Distance measurement

Horizontal Distances Are Measured

(1) Spacing or Stepping Method:

*Total distances = no. of paces * length space*

(2) Tapes Method:

Taping is a direct measurement of distance, there are many Kinds tapes

(Cloth tape, steel tape, metallic linen tape)

Additional tools used in measurement

1- Ranging poles (Range rod)

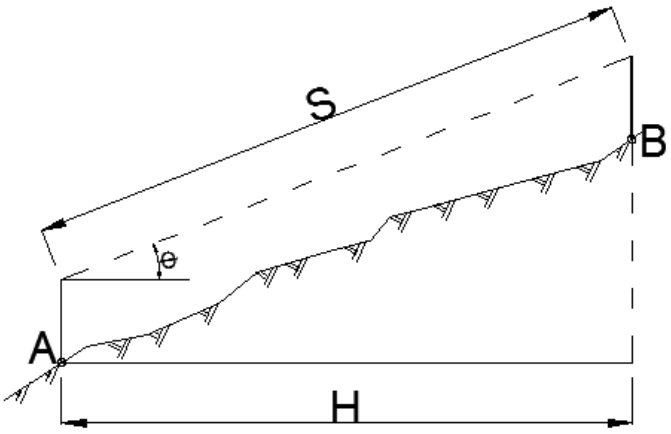
2- pins or arrow

3- Pegs

Measuring distance by tape

(1) *Slope taping*: - The tape is hold as required by the slope of the ground, the slope of the tape is measured and the horizontal distance is computed.

(2) *Horizontal taping*: - The tape is hold horizontal and the required graduation is projected to the ground with plumb - bob (or spirit level).



(Case I): - When the distance between two stations is less than length of the tape, so the determining of distance should be found directly.

(Case II): - When the distance between two stations is more than length of the tape, in this case we need range poles in the start and end stations also range pole and pins in intermediate stations, then measure the distance between each two pigs to the end of line.

$$\mathbf{M = N * L + G}$$

M = total distance L = tape length

N = no. of pins G = rest part of tape

Example: -

During Spacing or stepping method if (no. of pin = 10) (rest part of tape = 9.75 m), length 50 m

Find the total distance (M)

sol

M = N * L + G

M = 50 * 10 + 9.75 = 509.75 m

Correction For Distances

(1) Correction for Length of the Tape.

(2) Correction for Slope of the Earth.

(3) Correction for Temperature.

(4) Correction for Sag.

(5) Correction for Tension or Pull.

(6) Correction for Above or Below Means Sea Level.

(7) Correction for Slope of the Earth and Inclined of the Tape.

1. Correction for length of the tape: -

The tape may be too long or too short with respect to the stander length in both cases correction must be due by using the formula.

$$D_0 = D * L / L_0$$

D_0 = true distance need it.

D = field distance measured.

L = field tape length.

L_0 = standard tape length.

Note: -

When L > L_0 D_0 > D

When L < L_0 D_0 < D

Example: -

20 m tape which was 20 cm too short, was used to measure a line AB and the result was (196.1 m), What was the true length of line AB?

SOL

L = 20 – 0.20 = 19.80 m (field tape length).

D0 = D * L /L0 = 196.1 * 19.80 / 20 = 194.139 m.

2. Correction for slope of the earth (C_S): -

This correction is applied because the length on a slope is not the same as the distance projected on a horizontal plane.

{ Case I }:- When L and θ was known.

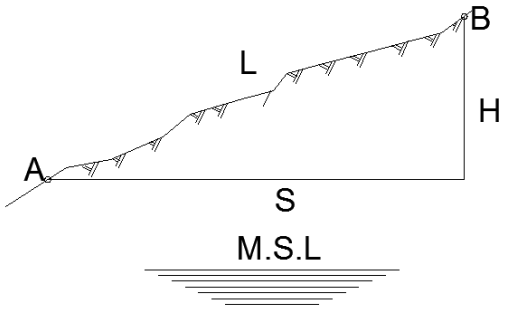
cos θ = S / L S = L cos θ

L > S, $L - C_s = S$

$Cs = L - S$

Cs = L – L cos θ, L (1- cos θ)

Cs = L (1 - cos θ)



Example: -

Two lines are measured on a slope equal to (100 m) length each and the slope (1/12, 1/20). Fined the horizontal distance in each?

sol

Slope1 = tan θ1 = 1 / 12 θ1 = tan- 1 (0.0833) = 4.763 $0 < 8^0$

Slope2 = tan θ2 = 1 / 20 θ2 = tan- 1 (0.05) = 2.862 $0 < 8^0$

Cs = L (1 - cos θ1) = 100 (1 – cos 4.763) = 0.345 m

S = L – Cs = 100 – 0.345 = 99.655 m

Cs = L (1 - cos θ2) = 100 (1 – cos 2.862) = 0.124 m

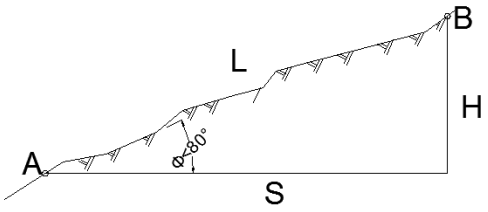
S = L – Cs = 100 – 0.124 = 99.876 m

(Case II): - when L and h are known.

When slope <= 14 % or θ^0 <= 8^0

L = S L, $L^2 = h^2 + s^2$, $h^2 = L^2 - s^2$

$$C_s = h^2 / 2L$$



When slope > 14 % or θ^0> 8^0

$$C_s = h^2 / 2L + h^4 / 8h^8$$

Example:

A line ab (2260.65 m) along constant slope the difference in elevation between two ends of the line is (85. 96) m.

