Systematic propeller series

- Open water diagram
- Efficiency, Propeller-hull interaction, Quality index
- Systematic propellers series
- Propeller design through series
 - Choice of Propeller D, n, Ae/A0, Z



Exam question

Practise Exam

- Wo 5 okt, 7e uur Zaal E, vraag 1 Weerstands berekening
- Wo 12 okt, 7e uur Zaal E, vraag 2 Schroef berekening



Open water diagram



Propeller blade hydrodynamics









Velocity diagram on propeller blade section





Propeller Open Water Diagram



Velocity diagram on propeller blade section









Efficiency, Hull-prop interaction and Quality Index



Efficiency





Quality Index

Definition of Quality Index

$$QI = \frac{\eta_O}{\eta_I}$$

 Ideal efficiency comes from Actuator Disk consideration on axial energy losses

$$\eta_I = \frac{2}{1 + \sqrt{1 + C_T}}$$

Systematic propeller series



Series

- Wageningen B series
- Kaplan Series
- (M)AU Series
- Large BAR/Pitch/Blade number range



General plan of B-4 series propeller with varying A_E/A_0



Open water diagrams of B4-70 Propeller Series



B 4-70

1973

Example of Bp2-δ diagram known power and D_{prop}



Propeller design through propeller series



Parametric design – Elimination of variables



Independent variables KT and KQ

• Use K_Q/J^3 when power is known to determine operating point J

• Use K_T/J^x when thrust is known to determine operating point J

• Any 2 of 3 variables in J should be known to determine third from non dimensional working point



Determine e.g. rpm

$$K_{T} = \left(\frac{K_{T}}{J^{2}}\right) J^{2} = \left(\frac{T}{\rho n^{2} D^{4}} \frac{n^{2} D^{2}}{V_{A}^{2}}\right) J^{2} = \left(\frac{T}{\rho D^{2} V_{A}^{2}}\right) J^{2}$$

- Constant en bekend
- Max Diameter fixed by afterbody



Determination of optimum propeller diameter



Determination of optimum propeller diameter



Characteristics of optimized propellers

- Optimum depends on required velocity, thrust and rpm
- Optimum rarely lies on the top of an open water curve
- Optimum can be as low as 35-40% for certain choices of propulsion



Four quadrant measurement results of B4-70 propeller

