GMAT8711 PROFESSIONAL PRACTICE

PRACTICAL EXAMINATION

Appendix E:

THE UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF GEOMATIC ENGINEERING

Instructions for the Use of the UNSW EDM Research Baseline in Regents Park

(6th Edition, 1998)

Permission for the use of the baseline is granted under the condition that the procedures listed below are closely followed, that all specified data are supplied to the School without delay and that any costs arising from damage to equipment supplied are borne by the user.

1. GENERAL INSTRUCTIONS

1.1 Book the date of use of the baseline with the Survey Fieldhand and Storeman of the School of Geomatic Engineering, UNSW, (Mr. Alan Edmunds, ph: 9385 4195) and arrange details for pick-up and return of equipment. In the absence of the storeman, the School Office may be contacted on 9385-4182 or Dr. Rüeger on 9385-4173.

1.2 The following equipment must be collected from the Survey Store, School of Geomatic Engineering, The University of New South Wales on the day of measurement or (usually) in the afternoon of the day before:

1	padlock key (opens gate and pillar covers)
1	Set of UNSW Fieldwork Safety Guidelines (Please read and follow.)
1	can of WD 40
3	WILD (Leica) GDF-21K tribrachs (with Kern centring system underneath and Wild centring on top, 2 footscrews!)
1	cyclic error rail tape clamp
1	cyclic error rail pulley
1	5 kg weight
1	30 m LUFKIN "chrome clad" steel tape
1	roller grip with hook
1	old WILD GDF-6 tribrach (for use on the cyclic error rail)
1	chaining thermometer (marked 'RP')
.	some rags

This equipment must be returned to the Survey Store on the day of the measurement or in the morning of the next day.

1.3 The eight pillars on the UNSW EDM Research Baseline in Regents Park are fitted with permanent Kern centring plates, giving an optimal centring accuracy. Kern instruments fit directly, all other brands with the Wild GDF-21K tribrach provided. If you have never used the Kern centring system before, ask the Survey Fieldhand and Storeman for a demonstration. The locking lever should be tightened only gently. Use of force permanently damages the precision centring mechanism.

1.4 The Baseline is located along the Sydney Water pipeline between Duck River (Creek) to the west and Carlingford Street to the east. Access by car is from Rose Crescent, west of Regents Park Railway Station. Driving southwards on Carlingford Street, turn into Rose Crescent on the right. At the gate in Rose Crescent, the University padlock (marked "Geomatic Engineering, University of NSW, Ph: 9385 4182") is to be locked "in series" with the Sydney Water lock.

1.5 Make sure that you lock the gate (University padlock "**in series**" with the Sydney Water padlock) when you leave the site. No rubbish is to be left at the site. (See **Appendix** for diagram.)

1.6 A maximum of two vehicles may be used on the site. Additional vehicles may be parked in Rose Crescent. While the vehicles are on site, do not park **on** the track along the pipeline. Do not drive on the grass, however.

1.7 The small pillar covers and padlocks are to be secured during the measurements. (Such items have been stolen by children during earlier measurements on the baseline). Leave the **big** covers on the ground, near the respective pillars. It is suggested that you hang the small pillar caps onto the sides of the small pillars and that you lock the locks onto the pillars once the caps have been removed. (This way, no locks should go missing in car boots.) Make sure that you put the covers correctly back onto the pillars and that they are locked.

1.8 In the past, pillar plates have been damaged by vandals even while users were working on the baseline. As a result we ask all users:

- to unlock the pillar caps immediately before the commencement of the measurements,
- to lock the pillar caps immediately once the measurements have finished,
- to keep an eager eye on all persons on site, in general, and idle youths, in particular.

1.9 Over the years, users have lost some of the locks used to lock the pillar covers to the pillars.

- Please make sure that the caps on the three big Pillars 1, 5, 8 are locked with three padlocks and the caps on the five small pillars with two padlocks.
- If you find locks missing, the surveyor/geomatic engineer in charge should personally report this to the Survey Fieldhand and Storeman of the School of Geomatic Engineering. In addition, please buy new locks in the hardware store in Regents Park to replace the missing and supply the keys to the School of Geomatic Engineering. (We will then exchange the non-standard with standard locks.)

1.10 It has been agreed with the Sydney Water Production Officer in charge of the "Eastern Delivery", that all users of the baseline will follow the *UNSW Fieldwork Safety Guidelines* (published in 1993). These Guidelines are supplied with the baseline equipment. Please read them, follow them and return them with the equipment.

1.11 If you find that the Sydney Water did not lock our lock in series with theirs at the gate, check the western access to the baseline, off Hector Street. Please stop any passing Sydney Water maintenance team and ask them to rectify the problem immediately. If there is any other problem with access, contact the two Sydney Water staff in charge of the pipeline section (Messrs. Tim Shanks and Trevor Buckley, phone: 9645 4150, mobile: (0417) 064 404). They are based at the Potts Hill Reservoir.

1.12 Should you find the EDM Research Baseline damaged or vandalised in any way, please report the details of the damage to Dr. J. M. Rüeger (or, in his absence to the Survey Fieldhand and Storeman) at or before the time of the return of the equipment. In particular, report any missing padlocks: The big pillars (1,5,8) should carry 3 locks each, the smaller pillars (2,3,4,6,7) two each.

