SNS COLLEGE OF TECHNOLOGY

AN AUTONOMOUS INSTITUTION

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COIMBATORE

DEPARTMENT OF CIVIL ENGINEERING

23CEB202 - SURVEYING
II YEAR / III SEMESTER

Unit 2 : Levelling

Topic 5 : Booking – Reduction - Curvature and refraction

Precautions For Surveying and Leveling

- Bubble should be centered carefully and it should be re-checked continuously during survey.
- Tripod should be fixed at suitable height so that field officer can easily take the readings.
- Foot screws of the level should be fastened or tightened properly.
- Tripod legs should be properly adjusted in the ground soul.
- Pass on necessary instructions to the rod man before starting the survey.
- Rod man should be directed before start of survey that rod should always be kept in state.
- Staff rod should be checked before conducting the survey, so that it may not cause error.

Precautions For Surveying and Leveling

- Survey should be preferably conducted in the morning or in the evening.
- Bench Mark should be established at proper and permanent places and their elevation should be marked, if possible.
- Ground should be leveled before taking the readings at turning point/change point and reading should be taken very carefully.
- Level should be handled and shifted carefully.
- Data like acre number, square meter and station distance should be carefully written on the field book.
- Level set should be handled and shifted very carefully.
- Survey must be closed.
- Level set equipment should be carefully packed after completing survey.

Precautions For Surveying and Leveling

- The BS and FS distance are made approximately equal wherever possible
- Readings are entered in the correct columns and in the order of observation
- First entry always in BA and last one in always FS
- Continuously entered from one page to other page
- If the last reading in a page happens to be an IS , it is entered in both IS & FS column and the same reading in BS and IS of the next page first entry.
- All the particular related to IS should also be describe in the next page
- FS and BS of CP should be in the same horizontal line
- RL of the HI should be in the same horizontal line wherever there is BS entry
- Each page of field book should have an arithmetic check

Reduction of Levels

Process of calculating the RL of points from the observed staff reading

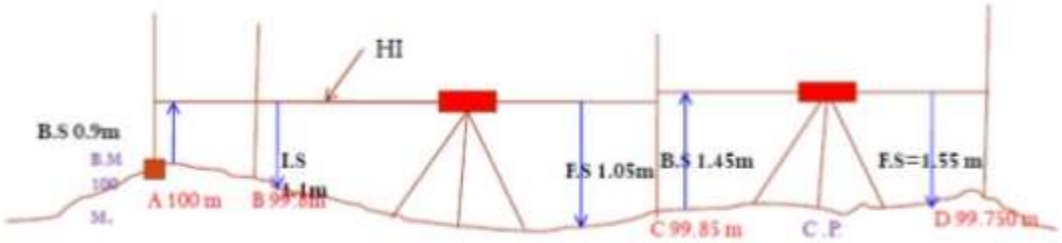
Methods are

1. Height of Collimation method
2. Rise and Fall method

Methods of Reducing Levels

Height of Instrument Method

Finding H.I. for every setup of instrument, and then obtaining the R.L. of point of reference with respect to H.I

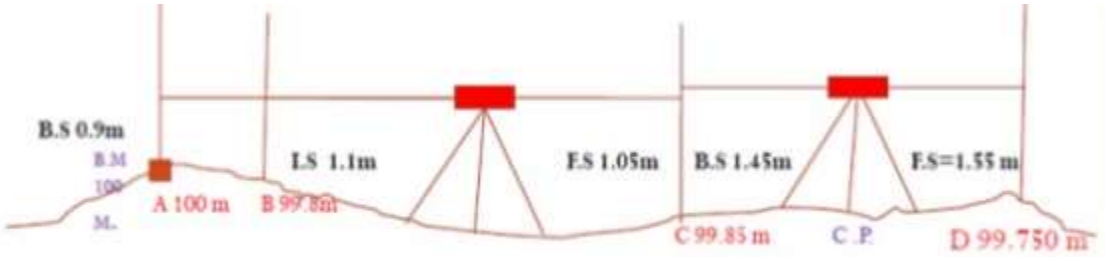


Station	B.S	I.S	F.S	H.I	R.L	Remark
A	0.9			100.9	100.00	B.M
B		1.1			99.800	
C	1.450		1.05	101.3	99.850	C.P.
D			1.550		99.750	

Methods of Reducing Levels

Rise and Fall Method

Determining the difference of level between consecutive points by comparing each point with immediate preceding point.



