

POSISI VERTIKAL

Pendidikan Geografi FISH Unesa

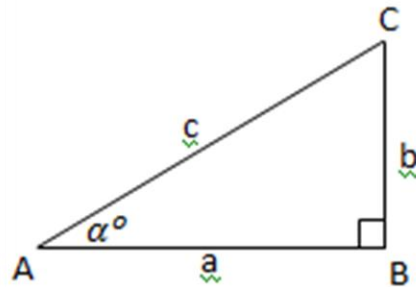
Posisi Vertikal

- Maksud : Menentukan tinggi titik dengan mengukur beda tinggi antara dua titik
- Tinggi : Jarak vertikal terhadap acuan tertentu.
- Beda Tinggi : Jarak vertikal antar dua bidang nivo.
- Bidang Nivo : Bidang tempat kedudukan titik-titik dengan potensial yang sama.
- Acuan Tinggi : Bidang Nivo melalui muka laut rata-rata / *Mean Sea Level (MSL)*
- Sudut Vertikal : Sudut pada bidang vertikal.

METODE PENENTUAN BEDA TINGGI

1. Metode Barometri: Kasar → Gunung
2. Metode Trigonometrik: Sedang → Bukit
3. Metode Sipat Datar: Teliti → "Datar"

Prinsip metode Trigonometrik :



