第十七次初階課程授課紀錄

授課時間	民國 97 年 12 月 31 日（星期三）下午 1:15 至 3:05		
授課地點	圖書資訊大樓四樓演講廳		
授課師資	王武雄	紀錄	林素如
出席學生	109 人		
缺席學生	7 人		
授課大綱	一、 高速艇螺槳運轉環境 －高速艇推進系統布置—雙俥雙舵 －跡(伴)流分佈 －高速艇斜軸布置 －艉隧道線形 －空泡狀態下之螺槳性能_推力、扭矩與效率－ 二、 高速艇螺槳應用現況趨勢 －高速艇螺槳之一般趨勢 －無因次參數 －高速 + 高軸傾斜角 －空泡趨勢_Gawn Burrill 圖表 三、 高速艇螺槳應用現況（I） －PJ 234 _ 15 knots _ 37.68 m（巨型遊艇） －Fleming _ 15.5 m _ 18.5 knots（中型遊艇） －Carver 650 _ 16.6 m _ 31 knots（中型高速遊艇） －GC Patrol _ 13.7 m _ 41 knots（高速巡邏艇） －Fast Patrol _ 11.2 m _ 51 knots（超高速巡戢艇） －Tige _ 5.5 m _ 38 knots（滑水艇(ski boat)） 四、 高速艇螺槳應用現況（II） －Speed versus Length, Displacement 速長比- Froude Number 佛勞數 －推進器應用趨勢 －局部空泡數(0.7R)與推力負荷關係圖 五、 高速艇螺槳系列與翼型斷面 －不同船速狀況適用之螺槳葉片斷面型狀 －螺槳系列 六、 高速艇螺槳使用材料 －螺槳用材料分類 －螺槳材料之演進（1960-1988） －英國勞氏驗船協會規定之螺槳材料 七、 高速艇螺槳最新產品_小型英式推進器 －POD _ Volvo IPS 350/400/450/500/600 －New Rampage 34 with IPS Pod Drives - 07/09/2008 －Zeus® Pod Drive System		

內容目錄

一、 演講海報

敬邀您參加

教育部補助大學校院培育海洋科技實務人才計畫
初階實務課程－船廠經營管理

高速艇螺槳發展趨勢與展望

王武雄

瑞孚宏昌船舶推進系統股份有限公司
總經理

97 年 12 月 31 日
下午 1:15 至 3:05
圖書資訊大樓四樓演講廳

二、 師資簡介

中文姓名	王武雄	公司電話	07-7871831ext33
E-mail	wuu.shyong.wang@zf-marine.com		

主要學歷

畢業學校	國別	主修學門系所	學位	起迄年月
國立成功大學	中華民國	造船工程學系	學士	62.9-66.6

現職及與專長相關之經歷（由最近工作經驗依序往前追溯）

公司名稱	部門	職稱	起迄年月
瑞孚宏昌船舶推進系統股份有限公司		總經理	87.7 迄今
財團法人聯合船舶設計發展中心	初步設計組 – 科技專案室	工程員-副主任	66.9-87.6

本計畫中負責項目

初階實務演講課程：

主題：高速艇螺槳發展趨勢與展望

日期：97 年 12 月 31 日

時間：下午 1：15 至 3：05

地點：圖書資訊大樓四樓演講廳

三、 授課簡報

高速艇螺槳發展趨勢與展望
Development of Propeller for HSC

National Kaohsiung Maritime University
31 December 2008

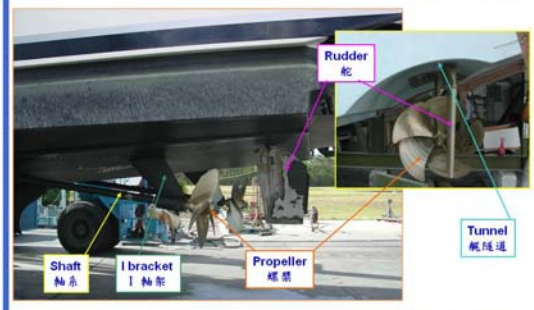
Wuu-Shyong Wang
ZF Faster Propulsion System Co.,Ltd.

