Notes on Tellurometer Surveys in Australia

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Introduction

Details of first order Tellurometer surveys completed to 31st December, 1959, are given in the National Report on Triangulation.

In addition, a very large amount of lower order survey has been carried out.

At present about 50 sets of equipment are being used in Australia.

Accuracy

Experience has shown that a precision involving a probable error of ±4 parts per million is usually obtained from a single measurement over lines of geodetic length.

This precision can be lifted to approximately ±2 parts per million by the following means :

(a) repeated measurement of the one line using different instruments and operators on different days;

(b) breaking a line into two parts with the *break* station located approximately near the mid-point of the line and then measuring the whole line and the parts with the one instrument and operator - by this technique the effects of an incorrect index error can be minimised;

(c) measuring with the Tellurometer all sides of a *base figure* of a triangulation chain (quadrilateral or similar figure), of which the angles are also read to first order accuracy, and then accepting a mean scale for the sides which will give the best fit to the Tellurometer lengths, whilst retaining the relationship of the side equations as derived from the adjusted angles. Alternately a simultaneous adjustment of angles and distances can be carried out.

Comparisons with existing first order surveys have shown that scale errors of 20 parts per million are not uncommon and a few errors as low as 30 parts per million have been encountered.

Many tests have been conducted involving the application of the Tellurometer to triangulation base lines.

The measurement of single sides at distances of about 150 to 250 miles apart results in much the same differences between computed and measured length of the closing base as are encountered in traditional first order triangulation.

The use of base figures of the type mentioned above resulted in some improvement of the situation.

However, it has been decided to measure a traverse continuously through each existing first order triangulation chain and to adopt the first order Tellurometer traverse as the standard form of geodetic survey.

On first order traversing it is usual to measure the length of each line in both directions, to restrict *ground swings* to 6 and preferably not more than 4 millimicro

seconds and to repeat the observation whenever the two measurements differ by more than 10 parts per million (this rarely happens).

During 1961 many extensive loops of first order Tellurometer traversing will be closed and should give an indication of the accuracy of this type of survey.

Disadvantages

One authority the Victorian State Lands Department has reported :

> *In flat areas of Victoria many lines of sight are not more than ten or fifteen feet above the ground for their entire length. Also the line may be fringed on either side by trees whose main foliage is well above the line of sight.*
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> *If these trees were stringybarks, no severe swing was experienced. except in one case when the foliage was wet. On the other hand, if the trees were river red gum, wattle trees or dead trees, huge swings have been encountered. The swings encountered in this type of country on short lines are more of a* side *swing type. resulting from reflections off the trees in the proximity of the line; these trees seem to possess highly radio reflective properties. When master and remote units have been set up out of sight of each other screened by a rise in the ground, on particular carrier frequencies, very clear displays were obtained which rotated in the presence of wind as the limbs of the trees moved.*
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> *Over one hundred short line measurements have been made and trouble has usually been experienced when measuring through red gum savannah country. Under conditions where wind is moving the trees, a superimposed rotation of display on top of a swing of 15 millimicro seconds, makes tellurometer reading meaningless.*
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> *Apart from elevating the tellurometer or its reflector and antenna above the trees, the only way a satisfactory measurement has been made is to manoeuvre into a position where scrub foliage has a baffling or absorbent effect on the reflected radio waves without obscuring the actual line of sight; this has been done successfully a few times, but frequently it is not possible.*

The facility with which Tellurometer measurements can be made in almost every type of terrain has brought about a tendency to locate the surveys close, and usually parallel, to lines of communication, with the result that traverse sides have been used along which considerable horizontal refraction has been noticed when making the angular measurements.

Future trends

It is the personal opinion of the writer that ultimately National Geodetic Survey Authorities will, of necessity, have to measure all sides of existing triangulation with the Tellurometer or a similar instrument.

No such Authority can long remain in the embarrassing situation where engineering and cadastral surveyors can readily measure distances with an accuracy greater than that of the country's first order geodetic survey.

It is thought that the most practical way of adjusting the great mass of overlapping data resulting from such an operation will be found along the lines recently evolved by Dr. Jerie for the analogue type adjustment of blocks triangulation.