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STAT_NON_LINE

Modelings AXIS_INCO_UPG, D_PLAN_INCO_UPG

Summary:

This document describes for modelings AXIS_INCO_UPG, D_PLAN_INCO_UPG :

- degrees of freedom carried by the finite elements which support modeling,
- the related meshs supports,
- supported loadings,
- non-linear possibilities,
- CAS-tests implementing modelings.

This modeling is based on finite elements adapted to the treatment of the incompressible problems quasi -. It is essential to carry out calculations of limiting analysis with the law of Norton-Hoff and is also useful for the studies presenting of strong plastic deformations for which the classical formulation in displacement appears insufficient (oscillation of the constraints). The formulation used is a formulation with 3 fields: displacement-pressure-swelling [R6.03.05], usable with all the behaviors written in incremental form. Modelings are supported by plane meshs of degree 2 (TRIA6 and QUAD8).

1 Discretization

1.1 Degrees of freedom

Modeling	Degrees of freedom to all the nodes	Degrees of freedom only to the nodes tops
D_PLAN _INCO_UPG	DX, DY	CLOSE (*), GONF
AXIS _INCO_UPG	DX, DY	CLOSE (*), GONF

* no kinematic condition can be imposed on the degree of freedom NEAR.

1.2 Mesh support of the matrices of rigidity

The meshs support of the finite elements can be triangles, or quadrangles (degree 2) for modelings D_PLAN_INCO_UPG and AXIS_INCO_UPG.

Modeling	Mesh	Interpolation in displacement	Interpolation in pressure and swelling
D_PLAN _INCO_UPG	TRIA6	Quadratic	Linear
	QUAD8	Quadratic	Linear
AXIS _INCO_UPG	TRIA6	Quadratic	Linear
	QUAD8	Quadratic	Linear

1.3 Mesh support of the surface loadings

Modeling	Mesh	Interpolation in displacements
D_PLAN_INCO_UPG and AXIS_INCO_UPG	SEG3	Quadratic

2 Supported loadings

Loadings available are following:

- **'CONTACT'**
  Allows to define the zones subjected to conditions of contact.
  Supported modelings: D_PLAN_INCO_UPG, AXIS_INCO_UPG
- **'FORCE_ CONTOUR '**
  Allows to apply forces linear at the edge of a 2D field.
  Supported modelings: D_PLAN_INCO_UPG, AXIS_INCO_UPG
- **' FORCE _INTERNE'**
  Allows to apply voluminal forces.
  Supported modelings: D_PLAN_INCO_UPG, AXIS_INCO_UPG
- **'GRAVITY'**
  Allows to apply a loading of type gravity.
  Supported modelings: D_PLAN_INCO_UPG, AXIS_INCO_UPG
- **'PRES_REP'**
  Allows ofto apply a pressure with a field of continuous medium.
  Supported modelings: D_PLAN_INCO_UPG, AXIS_INCO_UPG

3 Non-linear possibilities

Attention, this modeling is accessible only from STAT_NON_LINE. It cannot be used with MECA_STATIQUE or by a manual assembly.

3.1 Laws of behaviors

Allyour laws of behavior usable on meshs of continuous mediums a physical direction for these modelings has and is easily affected as from the moment when they are accessible from BEHAVIOR in STAT_NON_LINE (Cf [U4.51.11]).

A law of behavior is specific to this modeling (dedicated to the calculation of limiting load, cf [R7.07.01]):

/ ' **NORTON_HOFF** '

Supported modelings: D_PLAN_INCO_UPG, AXIS_INCO_UPG

3.2 Deformations

Deformations available, used in relations of behavior under the keyword DEFORMATION for the operators STAT_NON_LINE and DYNA_NON_LINE are (Cf [U4.51.11]):

/ ' **SMALL** '

The deformations used for the relation of behavior are the linearized deformations.

/ ' **SIMO_MIEHE** '
/ ' **GDEF_LOG** '

Allows to carry out calculations in great plastic deformations.

3.3 Method of Newton

For the resolution of the problem by the method of Newton-Raphson, the elastic matrix is not available. It is thus necessary to use under the keyword NEWTON for the operators STAT_NON_LINE and DYNA_NON_LINE (Cf [U4.51.11]):

/ **PREDICTION = 'TANGENT'**

The phase of prediction is carried out with the tangent matrix.

/ **MATRIX = 'TANGENT'**

The matrix used for the iterations total is the tangent matrix.

Note:

The formulation used leads to nonpositive matrices and the current solveurs cannot solve always well the linear systems which are associated for them. In the event of difficulty of convergence, it can thus be useful to test the other solveurs available in the code or the other methods of renumérotations (cf [U4.50.01]).

4 Examples of implementation: CAS-tests

- **AXIS_INCO_UPG**
  - Incompressible elasticity:
    SSLV130D [V3.04.130]: analysis of a hollow roll subjected to an internal pressure. The material has a Poisson's ratio equal to 0.4999.
  - Limiting example of analysis:
    SSNV146A [V6.04.146]: spherotoric bottom reserve

- **D_PLAN_INCO_UPG**
  - Elastoplastic material:
    SSNP123B [V6.03.123]: Analysis of a notched rectangular plate made up of an elastoplastic material with isotropic work hardening which is subjected to a traction at its ends.

  - Limiting example of analysis:
    SSNV124A [V6.04.146]: calculation of load limits of a rectangular plate