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UNDERWATER PROFILING OF ICEBERGS

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ABSTRACT

This paper deals with the measurement of the profiles of icebergs; specifically with the underwater cross sections of free floating icebergs. Experimentation is being conducted off the east coast of Canada.

A designed stage of the underwater profile system incorporating practical operating knowledge gained from previous experimentation has been realized. A dual channel sonar was procured and an acoustical range finder employed. Correlation of the data obtained provide an approximation of overall shape.

In the scheme, a transducer was lowered and raised while being rotated in a horizontal plane. The iceberg is outlined in this way from a succession of stations on a 200 meter circumference about the berg.

Information on the overall configuration will assist in any endeavours threatened with iceberg collisions.

INTRODUCTION

The science of icebergs performs an important function in oceanology. However, very scanty exertions have been conducted on the submerged determinate factors of icebergs.

Much recently revived interest has been expressed in

(c) subsea electric transmission line proposals made feasible by increased energy costs.

Existing knowledge is restricted to qualitative data of above-water topographies. Any below water measurements are conducted indirectly [1] or inferred from grounding in water of known depth.[2] One experiment utilized back scattered acoustical waves coupled with sonar techniques to map the underside of arctic sea ice.[3]

In 1971, a group of engineers from Memorial University developed a technique for towing icebergs.[4] Subsequent expeditions employing the C.S.S. Dawson, a research vessel from the Bedford Institute of Oceanography, recorded the physical dimensions and explored the surrounding water envelopes of icebergs.

The large iceberg population on the Grand Banks indicates the importance of measures taken to avoid collisions with offshore structures. Avoiding impending collisions usually turns about the hazardous task of both harnessing and towing the threatening iceberg.

This paper describes a simple procedure for direct measurement of the underwater portion of icebergs. The method establishes shape and stability parameters essential for intelligent deployment of towing gear, possible grounding and trajectory alteration.

OPERATIONAL APPARATUS AND TECHNIQUE

Any dual channel side scan unit using operational amplifiers to add the two channels and display them on one side of a paper recorder is suitable. A high frequency (100 KHz) transducer is preferable because of narrow beam width and low range requirements.

A winch provides the means to lower and raise the transducer array in profiling. Rotation of the assembly is best facilitated by weighted fins mounted to the housing. A marked cable and an event marker furnish depth intervals on the sonar records. Both optical or acoustical range finding methods can be employed to obtain ship to berg distances (datum).

The technique developed involves the routine procedure of lowering and raising the sonar source with a record being made of the return echo (datum). Concurrent to these operations ship to berg distances are measured and polaroid photographs are taken for identification. This procedure is continued until a sufficient number of stations circumscribing the iceberg are obtained and through correlation of the sets of data, a profile is plotted.

RESULTS

Diagram 1 shows the necessary measurements to be obtained for a first approximation of shape, followed by a second more detailed analysis. Successive values of "Dist" are plotted to provide a profile.

Taking these profiles in conjunction with photographs, crossections (Diagram 2) and plan views (Diagram 3) are obtained.

