SHORT DISTANCE MEASUREMENT WITH THE TELLUROMETER

By D.H. Richardson, O.L.S. *

The Tellurometer has been tried, proven and accepted for measuring long lines at accuracies acceptable for geodetic surveys. As the Ontario Hydro Survey Department was concerned with measuring lines from 500 feet to 10,000 feet at an accuracy of 1/10,000, we undertook with the assistance of Mr. Blair Erskine of the Tellurometer Company, in July of last year, a field trial of the Tellurometer system of distance measurement to determine its adaptability to short distance measurement.

The type of job and area chosen for this test was a photogrammetric control survey being conducted by our Resident Surveyor, H. Wilde, O. L. S. along the valley of a northern river for a distance of some twenty miles.

Inter-visible points along the river were picked out as tellurometer sites. These points were marked by iron bar or brass caps cemented in rocks. Whenever possible the ideal condition of the ground falling away from the site in the direction of the measurement was followed. However, this did not apply throughout as the terrain was typical of most northern river valleys, i. e., steep high banks, low flat gravel beds; rocky ridges; heavily wooded areas, lightly wooded areas; open country etc. and fast water. The physical features encountered were so widely varied that almost all possible conditions for getting good and bad readings were dealt with.

The most time consuming part of the job was transporting the equipment from station to station. The water was very low in the river and with many rapids it was slow work.

The field party comprised two operators for each unit and two boatmen. Each unit was supplied with a vehicle and used the boat when necessary to cross and re-cross the river.

A system of hopping the instruments was used. This meant that one instrument remained at the same site for two measurements before moving ahead. The phone system, an intregal part of the equipment, maintained communications between stations and was invaluable for both the tellurometer measurements and the vertical and horizontal angle measurements made with the Wild T2 theodolite.

The average time needed for one distance measurement was less than half an hour including setting up the equipment, taking 12 sets of readings and re-packing the equipment again before moving on to the next station. Before leaving the station, a quick check was made by reducing the coarse readings. It may be seen from this that our rate of progress depended on how quickly we were able to move between stations.

The distance between the stations was measured by tellurometer, taking 12 sets of readings. These readings were checked to see that the swing was proper and that there were no ambiguities. Vertical and horizontal angles were read at all stations with the Wild T2. From this information we calculated the distance and bearing of all courses and the co-ordinates and elevations of all stations. It must be pointed out here that tellurometer measured distances are slope distances and have to be reduced to horizontal measurements. The measurement of the vertical angles between stations to an accuracy sufficient for carrying elevations was done with the Wild T2 reading to decimals of a second.

The following is an extract from the daily progress report of the operation:

"<u>Monday, July 21</u>

We met other members of

the party and commenced instrument work at 2:00 p.m. We measured 5 distances for a total of 13,385.32 feet. No difficulties encountered.

Tuesday, July 22

Commenced reading at 9:00 a.m. Measured 10 distances for a total of 25,107.51 feet. Had some difficulty in getting sets tuned for the first reading but this was resolved in half an hour and the rest of the day's work proceeded smoothly.

Wednesday, July 23

Commenced reading at 8:30 a.m. Measured 8 distances for a total of 25,803.77 feet. Had difficulty reading another line so we decided to leave it and start there next morning.

Thursday, July 24

Commenced reading at 8:45 a.m. Measured 7 distances for a total of 16,918.21 feet. Finished traverse by 2:00 p.m. No difficulties.

Friday, July 25

Commenced reading at 8:00 a.m. Rained all morning. Completed traverse by 1:00 p.m. Measured 8 distances for a total of 21,167.38 feet. We had to stop operations for two twenty minute periods due to heavy down pour. Other than that we worked during the rain and ground mist and had no difficulties."

The instrument difficulties mentioned were interference and crystal temperature.

Interference

The measurement of the last course on Wednesday did not work out properly as the swing was too great. This was left to be completed the next morning. The problem was resolved by moving the master set back five feet to a new position and taking a complete set of new readings. Difficulties due to interference can easily be overcome by moving the position of one or both sets or by raising the antennae of one or both sets.

Crystal Temperature

The difficulty was caused by the difference in crystal temperatures between the master and the remote sets. On the morning of July 22 the first set-up for the remote instrument was in the shade whereas the master instrument was in the sun. The master set warmed up quickly but the operation was delayed a half hour while the remote set warmed up sufficiently to allow the crystals to be properly tuned. This difficulty can be eliminated by having the crystals in each set maintained at the proper temperature by thermostatically controlled heaters.

Conclusion:

As the tellurometer equipment was on trial for the short period of five days we did not have sufficient time to make a closed traverse to work out a ratio of closure error. To check the accuracies obtained, some courses were chained over a levelled line of hubs and corrected for sag, temperature and tension. The comparisons between chainage, triangulation and tellurometer distances gave us results better than 1/10,000.

A comparison was made with a similar operation using stadia and as a result indications are that it is possible to get accuracies ten times as great at a considerable savings in time and money.

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* *"Mr. Richardson is the District Surveyor for the Northwestern, Northeastern and Toronto Regions, Survey Department, Engineering Division of the Ontario Hydro. His wide experience in both Northern and Southern Ontario survey work makes this report especially interesting. Mr. Richardson is a member of the C.I.S. and of the A.C.S.M.*