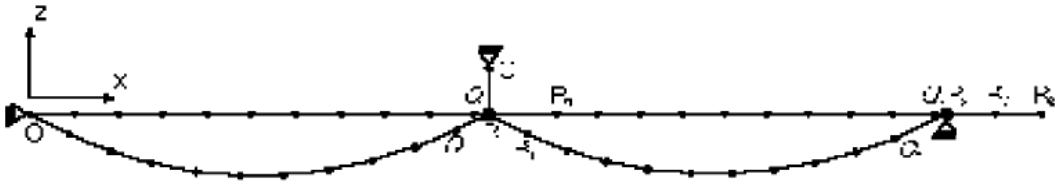
SSNL100 - Pose of a canton of line with two equal ranges

Summary:
This test simulates the operation of installation of a cable with two ranges. The cable is fixed at the one of its ends, passes on a fast pulley towards the other end and rests in its medium on a pulley placed at the bottom of a mobile suspension. One adjusts the arrow of the ranges in “giving” more or less cable to the level of the fast pulley.
The interest is to test the elements of cable and cable-pulley and their operation in the operator STAT_NON_LINE.

1 Problem of reference

1.1 Geometry



	O	P_1	P_2	R_2	C
x	0.	100.	200.	220.	100.
z	0.	0.	0.	0.	10.

Table 1.1-a : Coordinates of the points (in m)

Names and position of the nodes (medium of front range poses):
- range of left: $N6$ and $x=48.50\,m$
- range of right-hand side: $N19$ and $x=160.50\,m$

1.2 Material properties

Linear weight of the cable: $30\,N/m$
Axial rigidity of the cable (produced Young modulus by the surface of the cross-section): $5.10^7 N$

1.3 Boundary conditions and loadings

Points O , C and P_2 are fixed.
The cable, fixed in O , is pressed on two pulleys. First is attached at the lower end P_1 suspension fixed in C . Second is fixed at P_2 .
The cable is subjected to its weight and one gives him arrow by moving his right end of $10\ m$ of R_2 with R_2' .
The position of the points Q_1 , R_1 and Q_2 is not imposed, but one must make so that with the course the installation the pulley P_1 remain on the length of cable $Q_1 R_1$.

2 Reference solution

2.1 Method of calculating used for the reference solution

The arrow of reference is relative to an inextensible cable of $105\,m$ on a range of $100\,m$. It is obtained by the solution of a transcendent equation [bib2].

2.2 Results of reference

The arrow of reference is of $13.93\,m$, equalizes for each range.

2.3 Uncertainty on the solution

Semi-analytical solution.

2.4 Bibliographical references

[1] Mr. AUFAURE, “a finite element of cable-pulley”, Document R3.08.05 (1996).

[2] H. MAX IRVINE, “Cable Structures”, The MIT Close (1981).

3 Modeling A

3.1 Characteristics of modeling

10 elements of cable	MECABL2 enter O and Q_1, carried by meshs SEG2 ;
1 element	MEPOULI passing by the pulley P_1 and carried by the mesh SEG3 $Q_1 P_1 R_1$;
9 elements	MECABL2 enter R_1 and Q_2 ;
1 element	MEPOULI on $Q_2 P_2 R_2$;
1 element	MECABL2 on the suspension $P_1 C$.

3.2 Characteristics of the grid

Many nodes: 25
Many meshs and types: 20 meshs SEG2 and 2 meshs SEG3

3.3 Remarks

On the basis of a horizontal rectilinear cable in weightlessness, one applies gravity while increasing the length of the cable enters O and P_2 of $10 m$ by the displacement of R_2 in R_2' ($R_2 R_2' = 10 m$). As the not tended right cables do not have rigidity for the transverse loads, one cannot apply from the start the preceding loading case because one would lead to a singular system of equations.

Calculation is thus done in 2 stages:

- one puts the cables in prevoltage by applying a tension to the cable itself in R_2 and with the suspension in P_1 (one suggests taking tensions of $10\,000 N$).
- one makes a continuation on the preceding situation of balance by applying gravity and displacement $R_2 R_2'$. The load of gravity will be declared of type SUIV, because of elements MEPOULI the 2 parts are variable length.

3.4 Sizes tested and results

Identification	Reference
Arrow of the range of left $N6$	-1,3930E+001
Arrow of the range of right-hand side $N19$	-1,3930E+001

4 Modeling B

4.1 Characteristics of modeling

Modeling B is identical to modeling A. It is just used to validate the fact that one does not take into account the thermal loading. For that a constant temperature is imposed. The results are identical to modeling A.

5 Summary of the results

This test makes it possible to make sure that the evolutions of Code_Aster do not generate regressions for the elements of cable and cable-pulley, like for the following loads of the order STAT_NON_LINE.