J. Univ. Kuwait (Sci.) **16**, 1989

Gravity bases in the State of Kuwait

WARIS E. K. WARSI

Department of Geology, University of Kuwait, P.O. Box. 5969, Safat 13060, Kuwait

ABSTRACT

As part of a new programme of regional gravity measurements in the State of Kuwait, a new absolute gravity base has been established on the Khaldiya campus of the University of Kuwait. The absolute gravity value at this primary base has been determined by making a tie with the Hamburg P station using a G-type LaCoste and Romberg (LR) gravimeter. The IGSN71 gravity value at the new Kuwait base is 979,251·06 ± 0·1 mgal.

An additional set of 37 LR observations has been made at stations in Kuwait City as well as in surrounding desert areas, including a north-south line of bases. A network of 95 permanent bases with 15–20 km station spacing has been set up in the desert using a Worden gravimeter. This network includes many of the LR stations.

INTRODUCTION

A new programme of regional gravity measurements in the State of Kuwait has been undertaken by the Department of Geology, University of Kuwait. Systematic gravimeter observations commenced in late 1985, but in the absence of an absolute value gravity base in Kuwait the measurements were referred to an arbitrary datum. Warsi & Ali (1987) reported that the only absolute station (No. WA2049/ACIC 4379-1) observed at the old airport in Mansouria by the University of Wisconsin (Woollard & Rose 1963) had been completely destroyed in the wake of urban developments. Mansouria is now a residential area and it is not possible to recover the location of the old base. Thus a fresh absolute value gravity connection was needed to tie in the new measurements.

During March, 1987, a gravity tie was made between Kuwait and the Federal Republic of Germany (Warsi 1988). Measurements were carried out in a week-long Hamburg–Kuwait–Hamburg loop with assistance from the Institut für Geophysik (IFG), University of Hamburg (UH). A first-order gravity base has been established on the Khaldiya campus of the University of Kuwait along with a number of other stations in Kuwait City. Additional bases have been set up in other parts of the country. Gravity values presented in this paper are based on the International Gravity Standardisation Net 1971 (IGSN71) station at the Hamburg International Airport (Morelli *et al.* 1974). The gravity base at Hamburg International Airport is also a part of the European Calibration Line (ECL). It has been repeatedly tied to the absolute base at Hamburg–Harburg using LR gravimeters (J. Makris, personal communication).

LAYOUT OF GRAVITY TIE

Gravity measurements in Kuwait were made in a loop using the IGSN71 station at Hamburg International Airport as the starting and end points. The accepted gravity value at this base (IGB Station No. 21639 Hamburg P) is 981,378·66 mgal with a standard error of 0·015 mgal (Morelli *et al.* 1974). The gravity loop included two additional control points established earlier by the IFG and tied to the European Calibration Line. The station at Frankfurt Airport, located in the domestic terminal building was observed both towards the beginning and end of the loop. The second control station at Athens International Airport, located in the Olympic Airways Terminal, was occupied only once, before termination of the loop. Gravity observations in Kuwait extended over a period of one week, which included repeated observations in Kuwait City and establishment of bases in the desert. Measurements within Kuwait were made in loops opened and closed at the primary base on Khaldiya campus. To ensure quality of data, gravimeter readings were checked for reproducibility. Precautions were taken to make gravimeter transportation as much shock-free as possible. Daily observations at the base provided a check on possible reading jumps.

THE INSTRUMENTS

Gravity measurements were carried out with a LaCoste and Romberg (LR) G-Type geodetic gravimeter (serial number G-260). The instrument was calibrated along the ECL in September, 1986, six months prior to the tie. Accuracy of this gravimeter is better than 0·005 mgal. Throughout the measurement loop the gravimeter system was kept at a constant temperature of 52°C since the gravimeter spring must be maintained at this value to avoid instrumental drift errors due to temperature fluctuations. Simultaneous observations were made at most points with a Master Model Worden gravimeter (serial number 882) available in the Department of Geology. Worden observations provided additional control on gravity measurements.

