PRELIMINARY OBSEA MOORING DESIGN

Alejandro Arbós[2], Marc Nogueras[1], Joaquín del Río[1]
1-SARTI Research Group. Electronics Dept. Universitat Politècnica de Catalunya (UPC).
2-SARTI Research Group. Fluid Mechanics Department. Universitat Politècnica de Catalunya (UPC).

Abstract. The Obsea Cabled Observatory (www.obsea.es) is going to be expanded with new sea surface sensors such a meteorological station and a video camera. These new sensors are going to be installed in a surface buoy with wireless communication to the Obsea Data Center at SARTI's Laboratories. The mooring design and simulations are presented in this paper, taken into account the marine conditions of the area located in the Vilanova I la Geltrú coast in the Metiterranean Sea. The simulations of the static and dynamic behaviour of the anchored buoy were done with the software OrcaFlex 9.4.

1. Buoy and accessories model

The aim of this work is to present the preliminary followed steps for the mooring design of the buoy. The scheme of the buoy is shown in Figure 1-a It is a 6m length buoy with a diameter of 1m in the centre. It has been modelled in the simulation environment, , as is shown in figure 1-b, and to known the physical properties of the buoy allow Orcaflex a quicker analysis.

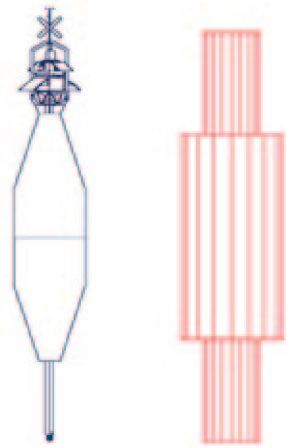

Figure 1. Real buoy schema and its Orcaflex model

The buoy was modelled as 3 cylinders, taking into account the centre of gravity and moment of inertia of the real buoy. The buoy will be anchored at the sea bottom using 3 chains. These chains will be fixed to the buoy through a custom design fixing structure, shown in Figure 2. This element has to be modelled in Orcaflex with a simple structure.

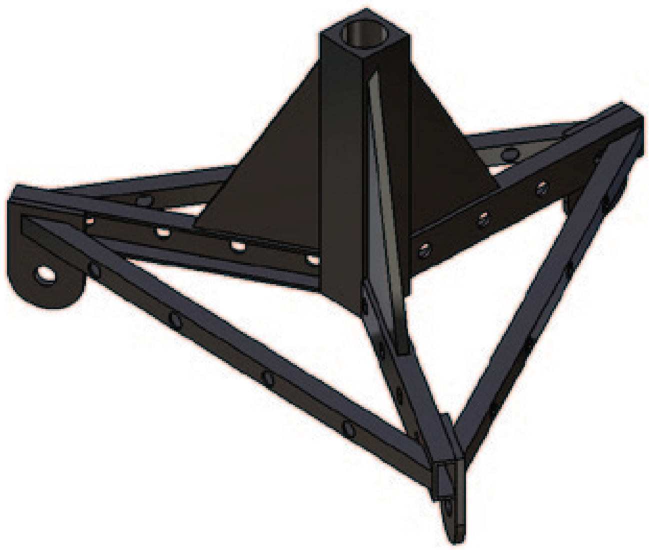

Figure 2. Custom structure to fix chains.

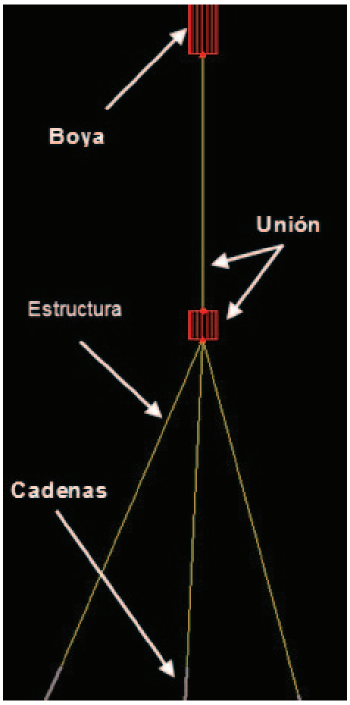

Figure 3. Chain fixing structure model

On the Figure 3 is shown the fixing structure model and how the chains are linked in a 3 leg shape, separated 120º because in this way the chains can keep in this same position.

