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SeaFEM - Validation Case 12

Flexible free oscillating cable

SeaFEM

Version
15.1.0

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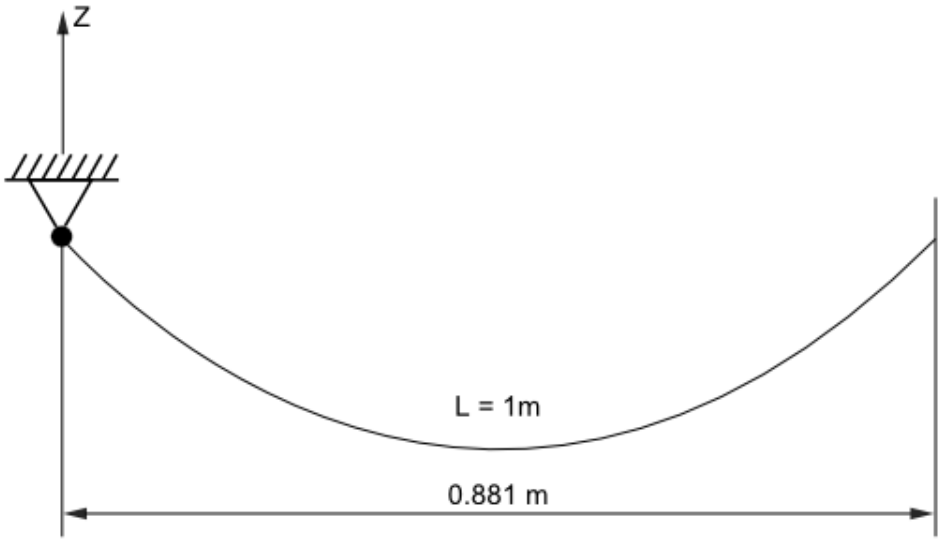
1 Problem description

The present validation case corresponds to a dynamic cable initially fixed at both ends in a given equilibrium position. One of the ends is further released so that the cable oscillates freely under the action of gravity. The initial distance between both ends of the cable is Δx = 0.881 m. On the other hand, the properties of the cable are listed in the following table:

Cable properties	
Cable length (L)	1.0 m
Apparent weight per unit length (w)	0.98 N/m
Cross section area (A)	$1x10^{-4}$ m^2
Young's modulus (E)	$5x10^{6}$ N/m^2

A schema of the problem under consideration is shown in the figure below.



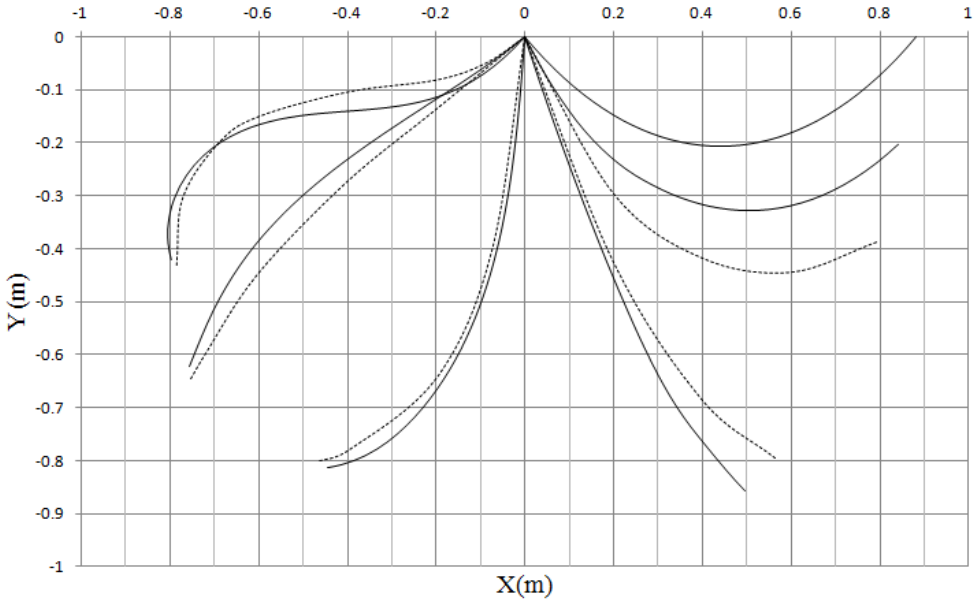
2 Mesh

For the present analysis the cable was discretized using 100 linear elements.