2. EQUIPMENT TO BE PROVIDED BY THE USER OF THE BASELINE

1 Electronic Tacheometer (or EDM instrument, possibly on a theodolite) with battery
(fitting WILD tribrach or KERN centring system)
1 Single prism reflector combination (fitting WILD tribrach or KERN centring system)
2 Survey umbrellas
2 Small barometers (calibrated!)
2 Calibrated mercury thermometers (or aspirated psychrometers or electronic temperature/humidity sensors)
(If precision distance meters are tested, aspirated psychrometers or electronic temperature/humidity probes should be provided).
1+ Spare battery (see 3.6)
2 Two-way radios (walkie-talkies)

It is desirable, that all 28 combinations of distances are measured. There is, however, no absolute requirement to do so if the instrument fails to measure all lines to a single prism, provided the analysis software can cope with this. However, if the EDM instrument is unlikely to measure over 1 km with one prism, you may wish to provide also:

1 Triple prism reflector combination (fitting WILD tribrach or KERN centring system)

3. MEASUREMENT PROCEDURES ON THE BASELINE

3.1 Sequence of Measurements: 2-1, 3-1, 3-2, 4-3, 4-2, 4-1, 5-1, 5-2, 5-3, 5-4, 6-5, 6-4, 6-3, 6-2, 6-1, 7-1, 7-2, 7-3, 7-4, 7-5, 7-6, 8-7, 8-6, 8-5, 8-4, 8-3, 8-2, 8-1. The electronic tacheometer (or EDM instrument) starts, therefore, on Pillar 2 and moves then to Pillar 3, etc. Pillar 1 is the most easterly pillar; Pillar 8 the most westerly.

3.2 EDM instrument, thermometer and (two) barometers to be shaded by survey umbrella in sunny (and rainy) conditions.

3.3 Reflector and thermometer to be shaded by second umbrella.

3.4 Level the electronic tacheometer (EDM instrument) and reflector carefully on all stations. (Note in the field book every time the EDM instrument is levelled; levelling errors result in errors of the adjusted distances).

3.5 Before and after the baseline measurement, measure the height of the **tilting axes** of the electronic tacheometer (or EDM instrument and/or theodolite), single prism and triple prism on a flat surface (office table) from the bottom surfaces of the tribrachs accurately **to mm**. All footscrews should be turned to the mid-position before doing so and also during the baseline measurements.
NOTE: The relevant height of any telescope mounted EDM instrument is the **same as** the trunnion axis height of the host theodolite. The offset of the telescopes of theodolite and EDM instrument should be noted on the Sketch on the CHECKLIST form.

3.6 Turn on the EDM instrument at least 15 minutes before the first measurement and **do not** turn it off before the last distance (for the cyclic error test) is measured. It is important that the necessary spare batteries are taken into the field.

3.7 Set the "ppm-knob" of your instrument to the **neutral** position (±0 ppm) (or enter the reference temperature and pressure specified by the manufacturer) and keep it on this position for all measurements on the baseline and the cyclic error test line. Record **carefully** any preset "instrument constants" and "reflector constants" as the baseline observations are biased by such on-line corrections.

3.8 Measure each of the 28 distances as follows:

(1) Measure the (dry bulb) temperature at the instrument and the reflector stations in the shade and at instrument height. Book the values as read. Add any applicable additive constants of the thermometers later, when preparing the summary form.

(2) Read the two barometers at the instrument station and book the values as read. Do not forget to add the additive constants of the barometers when preparing the summary form.

(3) Point to reflector (optically or electronically, as required by manufacturer). Measure distance two times. Record signal strength (if displayed).

(4) Turn horizontal and vertical slow motion screws a bit. Repoint to reflector. Two distance measurements.

(5) Turn horizontal and vertical slow motion screws a bit. Repoint to reflector. Two distance measurements.

(6) Turn horizontal and vertical slow motion screws a bit. Repoint to reflector. Two distance measurements.

(7) After this **total of eight measurements**, read the two barometers at the instrument station and book values "as read".

(8) Measure the (dry bulb) temperature at the instrument and the reflector stations in the shade and at instrument height. Book the values as read.

(9) Record the time.

NOTE: If you test a precision distance meter, it is suggested to also measure and record wet bulb temperatures or relative humidity.

3.9 Between the first and the last distance measurement on the baseline (and during the cyclic error test) the electronic tacheometer (EDM instrument) and the reflector should be kept in the open air and in the shade.

3.10 Proceed with the measurement of the 28 lines as quickly as possible.

3.11 Attenuator, Aperture Setting (if applicable): If possible, measure all distances with the same attenuator/aperture setting. If not possible, make full sets of measurements with and without attenuator (e.g.) for distances where both techniques give proper results.

3.12 Number of Prisms: Ideally, use only one prism. It does not matter if the instrument cannot measure a couple or so of the longest lines. (Some but not all analysis softwares can handle such cases. See also comments in Sect. 2.)
If a larger number of the 28 distances cannot be measured with a single prism and a triple prism is available, measure as many of the 28 distances with a single prism and as many as possible with a triple prism, observing the appropriate minimum distance for the triple prism reflector (EDM beam must cover all 3 prisms at all distances: Consult beam divergence.)
Do not use more than three prisms, even if certain distances cannot be measured.

