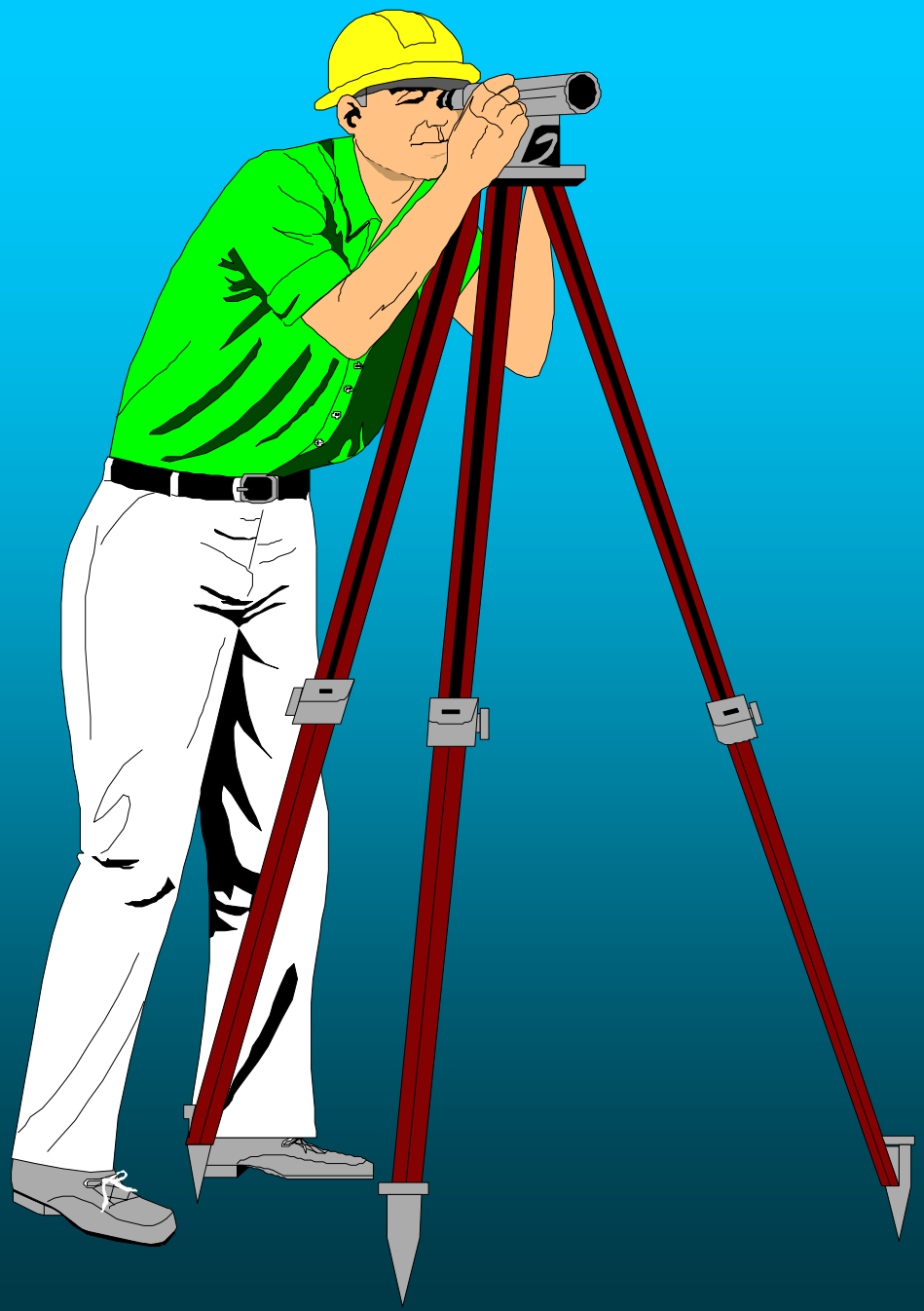
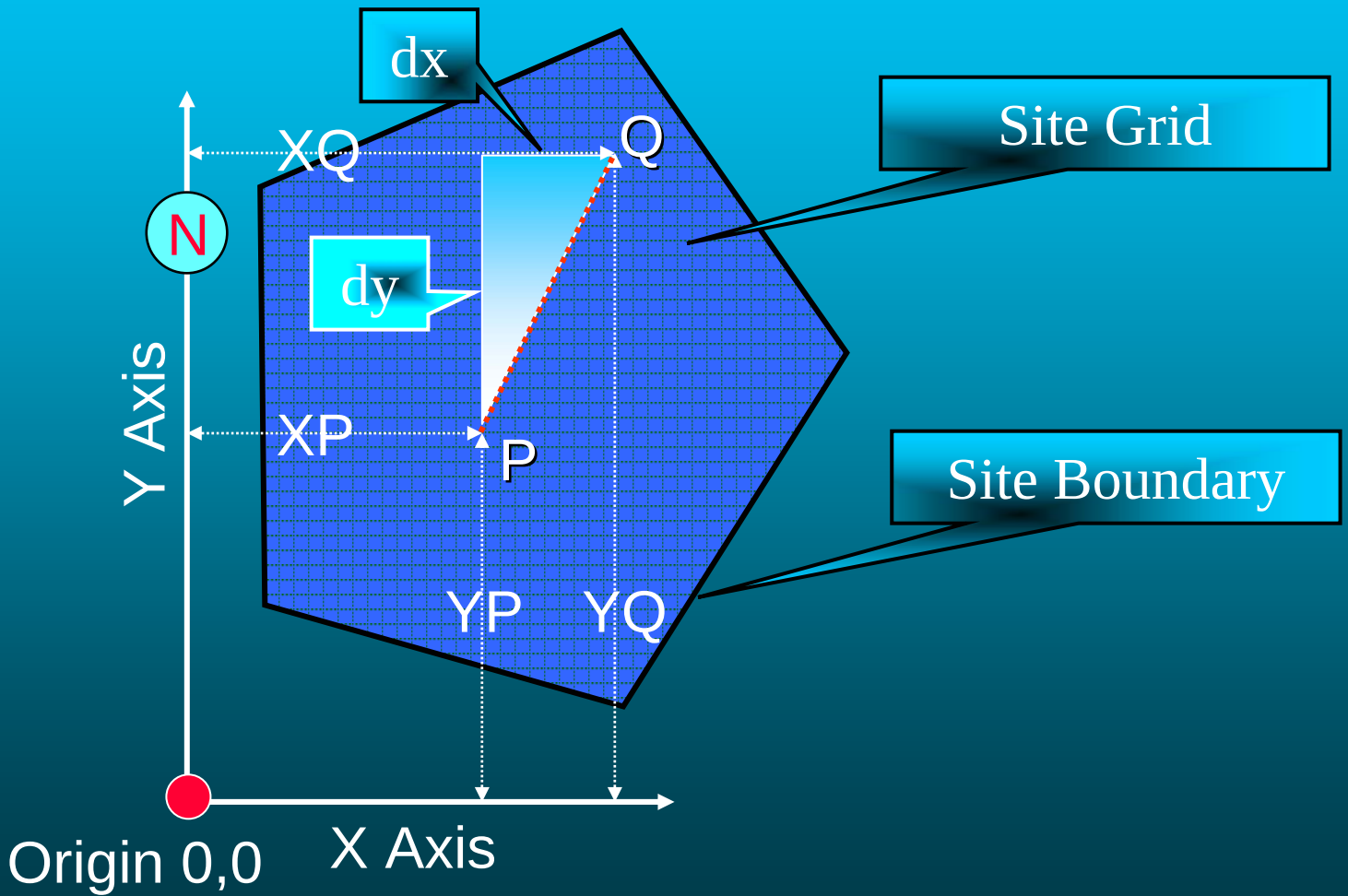
Coordinate Calculations



