

Titre : SSNP302 - Élément chargé en thermique - Apparition[...] Responsable : DELMAS Josselin Date : 13/02/2013 Page : 1/6 Clé : V6.03.302 Révision : 75423c70717f

SSNP302 - Element charged in thermics -Appearance of the secondary stresses

Summary:

This test of linear quasi-static mechanics 2D consists in charging in thermics an element with plate to degree 1, by applying a field of temperature which varies linearly on the element and by fixing a side of the element.

This element being of degree 1, the total mechanical deformation will be constant in the element. The fields thermics imposing a linear deformation in the element, it will be necessary to take a dilation coefficient and a sufficiently large heat gradient to make the deformation mechanical total sensitive to the imposed thermal field.

The plate is modelled by an element plan (MECPQU4).

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1 Problem of reference

1.1 Geometry



Length a=1

1.2 Material properties

Isotropic elastic material:

$$E = 200000 Mpa$$

 $v = 0.$
 $\alpha = 1E-6/°C$

1.3 Boundary conditions and loadings

Not A :	$u_x = 0.$
	$u_{v}=0.$
On the side AD :	$u_x = 0.$
On the side BC :	$\sigma_D = 100 MPa$

Application of a field of temperature which varies linearly on the element with $Tmax = 1000 \circ C$.

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2 Reference solution

2.1 Method of calculating used for the reference solution

Analytical solution.

2.2 Results of reference

The mechanical deformation is worth:

$$\epsilon^{mec} = \epsilon - \epsilon^{th}$$
$$= \epsilon - \alpha T$$

With an element with the degree one and a diagram 2×2 of integration one will have:

$$\epsilon^{mec} = \frac{u_{xB} - u_{xA}}{a} - \alpha \left[\frac{1 + \xi}{2} T_{max} \right]$$
$$= \frac{\sigma_d}{E} + \frac{1}{2} \alpha T_{max} - \alpha \left[\frac{1 + \xi}{2} T_{max} \right]$$

The constraint in the test will be worth:

$$\sigma = E \epsilon^{mec}$$
 with $\epsilon^{mec} = 10^{-3} - \alpha \left[\frac{1 + \xi}{2} T_{max} \right]$

2.3 Notice

The thermal component of the constraint depending on the intrinsic coordinate, the solution is to consider an average temperature by element.

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3 Modeling A

3.1 Characteristics of modeling A



Modeling in plane constraints: C_PLAN

The loading and the boundary conditions are modelled by:

- DDL_IMPO (Node NO1 DX = 0DY = 0) (Node NO4 DX = 0)
- nodal forces imposed on the nodes NO2 and NO3
- temperatures imposed on the nodes

NO1 , NO4 : $T=0^{\circ}$ NO2 , NO3 : $T=1000^{\circ}$

3.2 Characteristics of the grid

Many nodes: 4 Many meshs and types: 1 $_{\text{MECPQU4}}$ with diagram of integration $2\times\!2$

3.3 Sizes tested and results

Identification	Reference
SIXX (NO1)	200
SIXX (NO4)	200
SIXX (NO2)	0
SIXX (NO3)	0

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4 Summary of the results

The results provided by Code_Aster are very satisfactory.