VERTICAL ELEVATIONS
OF
CAMPUS MONUMENTS

Thesis for the Degree of B. S.

W. H. VanAtta A. E. Ward

1937

SUPPLEMENTARY
MATERIAL
IN BACK OF BOOK

Civil engineering Surveying

Vertical Elevations

of

Campus Monuments

A Thesis Submitted to

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by

W. H. VanAtta   A. E. Ward

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THESIS

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Note: Field Notes on file in the office of the Head of the Civil Engineering Dept.

Note: All figures used in this paper are in meters except those under 'Results' which are in feet.

ACKNOWLEDGMENT

We wish to express thanks to the faculty of the Civil Engineering Department of Michigan State College for the cooperation we received in this work and especially to Professor Cade for acting as technical adviser.

W. H. Van Atta
A. E. Ward

INTRODUCTION

Our purpose in carrying out this project as our undergraduate thesis has been two-fold. Firstly, in finding and recording the elevations of the Campus Monuments, we have contributed valuable data to the Civil Engineering Department of the College. The elevations we have found may be used as a check on the work done by elementary surveying classes. Secondly, we have gained practical experience in leveling. Neither of us had had any previous experience with a precise level and although our work on this control was only semi-precise due to the nature of the problem, we used the precise level on all lines and now feel well acquainted with it. Consequently, we have written the following pages describing our methods of field work and computations and some hints on errors we encountered. We hope that our efforts may benefit some reader contemplating a similar leveling venture.

We have discussed none of the technical points of this work as taken up in the United States Coast and Geodetic Manual, but rather would refer the reader to that publication for further information.

Picture of the party and the equipment used.

PROCEDURE

At various locations on the Michigan State College Campus, the Civil Engineering Department has placed concrete monuments, in groups of four, for use in elementary surveying classes. In 1935, Aldrich, Alston, and Semppala, in their undergraduate thesis, accurately established the horizontal position of each monument. It shall be the purpose of this thesis to establish within fairly accurate limits the vertical elevation of each monument.

The enclosed map of the Campus will show the relative proximity of the groups of monuments and will indicate to anyone familiar with the topography of the Campus the difficulties at once apparent in running a precise line over such a short distance with a comparatively large number of accurate intermediate elevations required. In but few instances was more than one set-up required between any two groups. The abundance of trees and shrubs on the Campus made it exceedingly difficult to keep the backsight and foresight distances equal. Early in the term, we abandoned the orthodox method of procedure as outlined for precise leveling by the United States Coast and Geodetic Surveying

Manual, realizing that we had encountered a problem different from the ordinary and requiring specialized treatment. Any surveying project should be accomplished with due regard for the element of time. After considering several methods of approach, we decided to adopt two lines (MBM - B - C - D - E - F - P - G - H - N - A - MBM and MBM - Z - L - BM#N - K - O - N - A - MBM) and to run each both forward and backward making the most advantageous set-ups attempting, of course, to keep the foresight and backsight distances as nearly equal as could be approximated by eye and, at the same time, adapting the set-up to the nature of the ground even at the expense of unequal foresight and backsight distances. Using this method, we were able to cover a considerable amount of line in what we considered a reasonable time, as will be shown by an inspection of our field notes on file in the office of Professor Allen, Head of Civil Engineering Department.

While on the subject of time, it may be well at this point to mention the fact that we found a two man party scarcely adequate to handle a level circuit of this type. A heavy burden is placed upon the instrument man who must not only handle the instrument but must also keep the notes and watch carefully for any accidental errors

in reading which are likely to appear. The Coast and Geodetis Survey Manual recommends a five or six man party for precise work. We believe that fair progress on projects similar to this problem and of the same general nature can be made with a three man party consisting of one instrument man, one note keeper, and one rodman.

Upon completion of the lines described before, we examined the data for the errors which we thought would appear as an expected consequence of the method employed. It can truthfully be said that we were not disappointed in this respect. Our attempts to correct and balance the circuits and the problems encountered are discussed later in this report. We will also include an analysis of our method in regard to its advantages and disadvantages, its attributes and faults, and a general discussion of how we think a problem of this kind should be handled.

It will be noticed that all of our lines were returned to the point of beginning thus giving us the actual error present in each circuit and offering a reliable basis for correction. As insurance against consistent personal error, the instrument man on the forward running of a line became rodman on the backward

running.

