

Determination of Curvature Correction (CC) by Experimental Approach

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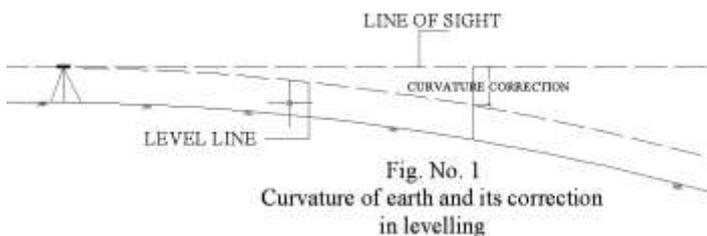
Abstract— The curvature of Earth means that a line of sight is horizontal at the instrument will be higher and higher above spheroid at greater distances. The line of sight is horizontal at the instrument but it is not a straight line because of curvature of earth. The vertical distance between the line of sight and the level line at a particular place is called curvature of Earth and its correction. Due to curvature, objects appear lower than they really are. Curvature correction is always subtractive (-ve). The formula for curvature correction is derived as geometrically (given in surveying & levelling by Dr. N.N. Basak & Dr. N. Chandra). The above value of curvature correction can be modified through experimental research by levelling process at and along Sea shore with adopting the concept of a Technique of maintaining uniform line of sight (ie. Height of instrument) after each successive change point, where as in past in all levelling process the Height of instrument changed after each change point.

Keywords- curvature of earth, curvature corrections in leveling.

I. INTRODUCTION

Determination of curvature of earth by conventional method, with experimental approach has to be carried out along Sea shore for the distance 8km to 10 km and new modified value can be obtained. Actual corrections will be obtained by Experimental approach in the form of new derived relations for the calculation of corrected values in levelling process as well as in mapping analysis. As we know the shape of Earth is spheroidal, hence the curvature correction is determined directly by levelling process.

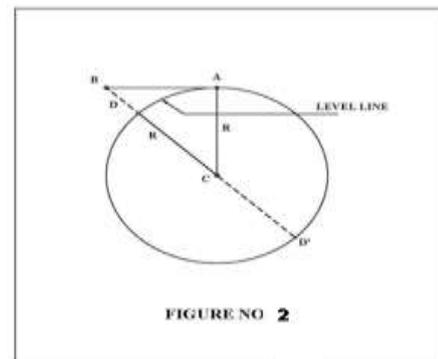
The line of sight is horizontal at the instrument but it is not a straight line because of curvature of earth, as shown in Figure No: 1



The vertical distance between the line of sight and the level line at a particular place is called curvature correction, Due to curvature, objects appear lower than they really are.

Curvature correction is always subtractive (-ve). From the fig No: (1) The formula for curvature correction is derived as geometrically (given in surveying & levelling by Dr. N.N. Basak & Dr. N. Chandra)

AB = D = Horizontal distance in Km
BD = CC = Curvature correction
DC = AC = R = Radius of earth
DD' = Diameter of earth



$$BC^2 = AC^2 + AB^2$$

$$(R + Cc)^2 = R^2 + D^2$$

$$R^2 + 2RCc + Cc^2 = R^2 + D^2 \quad Cc \times 2R = D^2$$

$$\text{Curvature Correction} = Cc = D^2/2R$$

(Cc^2 is neglected as it is very small in comparison to the diameter of the earth)

In previous research curvature of earth, calculated from the geometrically derived formulae, by using earth diameter as shown in figure No.02 (above) In this study to work out cc, experimentally by using the instrument automatic level, Electronics Distance meter and total station, with the practical work at sea shore (along beach at ideal site condition).

II. OBJECTIVE & SCOPE

- To set up experimental Parameters.
- To compare the value of curvature of earth for the known horizontal distance. To compare curvature correction due to refraction.
- To compare radius of curve, degree of curve and curvature correction.
- To compare true values of levelling and mapping analysis.

