

Determination of the Heights of inaccessible Target in Majmaah using Digital Theodolite Instrument

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Abstract

This mini project aims at measuring the heights of some famous places in Majmaah city using digital theodolite instrument. It is an application of what theoretically the student learned in the course: (Surveying 2- CE371). The tallest target (Castle of the Observatory - Almergeb) was subjected to this application, where many people are interesting to know its approximate height and no clear answer is given. The methodology is explained with short historical background about the target.

Objectives

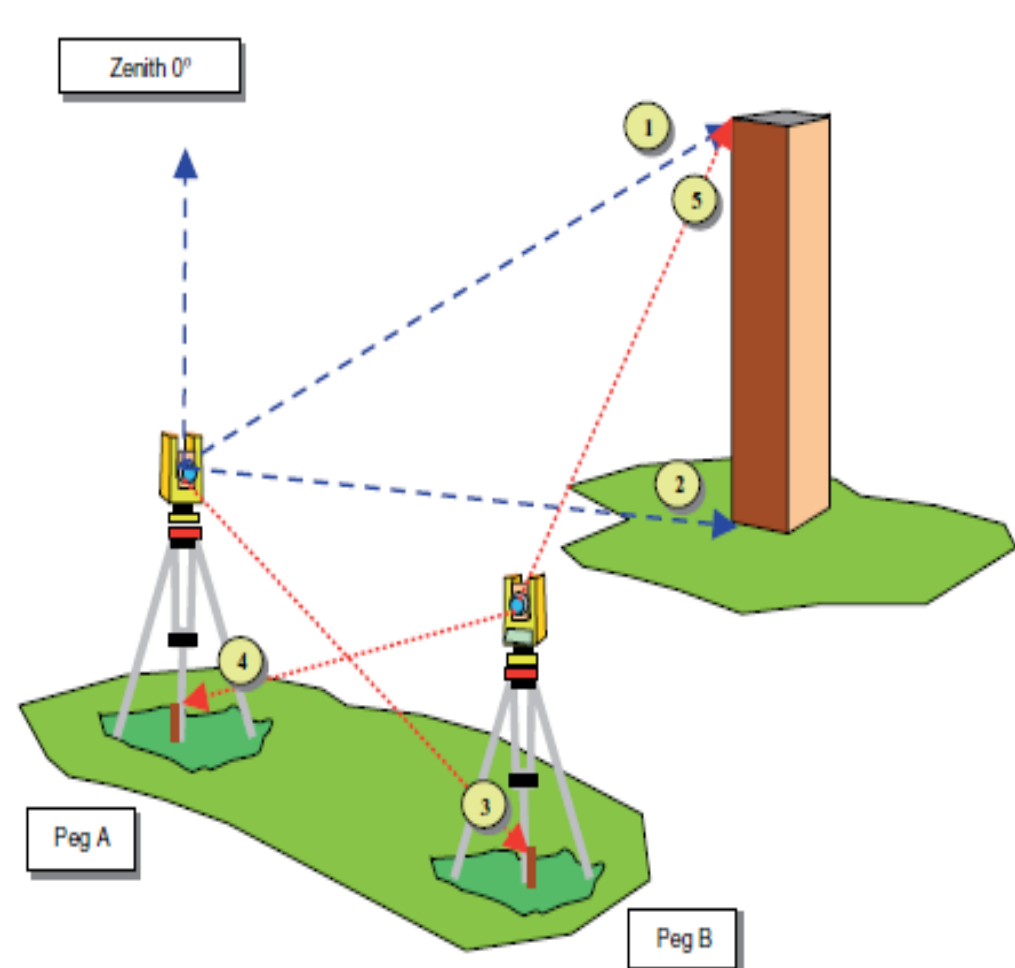
The main objective of this mini project is to use modern surveying instruments to determine the heights of the most famous places in Majmaah city.

Other objectives are:

- Conduct an application using Digital Theodolite instrument;
- Demonstrate a practical problem for the student by solve a real life problem; and
- Enhance the student abilities to think, create solutions, and work as a team.