2. Positioning of anchored buoy system

The positioning chain system has a tripod diagram, separating the chains 120º, as shown in Figure 4.

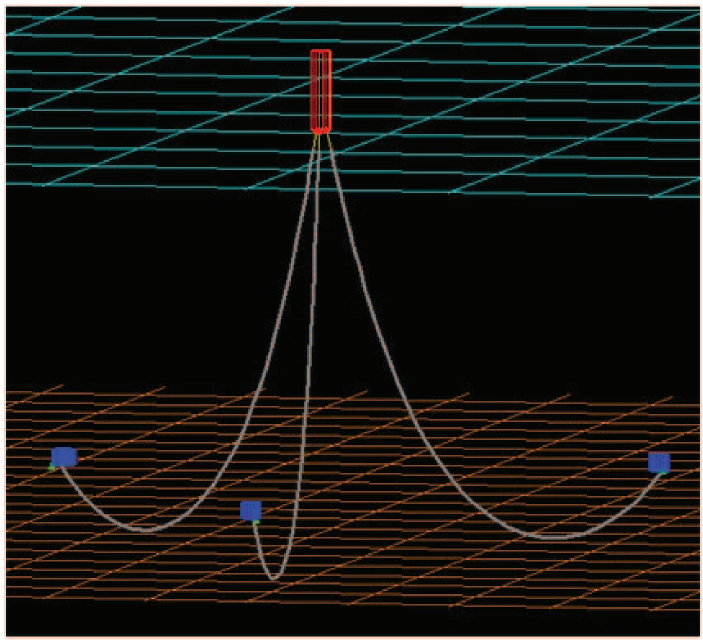

Figure 4. Three-dimensional representation of anchored buoy system with 3 chains

Once the different elements are defined in the Orcaflex simulation environment, a static analysis gives us information about the static position of the chains, and what are the forces at the ends. In this case, we have 20m depth and 50m chains length. Figure 5 shows the static position of the system.

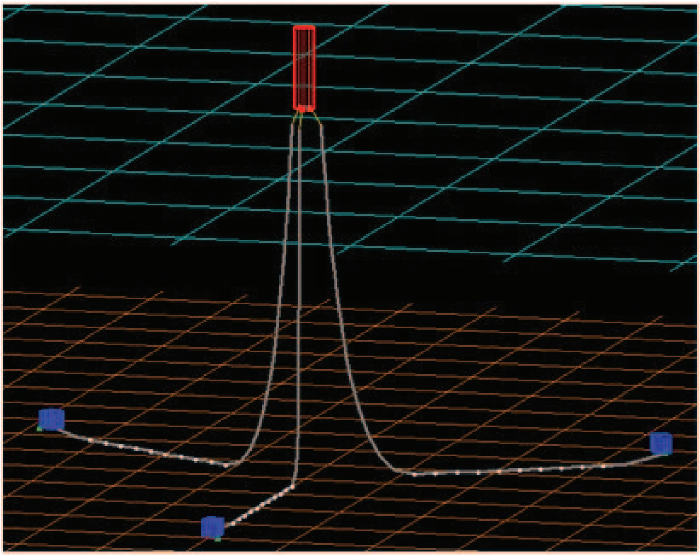

Figure 5. Three-dimensional representation of anchored buoy system with 3 chains with static analysis

After the static analysis, a dynamic analysis takes into account boundary conditions that have been carried out. In order to know what is the best orientation of the chains, and which will be the forces in presence of different wave heights, we took into account the information of "Puertos del Estado" about most common and maximum heights, periodicity, and direction of waves in the area.

Zone	Hs max [m]	Hs min [m]	Hs Average [m]	Tp max [s]	Tp min [s]	Tp average [s]	year
Cantabria (Peñas cape)	10,1	2,8	6,61	18,2	10	12,97	2009
Cantabria (Peñas cape)	7,8	2,6	6,28	16,6	10	12,44	2008
Cantabria (Peñas cape)	12,2	3,6	6,46	16,7	8	11,49	2007
Catalonia (Tarragona)	5	1,5	2,9	10	4,8	6,775	2009
Catalonia (Tarragona)	6,2	1,4	3,06	11	6,3	7,08	2008
Catalonia (Tarragona)	4,1	1,7	2,676	10	6,2	7,4	2007
Galicia (Silleiro cape)	11	3,2	8,06	18,2	9,2	12,776	2009
Galicia (Silleiro cape)	10,9	3	8,08	16,4	8,7	12,60	2008
Galicia (Silleiro cape)	10,4	3,6	6,7	16,7	10,6	12,923	2007
Andalucía (Cádiz gulf)	5,4	1,8	2,99	16,6	4,8	8,33	2009
Andalucía (Cádiz gulf)	5,9	1,9	3,16	11,1	5,9	7,14	2008
Andalucía (Cádiz gulf)	4,3	1,9	2,74	12,5	5,9	7,125	2007