Overview


dx
XQ
Q
N
dy
Y Axis
XP
P
YP
YQ
Origin 0,0
X Axis
Site Grid
Site Boundary

Contents

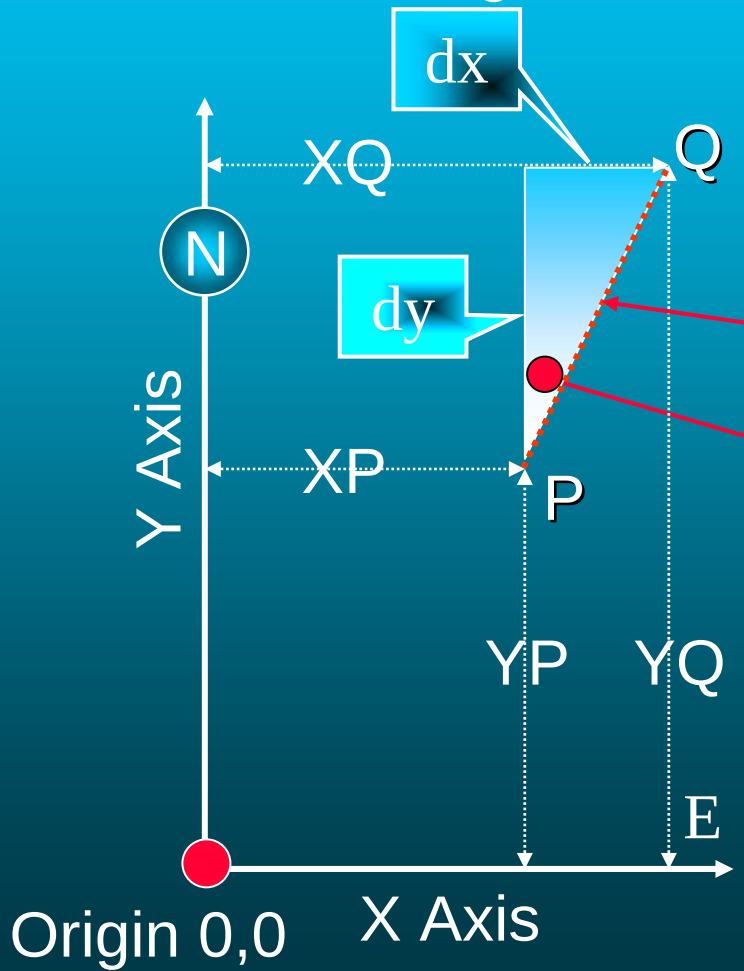
Terminology

- Quadrant Bearing, (QB).
- Whole Circle Bearing,(WCB), (Azimuth).
- Slope Distance, (SD).
- Horizontal Distance, (HD).

