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.
# Problem of reference

## 1.1 Geometry

![Diagram of cable suspension system]

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>P₁</th>
<th>P₂</th>
<th>R₂</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>0</td>
<td>100</td>
<td>200</td>
<td>220</td>
<td>100</td>
</tr>
<tr>
<td>z</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

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): $5 \times 10^7$ N

## 1.3 Boundary conditions and loadings

Points O, C and P₂ are fixed.

The cable, fixed in O, is pressed on two pulleys. First is attached at the lower end P₁ suspension fixed in C. Second is fixed at P₂.

The cable is subjected to its weight and one gives him arrow by moving his right end of 10 m of R₂ with R₂'.

The position of the points Q₁, R₁ and Q₂ is not imposed, but one must make so that with the course the installation the pulley P₁ remain on the length of cable Q₁ R₁.
2  Reference solution

2.1  Method of calculating used for the reference solution

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

2.2  Results of reference

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

2.3  Uncertainty on the solution

Semi-analytical solution.

2.4  Bibliographical references

3 Modeling A

3.1 Characteristics of modeling

10 elements of cable MECABL2 enter $O$ and $Q_1$, carried by meshes SEG2;
1 element MEOULI passing by the pulley $P_1$ and carried by the mesh SEG3 $Q_1P_1R_1$;
9 elements MECABL2 enter $R_1$ and $Q_2$;
1 element MEOULI on $Q_2P_2R_2$;
1 element MECABL2 on the suspension $P_1C$.

3.2 Characteristics of the grid

Many nodes: 25
Many 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 $P_2$ of 10 m by the displacement of $R_2$ in $R_2'$ ($R_2R_2' = 10 m$). 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 10000 N).
• one makes a continuation on the preceding situation of balance by applying gravity and displacement $R_2R_2'$. The load of gravity will be declared of type SUIV, because of elements MEOULI the 2 parts are variable length.

3.4 Sizes tested and results

<table>
<thead>
<tr>
<th>Identification</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrow of the range of left $N6$</td>
<td>-1.3930E+001</td>
</tr>
<tr>
<td>Arrow of the range of right-hand side $N19$</td>
<td>-1.3930E+001</td>
</tr>
</tbody>
</table>
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.