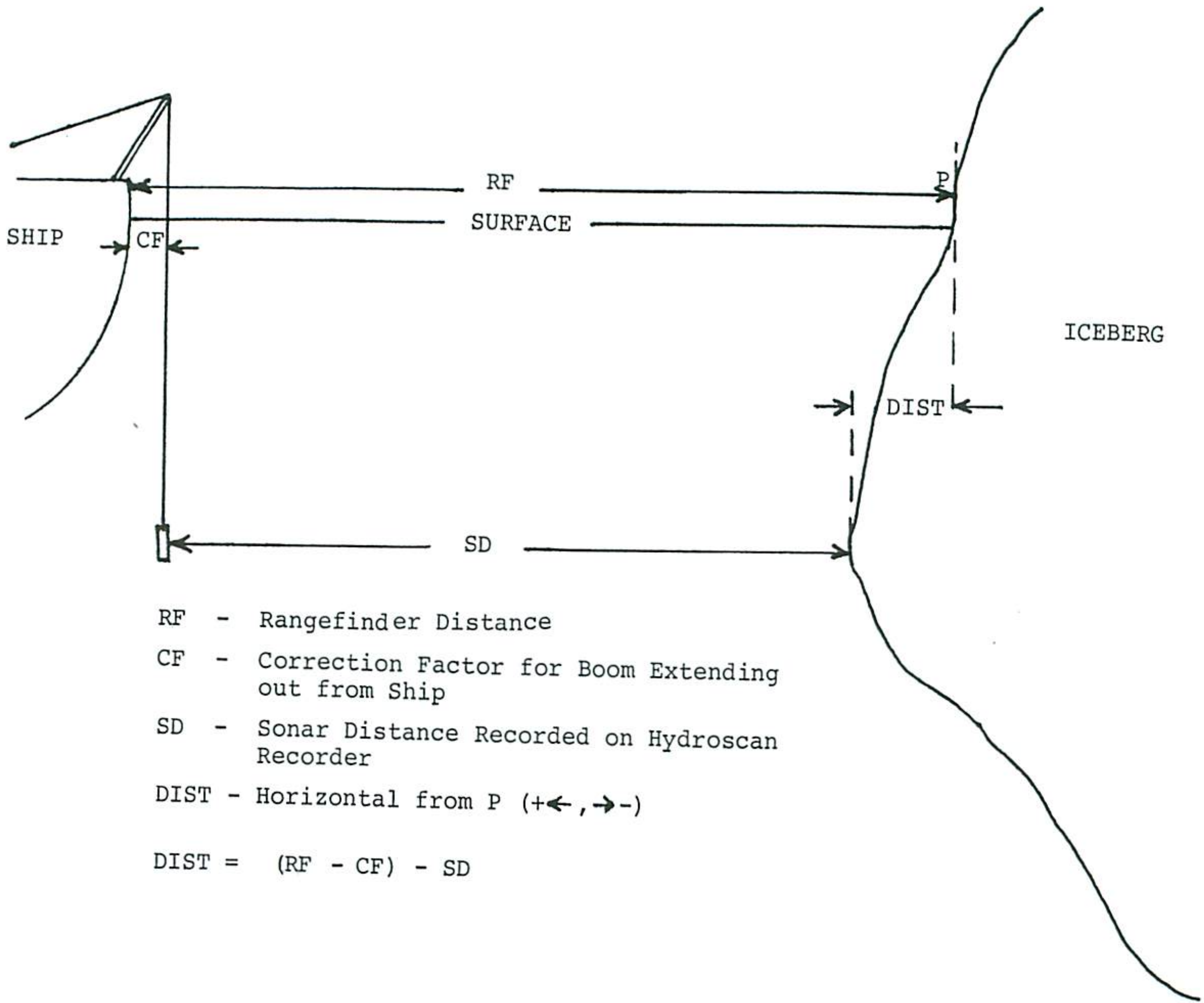
The results of a detailed analysis of one of five icebergs investigated are shown in Table 1.

TABLE 1

Iceberg No.	9A
Classification	Drydock
Number of stations	4
Time	30 minutes
height*	28 meters
length*	105 meters
width*	40 meters
depth	93 meters
volume above water	5.2×10^{4} cubic meters
volume below water	1.298×10^{6} cubic meters
total volume	1.35×10^{6} cubic meters
total weight	1.24×10^{8} kilograms or 1.36×10^{5} tons (short)
stability	unstable