Table 1. Table swell results according to Spanish study zone

Once the simulation elements, their positioning, and environmental parameters or boundary conditions are known, the dynamic simulation can be performed, and in this way, the system behaviour can be shown, according to swell, periods, and average heights, such as data showed on Table 1. Figure 6 shows different images captured during dynamic analysis.
The next step is the analysis of the simulation results in terms of maximum forces that a chain undergoes, and verifies the correct orientation of the mooring in order to minimize chain forces.

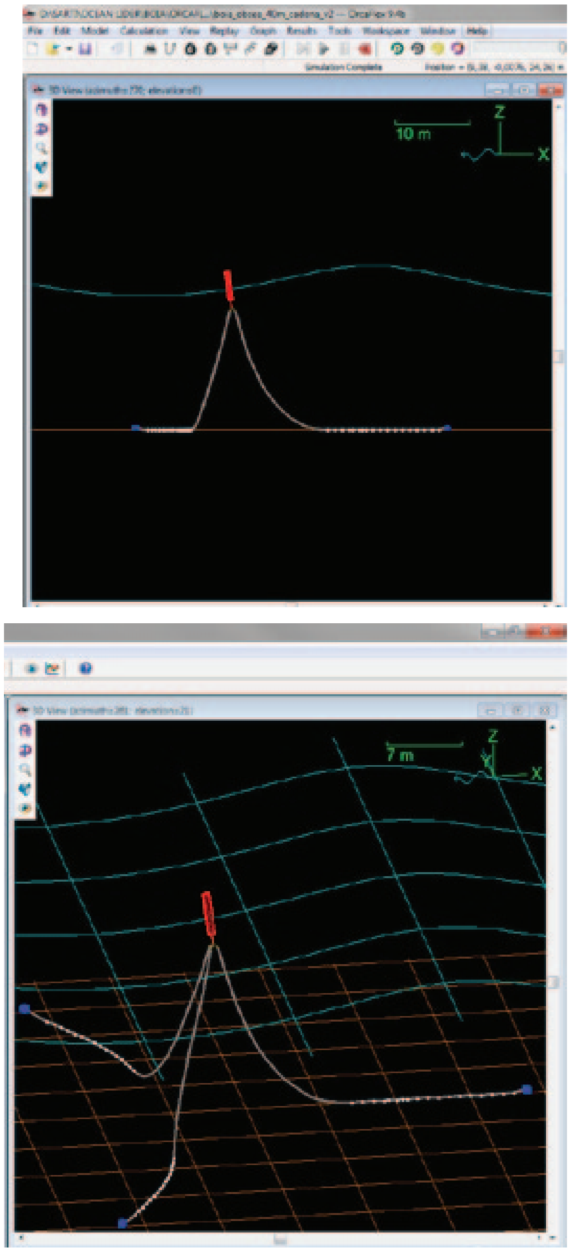

Figure 6. Three-dimensional representation of anchored buoy system with 3 chains with dynamic simulation

7. Conclusion

A static and dynamic simulation of the Obsea mooring design has been presented. First approach to the use of Orcaflex software has been done in order to evaluate its functionality. At this time a depth evaluation of the results has to be done in order to verify the correct design. These results will be published soon.

References

[1]Classical Mechanics – Moment of Inertia of a uniform hollow cylinder (http://www.livephysics.com/problems-and-answers/classical-echanics/find-moment-of-inertia-of-a-uniform-hollow-cylinder.html). LivePhysics.com. retrieved on 2008-01-31.
[2]Ferdinand P. Beer and E. Russell Johnston, Jr (1984). Vector Mechanics for Engineers, fourth ed.. McGrawHill. P. 911. ISBN 0-07-004389-2