III. METHODOLOGY

This can be done along sea shore with adopting the concept of levelling with technique of maintaining uniform line of sight

(i.e. uniform Height of instrument at successive change point, where as in past this concept was not adopted).

If it is adopted conventionally, in the form of comparative study with available data can be form as shown in figure below. First of all establish points A, B, C,D, E and F along seashore during low tide known time and set up the instrument near A, take back sight on A and fore sight on B and note down h_1, H_1, h_2, Cc_1 . Similarly setup level near B and bring it to the same H.I record the further readings in progressive direction.

D1 = 0.5 Km,; D2 = 1.0 Km; D3= 1.5 Km
 D4 = 2.0 Km; D5 = 2.5 Km up to 5 Km

& note down the value of cc corresponding to above distance as, Cc_1, Cc_2, Cc_3, Cc_4 and value with geometrically derived relations as mention above,

$$Cc = Cc_1 + Cc_2 + Cc_3 + Cc_4 + \dots + Cc_n$$

In this study all the results are obtained on guidelines of “surveying and levelling” by Prof. S.K Duggal, volume 1 and Dr. N.N Basak. This performance has to be carried out experimentally at an along sea shore by using automatic level, electronic distance meter and total station.

From the earlier research of conventional method of determination of curvature correction by levelling, from (1) the distance to visible horizon concept from ship and (2) Dip of horizon concept (given by Dr. S.K. Duggal) which may be too costly.

Whereas in this conventional method of determination of curvature correction by experimental approach is easier and low cost than the other methods and the value of Cc obtained directly by observation and calculation with adopting the technique of uniform height of instrument (even after each successive change point as shown in figure No. 3) when the conditions of shore site is ideal and if the conditions are not ideal then alternative observation recorded then apply corrections for the distances.

$D = D_1 + D_2 + D_3 + D_4 + \dots + D_n =$ Total Horizontal Distance

Cc = experimentally observed value

H= Height of instrument

$h_1, h_2, h_3, h_4, \dots, h_n =$ respective staff reading above spheroidal surface of earth, as shown in table -01.

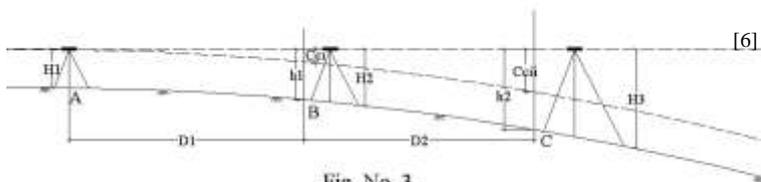


Fig. No. 3
 $D = D_1 + D_2 + \dots + D_n$
 H1 = Height of instruments of first position
 H2, H3, Hn = Height of instruments of 2nd, 3rd and n position.



Points established on seashore

Fig. No. 4

Table-01

Station	B. S	I . S	F. S	Fall (-)	Reduced Level (R.L)	Remark
A=0	h1				1.000	B.S on A
B=0.5km	h2		h2	$h_2 - h_1 = x_1$	$1 - x_1 = y_1$	C.P1
C=1.0km	h3		h3	$h_3 - h_2 = x_2$	$y_1 - x_2 = y_2$	C.P2
D=1.5km	h4		h4	$h_4 - h_3 = x_3$	$y_2 - x_3 = y_3$	C.P3
E=2.0km	h5		h5	$h_5 - h_4 = x_4$	$y_3 - x_4 = y_4$	C.P4
F=2.5km			h6	$h_6 - h_5 = x_5$	$y_4 - x_5 = y_5$	

$$\text{Check : } \sum BS - \sum FS = \sum \text{Rise} - \sum \text{Fall} = \text{Last R.L} - \text{First R.L} = Cc = \text{Curvature correction}$$

IV. RESULT & CONCLUSION

Actual corrections (Cc) will be obtained by experimental approach in the form of asthmatic checks for the calculation of corrected values in levelling process corresponding to horizontal distances and final value of Cc obtained as an arithmetic check mentioned above and it is concluded that the value of Cc is the actual value of earth curvature as well as curvature correction.

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