

AIM → To study & sketch linear measuring instruments

Objective of Surveying

Surveying is the act of determining the relative positions of points on above or beat beneath the surface of earth by means of direct or indirect measurements of distance, direction and duration. It also includes the act of establishing points by predetermined angular & linear measurements.

Linear Measurements

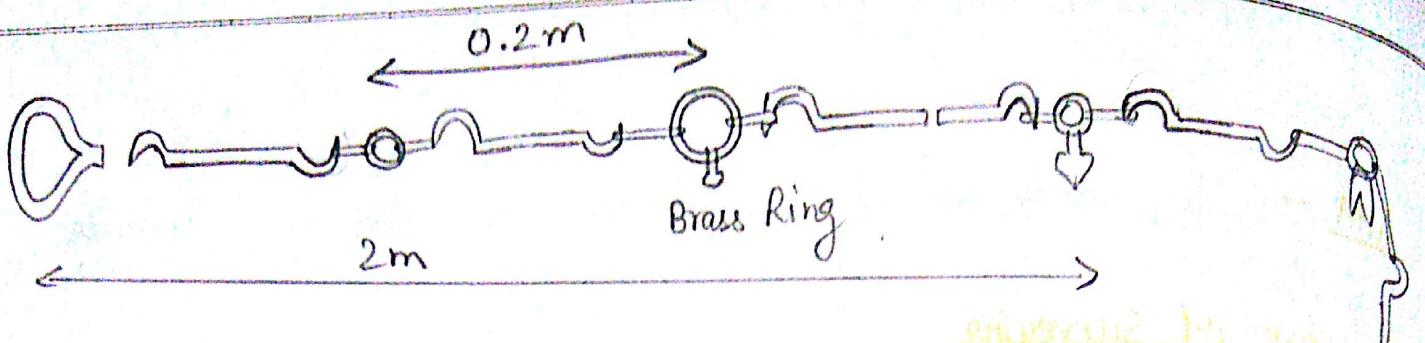
There are various measurements of making linear measurements and depends upon the degree of precision required. One of the various methods of measuring distance directly is chaining.

The various instruments used for the determination of length of line by chaining are as follows→

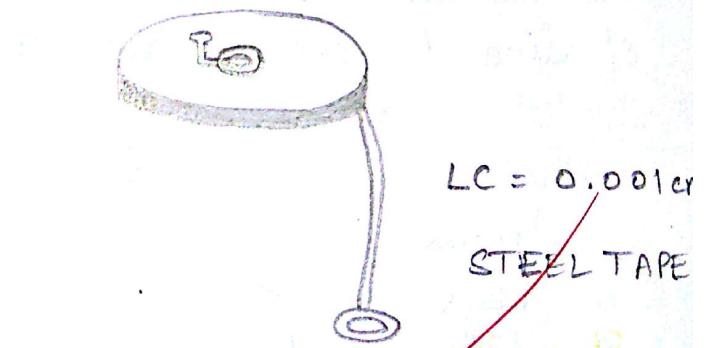
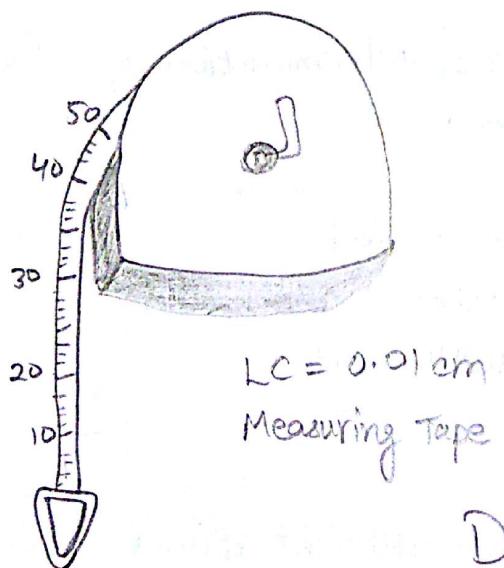
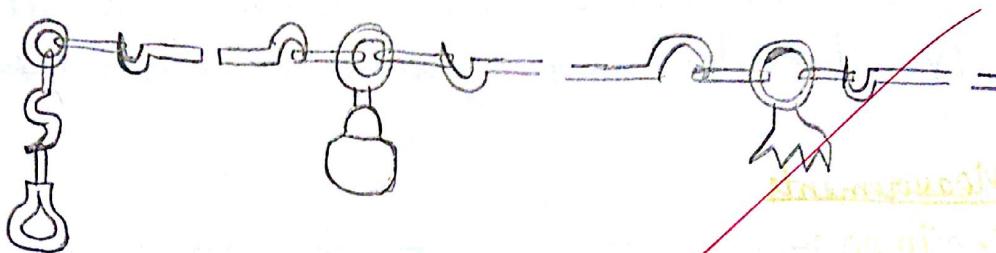
- 1. Chain
- 2. Arrows
- 3. Pegs
- 4. Ranging Rods
- 5. Offset Rod
- 6. Plaster
- 7. Plumb bomb

