UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF SURVEYING

29.002 SURVEYING II

Field Exercise: Theodolite 2 (Horizontal Angle and Zenith Distance Observations)

1. AIM

To familiarise students with the scale reading theodolite (0.1' theodolite), its centring and levelling and use in measuring zenith distances and horizontal angles.

2. EQUIPMENT (Groups of 2 Students)

1 Scale Reading Theodolite WILD T16 (or RDS), ZEISS Th4, ZEISS 020 or KERN K1-SE
1 Tripod
1 Plumb-bob
1 Peg
1 Hammer
1 Clip Board
1 Survey Umbrella (rain or sun) for hard ground

DEMONSTRATOR 3 WILD Targets
3 WILD GST 20 Tripods

3. EXERCISE

3.1 Choose on the lawn west of the C.E. Building a spot where you can see the three targets (A, B, C) set up by the demonstrator. Drive a peg firmly into the ground and mark a pencil cross on top of it.

3.2 Set up the theodolite over the cross on the peg. Centre by using the optical plummet and by extending and retracting the tripod legs to get the circular level centred.

3.3 Make the vertical axis truly vertical by levelling up with the plate level. Check the centring. If necessary, adjust it by moving the instrument over the tripod head. Avoid any rotation of the instrument when doind this. Check levelling and level again, if necessary. Check again centring.

3.4 Each student in the group will check (and adjust, if necessary) the levelling of the theodolite, will determine 5 times his personal eyepiece constant and will then measure one zenith distance (in both faces) to the most southerly (A) and one to the most northerly (C) target. Adjust the altitude level (if any) carefully before every circle reading and check it again after every reading. (Repeat, if necessary!). Book time, too!

3.5 Select as many targets as there are students in your group this day (in general two, therefore, A and C). The first student measures the horizontal angle clockwise from A to C four times in both faces. Change the "zero" of the circle after every single angle by 90^{o}.

3.6 Repeat the zenith distance measurements described in 3.4

3.7 The second student measures the opposite horizontal angle (clockwise from C to A) also four times in both faces.

3.8 Repeat the zenith distance measurements described in 3.4. (If there is a third group member, he should measure now the third horizontal angle four times).

3.9 Compute in the field the following means, standard deviations of mean and standard deviations of one single observation.

- 1st horizontal angle
- 2nd " "
(- 3rd " ") if 3 students in group
- Vertical angle to A of 1st student
- " " to A of 2nd student
(- " " to A of 3rd student)
- Vertical angle to C of 1st student
- " " to C of 2nd student
(- " " to C of 3rd student)

Check, if the sum of all horizontal angles closes to 360^{o}.

3.10 Get the forms signed by your demonstrator, remove peg from ground and return the equipment to the store.

4. REPORT

Each student shall submit the following calculations and graphs:-

4.1 Adjust the two{or three} horizontal angles, using the condition equation:-

$$(\text{1st angle}) + v_1 + (\text{2nd angle}) + v_2 \{+ (\text{3rd angle}) + v_3\} = 360^{o}$$

and the misclosure $w = (\text{1st angle}) + (\text{2nd angle}) + \{(\text{3rd angle})\} - 360^{o}$. Use the standard deviations (calculated in the field) to derive the appropriate weights. Check if the sum of the adjusted angles is equal to 360^{o}.

4.2 Plot in a first diagram, your personal zenith distances to A in function of time. Comment on eventual trends.

4.3 Do the same with your three zenith distances to C.

4.4 Compute the vertical circle index error i out of all your six personal zenith distance measurements. Calculate mean and standard deviations and plot i in function of time in a small diagram.

$$i = 0.5\ (360^{o} - (Z_{FL} + Z_{FR}))$$

where Z_{FL} = zenith distance in face left

Z_{FR} = zenith distance in face right

Comment on possible trends.

J.M. RÜEGER.

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APPENDIX FW THEODOLITE II

DIRECTION MEASUREMENT

(VERTICAL ANGLE MEASUREMENT)

STATION NO.: GROUP A

NAME: no name, West of CE Bldg

Date: 28/6/76 Locality: UNSW Time: 12^{00} - 16^{00} Instrument T16 No ____

Observer: H. Miller Booker: W Jones Weather: sunny, no wind

Target	F.L.	F.R.	~~Mean~~ (FL+FR)	~~RedMean~~ (VertA)	~~Grand Mean~~ MeanVA	v'	v	vv	(i)	(t)	Remarks: st.dev., time, ...
Zenith Distance to TS 138 (Library)											
	° ' "	° ' "	' "	° ' "	° ' "		"				
TS 138	50 48 18	309 12 06	00 24	+39 11 54	+39 11 45	−	-9	81	1.678	0.000	12^{00} Centre of
TS 138	50 48 24	309 11 54	00 18	+39 11 45		−	0	0	1.678	0.000	14^{10} ball
TS 138	50 48 36	309 11 42	00 18	+39 11 33		−	+9	81	1.678	0.000	15^{40} "
								162			
							stand dev of one observation				$s = \pm\sqrt{\frac{162}{2}} = \pm 9''$
							stand dev of mean				$\bar{s} = \pm\frac{9}{\sqrt{3}} = \pm 5.2''$
Zenith Distance to TS 103 (Applied Science)											
	° ' "	° ' "	' "	° ' "	° ' "		"				
TS 103	91 16 24	268 43 54	00 18	− 1 16 15	− 1 16 18		-3	9	1.678	0.000	12^{10} Centre of
TS 103	91 16 24	268 43 48	00 12	− 1 16 18			0	0	1.678	0.000	14^{20} ball
TS 103	91 16 30	268 43 48	00 18	− 1 16 21			+3	9	1.678	0.000	15^{50} "
								18			
							stand dev of single obs				$s = \pm\sqrt{\frac{18}{2}} = \pm 3''$
							stand dev of mean				$\bar{s} = \pm\frac{3}{\sqrt{3}} = \pm 1.7''$
Horizontal angle TS 123 (St. Spiridon) → TS 103 (Applied Science)											
	° ' "	° ' "	' "	° ' "	° ' "		"				
TS 123	0 00 54	180 00 48	00 51	Angle	Mean Angle						
TS 103	51 36 18	231 36 18	36 18	51 35 27	51 35 28		+1	1			st of one single angle:
TS 123	45 01 12	225 01 12	01 12								
TS 103	96 36 36	276 36 42	36 39	51 35 27			+1	1			$s = \pm\sqrt{\frac{[vv]}{n-1}}$
											$= \pm\sqrt{\frac{43}{3}} = \pm 38''$
TS 123	90 00 36	270 00 42	00 39								
TS 103	141 36 12	321 36 12	36 12	51 35 33			-5	25			stand dev of mean angle
TS 123	135 01 00	315 01 06	01 03								
TS 103	186 36 30	6 36 24	36 27	51 35 24			+4	16			$\bar{s} = \pm\frac{3.8}{\sqrt{4}} = \pm 1.9''$
							+1	43			

Eyepiece Constant (H. Miller)

−1.2
−1.5
−1.0
−1.8
−1.4

−1.4 = Mean