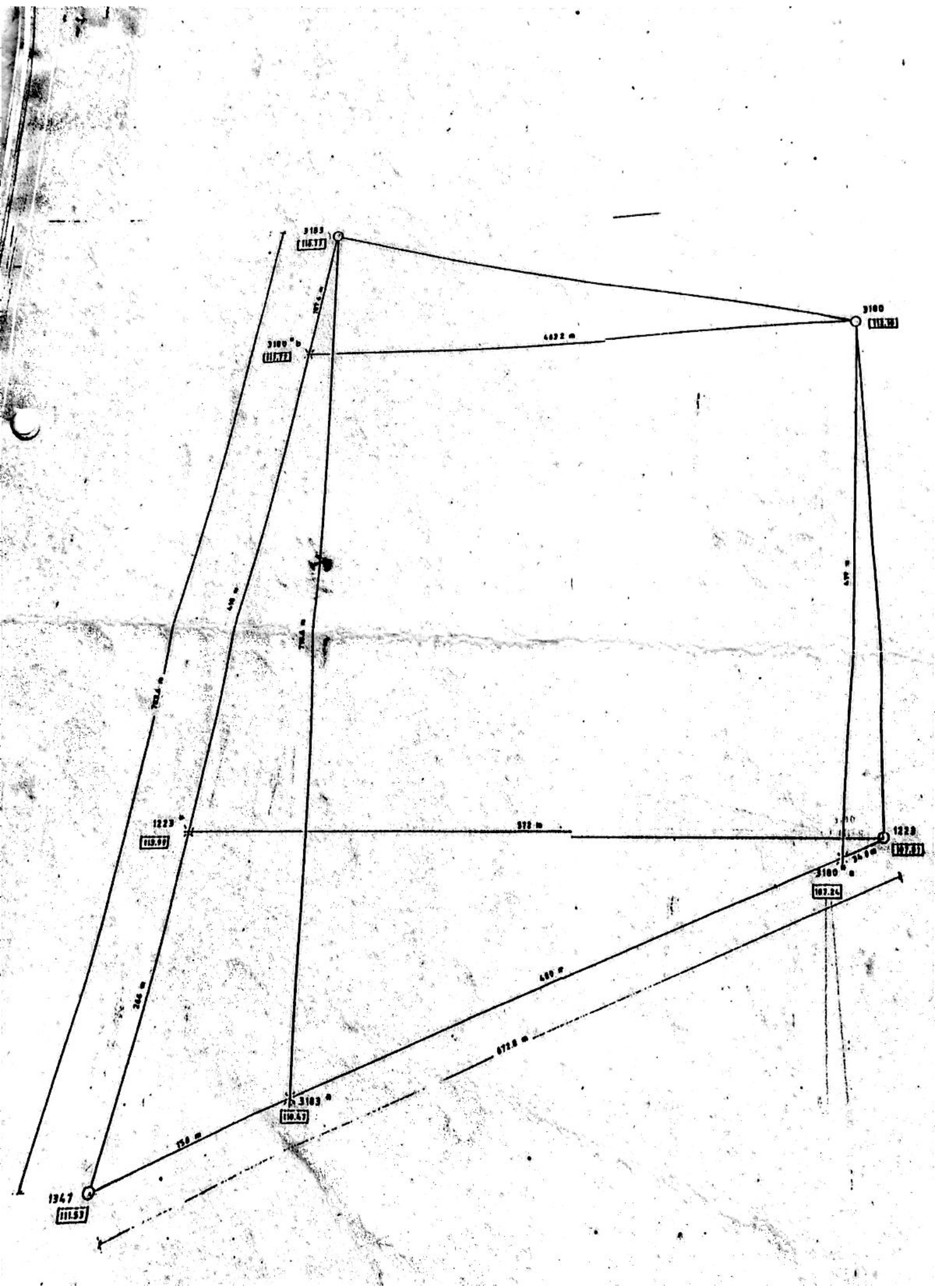


ABSOLUTE ORIENTATION
AT PLANICART E3

Example:

Model ULM 44/46

Photo Scale	1 : 5000
Focal length	153.19 mm
Model Scale	1 : 2000

1. **SCALING:**

1.1 Set gear for the elevation counter, Scale 1:2000
(See list in Planicart manual)

1.2 Compute the spatial distance between two points on ground.

$$S = \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2 + (H_2 - H_1)^2} \quad \ldots (1)$$

Compute for two distances

First distance between point 3183 and 1347

Second distance between point 3180 and 1223

Point	X m	Y m	Z m
3183	69050.38	- 8558.62	584.1
1347	68267.36	- 8533.19	590.1
3180	69014.86	- 9011.02	586.7
1223	68621.90	- 9105.00	576.1

Distance between point 3183 and 1347

S_1 = 783.45 m

Distance between point 3180 and 1223

S_2 = 404.18 m

1.3 Compute the spatial distance in the Stereomodel

$$S' = \sqrt{\bar{s}'^2 + \Delta h^2} \quad \ldots \quad (2)$$

$\bar{s}'$ = Plotted model distance between two points in the Stereoplotter.