Page 1 ZF FASTER PROPULSION SYSTEM

高速艇螺槳運轉環境

Page 2 ZF FASTER PROPULSION SYSTEM

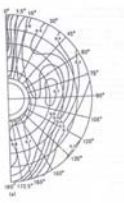
General Layout of Propulsion System
高速艇推進系統布置—雙伸雙舵



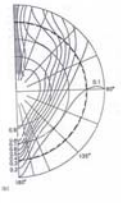
Page 3 ZF FASTER PROPULSION SYSTEM

Wake Field
跡(伴)流分佈

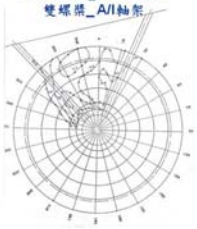
Single screw _ U form
單螺槳_U艉線形



Single screw _ V form
單螺槳_V艉線形



Twin screw _ A/I bracket
雙螺槳_A/I軸架



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Shaft Inclination for HSC
高速艇斜軸布置

Shaft inclined angle: 6 to 13 degrees
(current trend) 現行趨勢
→ high risk of root cavitation erosion
高風險之根部空泡浸蝕


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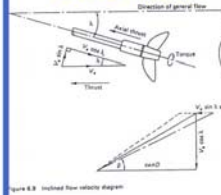


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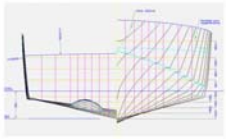
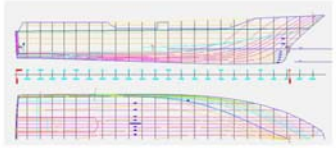
Page 5 ZF FASTER PROPULSION SYSTEM

Tunnel Hull Lines
艉隧道線形

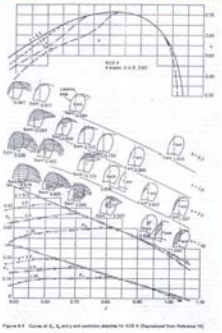


. Reduce shaft inclination angle
降低軸傾斜角度
. Increase tip hull clearance
增加螺槳葉尖與船底間隙
. Adjust static trim angle
調整靜止狀態之俯仰度(角度)



Page 6 ZF FASTER PROPULSION SYSTEM

Propeller Characteristics in Cavitation Condition
空泡狀態下之螺槳性能_推力、扭矩與效率




Alpha=90, back
斜軸角90度，葉背面

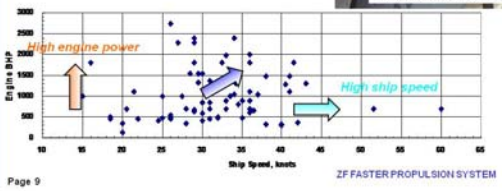
Page 7 ZF FASTER PROPULSION SYSTEM

高速艇螺槳應用現況趨勢

Page 8 ZF FASTER PROPULSION SYSTEM

General Trend of Propeller for High Speed Craft
高速艇螺槳之一般趨勢

◎ 引擎大馬力
◎ 船速提高
◎ 大斜軸角度
◎ 螺槳直徑限制
◎ 螺槳高推力密度
◎ 螺槳高空泡風險



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Non-dimensional Parameters
無因次參數

Froude Number, Speed Length Ratio

$$F_{nL}=\frac{V}{\sqrt{gL}} \qquad F_{nV}=\frac{V}{\sqrt{gV^{1/3}}} \qquad F_{nB}=\frac{V}{\sqrt{gB}}$$

$$\frac{V}{\sqrt{L}} \qquad \frac{V}{\sqrt{V^{1/3}}} \qquad \frac{V}{\Delta^{1/6}}$$

Cavitation Number $\sigma=\frac{P_0-P_V}{\frac{1}{2}\rho V^2}$

Local Cavitation Number $\sigma_{0.7R}=\frac{P_0-P_V}{\frac{1}{2}\rho V_R^2}$ $V_R^2=V_a^2+(0.7\pi nD)^2$

Mean Thrust Loading Coefficient $\tau_c=\frac{T/A_p}{\frac{1}{2}\rho V_R^2}$

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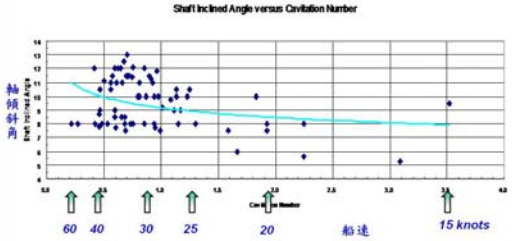
High Speed + High Shaft Inclined Angle
高速＋高軸傾斜角

High Risk on Cavitation (efficiency reduced + cavitation erosion)
高空泡風險(效率降低+空泡浸蝕)



