165 190

No 1985 122

- [ ] NEW PROPOSAL
- [ ] CONTINUING PROJECT
- [x] FINAL REPORT
- [ ] PROGRESS REPORT

FISHING INDUSTRY RESEARCH TRUST ACCOUNT

TITLE OF PROPOSAL/PROJECT: Underwater Filming and flume tank testing of conventional and horizontal louvred otterboards.

ORGANISATION: Australian Maritime College

PERSON(S) RESPONSIBLE: Mr. F. Chopin

FUNDS SOUGHT/GRANTED

YEAR	SOUGHT	GRANTED
1985/86	$72 724	$11060

RELATED APPLICATIONS:

RECEIVED 30/9/1986

DISTRIBUTED ..../..../19...

Kennedy for
Secretary
Fishing Industry Research Committee

F139–12/84

189

Australian Maritime College

Principal: Capt. D. M. Waters, M.Sc., Extra Master Mariner

Telephone: (003) 260711
Telex: AMC 58827

Reference: 274/1/A

Enquiries:

P.O. Box 986
Launceston
Tasmania
Australia 7250

24 September, 1986.

Ms. G. Stablum,
Secretary,
Fishing Industry Research
Committee,
Department of Primary Industry,
CANBERRA, A.C.T. 2600.

Dear Ms. Stablum,

Please find enclosed a copy of the final report on "Underwater filming and flume tank testing of conventional and horizontal louvred otterboards" FIRTA Project 85/122.

I also wish to inform you that a copy of this report has been sent to Dr. Mike Walker, Perth, Western Australia.

Should you require any further information, please do not hesitate to contact us.

Yours sincerely,

K McLiddell

for P. McGOVERN
Deputy Principal/
Head of School of Fisheries

enc.

188

UNDERWATER FILMING AND FLUME TANK TESTING OF CONVENTIONAL AND HORIZONTAL LOUVRED OTTERBOARDS

FIRTA PROJECT No.85/122

187

1. INTRODUCTION

In Australia, all the offshore prawn resources are harvested using some form of ottertrawl (Bowen and Hancock 1985, Haysom 1985). The basic prawn ottertrawl consists of a net held open by a set of otterboards attached to the end of each wing of the net. A set of bridles and warps connected to the otterboard towing bracket connect the otterboard to the fishing vessel. There are many variations of this basic set-up as shown in Figure 1.

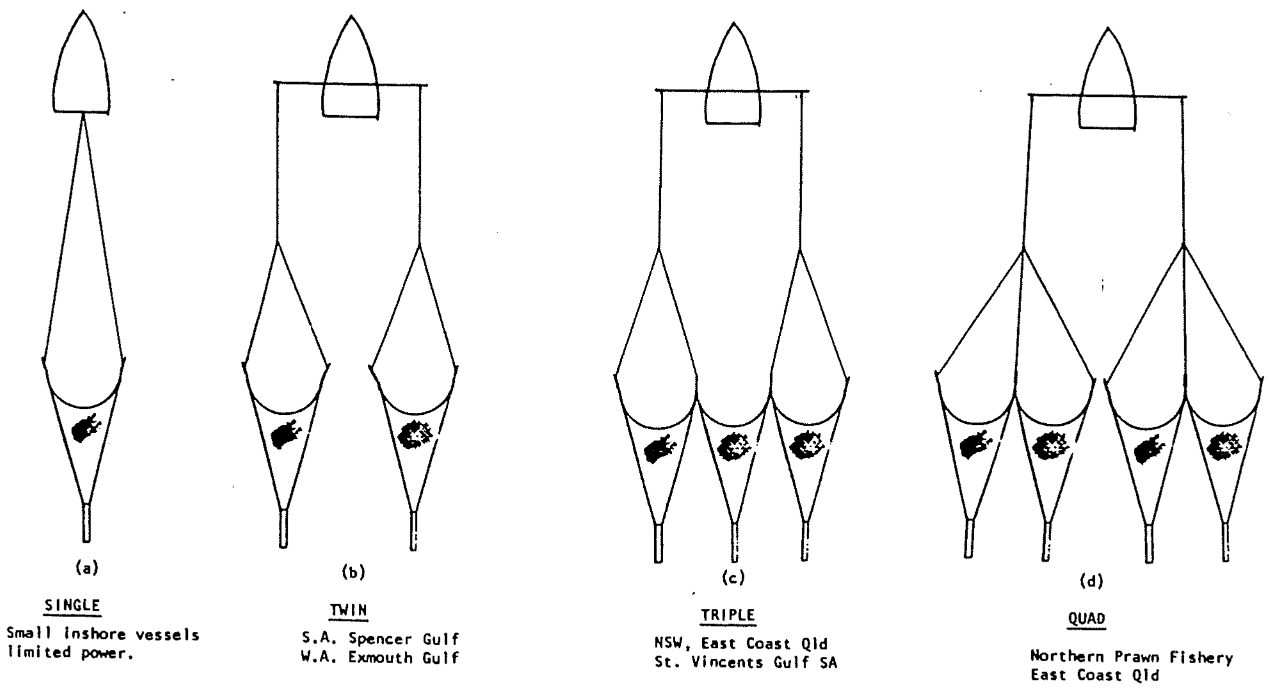


Fig. 1 : Variations on ottertrawl rigs used in prawn trawling

As the net is towed through the water a complex set of forces are generated which, when in equilibrium, hold the net open in a stable position. The eventual geometric shape of the fishing gear i.e. the net spread, otterboard spread, vertical opening etc., will depend on the size of each force generated by the fishing gear components. To make the analysis of these forces easier they are by convention, resolved into components of lift and drag (see Figure 2), the size of each being determined by the dimensions and shape of the component, its orientation in the water flow and the towing speed.

3. RESULTS

The filming trials were carried out in July 1985 at Jervis Bay, New South Wales. Some video and slide film was collected of both the horizontal louvred otterboards and rectangular flat otterboards connected to a 14.6 metre Headline length Florida Flyer prawn trawl.

3.1 DIVERS OBSERVATIONS OF HORIZONTAL LOUVRED OTTERBOARDS

The first run was carried out above 3.0 knots and included a high speed turn to port. The diver observing the otterboards had great difficulty hanging onto the net for more than a very short period but the otterboards seemed to hold the bottom well and were stable throughout the turn (at a speed of 3.5 knots the footrope of the net was off the bottom). Further runs were made between 2.0 and 2.5 knots with the towing point set 6.3cm below centre, however this made the otterboards very difficult to shoot away and was reduced back to 2.5cm below centre which improved shooting performance. At 2.5cm below centre divers noted that the otterboards heeled slightly inwards. Water flow through the slots in the otterboard were observed by tying white nylon "tell tales" to sections of the otterboard. Divers noted that the "tell tales" attached in the angled slots streamed upwards at the front section of the otterboard but parallel to the otterboard further aft. There were noticeably smaller sand clouds generated than with the rectangular otterboards. Angle of attack was estimated at 38 degrees.

