THE DESIGN AND CONSTRUCTION OF THE NEW SYDNEY CATAMARAN FERRIES

Notes to accompany the lecture to be delivered by Mr. Alan Payne, F.R.I.N.A., M.I.E. (Aust), Chartered Engineer (Australia) to a meeting of the Institute of Marine Engineers and the Royal Institution of Naval Architects, 28th August 1985.

Attached for reference during the lecture are reduced-scale copies of various drawings and diagrams as follows:-

1. General Arrangement
2. Frame Body Plan
3. Lines Plans - Designs BB and C
4. Lines Plan - Design A
5. Typical Diagram of Wave Heights
6. Arrangement of 1:3 scale model
7. Test rig to measure thrust of twin outboard motors
8. Extract from "Basic Naval Architecture" by K.C. Barnaby.

The principal purpose of the lecture is to discribe a method of developing a new design when the design is for a type of vessel which is not closely similar to existing vessels. The method is an alternative to the usual procedure of conducting model tests via the large established design research organisations, all of which are situated far from Australia. It will be suggested that the method has advantages for dealing with any unusual local design problems.

The under-noted list of tasks and prices is taken from an offer by an established research organisation. The prices shown are in Australian dollars and are approximately as were quoted in early 1980, for a catamarn ferry design.

. Manufacture of a 3.5 metre model, with appendages.	$9,800
. Resistance tests, one hull shape without modification, bare hull.	$4,200
. Similar tests, but with appendages.	$6,900
. Wave height tests, with movie-film record.	$2,700
. Manoeuvring tests, one hull shape.	$30,000

These items can add up to about $70,000 in 1980 money to try out one hull shape. Alterations to hull shapes involve extra costs which can only be guessed at, depending on which tests are repeated. It will be noted that manoeuvring tests are expensive.

Diagram No.5, the wave graph, is included to show the scatter of the observed data, and the amount of difference between hull forms.

The graph is not intended to be indicative of the wave heights produced by the Sydney Harbour ferries as built.

The principal dimensions and characteristics of the Urban Transit Authority's Sydney Harbour twin-hull ferries are as follows:

Length overall	25.37 metres
Length on normal full load waterline	24.42 metres
Breadth moulded over hulls	9.60 metres
Breadth extreme over fenders	10.0 metres

Construction in aluminium alloy:-

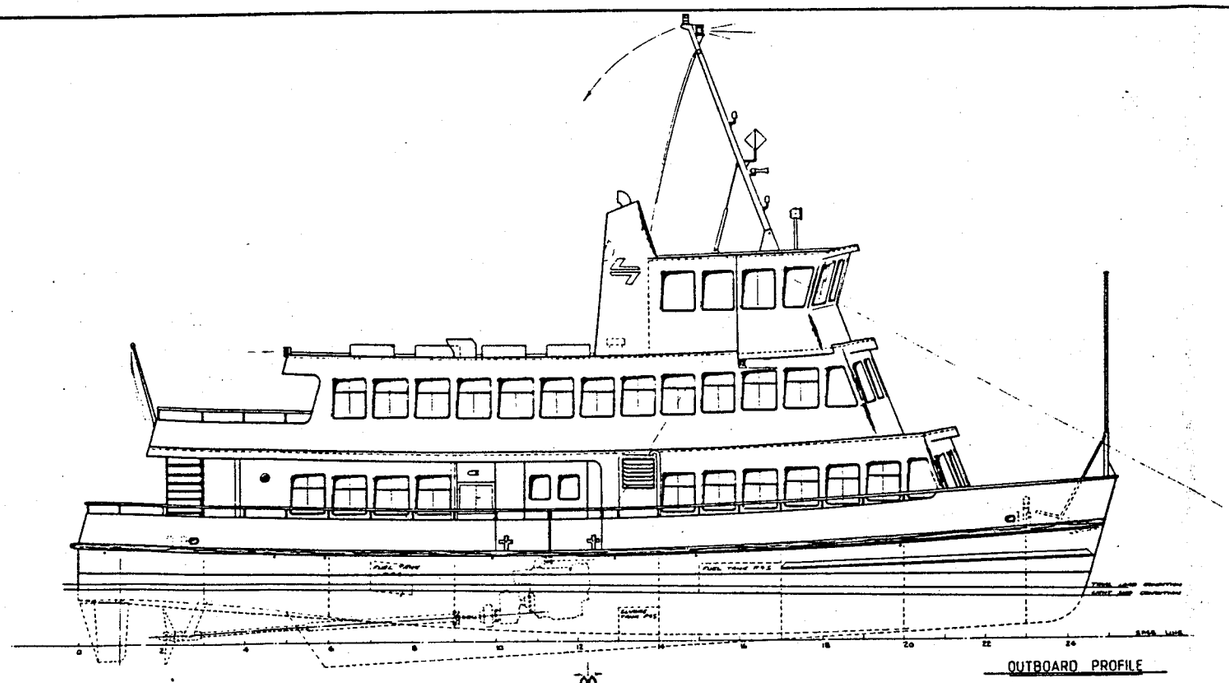
Transverse web frames spaced 1 metre and longitudinal flat bar frames 65 mm x 8 mm, spaced not more than 400 mm.

