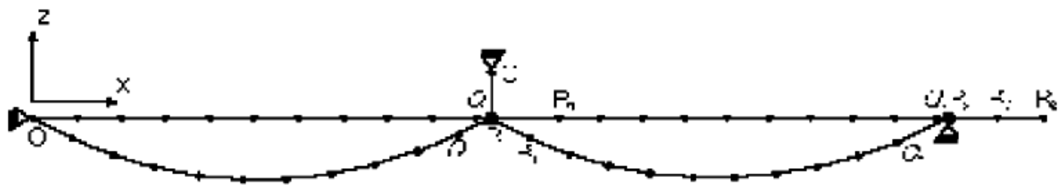
SSNL100 - Pose of a canton of line to two equal ranges

Abstract:
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 deflection of the ranges in “giving” more or less cable to the level of the fast pulley.
The interest is to test the cable elements and of cable-pulley and their operation in 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 : Coordinated 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: $N19$ 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 area of the cross-section): $5.10^7 N$

1.3 Boundary conditions and loadings

the points O , C and P_2 are fixed.

The cable, fixed in O , leans on two pulleys. First is attached at the lower end P_1 of the built-in suspension in C . Second is fixed at P_2 .

The cable is subjected to its weight and one gives him deflection by moving his right end of $10\ m$ 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 remains on the length of cable $Q_1 R_1$.

2 Reference solution

2.1 Method of calculating used for the reference solution

the deflection 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 deflection of reference is of $13.93 m$, equal for each range.

2.3 Uncertainty on the semi-analytical

solution 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 Modelization A

3.1 Characteristic of the modelization

10 cable elements	MECABL2 enters O and Q_1 , carried by meshes SEG2 ;
1 element	MEPOULI passing by the pulley P_1 and carried by mesh SEG3 $Q_1 P_1 R_1$;
9 elements	MECABL2 enters 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 mesh

Many nodes: 25
Number of meshes and types: 20 meshes SEG2 and 2 meshes 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 from $10 m$ the displacement of R_2 in R_2' ($R_2 R_2'=10 m$). As the not tended right cables do not have a stiffness for the transverse loads, one cannot apply from the start the preceding loading case because one would lead to a singular system of equations.

The computation 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 poursuite on the preceding situation of equilibrium by applying gravity and displacement $R_2 R_2'$. The load of gravity will be declared of type SUIV, because of elements MEPOULI of which the 2 parts are variable length.

3.4 Quantities tested and results

Identification	Reference
Marks with arrows range of left $N6$	-1.3930E+001
Deflection of the range of right $N19$	-1.3930E+001

4 Summary of the results

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