UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF SURVEYING

29.002 SURVEYING 2

FIELD EXERCISE: INTEGRATED SURVEY TRAVERSE

1. AIM

To familiarize students with the technique of traversing between control points and its calculation on an integrated survey grid.

2. EQUIPMENT

1 Scale Reading Theodolite Zeiss Th4, Wild T16 or Wild T1
1 Tripod Zeiss S2R or Wild GST20
2 Plumb bobs
2 Sighting Tripods(with red/white's)
1 Crayon
1 100 m steel band and reader (same no as in 29.001)
1 Thermometer
1 Spring balance
1 Clip-Board
1 Survey Umbrella (for rainy days)
1 Pocket Tape

3. EXERCISE

In the appendix, traverses within the campus network are allotted to the different groups. It is absolutely necessary that all groups inform themselves about the location of the involved control and trigonometric points prior to the field session. A plan of the campus and photos of control points are on display on the 6th floor of the MEE Building.

3.1 Set up your instrument on the specified starting point of your traverse and follow the instructions below:

3.2 Horizontal angle measurements:
(i) On both terminals of your traverse, two complete set of directions (in two faces each) must be measured. At least two, better three distant trig stations must be observed as well as the nearest new traverse station. Some guidelines about trig stations (or control points) to be used for traverse orientation are given in the appendix. Change observer after first set and start second set with 90^{o}. Book on field form.

(ii) On all intermediate traverse stations, measure two complete horizontal angles clockwise from back station to fore station. Set circle to 90^{o} after first angle is measured and change observer. Set up sighting tripods on both target points. Book on field form.

3.3 Zenith distance measurements: They are used for the reduction of band measurements *and* for the calculation of height differences. Do not forget therefore to book for every zenith distance the corresponding instrument height and target height (top of spike) to mm.

On starting and end station only one zenith distance is measured to the top of the sighting tripod (two faces); on intermediate stations, two angles are observed (one foreward, one backward). Book on field form.

3.4 Distances are measured in catenary with one intermediate support (in general) from the transit axis of theodolite to the top of the sighting tripod. On starting and end station, one distance is measured. On intermediate

stations, two distances are measured (one foreward, another backward). We get this way two independent measurements (different slopes) for every traverse line. Legs of more than 100 m length may be measured with a special technique, which produces two independent observations for distance and height difference, or may be divided into two legs of about equal length. This leads to an auxiliary intermediate station.

Use the band which you standardized in Surveying 1A and use it at standard tension. Book in field book.

3.5 Auxiliary intermediate stations: The intermediate stations of all traverses are listed in the appendix. For special reasons, it may become necessary to introduce more intermediate stations. Ask supervisor for permission.

4. REPORT

Individual reports have to be submitted.

4.1 Calculate all plane bearings from the starting and end stations to the distant trig or control stations. See list of coordinates and heights in the appendix.

4.2 Reduce all distances into the NSW Integrated Survey Grid, Zone 56/1, using the standard temperature determined in 1st session. Assume a point scale factor of 1.000 000 00 and NOT the factor listed below.

$$(k = k_o\ (1 + \frac{y^2}{2r^2}) = 0.999\ 945\ 65 = \text{point scale factor})$$

Grid distance = (horizontal distance at sea level) * k

4.3 Compute the plane bearings of the first and the last leg of the traverse, using the bearings from (6.1) and your observed sets of directions.

4.4 Introduce all data in traverse computation form and calculate traverse. Execute Bowditch adjustment.

4.5 Insert all necessary data into the height computation form and notice, that not ISG distances should be used but the horizontal distances on the actual height of terrain.

$$\Delta h = d \cot z + h_i - h_t$$

where Δh = height difference, d = horizontal distance on terrain height, z = zenith distance, h_i = height of theodolite and h_t = height of target. Compute to mm.

Distribute misclosures proportional to length of traverse legs (Bowditch).

4.6 Error analysis
(i) All height differences in 4.5 are obtained twice. Compute the standard deviation of one single height difference determination from differences between forward and backward measurements.

$$S_h = \pm\sqrt{\frac{[dd]}{2n}}$$

n = number of differences d
S_h= standard deviation

Compare with precision obtained in levelling exercises and with misclosures obtained in (4.5).

(ii) Compute the standard deviation of one single direction (measured in both faces) for all your set of directions. (Each of them measured twice). Use formula given during lectures. Compare these values with the value given by the manufacturer (= ±3").

(iii) Compute the same standard deviation of one single direction (in both faces), but using this time the differences between the two measured angles

on all intermediate traverse stations.

$$m_a = \pm\sqrt{\frac{[d_a d_a]}{2n}}$$

$$m_d = \pm \frac{m_a}{\sqrt{2}}$$

d_a = difference between angles

m_a = standard deviation of one angle (measured in both faces)

n = number of differences (or pair of angles)

m_d = standard deviation of one single observed direction (in both faces).