Station	B.S	I.S	F.S	Rise	Fall	R.L	Remark
A	0.9					100.00	B.M
B		1.1			0.2	99.800	
C	1.450		1.05	0.05		99.850	C.P.
D			1.550		0.1	99.750	

Rise and Fall Method

BS	IS	FS	Rise	Fall	RL	Remarks
1.034					86.452	BM(A)
	1.961			0.927	85.525	PT01
	0.672		1.289		86.814	PT02
2.741		0.488	0.184		86.998	TBM01
	2.571		0.17		87.168	PT03
	1.991		0.58		87.748	PT04
		1.632	0.359		88.107	BM(B)
3.775		2.12	2.582	0.927		SUM
		1.655		1.655	1.655	CHECK

1) If,

BS – FS = -ve → Fall

BS – FS = +ve → Rise

2) Checking,

$\Sigma BS - \Sigma FS = \Sigma Rise - \Sigma Fall = RL_{BM(B)} - RL_{BM(A)}$

Difference between HI and Rise and Fall method.

Sr No.	HI Method (Collimation plane)	Rise and fall method
1	HI method is less tedious, more rapid and simple method	Rise and fall method is more tedious
2	In an HI method less calculation is required	Rise and fall method more calculation is required
3	HI method is less accurate	Rise and fall method is more accurate

Difference between HI and Rise and Fall method.

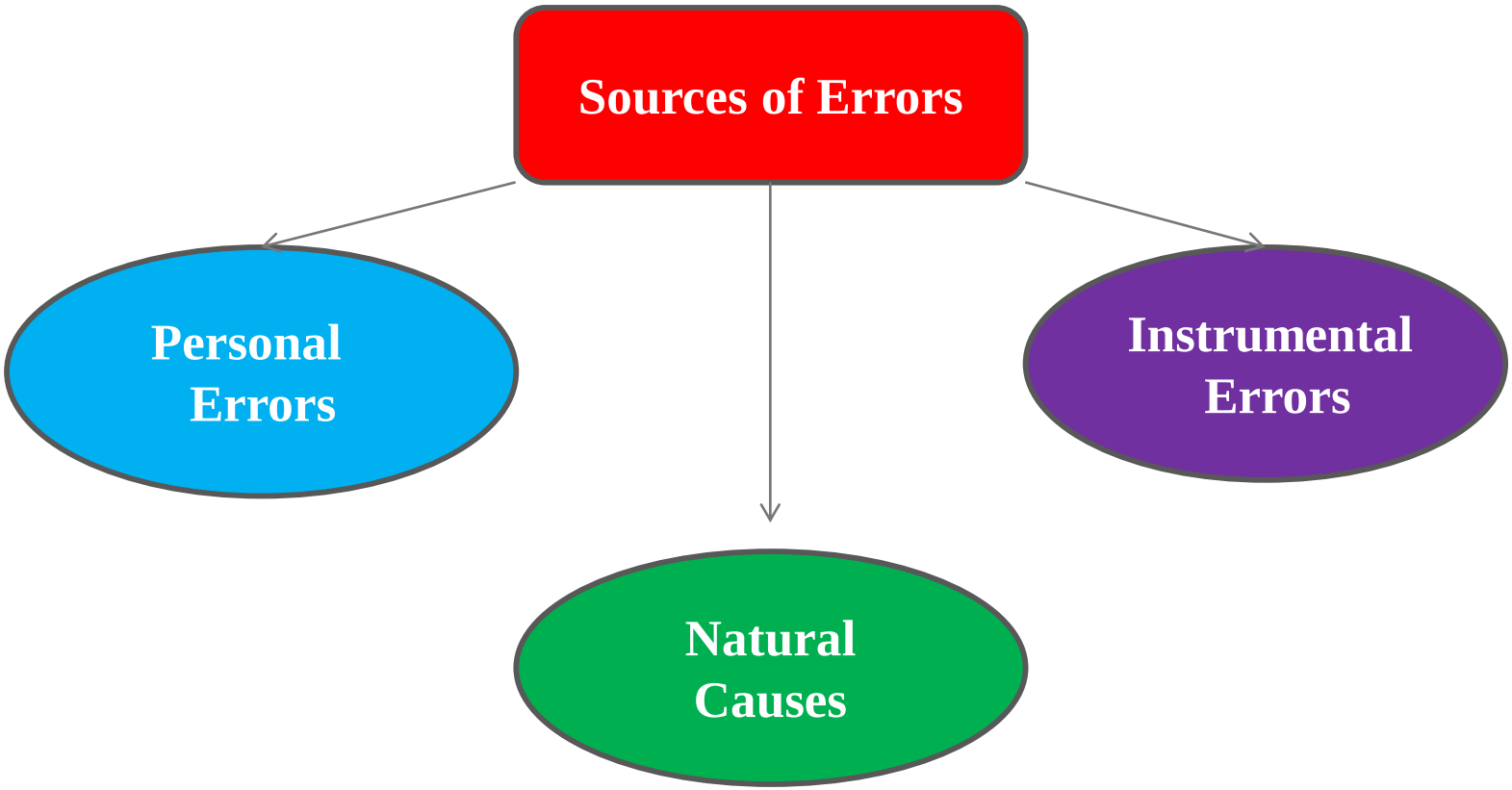
Sr No.	HI Method (Collimation plane)	Rise and fall method
4	There is no check on RL of intermediate points, hence possibilities of more mistake in calculation	There is cross-check on each RL of intermediate points, hence possibilities of less mistake in calculation
5	The error in the calculation of RL of any point is not carried forward	The mistake made in the calculation of RL of any point will be carried forward
6	Used for calculation the RL of profile levelling work, for preparation of contour map	Used for precise levelling, fly levelling and check to level

