SSLL116 - Lattice reinforced 3D

Summary:
This test relates to the study of a lattice made up of hurled beams, in linear static analysis.

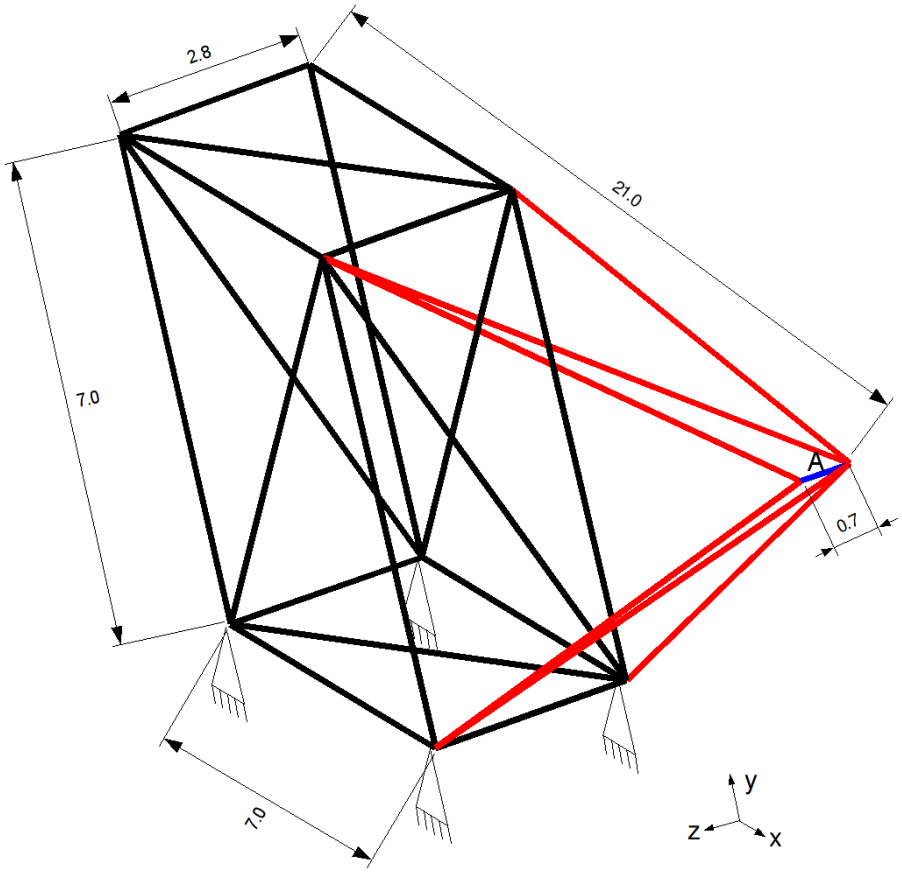
The lattice is modelled with linear elements (SEG2) and subjected to a specific loading and the effect of gravity.

There is a modeling with a first geometry, then a modeling with bars of reinforcement.

This test is an example with didactic aiming since it shows the construction of the solution by finite elements rather than to use directly MECA_STATIQUE.

1 Problem of reference

1.1 Geometry



The lattice consists of beams of sections:

- for ——, annular $R=0.05$, $ep=0.02$
- for ——, circulars $R=0.05$
- for ——, circulars $R=0.07$

The point A is in the middle of the final stem.

1.2 Material properties

Isotropic linear elastic material:

$$E=1.962\,E11\,Pa \quad ; \quad \nu=0.3$$

1.3 Boundary conditions and loadings

The base of the lattice is embedded.