3.13 Book all distance measurements obtained in accordance with Section 3.6, even if they are obviously wrong.

3.14 Temperatures to be rounded to nearest °C, pressures to be measured to nearest hPa (mb).

3.15 The prevailing weather conditions are most important for the assessment of precision and range obtained. Book at the beginning and wherever conditions change: wind (velocity, azimuth), cloud cover, sun, shimmer, rain (intensity).

3.16 Book all data (make, type, S/N) of instruments (electronic tacheometer (or EDM instrument and theodolite, if applicable), thermometers, psychrometers, temperature-humidity probes, barometers, reflector(s)).

3.17 Note the battery voltage every half hour or so and indicate battery failures and changes of batteries.

3.18 Any anticipated deviation from the above measurement procedures should be discussed prior to the field day, because data are used for research purposes. It is important for pillar movement monitoring purposes that all pillars are occupied or measured to. In special cases, extreme long lines and extreme short lines may be omitted for short and long range distance meters, respectively.

4. MEASUREMENT PROCEDURES ON CYCLIC ERROR TESTLINE

NOTE: Although pulse distance meters are unlikely to exhibit short periodic (cyclic) errors, it is suggested to verify their performance over a 10 metre interval as discussed below.

4.1 Since May 1981, a cyclic error test beam of about 12 m length is available at Regent Park; it is located between Pillars 7 and 8. Because the eight-pillar baseline is of the AARAU DESIGN (**all sections are multiples of 10 m**), short periodic errors ('cyclic errors') remain hidden in all measurements. A special cyclic error test is required to determine any short periodic errors and any corrections to the additive constant determined on the eight-pillar baseline.

ALL USERS OF THE 8 PILLAR BASELINE ARE REQUIRED TO DETERMINE THE CYCLIC ERROR OF ANY INSTRUMENT OVER THE APPROPRIATE UNIT LENGTH AT LEAST ONCE AND OVER ONE DISTANCE RANGE immediately after completion of the baseline test and without turning the instrument off in between. (See paragraph 4.18 for instruments with unit lengths other than 10 m!)

Failure to determine cyclic errors leads to erroneous additive constants.

It is suggested that short range distance meters are set up on Pillar 8 for the cyclic error test and long range distance meters on Pillar 6. Cyclic errors are then determined in the intervals 70-80 metres and 250-260 metres for short and long range instruments, respectively.

Users of the Regents Park facility are encouraged to test cyclic errors at more than one distance. The longest and shortest range over which short periodic errors can be tested is 900 to 910 m (from Pillar 1) and 20-30 m (from Pillar 7), respectively.

4.2 Best measurements are obtained with the complete cyclic error test facility being shaded or, alternatively, on an overcast day. Shading on sunny days can be achieved with a large number of umbrellas.

4.3 If measuring from Pillar 8, attach tape clamp at **western** end (closer to Pillar 8) on cyclic error test beam and fix steel tape. In all other cases, clamp tape at **eastern** end (closer to Pillar 7).

4.4 If measuring from Pillar 8, attach pulley assembly to **eastern** end of beam, position tape over it and load tape with 5 kg weight, using roller-grip and hook for the purpose. In all other cases, attach pulley assembly to **western** end. Secure roller grip to tape with string.

4.5 Set up reflector (on the WILD GDF-6 tribrach supplied) at the 1.0 m mark of the tape. The telescope of the optical plummet should be positioned over the tape, on the back face side of the reflector. The leading edge of the tribrach on the front side of the reflector (reflector pointed to distance meter) should be aligned **with great care** with the tape mark as accurately as possible (±0.2 mm). The reflector is then levelled, using the spot bubble of the tribrach.

4.6 Point EDM instrument to reflector, execute two measurements, re-point and execute another two measurements.

4.7 Measure temperature and pressure. Note: If cyclic errors are tested from pillars other than No.7 and No.8, temperatures should be measured at both terminals (and mean taken).

4.8 A booking form for the cyclic error test is supplied.

4.9 Check that no reflecting surfaces (such as car windows and prisms on other pillars) are positioned beyond the reflector and within the EDM beam. Any unwanted reflections **cause** cyclic errors.

4.10 When testing a distance meter of unit length U = 10.000 m, move reflector to tape marks 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, and then to 10.5, 9.5, 8.5, 7.5, 5.5, 4.5, 3.5, 2.5, 1.5 m, each time repeating paragraphs 4.4, 4.5, 4.6, and 4.8.

When testing distance meters with unit lengths U other than 10 metres exactly, the reflector should be moved over a full unit length U in steps of U/20 exactly. See also Paragraph (4.18).

4.11 Record signal strength and battery voltage during the first and the last of the 20 observations.

4.12 The height of instruments and reflectors may be taken from Section 3.5. Consider however that the reflector is in the WILD GDF-6 (and not the WILD GDF-21K) tribrach during cyclic error tests.

4.13 The temperature of the steel tape on top of the cyclic error test beam should be evaluated with a chaining thermometer before the first and after the last EDM observation on this test line.

4.14 A cyclic error test should be completed speedily and without interruptions.

4.15 Care should be exercised when moving the reflector from one tape position to another in order not to disturb the steel tape.

4.16 For better resolution of higher order short periodic errors, the step interval may be reduced to 0.25 m (if U = 10.000 m).