Shell plating 8 mm on outer side of hulls, 6 mm on the inner side, 10 mm bottom, increased to 12 mm at propellers and rudders.

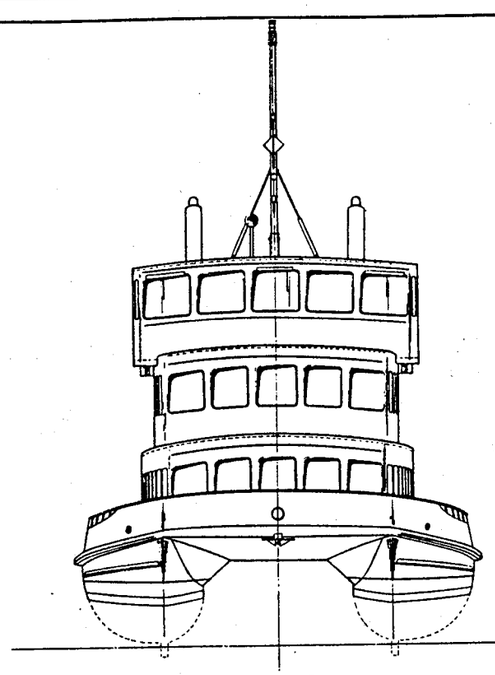
Main deck plating generally 8 mm.

Deck house sides and upper deck plating generally 4 mm.

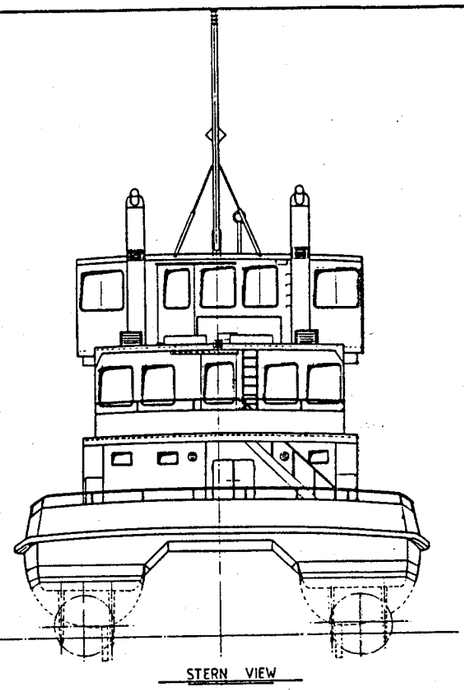
Light ship displacement	64.0 tonnes
Draft at normal full load	1.95 metres
Normal full load displacement 250 passengers 3 tonnes fuel	83.2 tonnes
Designed deep load displacement with 250 passengers & 8 tonnes fuel	88.2 tonnes
Designed maximum power output of main engines at Maritime Services Board rating	375 Kw per engine, 750 Kw total
Speed at normal full load and Maritime Services Board rated power	14.3 knots