$$\sin \alpha = \frac{b}{c}$$

$$\cot \alpha = \frac{c}{b}$$

$$\cos \alpha = \frac{a}{c}$$

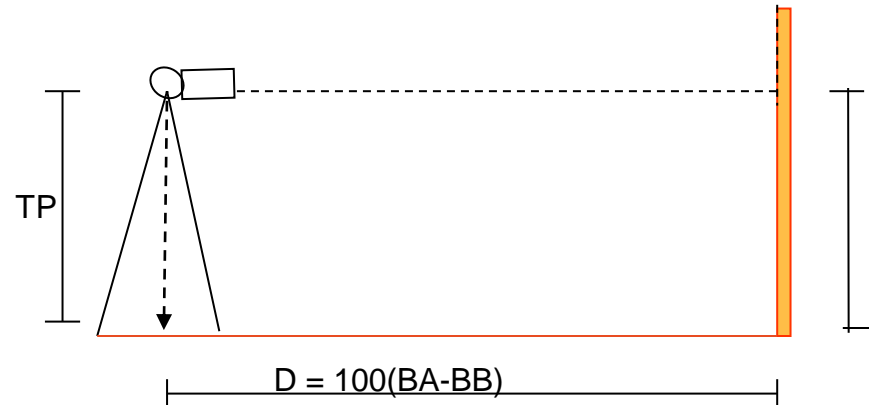
$$\sec \alpha = \frac{c}{a}$$

$$\tan \alpha = \frac{a}{b}$$

$$\operatorname{cosec} \alpha = \frac{b}{a}$$

PENGUKURAN JARAK DAN BEDA TINGGI SECARA OPTIS

Dengan catatan sudut vertikal (β) = 90°



DIMANA : TP = TINGGI PESAWAT

BA = BACAAN BENANG ATAS

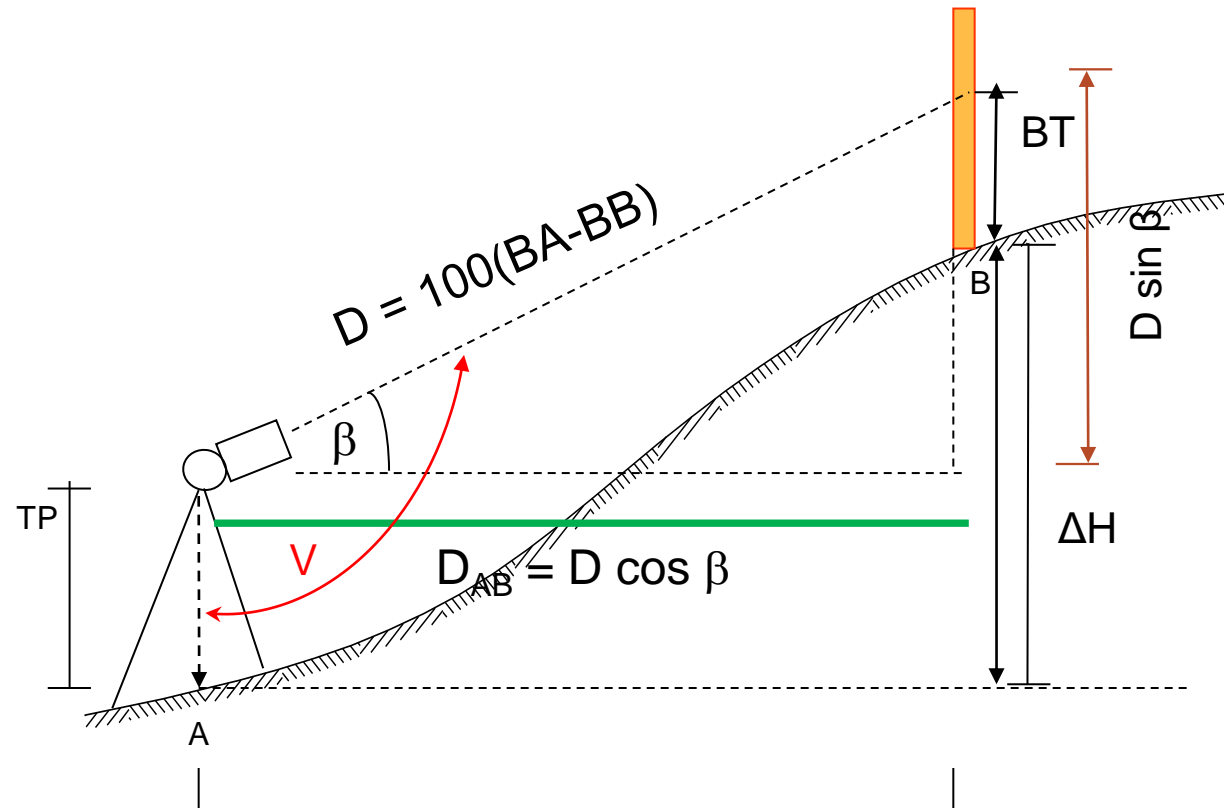
BT = BACAAN BENANG TENGAH

BB = BACAAN BENANG BAWAH

β = SUDUT VERTIKAL

Bila bacaan sudut vertikal (V) $> 90^\circ$, maka

$$\beta = V - 90^\circ$$

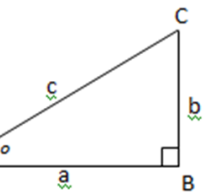


Elevasi B = elevasi A + ΔH

$$= \text{elevasi A} + (D \sin \beta + TP) - BT$$

