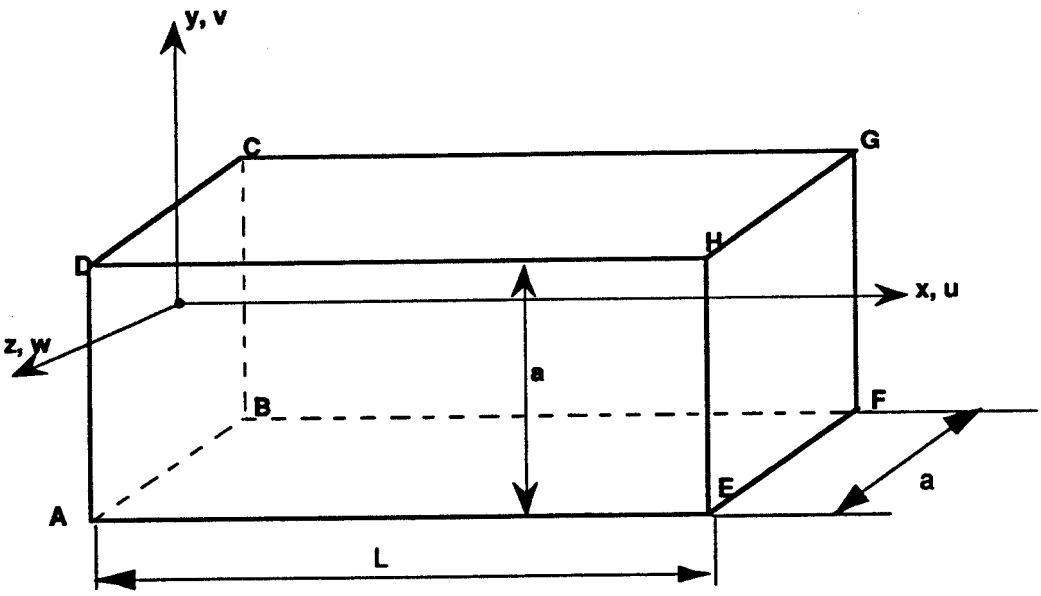
SSLV306 - Beam 3D in imposed displacements

Summary:

The purpose of the test is to validate the displacements imposed on faces (FACE_IMPO), their values being variable in space. These values are imposed at the end of a beam 3D, modelling a bending strain.

1 Problem of reference

1.1 Geometry



Length	:	$L=2\,m$
Square section, on side	:	$a=0.2\,m$
Moment of inertia	:	$I=1.333\times10^{-4}\,m^4$

1.2 Material properties

$E=2.1\times10^{11}\,Pa$
$\nu=0.3$

1.3 Boundary conditions and loadings

Embedding of the section $ABCD$
Displacement imposed on the face $EFGH$:

- constant v_o in the direction y, $v_o=0.952\times10^{-5}m$
- varying according to the position y point of the section, and being worth:
  $u_o=-y\theta_o$, $\theta_o=0.714\times10^{-5}\,radians$

1.4 Initial conditions

Without object for the static analysis.

2 Reference solution

2.1 Method of calculating used for the reference solution

The displacements imposed equivalent on a force applied at the end of resultant:

$$F = \frac{3EI}{L^3} v_o = 100N$$

θ_o represent the rotation of the section $EFGH$:

$$\theta_o = \frac{FL^2}{2EI}$$

The bending stress σ_{xx} with embedding is worth then:

$$\sigma_{xx}(ABCD) = \pm \frac{FL}{I/y}$$

2.2 Results of reference

1) Displacement v points E, F, G, H
2) Bending stresses σ_{xx} at the points A, B, C, D

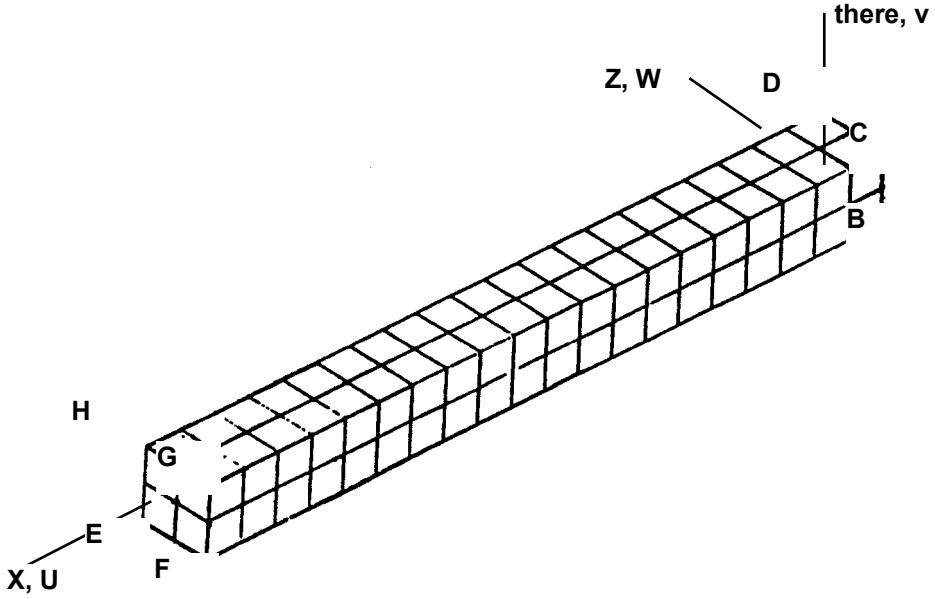
2.3 Uncertainty on the solution

Analytical solution.

3 Modeling A

3.1 Characteristics of modeling

3D, H20 meshs



Loading by displacements imposed on face $EFGH$:

DY : 0.952×10^{-5}
DX : function of y defined in 2 points: $f(0)=0$
$f(0,1)=-0.0714\mathrm{E}-5$

Cutting:

1) 20 elements according to the length
2) 2 elements according to the width and the thickness

3.2 Characteristics of the grid

Many nodes: 621
Many meshs and types: 80 HEXA20

4 Results of modeling A

4.1 Values tested

Localization	Type of value	Reference	*Aster*	% difference
Points E, F, G, H	$v(m)$	9.52 X 10^{-6}	9.52 X 10^{-6}	0
Points E, F	$u(m)$	7.14 X 10^{-7}	7.14 X 10^{-7}	0.
Points G, H	$u(m)$	–7.14 X 10^{-7}	–7.14 X 10^{-7}	0.
Points A, B	$\sigma_{xx}(Pa)$	1.5 X 10^{5}	1.64 X 10^{5}	9.5
Points C, D	$\sigma_{xx}(Pa)$	– 1.5 X 10^{5}	– 1.64 X 10^{5}	– 9.5

5 Summary of the results

The functionality “displacements imposed function” provides the expected results; the values of bending stresses are satisfactory, given that with the dealt problem is a problem of inflection.