

A METHOD OF FIXING FLOATING MARKS BY THE USE OF TWO-RANGE DECCA

by Lieutenant Commander G. L. HASKINS
Royal New Zealand Navy

Paper received in June 1960

Two-range Decca equipment was fitted in H.M.N.Z.S. *Lachlan* the surveying ship of the Royal New Zealand Navy's Hydrographic Surveying Service in 1958. This equipment was immediately put to use in the western approaches to the Cook Strait, dividing the North and the South Islands of New Zealand, and this area proved an excellent testing ground. During the 1958-59 season an immense amount of sounding was completed and in 1959-60 the approaches were completed almost as far as Cape Egmont on the west coast of the North Island.

This northern part of the area included on the inshore end the South Taranaki Bight, stretching from Patea southwards for a coastline distance of 42 miles (see figure 1). Depths of under 20 fathoms were surveyed on a scale of 1/72 000 and inshore the traditional methods of boat sounding were used up to the high water line. Two 72 foot surveying motor launches and two 30 foot sounding boats were available for this task, backed up by *Lachlan*. Time was short, for a number of reasons, and as the hinterland in this region is rather featureless it was decided that use would be made of standard Moresby type floating beacons as control marks for the boats. Marks ashore were not very conspicuous except from close inshore and difficulty was experienced in connecting the beacons into the shore control. The following method was devised to fix the beacons making use of the two-range Decca in conjunction with taut wire measuring gear and, where possible, visual check angles into the shore control marks.

Transfer of Decca coordinates into N.Z. national grid coordinates in yards

Two-range Decca coordinates are direct measurements from the slave stations and these, together with data already available, i.e., distance and grid bearing between slave stations, provide a triangle that can be simply solved by use of the cosine formula (see figure 2).

The bearing and distance from a slave station to the ship station can be computed and grid coordinates transferred. A simple standard form

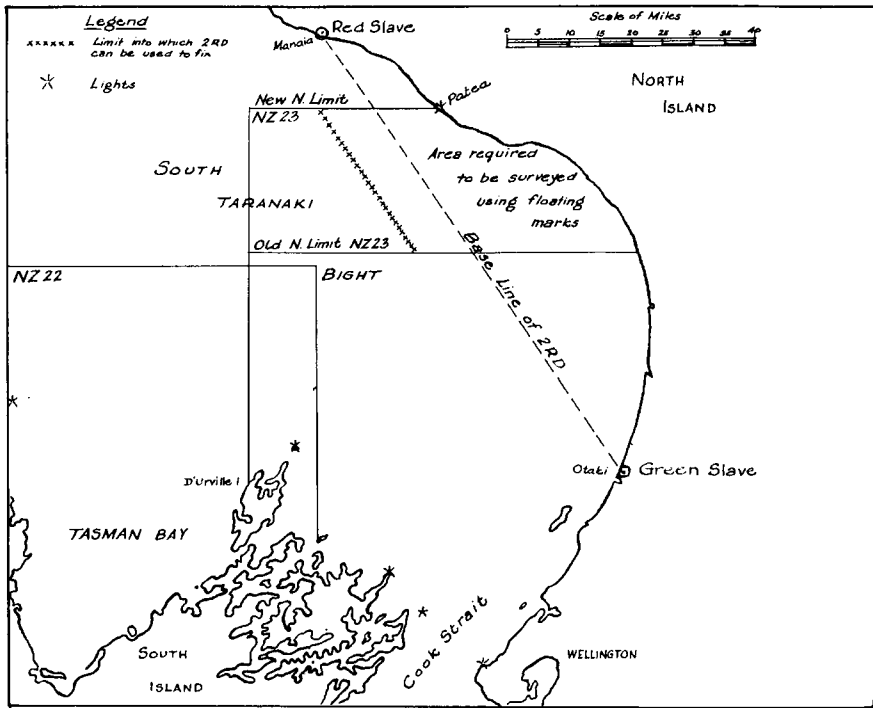


FIGURE 1. — Limits of area surveyed.

was prepared to cover as many circumstances as possible of this solution (see figure 3 for example).

Application in practice of the above principle

A large portion of the area to be surveyed was on the baseline between the two slave stations at Manaiia and Otaki.

A line of six floating beacons was laid along the baseline on normal single moorings with the usual scope acceptable for the scale of the survey. Taut wire measuring gear was run until steady well off the baseline to the north eastward in an area of reasonable cut of the Decca lanes. Readings were then taken and a steady course steered past the northernmost beacon, where taut wire was read, and then continued across into the good fixing area again. A final Decca fix was taken and the taut wire was cut.

Run 2 was taken from the south west of the beacons into the northern beacon again and the run continued down the line of beacons passing as close as possible to each one and taking readings of the taut wire measuring gear each time one was abreast of the bridge. The beacons had been laid in transit with each other so that no lateral error was introduced into this traverse.

The whole system was then repeated working northward after fixing the southernmost beacon in the same manner used for its northern counterpart and described above.

