

CIVIL ENGINEERING

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Civil Engineering :-

Civil eng. is the discipline in which we design, construct and maintain the structures like buildings, airports, railways etc.

Surveying :-

Surveying is the science in which we determine relative position on the surface above the surface & below the surface.

① Plane surveying :- In this we neglect curvature of Earth surface. It is used for plane surface and smaller areas.

② Geodetic surveying :- In this we consider of curvature of surface. It is used when we plan for larger areas.

Types of Map

1) Topographical map :- It is use to understand topography of any area it considers natural structure of phenomena like rivers, valley etc.

2) Cadastral map :- It considers boundary or layout of any area.

3) Engineering map :- It is used to represent engineering structures like dam, railway, canal etc.

4> Geodetic map :- It is used to present what lays in beneath the surface of the earth. like natural resources.

5> Hydrological map :- It is used to represent water bodies according to nature like river pond, tubewells etc.

Principle of

- To work from whole to part
- Measure of point with respect to two other points.

Instrument used in measuring horizontal

1> CHAINS	1> METRIC
	2> GUNTERS
	3> ENGINEERS
	4> REVENUE

1> Metric chain :- These are made up of metals either made of brass steel or copper. It has 100 or 150 links in general which counts to 20 & 30 meter.

2> Gunter's chain :- It is also called as surveyor's chain. It has 100 links and 66 feet in length. It is mostly used by surveyors in ^{plain table} ~~plane~~ surveying.

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3> Engineer's chain :- It consist of 100 links and 100 feet in length.

4> Revenue chain :- It is 33 feet in length & have 16 links. It is mostly used in cadastral surveying.

2> TAPES

(i) Linen tape :- It is made up of cloth called as linen. It is available in length of 2 meter, 5m, 10m, 20m, 30m, 50m.

(ii) Metallic tape :- It is made up of linen interwoven with brass & copper ~~wire~~ at its edges. It is also available in 2m, 5m, 10m, 20m, 30m & 50 meters.

(iii) Steel tape :- It is made up of steel and have less tear out than linen & metallic tape. It has width of 5 to 7 mm. It is available 2m, 3m, 5m and 10 meters of length.

(iv) Invar tape :- It is made up of alloy consisting of 36% nickel and 64% steel. It has width of 3 to 5 mm. It is the most durable tape available for use.

3> RANGING RODS :- It is used to assure linearity of line. It is available in two sizes 2m & 3m. It is used in chain & tape measurements. It has alternate stripes of colour combination ~~stripes~~, white & red.

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12/5
25/1000 x 100 = 2.5
2 =
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2 10 5

and (red and black).

4) ARROW :- It is used for establishing temporary benchmark on the ground. It has length of about 300mm and is of 4mm in diameter.

5) PEG :- It is made up of wooden block & have cross section of 20mm. It has ~~length~~ length of 20mm. It is used for permanent benchmarking.

6) OFFSET ROD :- It is used when we have any obstruction on the ground. It is similar to ranging rod.

REPRESENTATIVE FRACTION :- It is the ratio of scale taken on the map to the scale taken on ground.

ERRORS :-

1) Mistake :- It is caused due to inaccuracy of the human (Human error). It also include carelessness, lack of knowledge & laziness.

2) Compensating Error :- It is compensatory in nature and opens only in one direction. It include inaccurate length of chain excessive or inferior pull.

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3) ^{*}Cumulative Error :- It is also known as systematic error. This error can be present in only one direction. It can be only positive or only negative. It is directly proportional to length of the survey length.

Ex:- Sagging of the chain

Correction = True value - Measured value

ERROR = - Correction

OFFSETTING :- It is the literal distance measured in the ground on the survey line. It can be perpendicular or oblique.

RANGING :-

1) DIRECT RANGING :- It is used when end terminals or stations are intervisible to each other.

2) INDIRECT RANGING :- It is also known as reciprocal ranging. It is used when both the stations and terminals are not intervisible to each other.