In order to investigate the waterflow characteristics in more detail a dye bag was streamed in front of the starboard otterboard. The dye from the bag flowed across the otterboard before some of it emerged from between the slots near the aft end of the otterboard. The otterboards were quite stable but were not pressed particularly hard on the seabed, it was possible for the diver to lift the otterboards a little off the bottom.

Headline spread of the Florida Flyer using the horizontal louvre otterboards was 9.8 metres (67% of total headline length) at 2.0-2.5 knots. Good video footage was obtained of the net and otterboards.

3.1.1 DIVERS OBSERVATIONS OF RECTANGULAR FLAT OTTERBOARD

The 2.4m long Humphrey otterboards are a lightly constructed flat wooden otterboard with steel towing brackets popular with East Coast prawn fishermen. Generally, the towing point is set slightly below centre to ensure the otterboards heel outwards to give a downward shearing force to help keep the otterboards in seabed contact. The headline and fishing line are attached directly to towing lugs on the aft end of the otterboard. The hydrodynamic characteristics of the otterboard are similar to any other rectangular flat otterboard. Sometimes a plank is removed to reduce board area and prevent overspreading the trawl nets.

At just over 2.0 knots the otterboards heeled out slightly and were slightly nose up. The angle of attack was estimated at about 35° and they generated large sand clouds which partly obscured the wingends of the trawl. They took the bottom well without digging in excessively and flexed about to accommodate irregularities in the seabed. They were very stable and the divers were unable to disturb them significantly by hanging onto them or the lifting strap secured to the top of the otterboard. Headline spread was 11.1 metres between the wings (76% of total headline length). Good video footage was obtained of the otterboards and net.

The initial observations of the horizontal louvred otterboards indicated that they did have good stability although no better than the rectangular flat otterboards. The measured otterboard spread with the horizontal louvred otterboards was slightly less than the rectangular flat otterboards (67% compared to 76%), however since angle of attack of the otterboards or accurate towing speeds were not measured it is not possible to give reasons for these different spread figures.

3.2 FLUME TANK TESTS

Testing of both horizontal louvred otterboards and rectangular flat otterboards was completed in July 1986. A revised testing schedule had to be made when it was found that both types of otterboards lifted off the seabed at warp/depth ratios greater than 3:1 and at speeds greater than 3.0 knots trawling speed for steep warp/depth ratios. The revised schedule is shown in Appendix III.

3.2.1 WARP/DEPTH RATIO

The horizontal louvred otterboard stayed in full seabed contact at warp/depth ratios up to 3:1 when rigged at an otterboard angle of 37 degrees and 5cm below centre. At a warp/depth ratio of just over 3:1 the back end of the Horizontal louvred otterboard started to lift off and total seabed contact lost at a warp/depth of 2.5:1 (see Table 1). Otterboard heel (see Fig.9) increased with decreasing warp/depth ratio i.e. the otterboards started to lay outwards as the warp/depth ratio was decreased. Otterboard spread reduced greatly as seabed contact was reduced.

When the towing point on the horizontal louvred otterboards was put back to centre, otterboard spread increased to 9.5 metres (65%) and the otterboards heeled outwards 5 degrees. However the otterboards started to lift off the seabed at a shallower warp/depth ratio than when rigged 5cm below centre.

The rectangular flat wooden otterboards were rigged at an otterboard angle of 37 degrees and 5cm below centre. The otterboards stayed in seabed contact at warp/depth ratios up to 3:1 but were completely off the seabed when the warp/depth ratio was reduced to 2.5:1. The angle of heel increased with decreasing warp/depth ratio. Maximum otterboard spread was 9.5 metres (65%).

OTTERBOARD TYPE	WARP/DEPTH RATIOS	OTTERBOARD ANGLE	TOWING POINT POSITION BELOW CENTRE	HEADLINE SPREAD (m)	%	ANGLE OF HEEL	COMMENTS
Louvred	4.0	37°	0	9.5	65	5°	Good seabed contact
Louvred	3.5	37°	0	9.5	65	5°	Light seabed contact
Louvred	3.0	37°	0	8.5	58	15°	Otterboards off seabed 0.3m
Louvred	2.5	37°	0	6.5	44	15°	Otterboards off seabed 5m
Louvred	2.0	37°	0	6.5	44	20°	Otterboards off seabed 9.0m
Flat	4.0	37°	5cm	9.5	65	10°	Good seabed contact
Flat	3.5	37°	5cm	9.5	65	15°	Good seabed contact
Flat	3.0	37°	5cm	9.5	65	15°	Light seabed contact
Flat	2.5	37°	5cm	9.25	63	15°	Otterboard off seabed 1.3m
Flat	2.0	37°	5cm	9.25	63	15°	Otterboard off seabed 8.4m
Louvred	4.0	37°	5cm	8.75	60	20°	Good seabed contact
Louvred	3.5	37°	5cm	8.75	60	20°	Good seabed contact
Louvred	3.0	37°	5cm	8.0	55	25°	Light seabed contact
Louvred	2.5	37°	5cm	5.0	34	25°	Otterboards off seabed 4.5m
Louvred	2.0	37°	5cm	5.0	34	25°	Otterboards off seabed 9.0m

Table 1 : The effect of warp/depth ratio on headline spread and angle of heel at constant speed (3.0 knots)

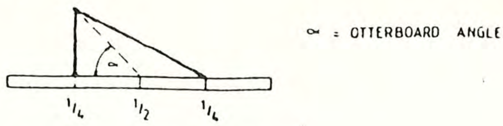
3.2.2 OTTERBOARD ANGLE

Gear drag increased with increasing otterboard angle (see Fig.3 for definition) for both designs of otterboard. Table 2 compares both net spread and gear drag for the two designs of otterboard at 3.0 knots. The gear drag for the rectangular otterboard was on average 16% greater than for the horizontal louvred otterboards.

	RECTANGULAR FLAT			HORIZONTAL LOUVRE		
Otterboard Angle (degrees)	30°	35°	40°	30°	35°	40°
Wing spread (m)	9.0	9.75	9.75	9.0	9.75	9.5
% Headline Spread	61.5%	66.6%	66.6%	61.5%	66.6%	64.9%
Gear Drag (kN)	4.27	4.74	4.90	3.4	3.95	4.11
Angle of Attack (degrees)	33°	36°	38°	30°	32°	34°

Table 2 : A comparison of gear drag and wing spread for rectangular flat and horizontal louvred otterboards at 3.0 knots.

There were no significant differences in headline spread when using either the rectangular flat otterboards or horizontal louvre otterboards.