Loadings

Vertical nodal force in A : $F_y=-20E6\,N$

Field of gravity **(according to x)** $g=-9.81\,m/s^2$

2 Reference solution

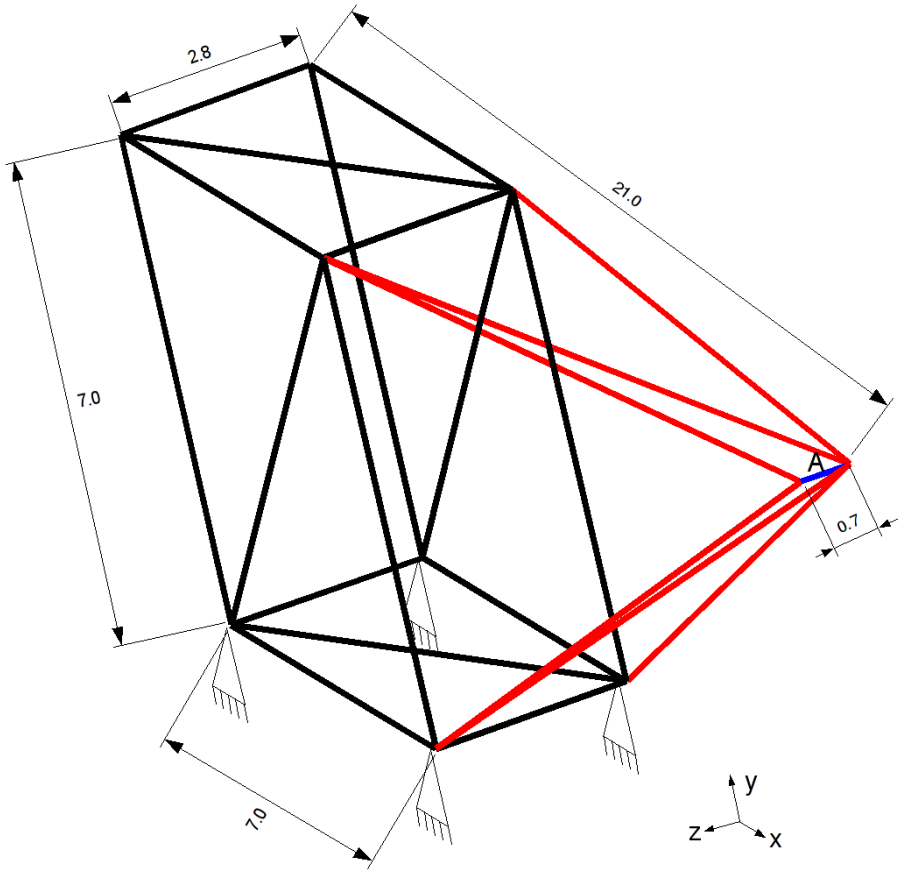
2.1 Results of reference

Displacements and rotations of the node A (DEPL).

The results calculated in this case test result from a former execution of Aster. It is a case test of nonregression.

3 Modeling A

3.1 Characteristics of modeling



- Modeling POU_D_T
- Pas de reinforcements

3.2 Characteristics of the grid

The grid is obtained by **GMSH**.
Many nodes: 247
Many meshs: 267

3.3 Sizes tested and results

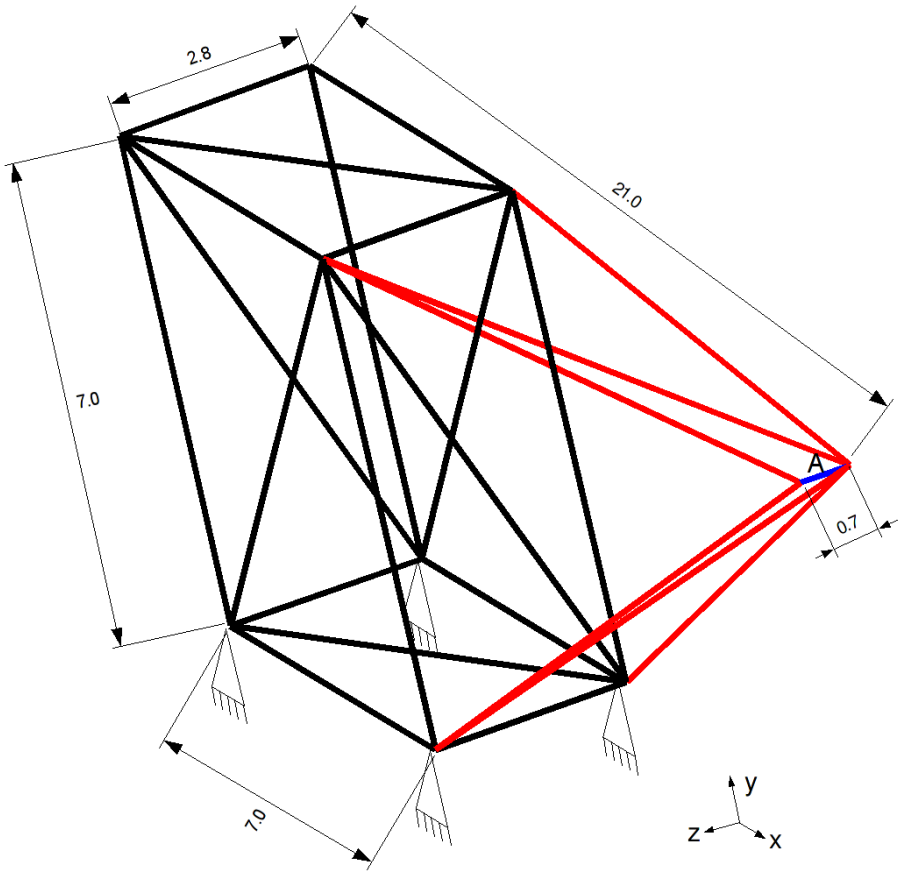
Loading	Value tested	Aster
Vertical force concentrated in A	Displacement in A Dx	7.20564E-01
	Displacement in A Dy	-2.02277
	Displacement in A Dz	-1.12417
	Rotation in A Drx	9.88004E-01
	Rotation in A Dry	1.83637E-01
	Rotation in A Drz	-1.12592E-01

3.4 Remarks

It is seen that the not-symmetry of the arrow of the lattice involves displacements according to z, although the force applied is it according to Y and X only (force of gravity)

4 Modeling B

4.1 Characteristics of modeling



- Modeling POU_D_T
- Bars of reinforcement

4.2 Characteristics of the grid

The grid is obtained by **GMSH**.
Many nodes: 265
Many meshs: 287

4.3 Sizes tested and results

Loading	Value tested	*Aster*
Vertical force concentrated in A	Displacement in A Dx	6.61627E-01
	Displacement in A Dy	−1.82145
	Displacement in A Dz	−2.6628E-01
	Rotation in A Drx	8.48048E-01
	Rotation in A Dry	1.68397E-01
	Rotation in A Drz	−9.43511E-02

4.4 Remarks

The reinforcements made it possible to decrease displacements of the arrow of the lattice.

5 Summary of the results

This example shows a way of carrying out the “didactic” calculation of manner by explicitly building the vectors and the matrices necessary for a standard calculation by finite elements.