COMPASS SURVEYING

PRISMATIC COMPASS

SURVEYOR

In this compass bearing is measured from 0° to 360°

In surveyor Compass bearing is measured from 0° to 90°

Bearing measured is called whole circle bearing

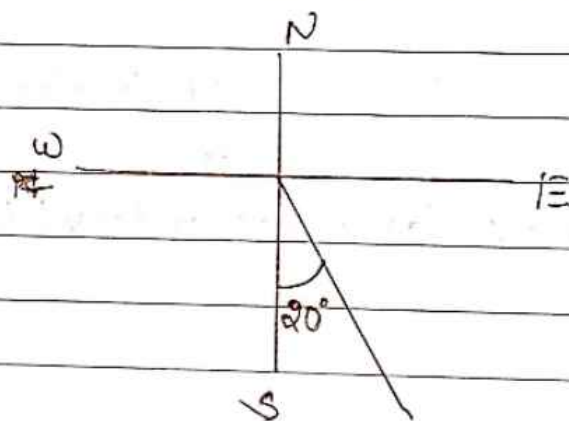
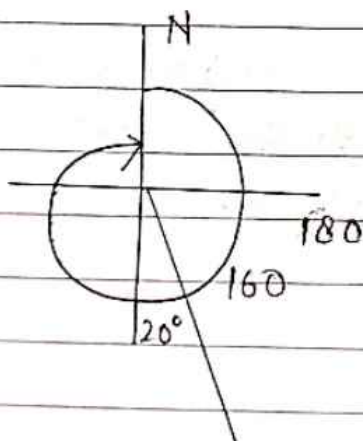
Bearing measured is called reduced bearing / Quadrantal bearing.

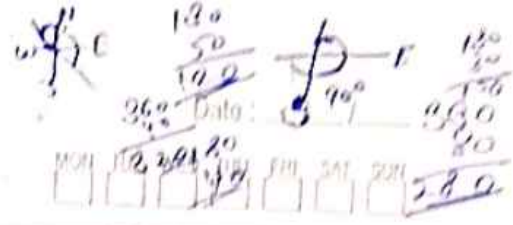
In prismatic compass bearing is clockwise only.

In surveyor Compass bearing is clockwise and anticlockwise both.

In this compass bearing is measured from ~~both~~ north dirⁿ.

In this Compass bearing is measured from both dirⁿ north and south.





Subject :
Whole circle bearing
WCB

Reduced bearing
RB

270°

N90°W, S90°W

160°

S20°E

70°

S90° N10°E

180°

S90°E

340°

N20°W

R.B

WCB

S50°E

130°

N40°W

320°

N80°E

280°

S30°E

150°

S40°W

220°

Basic definitions in Surveying

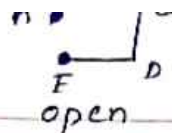
1) Chain surveying :- In this method we only take linear measurement of the ground. It is often used for small areas and for rough surface.

2) Compass surveying :- In this method we only use angular measurements of the ground. It only shows direction of the survey line.

3) Traversing :- It is the composition of chain surveying and compass surveying. That means we take angular measurement as well as linear measurement.

a) Open :- On the ground when we start from station A and at the end of work we reach at station A that is called as open traverse. do not.

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open



close traverse.

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b) Closed traverse :-

When an object start traversing from station A and at the end of work object again reaches at station A a close loop is formed and that traverse is called as closed traverse.

4) Theodolite :-

It is an instrument in which we take horizontal angles as well as vertical angles on ground.

5) Plane table survey :- In this method of surveying ~~sight~~ sighting is done at the ground. In this surveying and drawing of the plane is done simultaneously.

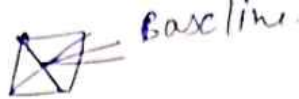
6) Level surface :- It is the surface parallel to the earth from which every point on the level surface is equidistance from the circle of earth.

a) Level line :- It is an imaginary line present on the level surface.

b) Horizontal line :- It is the line tangential to the level line.

⇒ Contour :- It is an imaginary line joining the points of equal elevation.

8) Well Conditioned triangle :- In this type of ~~con~~ triangle is goes from 30° to 120° .



Base line

Mean sea level
at 2000
→ 150 to 200m

$(2n-4)90^\circ = \text{per angle}$
↓
sides

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TRIANGULATION :-

It is method in surveying in which we divide a polygon in no. of triangles and then we calculate area of the polygon.

STATION :- It is the point on the ground of which reduced level is known so.

SURVEY LINE :- The line joining two stations called survey line.

Base line :- It is the longest line present in the map/plan which divides the polygon into approximately two equal halves

Check line :- Checkline is drawn to find out accuracy of the drawing

OFFSET line :- It is the line drawn from base line features of the plan.

Bearing :- It is the angular meas. taken from geographical north and geographical south from the earth

(i) **FORE BEARING** :- In the Compass surveying ~~the~~ when we move forward on a ~~traverse~~ traverse the bearing is called forward bearing

(ii) **BACK** :- In compass survey when we move in ~~backward dir~~ backward dirⁿ on a traverse the bearing is called traverse.