Compare with value in (ii) and with misclosure (angular) in 4.4.

(iv) Precision of distance measurement: The length of each traverse leg is obtained twice in (4.2). Compute the standard deviation of one single distance measurement using the differences between forward and backward distances.

$$m_D = \pm\sqrt{\frac{[d_D\ d_D]}{2n}}$$

m_D = standard deviation of one distance measurement

d_D = differences of distances

n = number of pairs of distances = number of d_D.

(Weights due to different lengths of distances are neglected here)

Compare with your experience during standardization in field exercise "Linear Measurement" and with linear misclosure in 4.4.

5. APPENDIX

5.1 Coordinates and Heights of Trig and Control Stations

Grid: Quasi NSW I.S.G. Zone 56/1 (Point scale factor = 1.000 000 00)
Vertical Datum: NSW Standard Datum

Station		E	N	H
TS1	UNSWPillar	321 406.40	1 245 423.52	-
TS12	Medicin	321 707.30	1 245 593.97	-
TS103	Applied Science	321 029.47	1 245 540.72	-
TS121	Science Bdg	321 559.40	1 245 482.04	-
TS122	Howard Radio	322 638.64	1 245 012.36	-
TS123	St.Spiridon	320 651.84	1 244 642.23	-
TS125	Cornflakes	319 294.89	1 242 227.89	-
TS127	P.O.W.Hosp	322 019.44	1 245 460.66	-
TS131	Showground	320 853.42	1 248 305.31	-
TS133	Monastery	320 268.76	1 245 880.19	-
TS135	Green Spire	322 232.67	1 245 641.48	-
TS138	Library	321 460.80	1 245 506.96	-
U3		320 942.13	1 245 507.32	-
U4		321 006.38	1 245 745.76	28.43
U9		321 483.42	1 245 667.77	-
U10		321 570.39	1 245 624.35	57.77
U13		321 189.16	1 245 593.71	30.38
W42		321 422.82	1 245 631.64	
B50		321 362.61	1 245 495.09	
U80		321 658.19	1 245 445.54	54.25
G108		320 769.07	1 245 786.99	27.16
107				
G181		321 254.39	1 245 471.08	
G183		321 272.80	1 245 579.90	34.44

Station	E	N	H
G184	321 252.13	1 245 583.32	33.65
D241	321 065.59	1 245 494.64	29.13
W301	320 975.46	1 245 529.05	
P302	320 985.95	1 245 600.24	28.50
W303	320 978.39	1 245 618.41	28.66
G308	320 783.66	1 245 671.23	
G401	321 128.28	1 245 725.53	
G402	321 274.62	1 245 700.99	36.41
G403	321 382.36	1 245 683.19	45.99
W501	321 373.41	1 245 535.14	48.08
D502	321 366.48	1 245 560.56	48.12
D503	321 327.22	1 245 569.54	
D504	321 294.93	1 245 576.25	35.60
G505	321 363.32	1 245 406.44	50.59
D507	321 552.38	1 245 561.18	57.72
G602	320 910.78	1 245 512.65	27.50
G603	321 038.29	1 245 330.90	26.99
G802	321 506.00	1 245 378.42	64.88
G1301	321 129.70	1 245 612.20	29.82
S4779	321 221.75	1 245 273.44	32.26

B = Brass Rod
D = Drill Hole
G = Galvanised Iron Pipe
S = State Survey Mark
U = Ex-Snowy Mountains brass plaque
W = Washer

5.2 Allocation of Traverse Runs:

Group No.	Starting Station A	Intermediate Station	End Station B	Orientate to On A	Orientate to On B
100, 200	602	U3, 301	302	TS1	TS1, TS103
101, 201	241	242, 243	U13	U3, TS1	TS138, TS1
102, 202	1301	54, 13/1	504	U13	U13, 503
103, 203	504	503, 502	501	U13	50, 505
104, 204	603	U6, 601	602	TS103, 133	TS1, TS103
105, 205	4779	104, 4775	603	133, TS1	103, 133
106, 206	501	50, 20	505	50, 505	138, 103
107, 207	402	185, 4782	184	133, 401	TS1, 181
109, 208	303	304, 305	U4	103, 301	133, 103
110, 209	U4	401, 402	403	103	133, 131
111, 210	403	U9, 901	U10	133, 131	TS12, TS121
113, 211	507	51, 461	802	U10, 121	138, 121
114, 212	183	181 + add	4779	133, 401	133, TS1
115	U10	44, 451	U80	12, 121	TS1, 127
Reserve	502	192, 191	42	TS1, 501	131, U9
(Reserve	308	307, 306	602	108, 107	TS1, TS103)

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