Activity

There are two ducks in front of a duck, two ducks behind a duck and a duck in the middle. How many ducks are there?

Answer: Three. Two ducks are in front of the last duck; the first duck has two ducks behind; one duck is between the other two.

Errors in Levelling



Personal Errors

- The Instruments may not be levelled
- The focusing of eye piece and objective glass may not be perfect
- The parallax may not be eliminated
- The position of staff may have changed
- Entry and recording in the field book may not be correct
- The staff may not be fully extended, may not be held vertical.

Instrumental Errors

- The Permanent adjustment of the instrument may not be perfect. That is the line of collimation may not be horizontal line.
- The internal arrangement of focusing tube may not be correct
- The graduation of the staff may not be perfect
- Defective bubble tube, if the bubble tube is sluggish, it may apparently be in the mid-position even though the bubble line is not horizontal.

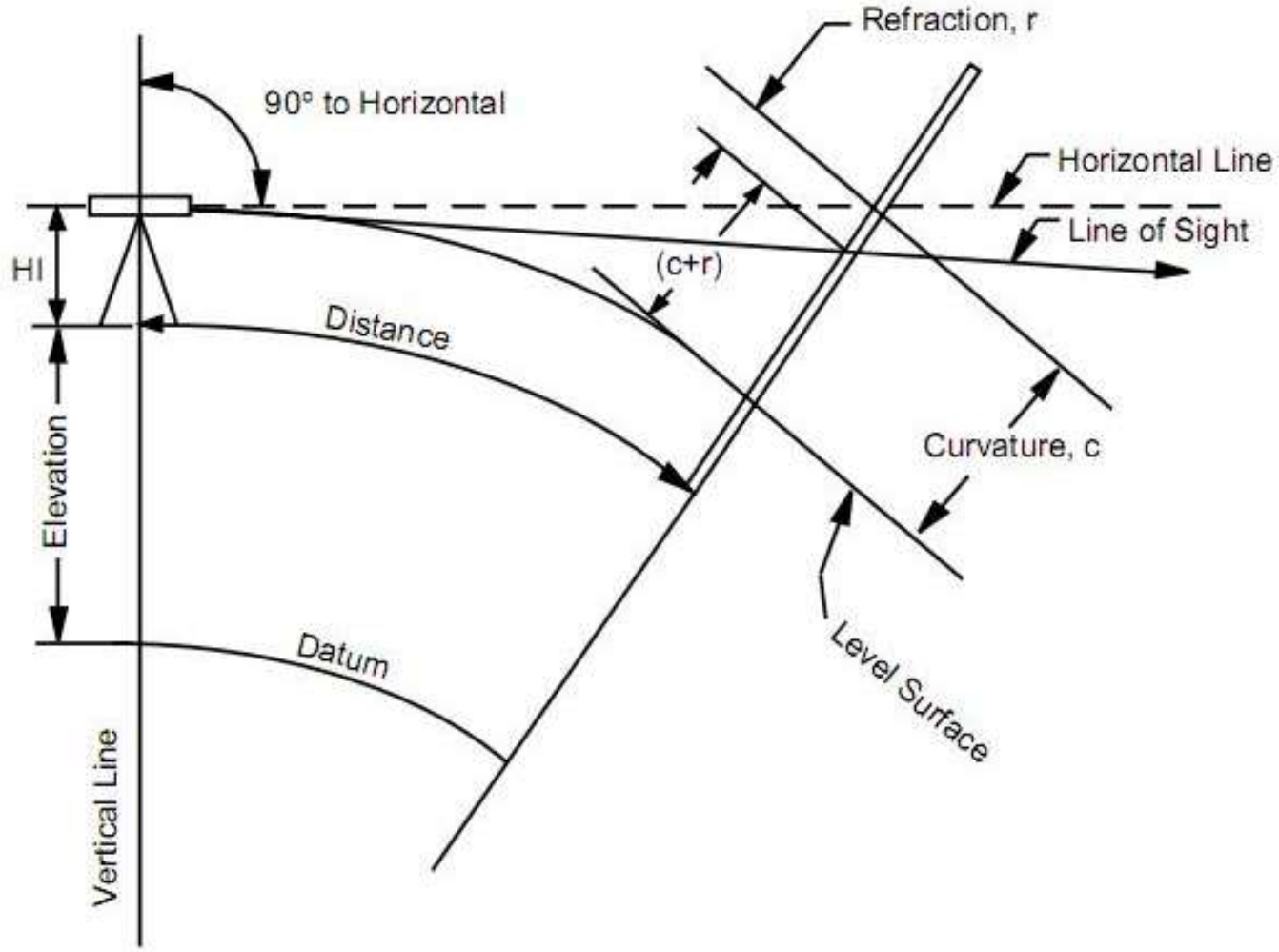
Natural Errors

- The Curvature of the Earth may affect the staff readings when the distance of sight is long.
- The effect of refraction may cause a wrong staff reading
- There are some errors in staff readings due to high velocity wind