Chain :- Chains are formed of straight links of galvanized mild steel were bent into rings & at the ends are joined each other by 3 small circular or oval wire rings. The ends of the chains are provided with brass handles at each other with survival joint so that the chain can be twined without being twisted.

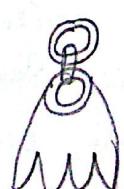
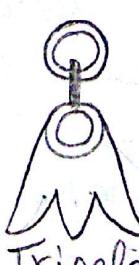
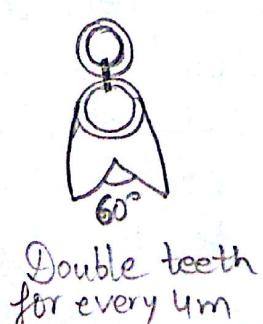
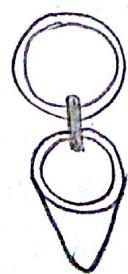
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TACS



DIFFERENT TYPES OF TACS



Double teeth
for every 4m

Triple teeth
for 6m

Quadra teeth
for 8m.

To enable the reading of fractions of chain without much difficulty the fallies are fixed at every two metre length for a chain of 30m, small brass rings are provided at every metre length except for length of 2m, 4m, 6m, 8m & 10m are different end are shown in figure.

Tape:- Tapes are used for more accurate measurements and are closed accordingly to the materials of which they are made.

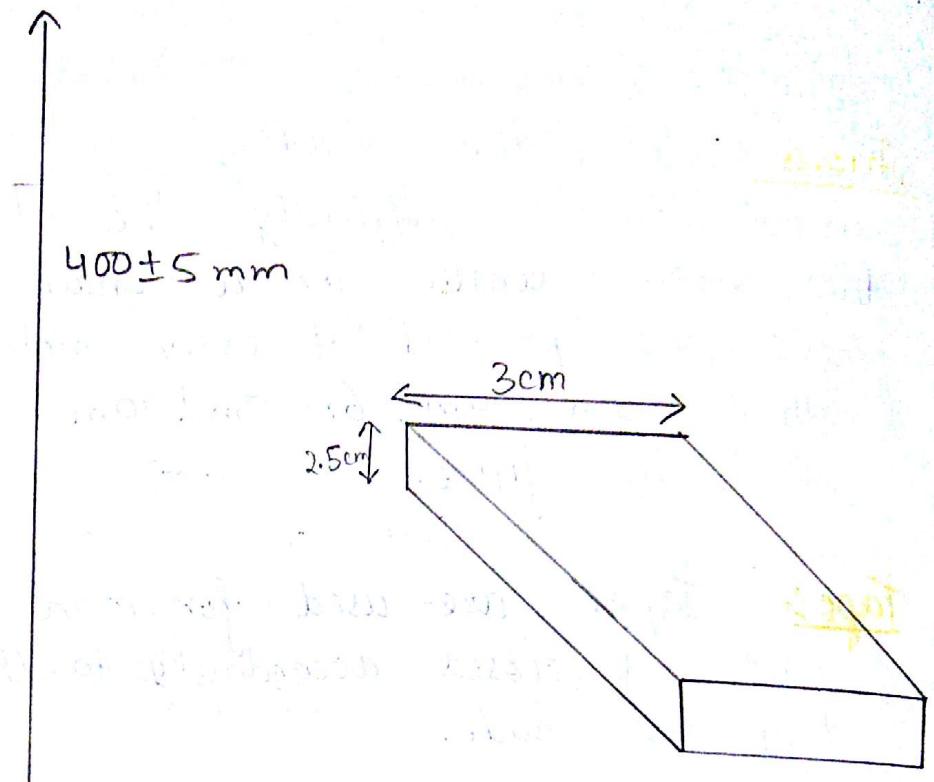
Metallic Tape:- A metallic tape is made of varnished strip of waterproof linear brass intrusion with small brass copper and bronze

