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# Manually Calculating Elevation of a Single Point in India

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**Abstract**: ***The elevation of a point is significant for creating a 3D model of the earth or for giving the positioning of the object. There are different methods or instruments are used for determining the elevation of the point. In this method, we use the trigonometric function for calculating the elevation of a single point which can be as small as possible. for the calculation, we draw two parallel lines one from a single point (observed point) and another from the observer that are perpendicular to India's mean sea elevation which is 160 m and is taken from Mumbai high. The elevation of the observer, angle, and distance between the point and the observer is also needed for calculating the elevation. The accuracy of this method is very high which gives the exact elevation of a single point.***

**Keywords:** Trigonometric function, India's mean sea elevation, Single-point elevation

## 1. Introduction

In the modern world, map-making is a difficult task as the earth has many undulations, rivers, forest cover, and many steep slopes which makes map-making as difficult as possible. In the 3D map-making process, the elevation is used which needs to be very precise so that the map gets its accuracy so it shows its exact position in the real world. So, the map maker needs to take very places elevations which are then used in 3D map-making. Using the information on the Earth's surface geologists can determine the zones of erosion and those zones that are prone to landslide and sediment accumulation.

In military and defense for a country, elevation maps help to analyze and determine strategic locations for watch towers, and unit placement and deal with any hostiles in the area. In urban planning and design, elevation maps are very crucial in planning and designing large infrastructure. For example, construction of railway tracks; for this, a very accurate understanding of the elevation will be needed. This is applicable for the water pipes, gas pipes, electrical cables, and placement of telecommunication towers. Also, in navigation elevation maps can help a great deal in navigating while trekking or hiking. These maps give a good idea about the topology of the area making it possible to plan movement and camping grounds. In, Navigation elevation is also needed for locating the location. The elevation also plays role in farming where the farmer uses elevation to farm mainly fruit crops in hilly areas. An elevation map can be used to calculate the average slope of a hill to identify the crop that would be suitable for that location.

The elevation plays a crucial role in our lives in many fields like e. g, 3D modeling, farming, urban planning, and infrastructure. But the elevation accuracy needs to be very precise so that this information about elevation makes human life very easy.

## 2. Problem Statement

To find the elevation of a single point that is observed by the observer.

## 3. Instrument Used

1: GARMIN etrex 30x (to measure elevation)

## 4. Solution

Case 1: For calculating the elevation of a single point that is above 90⁰. we consider the following diagram.

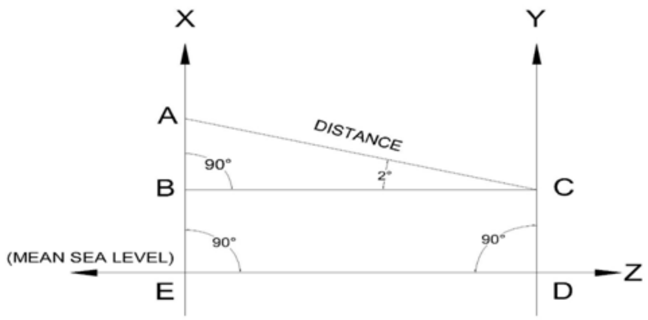


**Figure 1:** Point above 90⁰

In the given diagram,

Line X and line Y are parallel to each other, and both are perpendicular to line Z. point C is an observer and A is a single point.

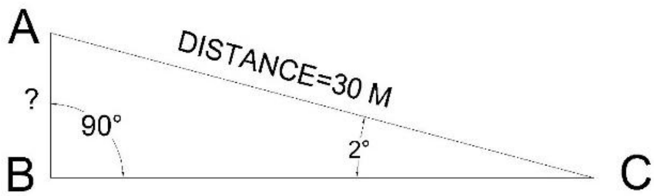


**Figure 2**

In ΔABC,
Line AC = 30 m,

$\angle ACB = 2^0$
To find line AB =?

Also, in the rectangle □BCDE,

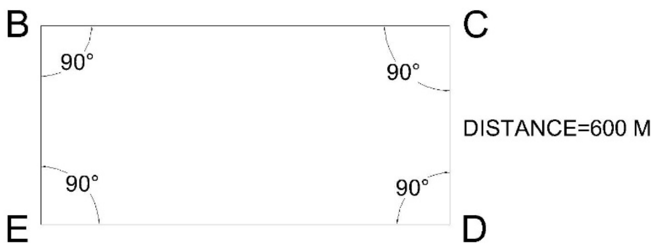


**Figure 3**

Line CD = 600m
Line BC = Line DC &
Line BE = line CD,

By using trigonometric function,

$$\sin\theta = \frac{\text{OPPOSITE SIDE}}{\text{HYPOTENUSE}}$$

$$\text{Sin}\,\theta = \frac{\text{Line AB}}{\text{Line AC}}$$

$$\therefore \text{Sin } 2^o = \frac{\text{Line AB}}{\text{D}}$$

$\therefore$ line AB = sin $2^o$ * 30 m

= 0.03489*30 m …… (from fig 2 & 3)

Line AB = 1.0467 m

Therefore, line AB = 1.0467 m.