4.17 Cyclic errors should be determined to single prism reflectors using only one aperture/attenuator setting for all of the 20 observations.

Should you determine the cyclic error over a distance at which you may or may not use an attenuator (according to the manufacturer's handbook), a second full test on the other aperture/attenuator setting may be of interest.

4.18 The cyclic error facility at Regents Park is suitable for testing instruments with unit lengths of about 10 m or smaller. 20 m unit length instruments may be tested by combining measurements from Pillars 7 and 8 (viz. 20-30 m, 70-80 m). However, the distance meters with unit lengths significantly longer than 10 m are best tested on a separate test facility established by the user. Separate test facilities are definitely required for distance meters of unit lengths greater than 20 m.

5. DATA TO BE SUBMITTED

Please **SEND** or **FAX** to:

Dr. J. M. RÜEGER
School of Geomatic Engineering
University of New South Wales
SYDNEY NSW 2052

Phone: (02) 9385 4173
Fax: (02) 9313 7493

within one week of the baseline measurements,

OR DELIVER to Survey Store, UNSW (together with baseline key, etc.) on the day of the measurement or the day after the following items:

5.1 One page 'Summary of Measurement' for every instrument tested. A blank copy is attached.

5.2 One page 'Checklist'. A blank copy is attached.

5.3 One Table 'Summary of Measurement' with the abstract of the baseline observations. A blank copy is attached. Make sure that **all** data are supplied and that the standard deviations of single observations are calculated. Compute the column 'corrected distance' by applying the first velocity correction to the 'mean measured slope distance'. Refer to paragraph 3.5 for details on 'heights of instruments').

5.4 One page 'Cyclic Error Test' for each instrument tested. A blank copy is attached. Reduce for first velocity correction and slope, if necessary, and complete form, including plot.

5.5 Photocopy of all original field notes (unless other arrangements have been agreed on).

6. DETERMINATION OF SHORT PERIODIC (CYCLIC) ERROR CORRECTION

The plot on the field sheet for cyclic error measurement and reduction (as supplied) provides already a good indication of the presence of a cyclic error or otherwise. Should the field temperature of the steel tape have been greatly different from its standard temperature (assumed 20°C), then the tape increment of D = 0.50000 m (or as applicable) may be amended accordingly for the computation of the 'subtract' column in the field form (provided).

The elevation of the cyclic error test beam (in same datum as baseline pillars) is as follows:

Elevation of cyclic error rail = 22.202 m

This elevation is required for the slope correction of cyclic error test data.

The cyclic error may be computed, following the procedure given in the book by J. M. Rüeger, "Electronic Distance Measurement" (Springer-Verlag, Berlin-Heidelberg-New York, 1990 and 1996). (A PC program is available at the School of Geomatic Engineering, UNSW, and may be used by users of the baseline and cyclic error test facility).

DEPENDING ON THE MAGNITUDE AND PHASE OF THE CYCLIC ERROR(S), THE ADDITIVE CONSTANT AS DETERMINED ON THE BASELINE **MUST** BE CORRECTED. The safest way to do this is to correct the measured distances for the short periodic (cyclic) error correction prior to the computation of the additive constant.

7. DETERMINATION OF THE ADDITIVE CONSTANT

Before the measurements can be adjusted, they must be corrected for the atmospheric conditions (1st velocity correction), for the offset of telescope mounted EDM instruments (if applicable) and for the short periodic (cyclic) errors (see Section 6) and reduced to horizontal distances; the necessary pillar elevations (top of KERN centring plate) are listed below.

PILLAR	ELEVATION (LOCAL DATUM) (JUNE, 1990)	APPROX. CO-ORDINATES AT ELEVATION OF PILLAR 1
1	34.301 m	0.0 m
2	31.283 m	140.0 m
3	30.192 m	200.0 m
4	28.504 m	310.0 m
5	26.329 m	460.0 m
6	23.958 m	650.0 m
7	22.253 m	880.0 m
8	22.000 m	980.0 m

Since 1996, the UNSW EDM Research Baseline in Regents Park is measured by the Standards Officer of the NSW Surveyor General's Department. The measurement reports of 1996 and 1997 are attached in the Appendix. The next verification is planned for 1999. Please contact the "Survey Services" of the "Land Information Centre" for the current values of the baseline distances. The baseline distances published by LIC are traceable to the National Standard of Length.

Users of the Regents Park Baseline are referred to the book by J. M. Rüeger, "Electronic Distance Measurement" (Springer-Verlag, Berlin-Heidelberg-New York, 1990 and 1996), for the methods to be used in analysing baseline measurements. A pocket calculator is all that is required, as long as all combinations have been measured. Computer programs for the analysis of data are installed at the University of New South Wales and may be used by users of the baseline.

8. USE OF BASELINE DATA

The School of Geomatic Engineering reserves the right of using data supplied by users of the baseline for research purposes. In the case of publications, the source of data will be acknowledged.

Dr. J. M. RÜEGER

November 1998

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GMAT8711 PROFESSIONAL PRACTICE

PRACTICAL EXAMINATION

Appendix F:

SAMPLE FIXIT INPUT FOR EDM CALIBRATION

Note: Sample only, measurements are erroneous!