Early in the term, we were prevented from doing much field work by an unusual amount of inclement weather. The larger part of our work was accomplished on clear days and in moderate to strong winds. The advisability of having a sunshade and a windshield for the instrument became forcedly apparent as we experienced considerable difficulty in keeping the bubble in the center of the tube long enough for the instrument man to take and record the three readings necessary.

Our results, in conjunction with those obtained by Aldrich, Alston, and Samppala for the horizontal location of the Campus Monuments, we present on the outline map of the Campus enclosed in this report.

ERRORS

Both large and small errors occurred during our work on this project. The only glaring error we found was that of recording the wrong meter interval, that is, 2.385 instead of 3.385. This is especially apt to happen after taking a series of readings in the two meter interval and then failing to notice a slight drop in the ground at the next station. The fact that the instrument man had to keep the notes offered a likely source for this type of error. Such mistakes are easily located from the reverse running of the line.

Small errors we found to be far more troublesome. It is difficult to determine whether such an error occurred at one point or was accumulated during the run through some maladjustment of the instrument, or through some repeated personal error in technique. We believe these small errors to be due to neglect in accurately balancing foresight and backsight distances as shown by the discrepancy in cross-hair intervals, and have corrected the circuits accordingly. On an area such as the Campus, it is difficult to run a line according to accepted methods because of the numerous obstacles encountered, namely: bushes, trees, buildings, roads, other surveying parties, and co-eds, all of which are

present in great abundance.

Among the personal errors which may occur is that due to a very slight amount of parallax that both of us noticed occasionally. It became manifest only on medium short sights in which with the cross-hairs clear and the objective focussed on the rod a slight movement of the eye seemed to move the cross-hairs about 1 mm. along the rod. This could usually be corrected somewhat by re-focussing the eyepiece but, after our eyes became tired, any off- focus position of the hairs to overcome parallax made the cross-hairs fade and reading became exceedingly uncertain.

An inexcusable personal error that could easily result from having too short or too long a bubble is that of not having the two ends at corresponding graduations of the tube. When the bubble is of proper length, the ends of the bubble fall near the marked graduations of the tube and such an error would be unlikely to occur. However, should such an error occur it is immediately apparent upon swinging the instrument 180 degrees because, if the reversing point of the bubble had been found, the bubble would then be markedly off center, a condition which would at once indicate the error.

Most of our difficulty in getting good readings was the result of unfavorable weather. Naturally rain kept us from doing any work outside and, early in the term, medium to strong winds prevented our getting any reliable data. The ten-second bubble on the instrument we were using nearly discouraged us early in the term by slipping from one end of the tube to the other with each change in direction or intensity of the wind. Later in the spring, however, the days were more nearly calm but we had some trouble with heat waves during the last few days. In fact, we believe that there have been only two perfect precise leveling days for a two man party this term. A perfect day is one which is cloudy with no wind, such conditions resulting in no heat waves, glare on the bubble tube, or shifting of the instrument. We readily concede the necessity for an additional two men, one with a sunshade and one with a windshield, in a precise leveling party.

OPERATION OF THE INSTRUMENT

The speed with which precise leveling work is carried on depends primarily upon the proficiency of the instrument man in setting up the level. One thing we soon learned was the importance of setting up the tripod in a position that made it convenient to adjust the instrument without moving about. The accepted position is with a line through two of the tripod legs parallel to the line of sight. Moving about while adjusting the instrument not only slows the work, but, on soft turf, may alter the position of the legs and throw the base off level. We adopted the following procedure in leveling the instrument:

1. Loosen the base clamp nut and vertical spindle clamp screw.
2. Lower the telescope on the micrometer adjustment contact or bearing.
3. Center the circular bubble with the telescope parallel to one leg of the base.
4. Center the telescope bubble over each of the three base legs in order.
5. Level on the line of sight with the micrometer screw.

Step 4. brings the instrument very nearly level, the fine adjustment being completed on the line of sight by use of the micrometer screw as indicated in step 5. At first, we encountered difficulty in step 4. because we had not found the reversing point of the micrometer screw adjustment. This was easily done by leveling, swinging the telescope 180 degrees, and bringing the bubble back half-way with the leveling screws and half-way with the micrometer screw. Three or four repetions of the above soon located the exact reversing point.

We found it worthwhile to take care that the bubble be kept as nearly as possible the same length to facilitate leveling by getting accustomed to seeing the bubble ends at nearly the same tube graduations. This was done by clamping the telescope before moving from one set-up to the next and carrying the instrument with the telescope horizontal so that no air could escape to or from the vial at the end of the bubble tube.

