Case 2.1: Open water tests PPTC

Open water tests with the propeller were carried out in the SVA Potsdam. For the measurements the ship coordinate system (SCS) was used.

Test set up
The open water tests were performed in the towing tank of the SVA Potsdam. The towing tank has a breadth of 9.0 m and a depth of 4.5 m, as illustrated in Fig. 1. During the tests the propeller shaft is submerged by 1.5 *D* (propeller diameters) below the free surface and positioned in the lateral centre of the towing tank.

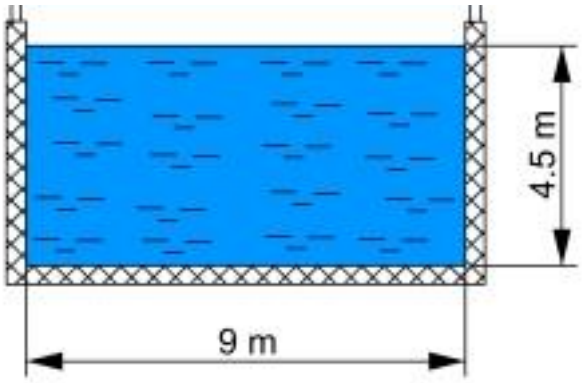

Fig. 1: Cross section of towing tank

The propeller is tested in a pull configuration. The dynamometer is illustrated in Fig. 2. The nose cap length corresponds to 1.5 times the boss diameter at the forward end. The connection between the hub and the nose cap is fair. The downstream end of the propeller hub is designed to avoid a pressure build-up. The geometry is designed according to the ITTC recommendations.

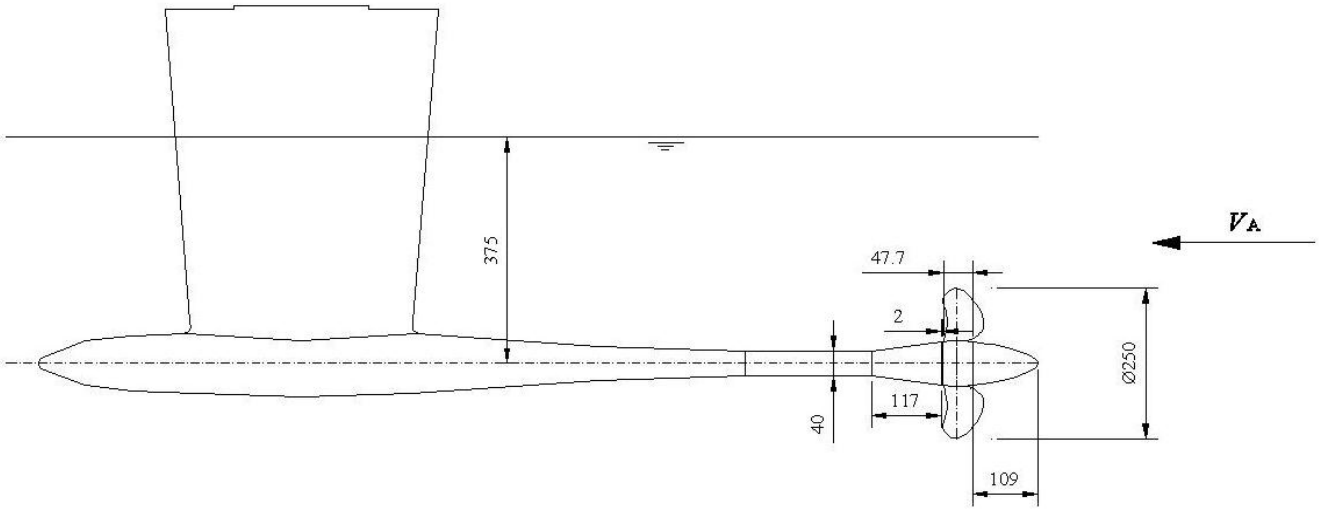

Fig. 2: Dynamometer for the open water tests in the towing tank of the SVA Potsdam.

Test description:
The measurements were conducted under the following conditions, giving Reynolds numbers in the range of 8.32E+05 < Re < 9.52E+05, generated on basis of the section advanced speed at $r/R = 0.7$.

Water density (for T = 17.5°C)	ρ	[kg/m^3]	998.67
Kinematic viscosity of water (for T = 17.5°C)	ν	[m²/s]	1.070E-06
Rate of revolutions	n	[1/s]	15
Speed Velocity	V_A	[m/s]	2.25-5.25

- Preceding the open water tests, measurements with solely the rotating hub and nose cap were carried out, in order to calibrate the measuring probe. Thus the given measurement data is understood as being entirely generated by the propeller blades.

Requested computations:

Case 2.1:

- The requested data is the thrust (K_T) and torque ($10K_Q$) coefficient and the open water efficiency (η_0) for the advance coefficients J = 0.6, 0.8, 1.0, 1.2 and 1.4. If desired, additional operation points may also be given.
- Data format:
  The data shall be provided in ASCII-format, with the advance coefficient in the first, the thrust coefficient in the second, the torque coefficient in the third and the open water efficiency in the forth column. Blanks should be used as separator. The column descriptors should have a preceding hash key.

  Example:

```
# J    KT       10KQ     ETA0
0.6    0.600    1.400    0.500
0.8    0.500    1.200    0.550
…
1.4    0.150    0.550    0.700
```

- File name:
  [identifier]_owt_case2-1.dat

  The identifier should be [Institute Name]-[Solver Name]. For the SVA Potsdam using the CFX solver it would be SVA-CFX_owt_case2-1.dat

Equations:

Advance coefficient: $$J = \frac{V_A}{n * D}$$

Thrust coefficient: $$K_T = \frac{T}{\rho \cdot n^2 \cdot D^4}$$

Torque coefficient: $$K_Q = \frac{Q}{\rho \cdot n^2 \cdot D^5}$$

Open water efficiency: $$\eta_0 = \frac{J}{2\pi} * \frac{K_T}{K_Q}$$

Reynolds number of number (r/R = 0.7) $$Re = \frac{c_{0.7R}}{\nu} * \sqrt{{V_A}^2 + (0{,}7D \cdot \pi \cdot n)^2}$$

Thrust loading coefficient: $$C_{TH} = \frac{8}{\pi} * \frac{K_T}{J^2}$$

With D being the propeller diameter, T the propeller thrust, Q the propeller torque and $c_{0.7R}$ the chord length of the propeller section at radius $r/R = 0.7$.