* max. value

DIAGRAM 1



RF - Rangefinder Distance

CF - Correction Factor for Boom Extending out from Ship

SD - Sonar Distance Recorded on Hydroscan Recorder

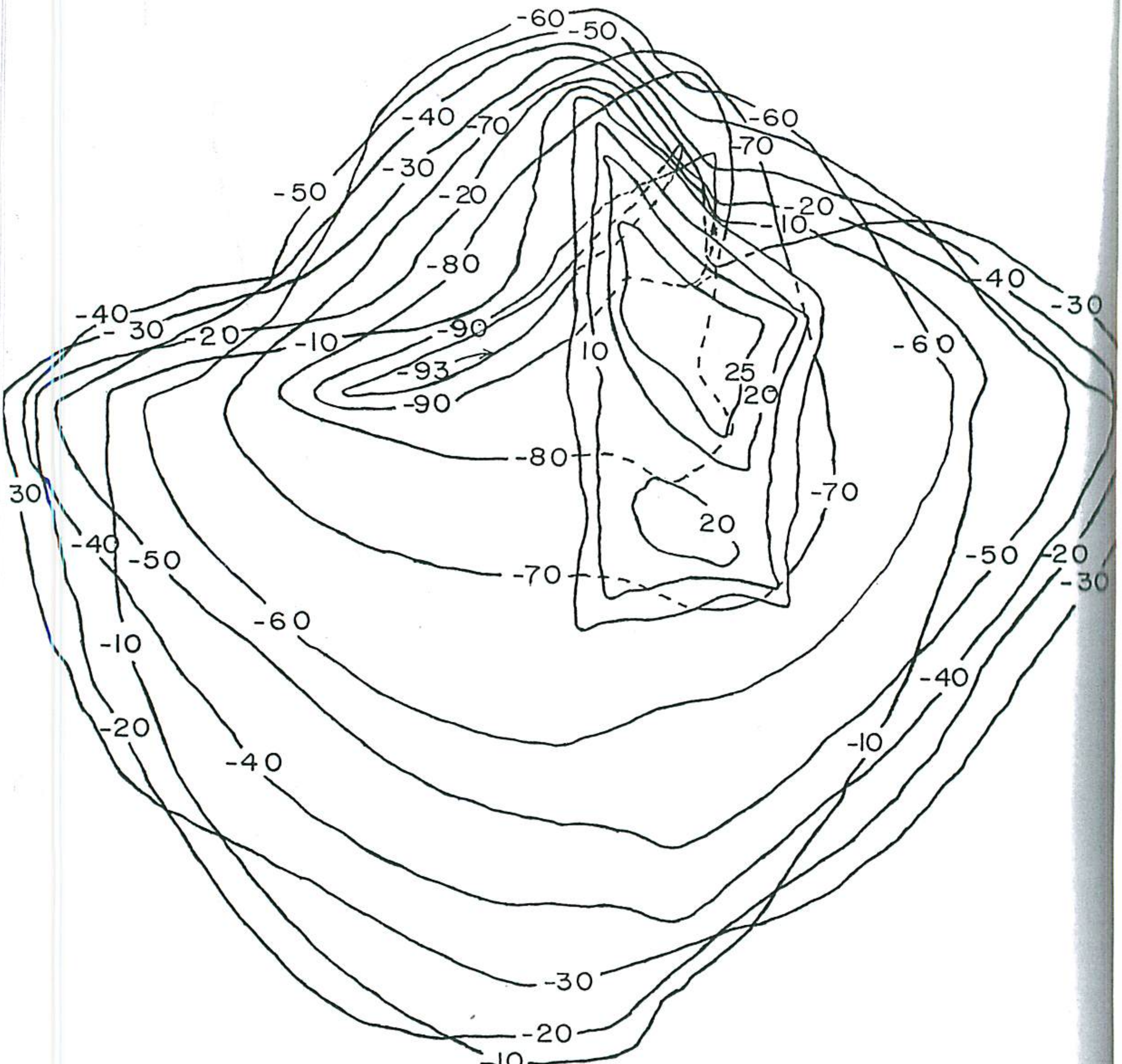
DIST - Horizontal from P (+←, →-)

DIST = (RF - CF) - SD

DIAGRAM 2


ICEBERG 9A CROSS SECTION
WATER LINE
OPTIMAL
TOWING
DIRECTION
SCALE: 1cm = 10m

DIAGRAM 3



SCALE: 1 cm = 10m

ICEBERG 9A

CONCLUSION

An acoustical technique was devised and employed rather than an optical method (i.e. underwater photography) because of

(a) difficulty in obtaining three dimensional observations from a surface of low resolution

(b) distortion in the water envelope surrounding the iceberg, and

(c) attenuation.

Accuracy being inversely proportional to distance away, a 200 meter range is found to be the optimal. Also a 200 meter cable proves adequate for the icebergs profiled.

A series of four profiles circumnavigating the iceberg can be obtained in approximately 30 minutes and is sufficient to determine a rough shape on board a ship.

This knowledge gained through profiles is essential for the optimal positioning of any towing girdle.

Detailed analysis provides necessary data for the prediction of shape, volume, weight, physical dimensions, and stability parameters.

REFERENCES

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