TRUE BEARING :-

The bearing measure from geographical north and geographical south is known as true bearing.

Magnetic Bearing :-

When we suspend a magnet and observe bearing from magnetic north or magnetic south then it would be called Magnetic bearing.

DECLINATION :-

It is the angular difference b/w true bearing and magnetic bearing.

$$\text{TRUE B} = \text{MAGNETIC BEARING} \pm \text{DECLINATION}$$

WESTWARD DECLINATION :-

When magnetic meridian lies on the westward dirⁿ of the compass then it is called westward declination. It is subtractive in nature.

EASTWARD DECLINATION :-

When magnetic bearing lies on the Eastward dirⁿ of the compass it is called Eastward declination. It is additive in nature.

DIP :-

When needle on the compass move in upward or downward dirⁿ. When the object is present b/w equator & poles it is called as Dip. It is 0° at the equator & 90° at the poles.

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Radius of curvature
 $C = \frac{d^2}{2R}$ Date 07.8.5 d²m }
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 $C_R = \frac{1}{2R} = 0.1129$

LOCAL ATTRACTION :-

When any magnetic subject is present nearby the compass then the observed bearing will be inaccurate and the phenomenon is called local attraction.

$$\text{FORE B} = \text{BACK B} \pm 180^\circ$$

LEVELLING

→ It is the measurement of vertical distance below the ground or above the ground. It is also the difference of elevations b/w two points or a point w.r.t datum.

1st Read. Back sight

Last Read. fore sight

B/w Read. Intermediate Sight

① Direct : → 1> Simple 2> differential 3> fly 4> Reciprocal
5> Cross-section

② Indirect : → 1> Trigonometric 2> Barometric
3> Hypsometric

$$\left[C_c = 0.0678 d^2 \right]$$

(+)

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Reading increase $\rightarrow$ fall
decrease $\rightarrow$ Rise.

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Method of levelling

1) HI Method

2) Rise and fall

Levelling :- The art of determining the relative elevation on or below the surface of earth and setting out points at various side is called levelling.

It is useful in two aspects

- 1) Points establishment for various eng. projects at desired elevation w.r.t to given datum.
- 2) To work out the elevations of given points w.r.t to each for a given datum.

BASIC DEFINITIONS

1. **Level surface :-** It is the surface which is parallel to the beam spheroidal surface of the earth.
2. **Level line :-** Level line is the line of the level surface of which all the points are equidistance from the centre of the earth.
Eg: The cross section of the spinned bottom.
3. **Horizontal surface :-** It is the surface whose plane is tangent to the level surface.

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Horizontal line :- It is a line tangential to the level line.

Vertical line :- It is the line perpendicular to the level line. It is also called plumb line.

Vertical surface : It is a plane which contains the vertical line.

Vertical Angle :- It is the angle b/w inclined line and horizontal line.

Datum :- Datum is an imaginary level surface of which reference elevation of various points/stations are measured.

Mean sea level :- It is the sea level measure for all high & low height and average out for the last 30 yrs it act as level purpose datum.

Reduced level :- It is the height of a station in the vertical plane measured above and below the datum. It is also called elevation of that station.

Benchmark :- It is a station or a point of which reduced level is known.

GTS Benchmark :- These are the benchmarks establish during Great Trigonometric Surveying. The RL of the benchmark directly measure with Mean sea level.

Permanent benchmark:- These are the benchmark established by government agency of which RL is measured w.r.t nearest GTS benchmark.

Arbitrary benchmark:- These are the benchmarks whose RL is assumed arbitrary.

Temporary benchmark:- It is the last station of the day's work from where the work of the next day is restarted.

Dumpy level :- It is an instrument used to calculate the RL of various stations.

Levelling staff:- It is a spirit rectangular bar having graduations. The foot representing the zero reading. It determines the level along which the station is above & below the line.

Principle axis of telescope:- It is the line joining optical centre of the objective and centre of the eye piece.

Line of Sight :- It is the line passing through optical centre of the objective traversing the eye piece & entering the eye.

Line of collimation :- It is the line passing through optical centre of the objective & the pt of intersection of the cross hairs and its continuation.

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Permanant adjustment of a level :- These are those adjustm. which are done to satisfy the relation b/w the various fundamental axis of the level.

Temporary adjustment of a level :- These are those adjust. which are done each time the level is used at a sight

Instrument station :- It is the point where the instrument is setup for taking observations.