$$\Delta H = D \sin \beta + TP - BT$$

Dimana $D = 100(BA - BB)$



$$\sin \alpha = \frac{b}{c}$$

$$\cot \alpha = \frac{c}{b}$$

$$\cos \alpha = \frac{a}{c}$$

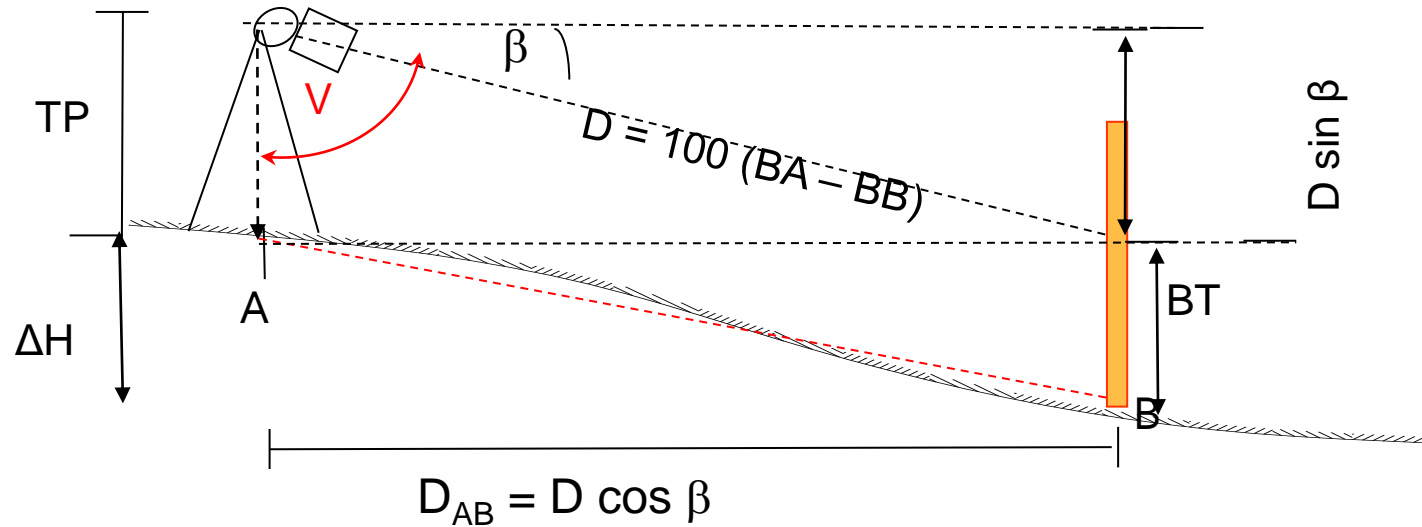
$$\sec \alpha = \frac{c}{a}$$

$$\tan \alpha = \frac{a}{b}$$

$$\operatorname{cosec} \alpha = \frac{b}{a}$$

Bila bacaan sudut vertikal (V) $< 90^\circ$, maka

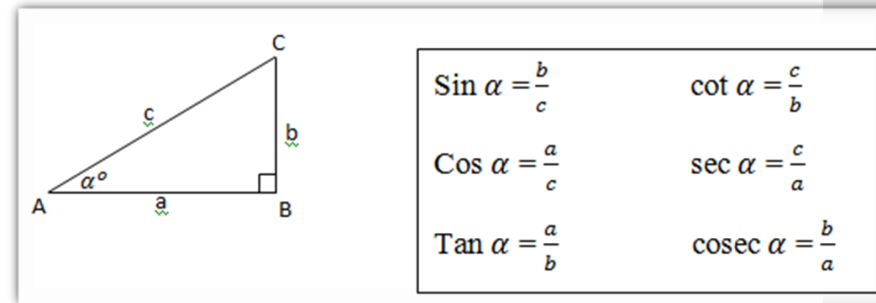
$$\beta = 90^\circ - V$$



Elevasi B = elevasi A - ΔH

$$\Delta H + TP = D \sin \beta + BT$$

$$\Delta H = D \sin \beta + BT - TP$$



$\sin \alpha = \frac{b}{c}$	$\cot \alpha = \frac{c}{b}$
$\cos \alpha = \frac{a}{c}$	$\sec \alpha = \frac{c}{a}$
$\tan \alpha = \frac{b}{a}$	$\operatorname{cosec} \alpha = \frac{b}{a}$