ADJUSTMENT OF CIRCUITS

Examination of the notes taken on the two lines selected showed a considerable error of closure in most cases. Further examination showed that where the foresight distances exceeded the backsight distances the circuit failed to close because the foresights exceeded the backsights and, conversely, that where the backsight distances exceeded the foresight distances the circuit failed to close because the backsights exceeded the foresights. This condition was present in every line which we ran. This fact seemed to offer the most reliable basis for correction so we adopted the method of adjustment described below.

Firstly, the amount by which the circuit failed to close was computed. This value represented the total error in the line. Our method of adjustment attempts the reduction of this error to zero and its uniform distribution over the circuit in accordance with the difference in foresight and backsight distances or stadia intervals. Secondly, the difference in foresight and backsight distances as represented by stadia intervals was computed. This difference in intervals was figured from the point of beginning to each station considered. Thirdly, the sumation of the differences in intervals from the point of beginning to each successive station for all stations considered in the line was taken. Fourthly, a partial correction to be applied at each station was determined by taking a proportion of the total error of closure by an amount represented by the proportion of the difference in intervals to the station to the sumation of the differences in intervals. Fifthly, the total correction to be applied at each station was determined by taking the sumation of the partial corrections to and including the station in question. Sixthly, the corrected difference in elevation between the point of beginning (MBM for every circuit) and the station in question was computed by applying the total correction with proper sign to the difference in elevation as figured by taking the difference in the sumation of the foresights and backsights to the station.

We have assumed the error of each circuit to be due to a difference in foresight and backsight distances, an assumption which is based upon a study of all the circuits made which, without exception, substantiate our contention. The method of adjustment used, however, assumes a constant difference in foresight and backsight distances through-out the circuit and assumes further that the difference will be consistently on either the foresight or the backsight side. Actually, such was not the case and it is expected that, following adjustment, some slight error would still remain in the circuit. We believed, however, that the amount of this error would be small and would fall within the limits of accuracy desired.

Station	Forward Elevation	Backward Elevation	Difference
BM#N	1.4627	1.4637	.001
K-2	.3199	.3193	.0006
O-4	.8976	.8973	.0013
N-1	.7048	.7047	.0001

A comparison of the elevations computed for the four stations tabulated above clearly indicates that a fair degree of accuracy may be obtained from the method of leveling and adjustment employed. Stations BM#N, K-2, O-4, and N-1 were selected at random from the backward and forward running of approximately the same line. It will be noticed that the greatest difference in computed elevation is .0013 meter or 1.3 millimeters, a value which well approximates the closest figure to which the rod can be read. The backward running of the line closed within .0001 meter and, the sumation of the foresight and backsight intervals being approximately equal, no correction or adjustment was made. The forward running of the line, however, failed to close by .0044 meter and a considerable difference between backsight and foresight intervals was noticed. This running was adjusted by the method previously explained and, as a result, checked very favorably with the backward running of the line.

This method has as its chief advantage speed of performance both in the field and in the office. The inconsistency between theory of adjustment and the actual case constitutes the principal fault of the method but, as we have shown, only slight errors result. We believe that, for the purpose intended, such a method of leveling may be advantageously employed.

On the following pages, we present several samples of data and adjustments made.

LINE NO. 2 - FORWARD

From		To	Sumation B. S.	Sumation Intervals	Sumation F. S.	Sumation Intervals
MBM	(1)	Z-2	3.6250	.748	3.8520	.821
MBM	(2)	L-3	6.6660	.928	4.7550	1.006
MBM	(3)	BM#N	7.9497	1.175	6.4887	1.234
MBM	(4)	K-2	9.0900	1.294	9.4120	1.343
MBM	(5)	O-4	9.7543	1.466	10.6550	1.594
MBM	(6)	N-1	12.4870	1.584	11.7860	1.676
MBM	(7)	MBM	15.2326	1.860	15.2370	1.955

	Difference Elevation	Difference Interval	Partial Correction	Total Corr.	Corrected Elevation
(1)	- .2270	- .073	+ .0006	+ .0006	- .2264
(2)	+ 1.911	- .078	+ .0006	+ .0012	+ 1.9122
(3)	+ 1.4610	- .059	+ .0005	+ .0017	+ 1.4627
(4)	- .3220	- .049	+ .0004	+ .0021	- .3199
(5)	- .9007	- .128	+ .0010	+ .0031	- .8976
(6)	+ .7010	- .092	+ .0007	+ .0038	+ .7048
(7)	- .0044	- .095	+ .0007	+ .0045	+ .0001

