

Workability Analysis of Ships and Constructions Offshore

WASCO

The use of information on the motion characteristics of ships and ocean-going structures is often hampered by the abstract and extensive nature of these figures. In order to facilitate easy translation of the calculated data into the operational performance MARIN developed a mathematical framework for a workability analysis as a post-processor for seakeeping calculations.

Method

A workability analysis comprises:

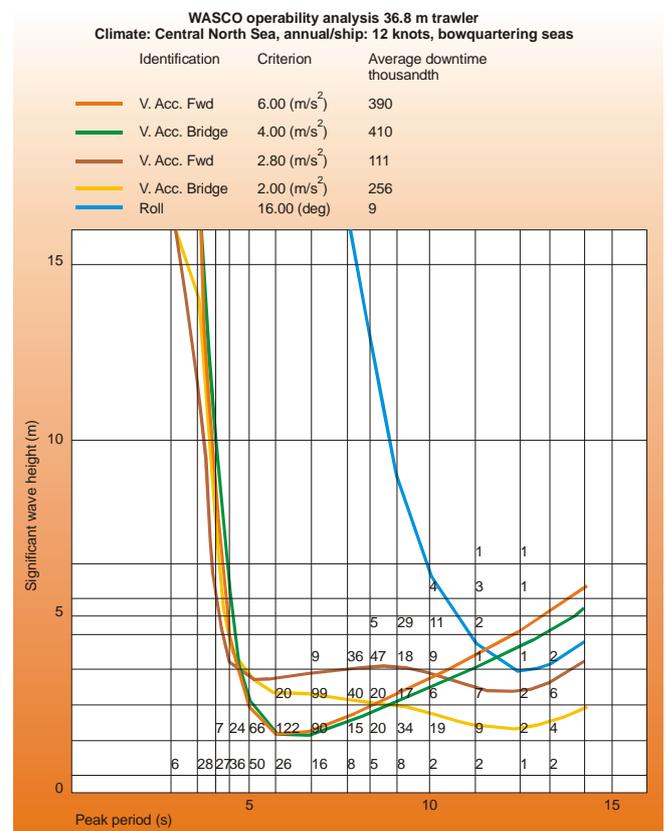
- The seakeeping behaviour characteristics of the structure
- The offshore climate
- Criteria for maximum responses

Structure

The seakeeping behaviour characteristics of the structure are defined with linear and quadratic transfer functions. Elements like drag coefficients and reference areas, which are related to the calculation of drag forces due to wind and current, can be defined as well.

The linear transfer functions are generally defined in terms of the six degrees of freedom of the ship or structure. The model facilitates manipulation of this information to obtain results like local motion, velocity and acceleration levels, seafastening loads, subjective motion magnitude, relative wave elevation and impact loading.

The quadratic transfer functions can be used to evaluate added resistance and average wave drift forces. This information can be combined with wind and current drag calculations. The involuntary speed loss of ships based on the thrust balance and the voluntary speed reduction due to excessive ship dynamics are evaluated.



Example of a WASCO operability analysis for a trawler



Climate

A so-called wave scatter diagram is used to define the wave climate. Three families of single peaked spectra are available to characterise the individual wave conditions.

A varying wind speed can be linked to each individual wave condition, accounting for relatively short waves representing 'young' growing sea states related to a relatively high wind speed. This is especially important when evaluating station keeping problems or the speed loss of ships. Wind and current can also be defined by the user.

Criteria

In general criteria are supplied by the user. Criteria for the dynamic behaviour can be expressed in several ways. Other criteria, e.g. the added resistance, average environmental loads and speed loss, are expressed in the maximum average value.

Input

The input consists of:

- Linear and quadratic transfer functions
- Wave scatter diagram
- Criteria

Output

The basic output of the program is a 'downtime' or an 'operability' figure: the average fraction of time that the adopted criteria are exceeded in a particular (wave) climate. In addition long term statistics can be calculated. For operations that cannot be analysed adequately by means of the 'downtime' a time domain version of the program is available. In these operations the 'downtime' itself effects the operation of the structure outside the actual 'downtime'.

Applications

The program allows a quantification of the performance of ships and structures in terms of:

- Safety of crew and passengers
- Habitability
- Passenger comfort
- Seafastening loads
- Fatigue problems
- Bow emergence and related impact loading
- Shipping of water
- Added resistance and speed loss of ships
- Environmental loads due to wind, waves and current

For more information please contact the department [Maritime Simulation & Software Group](#);

T +31 317 49 32 37

E msg@marin.nl