Station :- It is the point where elevation or RL has to be determined.

Height of instrument :- It is the RL of the line of sight.

Back sight :- It is the first reading taken on the station of a known elevation. It enable us to compute the height of Instrument. It is always additive in nature.

$$\{ H.O.I = R.L \text{ of Benchmark} + \text{Back sight} \}$$

fore sight :- It is the last reading taken on the station of an unknown elevation. It enable us to compute the RL of station. It is always subtractive in nature.

$$R.L \text{ of station} = H.O.I - F.S$$

Intermediat station :- Intermediate sides are the reading taken other than backsight & fore sight. It also enable us to compute RL of station, where readings are bigger

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It is always subtractive in nature.

$$RL \text{ of station} = HI - I.S$$

Balancing of the sights :- To reduce the effect of the error due to curvature of the earth refraction and faulty line of collimation. The instrument is setup midway b/w two point of which RL has to be computed.

Change point :- It represents shifting of the level from 1 station to the another. At the change point the back sight & fore sight is observed simultaneously. It is also known as turning point.

Simple levelling :- It is the levelling where RL of the stations are computed without shifting of the level hence there is no changing point in simple levelling.

Differential levelling :- It is the levelling where shifting of the level takes places. Hence there are change point in differential levelling. It is also known as compound levelling.

Direct levelling :- In this elevations are computed directly with the help of level & levelling staff.

Indirect levelling :- In this elevations are computed indirectly from the observation with instrument except a level.

Eg: Trigonometric levelling, ~~Para~~ barometric levelling & hypsometric levelling.

Fly levelling :- It is a type of differential levelling where every station is a change point. It is done to connect the starting point to the permanent benchmark or a gts benchmark.

Check levelling :- It is done to check the correctness of levelling work.

Profile levelling :- It is done along centre line of a proposed loop.

Cross section levelling :- It is the levelling done on the lines perpendicular to the centre line of the proposed loop at regular or desired intervals.

Trigonometric levelling :- In this elevations are computed from the observed vertical angles.

Hypsometric levelling :- In this elevations are computed in relation with the boiling temp. of the water at that point or a station.

Barometric levelling :- In this elevations are computed in relation with atmospheric pressure at that point.

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Reciprocal levelling :- It is a levelling where elevations are observed from both ends of stations. It removes error due to curvature, due to refraction, and faulty line of collimation.

The following readings were taken with the ^{Dumpy level} ~~numbering table~~ and a 3m staff on a continuously sloping down at common interval of 1 chain (30 m).

0.780 , 1.535 , 1.955 , 2.430 , 2.985 , 1.155 , 1.960 ,
2.365 , 2.895 , 0.935 , 1.045 , 1.635 , 2.545

The RL of 1st point be 190.75 meters, ²⁻ enter the readings in the form of level book and find the reduce level of the point apply usual checks also calculate the gradient of the page and find RL of point. Apply usual checks and also calculate gradient of line joining first and last point.

$$[H.O.T = B.S + R.L]$$

Sol ⁿ :	Station	(Backsite)	(Intermediate (sight))		H.O.T	R.L	Remark
		B.S	I.S	F.S			
	1	0.780			191.53	190.75	
	2		1.535			189.99	
	3		1.955			189.97	
	4		2.430			189.81	
	5	1.155		2.985	189.7 2.985	188.54	C.P
	6		1.960		d	187.74	
	7		2.365			187.35	
	8	0.935		2.895	187.74 2.895	186.805	C.P

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				<u>Mos</u>	<u>RL</u>	
9		1.045			186.675	
10		1.635			186.105	
11			2.545		185.195	

(H - This = 185.195)

$$\text{Slope} = 190.75 - 185.195 = 5.555$$

$$\text{Slope} = \frac{190.75 - 185.195}{300} = \frac{5.555}{300} = 0.0185$$

$$(\text{Here total interval} = 30m \times 10 = 300)$$

↓ ↓
dis b/w two reading Total intervals

$$= \frac{1}{54}$$

↓
(54 move out of 100
1 m out interval (100m)
Vertical dis. 300m)

Check answer

$$\begin{aligned} \text{Las R.L} - \text{first RL} &= -5.555 \\ &= \sum B.S - \sum F.S \\ &= 2.87 - 2.425 \\ &= -5.555 \end{aligned}$$

Q:- The following staff reading were observed ^{with level} successfully. The ins. have been moved after 3, 6 & 8th reading.