LINE NO. 2 - BACKWARD

From		To	Sumation B. S.	Sumation Intervals	Sumation F. S.	Sumation Intervals
MBM	(1)	N-1	3.245	.214	2.5403	.349
MBM	(2)	O-4	4.257	.320	5.1533	.441
MBM	(3)	K-2	5.232	.544	5.5513	.641
MBM	(4)	BM#N	8.162	.659	6.6983	.753
MBM	(5)	L-1	10.558	.871	8.1643	1.008
MBM	(6)	Z-1	12.887	1.049	13.0763	1.226
MBM	(7)	M-1	14.220	1.401	15.0076	1.473
MBM	(8)	MBM	16.7710	1.930	16.7709	1.940

	Difference Elevation	Difference Interval	Partial Correction	Total Corr.	Corrected Elevation
(1)	+ .7047	- .135	0.0	0.0	+ .7047
(2)	- .8963	- .121	0.0	0.0	- .8963
(3)	- .3193	- .097	0.0	0.0	- .3193
(4)	+1.4637	- .095	0.0	0.0	+1.4637
(5)	+2.3937	- .137	0.0	0.0	+2.3937
(6)	- .1893	- .177	0.0	0.0	- .1893
(7)	- .7876	- .072	0.0	0.0	- .7876
(8)	+ .0001	- .010	0.0	0.0	+ .0001

LINE NO. 1 - FORWARD

From	To	Sumation B. S.	Sumation Intervals	Sumation F. S.	Sumation Intervals
MBM	(1) B-1	1.8333	.107	1.2403	.133
MBM	(2) C-1	4.0953	.371	3.6830	.449
MBM	(3) D-1	6.9200	.701	4.1830	.767
MBM	(4)* Thana	8.0760	.883	6.1390	.951
MBM	(5) E-1	9.8153	1.056	7.4197	1.195
MBM	(6) Vir.	10.8053	1.336	10.4907	1.393
MBM	(7) F-1	12.3526	1.431	12.2417	1.493
MBM	(8) P-1	14.2490	1.586	13.9630	1.716
MBM	(9) G-1	16.1532	1.701	15.7197	1.823
MBM	(10) H-1	18.0625	1.854	18.1977	2.023
MBM	(11) Dibbo	19.1145	2.098	19.9527	2.353
MBM	(12) Pat	21.2438	2.269	20.4037	2.451
MBM	(13) Rhea	23.7261	2.336	23.3270	2.598
MBM	(14) N-1	25.4261	2.418	24.7287	2.661
MBM	(15) A-1	26.2898	2.612	27.4764	2.797
MBM	(16) MBM	28.3298	2.686	28.3477	2.858

* To relieve the monotony of the situation we named turning points thusly.

LINE NO. 1 - FORWARD

	Difference Elevation	Difference Interval	Partial Correction	Total Corr.	Corrected Elevation
(1)	+ .5930	- .026	+ .0002	+ .0002	+ .5932
(2)	+ .4123	- .078	+ .0007	+ .0009	+ .4132
(3)	+1.7370	- .068	+ .0006	+ .0015	+1.7385
(4)	+1.9370	- .068	+ .0006	+ .0021	+1.9391
(5)	+2.3956	- .039	+ .0003	+ .0024	+2.3980
(6)	+ .3146	- .057	+ .0005	+ .0029	+ .3175
(7)	+ .1109	- .062	+ .0005	+ .0034	+ .1143
(8)	+ .2869	- .130	+ .0011	+ .0045	+ .2914
(9)	+ .4335	- .122	+ .0010	+ .0055	+ .4390
(10)	- .1352	- .169	+ .0014	+ .0069	- .1283
(11)	- .8382	- .255	+ .0022	+ .0091	- .8291
(12)	+ .8401	- .182	+ .0015	+ .0106	+ .8507
(13)	+ .3991	- .262	+ .0022	+ .0128	+ .4119
(14)	+ .6874	- .243	+ .0020	+ .0148	+ .7022
(15)	-1.1866	- .185	+ .0016	+ .0164	-1.1702
(16)	- .0179	- .172	+ .0015	+ .0179	0.0000