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TITLE      REGENTS PARK  WILD DI 5S (56428) & T1000 (341499) 3 AUG 92
COMMENT    Daniel Kennedy of Carpenter Dumbrell & Co
COMMENT    Eastings: Survey Services Sydney, LIC, 17 Sep 97 (at RL 34.30m)
COMMENT    Alignment of 1989
COMMENT    Levelling from 1990
FREE NET
DIFFERENCE
ITERATIONS     3
COORDINATE     1 ENH PILLAR 1          0.0000       1000.0000       34.3007
COORDINATE     2  NH PILLAR 2        140.0008        999.9946       31.2832
COORDINATE     3  NH PILLAR 3        200.0001        999.9982       30.1922
COORDINATE     4  NH PILLAR 4        310.0052       1000.0047       28.5044
COORDINATE     5  NH PILLAR 5        459.9966       1000.0000       26.3293
COORDINATE     6  NH PILLAR 6        650.0020        999.9952       23.9575
COORDINATE     7  NH PILLAR 7        879.9968       1000.0018       22.2532
COORDINATE     8 ENH PILLAR 8        980.0043       1000.0000       22.0000
ADDITIVE C     2    0.900     0.60   Add Const of WILD DI 5S on T1000
SCALE FACT     1                     Scale Correction of WILD DI 5S
RAW DISTAN     2    1    1  140.04000              0.258     0.258         2
RAW DISTAN     3    1    1  200.05100              0.258     0.258         2
RAW DISTAN     3    2    1  060.01400              0.258     0.258         2
RAW DISTAN     4    2    1  170.04100              0.258     0.258         2
RAW DISTAN     4    1    1  310.08000              0.258     0.258         2
RAW DISTAN     4    3    1  110.02900              0.258     0.258         2
RAW DISTAN     5    3    1  260.04100              0.258     0.258         2
RAW DISTAN     5    4    1  150.01400              0.258     0.258         2
RAW DISTAN     5    2    1  320.05700              0.258     0.258         2
RAW DISTAN     5    1    1  460.09300              0.258     0.258         2
RAW DISTAN     6    1    1  650.12700              0.258     0.258         2
RAW DISTAN     6    2    1  510.08900              0.258     0.258         2
RAW DISTAN     6    3    1  450.07600              0.258     0.258         2
RAW DISTAN     6    4    1  340.04200              0.258     0.258         2
RAW DISTAN     6    5    1  190.03300              0.258     0.258         2
RAW DISTAN     7    5    1  420.04600              0.258     0.258         2
RAW DISTAN     7    6    1  230.01300              0.258     0.258         2
RAW DISTAN     7    4    1  570.06100              0.258     0.258         2
RAW DISTAN     7    3    1  680.08900              0.258     0.258         2
RAW DISTAN     7    2    1  740.10000              0.258     0.258         2
RAW DISTAN     7    1    1  880.13300              0.258     0.258         2
RAW DISTAN     8    1    1  980.13700              0.258     0.258         2
RAW DISTAN     8    2    1  840.10600              0.258     0.258         2
RAW DISTAN     8    3    1  780.09600              0.258     0.258         2
RAW DISTAN     8    4    1  670.07100              0.258     0.258         2
RAW DISTAN     8    5    1  520.05500              0.258     0.258         2
RAW DISTAN     8    6    1  330.02600              0.258     0.258         2
RAW DISTAN     8    7    1  100.01400              0.258     0.258         2
```

ELECTRONIC DISTANCE MEASUREMENT

locality ________	edm instr. ______ No ______	theodolite ______ No ______	Barometer Type ______ No ______
date ________	int add const ________	index corr. ________	const. ________
observer ________	zero error ________	refl. const. ________	Thermometer ______ No ______
booker ________	scale factor ________	envir. dial ________	const. ________

Station	Target	Distance Measurements														Vertical angles			
		Instrument						Reflector								$i_v - i_D$	$t_v - t_D$		
		Slope dist																	
		1st	2nd	i_{D_m}	p_{mb}	t°C	Remarks: Time, s.d., . .	t_{D_m}	p_{mb}	t°C	Baro. No.	Th. No	Refl. Type	num of Refl.	obs	FL	FR	sum	vertic. angle

CYCLIC ERROR TEST Date: _____ Observer: _____ Booker: _____ Steel Tape Used: Make: _____ No.: _____

UNSW EDM RESEARCH Instrument: Make: _____ Type: _____ S/N: _____ Weather: _____

BASELINE, REGENTS PARK Reflector: Make: _____ Type: _____ S/N: _____ Attenuator: YES / NO Time: From: _____ To: _____