PLAN VIEW OF OTTERBOARD AND TOWING CHAINS

TRUE ANGLE OF ATTACK

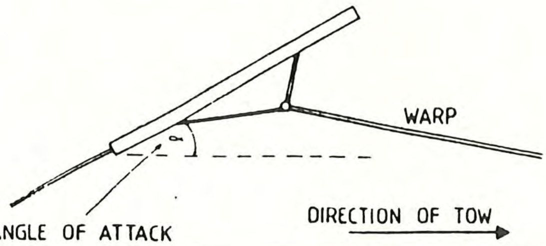


Fig. 3 : Otterboard angle referred to in the text (top) and true angle of attack.

3.2.3 GEAR DRAG

Gear drag was found to increase linearly with speed for all rigs tested. Table 3 compares the gear drag for both designs of otterboards over the towing speed test range. Overall drag was about 16% less for the horizontal louvred otterboards (Fig.4).

	RECTANGULAR FLAT				HORIZONTAL LOUVRE			
Towing Speed (knots)	2.0	2.5	3.0	3.5	2.0	2.5	3.0	3.5
Headline Spread (metres)	8.75	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Gear Drag (kN)	2.53	3.16	4.27	6.32	2.21	2.53	3.40	6.32

Table 3 : Comparison of gear drags for rectangular flat and horizontal louvre otterboards

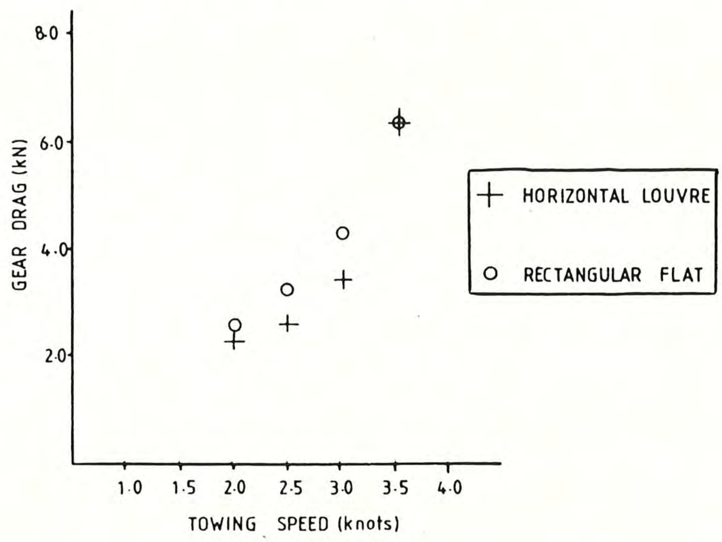


Fig.4 : Comparison of gear drag at various speeds using rectangular flat and horizontal louvre otterboards

3.2.4 COMPARISON OF NET SPREAD

When attached to the same size net and rigged at the same otterboard angle, there were no significant differences between the headline spreads when using either the rectangular flat or horizontal louvre otterboards (Fig.5).

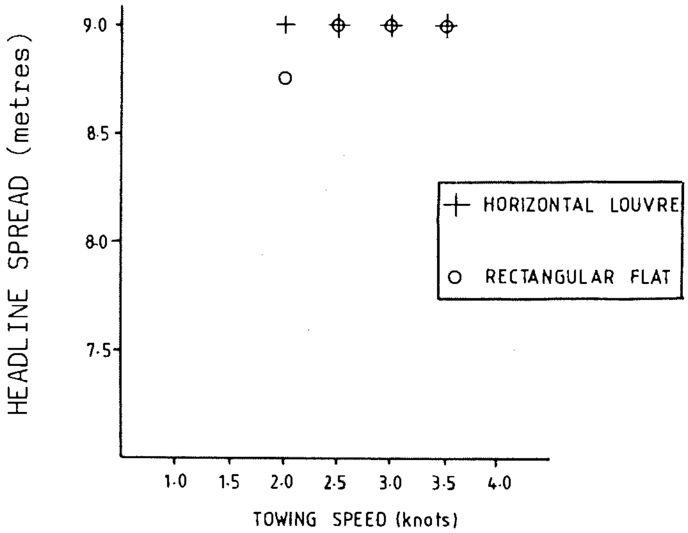


Fig.5 : Comparison of wing spread for various towing speeds rectangular flat and horizontal louvre otterboards

3.2.5 COMPARISON OF TOTAL GEAR DRAG

The Horizontal louvre otterboards did have about 16% less drag than the same nominal surface area rectangular flat otterboards (see Fig.4).

3.2.6 COMPARISON OF SEABED CONTACT BETWEEN RECTANGULAR AND HORIZONTAL LOUVRED OTTERBOARDS

The ability of the otterboard to maintain seabed contact was measured by adjusting the warp/depth ratio till the otterboards started to lose seabed contact. Both designs of otterboard started to lift off the seabed at a warp/depth ratio of 3:1 and it is concluded that the horizontal louvre otterboards are not superior to the conventional rectangular flat otterboards in maintaining seabed contact (see Table 4).

HORIZONTAL LOUVRED OTTERBOARDS (3 knots)

WARP/DEPTH RATIO	5:1	4:1	3.5:1	3:1	2.5:1	2:1	5:1	4:1	3.5:1	3:1	2.5:1	2:1
Towing Point	<----------------		on centre	---------------------		---->	<-----------			5cm below centre		---------->
Angle of Heel	0°	5°	5°	15°	15°-20°	20°	15°	20°	25°	30°	30°	30°
Wing Spread (m)	9.5	9.5	9.5	8.5	6.5	6.5	9.0	8.75	8.75	8.0	5.0	5.0
Ground contact	Good	good	light	lifting off	off seabed	off seabed	Good	Good	Good	lifting off	off seabed	off seabed

RECTANGULAR FLAT OTTERBOARDS (3 knots)

WARP/DEPTH RATIO	5:1	4:1	3.5:1	3:1	2.5:1	2:1
Towing point	<-------------		5cm below centre	---------------------		---->
Angle of Heel	5°	10°	15°	15°	15°	15°
Wing Spread (m)	9.5	9.5	9.5	9.25	9.25	9.25
Ground contact	good	good	light	lifting off	lifting off	off seabed

Table 4 : The effect of altering warp/depth ratio of wing spread and ground contact

4. DISCUSSION

This project was set up to determine if a new design of otterboard when rigged to a standard ottertrawl:-

(1) had better stability than rectangular flat otterboards

(2) had reduced fishing gear drag than the same net equipped with rectangular flat otterboards

(3) produced a greater horizontal spread than a net equipped with rectangular flat otterboards.