Rectangular to Polar

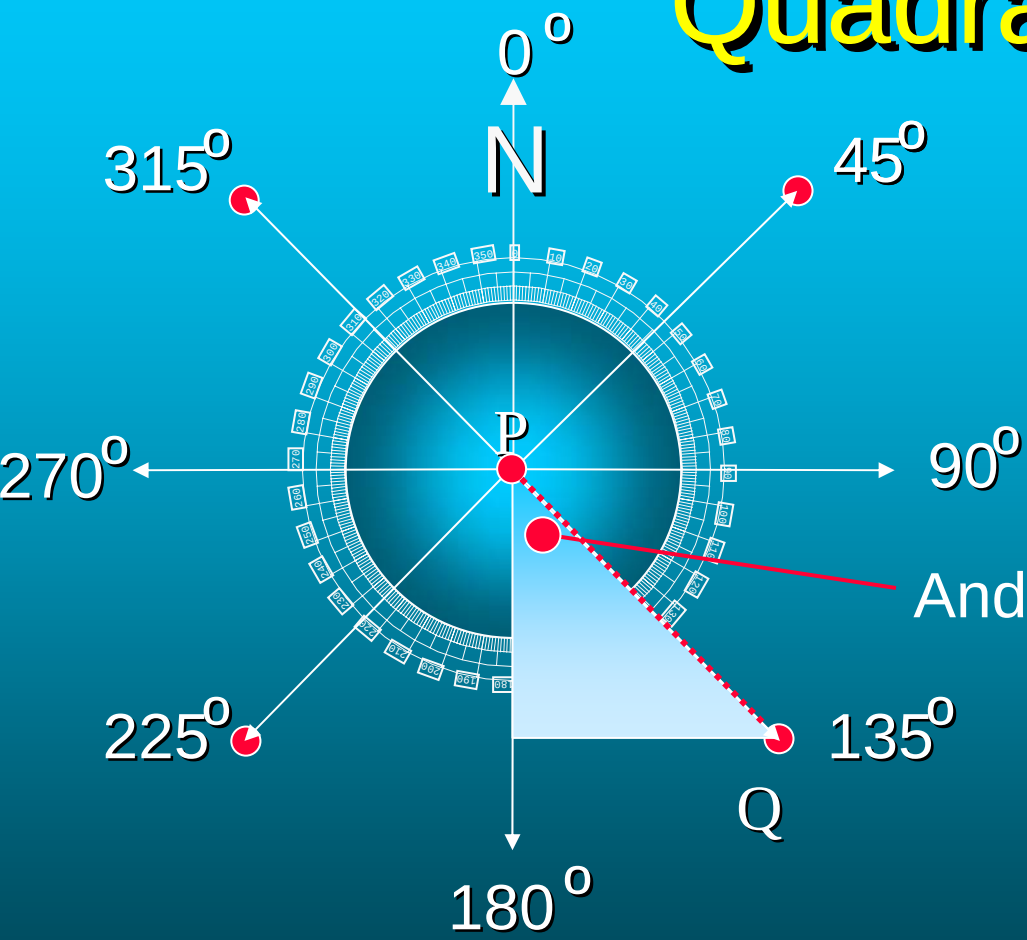
Given that the X and Y coordinates of P are XP and YP, and that the X and Y coordinates of Q are XQ and YQ

To find the bearing and distance P to Q:-



- Let dx = XQ-XP,
- and let dy = YQ-YP
- Then $(HD)^2 = (dx)^2 + (dy)^2$
- And tan-1 (dx/dy) is the angle between grid north and P to Q.
- This angle is known as the "Quadrant Bearing"

Rectangular to Polar Quadrant 2



Again Let dx = XQ-XP,

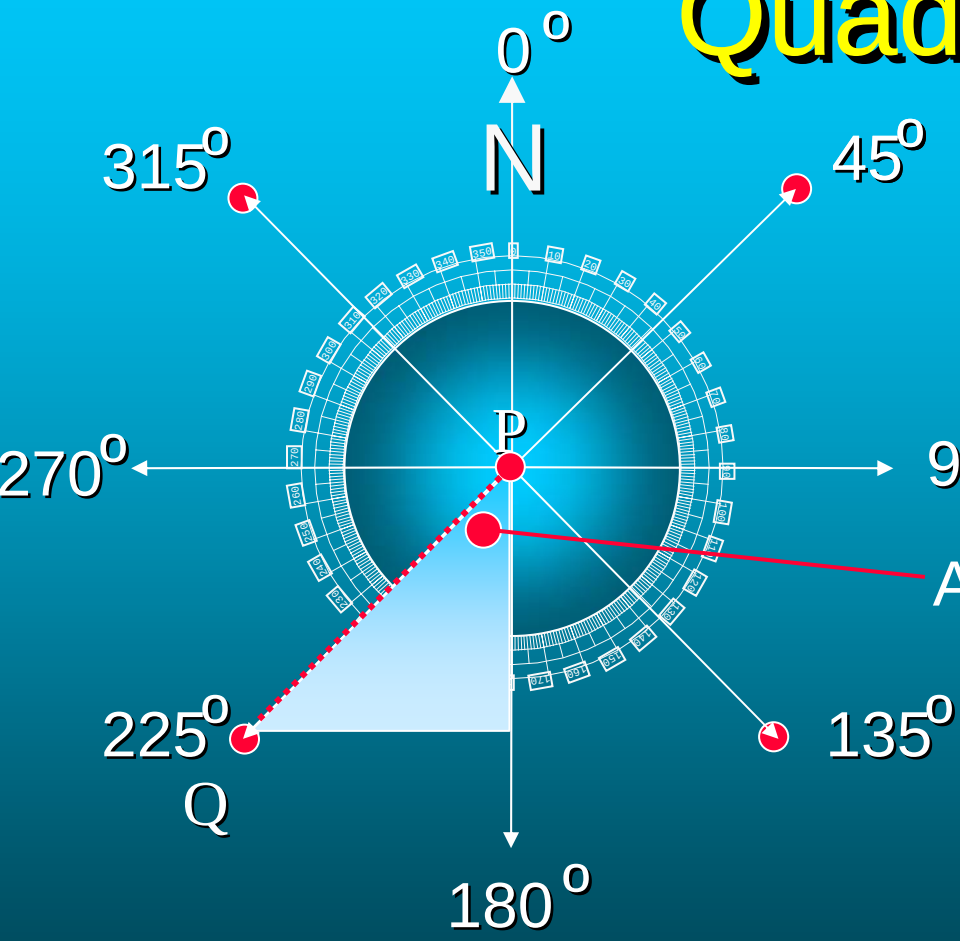
and let dy = YQ-YP.