Δh = Model Height difference between two points read on the elevation counter.

Converte S' into meter by multiplying with the scale factor.

	Distance	$\bar{s}'$ [mm]	$\bar{s}'$ [m]	Δh [m]
S_1'	3813-1347	403.0	806.0	13.49
S_2'	3180-1223	208.0	416.0	5.70

$S_1'' = 806.11$

$S_2'' = 416.04$

1.4 Computation of the Scale factor μ

$$\mu = \frac{S}{S'} = \frac{\text{Distance on Ground}}{\text{Distance in Model}} \quad \ldots\ldots(3)$$

$$\mu_1 = \frac{783.45}{806.11} \qquad \mu_2 = \frac{404.18}{416.04}$$

$\mu_1 = 0.971889$ $\mu_2 = 0.971493$

Take the mean value of μ

$\mu = 0.971691$

1.5 Computation of new base elements:

$$bx_{new} = bx_{old} \times \mu$$
$$by_{new} = by_{old} \times \mu \quad \ldots (4)$$
$$bz_{new} = bz_{old} \times \mu$$

bx_{old} = 225.00 by_{old} = 17.64 bz_{old} = 0.00

bx_{new} = 218.63 by_{new} = 17.14 (2.86) bz_{new} = 0.00

1.6 Setting of new base elements.

1.7 Checking of the Scale.

Plot new points and repeat procedure from (1.3) for check.

Scaling is finished if the difference to $\mu = 1$ is negligible.

Distance	Model	Ground	Difference
3813-1347	783.6	783.45	- 0.15
3180-1223	404.6	404.18	- 0.42

Max. difference 0.42

Max. difference 0.42 m on Ground = 0.21mm on Map = Plotting accuracy

2. LEVELLING:

2.1 Plotting of the control points

2.2 Connecting the control points

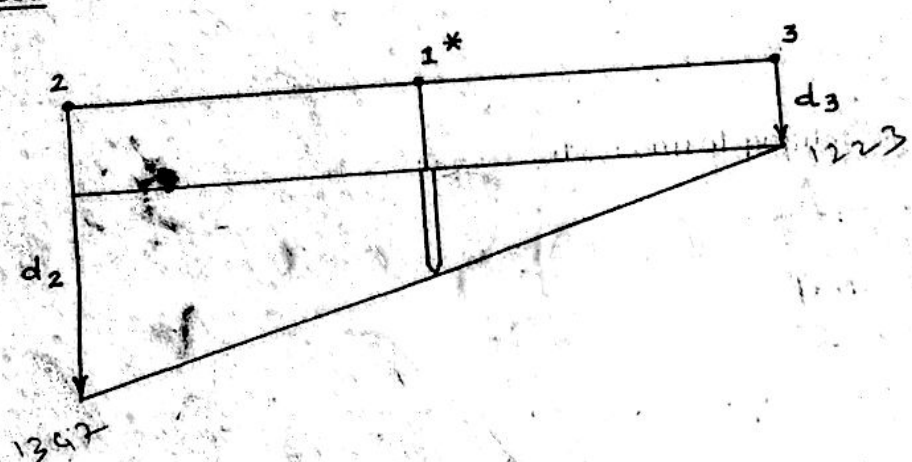
2.3 Plotting parallel lines to the instrument axis through the control points.

2.4 Determination of height differences at the control points:

Point	H Ground	h Model	d Difference
3183	584.1	465.33	118.77
3180	586.7	474.60	112.10
1347	590.1	478.57	111.53
1223	576.1	469.09	107.01

2.5 Computation of the interpolated height corrections

Principle:

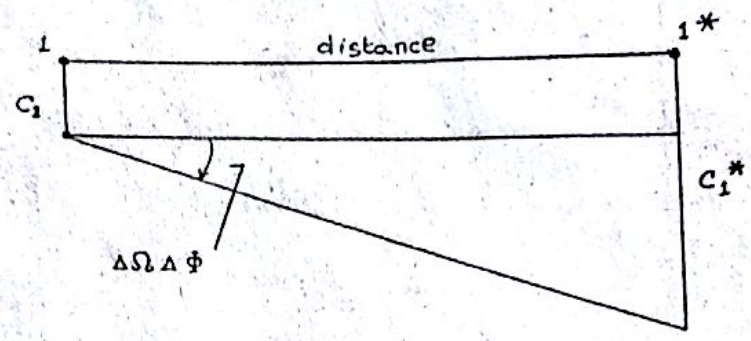


$$C_1^* = C_3 + \frac{C_2 - C_3}{S_{23}} \cdot S_{31}^* \quad \text{(or)} \quad C_1^* = C_2 + \frac{C_3 - C_2}{S_{23}} \cdot S_{21}^* \quad \ldots(5)$$