LOCATION OF BASES

Gravity measurements were made at seven locations in Kuwait City area (Fig. 1). These sites were selected on the basis of their permanence, ground stability, remoteness from cultural noise and easy access. Multiple locations were chosen to avoid accidental loss of gravity value in the course of rapid urban development. The primary gravity point, KUGW, was selected on the Khaldiya campus of Kuwait University. This point is located at the entrance of the Department of Geology Workshop. Six additional observations included measurements made at the Kuwait Institute for Scientific Research (KISR), Kuwait Municipality (KMCP), Kuwait Foundation for the Advancement of Sciences (KFAS), Kuwait International Airport (KIAP) and two locations on the Shuwaikh campus of Kuwait University (KUTW and KUMQ). Descriptions of these bases and their schematic locations are given in the Appendix.

Thirty-one bases were observed in the desert (Fig. 2). These stations were established earlier, using the Worden gravimeter, to facilitate regional gravity surveys. In general, the desert of Kuwait is flat and featureless and so difficult for location.

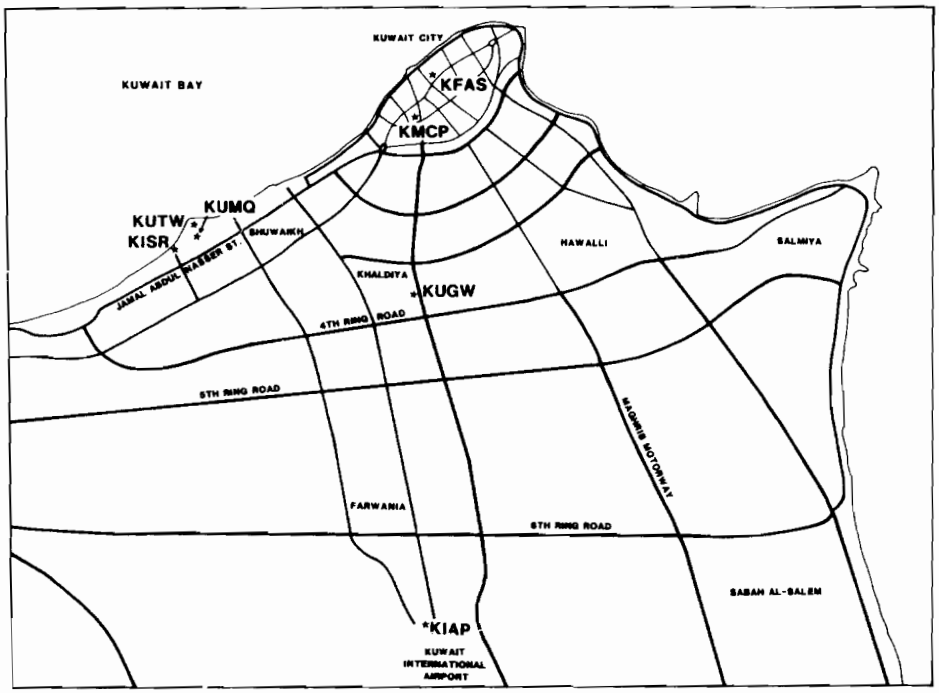


Fig. 1. Map showing locations of gravity bases in Kuwait City area.

