SSNL116 - Length of cable with gas insulation

Summary:

The problem is quasi-static nonlinear in mechanics of the structures.

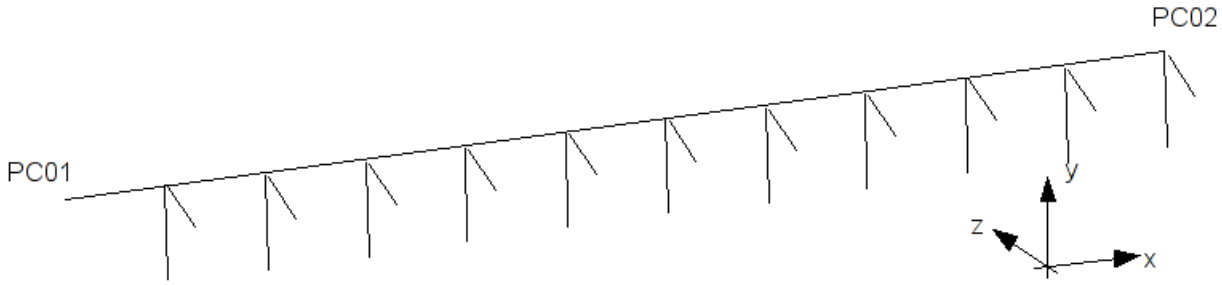
One analyzes the behavior of a length of cable with gas insulation, hidden with a low depth modelled by bars. The interaction with the ground is taken into account by elements of bar with nonlinear behavior. In the vertical direction, this behavior is asymmetrical.

Only one modeling implements this cable at gas insulation (C.I.G.), whose grid is obtained by a FORTRAN program associated with the test.

1 Problem of reference

1.1 Geometry

A section of C.I.G (correspondent to an experiment carried out on the site of the Fox farms). The cable is modelled by elements of multifibre beam of Euler. To model the behavior of the ground, with each mesh of the line, one associates 6 bars: 3 in each node of the mesh. In each node, a bar is directed in the same direction that the C.I.G, and makes it possible to take into account the axial loads of the ground on the C.I.G. A bar is directed according to the vertical, and makes it possible to take into account the action (asymmetrical) of the ground following the vertical. Third is directed in order to supplement the trihedron.



The characteristics of the sections are:

- Elements of BEAM : circular section, external Ray 0.25765, thickness 0.01
- Elements of BAR : unspecified section, of surface $A=1$ (without physical significance)

1.2 Material properties

C.I.G		
elasticity	$E=7.2\text{E}10\,Pa$ $\nu=0,3$	$\alpha=22.4\text{E}-6$
plasticity beams with work hardening	$D\_SIGM\_EPSI=0.$	$SY=75.E6$
Horizontal bars		
elasticity	$E=5000000.\text{Pa}$ $\nu=0,3$	$\alpha=0.$
Linear work hardening	$D-SIGM-EPSI=1000000\,Pa$	$SY=5000.Pa$
Vertical bars		
elasticity	$E=5000000.\text{Pa}$ $\nu=0,3$	$\alpha=0.$
Linear work hardening	$DT\_SIGM\_EPSI=1000000.$ $DC-SIGM-EPSI=1000000.$	$SY_C=10000.0$ $SY_T=5000.0000000000$

1.3 Boundary conditions and loadings

The ends (off-line to the IGC) of all the bars are blocked. The point $PC01$ is embedded. The point $PC02$ has all its blocked degrees of freedom, except DZ for which one imposes the following history of displacement:

12Instant	$DZ(m)$
0	0
1	-0,004
2	-0,004
3	0,002
4	0,002

2 Reference solution

2.1 Method of calculating used for the reference solution

Solution of nonregression.

2.2 Results of reference

Values of vertical displacement and the normal bar tension vertical with the node with $t=0.1,1.,2.6$ and $4s$.

Moment	Dz	N
0.1	– 4.0E-04	– 2000
1.	– 4.0E-03	– 12000
2.6	– 4.0E-04	5200
4.	2.0E-03	7600

2.3 Uncertainty on the solution

Solution of nonregression.

2.4 Bibliographical references

[1] J.C. MASSON, A. STROOBANT: “Study of displacements and the constraints due to the cyclic heating of a buried model of Cable with Gas Insulation” Notes EDF RETD HT-2C/99/22/A

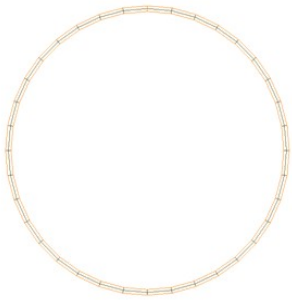
3 Modeling A

3.1 Caracteristic of modeling

Modeling: 10 elements of multifibre beam for the C.I.G, 60 elements of bar

3.2 Characteristics of the grid

- Grid of the beam: 70 meshs SEG2
- Grid of the section: 108 nodes; 72 QUAD4



3.3 Sizes tested and results

Vertical displacement Dz , at the point $PC02$

Moment	Not	Identification		Type of Reference	Reference	Tolerance
0.1	PC02	DEPL	DZ	NON-REGRESSION	−4.0E−04	0.10 %
1.0	PC02	DEPL	DZ	NON-REGRESSION	−4.0E−03	0.10 %
2.6	PC02	DEPL	DZ	NON-REGRESSION	−4.0E−04	0.10 %
4.0	PC02	DEPL	DZ	NON-REGRESSION	2.0E−03	0.10 %

Normal effort N , at the point $PC02$, in the vertical bar.

Moment	Mesh	Node	Identification		Type of Reference	Reference	Tolerance
0.1	MV01F010	PC02	EFGE_ELNO	NR	NON-REGRESSION	−2000	0.10 %
1.0	MV01F010	PC02	EFGE_ELNO	NR	NON-REGRESSION	−12000	0.10 %
2.6	MV01F010	PC02	EFGE_ELNO	NR	NON-REGRESSION	5200	0.10 %
4.0	MV01F010	PC02	EFGE_ELNO	NR	NON-REGRESSION	7600	0.10 %

Generalized efforts N , MT , MFY , MFZ , with the node NP01_006.

Moment	Mesh	Node	Identification		Type of Reference	Reference	Tolerance
0.1	MP01_005	NP01_006	EFGE_ELNO	NR	NON-REGRESSION	0.	1.0E−03
1.0	MP01_005	NP01_006	EFGE_ELNO	MT	NON-REGRESSION	0.	1.0E−03
2.6	MP01_005	NP01_006	EFGE_ELNO	MFY	NON-REGRESSION	1087.2296	0.10 %
4.0	MP01_005	NP01_006	EFGE_ELNO	MFZ	NON-REGRESSION	0.	1.0E−03

Moment	Mesh	Not	Under-point	Identification		Type of Reference	Reference	Tolerance
0.1	MP01_005	1	1	VARI_ELGA	V1	NON-REGRESSION	0.	1.E−03

3.4 Remarks

The program making it possible to build the grid as well as the data of this program are associated with the test (files ssnl116a.38 and ssnl116a.39).

4 Summary of the results

This test makes it possible to validate the behavior VMIS_ASYM_LINE on a real structure.