Point	Interp. heights
3183*	110.47
3180*a	107.24
3180*b	117.77
1223*	113.99

2.6 Computation of the model tilts Ω and Φ

Principle:



Ω = Rotation around the x-axis of the instrument (common)

Φ = Rotation around the y-axis of the instrument (common)

$$\Delta\Omega = \text{arc tan} \frac{C_{rear} - C_{front}}{\text{distance}} \quad .. \quad (6)$$

$$\Delta\Phi = \text{arc tan} \frac{C_{left} - C_{right}}{\text{distance}} \quad .. \quad (7)$$

2.7 Measure the distance of parallel lines to the intersection points
Convert the distances to meters. (Height differences are in meters)
Compute Ω and Φ according the formula (6) and (7)
(Computation in grads)

$$\Delta\Omega_1 = \text{arc tan} \frac{118.77 - 110.47}{710.6}$$

$$\Delta\Omega_1 = 0.743 \text{ grad}$$

$$\Delta\Omega_2 = \text{arc tan} \frac{112.10 - 107.24}{419}$$

$$\Delta\Omega_2 = 0.738 \text{ grad}$$

$$\Delta\Omega = \frac{\Omega_1 + \Omega_2}{2}$$

$\Delta\Omega$ = 0.74 grad

$\Delta\Omega_2$ = 0.74 grad.

$$\Delta\Phi_1 = \text{arc tan } \frac{117.77 - 112.10}{463.2}$$

$$\Delta\Phi_1 = 0.779 \text{ grad}$$

$$\Delta\Phi_2 = \text{arc tan } \frac{113.99 - 107.01}{572}$$

$$\Delta\Phi_2 = 0.777 \text{ grad}$$

$$\Delta\Phi = \frac{\Phi_1 + \Phi_2}{2}$$

$$\Delta\Phi = 0.778 \text{ grad}$$

2.8 Setting of the orientation elements Ω and Φ:- For the setting of $\Delta\Omega$ and $\Delta\Phi$ of the Planicart, the signes have to be reversed.

$\Delta\Omega$	=	- 0.738 grads
$\Delta\Phi$	=	- 0.777 grads

Initial readings		Corrections	Settings
φ_L	= 3.668	- 0.777	2.891
φ_R	= 3.018	- 0.777	2.241
ω_L	= 0.000	- 0.738	99.262
ω_R	= 0.02	- 0.738	99.282

2.9 Clearing of new parallaxes and checking the scale:- The setting of the new orientation elements causes new parallaxes, since there is no common Φ in the instrument. The parallaxes occur only in the front and rear of the model and can be eleminated by the use of bz. Move to one of the corner points and remove the parallaxe by bz. The entire model has to be parallaxe free. (Check all corners) for checking the scale plot the ground control point once more and compute μ as in (1.4)

3. ADJUSTING THE HEIGHT COUNTER:

For adjusting the height counter take height readings at all ground control points. Correct the reading by the mean difference to to the nominal heights.

Point	H Ground	h Model	d Difference
3183	584.1	484.39	99.71
3180	586.7	487.20	99.50
1347	590.1	490.22	99.88
1223	576.1	476.45	99.65
			d_m 99.69

Set the Z counter to a round value. Disengage the Z carriage and correct the reading by turning the knurled screw at the gear. Tighten the screw again.

3.1 DETERMINATION OF THE HEIGHT ACCURACY:

$$m_h = \pm \sqrt{\frac{[\varepsilon\varepsilon]}{n}} \quad \ldots (8)$$

$\varepsilon = H_{Ground} - h_{Model}$

n = Number of points

Measure Model heights:

Points	H Ground	h Model	ε	εε
3183	584.1	584.20	- 0.1	0.010
3180	586.7	586.82	- 0.12	0.014
3147	590.1	589.84	+ 0.26	0.067
1223	576.1	576.09	+ 0.01	0.000

$[\varepsilon\varepsilon] = 0.091$

$$m_h = \pm \sqrt{\frac{0.091}{4}}$$

$$m_h = \pm 0.15 \text{ m}$$