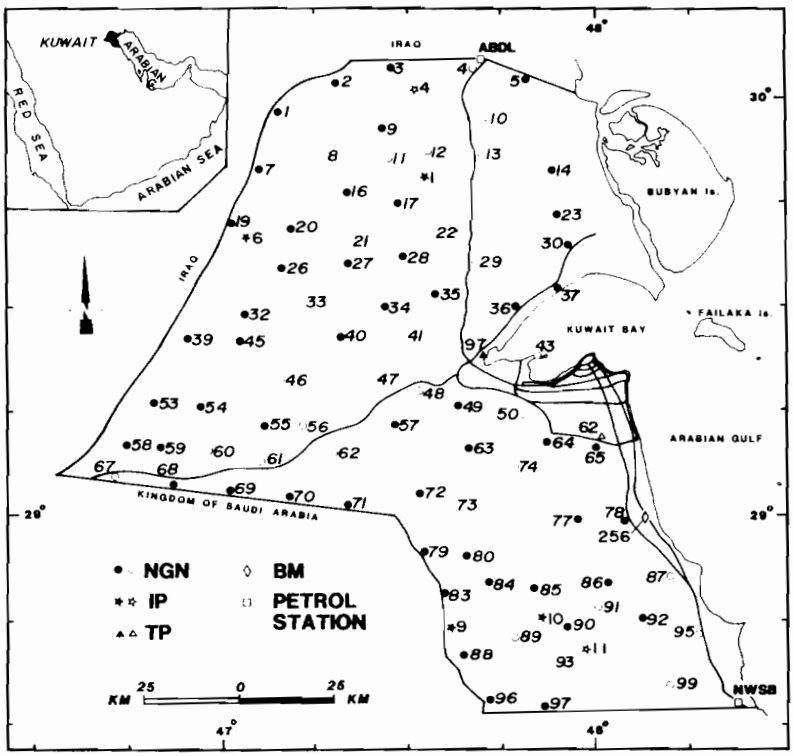


Fig. 2. Map showing distribution of permanent gravity bases in Kuwait. Filled symbols show location of Worden measurements. Open symbols indicate common LR and Worden points.

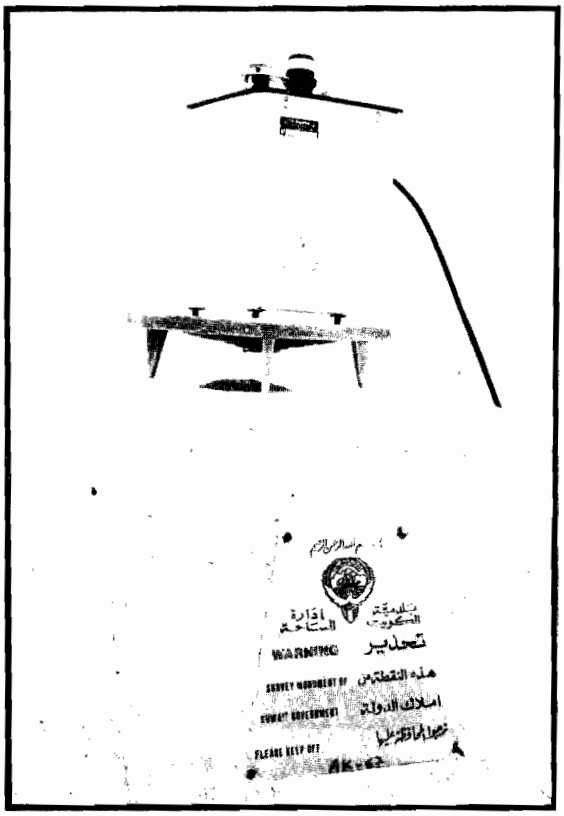


Fig. 3. A typical LR observation set-up on top of a monumented NGN point.

However, the Survey Department of the Kuwait Municipality has recently established a new National Geodetic Network (NGN), with points spaced 10–15 km apart, providing permanent locations. Most of the desert bases were observed at these NGNs. Some bases were read at densification points (TP), intermediate points (IP) and bench-marks (BM) of Kuwait Municipality. All Municipality points are monumented with brass marks and the gravimeter was read about 10 cm above the brass marks. Fig. 3 shows a typical set-up at a monumented point. The border stations near Abdali (ABDL) and Nuwaisib (NWSB) are located at petrol stations. A number of points, mostly NGNs, were observed along the Kuwait-Abdali and Kuwait-Nuwaisib highways, which define a north-south line. These bases have fast and easy access and can be used for gravimeter calibration.