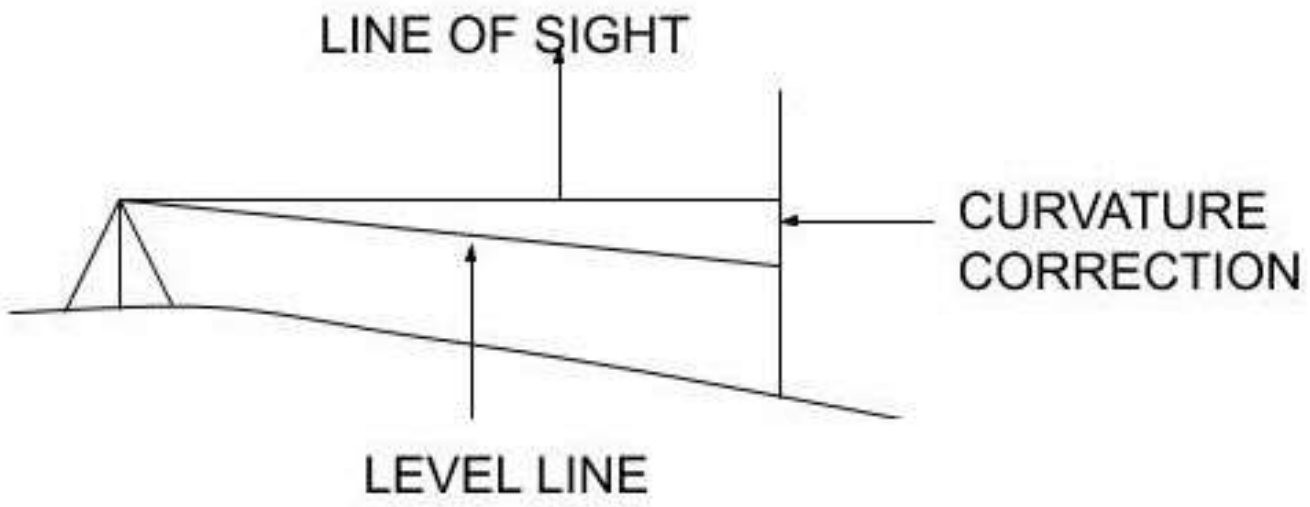
Common Errors

- Foresight and back sight not being taken on exactly the same point
- Reading the staff upward instead of downward
- Reading of stadia hair
- Reading of wrong number of metre and decimetre
- Entering B.S in F.S and vice versa
- Transposing the figures
- Omitting an entry
- The levelling staff not being fully extended.

Curvature & Refraction Correction



Curvature Correction



Curvature Correction

- For long sights the curvature of earth can effect staff readings.
- The line of sight is horizontal but the level line is curved and parallel to the mean spheroidal surface of the earth.
- **The vertical distance between the line of sight and level line at particular place is called the curvature correction**
- The effect of curvature is to cause the object sighted to appear lower than they really are. Curvature correction is always Subtractive(-)
- True staff reading=(Observed staff reading - 0.0785D^2)m
- Where D= distance in Km.

Curvature Correction

Let AB = D = horizontal distance in kilometres.
BD = Cc = curvature correction
DC = AC = R = radius of earth
DD′ = diameter, considered as 12,742 km

From right-angled triangle ABC (Fig. 5.19).

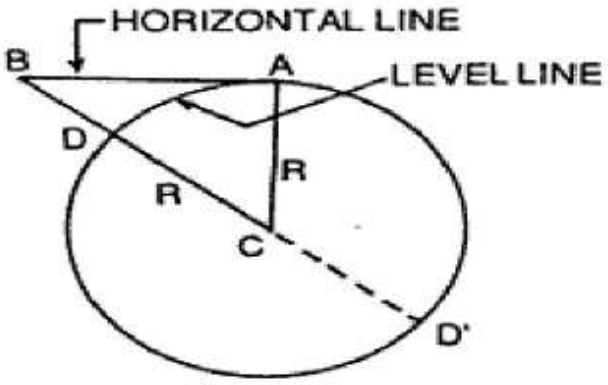


Fig. 5.19

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

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

or $$R^2 + 2RC_c + C_c^2 = R^2 + D^2$$

or $$C_c \times 2R = D^2$$

Curvature correction $$C_c = \frac{D^2}{2R}$$

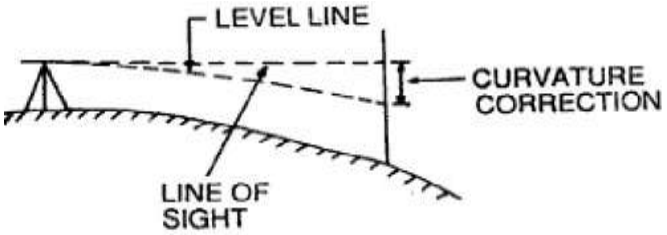


Fig. 5.18

$$BC = \frac{D^2}{12,742} \text{ Km}$$

$$= \frac{D^2 \times 1000}{12,742} \text{ metres}$$

$$= 0.0785\ D^2 \text{ metres}$$

Refraction Correction

- The ray of light pass through layers of air of different densities and refractor bent down.
- The effect of refraction is to make the object appear higher then they really are.
- Refraction varies considerably with climate conditions.
- However it is taken as, Cr=0.0112 D^2 m (+)
- Refraction is always additive
- True staff reading =Observed staff Reading + Refraction correction.

Q & A Session

Reduction Level - Problems

THANK YOU