i	Tape Mark (m)	Measurements (m) 1st	2nd	3rd	4th	Mean Measmt. (m)	St. Dev. Single Obs. (mm)	Temperature (°C)	Pressure (mb)	1st Vel. Corr. (K') (m)	Slope Corr. (K_2) (m)	Reduced Meas.→S_i (m)	Subtract i*D (m)	$S_i^* = S_i - iD$ (m)	Cyclic Err. $S_m^* - S_i^*$ (mm)	PLOT ($S_m^* - S_i^*$) VS i
0																-8 -6 -4 -2 +2 +4 +6 +8
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																-8 -6 -4 -2 +2 +4 +6 +8 (mm)

Height of EDM Instrument: _____ m Height of Reflector: _____ m Tape Temp: _____ °C (before)

Height of Theodolite: _____ m Steel Tape Shaded: YES / NO Tape Temp: _____ °C (after)

S^*_{mean} =

Σ = 0 CHECK

GMAT8711 PROFESSIONAL PRACTICE **APPENDIX H1**

UNSW EDM Research Baseline, Regents Park: Summary of Measurements

Date of Measurement: _____

EDM Instrument: Make: _____ Type: _____ S/N: _____

mounted on: telescope of theodolite (Make: _____ Type: _____ S/N: _____)

(if applicable) Standards of theodolite (Make: _____ Type: _____ S/N: _____)

built-in additive constant: _____

Reflectors: Single: Make: _____ Type: _____ S/N: _____ Tiltable YES/NO

Triple: Make: _____ Type: _____ S/N: _____ YES/NO

Heights above bottom face of tribrach:

EDM instrument = _____ mm Theodolite = _____ mm

Single reflector = _____ mm Triple reflector = _____ mm

Barometer 1: Make: _____ Type: _____ S/N: _____ Corr. _____ mm Hg / mb

Barometer 2: Make: _____ Type: _____ S/N: _____ Corr. _____ mm Hg / mb

Thermometer(Psychrometer) 1: Make: _____ Type: _____ S/N: _____ Corr. _____ ^{o}C

Thermometer(Psychrometer) 2: Make: _____ Type: _____ S/N: _____ Corr. _____ ^{o}C

General Weather Conditions:

Wind _____ Sun _____

Cloud Cover _____ Rain _____

Shimmer _____ Fog,Mist _____

(If conditions were variable, list under COMMENTS on reverse side)

Observer: _____ Other Members of Party: _____

_____

User of Base: NAME: _____ ADDRESS: _____

PHONE: _____ ext _____ _____

GENERAL COMMENTS: _____

_____

_____

_____

CHECKLIST of Regents Park Measurements

Instrument: _____ Date: _____

Please tick appropriate boxes:

(1) Was EDM instrument continually on power from 15 min. before first measurement on baseline to last measurement on cyclic error testline?

YES ☐ NO ☐

(2) Was the distance meter continuously shaded by an umbrella?

YES ☐ NO ☐

(3) Was repointing between multiple measurements executed as in (3.8) and (4.5)?

YES ☐ NO ☐

(4) Were the sequences as specified in (3.1) and (4.9) followed?

YES ☐ NO ☐

(5) What equation do you employ for the first velocity correction?

Equation: _____

(6) Were barometers and thermometers shaded at both termials of lines?

YES ☐ NO ☐

SKETCH OF EDM INSTR./THEODOLITE/ TRIBRACH ASSEMBLY	SKETCH OF REFLECTOR/TARGET/ SWIVEL BASE/TRIBRACH ASSEMBLY

Draw an outline of the combination of equipment used (side view) including details of the type of attachment. Indicate relevant heights, in particular all axes heights (from bottom of tribrach) and height differences between EDM instrument and theodolite and between reflectors, if applicable.

JMR 83

Date: ______________ EDM Instrument: Make ______________ Type ______________ S/N ______________

Heights above tribrach: EDM instrument ______________ mm Theodolite ______________ mm

Single reflector ______________ mm Triple reflector ______________ mm

FROM	TO	TIME	MEAN MEASURED SLOPE DIST. m	STAND. DEV. S.OBS. mm	DRY TEMP* °C	OPTION WET TEMP* °C	PRESS-URE p* mb	PPM DIAL	CORRECTED DISTANCE m	HOW MANY REFL.?	ATTEN-UATOR ON/OFF	SIGNAL STRENGTH	BATTERY VOLTAGE	COMMENTS

* Corrected for zero error.

REGENTS PARK

(1) CHECK EQUIPM WHEN COLLECTING

(2) FIND OUT WHAT DIFFERENT ITEMS ARE USED FOR

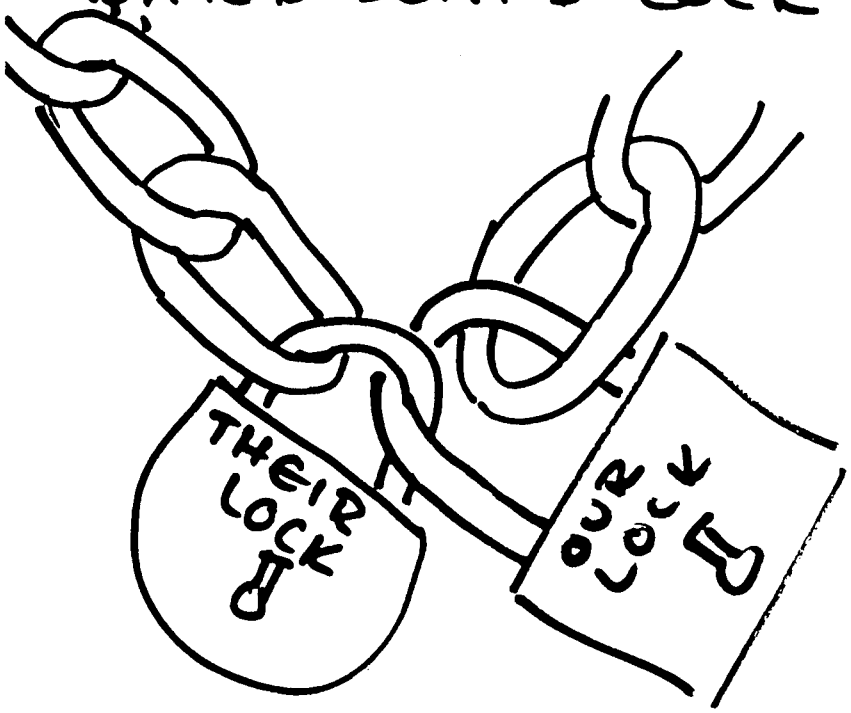
(3) LEARN TO USE WALKIE TALKIES (AND CHECK THEM)

(4) MAKE ADDITIONAL COPIES OF EDM FIELD FORM (YOU NEED ABOUT 28 × 5/6 LINES ⇒ 6 FORMS) (26 LINES PER FORM)

(5) AT LEAST 2 TEH/PRISS READ AT EACH PILLAR OCC BY REFL, BETTER EVERY HIN.

THR 9.3.95

LOCK GATE IN REGENTS PARK IN SERIES WITH WATER BOARD LOCK!



ON (16) MAR GROUPS (13) AND (14) MANAGED TO LOCK THE WATER BOARD OUT OF THEIR OWN PROPERTY !!!!!

23/3/95 JMR

The University of New South Wales

School of Geomatic Engineering

