

## Assessment of line and fender loads for moored tankers

### aNyMOOR.TERMSIM (draft)

aNyMOOR.TERMSIM is a time domain simulation program to analyse the dynamic behaviour of a moored export tanker subject to wind, waves and current. The mooring system can be a Single Point Mooring (SPM), a Multi Buoy Mooring (MBM) or a Jetty terminal. The program predicts the mooring loads and tanker motions when the system is exposed to operational environmental conditions.

#### aNyMOOR GUI

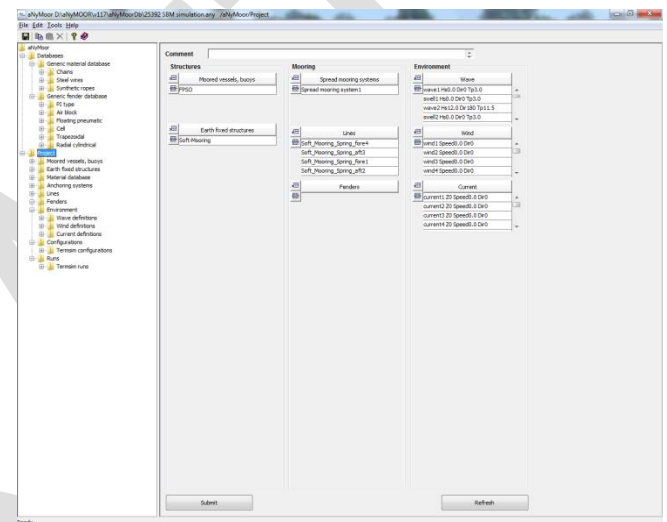
aNyMOOR.TERMSIM is part of the new aNyMOOR suite consisting of:

1. aNyMOOR.TERMSIM
2. aNyMOOR.DYNFLOAT
3. aNyMOOR.SHUTTLE (not commercially available yet)

aNyMOOR is basically a versatile GUI which interfaces with our in-house simulation kernel aNySIM (for more information, see separate leaflet), incorporating the knowledge gained during several JIPs (such as SHUTTLE and DYNFLOAT JIP) and feedback from clients. aNyMOOR.TERMSIM will not contain all aNySIM functionality but focuses on time-domain simulations for offloading, mooring and terminal design. aNyMOOR.TERMSIM is easily extended with .DYNFLOAT or .SHUTTLE functionality by installing an extended license.

The input of data is user-friendly and is performed by the GUI in different nodes following a certain workflow. Each node can be seen as a building block and are walked through separately. The input starts at the project-node where all required nodes are easily generated. At the end of the workflow all building blocks are put together in the configuration panel. By using this workflow different configurations can quickly be build. To even further speed up the project, all nodes can be copied and modified. The copy and paste action is also possible from Excel into tables.

The system layout is represented graphically in a schematic format to detect input errors in an early stage.



Below a summary of the most important input nodes:

#### Moored vessels and buoys

The software contains the OCIMF tanker database with hydrodynamic data for several tankers. A selected tanker can be scaled to the required dimensions. On request the database can be extended with dedicated vessels on project bases.

Besides the hydrodynamic database, a database with OCIMF wind and current data is provided. This database contains non-dimensional wind and current force/moment coefficients for use in the calculation of wind and current loads on a tanker.

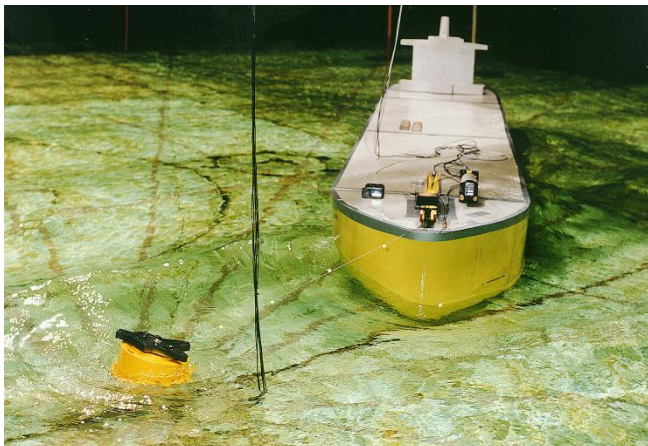
## Material and fender database

Defining the lines and fenders are an important aspect of a mooring system. Therefore aNyMOOR.TERMSIM is provided with a material and fender database. The material database contains a large collection of chains, steel wires and synthetic ropes. These can be combined to define multiple legs, anchor lines or hawsers. The fender database contains typical fender types such as PI type, air Block, floating pneumatic, cell, trapezoidal and radial cylindrical. The user is also allowed to copy and modify the standard databases or define it himself.

## Anchoring systems

Three types of terminals are considered:

- **SPM**  
The SPM terminal consists of a conventional CALM buoy which is moored to the seabed by means of anchor lines. The tanker is moored to the buoy by means of a bow hawser. The CALM buoy is in this case a hydrodynamic object with all its particulars, similar as a vessel.
- **MBM**  
In a multi buoy terminal the tanker is moored by mooring legs consisting of an anchor line, a surface buoy and a hawser.
- **Jetty**  
For the jetty terminal the tanker can be moored by means of mooring legs and fenders. A mooring leg can consist of a number of parallel running, but equal lines.



## Environment

The environmental conditions concern waves, wind and current. The waves can be defined as a theoretical spectrum (JONSWAP, Pierson-Moskowitz, Regular Wave, Gaussian or Torsethaugen), user defined spectrum or as wave train. The wind can be defined as a theoretical spectrum (NPD, API, Ochi-Shin, Wills or Harris), user defined spectrum or as time series. The current can be defined as fixed or changing. When fixed is chosen the current can consist of multiple layers each with their own speed, direction and depth. When changing is chosen one layer can vary in time, speed and direction. For each condition are random seed can be applied.

## Events

The following events can be simulated:

- External forces (earth or vessel fixed)
- Line failures (breaks at a certain time and/or at certain load)

## Output

The output of each simulation consists of an ASCII database containing all samples of the calculated signals. The signals include the tanker motions, mooring loads in all mooring legs and other interesting quantities for the analysis of the mooring system behaviour. The graphical User Interface presents all generated files, statistics, time traces and a 2D (birds eye view) animations.

## Validation

In order to validate aNyMOOR.TERMSIM the three different systems have been parallel simulated with TERMSIM and aNyMOOR.TERMSIM. A good correlation with the TERMSIM and the model tests was found.

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