

UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF SURVEYING

29.002 SURVEYING II

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

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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 doing 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  $90^{\circ}$ .

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  $360^{\circ}$ .

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:-

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

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

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.

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

where  $Z_{FL}$  = zenith distance in face left  
 $Z_{FR}$  = zenith distance in face right

Comment on possible trends.

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January, 1981