NOTICE to the USERS of the UNSW EDM RESEARCH BASELINE in REGENTS PARK

1. On 7 August 1996, the pillar plate on Pillar 3 was damaged by vandals with a steel bar whilst the baseline users were working on line 7-8. As a result we ask all users:

- to lock the pillar caps immediately once the measurements have finished,
- to unlock the pillar caps immediately before the commencement of the measurements,
- to keep an eager eye on all persons on site, in general, and idle youths, in particular.

2. Over the years, users have lost some of the locks used to lock the pillar covers to the pillars.

- Please make sure that the caps on the three big Pillars 1, 5, 8 are locked with three padlocks and the caps on the five small pillars with two padlocks.
- If you find locks missing, the surveyor/geomatic engineer in charge should personally report this to the Storeman of the School of Geomatic Engineering. In addition, please buy new locks in the hardware store in Regents Park to replace the missing and supply the keys to the School of Geomatic Engineering. (We will then exchange the non-standard with standard locks.)

3. It is suggested that you hang the small pillar caps onto the sides of the small pillars and that you lock the locks onto the pillars once the caps have been removed. (This way, no locks should go missing in car boots.)

4. If you find that the Water Board did not lock our lock in series with theirs at the gate (and you had to enter via Hector Road), please stop any passing Water Board maintenance team and ask them to rectify the problem immediately.

Thank you for your cooperation.

Dr. Jean M. Rüeger
Associate Professor
Phone: 9385 4173

30 September 1996

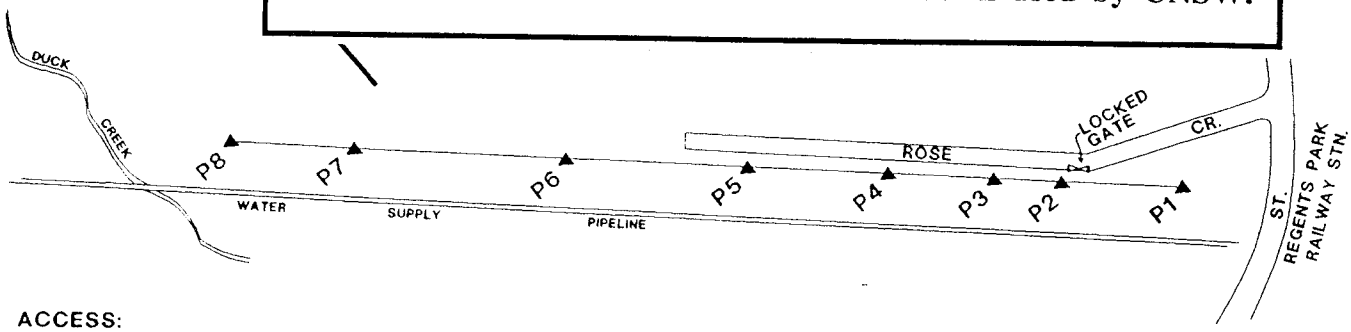
MEASUREMENT REPORT

UNIVERSITY OF NSW
REGENTS PARK BASELINE

LAND INFORMATION CENTRE

Survey Services

This page is for information only.
Use the "true distances" of Page 29.
They refer to the Datum Elevation of 34.30 m used by UNSW.



ACCESS:

All pillars are protected by locked steel caps. It is essential to make a booking for collection of the key, instructions & equipment with the storeman of the School of Geomatic Engineering, UNSW. ph (store) 93854195 or (office) 93854182.

All professionals prepared to follow the more stringent UNSW observation and reporting procedures are welcome to use the baseline.

DISTANCES AT DATUM 22.000 APPROX. A.H.D.

From	To	Distance	Mark	R.L. / A.H.D.
Pillar 1	Pillar 2	140.001	Pillar 1	34.301
Pillar 1	Pillar 3	200.000	Pillar 2	31.283
Pillar 1	Pillar 4	310.004	Pillar 3	30.192
Pillar 1	Pillar 5	459.996	Pillar 4	28.504
Pillar 1	Pillar 6	650.001	Pillar 5	26.329
Pillar 1	Pillar 7	879.995	Pillar 6	23.957
Pillar 1	Pillar 8	980.002	Pillar 7	22.253
			Pillar 8	22.000

Distances by the Surveyor General Of New South Wales, in accordance with the measurement of a reference standard of length as prescribed by the National Standards Commission.

Instrument used : Com-Rad Geomensor Serial No. 003

Uncertainty : +/- (2mm + 10p.p.m) at 95% confidence level

R. K. LOCK
A/Senior Surveyor
Standards Officer
for Surveyor General of NSW

DATE : 17 September 1997

14th Floor 175 Liverpool Street Sydney NSW 2000
Phone 02 92674988 Fax 02 92674942

UNSW EDM Research Baseline in Regents Park – 21 Years Old

Recently, it was 21 years since the first calibrations of electronic distance meters were carried out on the UNSW EDM Research Baseline in Regents Park. It seems fitting to give some information on the development of this facility over time and its present state. The EDM calibration baseline is 980 m long and consists of eight concrete pillars spaced at multiples of 10 m. Apart of the CSIRO Baseline in Lindfield, it is arguably the most sophisticated EDM calibration baseline in New South Wales. I carried out the reconnaissance for a baseline site in the Sydney Metropolitan Area in 1976. Dr. A. J. (Tony) Robinson obtained the licence for the baseline site from the then Metropolitan Water Sewerage & Drainage Board and arranged the construction of the eight pillars in 1977, with financial assistance by the then Sydney City Council and UNSW. Three concrete pillars were drilled in situ (outer diameter: 700 mm) and are 10 m deep. Five of the eight concrete pillars are standard NSW trigonometric station pillars and were donated by the then Central Mapping Authority and the Lands Department. The pillars carry KERN centring plates. Initially, non-Kern equipment was mounted with adaptor plates. Today, special Leica (two-foot-screw) tribrachs GDF-21K are being used for the purpose. A cyclic error test rail of 11.5 m length at one end was added in about 1983 to permit the calibration of short periodic errors on site. It features a pulley and clamp for the attachment of a 30 m steel tape.