Hence, the elevation of a single point is

= line AB + line BE
= 1.0467 m + 600 m ……. (from 1, 2 & 3)

Elevation of a single point A (from mean sea level) = 601.0467 m

Observation table:

| NO | Elevation of observer | Distance between observer and point | The angle between observer and point | By calculation | Checked by GRAMIN etrex 30x |
|---|---|---|---|---|---|
| 1 | 600 m | 30 m | $2^o$ | 601.0467 m | 602 m |
| 2 | 585 m | 60 m | $2^o$ | 587.09396 m | 587 m |
| 3 | 596 m | 90 m | $1^o$ | 597.57071 m | 598 m |
| 4 | 582 m | 120 m | $1^o$ | 584.09428 m | 585 m |
| 5 | 591 m | 150 m | $3^o$ | 598.85039 m | 597 m |

Case 2: For calculating the elevation of a single point that is below $90^o$. We consider the following diagram,

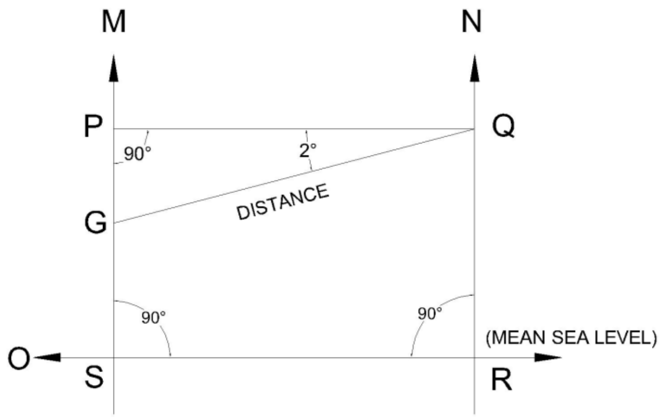


**Figure 4:** Point below $90^o$

In the given figure 4,

The line M and the line N are parallel to each other, and both are perpendicular to line O. point Q is an observer and G is a single point,

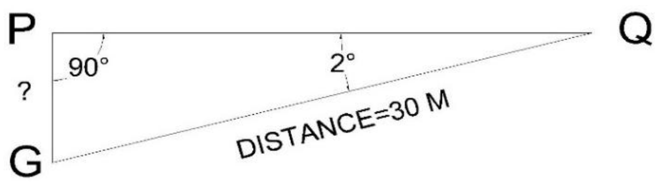


**Figure 5**

In ΔQPG,

Line QG = 30 m,
$\angle GQP = 2^0$
To find line PG =?

Also, In the rectangle □PQRS

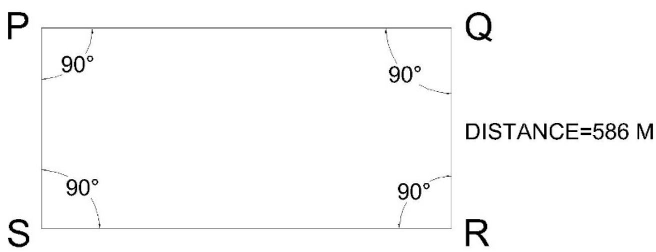


**Figure 6**

Line QR = 586 m
Line PQ = Line SR &
Line QR = line PS,

By using trigonometric function,

$$\sin\theta = \frac{\text{OPPOSITE SIDE}}{\text{HYPOTENUSE}}$$

$$\sin\theta = \frac{\text{Line PG}}{\text{Line QG}}$$

$$\therefore \sin 2^{\circ} = \frac{\text{Line PG}}{\text{D}}$$

$\therefore$ line PG = sin $2^{\circ}$ * 30 m
= 0.03489*30 m …… (from fig 5 & 6)
Line PG = 1.0467 m

Therefore, line PG = 1.0467 m.

Hence, elevation of single point is
= line PS - line PG
= 586 m - 1.0467 m ……. (from fig 4, 5 & 6)

Elevation of a single point G (From mean sea level) = 584.9533 m.

Observation table:

| NO | Elevation of observer | Distance between observer and point | The angle between observer and point | By calculation | Checked by GRAMIN etrex 30x |
|---|---|---|---|---|---|
| 1 | 586 m | 30 m | $2^{\circ}$ | 584.9533 m | 585 m |
| 2 | 594 m | 60 m | $1^{\circ}$ | 592.95286 m | 591 m |
| 3 | 580 m | 90 m | $2^{\circ}$ | 576.85905 m | 577 m |
| 4 | 592 m | 120 m | $2^{\circ}$ | 587.81207 m | 586 m |
| 5 | 596 m | 150 m | $1^{\circ}$ | 593.38214 m | 594 m |

## 5. Result and Discussion

The calculated elevation by this method is very precise and it is applicable in the Indian scenario which gives us the exact elevation of a single point. Using the elevation of a single point we make your life very easy to perform our work.3D modeling, survey land, farming, and infrastructure buildings are fields where elevation is needed for optimum working. If the elevation calculating instrument gets fails, but still, by this method, we can find the elevation of a single point.

## 6. Application

Following are the fields where elevation can be calculated by this method are,

Single Point in the air.
Single Point on / or in the water.
Navigation, 3D model building and big infrastructures.

## Author Profile

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