2.220, 1.605, 0.900, 2.090, 2.865, 1.260, 0.600, 1.980,
1.045, 2.685

Handwritten: Enter the reading on page of label book & calculate RL of point by rise & fall method if the first reading was a backsight on the benchmark of 432.680m.

Station	B.S	I.S	F.S	(+)	(-)	R.L	Remark
				Rise	fall		
1	2.220					432.68	
2		1.605		.615		433.29	
3	2.090	0.900	0.900	.705		434	
4		2.865			0.775	433.225	
5	0.600		1.260	1.605		434.83	
6	1.045		1.980		1.38	433.45	
7			2.685		1.64	431.81	

To find fall rise & fall subtract ^{lower} ~~upper~~ reading from upper reading.

In case of Rise R.L of the station comes by adding upper reading
R.L in rise value.

In case of fall subtract fall value from upper reading.

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Checking Result By three steps :-

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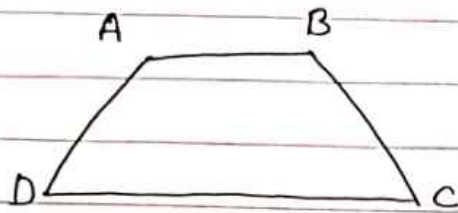
(1) $\Rightarrow$ Last RL - 1st RL = $431.81 - 432.68 = -0.87$

(2) $\Rightarrow \Sigma B.S - \Sigma F.S = 5.95 - 6.825 = -0.87$

(3) $\Rightarrow \Sigma Rise - \Sigma fall = 2.925 - 3.795 = -0.87$
 $= -0.875$

Q: A close traverse has following bearings

Line	Length	Bearing
AB	200	Roughly E (East)
BC	98	178°
CD	Not obtained	270°
DA	86.40	1°



The length CD could not be measured due to some obstruction in chaining and the bearing of AB could not be taken as station A was badly affected by local attraction. Find the length of CD and exact bearing of line AB.

Solⁿ: Latitude = $l \cos \theta$
 Departure = $l \sin \theta$

L

D

AB	$200 \cos 0$	$200 \sin 0$
BC	$98 \sin 178^\circ = -97.94$	$98 \sin 178^\circ = 3.42$
CD	$l \cos 270^\circ$	$l \sin 270^\circ$
DA	$86.40 \cos 1^\circ$	$86.40 \sin 1^\circ$
	$= 86.39$	$= 1.51$

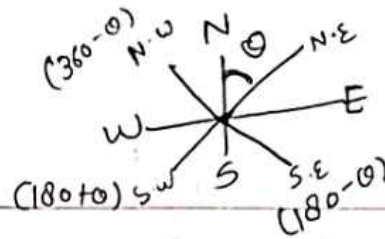
$$\sum L = 0$$

$$\sum D = 0$$

$$\sum L = 0$$

$$200 \cos 0 - 97.94 + l \cos 270^\circ + 86.39 = 0$$

$$200 \cos 0 + l \cos 270^\circ - 11.55 = 0$$



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$$200 \cos 90 = 11.55$$

$$\cos 90 = \frac{11.55}{200}$$

$$= 0.05775$$

$$\theta = 86.68$$

$$= 86^{\circ} 41' 21''$$

$$\sum p = 0$$

$$200 \sin \theta + 3.42 + 2 \sin 270^{\circ} + 1.51 = 0$$

$$200 \sin \theta + 3.42 - 2 + 1.51 = 0$$

$$200 \sin \theta + 4.93 = 2$$

$$200 \times 0.998 = 2$$

$$\{l = 199.66 + 4.93\}$$

$$\{l = 204.59\}$$

$$\{l = 204.6 \text{ m}\}$$

Q: To find out the included angle in a close surface survey PQRSTP. The following observations were made with the compass calculate the included angle after correcting of local attraction.

Diff	Line	Fore B	Back B
179° 30'	PA	N 62° 45' E = 62° 45'	S 62° 15' W = 242° 15'
179° 45'	QR	N 81° 00' W = 339°	S 80° 45' E = 159° 15'
180°	RS	N 71° 30' W = 288° 30'	S 71° 30' E = 108° 30'
181°	ST	S 39° 00' W = 219°	N 38° 00' E = 38° 00'
181° 15'	TP	S 54° 30' E = 125° 30'	N 53° 15' W = 307° 30' 45'

RS is free from local attraction. and Highlighted Readings too as they are fore & back bearing of R & S Stations.