My first baseline measurements (with one Geodimeter Model 6A and four Hewlett Packard distance meters) date back to January 1978. A first reference measurement was carried out with a KERN Mekometer ME3000 in June 1978 by the Hydro-Electric Commission of Tasmania. Since then, the baseline has been used by many students, (mainly government) surveyors and a few EDM instrument suppliers. Since 1995, all UNSW Geomatic Engineering students calibrate "their" EDM instruments for the Queens Park Exam on the Regents Park facility. With Nikon DTM-300 electronic tacheometers, the students achieve, on average, a precision of $\pm(0.7 \text{ mm} + 0.4 \text{ ppm})$ for a mean of 8 observations and determine the additive constant and the scale correction to ± 0.3 mm and ± 0.85 ppm, respectively. (Both values do not include the uncertainty of the baseline calibration by LIC.) The short periodic errors are usually at the 0.5 mm level or below and do not exceed 1.1 mm in any of the nine instruments of that type owned by UNSW. Such results give confidence in the use of an EDM instrument.

The baseline experienced some vandalism over the years. Many padlocks were lost due to lack of attention of users or the Water Board (lock in gate). In 1983, the cover and the centring plate of Pillar 8 were smashed. Following this incident, I designed stronger welded pillar covers. (The manufacture of the dome of the large covers seems to have caused some headaches in the UNSW workshop building them.) The large pillars got their new covers in 1984, the five smaller pillars in 1988. These new covers have withstood the test of time and vandals since 1984 and 1988. The centring plate on Pillar 8 was replaced in 1984. In 1990, the top beam of the cyclic error rail was stolen by vandals and had to be replaced. (The new profile is now welded on.) The centring plate on Pillar 3 was damaged whilst the baseline was used in 1996. This centring plate was later replaced in October 1998.

The UNSW EDM Research Baseline in Regents Park may be used by any surveyor free of charge as long as the observation and reporting requirements, set by UNSW for research purposes, are met. (Written instructions are available.) The baseline must be booked with the Survey Fieldhand and Storeman of the School of Geomatic Engineering (Mr. Alan Edmunds, phone 9385-4195). Typically, the key, the UNSW Fieldwork Safety Guidelines and the ancillary equipment are picked up on the day before and returned on the day after the field work on the baseline. Two to four instruments can be calibrated (in parallel) in an eight hour day.

The baseline was verified by Survey Services Sydney of LIC for the first time in August 1996, making it now legally traceable to national standards. The verified lengths for this baseline (as those of all other NSW EDM calibration baselines) can be obtained from Survey Services Sydney. A second verification occurred in 1997 and a third measurement is planned for 1999. With the verification by LIC, surveyors can now fulfil their obligations under the Survey Practice Regulations, namely to verify their EDM equipment in relation to the State Primary Standard at least once each year, on the UNSW EDM Research Baseline.

Recently, the Eastern Delivery Section of Sydney Water has indicated that it wishes to review the licence granted to UNSW. I hope that this will not lead to a loss of the facility for UNSW staff and students and other surveyors using it under the conditions set by UNSW.

JEAN RÜEGER

22 January 1999

(From the March 1999 Issue of *AZIMUTH, The N.S.W. Surveyors' Monthly Magazine*)