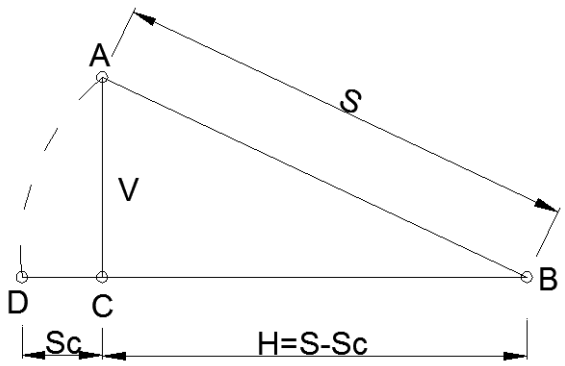
What is the horizontal length of the line ab?

Sin θ = 85.96 / 2260.65 = 0.038 θ = Sin -1 0.038 = 2.179 0 < 8^0
Cs = h 2 / 2L = (85.96)2 / 2 * 2260.65 = 1.634
S = L – Cs = 2260.65 – 1.634 = 2259.01 m.

Measurement On Sloping Grounds:

1. measurement on regular sloping grounds

a) by measure the vertical distance between the two ends of the inclined



$S^2=V^2+H^2$

$$S^2 = V^2 + (S - S_C)^2$$

$$\mathbf{S_C = \frac{V^2}{2S} + \frac{V^4}{8S^3}}$$

Example:

Measure the length of the slope and it was 30m, the vertical distance it was 12m, find the correction distance and find the horizontal distance.

Sol:

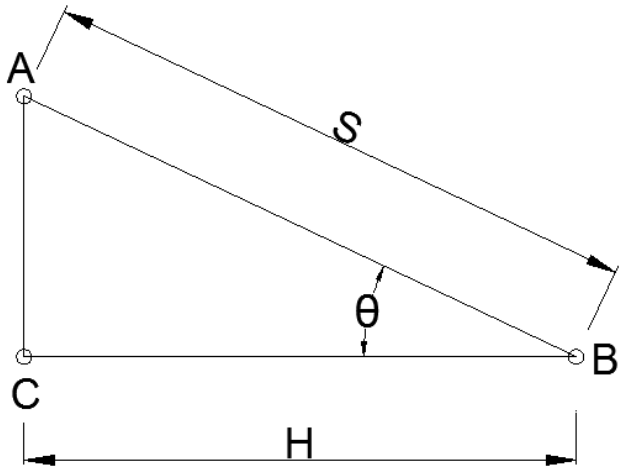
$$S_C = \frac{V^2}{2S} + \frac{V^4}{8S^3}$$

$$S_C = \frac{12^2}{2(30)} + \frac{12^4}{8(30)^3} = 2.496 \text{ M}$$

H = S - S_C = 30 – 2.496 = 27.04 M

b) Ground angle measure

The angle between the horizontal line and the ground may be measured by using clinometer or theodolite instruments.



* Theoretical method H=S cos θ

* approximate method S_C=(0.00015 θ^2)S

H=S-S_C

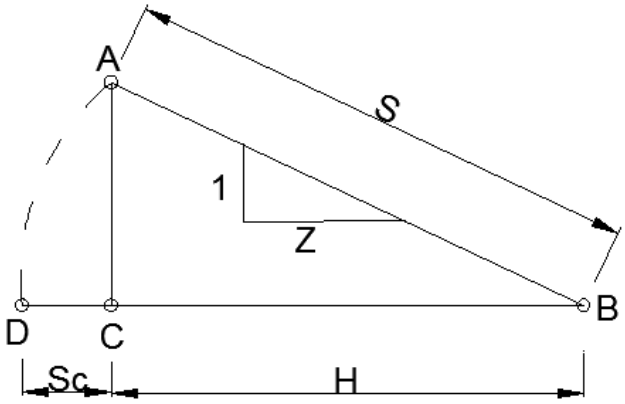
Example:

S=20m, θ=10

Theoretical method H=S cos θ=20*cos10=19.696 m

approximate method S_C=(0.00015 θ^2)S=(0.00015*10^2)*20=19.70m

c) If the slope of the ground is known



Approximate equation $S_C = \frac{S}{2Z^2}$

$$H=S-S_C$$

Example:

Measure The Length Of The Slope And It Was 100m, With Slope 1/4

Find The Horizontal Distance.

Sol:

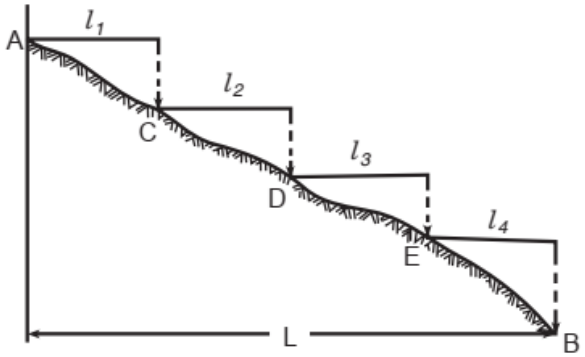
Approximate equation

$S_C = \frac{S}{2Z^2}$

$S_C = \frac{100}{2(4)^2} = 3.125$ m

$H=S-S_C = 100 - 3.125 = 96.875$ m

2. measure horizontal distance on slope ground (Position the tape horizontally) is called direct measure:



Stepping method.

L=l1+l2+l3+l4