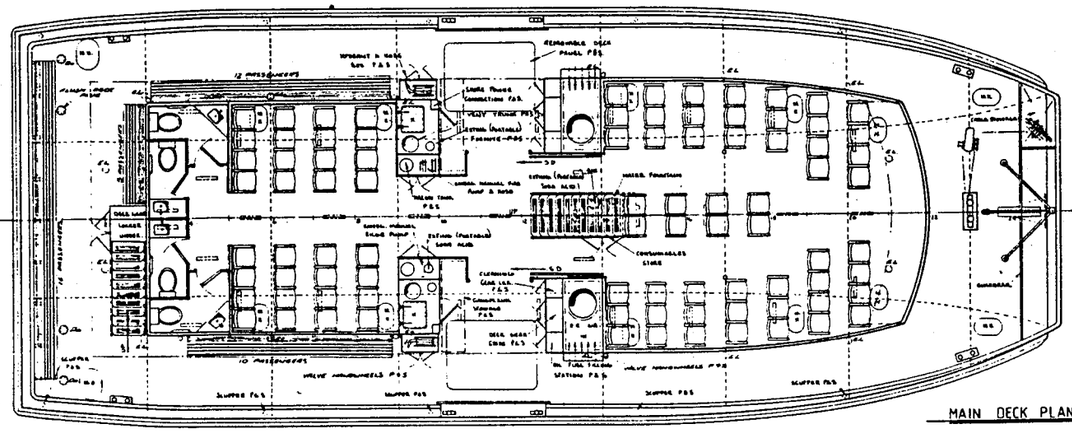
OUTBOARD PROFILE



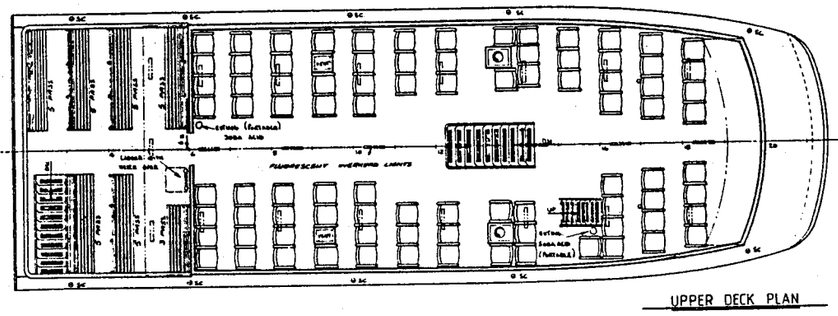
BOW VIEW



STERN VIEW



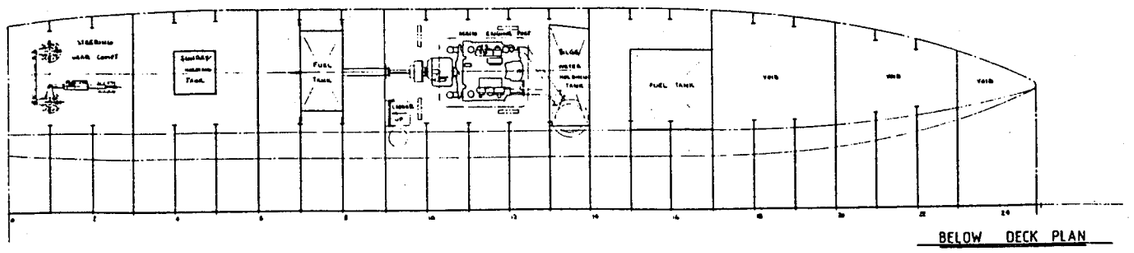
MAIN DECK PLAN



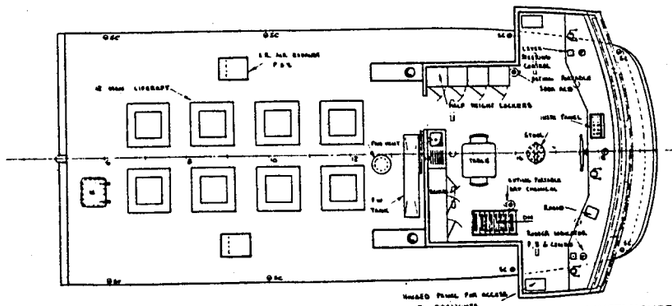
UPPER DECK PLAN

PRINCIPAL DIMENSIONS

LENGTH OVERALL	25·37 METRES
MEASURED LENGTH	24·90 METRES
BREADTH MOULDED	9·60 METRES
DRAUGHT TRIAL CONDITION	1·95 METRES
DISPLACEMENT	83 TONNES
PASSENGERS - MAIN DECK	129
UPPER DECK	121
TOTAL	250