LINE NO. 1 - FORWARD

Diff. Elev.	Diff. Int.	Change in Diff. Int.	Part. Corr.	Total Corr.	Corr. Elev.
(1)+ .5930	-.026	- .026	+.0027	+.0027	+ .5957
(2)+ .4123	-.078	-.052	+.0054	+.0081	+ .4204
(3)+1.7370	-.066	+.012	-.0013	+.0068	+1.7438
(4)+1.9370	-.068	-.002	+.0002	+.0070	+1.9440
(5)+2.3956	-.039	+.029	-.0030	+.0040	+2.3996
(6)+ .3146	-.057	-.018	+.0019	+.0059	+.3205
(7)+ .1109	-.062	-.005	+.0005	+.0064	+.1173
(8)+ .2869	-.130	-.068	+.0070	+.0134	+.3003
(9)+ .4335	-.122	+.008	-.0008	+.0126	+.4461
(10)-.1352	-.169	-.047	+.0049	+.0175	-.1177
(11)-.8382	-.255	-.086	+.0090	+.0265	-.8117
(12)+.8401	-.182	+.073	-.0076	+.0189	+.8590
(13)+.3991	-.262	-.080	+.0084	+.0273	+.4264
(14)+.6874	-.243	+.019	-.0020	+.0253	+.7127
(15)-1.1866	-.185	+.058	-.0061	+.0192	-1.1654
(16)-.0179	-.172	+.013	-.0014	+.0178	-.0001

LINE NO. 1 - FORWARD

It will be noticed that Line No. 1 - Forward has a considerable error of closure. On page 20 is the adjustment of this circuit according to the method previously explained. The elevations obtained did not check with those derived from the backward running of the line, a line in which no large error was present. It is more than likely that a blunder was made somewhere in the forward running which would account for the error but, as an experiment, we tried a second method of adjustment, the figures for which are given on page 21. This method is similar to the first except that the correction was applied not on the basis of a difference in intervals, but rather on the basis of the change in the difference in intervals from one station to the next. The results of the second correction failed to check with the backward running but came much closer than did those of the first correction. We enclose this information to illustrate a possible method of adjustment which, although we did not use it, is more nearly theoretically correct than the first method.

Following is the backward running of approximately the same line.

LINE NO. 1 - BACKWARD

From	To	Sumation B. S.	Sumation Interval	Sumation F. S.	Sumation Interval
MBM (1)	TP 1	2.138	.234	1.804	.230
MBM (2)	H-1	3.4277	.452	3.5553	.405
MBM (3)	G-1	5.8997	.664	5.4536	.544
MBM (4)	P-1	7.3907	.756	7.0929	.675
MBM (5)	F-1	9.0764	.978	8.9539	.830
MBM (6)	E-1	11.5717	1.236	9.1899	1.166
MBM (7)	TP 2	12.8347	1.543	10.6879	1.455
MBM (8)	BM R	14.5490	1.824	13.5366	1.709
MBM (9)	C-2	15.7177	1.950	15.2393	1.801
MBM (10)	B-1	18.4500	2.231	17.8526	2.104
MBM (11)	MBM	19.6173	2.365	19.6123	2.212

LINE NO. 1 - BACKWARD

	Difference Elevation	Difference Interval	Partial Correction	Total Corr.	Corrected Elevation
(1)	+ .3240	+ .004	-0.0	0.0	
(2)	- .1276	+ .047	- .0002	- .0002	- .1278
(3)	+ .4461	+ .120	- .0005	- .0007	+ .4454
(4)	+ .2978	+ .081	- .0004	- .0011	+ .2967
(5)	+ .1225	+ .148	- .0007	- .0018	+ .1207
(6)	+2.3818	+ .070	- .0003	- .0021	+2.3797
(7)	+2.1468	+ .088	- .0004	- .0025	
(8)	+1.0124	+ .115	- .0005	- .0030	
(9)	+ .4784	+ .149	- .0007	- .0037	+ .4747
(10)	+ .5974	+ .127	- .0006	- .0043	+ .5931
(11)	+ .0050	+ .153	- .0007	- .0050	+0.0000

COMMENTS

The preceding pages of computations indicate the method by which our results were obtained. Needless to say, we have included only a sample of the work done. We have previously explained the factors causing us to vary from the accepted standards of leveling practice. We have presented the theory of our adjustment. There now remain but few words to be written and, therefore, we have reserved this section for comment upon our own work and upon leveling practice in general.

