
	MAZARS	SSNV157E

BEHAVIOR	DEFORMATION	3D_GRAD_EPSI
	'SMALL'	SSNV157A

5.2 DYNA_NON_LINE

BEHAVIOR	RELATION	3D_GRAD_EPSI
	ENDO_FRAGILE	•
	ENDO_ISOT_BETON	•
	MAZARS	•

BEHAVIOR	DEFORMATION	3D_GRAD_EPSI
	'SMALL'	•

6 Postprocessing of calculation

6.1 Option CALC_CHAMP

	3D_GRAD_EPSI
ECIN_ELEM	•
ENEL_ELGA	•
ENEL_ELNO	•
EPME_ELGA	•
EPME_ELNO	•
EPOT_ELEM	•
EPSI_ELGA	•
EPSI_ELNO	•
EPMQ_ELGA	•
EPEQ_ELGA	•
SIEQ_ELGA	•
EPMQ_ELNO	•
EPEQ_ELNO	•
SIEQ_ELNO	•
SIEF_ELGA	•
SIEF_ELNO	•
VARI_ELNO	•

6.2 Option CALC_CHAM_ELEM

	3D_GRAD_EPSI
ECIN_ELEM	
EPOT_ELEM	•
ENEL_ELGA	•
ENEL_ELNO	•
EPSI_ELNO	•
EPEQ_ELGA	•
SIEQ_ELGA	•
EPEQ_ELNO	•
SIEQ_ELNO	•
SIEF_ELGA	•

6.3 Option CALC_CHAMP

	3D_GRAD_EPSI
FORC_NODA'	•
REAC_NODA'	•
ENEL_NOEU'	•
EPME_NOEU_DEPL'	•
EPSI_NOEU'	•
EPMQ_NOEU'	•
EPEQ_NOEU'	•
SIEQ_NOEU'	•
SIEF_NOEU'	•
VARI_NOEU'	•

6.4 Option POST_ELEM

	3D_GRAD_EPSI
MASS_INER	•
ENER_POT	•
ENER_CIN	
ENER_TOTALE	•
ENER_ELAS	•