Methodology

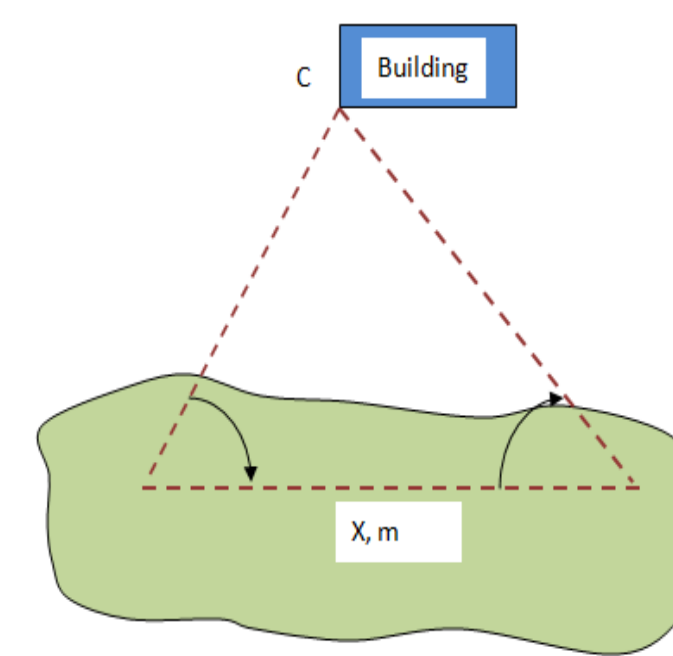
1. Set up two pegs reasonably spaced apart.
2. Set up the instrument over peg A and target the top of the object.
3. Take the vertical angle and book it.
4. Release the clamp and target the base of the object and book the reading.
5. Ensure the instrument has been set at zero horizontally and rotate the instrument clockwise, target peg B and book the reading.
6. Take lineal measurement between pegs A and B and book them.
7. Move the instrument and position it over peg B or use a second instrument.
8. Target peg A and set it at zero.
9. Rotate the instrument clockwise and target the top of the object; book the reading.
10. Take and book the remaining readings.



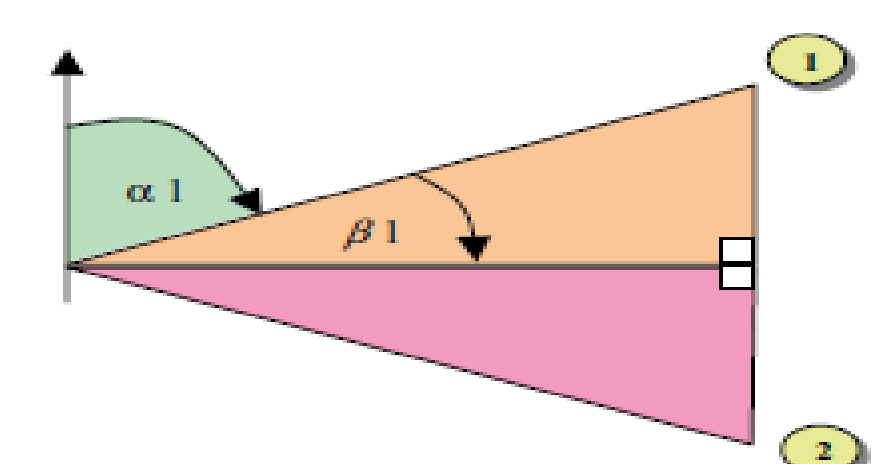
Calculations

The side opposite the angle is labeled with the corresponding lower case letter.

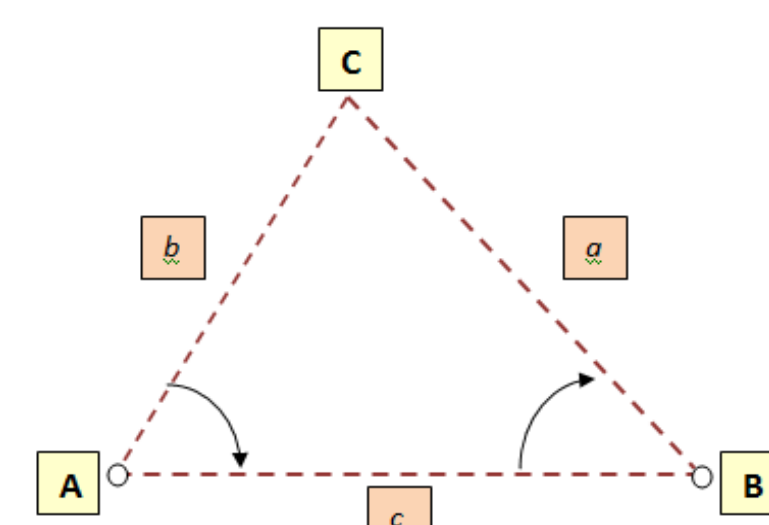
- Calculate the angle for corner C.