Now dx is positive

and dy is negative

And tan-1(dx/dy) is relative to180^{o}

Rectangular to Polar Quadrant 3



Again Let dx = XQ-XP,

and let dy = YQ-YP.

Now dx is negative

and dy is negative

And tan-1(dx/dy) is relative to180^{o}

Rectangular to Polar Quadrant 4

Again Let dx = XQ-XP,

and let dy = YQ-YP.

Now dx is negative

and dy is positive

And tan-1(dx/dy) is relative to 360^{o}

Rectangular to Polar Recap.

Given that the coordinates of P are XP and YP, and that the coordinates of Q are XQ and YQ

To find the bearing and distance P to Q:-

- Let dx = XQ-XP, and let dy = YQ-YP
- Then (P to Q)^2 = (dx)^2 + (dy)^2 = Horizontal Distance
- And tan-1 (dx/dy) is the Quadrant Bearing

To convert Quadrant Bearings into Whole Circle Bearings, use the table below:

QB to WCB Rules

dx	dy	WCB
+	+	QB
+	-	180 - QB
-	-	180 + QB
-	+	360 - QB

The above procedures give the WCB and HD from P to Q

Warning

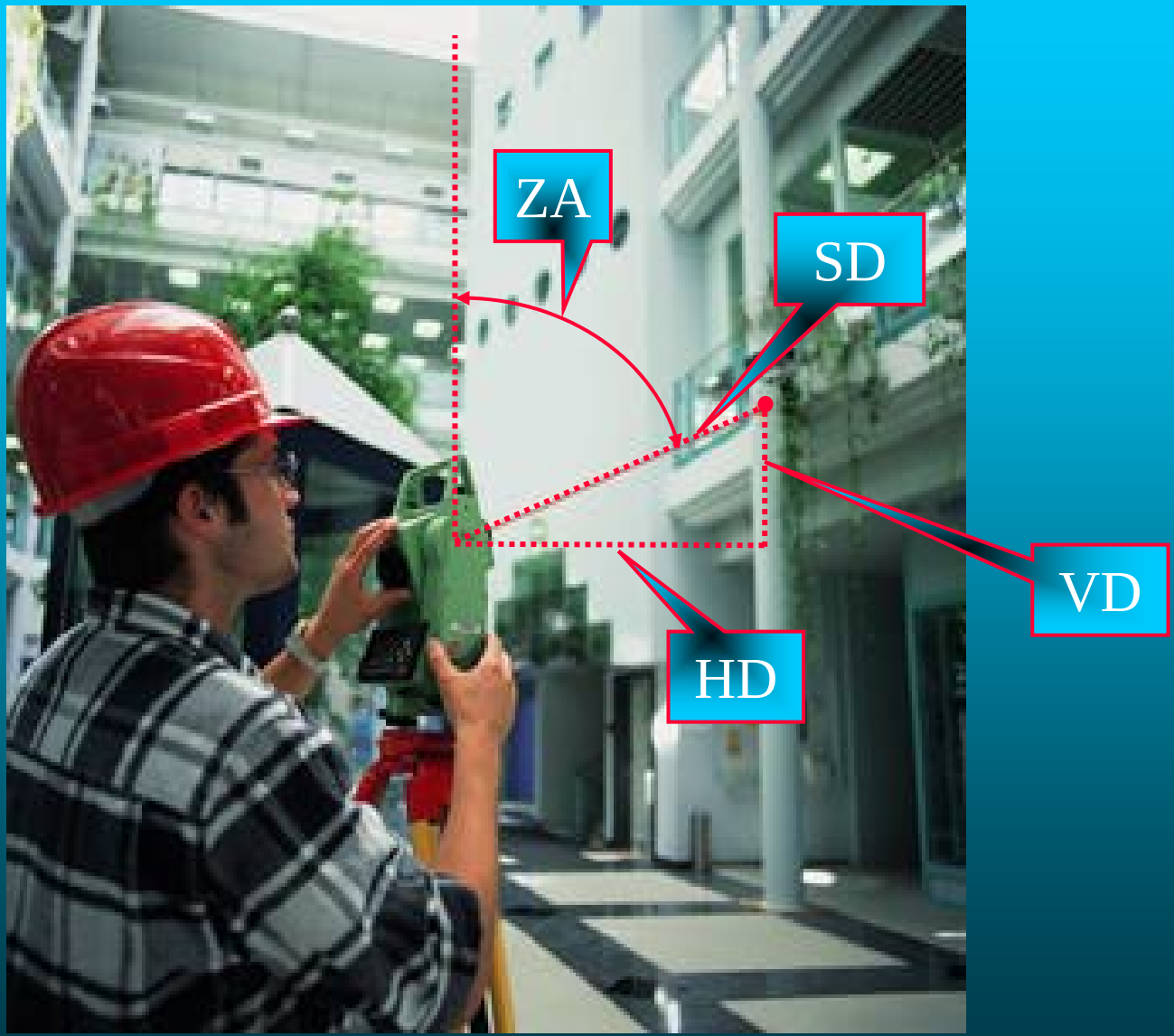
- In this country it is common practice to measure angles in the sexagesimal system.
- There are 360 degrees in a circle, 60 minutes in a degree, and 60 seconds in a minute.
- If you use a pocket calculator for angular calculations make sure it has conversion keys.
- If you use a spreadsheet such as Excel you will need a macro for this conversion, as Excel does not have an inbuilt function for this purpose.