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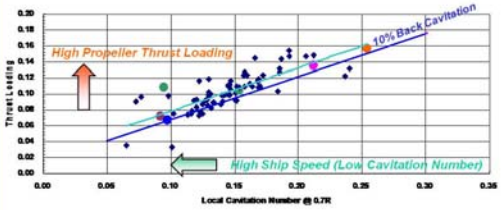
General Cavitation Trend Diagram
空泡趨勢_Gawn Burrill 圖表

High Ship Speed (Low Cavitation Number) 高速度(低空泡數)
High Propeller Thrust Loading (高螺槳推力負荷)
High Risk of Cavitation and Low Efficiency (高空泡浸蝕風險與低效率)



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高速艇螺槳應用現況(I)

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PJ 234 _ 15 knots _ 37.68 m
巨型遊艇

Engine: 2 x 1000 ps x 2100 rpm, 3.437:1
Cavitation number = 3.517, 0.254 @ 0.7R
Propeller: 48 x 46 x 5B x 0.85 NACA
Shaft inclination = 9.5 deg

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Fleming _ 15.5 m _ 18.5 knots
中型遊艇

Engine: 2 x 500 ps x 2600 rpm, 2.53:1
Cavitation number = 2.246, 0.212 @ 0.7R
Propeller: 31 x 30 x 4B x 0.90 KCA
Shaft inclination = 8 deg

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Carver 650 _ 16.6 m _ 31 knots
中型高速遊艇

Engine: 2 x 1370 ps x 2350 rpm, 2.467:1
Cavitation number = 0.812, 0.154 @ 0.7R
Propeller: 38 x 46 x 5B x 1.05 NF
Shaft inclination = 11 deg

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GC Patrol _ 13.7 m _ 41 knots

高速巡邏艇

Engine: 2 x 1100 ps x 2450 rpm, 1.525:1
Cavitation number = 0.464, 0.092 @ 0.7R
Propeller: 27.5 x 36.5 x 4B x 0.90 Cupping
Shaft inclination = 10.5 degrees

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Fast Patrol _ 11.2 m _ 51 knots

超高速巡戰艇

Engine: 2 x 700 ps x 2300 rpm, 1.485:1
Cavitation number = 0.273, 0.098 @ 0.7R
Propeller: 26 x 41 x 5B x 0.90 SPP
Stern Drive: SDS, inclination 8 degrees

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Tige _ 5.5 m _ 38 knots

滑水艇(ski boat)

Engine: 1 x 320 ps x 4600 rpm, 1.46:1
Cavitation number = 0.532, 0.095 @ 0.7R
Propeller: 13.5 x 16.5 x 4B x 0.80 Cupping

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高速艇螺槳應用現況(II)

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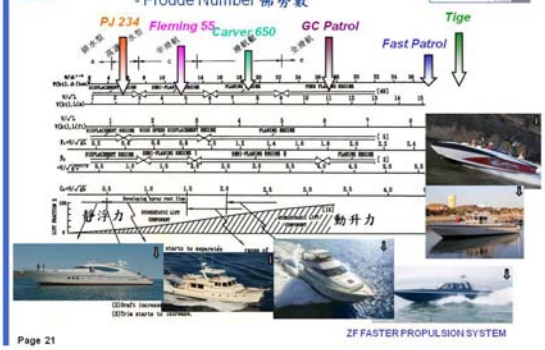
Speed versus Length, Displacement 速長比
- Froude Number 佛勞數



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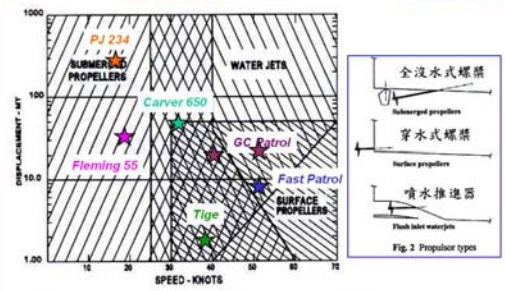
Trends for Propulsor Application
推進器應用趨勢



...nt trends for propulsor applications

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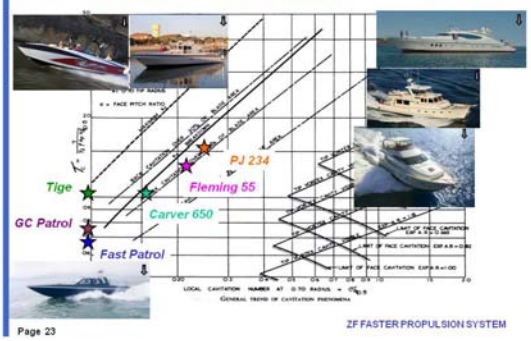
Cavitation Number versus Thrust Loading
局部空泡數(0.7R)與推力負荷關係圖