DATA REDUCTION AND INSTRUMENTAL DRIFT

Gravimeter readings exhibit time variations due to irreversible drift in the instrument spring and changes in tidal effects of the moon and the sun. Field observations must be corrected for these variations. Averaged LR readings were first corrected for tides using the algorithm of Longman (1959). Gravimeter drift was then calculated from the two tide-corrected end readings at the Hamburg base. A low drift of

Table 1. LR-gravimeter drift recorded during the international gravity tie

Station	First observation			Second observation			Difference
	Date	Time GMT	LR-Reading divisions	Date	Time GMT	LR-Reading divisions	mgal
Hamburg airport	16.03.87	05:54	5144.802	23.03.87	21:50	5144.867	0.065
Frankfurt airport	16.03.87	08:59	4805.590	23.03.87	18:28	4805.766	0.129

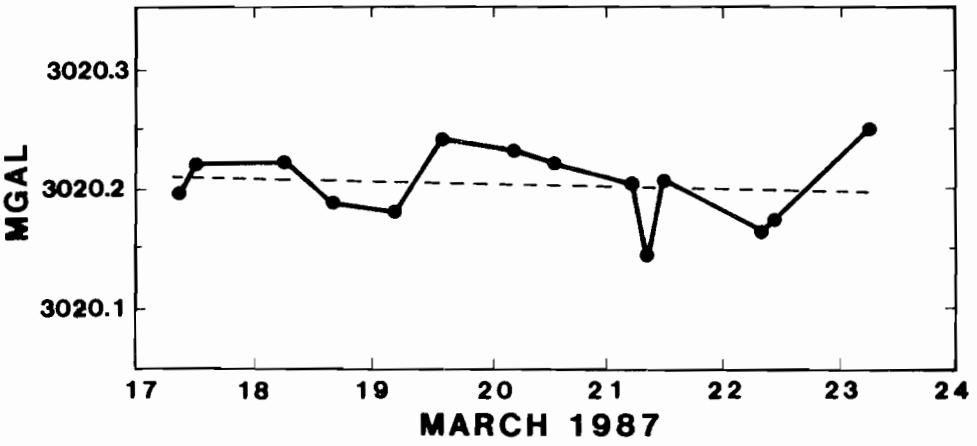


Fig. 4. Plot of tide-corrected LR readings at KUGW versus time. No significant jumps are recorded. Notice the narrow spread of the readings suggesting low drift rate. The dashed line is the best fit to the data.

0·065 mgal was recorded in the 184 h-long loop. Readings at Frankfurt airport also showed a difference of similar amplitude (Table 1). These values represent normal drift rates (~0·5 mgal/month) for G-Type LR gravimeters.

During the gravity tie loop, 14 observations were made at the primary base KUGW. Tide-corrected LR readings at KUGW exhibit a narrow spread of 0·1 mgal (Fig. 4). A straight line fit to these observations indicates a very low drift rate. These data also show that no significant jumps occurred within the gravity loop. Gravity measurements at KUGW were reduced by applying a linear drift correction based on the entire Hamburg-Hamburg loop. Gravity values for other LR observations were additionally adjusted for base reading differences recorded in the daily loops carried out from KUGW.

GRAVITY VALUES

Fourteen observations made at KUGW yield a mean difference of 2127·60 mgal between Hamburg P and KUGW with a standard deviation of 0·037 mgal. Thus, absolute gravity for KUGW in IGSN71 system is computed to be 979,251·06 mgal. Gravity values for LR stations are listed in Table 2. Values from the parallel Worden measurements are also listed in this table, and are referred to the base value

Table 2. Gravity values for stations observed during the international gravity tie