BELOW DECK PLAN



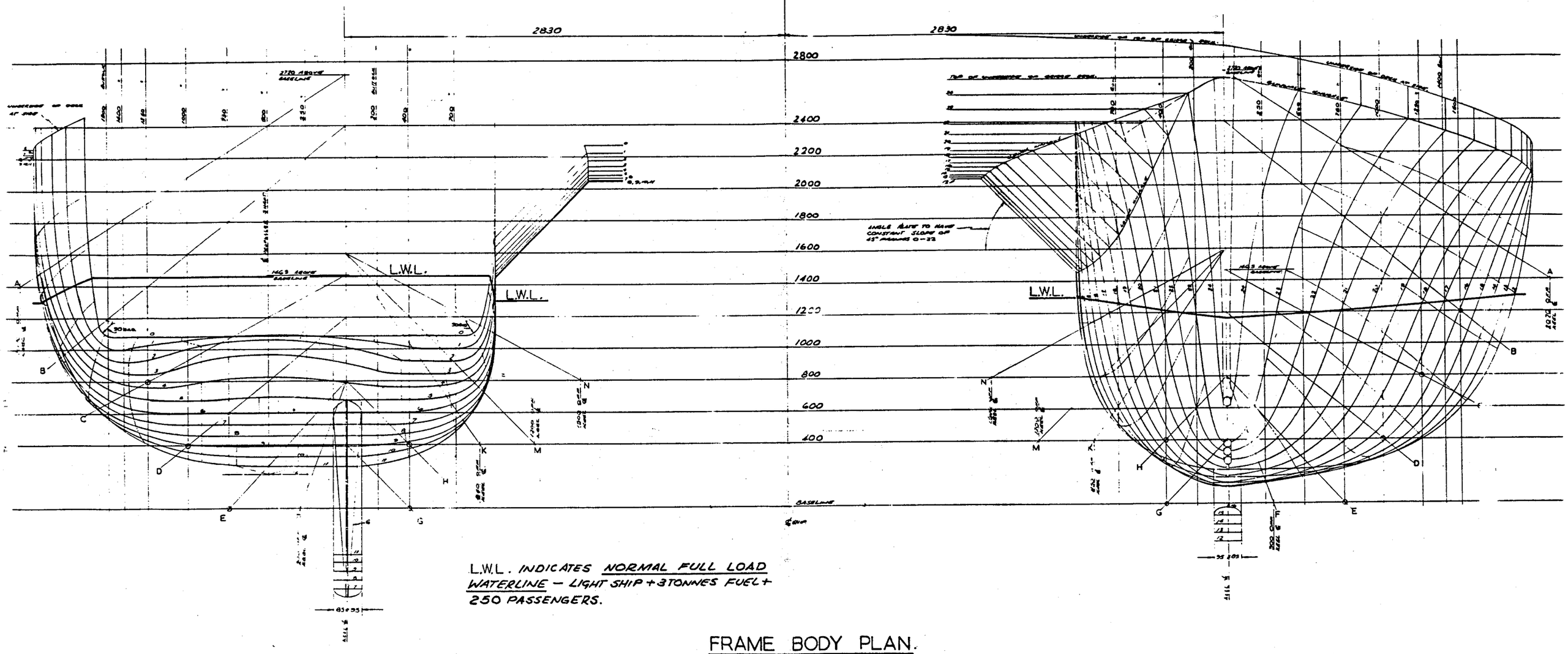
WHEELHOUSE DECK PLAN

REVISION	MODIFICATIONS	DATE
E	SUPPORT BOAT LINE AND STATION LINES	12/8/93
D	ADD EXTRA SUPPORTS FOR MAIN DECK MONOWHEELS. REFER TO 3D MODELLING CONFIGN. PILLARS 100dB ON MAIN DECK & WHEEL DRGS. M 7614 17 P&S SPRAY RAILS 100dB - 60dB SHOR TUMP RAILS.	
C	AS PER TENDER DRAWINGS	

PROJECT	TITLE
24·9m ALUMINIUM CATAMARAN FERRY for URBAN TRANSIT AUTHORITY for SYDNEY HARBOUR SERVICE	GENERAL ARRANGEMENT
SEAWORK PTY. LTD. IN ASSOCIATION WITH ALAN PAYNE AND PARTNERS PTY. LTD.	

DRAWN	N BALLARD	DRAWING No.	SERIAL No.
DATE	14 - 1 - 93	8010/2E	
SCALE	1 : 50		
ISSUED			

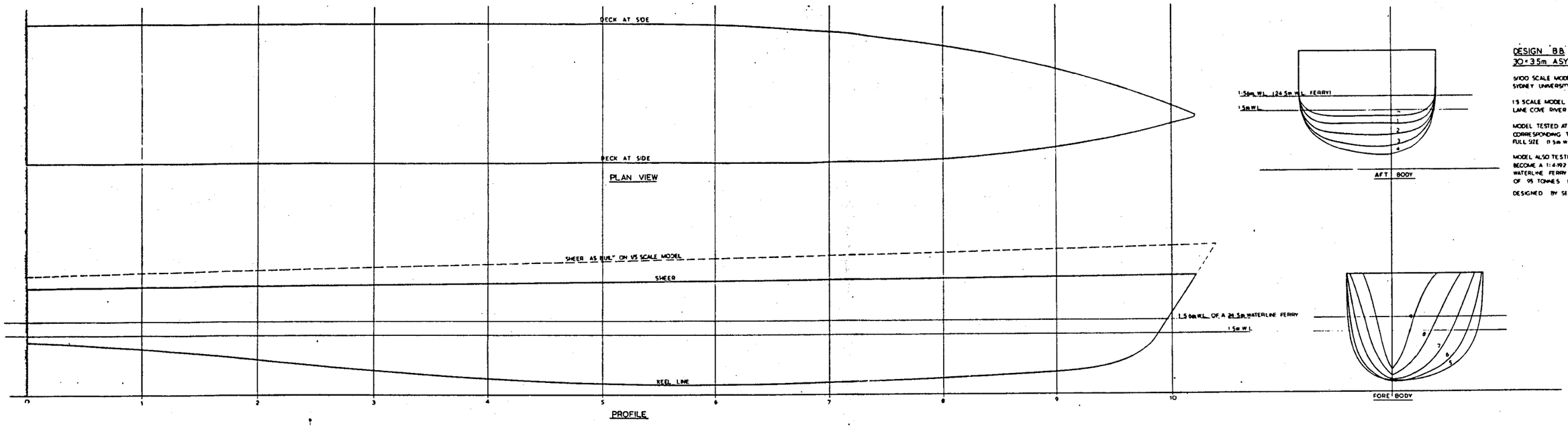
DIAGRAM 1



L.W.L. *INDICATES* NORMAL FULL LOAD WATERLINE – LIGHT SHIP + 3 TONNES FUEL + 250 PASSENGERS.

FRAME BODY PLAN.