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高速艇螺槳系列與翼型斷面

Page 24 ZF FASTER PROPULSION SYSTEM

Propeller Blade Sections (Series) for different Speed Application
不同船速狀況適用之螺槳葉片斷面型狀

SHIP SPEED (Knots)	PROPELLER BLADE SECTION	PROPELLER BLADE SECTION
<25	AEROFOIL	MAU,Wageningen-B,NACA
25-35	AEROFOIL	MAU,Wageningen-B,NACA
	OGIVAL	Gawn, Gawn-Burrill (KCA)
	CRESCENT	Newton-Rader, New-Foil
35-40	CRESCENT	Newton-Rader, New-Foil
40-50	CRESCENT	Newton-Rader, New-Foil
	SC or SPP	Rolls, SUS
>50	SC or SPP	Rolls, SUS
30-50	Cupping	Cupping KCA or NF

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Propellers Series 螺槳系列

KCA – Series

Blades : 3, 4, 5
Pitch Ratio : 0.60-2.00
Area Ratio : 0.20-1.10
Skew Angles : 0 degree
Section Type : Ogival
Remarks : Most widely use propeller series.
Suitable for most applications.
Cupped available.

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Propellers Series 螺槳系列

Skew KCA – Series

Blades : 3, 4, 5
Pitch Ratio : 0.60-2.00
Area Ratio : 0.50-1.10
Skew Angles : 25 30 35 degrees
Section Type : Ogival
Remarks : Modified from standard
KCA series for smooth application.
Suitable for most applications.
Cupped available.

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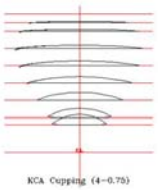
Propellers Series 螺槳系列

Cupping – Series



Blades : 3, 4, 5
Pitch Ratio : 0.60-2.00
Area Ratio : 0.50-1.10
Skew Angles : 0 25 30 35 degrees
Section Type : Ogival, Airfoil
Remarks : Modified from standard series.
Suitable for most applications.

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Propellers Series 螺槳系列

NACA – Series

Blades : 3, 4, 5, 6, 7
Pitch Ratio : 0.80-1.60
Area Ratio : 0.50-1.40
Skew Angles : According to design
Section Type : Airfoil
Remarks : Theoretical design propellers series.

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Propellers Series 螺槳系列

New Foil – Series

Blades : 3, 4, 5, 6, 7, 8
Pitch Ratio : 0.80-1.60
Area Ratio : 0.50-1.40
Skew Angles : According to design
Section Type : New Foil
Remarks : Theoretical design propellers series.

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Propellers Series 螺槳系列

Surface Piercing Propeller

Blades : 4, 5, 6
Pitch Ratio : 0.80-1.60
Area Ratio : 0.70-1.10
Skew Angles : According to design
Section Type : SPP

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高速艇螺槳使用材料

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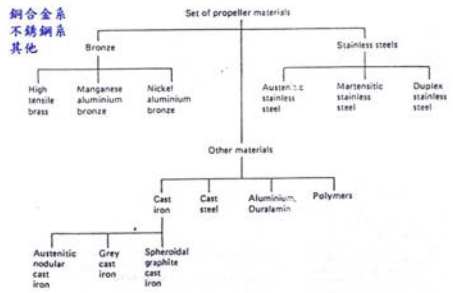
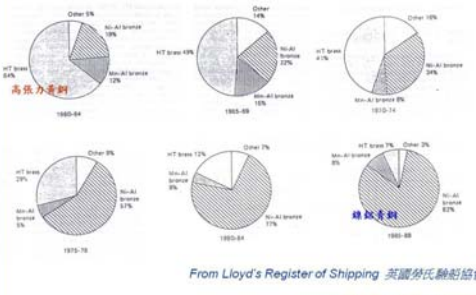
Propeller Materials Category
螺槳用材料分類



Popularity Progress of Propeller Materials
螺槳材料之演進 (1960-1988)