Polar to Rectangular

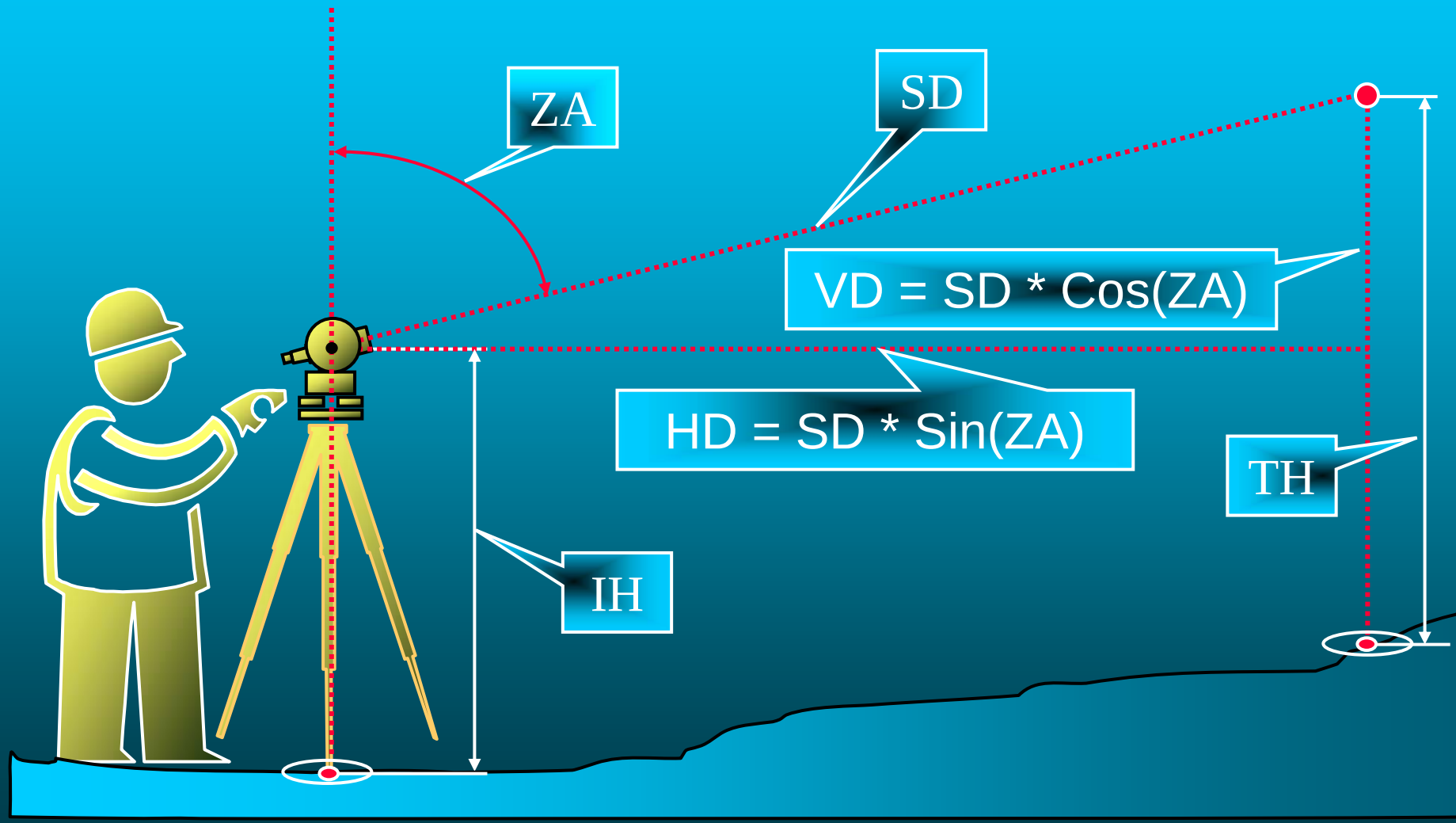
Further Terminology

- Zenith Angle, (ZA).
- Vertical Distance, (VD).
- Instrument Height, (IH).
- Target Height, (TH).

Polar to Rectangular.