In setting up the experiment in this way, only comparisons between overall spread and total gear drag for the two types of otterboard/net combination can be made. It is not possible to draw any conclusions about the spreading force, drag force or ground sheer forces generated by either otterboard from these tests only their combined effect on trawl net spread and total gear drag. However, previous work by several authors in particular Crewe (1964) and Patterson and Watts (1985,1986) can be used to explain why the performance of these new designs of otterboard are not strikingly different from conventional design otterboards.

As detailed in Figure 2, there are two main forces generated by an otterboard; namely the hydrodynamic forces and the ground sheer forces. These forces can be resolved into total spreading forces (3a + 4a), total drag forces (3b + 4 b) and downthrust generated by otterboard weight and positive angle of heel. The size of each of these forces being dependent upon the following factors:-

(1) Otterboard Shape : The shape of an otterboard exerts a primary influence on the magnitude of the spread and drag forces generated. Improved spread forces for a particular angle of attack can be achieved by curving the otterboard i.e. introducing camber. Figure 5 shows how a simple camber can increase the spreading force (side force) coefficient significantly when the otterboard is set below the stall angle (Crewe 1964, FAO 1974).

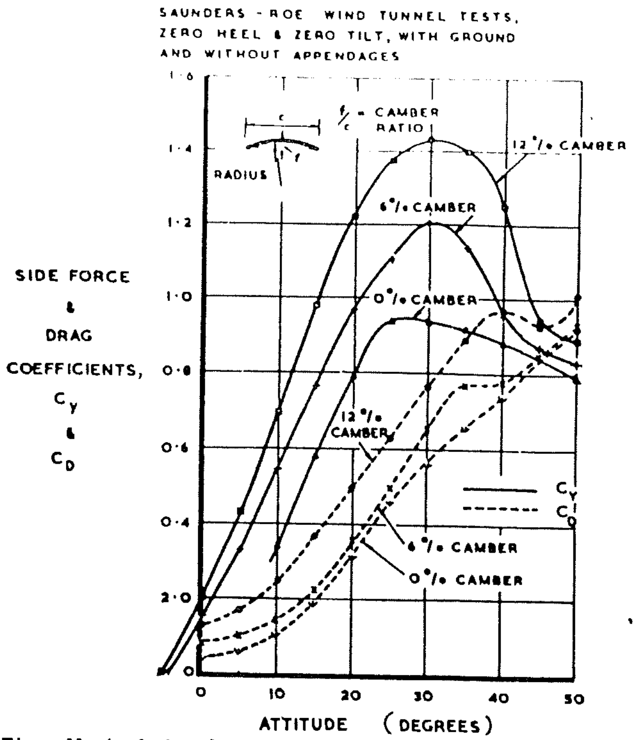


Fig.5 : The effect of simple camber on the hydrodynamic side force and drag of aspect ratio = 1/2 otterboards (from Crewe 1964).

Patterson and Watts tested a wide variety of cambered, faired and <u>vertically</u> slotted otterboards and found that whilst cambered otterboards can be particularly hydrodynamically advantageous, fairing produces little advantage at high angles of attack and that leading edge slots (not horizontal slots) can delay the onset of stall (Fig. 6).

Also included in under the heading otterboard shape is the effect of aspect ratio. This is the ratio of otterboard length : otterboard height. The result of reducing the aspect ratio e.g. through the use of horizontal slots is to delay the point at which the otterboards stall. The spreading force coefficient is reduced and the drag force coefficient increased (Patterson and Watts 1985).

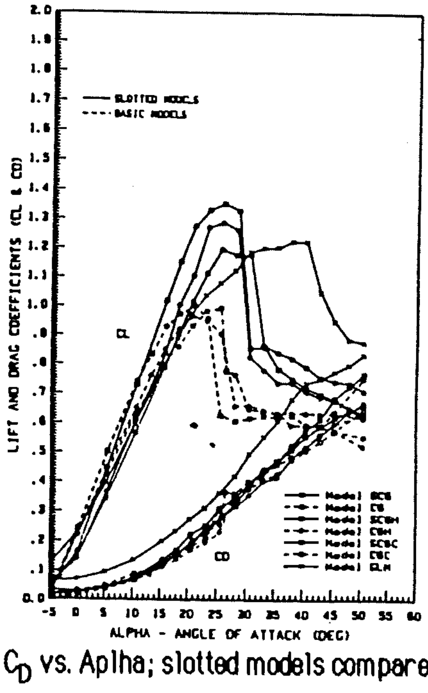


Fig.6 : C_L and C_D vs. Aplha; slotted models compared to basic models (from Patterson and Watts 1986).

178

4.1 ANGLE OF ATTACK AND HEEL

Figures 7 and 8 show how both the spreading force and drag force vary with angle of attack and heel. The most interesting point on the angle of attack graph is that maximum spreading force is

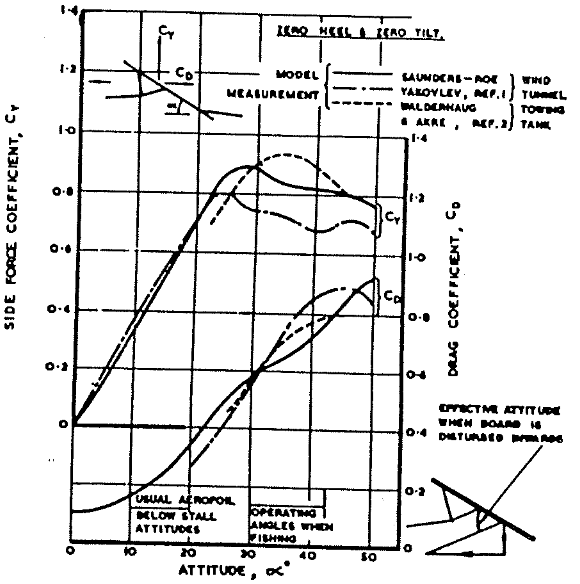


Fig.7 : Typical hydrodynamic side force and drag coefficients for flat rectangular otterboards of aspect ratio = 1/2 (From Crewe 1964)

