COMPACT PROPULSION CONCEPTS FOR DOUBLE ENDED FERRIES

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DOUBLE ENDED FERRIES IN GENERAL

The propulsion system of a double ended ferry is really special and hardly comparable to single ended ferries.
DOUBLE ENDED FERRIES
DIFFERENT PROPULSION SYSTEM

- Azimuth thrusters
- Conventional CPP system
DOUBLE ENDED FERRIES
AZIMUTHING THRUSTERS ADVANTAGES

- Higher maneuverability, even at zero speed
- Easy maintenance, can be exchanged even afloat
- Twin propeller systems are available
- No rudders or separate gearboxes are necessary
- Less space consuming
- the thrust losses at front increase with higher load (higher ship resistance)
- the inflow speed to the aft unit increases with higher load at the front unit
- the thruster efficiency at aft reduces with higher load (increased thrust load coefficient)
- a small load at the front leads to a low thruster efficiency
  (operation point distinctly behind the maximum efficiency)
DOUBLE ENDED FERRIES
HYDRODYNAMIC ASPECTS

Analysis of Power Distribution
Project "Double Ended Ferry" / 2 x STP 550

J / [-]
Kt
10Kq
Eta Th
aft unit
Front unit

Stern
Bow

J / [-]
0.4  0.5  0.6  0.7  0.8  0.9  1.0

Kt
10Kq
Eta Th

aft unit
Front unit
### DOUBLE ENDED FERRIES
### OPTIMISATION OF POWER CONSUMPTION

<table>
<thead>
<tr>
<th></th>
<th>Propulsion coefficients - Aft</th>
<th>Propulsion coefficients - Front</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$w = 0.04$</td>
<td>$w = 0.08$</td>
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<tr>
<td></td>
<td>$t = 0.13$</td>
<td>$t = 0.32$</td>
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<tr>
<td>$P_{\text{Aft}} / P_{\text{Front}} - 75/25$</td>
<td>$\eta_H = 0.906$</td>
<td>$\eta_H = 0.739$</td>
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<tr>
<td></td>
<td>$w = -0.01$</td>
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<tr>
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<td>$t = 0.11$</td>
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<tr>
<td>$P_{\text{Aft}} / P_{\text{Front}} - 60/40$</td>
<td>$\eta_H = 0.881$</td>
<td>$\eta_H = 0.719$</td>
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<td>$w = -0.03$</td>
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<td>$t = 0.10$</td>
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</tr>
<tr>
<td>$P_{\text{Aft}} / P_{\text{Front}} - 50/50$</td>
<td>$\eta_H = 0.874$</td>
<td>$\eta_H = 0.704$</td>
</tr>
</tbody>
</table>

$h_H = 0.906$

$h_H = 0.874$

$h_H = 0.719$

$h_H = 0.739$

$h_H = 0.704$

$h_H = 0.881$
DOUBLE ENDED FERRIES
OPTIMISATION OF POWER CONSUMPTION

Figure 11

Data-File: Symp-003.DAT
Graf-File: Symp-004.LPD

Power Distribution: \( P_{\text{total}} = f(V_S, \text{Distribution}) \)

- \( P_{\text{total}} \), 15 kts
- \( P_{\text{total}} \), 14 kts
- \( P_{\text{total}} \), 13 kts
- \( P_{\text{total}} \), 12 kts
- \( P_{\text{total}} \), 11 kts

- \( 2 \times 1200\text{kW} \)
- \( 2 \times 2050\text{ kW} \)
- \( 2 \times \text{STP 1010} \)
- \( 2 \times \text{STP 1515} \)
- \( 2.1\text{m Prop dia} \)
- \( 2.5\text{m Prop dia} \)
DOUBLE ENDED FERRIES
OPTIMISATION OF POWER CONSUMPTION

Installation with 2 units
- the optimum power distribution between front and aft unit is usually in the range between 70 / 30 and 85 / 15 with respect to total power
- An optimised installation configuration reduces the power consumption especially for 2 units

Installation with 4 units
- the optimum power distribution between front and aft unit is usually in the range between 50 / 50 and 60 / 40 with respect to total power
DOUBLE ENDED FERRIES
DIESEL DIRECT OR DIESEL ELECTRIC
DOUBLE ENDED FERRIES
DIESEL DIRECT OR DIESEL ELECTRIC

**Diesel direct**
- Lower CAPEX
- Sophisticated long shaft line
- Distinct engine position
- Higher emission since bow unit is very often operated in low load mode

**Diesel electric**
- Higher CAPEX
- Simple and short shaft line
- High flexibility with regards to the genset position
- Less emissions since genset always operates at the optimum rpm
- step less speed variation of prime mover till lowest rpm values (high maneuverability)
- Conversion losses approx. 12%
DOUBLE ENDED FERRIES
THE MOST COMPACT PROPULSION SYSTEM

- E-Motor
- Steering motor
- Slewing bearing
- Steering hub
- Torsional coupling
- Vertical power transmission
- Gear set
- Propeller shaft
COMBI DRIVE VS Z-DRIVE
SCHOTTEL COMBI DRIVE ASSEMBLING

E-Motor with elastic coupling before mounting
SCHOTTEL COMBI DRIVE ASSEMBLING

YOUR PROPULSION EXPERTS
SCHOTTEL COMBI DRIVE

- Compactness
- About 3% mechanical losses only
- Standard sealing’s
- Integrated motor foundation
- Motor sits inside the vessel
- Slim underwater housing
- No shaft line alignment
- Less mechanical parts
- Less maintenance costs
- Less mechanical interfaces
- Available as twin or single propeller with and without nozzle
DOUBLE ENDED FERRIES
ALTERNATIVE POWER SYSTEMS

- Generators and VFDs
- E-Motor
- Main Engine
- Thruster
DOUBLE ENDED FERRIES
ALTERNATIVE POWER SYSTEMS

maneuvering
THANK YOU FOR YOUR KIND ATTENTION