Since these are light and flexible they are not easily been broken, they are flexible particularly used in the cross-sectioning and in some methods of topography. In addition it's the brass ring, the outer ends are vein forced by a strip of leather.

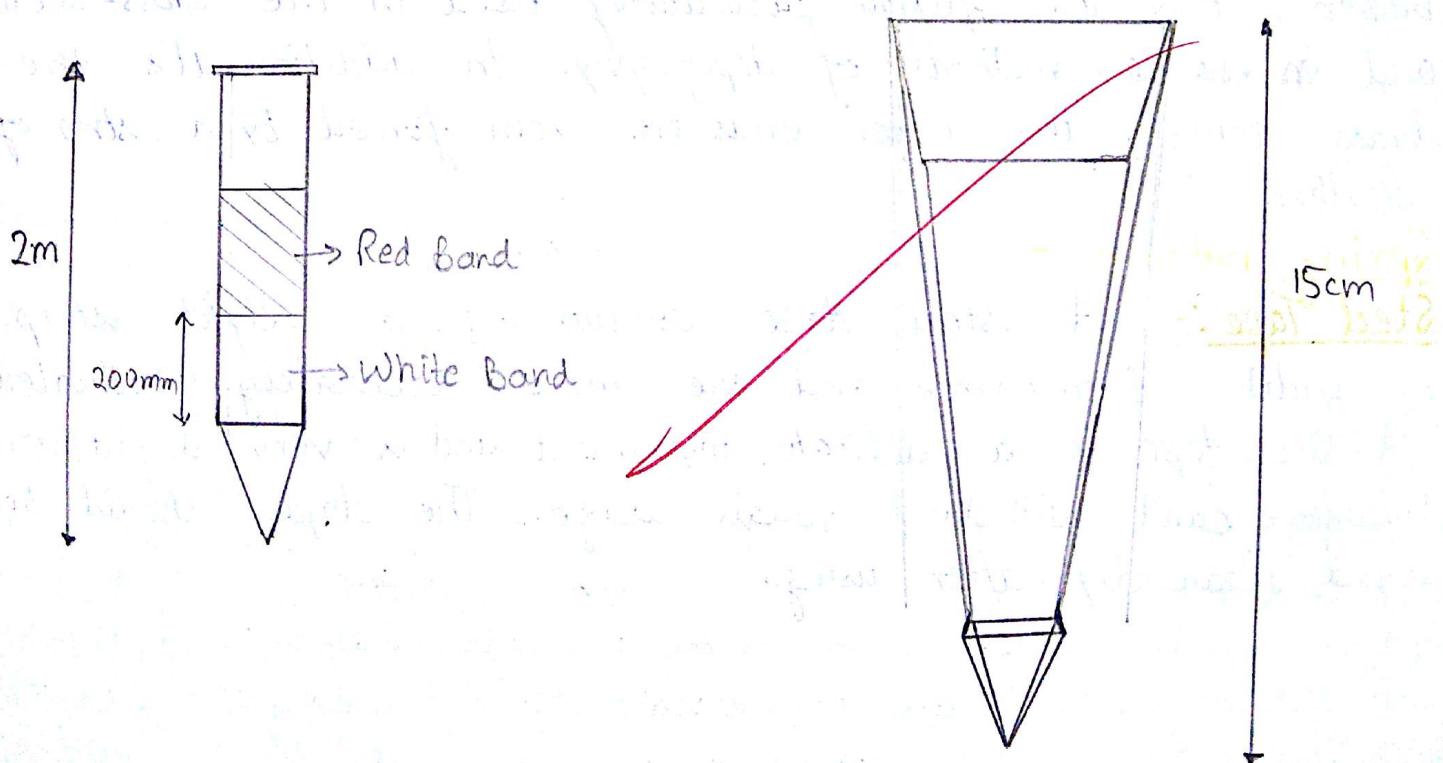
Steel Tape:- A steel tape consists of a light strip of width 6 to 10mm and are more accurately graduated. A steel tape is a delicate instrument and is very light end. Therefore can't withstand rough usage. The tape should be wiped clean dry after using.