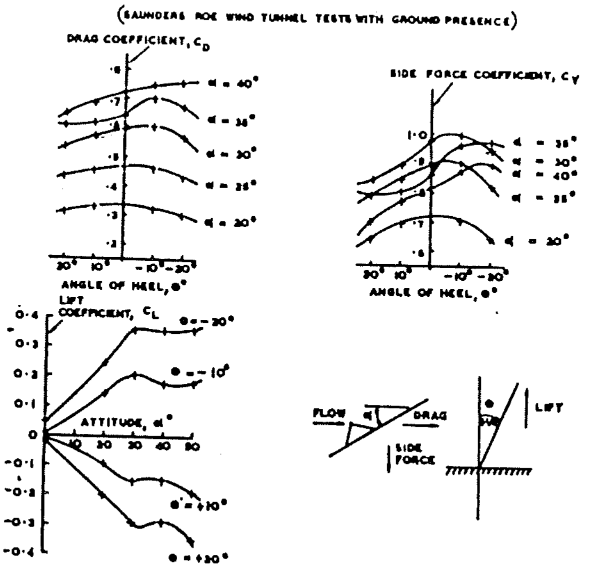


Fig.8 : The effect of heel on the hydrodynamic forces acting on a flat rectangular otterboard of aspect ratio = 1/2 (From Crewe 1964)

is achieved at 28 degrees angle of attack whilst most otterboards are towed at angles of attack between 35 and 55 degrees. At these high angles the boards are fully stalled with below maximum spread force and high drag forces being developed. Reasons for using these high angles of attack are that stalling gives the otterboards improved stability and thus a practical compromise is reached between what is theoretically the most suitable angle (about 28 degrees for a conventional wooden otterboard) and the angle required to ensure stall hence stability during shooting, and turning manoeuvres. It is generally in excess of 35 degrees and commonly around 40 degrees. During the diving trials the sand clouds generated by both sets of otterboards suggest that they were both stalled.

Figure 8 shows how the downthrust coefficient (C_L) of the otterboard can be increased/decreased by altering the angle of heel. If the otterboard is given positive heel i.e. it is made to lay outwards, then there will be a hydrodynamic force generated downwards tending to hold the otterboard in seabed contact. This has the effect of increasing the ground reaction and thus improving seabed contact. This increased ground reaction will increase ground shear and consequently both the ground spread and ground drag forces will increase. If the otterboard is given negative heel then the otterboard ground reaction will diminish and both ground spread force and ground drag will reduce. Practically speaking, the same otterboard will lift off the seabed a lot easier if given a negative heel angle i.e. the boards are rigged to lay inwards. It can be compensated for by making the otterboards heavier. Crewe (1964) suggests that up to 50 percent of the total spreading force can be provided by the ground reaction however, particular care must be paid to the type of ground the otterboard is to be towed over since a heavy otterboard may tend to bog into soft mud.

Towing Speed

The magnitude of all the forces mentioned will depend upon the speed at which the otterboards are towed through the water. The higher the towing speed, the larger the force generated.

Horizontal Louvred Otterboards vs. Rectangular Flat Otterboards

The essential characteristics of the two designs of otterboard tested are shown in the Table 5.

	RECTANGULAR FLAT	HORIZONTAL LOUVRE
Nominal area m^2	1.82	1.88
Wt. in Air	220kg	125kg
Otterboard Angle (degrees)	30, 35, 40	30, 35, 40
Towing Point Position	5cm below centre	On centre & 5cm below centre
Aspect ratio	0.45	0.4

Table 5 : Essential characteristics of otterboards under test

The rectangular flat otterboard is rigged so as to lean outwards between 5 and 15 degrees. This is achieved by dropping the bridle towing point 5cm below the centre point of the otterboard. As it is towed through the water a downthrust component increases the ground reaction. The horizontal louvre otterboard is designed to tow in a vertical plane, the downthrust being generated by wooden louvres set into the otterboards. They both achieve their downthrust in a similar fashion i.e., the water flow is deflected over an angled foil. The resulting force will have a component of spreading force, downthrust and drag. The magnitude of the downthrust will depend upon the angle of the foil to the water flow. In the rectangular flat otterboard the foil angle i.e. the angle of heel is 15° whilst in the louvred otterboard the foil angle is 55 degrees (the angle of the louvre in the upright otterboard) + otterboard heel angle. In the case of a vertical otterboard the heel angle is zero. This downward component of the hydrodynamic force will, with the weight of the otterboard in water, combine to produce the total ground reaction. For the otterboards tested, any advantage that the horizontal louvred otterboard may have gained from having a greater downward force (1.55m^2 louvre area at 55 degree angle to 1.88m^2 otterboard area at 15° angle), is seemingly lost since the horizontal louvre otterboards weigh less in water. If however the otterboards had the same weight in water then the horizontal louvred otterboard may have generated a larger spreading force but also larger drag force.

The high louvre angle is also responsible for loss in otterboard spread with steeper warp/depth ratios since as the warp/depth ratio is increased the otterboards will tend to heel out setting the louvre at angles of about 70 degrees to the water flow resulting in lower projected louvre area to the water flow (Fig.9).

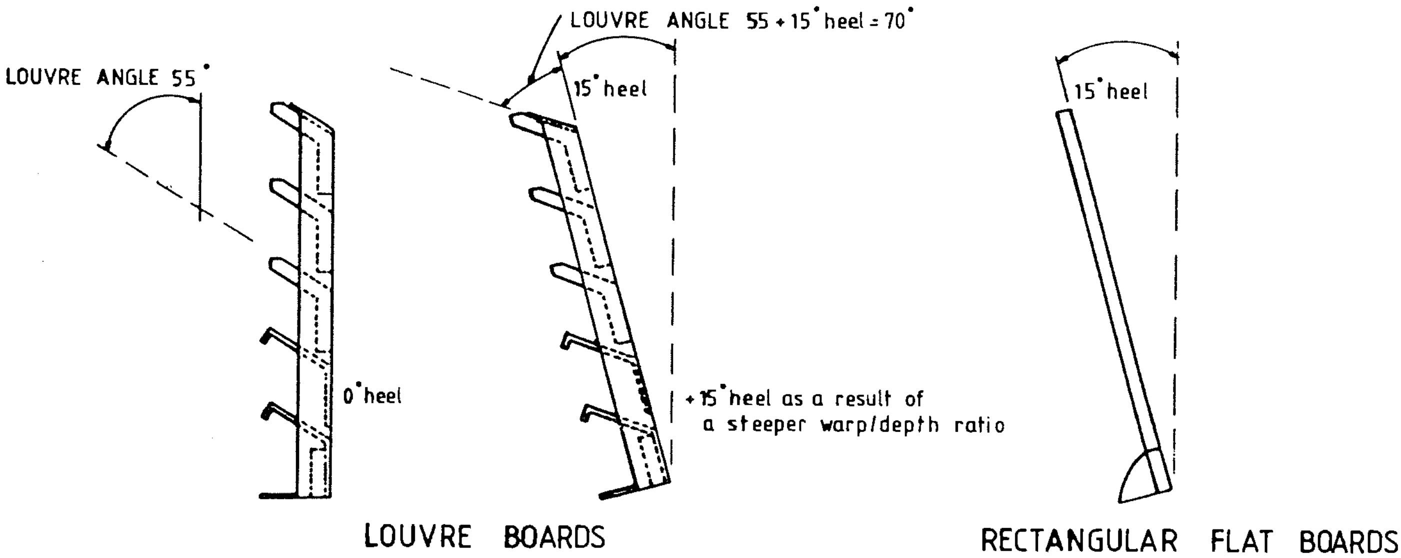


Fig.9 : Effect of reducing warp depth ratio on angle of heel.

