

SDNL101 - Range of cables subjected to electrodynamic strains

Summary:

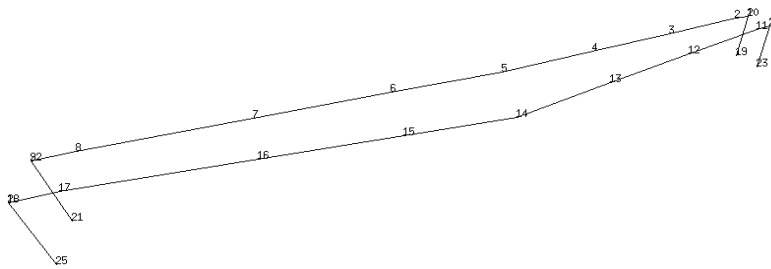
This test makes it possible to validate the operator `DEFI_FONC_ELEC` and the option `INTE_ELEC` order `AFFE_CHAR_MECA`. The structure considered consists of cables subjected to electrodynamic strains.

The results of reference result from tests carried out to the LGE on an equivalent range. This test makes it possible to validate the tool-trade `MEKELEC`, which makes it possible to calculate the behavior of stations and lines subjected to electrodynamic strains.

1 Problème de reference

1.1 Geometry

The figure represents a dry range with two phases. The frames correspond to the 4 vertical elements.



Length of the cables: $L_{ca}=154\text{ m}$

Length of the anchor chains: $L_{ch}=0,8\text{ m}$

Heights of the frames: 14 m .

Circular sections of the cables: $S_{ca}=1.71\text{ E}-03\text{ m}^2$

Circular sections of the chains: $S_{ch}=6.28\text{ E}-04\text{ m}^2$

Ray of the circular section full with the frame: $R=0.3\text{ m}$

1.2 Material properties

For the cables (modeling CABLE) :

$$E=5.4\ 10^{10}\text{ Pa}$$

$$\rho=2761\text{ kg/m}^3$$

For the chains (modeling CABLE) :

for chain CH1:

$$E=6.37\ 10^{10}\text{ Pa}$$

$$\rho=110841\text{ kg/m}^3$$

for chain CH2:

$$E=6.37\ 10^{10}\text{ Pa}$$

$$\rho=104173\text{ kg/m}^3$$

For the frame (modeling POU_D_E) :

$$E=2.1\ 10^{11}\text{ Pa}$$

$$\rho=7800\text{ kg/m}^3$$

$$\nu=0.3$$

1.3 Boundary conditions and loadings

Boundary conditions:

the points of anchoring of the frames are blocked: $DX = DY = DZ = DRX = DRY = DRZ = 0$ with the nodes N21, N25, N19, N23.

Loading:

- Gravity: $(0., 0., -9.81\text{m/s}^2)$;
- Forces of Laplace generated by the currents in the drivers.

The current is continuous. The short-circuit is two-phase it lasts $0.5 s$ (time interval $[0., 0.05 s]$).

Effective intensity of the current of short-circuit: $54559 A$.

Time-constant of the current of short-circuit: $0.120 s$

Dephasing of the current crossing the principal driver: $\phi = 1.5^\circ$

Dephasing of the current crossing the secondary driver: $\phi = 181.5^\circ$

1.4 Initial conditions

The ranges are initially at rest and the initial current is null.

2 Reference solution

2.1 Method of calculating

The reference solution is given by the calculations obtained by SAMCEF-CABLE software, them same validated by tests laboratory [bib1].

Displacements in medium of first phase (node 5):

- $DY = -1.981\ m$
- $DZ = -1.846\ m$

Displacements in medium of the second phase (node 14):

- $DY = -4.108\ m$
- $DZ = 3.229\ m$

Effort with the fixing of the first phase (node 1):

- $N = 7550\ daN$

Effort with the fixing of the second phase (node 10):

- $N = 2380\ daN$

2.2 Sizes and results of reference

Displacements and efforts in the mediums of phases and efforts to the fixing of the phases, calculated by SAMCEF-CABLE software.

2.3 Uncertainty on the solution

Comparison with test results [bib1].

2.4 Bibliographical references

- [1] M.Gaudry, notes EDF HM/72-5874, 1991. Validation of SAMCEF-CABLE software; assessment of the trial runs realized with the Fox farms.

3 Modeling A

3.1 Characteristics of modeling

The drivers are with a grid in 10 segments, of N2 with N8 and N12 with N17, to which are affected of the elements of the type `CABLE`.

The chains are with a grid in 4 segments, [N1-N2], [N8-N9], [N11-N12] and [N17-N18], to which are affected of the elements of the type `CABLE`.

The frames are with a grid in 4 segments to which are affected of the elements of the type `POU_D_E`.

3.2 Characteristics of the grid

Many nodes: 26

Many meshes 20 `SEG2`

The time of the transient is partitionné in 10 intervals on which one makes the resolution of the linear systems with different solveurs (in `STAT_NON_LINE` and `DYNA_NON_LINE`).

3.3 Sizes tested and results

Identification	Reference	% tolerance
Node 5 : Displacements (m), moment 4s	DY = -1,981 m DZ = -1,846 m	0.1 0.1
Node 14: Displacements (m), moment 4s	DY = -4,108 m DZ = 3,229 m	0.1 0.1
Node 1 : Efforts (NR), moment 2s	NR = 7550 dan	0.1
Node 10: Efforts (NR), moment 4s	NR = 2560 dan	0.1

4 Summary of the results:

The precision on displacements of the nodes mediums and the efforts on the nodes of fixing is excellent.

This test thus validates the operator `DEFI_FONC_ELEC` and the option `INTE_ELEC` order `AFFE_CHAR_MECA`.