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Titre : Modélisations 3D et 3D_SI mécaniques
Responsable : Xavier DESROCHES

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Clé : U3.14.01   Révision : 10062

Modelizations 3D and 3D SI Résumé

mechanics:

This document describes for mechanical modelizations 3D and 3D SI :

>   degrees of freedom carried by the finite elements which support the modelization,
>   the related meshes supports,
>   the supported loadings,
>   the nonlinear possibilities,
>   benchmarks implementing the modelization.

Modelizations 3D and 3D SI (Phénomène: MECANIQUE) correspond to finite elements whose meshes supports are voluminal.

The suffix _SI means: Under-Intégré: the integration of the terms relating to the constitutive laws is made in a reduced way (diagram of Gauss points of a nature less low than the modelization with full integration).

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1 Discretization

1.1 Degrees of freedom

Modelization	Degrees of freedom (with each top node)
3D, 3D SI	DX : displacement following X DY : displacement following Y DZ : following displacement Z

1.2 Maille support of the stiffness matrixes

Les meshes support of the finite elements can be tetrahedrons, pyramids, prisms or hexahedrons. The elements are isoparametric.

Modelization	Nets	Interpolation	Remarques
3D, 3D SI	TETRA4	Linéaire	
3D	TETRA10	Quadratique	
3D SI	TETRA10	Quadratique	reduced integration
3D, 3D SI	PYRAM5	Linéaire	
3D, 3D SI	PYRAM13	Quadratique	
3D, Bi--linear	3D SI	PENTA6	
3D, 3D SI	PENTA15	Tri-linear	
Serendip	3D	HEXA8	
3D SI	HEXA8	Tri-linear	method "assumed strain"
3D	HEXA20	Serendip	
3D SI	HEXA20	Serendip	reduced integration
3D, 3D SI	HEXA27	Tri-Quadratique	

1.3 Nets support of the Modélisation

loadings	Nets	Interpolation	Remarques
3D, 3D SI	TRIA3	Linéaire or bi--Linéaire	
	TRIA6	Quadratique or Bi--linear	
	Serendip	QUAD4	
	QUAD8	Serendip	
	QUAD9	Quadratique	

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2   Chargements supported

Les loadings available are the following:

- **"FORCE_ARETE"**

  Permet to apply linear forces, with an edge of voluminal element.

  Supported modelizations: 3D, 3D SI

- **"FORCE_FACE"**

  Permet to apply surface forces to a voluminal face of element.

  Supported modelizations: 3D, 3D SI

- **" FORCE_INTERNE "**

  Permet to apply volume forces.

  Supported modelizations: 3D, 3D SI

- **"PESANTEUR"**

  Permet to apply a loading of type gravity.

  Supported modelizations: 3D, 3D SI

- **"PRES_REP"**

  Permet to apply a pressure to a field of continuum.

  Supported modelizations: 3D , 3D SI

- **"PRE_EPSI"**

  Permet to apply a field of predeformation.

  Supported modelizations: 3D, 3D SI

- **"ROTATION"**

  Permet to apply a rotational speed and an instantaneous axis of rotation.

  Supported modelizations: 3D, 3D SI

- **"EFFE_FOND"**
  Permet to calculate and apply the basic effect on a branch of pipework subjected to an internal pressure.

  Supported modelizations: 3D, 3D SI

3   Possibilités nonlinear

3.1   Constitutive laws

Les constitutive laws (model conventional, model buildings with damage, models for the concrete and grounds,...), usable under COMP_INCR or COMP_ELAS in STAT_NON_LINE and DYNA_NON_LINE, key word RELATION, are described in details in the nonlinear document "Comportement" [U4.51.11].

3.2   Strains

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Les strains usable under COMP_INCR or COMP_ELAS in STAT_NON_LINE and DYNA_NON_LINE, key word DEFORMATION, are described in details in the nonlinear document "Comportement" [U4.51.11].

4   Examples of implementation: benchmark

- **3D**

linear Statics	FORMA01C [V7.15.100]: Quasi-static analysis of a pipework comprising an elbow subjected to a specific force, an internal pressure and a thermal transient.
Nonlinear statics	HSNV121A: [V7.15.121]: Quasi-static analysis in large deformation of a bar under thermal loading subjected to a tensile force.
Linear dynamics	SDLV100A [V2.04.100]: Seek frequencies and modes of bending associated with a slender beam of variable rectangular section (embed-free).
Nonlinear dynamics	SDNV100A [V5.03.100]: Direct transient analysis of an animated slender beam an initial velocity coming to run up against a rigid wall.

- **nonlinear**

3D SI Statics	HSNV125D: Quasi-static analysis of a volume in tension subjected to a variable temperature and a loading in shears with a viscoplastic constitutive law (case - test n°2 PHI2AS "nonlinear Comportement of the materials", 2000 - Volume XXIV - N°1).
Nonlinear dynamics	SDNV103A [V5.03.103]: Impact of an elastoplastic bar of Taylor analyzes on a rigid solid mass. The modelization contacts in account friction and a behavior elastoplasticity with large deformation.