Reasons for the reduced drag of the Horizontal louvre otterboards are most probably the result of their reduced weight in water and lower angle of attack than the rectangular flat otterboards (see Table 2).

Otterboard stability is primarily determined by setting the otterboard at a stalled angle of attack and consequently is not strictly a feature of otterboard design.

175

5. CONCLUSION

The Flume tank trials were not set up to determine why the otterboards might perform differently, they were set up to compare the values of net spread and total gear drag of two fishing rigs and achieved this objective.

The performance of the horizontal louvre otterboards when connected to a standard 14.6 metre Headline length Florida Flyer prawn trawl are not superior in terms of stability and increased net spread. Gear drag was 16% less when using the horizontal louvre otterboards but it is not possible to determine if this was a result of improved otterboard design, or a result of differences in angle of attack or weight in water.

The mechanism by which the horizontal louvre otterboard achieves its downthrust is similar to a conventional rectangular flat otterboard rigged with positive angle of heel.

Otterboard stability can be improved by towing at high angles of attack but a drag penalty will result. The spread force of conventional otterboards can be improved by increasing the ground reaction through using heavier otterboards or rigging the otterboard with positive heel.

179

REFERENCES

Bowen, B.K. and D.A. Hancock 1985. Review of Penaeid prawn fishery management regimes in Australia. P.C. Rothlinberg, B.J. Hill and D.J. Staples (editors), Second Australian Nat. Prawn Seminar, NPS2, Cleveland, Australia. 247-265

Haysom, N.M. 1985. Review of the penaeid prawn fisheries of Australia. P.C. Rothlinberg, B.J. Hill and D.J. Staples (editors), Second Australian Nat. Prawn Seminar, NPS2,, Cleveland, Australia. 195-203

Fridman, A.L. 1973. Theory and Design of Commercial Fishing Gear. Israel program for Scientific Translations Ltd. IPST Cat.No.60047 4. pp489

FAO, 1974. Otterboard Design and Performance. FAO, Rome pp82

Karlen, L. 1982. Introduction of the multi foil Otterboard Design in the Norwegian Trawl Fisheries. ICES Fish Capture Committee. Working Group Paper. May 1982. pp10

Crewe, P. 1964. Modern Fishing Gear of the World Vol.2. Second FAO World Fishing Gear Congress, London, 1963. p165-181

Wileman, D. 1986. Vee Door variants are tested by Danish Institute. Fishing News International Vol.25, No.2. p30-31

Patterson, R.N. and K.C. Watts 1985. The Otterboard as a Low Aspect Ratio Wing at high angles of attack; some theoretical aspects. Fisheries Research, 3 (1985). p351-372. Elsevier Science Publ. The Netherlands.

Patterson, R.N. and K.C. Watts 1986. The Otterboard as a low aspect ratio wing at high angles of attack; an experimental study. Fisheries Research, 4 (1986) p111-130. Elsevier Science Publ. The Netherlands.

APPENDIX I

DIVING AND CAMERA EQUIPMENT

172

SOUTH AUSTRALIAN DEPARTMENT OF FISHERIES VIDEO CAMERA AND DIVING EQUIPMENT

The camera and housing was an underwater self contained coloured video system. The housing was manufactured by Jay Mar Engineering in California, USA and had external fittings which allow diver voice input and coaxial cable to the surface to provide surface viewing. Other features included a dome port to provide 100 degree field of view when using the optical expander attached to the camera. The optical expander increases the depth of field objects in focus from about 100mm to infinity (average light).

Camera Model GZ-S3

The video camera was a JVC compact unit which incorporated a 38mm static magnetic high-resolution SATICON single tube. The unit is powered by 12V DC batteries.

Recorder

The recorder used 30 minute VHS compact video tapes (Model HR-C3). A unique record lock allowed the system to be shut down to save battery power. An external switch on the outside of the housing was used to activate the system into a recording mode.

Monitor Model TM-P3

The 76mm colour monitor allowed the operator an unrestricted view. It also provided an indication of what the final product would look like. The monitor was also useful when playing back the recorded tape - this could be done while all equipment remained in place in the housing.

Note:- At present the particular self contained underwater system is the only one in Australia.

DIVING EQUIPMENT

Apart from the diver communication system, all diving equipment used was standard Scuba diving gear.

All scuba tanks were alluminium 2.5m^3 with K valves. Back packs and vests were Scuba Pro. (B.C.D.).

171

COMMUNICATION EQUIPMENT

Diver/surface communication was used on all dives which involved the underwater sled.

The communication system includes an AGA full mask which incorporates a microphone and receiver.

Diver surface communication is transmitted by cable from the surface to the diver through a surface control unit which was fitted with headphones and microphone.

170

N.S.W. DEPARTMENT OF AGRICULTURE DIVISION OF FISHERIES CAMERA AND DIVING EQUIPMENT

CAMERA EQUIPMENT

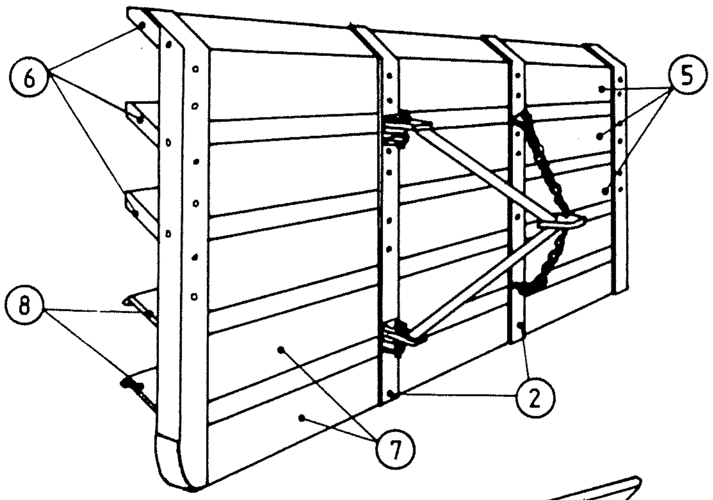
All the still photographs were taken using Nikonos 35mm underwater camera equipment fitted with a Nikon 15mm lense and finder. Light readings were taken with a hand held Sekonic L series meter in a housing. The film used was 400 I.S.O. colour positive material.