All Decca fixes were transferred into national grid coordinates and

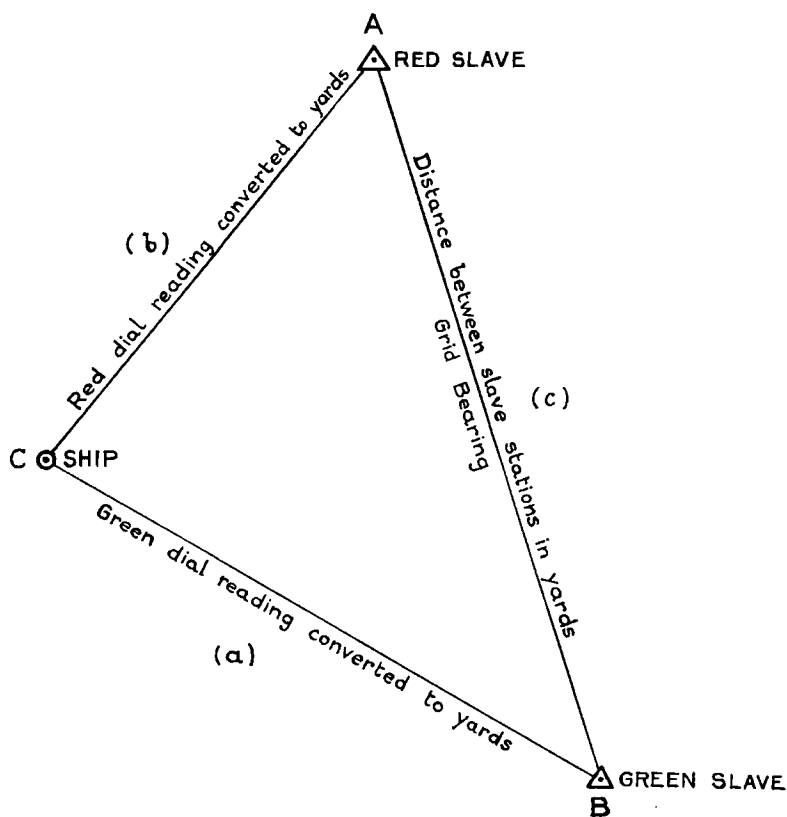


FIGURE 2. — Solution of triangle

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}, \text{ find } A.$$

Apply value angle A to bearing A-B find bearing A-C.

Using bearing A-C and distance *b*, transfer coordinates of A to C.

the traverse was adjusted to coordinate all the beacons. Errors computed were found to be within 60 feet, or 0.01 inch on paper, which for the purpose of this survey were within acceptable limits.

A further application

The use of this method of coordinating the position of the ship was extended to fixing individual beacons in the area of good Decca cut. Within the limits imposed by weather conditions beacons were laid during the hours of darkness in blocks of about six at a time. Early in the morning after *dawn effect* had settled down they were fixed by direct Decca readings being taken as the ship passed close by each one in turn, and transferred to national grid coordinates. After the day's work, when the boats had been hoisted, the beacons that had been used during the day and were no longer required were weighed, re-rigged and laid again in a fresh area ready to be fixed again in the morning. This enabled the boats to take advantage of all the daylight hours to continue working the area without interruption.

M.S.P. 299,700

AT FIX <i>Twelve</i>		SURVEY <i>Cook Strait</i>		SCALE $1/72,000$	
Depression Angle $3^{\circ}32'$		Distance 184 yds.		Bearing 048°	
Dist to GREEN (miles)	46.5	Dist to RED (miles)	44.0		
GREEN Dial Rdg.	431.47	RED dial rdg.	423.96		
No of Lanes	307.47	No of Lanes	191.96		
Phase Lag Corr'n.	$-.02$	Phase Lag Corr'n.	$-.03$		
Corr'd No of Lanes	307.45	Corr'd No of Lanes	191.93		
Factor (Lane Width)	309.146	Factor (Lane Width)	463.719		
(b) Dist. yds. (a)*	95	(a) Dist. yds. (b)*	89		
b^2/a^2 *	9	033	913	200	
c^2 (Dist. between Slaves) <i>170 651.3</i>	29	121	866	192	
sum	38	155	779		
a^2/b^2 *	7	921	285		
Difference	30	234	494		
Divide					
b . c	16	219	877		
$2 \cos A/B$ *	1.864	039	659		
$\cos A/B$ *	0.932	019	829		
A/B *	21°	$14'$	$53''2$		
Brg. of Base	324°	$36'$	$13''$		
Brg. to GREEN/RED *	345°	$51'$	$06''$		
Sin	0.969	666	16		
Cos	0.244	433	09		
	Eastings			Northings	
Coord. Diff.	$-$	23	233	$+$	92 164
Coords GREEN/RED *		265	271		189 585
Coords FIX (False Stn)		242	038		281 669
Corrn. to T.S.			137		123
Coords. FIX		242	175		281 792

FIGURE 3. — Transfer of two-range Decca coordinates into national grid coordinates in yards.

Only ten beacons and associated gear were carried by *Lachlan* and the whole task was completed in a remarkably small number of working days.

One further use made of this method was in the graphical plotting of minor conspicuous objects. By using one coordinated mark ashore as a zero, angles were observed into the conspicuous objects and simultaneously the ship was fixed by Decca. Fixes were transferred into national grid coordinates and plotted on the master plotting sheet. Rays were then drawn to intersect the objects ashore and very good results were obtained.

Conclusion

With very little practice it was found that Decca coordinates could be reduced to grid coordinates in ten minutes. Two computers with checkers could fix and plot six beacons and transfer their positions to the boats' field boards in about forty minutes, during which time the boats were being turned out ready for lowering and the day's work.

Limitations of distance from the slave stations are imposed by the effect of phase lag correction which becomes too large to be computed accurately at about 150 miles. Care was always taken therefore to compute coordinates using the shortest of the two sides of the triangle observed, where one was much longer by comparison with the other.

The speed of progress of the boat and motor launch sounding was greatly facilitated by being able to do much of the beacon handling work during the hours of darkness, and at no time during this particular survey were the boats held up for lack of suitable control marks.