DIAGRAM 2



PLAN VIEW

PROFILE

DESIGN BB
30 × 3.5m ASYMMETRIC DEMI HULL.

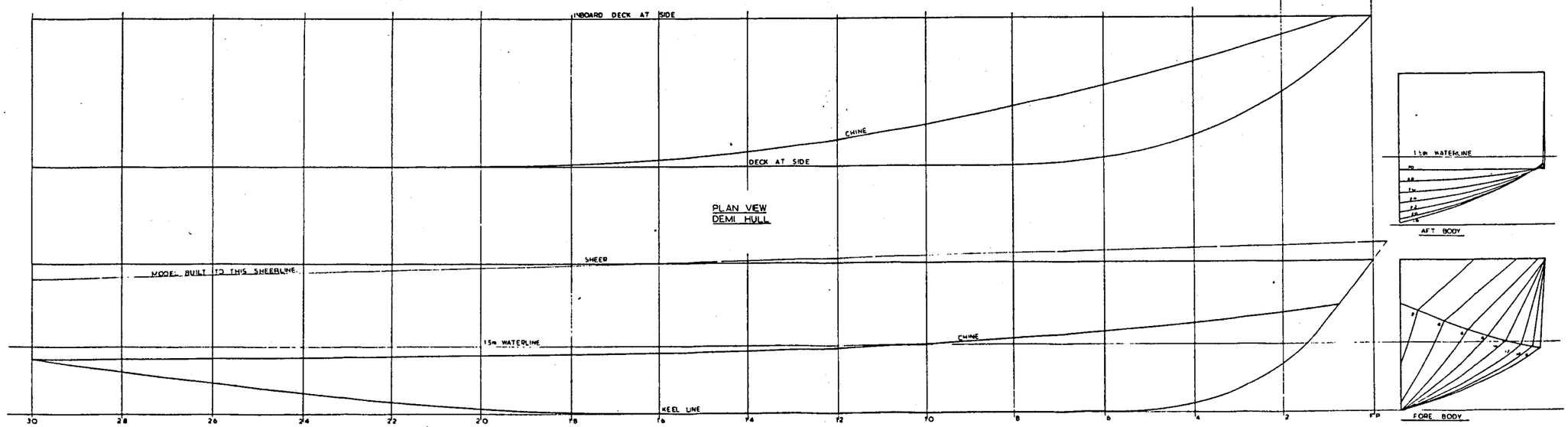
1/100 SCALE MODEL TESTED AT SYDNEY UNIVERSITY TOWING TANK

1:5 SCALE MODEL TESTED ON THE LANE COVE RIVER

MODEL TESTED AT A DISPLACEMENT CORRESPONDING TO 100 TONNES FULL SIZE (1.5m W.L.)

MODEL ALSO TESTED ON THE LANE COVE RIVER, BALLASTED TO BECOME A 1:4·92 SCALE MODEL OF A 24.5m WATERLINE FERRY WITH A DISPLACEMENT OF 95 TONNES 1.56m W.L.

DESIGNED BY SEAWORK/ALAN WYNNE & PARTNERS



PLAN VIEW
DEMI HULL

PROFILE

DESIGN 'C'
30 x 3.25m ASYMMETRIC DEMI HULL.