Subject $\rightarrow$ RS is back bearing of QR.

$$(i) QR_{FB} = 159^\circ 15' + 180^\circ = 339^\circ 15' \quad (\text{Corrected f.B.})$$

$$\text{Error} = 339^\circ - 339^\circ 15'$$

$$\text{Error} = -15'$$

$$\text{Correction} = +15' \quad (\text{opposite of error}).$$

$$(ii) PQ_{B.B} = 245^\circ 15' + 15' = 242^\circ 30'$$

~~Q.R.~~

$$(iii) PQ_{FB} = 242^\circ 30' - 180^\circ = 62^\circ 30'$$

$$\text{Error} = 62^\circ 45' - 62^\circ 30'$$

$$= +15'$$

$$\text{Correction} = -15'$$

$$(iv) TP_{BB} = 306^\circ 45' - 15'$$

$$= 306^\circ 30'$$

$$TP_{FB} = 306^\circ 30' - 180^\circ$$

$$= 126^\circ 30'$$

$$\text{Error} = 125^\circ 30' - 126^\circ 30' = -1^\circ$$

$$\text{Correction} = +1^\circ$$

$$(iv) ST_{BB} = 38^\circ + 1^\circ = 39^\circ$$

$$ST_{FB} = 39^\circ + 180^\circ = 219^\circ$$

$$\text{Error} = 219^\circ - 219^\circ = 0$$

$$\begin{aligned} \text{Interior angle } \angle T &= TP_{FB} - ST_{BB} = 126^\circ 30' - 39^\circ = 87^\circ 30' \\ &= 87^\circ - 108^\circ 30' \\ &= \end{aligned}$$

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$$\angle S_{BB} = S_{T_{FB}} - R_{S_{BB}} = 219^\circ - 108^\circ 30' = 110^\circ 30'$$

$$\angle Q = Q_{R_{FB}} - P_{Q_{BB}} = 288^\circ 30' - 159^\circ 15' = 129^\circ 15'$$

$$\angle P = P_{Q_{FB}} - T_{P_{BB}} = 62^\circ 30' - 306^\circ 30' = -244^\circ = 116^\circ$$

(ext) (int).

$$\angle R = R_{S_{FB}} - Q_{R_{BB}} = 288^\circ 30' - 159^\circ 15' = 129^\circ 15'$$

$$\text{Sum of all interior angles} = (2n-4) 90^\circ$$

$$= 540^\circ$$

$$\angle T + \angle S + \angle Q + \angle P + \angle R = 540^\circ$$

Included Angle = Exterior / Interior

↳ specifically asked.

IInd Part

Subject: BMC

3 days (66.7%)
7 days (66.7%)
28 days (100%)

Cooling is done because cement is exothermic rxnⁿ 2 due to temp. rise cooling is done.

Surveying (25%)

BMC (25%)

Env. Engineering (25%)

1. Correct chart

2. Compass L/D / CORR. B

3. Levelling 11.2 / R/L/D

BMC:-

(
Cement
Concrete
Wood
Brick
Stone
Building Comp.

CEMENT and BRICK

Cement:- (Binding material)

Portland cement → 33

OPC → 33

Physical. Cement → Hydraulic
→ Non hydraulic

Chemical. Cement → Lime (50-60%) → strength
→ Silica (25-35%) → binding
→ Alumina (15-25%) → setting
→ Iron oxide (5-7%) → hardening
→ Magnesium oxide (3-5%) → strength
→ Salt (potash, Sulphur < 1%) → heavy metal

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Major Component of brick = Silica

Chemical Basis

- ferrous (Cement + Ironoxide)
- Rapid hardening (II + Lime)
- flash set (II + Alumina) → around 30%
- Alumina Cement (Major part alumina) → around 50%
- white Cement (Remove ironoxide & magnesiam)

Bogu's Compound

Initial Hardening → C_3S (Aelite) ($3CaO \cdot SiO_2$)

Final Hardening → C_2S (Belite) ($2CaO \cdot SiO_2$)

Initial setting → C_3A (Celite) ($3CaO \cdot Al_2O_3$)

Less use → C_4AF ($4CaO \cdot Al_2O_3 \cdot Fe_2O_3$)

Manufacturing of Cement

Lime
(Calcareous C.)

Silica / Alumina
(argillaceous / silicious)

Grinding dry — mixing — Pressure washing wet

Density of cement = 1440 kg/m^3

Eg: 1 bage = 50 kg

Volume = $\frac{50 \text{ kg}}{1440} = 0.035 \text{ m}^3 = 35 \text{ ltr.}$