To calculate the height of the building the space between points 1 and 2 should be divided into two right angled triangles



Angle "A" and Angle "B" are measured
Angle "C" = $180^\circ - (A + B)$



To calculate the internal angle β_1 , subtract α_1 from 90° .
Angle " β_1 " = $90^\circ - \alpha_1$

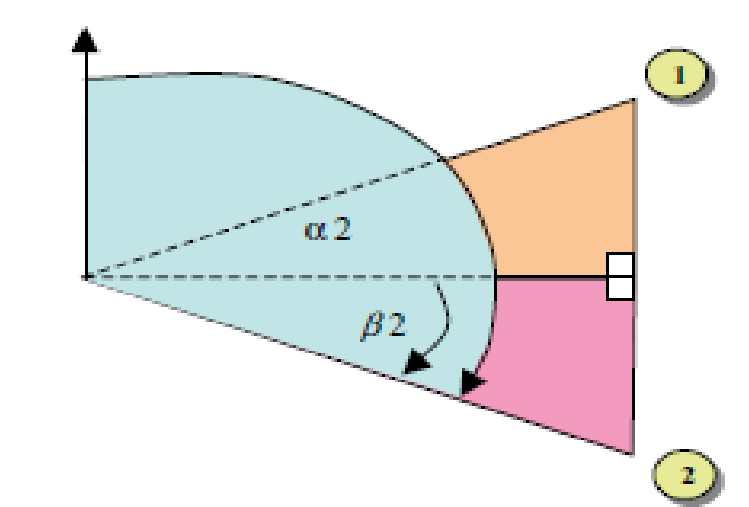
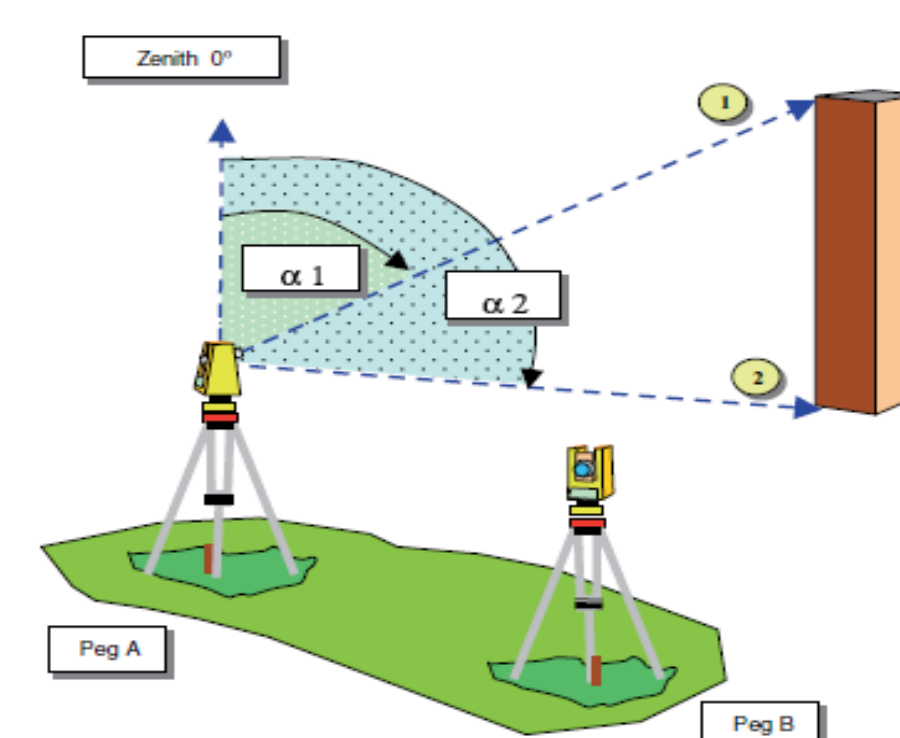
Opposite 1 = $\tan \beta_1 \times \text{Adjacent}$

$$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$$

Calculate the opposite on the lower triangle. To calculate the internal angle β_2 subtract 90° from α_2 :

$$b = \frac{c}{\sin(C)} * \sin(B)$$

$$\beta_2 = \alpha_2 - 90^\circ$$



Opposite 2 = $\tan \beta_2 \times \text{Adjacent}$

The overall height of the building is = Opposite 1 + Opposite 2

Main Results

The castle of the Observatory (Almarkab) at Majmaah city is built by the founder of the city, Abdullah bin Saif Al-Wibrari Al-Shammari in the year 830 AH on Mount Minikh. The castle was used to monitor flood and commercial convoys and after evolution is now a milestone tells the story of men who served their city



It reported that the height of the observatory is 11 m. however we determine the height using our surveying instrument, and the above method and found that the height is 10.82 meter.

Significance to the Kingdom

The methodology used in this mini project can be used for similar application in KSA, for example, determination of the heights of inaccessible towers and high building in any place.

References

- [1] Sameh S Ahmed, (2017), "Surveying 2" Lecture notes of surveying course at CEE Department., MU, KSA.