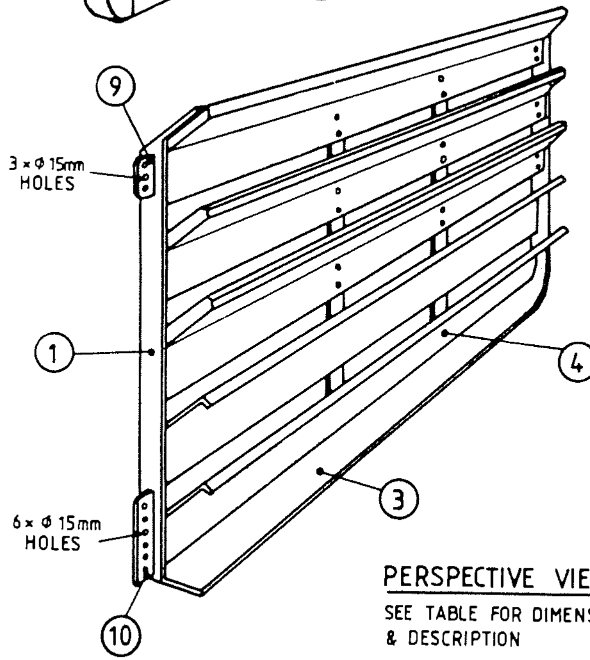
DIVING EQUIPMENT

Standard Scuba gear was used. The demand valves were fitted with side mounted exhaust outlets and purge buttons. This eliminated the bubble stream caused by water pressure at high towing speeds on front mounted purge buttons.

APPENDIX II

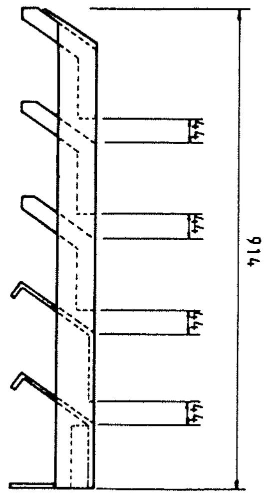
FISHING GEAR USED



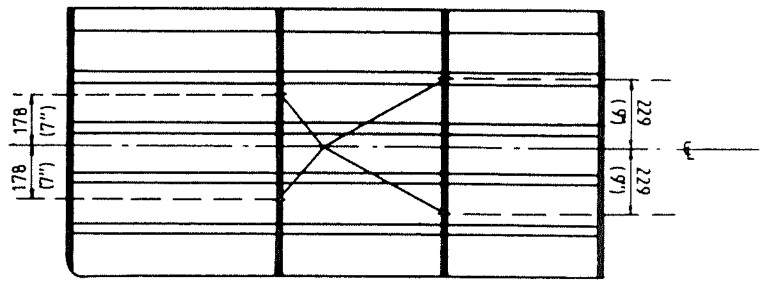


PERSPECTIVE VIEWS

SEE TABLE FOR DIMENSIONS & DESCRIPTION



FLOW PASSAGE DIMENSIONS



TOWING BRACKET POSITIONING

NOTE :

BOTH OF THE LOWER LOUVRES ARE CONSTRUCTED FROM STEEL, WHEREAS THE OTHERS ARE TIMBER.

No	DESCRIPTION	DIMENSIONS
10	LOWER NET TOWING BRACKET	175 × 50 × 3 mm FL
9	UPPER NET TOWING BRACKET	80 × 50 × 3 mm FL
8	STEEL ANGLED (55°) LOUVRES SECTIONS	125 × 3mm FL
7	STEEL UPRIGHT LOUVRE SECTIONS	100 × 3mm FL
6	TIMBER ANGLED (55°) LOUVRE SECTIONS	125 × 25mm
5	TIMBER UPRIGHT LOUVRE SECTION	100 × 25 mm
4	KEEL PLATE	100 × 25 mm FL
3	SHOE (CURVED	75 × 3mm FL
2	INTERMEDIATE STRAPS	50 × 6 mm FL
1	END STRAPS	50 × 50 × 6 mm ∠

Drawn: C.A.SCOTT	**Materials:**	**Date:** 18 AUG 86	COLLINS 2·13m × 0·91m (7' × 3') LOUVRED OTTERBOARDS	**Dimensions:** mm U/NOTED
Checked:		**Scale:**	AUSTRALIAN MARITIME COLLEGE	**Dwg. Nº:** 10 - 3 - 86

168

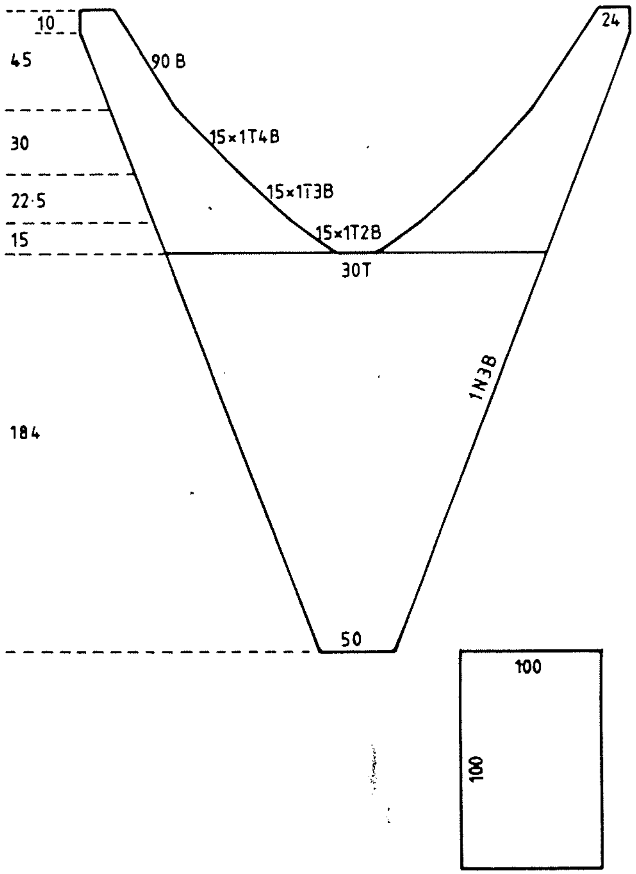
ALL DIMENSIONS WITHIN - - - - LINES ARE MESHES DEEP