4 mm diameter
WIRE BLACK
ENAMELED



The board be shifted in 20 cm distance to right \rightarrow 39.5 cm



Arrows :- Arrows ~~are~~ or marking pins are made of stone steel wire and generally 10 arrows are supplied with a chain. Arrows are made of good quality hardened and tempered steel wire 1mm in diameter and are enamelled. An arrow is inserted into the ground after every chain length measured on the ground.

Pegs :- Wooden pegs are used to mark the position of the stations or the terminal point of the line. They are made of steel, timber generally 25cm^2 or 3cm^2 and 15cm long. tapered at ends. They are driven into the ground with the help of wooden hammer.

Ranging Rod :- Ranging rods have a length of either 2m or 3m. They are stood at the bottom with a heavy iron pointer and are pointed in alternate barrels of white & red, each band of 20cm. Ranging rods are used to range some intermediate points in survey line.

Spring Balance :- When the chain is used for measuring distances, it becomes slack at some regions, which gives an error in measurement due to the undulating surface of the earth. To reduce this error the chain is fixed with a spring balance and pulled on the outer side. The min. weight required to straighten the chain is noted from the reading of the corresponding weight from the spring balance and an appropriate reading is fixed.

Aim → To carry out chain surveying

Instruments used → Matrix chain (30m), tape, ranging rod, arrow, wooden peg, hammer, optical square

Procedure :-

- (1) Two chain men are required in this process. The chain man at the forward end of the chain is called leader & chain man at zero or near end of the chain is called follower.
- (2) The station A & B are fixed at some distance by fixed wooden peg to determine horizontal distance b/w them.
- (3) Position of A & B is fixed. By measuring their position from atleast three permanent objects & location.
- (4) The follower holds one handle of the chain in contact with the peg of station A.
- (5) The leader takes the other handle of chain, arrow & ranging rod 'B'.
- (6) The follower directs the leader to stand exactly in the line. The leader puts a stretch at the position with the chain handle & remaining length is measured.

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- (7) Total length of AB is then calculated.
- 8) The same procedure is repeated for 3rd point.
- 9) During their procedure detect which are along the side of the chain line are located by lateral measurement with offset & tape, the points are perpendicular offset.
- 10) All the Perp. offset are measured till ~~strength~~ straight line BC is reached.

Calculation

In $\triangle ABC$,

$$AB = 39.12 \text{ m}, \quad BC = 21 \text{ m}, \quad CA = 23.4 \text{ m}$$

i.e. $a = 21 \text{ m}, \quad b = 23.4 \text{ m}, \quad c = 39.12 \text{ m}$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$= \frac{(23.4)^2 + (39.12)^2 - (21)^2}{2(23.4)(39.12)}$$

$$\cos A = 0.8941$$

~~$\cos A = \cos$~~

$$\angle A = 26.60^\circ$$

$$\cos B = \frac{a^2 + c^2 - b^2}{2ac} = \frac{(21)^2 + (39.12)^2 - (23.4)^2}{2(21)(39.12)}$$

$$\angle B \approx 29.94^\circ$$

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Similarly, $\angle C \approx 123.46^\circ$

Now, $\angle A + \angle B + \angle C = 179.996^\circ$

$$\text{Error} = 180^\circ - 179.996^\circ \\ = 3.98 \times 10^{-3}$$

$$\% \text{ Error} = \frac{\text{error}}{\text{Original Value}} \times 100 = \frac{3.98 \times 10^{-3} \times 100}{180} \\ = 2.21 \times 10^{-3} \%$$

Conclusion

Thus we have carried out chain surveying in which we have 3 stations & measured distance b/w them.

Aim:- To study compass & carry out compass traversing.

Apparatus Required :- Prismatic compass, Steel tape, ranging rod, wooden peg, tripod stand, hammers, chain.

Theory :-

True Meridian :- The line or plane passing through geographical north pole, geographical south pole & point on the surface of earth is known as true meridian.