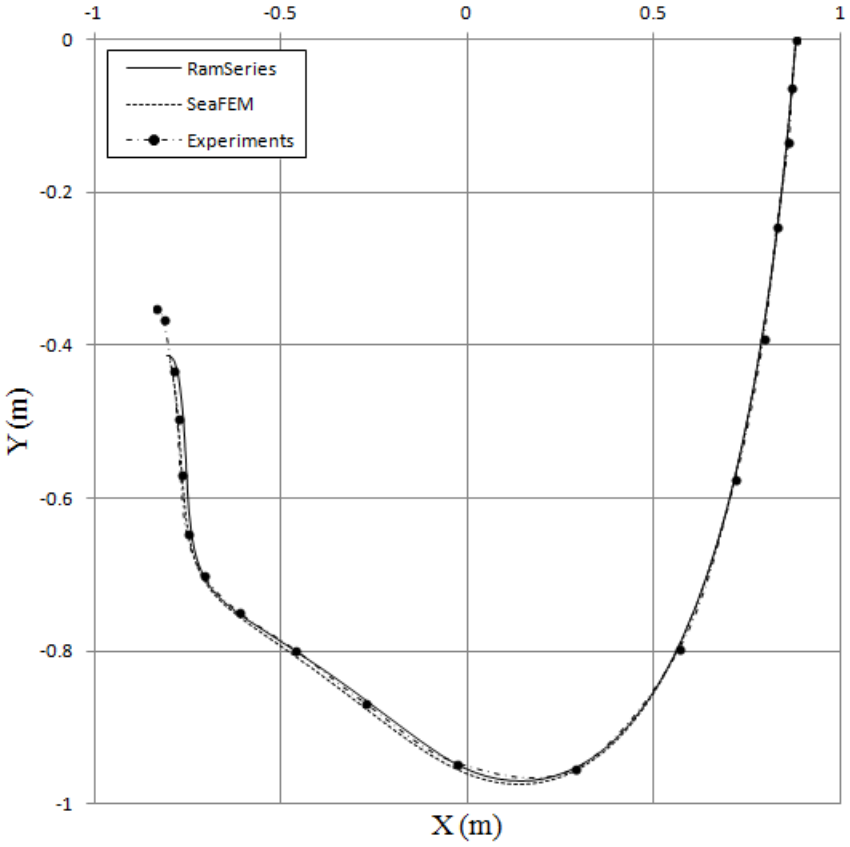
3 Results

For the sake of validation, displacements and cable configuration obtained from the present analysis are compared against experimental results in [1] and also against numerical results obtained with the structural solver RamSeries by CompassIS [2].

The first figure below shows the geometrical configuration of the cable in the experiment by Lazzari et al. (2011) and the corresponding configuration obtained with the dynamic cable solver in SeaFEM. It can be observed that the results are in good qualitative agreement.



On the other hand, the next figure shows a comparison between experiments and simulations for the position of the free end of the cable. Experimental results by Lazzari are compared against both, SeaFEM and RamSeries, numerical results. SeaFEM results closely match those obtained with RamSeries and the experiments. Small differences are observed in the lowest portion of the trajectory of the cable. Such small discrepancies can be due to differences in the actual values of the parameters controlling the numerical methods used to solve the dynamics of the cable.


-1
-0.5
0
0.5
1
0
-0.2
-0.4
-0.6
-0.8
-1
RamSeries
SeaFEM
Experiments
Y (m)
X (m)

4 Appendix

The following code describes the tcl script used for the present analysis. TdynTcl_CreateMooring procedure is used to create the catenary line and to link it to the floating bodies. Additionally, the numerical calculation of the diffraction-radiation problem is deactivated.

```
proc TdynTcl_CreateMooring { } {
    # Validation Case 2
     # Time step suggested for simulation: 0.001 sec.

     # values: Body Type_Mooring Xe[3] Xi [3] w L A E S n_elements
     damp_ratio_1 damp_ratio_2
     set seg1 [create_mooring_segment 1 6 0.0 0.0 0.0 0.881 0.0 0.0 0.98 1.0
     0.0001 5.0e6 0 100 0.025 0.025]
     # values: Gk Gc Gu Ms Md Cd Cf Cm alpha_bs bci
     TdynTcl_Configure_Mooring_Segment 1 0.0 0.0 0. 0.0 0.0 0.0 0.0 0.0 0.1 0

    TdynTcl_Configure_Analysis Solve_Dif_Rad 0
    TdynTcl_Message "TdynTcl_CreateMooringLine finished!!!" notice
}
```

5 References

[1] Lazzari M., Saetta A. and Vitaliani R.V., Non-linear dynamic analysis of cable-suspended structures subjected to wind actions. Computers and Structures. 79, 9563-969 (2001)

[2] RamSeries - Validation Case 28 - Free vibration of a cable

6 Validation Summary

CompassFEM version	15.1.0
Tdyn solver version	15.1.0
RamSeries solver version	15.1.0
Benchmark status	Successfull
Last validation date	27/11/2018