Station	LR-gravity value mgal	Worden gravity value mgal	Difference mgal
KUGW	979251.06	–	–
KUTW	979254.86	979254.85	0.01
KUMQ	979254.78	979254.77	-0.02
KISR	979254.34	979254.42	-0.08
KMOP	979256.56	–	–
KFAS	979257.56	979257.52	0.04
KIAP	979238.82	979238.69	0.13
NGN 08	979241.04	979241.09	-0.05
NGN 10	979272.82	979272.93	-0.11
NGN 11	979252.50	979252.57	-0.07
NGN 12	979260.60	979260.68	-0.08
NGN 13	979272.97	979273.00	-0.03
NGN 22	979246.73	979246.85	-0.12
NGN 29	979244.93	979244.74	0.17
NGN 43	979255.97	979256.08	-0.11
NGN 44	979199.70	979199.47	0.23
NGN 47	979200.51	979200.50	0.01
NGN 48	979202.27	979202.31	-0.04
NGN 50	979232.53	979232.83	-0.30
NGN 56	979189.09	979189.02	0.07
NGN 60	979170.13	979169.87	0.26
NGN 61	979169.65	979169.56	0.09
NGN 62	979183.72	979183.67	0.05
NGN 67	979159.80	979159.75	0.05
NGN 73	979181.15	979181.11	0.04
NGN 74	979212.58	979212.57	0.01
NGN 87	979202.18	979202.18	0.00
NGN 89	979153.01	979152.96	0.05
NGN 91	979187.03	–	–
NGN 93	979159.28	979159.22	0.06
NGN 95	979193.65	979193.79	-0.14
NGN 99	979175.31	979175.40	-0.09
IP 4	979272.03	979271.93	0.10
IP 11	979177.76	979177.53	-0.12
TP 62	979230.75	979230.87	-0.12
BM 256	979209.13	979209.02	0.11
ABDL	979289.55	979289.45	0.10
NWS8	979183.40	979183.57	-0.17

of KUGW given above. The two independent sets of measurements are in good agreement. Most stations show an average absolute difference of 0·10 mgal between the LR and Worden values. Maximum error for the LR values is estimated to be $\pm 0{\cdot}10$ mgal. Errors in Worden values could be as high as $\pm 0{\cdot}20$ mgal due to larger drift characteristics of this type of gravimeter.

WORDEN MEASUREMENTS

Since the beginning of the project, permanent bases were established on a regular basis throughout Kuwait using the Worden gravimeter. A total of 95 stations were set up to facilitate the gravity surveying. As mentioned earlier, these stations are located at Kuwait Municipality monumented points (Fig. 3). Gravity values were carried out to these bases from KUGW, which has now been tied to Hamburg P.

A critical factor in computation of Worden gravimeter data is its dial constant.

Table 3. Calibration check on Worden gravimeter No. 882

Loop	Gravity difference* mgal	Difference of Worden readings divisions†	Dial constant mgal/ division
ABDL-NWSB	106.15	1148.0	0.09247
ABDL-NGN67	129.75	1402.1	0.09254
ABDL-NGN95	95.90	1036.5	0.09252

* Based on LR-ties

† Tide and drift corrected

Although the instrument was last calibrated in 1971 by the manufacturers, the originally supplied constant (0·0925 mgal/division) is still valid. A check on Worden gravimeter calibration was made using bases established with the LaCoste and Romberg gravimeter. Straight runs made from ABDL to NWSB, NGN67 and NGN95 show LR gravity differences of the order of 100 mgal (Table 3). These measurements cover about half of the Worden dial range and provide a good check on the dial constant. Results of this calibration test given in Table 3 clearly demonstrate that the Worden gravimeter constant has not changed since its initial calibration. Another test for the Worden gravimeter constant was made from the parallel LR and Worden observations taken during the gravity tie. Fig. 5 shows a plot of RMS differences of the Worden and LR values calculated from various assumed values of the gravimeter constant. The differences are minimized for a value in the close vicinity of the dial constant given above.

Gravity values for the Worden bases are presented in Table 4. Multiple observations were made at most of these stations. Quality of these measurements is