1:5 SCALE MODEL TESTED ON THE LANE COVE RIVER

MODEL TESTED AT A DISPLACEMENT CORRESPONDING TO 100 TONNES FULL SIZE

THIS MODEL WAS ALSO TESTED AT BROOKLYN WITH THE FLAT SIDES OF THE HULLS OUTBOARD

DESIGNED BY WYNNE MARINE INC

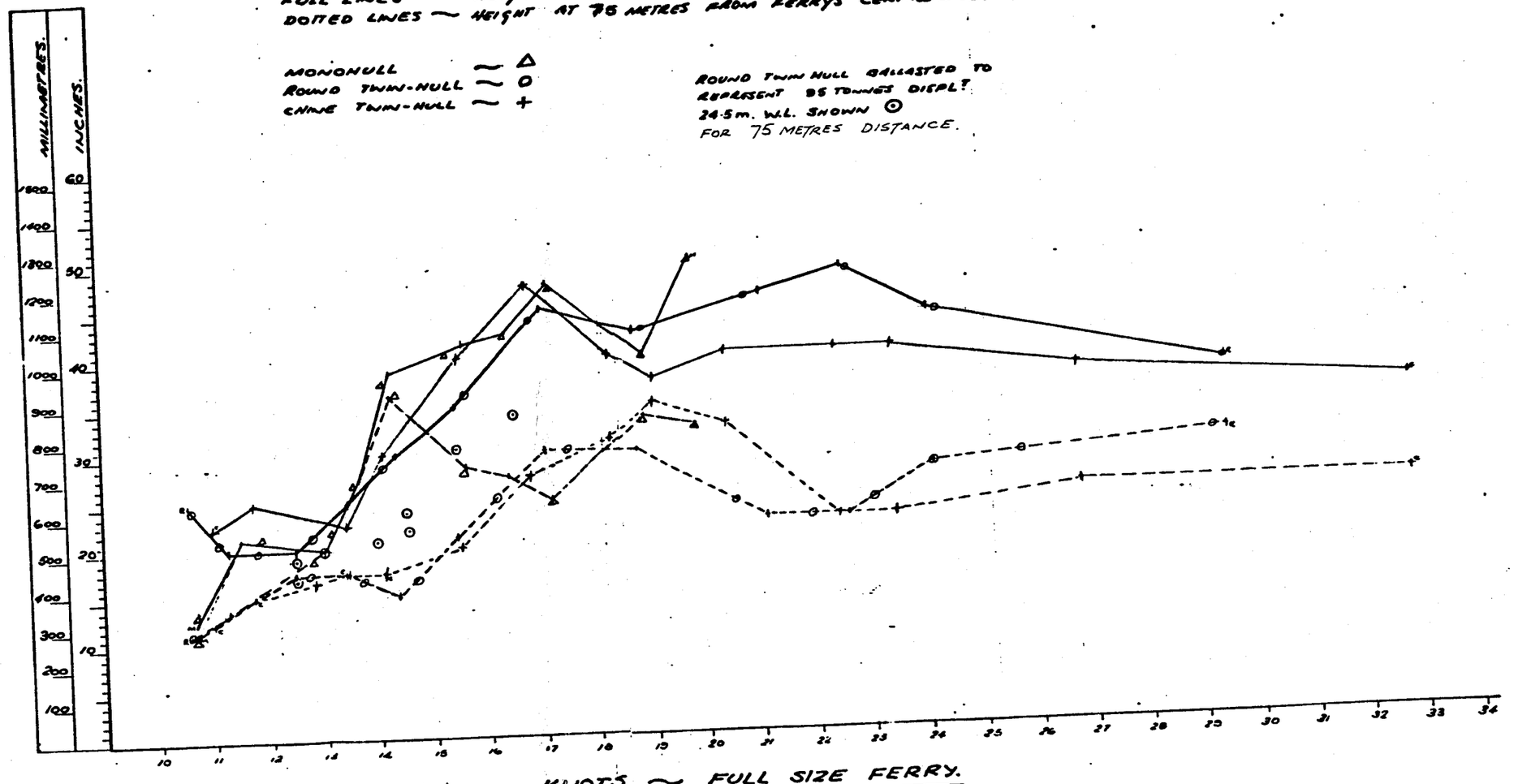
DIAGRAM 3

FULL LINES — HEIGHT AT 10 METRES FROM FERRY'S CENTRELINE.
DOTTED LINES — HEIGHT AT 75 METRES FROM FERRY'S CENTRELINE.

MONOHULL — △
ROUND TWIN-HULL — o
CHINE TWIN-HULL — +

ROUND TWIN HULL BALLASTED TO REPRESENT 85 TONNES DISPL.?
24.5m. W.L. SHOWN ⊙
FOR 75 METRES DISTANCE.

WAVE HEIGHT
FULL SIZE FERRY.



KNOTS ~ FULL SIZE FERRY.

DIAGRAM 5

ARRANGEMENT OF 1:3 SCALE MODEL.