Slope Distances

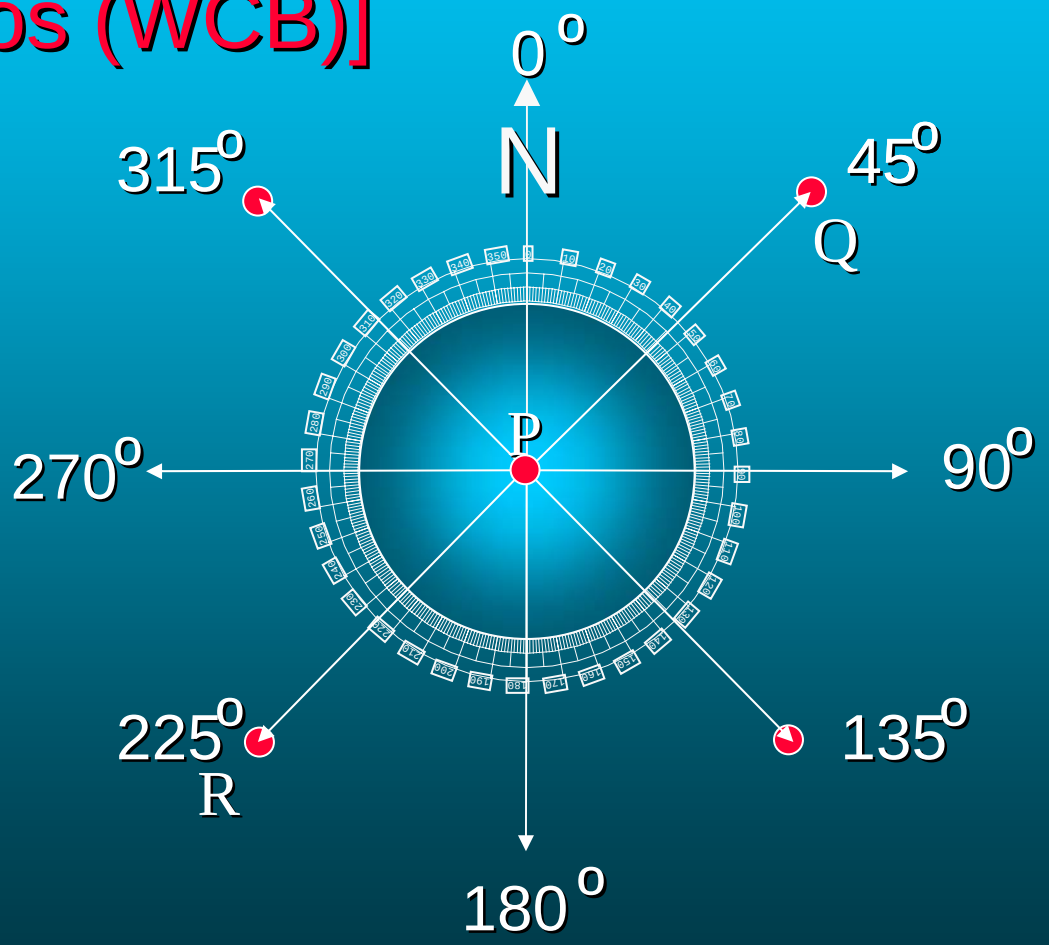


Polar to Rectangular, (x and y)

XQ = XP+ [HD X Sin (WCB)]

YQ = YP + [HD X Cos (WCB)]

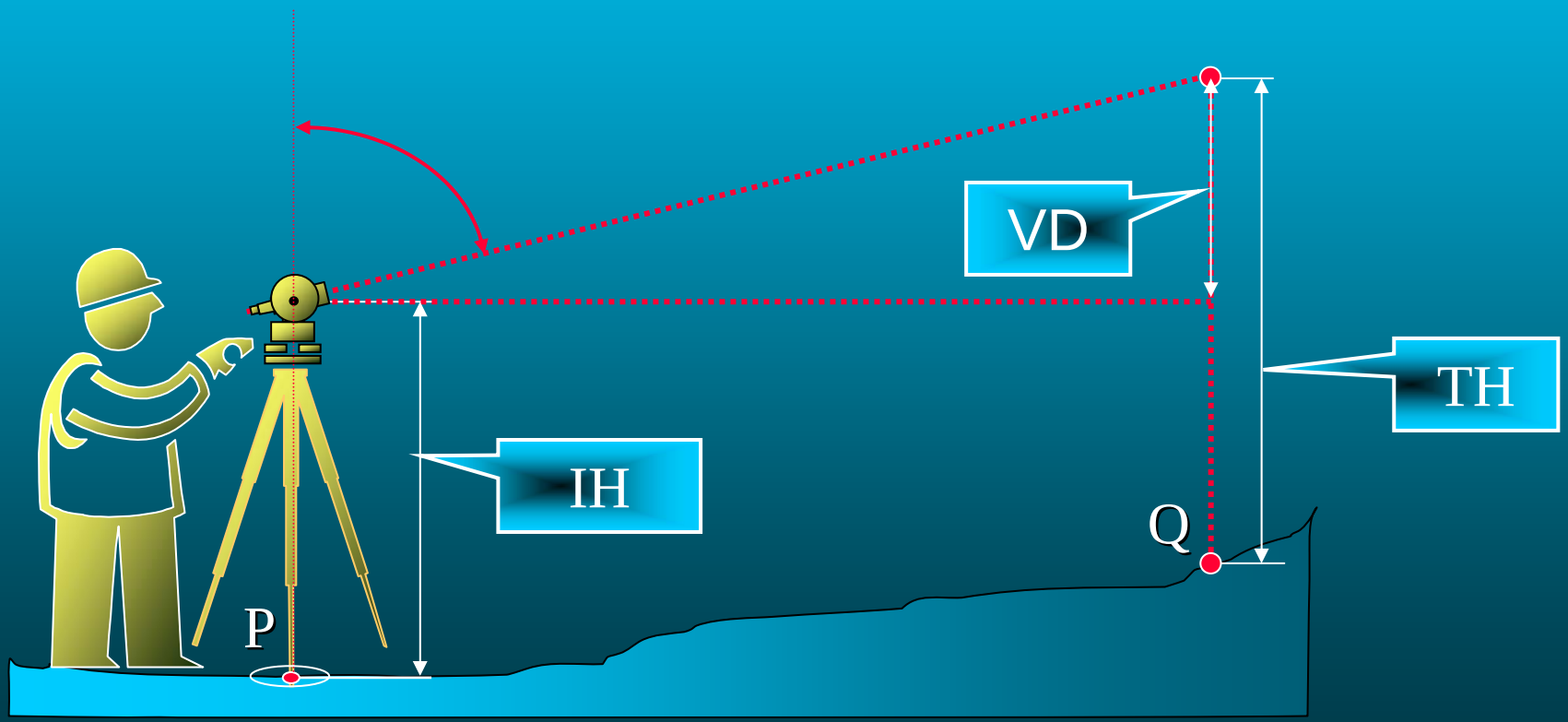
For this calculation the quadrant location is irrelevant.