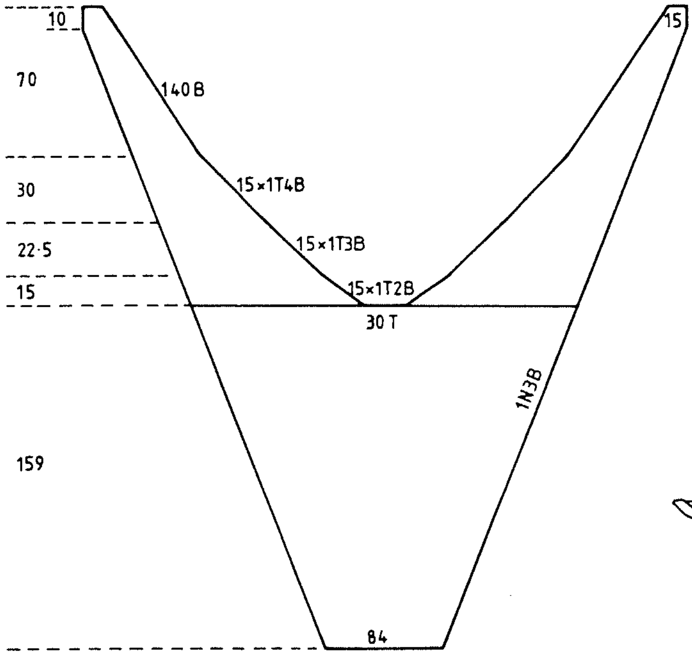
1T2B	1M2B
1T3B	1M3B
1T4B	1M4B
1N3B	1P3B

CUTTING RATE CONVERSION

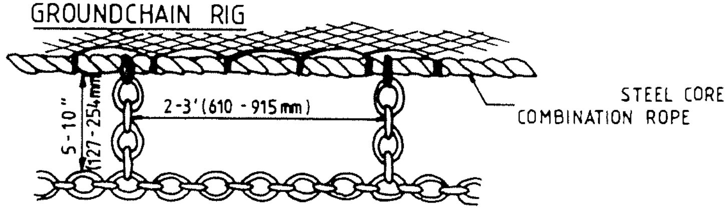
HANGING DETAIL

6 BARS	on	6" (150 mm)
1T4B	"	5" (127 mm)
1T3B	"	4" (100 mm)
1T2B	"	3" (76 mm)
3T	"	4" (100 mm)

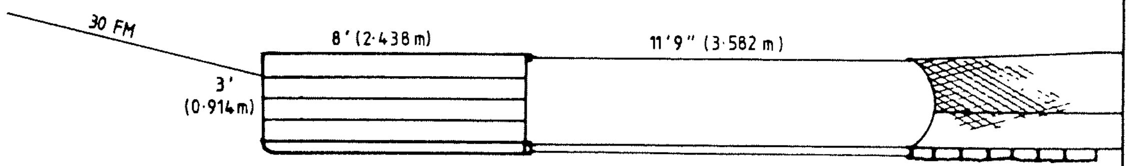




GROUNDCHAIN RIG



Φ CHAIN 1/4" TO 3/8" (6 - 9 mm)



LOCALITY : E.COAST QUEENSLAND
REFERENCE : J. DERRICK

Drawn: C.A.SCOTT	**Materials:** NETTING - 400/30 (R TEX 1466) 2" (50 mm) CODEND - 400/38 (R TEX 1858) 1¾" (45 mm)	**Date:** 24 SEPT '85	8FM FLORIDA FLYER	**Dimensions:**
Checked: T.C.		**Scale:** 1:25	AUSTRALIAN MARITIME COLLEGE	**Dwg. Nº:** 7-1-85

95

APPENDIX III

REVISED FLUME TANK SCHEDULE

FLUME TANK SCHEDULE

FISHING GEAR	OTTERBOARD ANGLE	TOWING POINT POSITION	WARP DEPTH RATIO	TOWING SPEED (Knots)
Horizontal louvre	30°	on centre	5:1	2.0
Otterboards +	30°	on centre	5:1	2.5
Florida Flyer	30°	on centre	5:1	3.0
trawl	30°	on centre	5:1	3.5
Horizontal louvre	35°	on centre	3:1	2.0
Otterboards +	35°	on centre	3:1	2.5
Florida Flyer	35°	on centre	3:1	3.0
trawl	35°	on centre	3:1	3.5
Horizontal louvre	35°	on centre	5:1	2.0
Otterboards +	35°	on centre	5:1	2.4
Florida Flyer	35°	on centre	5:1	3.0
trawl	35°	on centre	5:1	3.5
Horizontal louvre	40°	on centre	5:1	2.0
Otterboards +	40°	on centre	5:1	2.5
Florida Flyer	40°	on centre	5:1	3.0
trawl	40°	on centre	5:1	3.5
Rectangular Flat	30°	5cm below centre	5:1	2.0
Otterboards +	30°	5cm below centre	5:1	2.5
Florida Flyer	30°	5cm below centre	5:1	3.0
trawl	30°	5cm below centre	5:1	3.5
Rectangular Flat	35°	5cm below centre	3:1	2.0
Otterboards +	35°	5cm below centre	3:1	2.5
Florida Flyer	35°	5cm below centre	3:1	3.0
trawl	35°	5cm below centre	3:1	3.5
Rectangular Flat	35°	5cm below centre	5:1	2.0
Otterboards +	35°	5cm below centre	5:1	2.5
Florida Flyer	35°	5cm below centre	5:1	3.0
trawl	35°	5cm below centre	5:1	3.5

Rectangular Flat	40°	5cm below centre	5:1	2.0
Otterboards +	40°	5cm below centre	5:1	2.5
Florida Flyer	40°	5cm below centre	5:1	3.0
trawl	40°	5cm below centre	5:1	3.5
Horizontal louvre			5:1	2.0
Otterboards +			5:1	2.5
Florida Flyer			5:1	3.0
trawl	30°	5cm below centre	5:1	3.5
Horizontal louvre	35°	5cm below centre	3:1	2.0
Otterboards +	35°	5cm below centre	3:1	2.5
Florida Flyer	35°	5cm below centre	3:1	3.0
trawl	35°	5cm below centre	3:1	3.5
Horizontal louvre	35°	5cm below centre	5:1	2.0
Otterboards +	35°	5cm below centre	5:1	2.5
Florida Flyer	35°	5cm below centre	5:1	3.0
trawl	35°	5cm below centre	5:1	3.5
Horizontal louvre	40°	5cm below centre	3:1	2.0
Otterboards +	40°	5cm below centre	3:1	2.5
Florida Flyer	40°	5cm below centre	3:1	3.0
trawl	40°	5cm below centre	3:1	3.5
Horizontal louvre	40°	5cm below centre	3:1	2.0
Otterboards +	40°	5cm below centre	3:1	2.5
Florida Flyer	40°	5cm below centre	3:1	3.0
trawl	40°	5cm below centre	3:1	3.5
Horizontal louvre	40°	5cm below centre	3:1	2.0
Otterboards +	40°	5cm below centre	3:1	2.5
Florida Flyer	40°	5cm below centre	3:1	3.0
trawl	40°	5cm below centre	3:1	3.5
Horizontal louvre				
Otterboards +				
Florida Flyer				
trawl	35°	on centre	5:1 – 2:1	3.0

Rectangular flat Otterboards + Florida Flyer trawl	35°	5cm below centre	5:1 - 2:1	3.0