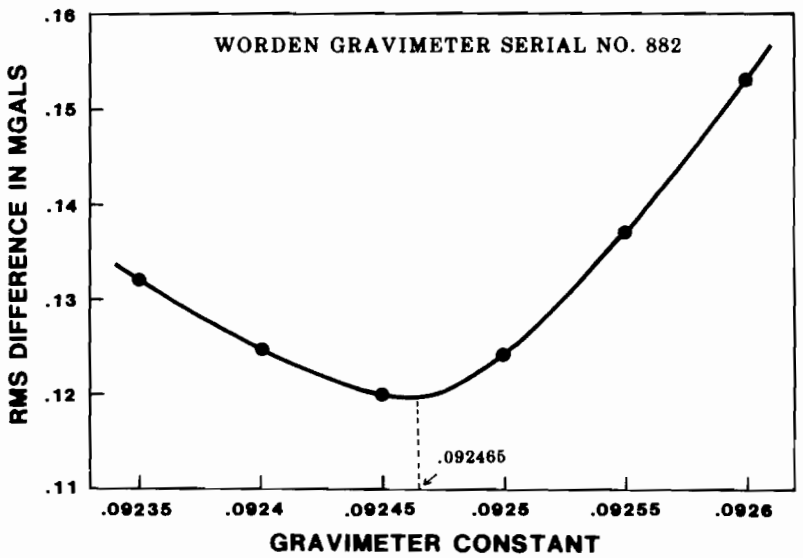


Fig. 5. Plot of RMS difference of LR and Worden gravity values versus gravimeter constant. Worden values were calculated for a set of assumed calibration constants. Minimum of the curve is observed in the close vicinity of the dial constant (0·0925) supplied by the manufacturers.

Table 4. Basic facts of gravity bases established with the Worden gravimeter

Station	Latitude degrees North	Longitude degrees East	Elevation metres	Observed gravity mgal	Times read	Standard deviation mgal	LR-Worden difference mgal
NGN 01	29.97300	47.15733	116.1	979254.71	1	–	–
NGN 02	30.04000	47.30983	90.0	979263.18	3	0.036	–
NGN 03	30.08200	47.45983	72.9	979273.62	1	–	–
NGN 04	30.06083	47.60850	48.1	979281.21	3	0.210	–
NGN 05	30.04800	47.82067	21.2	979288.75	1	–	–
NGN 07	29.83933	47.10600	126.6	979244.98	4	0.120	–
NGN 08	29.86833	47.27000	131.1	979241.18	5	0.065	–0.14
NGN 09	29.93483	47.43333	88.8	979260.15	4	0.140	–
NGN 10	29.95700	47.70583	64.0	979272.95	6	0.144	–0.13
NGN 11	29.85917	47.45217	96.2	979252.68	8	0.160	–0.16
NGN 12	29.87500	47.55667	81.0	979260.63	6	0.210	–0.03
NGN 13	29.87233	47.69333	43.9	979273.07	14	0.130	–0.16
NGN 14	29.82900	47.82550	60.3	979272.53	1	–	–
NGN 16	29.78167	47.33500	139.0	979235.87	2	0.035	–
NGN 17	29.75000	47.47500	111.1	979242.83	4	0.153	–
NGN 19	29.70900	47.02917	148.3	979233.29	1	–	–
NGN 20	29.69367	47.18633	163.7	979226.05	2	0.191	–
NGN 21	29.66533	47.33667	154.1	979227.32	5	0.114	–
NGN 22	29.68000	47.63667	111.2	979246.92	5	0.105	–0.19
NGN 25	29.55317	46.99433	213.1	979214.81	2	0.085	–
NGN 26	29.57500	47.16383	187.6	979215.87	3	0.081	–
NGN 27	29.60433	47.34000	163.8	979221.48	5	0.096	–
NGN 28	29.62333	47.48917	137.3	979230.51	6	0.151	–
NGN 29	29.61000	47.68000	109.7	979245.08	6	0.171	–0.15
NGN 30	29.65583	47.92217	94.6	979257.87	3	0.136	–
NGN 32	29.48533	47.06933	211.2	979210.63	4	0.117	–
NGN 33	29.51633	47.21267	189.8	979209.86	8	0.131	–
NGN 34	29.50333	47.44417	157.5	979217.44	6	0.184	–
NGN 35	29.53133	47.57683	119.0	979232.60	5	0.112	–
NGN 36	29.50000	47.77983	102.5	979243.20	1	–	–
NGN 37	29.55633	47.91633	13.8	979270.90	1	–	–
NGN 39	29.42583	46.99967	237.5	979196.96	4	0.065	–
NGN 40	29.43200	47.31917	195.8	979202.90	8	0.086	–
NGN 41	29.42583	47.48617	167.5	979211.40	6	0.090	–
NGN 43	29.38500	47.83917	7.1	979256.17	3	0.077	–0.20
NGN 45	29.41867	47.04517	222.5	979204.07	4	0.060	–
NGN 46	29.32500	47.15867	232.5	979199.73	7	0.132	–0.03
NGN 47	29.32883	47.40417	182.1	979200.63	9	0.119	–0.12
NGN 48	29.29917	47.53083	168.7	979202.35	8	0.106	–0.08
NGN 49	29.26300	47.63383	108.0	979214.48	1	–	–
NGN 50	29.24167	47.80617	47.9	979232.75	5	0.076	–0.22
NGN 53	29.27367	46.82167	264.0	979178.61	7	0.137	–
NGN 54	29.27050	46.97050	246.6	979183.41	3	0.117	–
NGN 55	29.21950	47.11833	239.4	979183.79	7	0.102	–
NGN 56	29.21600	47.22083	227.0	979189.14	3	0.120	–0.05
NGN 57	29.21950	47.46600	204.6	979186.97	1	–	–
NGN 58	29.17517	46.74567	280.9	979167.25	4	0.153	–
NGN 59	29.17083	46.83567	271.0	979168.37	4	0.059	–
NGN 63	29.16117	47.66733	139.2	979198.98	6	0.184	
NGN 64	29.17683	47.87633	60.1	979229.37	1	–	–
NGN 65	29.16667	48.00833	66.5	979230.13	1	–	–
NGN 67	29.09167	46.71083	289.1	979159.80	3	0.070	0.00
NGN 68	29.08167	46.85500	278.1	979159.41	2	0.141	–
NGN 69	29.06383	47.02067	264.4	979158.32	1	–	–
NGN 70	29.04533	47.18183	246.1	979164.64	1	–	–
NGN 71	29.01950	47.33717	230.0	979179.91	1	–	–
NGN 72	29.05817	47.53217	186.9	979177.15	4	0.100	–