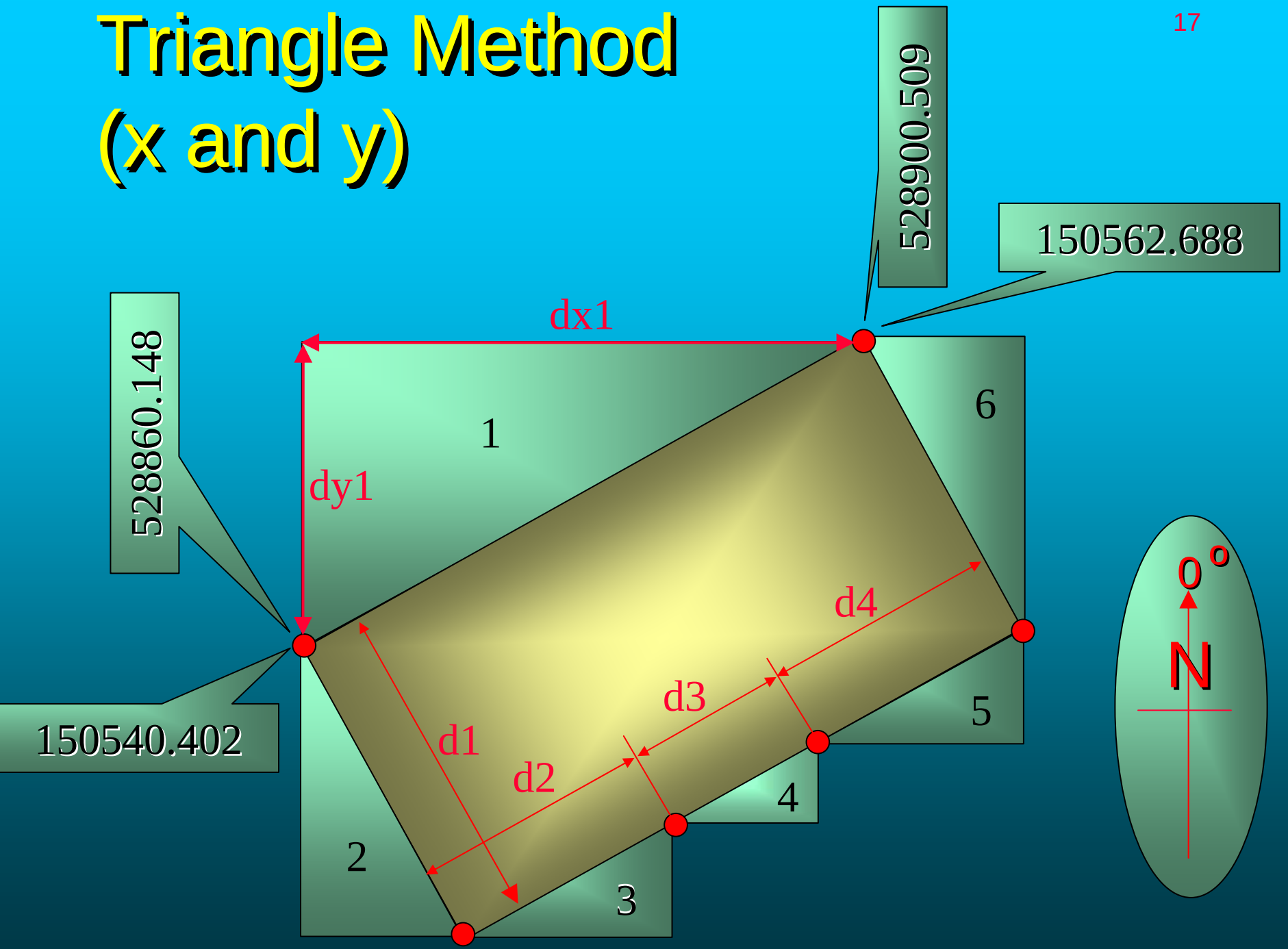
Polar to Rectangular, (z)

Given that the Z coordinate of P is ZP and that the Z coordinate of Q is ZQ, then:-