For short lines of levels, we believe the method presented in this paper thoroughly practical and sufficiently accurate for work requiring considerable refinement. For long lines, there can be no question but that the accepted procedure of precise leveling as defined by the United States Coast and Geodetic Surveying Manual is, at the present time, the best.

When running our lines, we, at every opportunity, tied our circuit in on the old set of campus monuments, the elevations of which are stamped on the monument to the nearest ten-thousandth of a foot. All of our circuits started and ended at MBM in front of Olds Hall. The elevation of this bench mark we carried from station STATE. In checking over the circuits, we found the old

set of monuments to be in error in excess of .5 foot. From a practical point of view, it is difficult to understand how an elevation deemed sufficiently accurate to be given to such fine limits could possibly be in error by such a large amount. This condition would seem to indicate that such elevations carried over a long distance could not properly be given to much less than the nearest foot. For this reason, we have listed our results not only as elevations above what we must assume to be sea-level but have also referred them to MBM taken as a datum of elevation 100.00 feet.

wrong Conclusion
CMB
1947

Note there was discrepancy between the 1913 and the 1929 adjustment C & G Survey.
CMB

847.224

ELEVATIONS OF CAMPUS MONUMENTS

Station	Elevation MBM-100.000	Elevation Sea-level
A-1	96.166	840.0~~4~~21
A-2	96.207	840.4~~5~~30
A-3	96.585	840.8~~2~~09
A-4	96.707	840.9~~9~~75
B-1	101.946	846.1~~4~~70
B-2	101.878	846.1~~2~~02
B-3	101.760	~~846.00~~845.984
B-4	101.720	845.9~~6~~44
C-1	101.362	845.~~60~~586
C-2	101.557	845.~~80~~781
C-3	101.626	845.8~~7~~50
C-4	101.622	845.8~~6~~46
D-1	105.757	8~~50.00~~49.981
D-2	106.119	850.3~~6~~43
D-3	106.293	850.5~~3~~17
D-4	106.613	850.8~~5~~37
E-1	107.903	852.1~~4~~27
E-2	107.807	852.0~~5~~31
E-3	107.600	851.8~~4~~24
E-4	107.370	851.~~61~~594
F-1	100.396	844.6~~4~~20
F-2	100.470	844.~~71~~694

.02 error by
Checked
R.m.l.

Station	Elevation MBM-100.000	Elevation Sea-level
F-3	100.569	844.~~81~~793
F-4	100.712	844.9~~5~~36
G-1	101.461	845.~~70~~685
G-2	101.733	845.9~~7~~57
G-3	101.997	846.2~~4~~21
G-4	102.390	846.3~~6~~44
H-1	99.530	843.8~~7~~04
H-2	99.618	843.8~~6~~42
H-3	99.706	843.9~~5~~30
H-4	100.212	844.4~~7~~34
K-1	99.824	844.0~~6~~48
K-2	98.951	843.1~~2~~45
K-3	98.464	842.~~70~~688
K-4	98.386	842.6~~7~~10
L-1	107.853	852.0~~8~~77
L-2	107.404	851.6~~7~~64
L-3	106.274	850.~~51~~498
L-4	105.320	849.5~~6~~44
M-1	97.416	841.6~~6~~40
M-2	97.459	841.~~70~~683
M-3	97.426	841.6~~7~~50
M-4	97.264	841.~~50~~488

Station	Elevation MBM-100.000	Elevation Sea-level
N-1	102.312	846.556
N-2	102.739	846.983
N-3	103.155	847.399
N-4	103.651	847.895
O-1	95.945	840.189
O-2	96.306	840.550
O-3	96.719	840.963
O-4	97.057	841.301
P-1	100.973	845.201
P-2	101.172	845.416
P-3	101.077	845.321
P-4	101.074	845.318
U-2	105.528	849.772
Z-1	99.385	843.629
Z-2	99.257	843.501

CONCLUSION

In this thesis, we have attempted to solve the problem undertaken and, at the same time, to experiment with something new and different in leveling practice. Future surveys will show whether or not our results are accurate but, accurate or not, we feel that this project has been of great value to us in experience. We found the work enjoyable and interesting. All through the term we acted as much as possible on our own, feeling that, in our final term, we should place to test the judgement and knowledge acquired during our careers as students at this institution. We submit this paper not as a statement of fact and mathematical results but as a narrative of our experiences in carrying out this work.

THE END

[redacted]

Pocket has:
1 map