Case 1: Propeller forces in oblique flow of 12°

Description:
The propeller is operating in a pull configuration, with the hub cap pointing upstream. The propeller axis is inclined by 12°.

In this case the inflow from the perspective of the propeller becomes inhomogeneous. This is due to the circumstance that the propeller is rotating on one side with and on the other side against a tangential flow component and also for reason of the hub cap. In this condition the propeller generates forces normal to the rotation axis, with the z-component having impact on the propeller thrust. The propeller coordinate system (PCS) is provided below.

The forces shall be evaluated on the entire rotating "propeller part" (blades, hub and hub cap) as shown in green in the figure below.

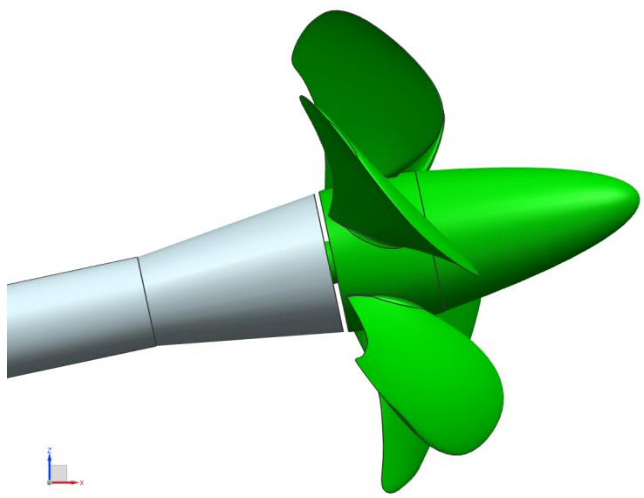

Fig. 1: Parts on which forces shall be evaluated (green) and rotating (green) and non-rotating (grey) parts

Requested computations:

Case 1:

Water density (for t_w = 17.9°C)	ρ	[kg/m^3]	998.62
Kinematic viscosity of water (for t_w = 17.9°C)	ν	[m²/s]	1.057E-06
Rate of revolutions	n	[1/s]	15
Inclination angle	Ψ^{bP}	[°]	12

- The requested data are the three dimensionless thrust coefficients (K_{Tx}, K_{Ty} and K_{Tz}) in the PCS and the propeller torque coefficient ($10K_Q$) for the advance coefficients ***J* = 0.6, 0.8, 1.0, 1.2 and 1.4**.
- Data format:
  The data shall be provided in ASCII-format, with blanks as separator. The column descriptors should have a preceding hash key.

  Example:
```
# J   KTx     KTy     KTz     10KQ
0.6   1.000   1.000   1.000   1.000
0.8   2.000   2.000   2.000   2.000
…
1.4   5.000   5.000   5.000   5.000
```
- File name:
  [identifier]_case1-1.dat

  The identifier should be [Institute Name]-[Solver Name]. For the SVA Potsdam using the CFX solver it would be SVA-CFX_case1-1.dat

Equations:

Advance coefficient: $$J = \frac{V_A}{n \cdot D_P}$$

Thrust coefficient: $$K_{TX} = \frac{T}{\rho \cdot n^2 \cdot D_P^4}$$

Thrust coefficient: $$K_{TY} = \frac{F_Y}{\rho \cdot n^2 \cdot D_P^4}$$

Thrust coefficient: $$K_{TZ} = \frac{F_Z}{\rho \cdot n^2 \cdot D_P^4}$$

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

With D_P being the propeller diameter, T the propeller thrust in x-direction (PCS), F_Y the propeller force in y-direction (PCS), F_Z the propeller force in z-direction (PCS) and Q the propeller torque.

Propeller coordinate system (PCS)

An orthogonal coordinate system is used for the propeller, with the x-axis pointing upstream against the flow direction and the z-axis upwards.

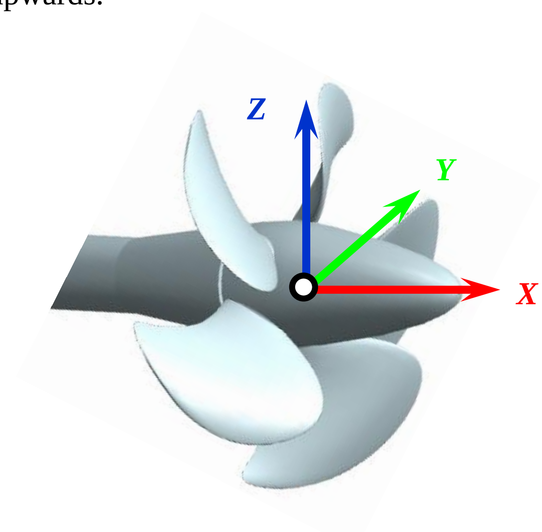

Fig. 2: Propeller coordinate system