Magnetic Meridian :- When a magnetic needle is suspended freely & balanced properly infected by magnetic substance, it indicates in a dirⁿ, the dirⁿ is magnetic meridian.

Arbitrary meridian

Sometimes for a survey line, a convenient dirⁿ is assumed as meridian known as arbitrary meridian.

Forward & backward bearing

The bearing of a line is the dirⁿ of progress of survey is called forward & backward bearing.

Properties

- (i) $1 \text{ B.B.} = F.B = 180^\circ$ (for a survey line)
- (ii) Angle included b/w two lines = FB of 1st - B.B. of 1st

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Local Attraction

Magnetic needle inclined to the north dirⁿ when freely suspended on pivoted, if the needle come near some magnetic substance, it is found to show actual magnetic earth. This disturbing influence of magnetic substance is known local attraction.

Prismatic Compass

A cord fastened to the underside of pivoted needle carries the graduation, the zero of which coincides with the needle south end. The index attached to and making with the signing lines is needed against the needle.

Controlled core, the observer measuring prism with a minute upward movement of the eye be sign the opposite vertical hair. The lines with the distance object, the magnitude bearing of which is used by leaving the lowering eye slightly & receiving the horizontal & reflection through the prism of graduated cord.

To make an observation, the survey for prismatic compass is placed on a tripod stand, the whole of box being approximately less than being no accurate means of levelling with the nearly vertical. We pass through a sightseeing slot at the same time observes the reading of cord.

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Procedure

- (1) We select the required instruments.
- (2) We choose a field.
- (3) We fixed stations A, B, C, D.
- (4) We sketched a net diagram.
- (5) We used wooden pegs to mark 4 stations.
- (6) We put the tripod stand out at any station & hence included angle is calculated.

Station	Line	F.B.	B.B.	Difference	Correction	Corrected F.B.	Corrected B.B.
A	AB	260°31'0"		AB - BA	30'	261°	250°
	AC		246°30'0"	= 179°			
B	BC	123°0'0"				123°30'	81°
	BA		81°30'0"	BC - CB = 179°	30'		
C	CA	59°0'0"		CA - AC		59°15'	299°45'
	CB		300°0'0"	= 180°30'	15'		

Conclusion :- Using prismatic compass we have calculated the included angle b/w the two points.

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Aim- To study & sketch of vernier theodolite & angle measurement by repetition method.

Materials Required- Transit theodolite, wooden peg, two fixed points 'A' & 'B'.

Theory :-

The theodolite is precise instrument designed for the measurement of horizontal & vertical angle and has wide applicability in surveying such as laying off horizontal angle, locating points on line, prolonging survey line, establishing grades, determine difference in elevation etc.

• Essentials of the theodolites

(i) The telescope: It is an integral part of the theodolite. It is mounted on is known as horizontal axis or trunnion axis. Telescope may be focussing types or external focussing type. In most of the transit, an internal focussing telescope is used.

(ii) Index Frame:- It is T-shaped frame consisting of the vertical leg known as clipping arm & a horizontal bar known as vernier arm in index arm. At the two extremities of the index-arm are fitted two verniers to read the vertical circle. When the telescope is moved in vertical plane, vertical circle moves relative to vernier with the help of which reading can be taken.

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(iv) The standards

Two standards resembling the letter 'A' are mounted on the upper plate the trunian axis of the telescope is supported on there.

(v) The levelling head :-

It usually consist of two parallel triangular plates known as triblock plate. The upper triblock has 3 arms each carrying a levelling screw. The lower triangular on foot-plate has a circular hole through which bob may be suspended.

(vi) Two spindles :-

Inner spindle is solid & conical & fits into the outer spindle which is hollow & ground conical in the intermediate also called upper axis since it carries the vernier on upper plate. The outer spindle carries the scale on lower plate & it therefore also known as lowering spindle.

(vii) The lower plate :-

The lower plates carry a lower clamp screw & a current reading slow motion on tangent screw with help of which it can be fixed accurately.

(viii) The upper plate

It is attached to the inner axis & carries to a vernier with magnitudes at 2 extremities diametrically opposite. The upper plate supports the standard on

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upper clamp & to a corresponding tangent screw for accurately fixing it to lower plate.