Dimana $D = 100(BA - BB)$

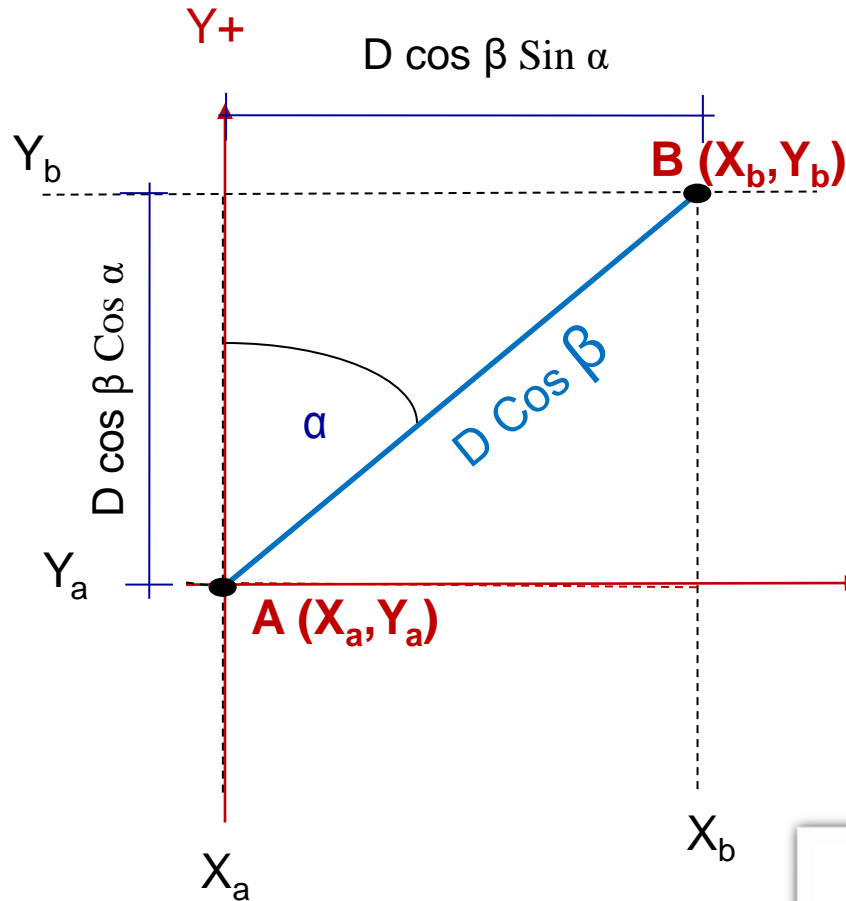
Posisi horizontal bak ukur

$$X_B = X_A + b$$

$$X_B = X_A + D_{AB} \cdot \sin \alpha$$

$$Y_B = Y_A + a$$

$$Y_B = Y_A + D_{AB} \cdot \cos \alpha$$



α = sudut horisontal

β = Sudut vertikal

D = Jarak optis antara theodolit dengan bak ukur

X_b = Koordinat X dari bak ukur

Y_b = koordinat Y dari bak ukur

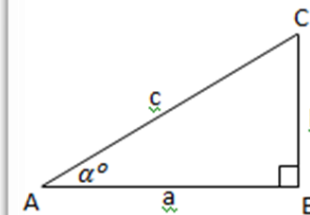
X_a = koordinat X theodolit

Y_a = koordinat Y theodolit

$$X_b = X_a + D \cos \beta \sin \alpha$$

$$Y_b = Y_a + D \cos \beta \cos \alpha$$

Dimana $D = 100(BA - BB)$



$$\sin \alpha = \frac{b}{c}$$

$$\cos \alpha = \frac{a}{c}$$

$$\tan \alpha = \frac{b}{a}$$

$$\cot \alpha = \frac{c}{b}$$

$$\sec \alpha = \frac{c}{a}$$

$$\operatorname{cosec} \alpha = \frac{b}{a}$$

LATIHAN SOAL

Pengukuran dari - ke	Tinggi pesawat (m)	Sudut horizontal (α) ($^{\circ}$)			Sudut vertical (V) ($^{\circ}$)			BA	BT	BB
		0	'	"	0	'	"			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0 - 1	130	0	0	0	91	50	40	8,50	6,00	3,50
0 - 2	130	154	3	40	91	20	50	12,80	10,00	3,50
0 - 3	130	222	7	50	91	22	10	23,70	21,00	18,30
0 - 4	130	309	17	30	84	30	20	66,7	50	33,3