Propeller Material of Lloyd's Classification
英國勞氏驗船協會規定之螺槳材料

Steel Propeller Casting

Copper Alloy Casting

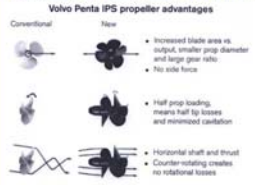
高速艇螺槳最新產品_小型英式推進器

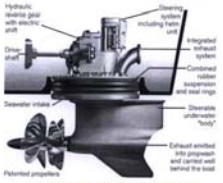
POD _ Volvo IPS 350/400/450/500/600

A revolutionary marine propulsion system

- demand for high speed, improved handling, enhanced onboard comfort and reduce emissions
- engine power ranging 350 to 600 hp
- suitable for 30 up to 50 feet planning hulls
- outstanding efficiency over 25-45 knots
- a reduced fuel consumption at 30 knots by 30%+

Volvo Penta IPS propeller advantages





New Rampage 34 with IPS Pod Drives - 07/09/2008

The new Rampage 34 will be one of the first express fishboats built in the U.S. with Volvo Penta's IPS drive system.

- better fuel mileage
- better performance
- better maneuverability
- run faster
- much easier to maneuver around docks with joystick technology
- 30%+ more fuel efficient than conventional inboard installations

Zeus® Pod Drive System

New ZF POD, Zeus Pod Drive
Powered by Caterpillar C9 ACERT @ 575 mhp x 2500 rpm
into a 44' Sea Ray reaches top speed of 39 knots

FASTER CRUSING, HIGHER TOP SPEEDS,
ENHANCING MANEUVERABILITY, FUEL ECONOMY
A Clean, Quiet, and Comfortable Ride plus Precise One-Hand Docking

- Joystick control to dock the boat with ease
- Reliable, smooth, hydraulic power steers the pods
- Actuates the integrated trim tabs
- Allows each pod to be steered independently, leads to much smoother and more accurate maneuverability
- The thrust from pod drives is horizontal compared to standard inclined shaft
- Minimize drag of pod shape than a shaft, strut and rudder
- Counter-rotating propellers eliminate rotational loss, produce no lateral forces and minimize cavitation
- Noise and vibration are significantly reduced, resulting in a quiet, comfortable ride
- A dedicated trolling valve enables lowest speeds

Thank you
谢谢指正

四、授課照片

<table>
<tr><td colspan="2">97 年 12 月 31 日：高速艇螺槳發展趨勢與展望</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>主任介紹演講者－王武雄總經理</td><td>說明高速艇螺槳發展趨勢與展望</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>說明高速艇螺槳運轉環境</td><td>高速艇螺槳推進系統布置－雙俥雙舵</td></tr>
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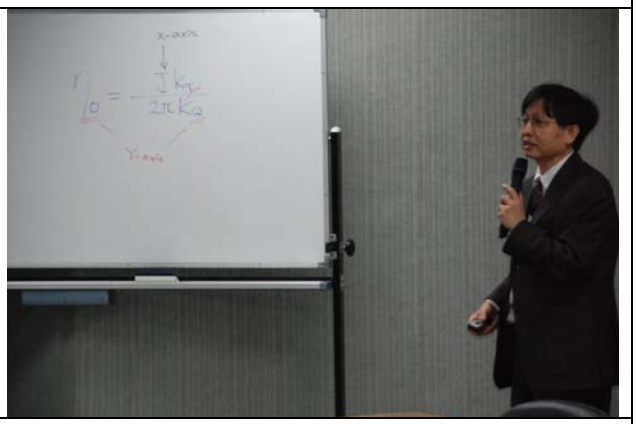
<tr><td>  </td><td>  </td></tr>
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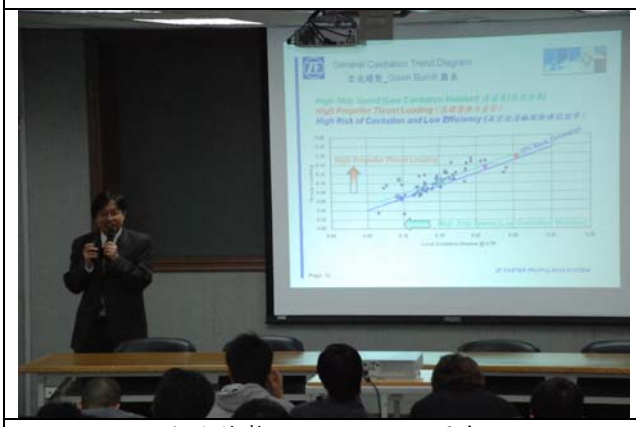
<tr><td>空泡狀態下螺槳性能、推力、扭力與效率</td><td>高速螺槳之一般趨勢</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>空泡趨勢_Gawn Burrill 圖表</td><td>頒發遊艇設計獎學金</td></tr>
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五、演講內容