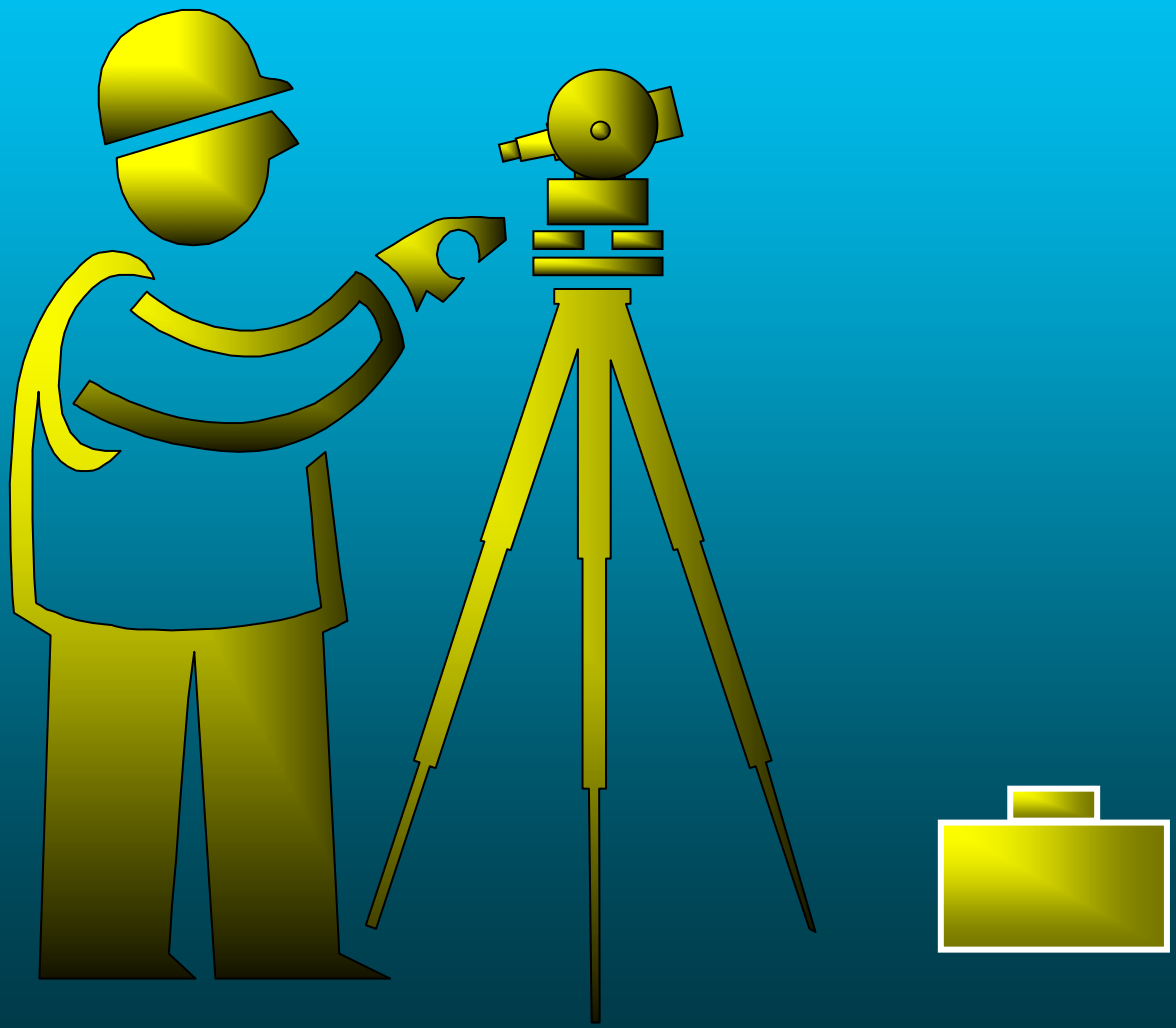
$$ZQ = ZP + IH + VD - TH$$



Triangle Method (x and y)



THE END



Slide 3.

- The QB is the angle obtained by taking the tangent of the difference in X coordinates divided by the difference in Y coordinates between two known points. Its value lies between zero and 90 degrees.
- The WCB, or Azimuth, is the direction of a line expressed as a value between zero and 360 degrees, and measured clockwise.
- The SD is the slope distance between two points, it can have any magnitude.
- The HD is the horizontal distance between two points, it can have any magnitude.

Slide 4

- By convention, the Y axis is assumed to be local grid North
- And X values are often called Eastings, Y values Northings
- In this case the line P to Q is in the first quadrant, i.e. between zero and 90 degrees.

Slide 11

- The ZA is the angle of the instrument telescope in the vertical plane measured from the Zenith where its value is zero, (or 360), degrees. It follows that 180 degrees is the plumb line to the centre of the earth, and 90 degrees and 270 degrees are horizontal.
- The VD is the vertical distance between two points, it can have any magnitude.
- The IH is the height of the instrument transit axis above a survey station. Its magnitude is usually less than 2 metres.
- The TH is the height of the target transit axis above a survey station. Its magnitude is usually less than 4 metres.

Slide 13

- If you do not have the horizontal distances but only slope distances, it is necessary to calculate the HD's before the X and Y coordinates can be computed.
- It is expedient to calculate the VD's at the same time so that levels, (Z coordinates), can also be computed.
- If the SD's are measured by tape it will be necessary to correct for temperature, tension, standard, and sag, before calculating the HD's and VD's

Slide 14

- Given that XP = 500.000, and YP = 1200.000, and P to Q= 35.123
- XQ = 500 + (35.123 * 0.7071) = 524.836
- YQ = 1200 + (35.123 * 0.7071) = 1224.836
- XR = 500 + [35.123 * (-0.7071)] = 475.164
- YR= 1200 + [35.123 * (-0.7071)] = 1175.16

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If the ZA is greater than 90 degrees but less than 270 degrees, then VD is negative.