Diketahui koordinat titik O (686229 , 9366766) dengan elevasi 3,2 m

Hitunglah:

- beda tinggi (ΔH) antara titik 0-1
- Elevasi tanah di bak ukur 1
- Koordinat titik 1

$$\begin{aligned}
 \text{a. } \Delta H &= D \sin \beta + TP - BT \\
 &= 100(8,5-3,5) \times \sin 1^{\circ}50'40'' + 1,3 - 6 \\
 &= 11,39 \text{ m}
 \end{aligned}$$

$$\text{b. Elevasi titik 1} = \text{elevasi titik 0} + \Delta H = 3,2 + 11,39 = 14,59 \text{ m}$$

O (686229 , 9366766)

$$\bullet X_b = X_a + D \cos \beta \sin \alpha$$

$$\bullet = 686229 + 100(8,5-3,5) \times \cos 0,999 \times \sin (0^\circ 0' 0'')$$

$$\bullet = 686229 + 0$$

$$\bullet = 686229 \text{ m}$$

$$\bullet Y_b = Y_a + D \cos \beta \cos \alpha$$

$$\bullet = 9366766 + 500 \times \cos 0,999 \times \cos (0^\circ 0' 0'')$$

$$\bullet = 9366766 + 500 \cos 0,999 \times 1$$

- TP 1,3 m
- $b = 91^\circ 50'40'' - 90^\circ = 91^\circ 50'40'' - 90^\circ = 1^\circ 50'40'' = 1 + (50/60) + (40/3600)^\circ = 1,84^\circ$
- $D = 100(8,5 - 3,5) = 500$ m
- TP = 1,3 m
- BT = 6

$$\Delta H = D \sin b + TP - BT$$

- $\Delta H = 500 \sin 1,84 + 1,3 - 6$

$$\Delta H = 11,354$$
 m

$$\text{Elevasi B} = \text{elevasi A} + \Delta H$$

$$\text{Elevasi B} = 3,2 + 11,354 = 14,55$$
 m

$$X_b = X_a + D \cos \beta \sin \alpha$$

$$Y_b = Y_a + D \cos \beta \cos \alpha$$

$$X_b = X_a + D \cos \beta \sin \alpha$$

$$X_b = 686229 + 100(8,5-3,5) \times \cos 1,84^\circ \times \sin 0$$

$$= 686229 + 500 \times 0$$

$$= 686229 \text{ m}$$

$$Y_b = Y_a + D \cos \beta \cos \alpha$$

$$Y_b = 9366766 + 100(8,5-3,5) \times \cos 1,84^\circ \times \cos 0$$

$$Y_b = 9366766 + (500 \times 0,99 \times 1)$$

$$= 9367265,74 \text{ m}$$

Jadi koordinat 1 (686229, 9367261)

LATIHAN SOAL 2

Pengukuran dari - ke	Tinggi pesawat (cm)	Sudut horizontal (a) (°)			Sudut vertical (V) (°)			BA	BT	BB
		°	'	"	°	'	"			
1	2	3	4	5	6	7	8	9	10	11
P ₄ -P ₃	110	0	0	0	86	15	20	28,80	26,00	23,20
P ₄ -P ₅	110	113	48	40	95	52	30	26,60	25,00	23,40
A ₅ -A ₄	110	0	0	0	79	9	0	11,80	11,00	10,20
A ₅ -A ₆	110	150	32	50	91	16	10	17,5	14	10,5

Titik	X _o	Y _o	Elevasi (m)
P ₄	686127,015	9366782,463	3,6
A ₅	686116,617	9366774,961	3,5

Diketahui hasil pengukuran lapangan seperti tabel di atas
Hitunglah:

- beda tinggi (ΔH) antar titik P₄-P₃, P₄-P₅, A₅-A₄, A₅-A₆
- Elevasi tanah di bak ukur P₃, P₅, A₄ dan A₆
- Koordinat titik P₃, P₅, A₄ dan A₆
- Gambarlah posisi 6 titik tersebut