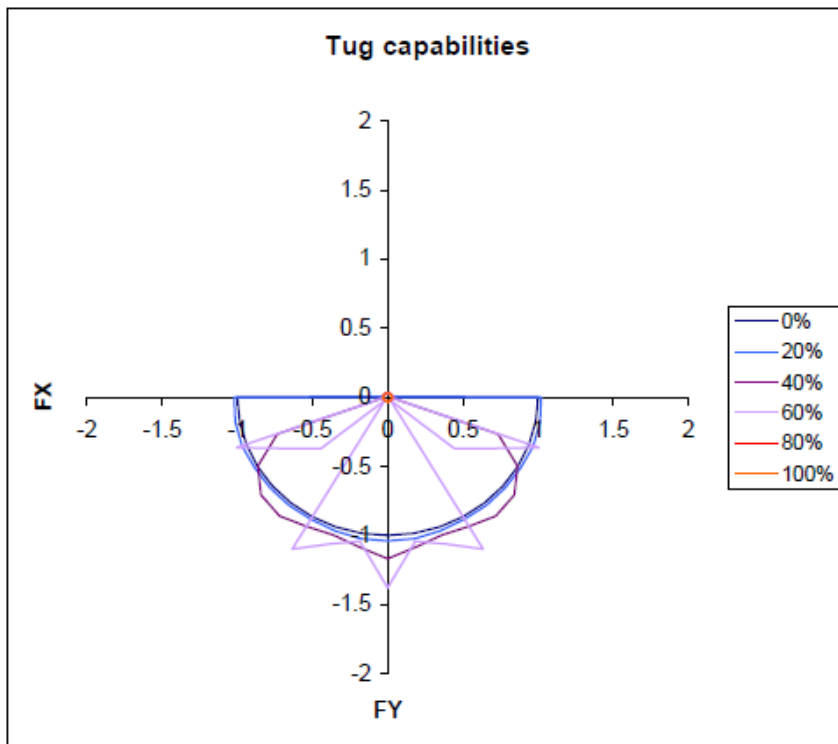


Tugs

The tug model generates realistic tug forces as a function of:

- Type of tug;
- Vessel velocity;
- Operating mode (pull or push);
- The bollard position.

To make the simulation not too complex tugs are modelled as tug capability diagrams. These diagrams show the effective pull/push forces and pull/push angles. Diagrams (Tug Assist Capabilities) are available for a typical conventional tug, an azimuthing stern drive (ASD) tug and a Voith Schneider tug. Figure 3.1 shows an example of a tug capability diagram (ASD tug pulling at the stern).



Bollard: stern
TugType: ASD
Assist: pull
Max. vel 13.6 knts

Assist force contours defined as fraction of the maximum effective bollard pull, depending on the forward velocity of the tanker. The velocity contours are related to the maximum tug velocity (e.g. 100% = 13.6 kts).

Figure 3.1 Example of a tug capability diagram

Tugs can operate in pull mode connected with a line to the bollard specified and in push mode pushing to the side of the vessel at the specified bollard position (connected). During a run the tug can not change from push to pull or the other way around.

Tugs can be made fast or push on eight bollard positions at the assisted vessel, At the stern, at the bow and three

position on either port and starboard side (See Figure 3.2)

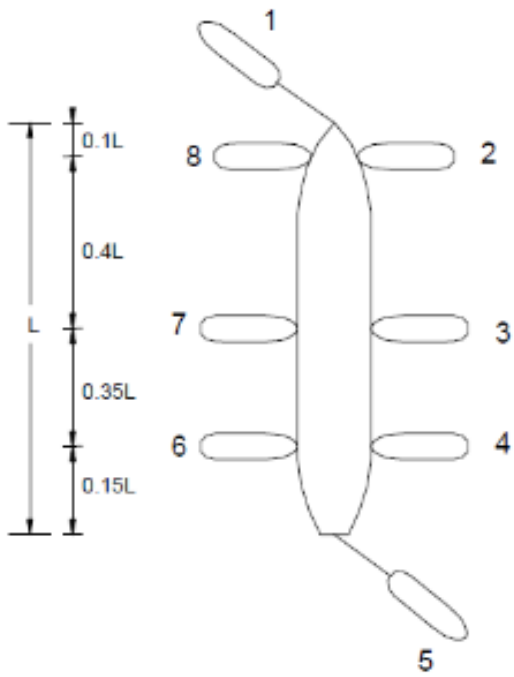


Figure 3.2 Definition of the bollard positions