(ix) The plate levels :- The upper plate carries two plates levels placed at right angle to each other. One of the plates level is kept parallel to tunnicon axis.

(x) Tripod:-

when in use , theodolite is supported on a tripod which consist of 3 solid mounted legs.

(xi) The plumb bob :- It is suspended from the hook fitted to the bottom of inner axis with analyze the instrument.

(xii) The compass :- Some theodolite are provided with a compass which can be either tabular type or through type.

• Procedure

(i) Set the instrument at station O & level it & with the help of upper clamp & tangent screw. Set the reading-

(ii) Loosen the lower clamp & direct the telescope towards the point A, clamp the lower one & bisect the point 'A' accurately by slower tangent screw.

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- (iii) Unclamp the upper clamp & turn the instrument clockwise about the inner axis towards 'B'. Clamp the upper clamp and bisect 'B' accurately with the upper tangent screw.
- (iv) Unclamp the lower clamp of two turn telescope clockwise to right A again. bisect A accurately.
- (v) Unclamp the upper clamp, then the telescope rotate clockwise & right B. Bisect B accurately by upper tangent screw.
- (vi) Repeat the process until the angle is repeated.
The required member or
- (vii) The average horizontal angle is then obtained by taking the average of two angle obtained with face left & face right.

	Reading			Angle	No. of Repeation	Corrected Angle	Mean Corr Angle
	V _A	V _B	V _C				
	3°50'40"	183°51'20"	183°51'		1		
	20°24'40"	200°29'20"	200°24'30"	16°53'30"	2	16°31'10"	
	36°24'40"	216°40'40"	216°40'	16°23'30"	3		
	53°24'20"	283°24'40"	233°24'50"	16°36'30"			16°35'40"
	210°5'	30°5'20"	30°5'10"		1		
	226°53'20"	46°40'20"	48°46'50"	16°41'40"	2	16°40'40"	
	243°33'40"	63°31'20"	63°32'30"		3		
	260°5'40"	80°5'	80°5'20"				

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Aim:- Study of construction features of micro optic theodolite and measurement of horizontal angle by reiteration method. ~~method~~

Instrument Used:-

Tripod, plumb bob, optical theodolite

Micro-optical theodolite:-

The theodolite has a horizontal and vertical circle of glass & images of both are together with that of micrometer scale into the field of view of reading eye-piece. Both circles are divided into minimum two minutes. This is another scale to give a much finer reading and is known as micrometer scale.

Theory:-

Reiteration Method:-

This is very simple & very suitable technique to measure more than one angle from particular station. In this method, we choose the horizontal as we traverse entire 360° . In this method, if we have to measure an angle, we measure the vertex angle too. This technique helps us evaluate the angle.

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about a point. We evaluate the angle about a point. We first operate the up screw and repeat the procedure in both face left & face right condition to eliminate an error due to improper centering on levelling.

This correlation of an angle about a point is 360° , where checking can be done by sum of angles.

Procedure:-

- (i) Setup the transit to a level & level it with the help of a clamp & tangent below.
- (ii) The apparatus is levelled and forkles is removed.
- (iii) The lower clamp was loosened to adjust vertically.
- (iv) The upper clamp noted as it appears on scale.
- (v) The error in this procedure is removed by correction application.
- (vi) The above steps were repeated & readings are taken.

Precautions :-

- (1) The parallax must be removed before taking reading.
- (2) The levelling & controlling must be proper.

Errors :-(I) Instrumental Errors :-

- (i) The needle may be cracked.
- (ii) There might be an inbuilt error in the instrument.

(II) Personal errors

- (i) The levelling must not be proper.
- (ii) The reading might not be taken accurately.

	Face Left	Face Right	Mean Angle	Remarks
C	$56^{\circ} 38' 20''$	264° $24' 20''$		
D	$70^{\circ} 43' 40''$ $5'$ $20''$	276° $29'$ $40''$	$145^{\circ} 20'$	$\angle COD = 143^{\circ} 3''$
D	$84^{\circ} 17'$	292° $34' 40''$		
PF	$018^{\circ} 32' 40''$ $42'$ $15'$ $20' 20''$	$166^{\circ} 39'$ $42'$ $15'$ $20' 20''$	U218	Teacher's Signature : _____