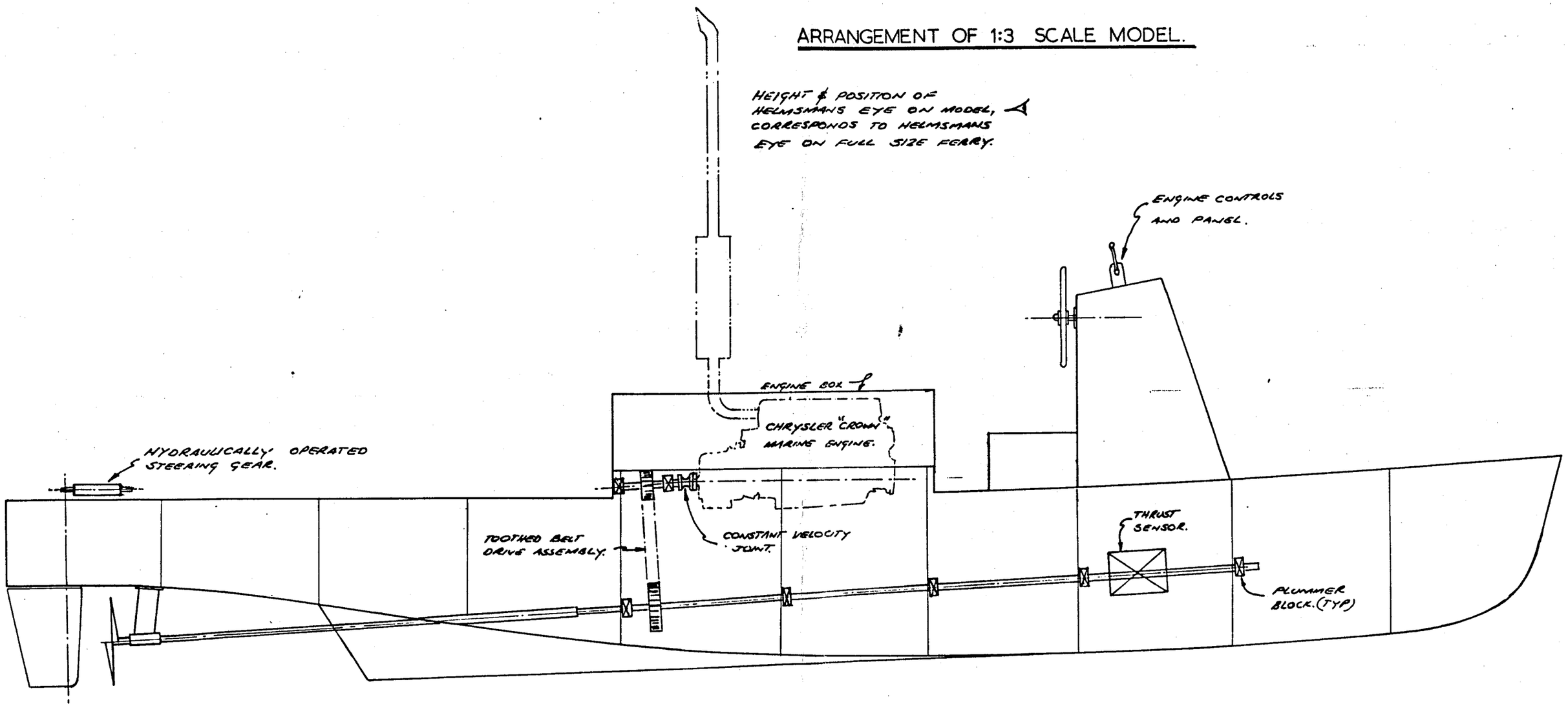


DIAGRAM 6

TEST RIG DIAGRAM.

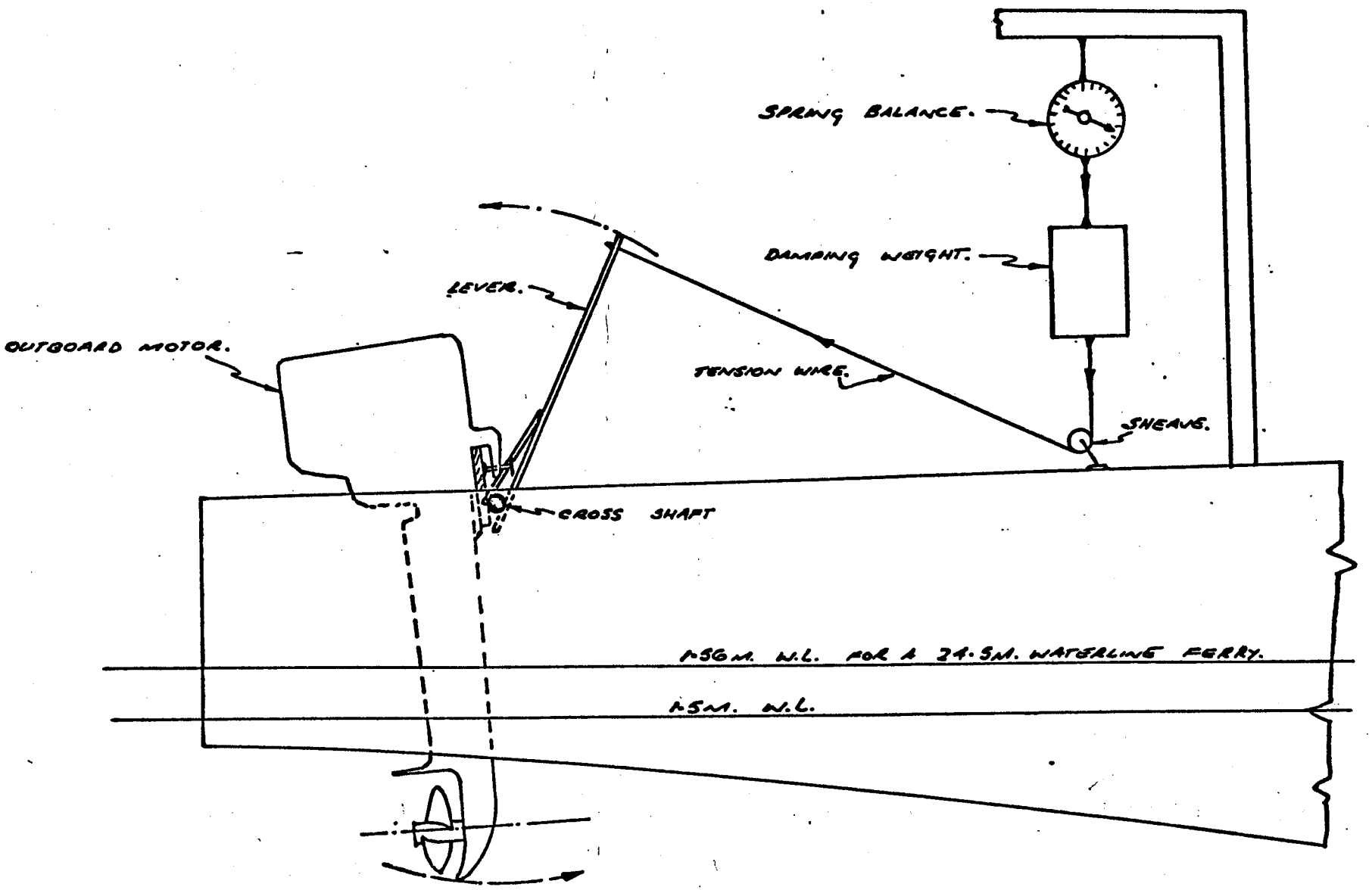


DIAGRAM 7

to run at speed/length ratios in excess of $V/\sqrt{L} = 1{\cdot}25$. Curves for the frictional resistance Rf to the same basis of lb. per ton and on the assumption of a 50-ft. vessel have been added for the sake of comparison.

It will be noted (from fig. 74) that the residuary resistance is very low above $N = 3$ or $V/\sqrt{L} = 0{\cdot}775$ but increases at a quickening rate to about $N = 1{\cdot}8$ when $V/\sqrt{L} = 1{\cdot}0$. The rate of increase then slows down to about $N = 1{\cdot}63$ or $V/\sqrt{L} = 1{\cdot}05$. Above this point the curve becomes exceedingly

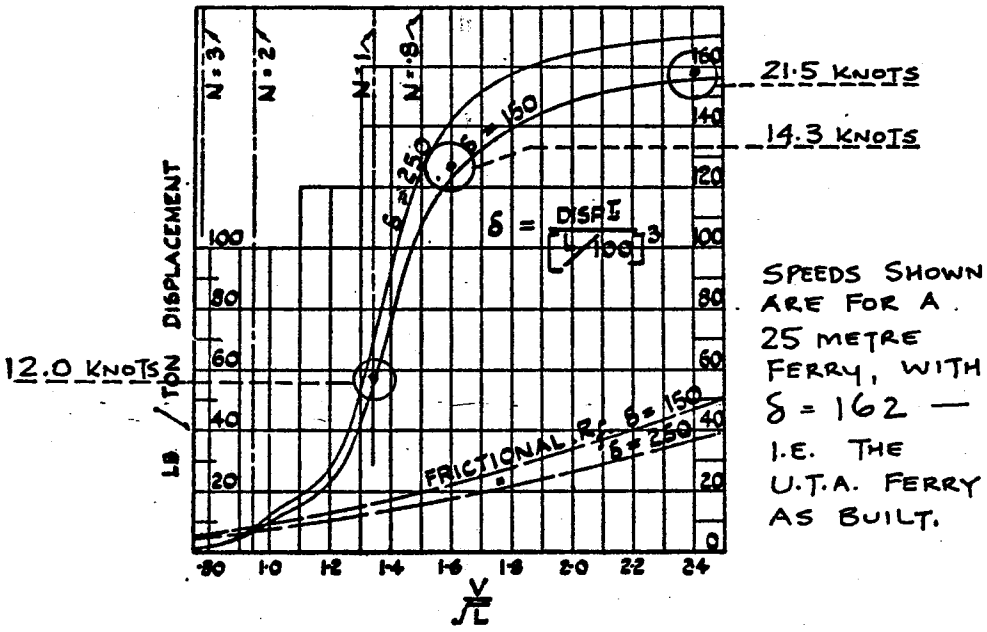


Fig. 74.

CURVES OF RESIDUARY RESISTANCE FOR SMALL POWER VESSELS OF ABOUT $Cp = 0{\cdot}64$ AND COMPARATIVE CURVES OF FRICTIONAL RESISTANCE. FOOT, POUND, TON, AND KNOT UNITS.

steep until about $N = 0{\cdot}8$ or $V/\sqrt{L} = 1{\cdot}5$. The remaining portion of the curve is flattening out and approaching the horizontal, that is to a nearly constant residual resistance.

If the wave amplitude ratio is assumed to be about 25% greater when $N = 1$ than when $N = 6$, energy requirements for the transverse system suggest that residuary resistance might increase by about $1{\cdot}25^2 \times 6^2$, or about 56 times between $V/\sqrt{L} = {\cdot}547$ and $V/\sqrt{L} = 1{\cdot}34$. Examination shows increases of about the order suggested by this very crude method. The tremendous variation of resuduary resistance with speed/length ratio will be very evident. It has been seen (art. 122) that one half of the energy in a wave system (the kinetic energy) remains bound to the wave and only

DIAGRAM 8