Table 4 (*continued*)

Station	Latitude degrees North	Longitude degrees East	Elevation metres	Observed gravity mgal	Times read	Standard deviation mgal	LR-Worden difference mgal
NGN 73	29.02817	47.62567	167.1	979181.17	5	0.201	-0.02
NGN 74	29.11667	47.79000	84.7	979212.64	12	0.063	-0.06
NGN 77	28.99083	47.95300	102.6	979207.05	1	–	–
NGN 78	28.99017	48.07517	107.0	979204.33	1	–	–
NGN 79	28.91700	47.54633	179.5	979169.91	1	–	–
NGN 80	28.90417	47.66150	185.3	979169.89	2	0.127	–
NGN 83	28.81450	47.59500	177.9	979162.93	1	–	–
NGN 84	28.84250	47.71583	189.1	979164.18	2	0.042	–
NGN 85	28.82383	47.83867	138.3	979178.54	2	0.325	–
NGN 86	28.85667	48.10550	78.7	979196.92	1	–	–
NGN 87	28.85417	48.20333	30.0	979202.18	1	–	0.00
NGN 88	28.66550	47.65467	208.1	979143.87	2	0.120	–
NGN 89	28.71050	47.78333	202.1	979152.99	6	0.156	-0.02
NGN 90	28.73767	47.92617	131.9	979179.47	1	–	–
NGN 91	28.78017	48.01417	113.4	979187.10	1	–	-0.07
NGN 92	28.75500	48.12967	62.6	979190.92	2	0.057	–
NGN 93	28.64783	47.88217	181.7	979159.31	8	0.099	-0.03
NGN 95	28.72417	48.28533	15.9	979193.79	6	0.084	-0.14
NGN 96	28.55900	47.72067	204.8	979138.75	1	–	–
NGN 97	28.53917	47.87083	203.5	979145.82	1	–	–
NGN 99	28.59317	48.20333	71.1	979175.34	5	0.088	-0.03
IP 01	29.81250	47.55000	91.7	979254.07	3	0.084	–
IP 04	30.02717	47.52367	73.3	979272.11	3	0.153	-0.08
IP 06	29.67333	47.07083	178.1	979224.91	2	0.049	–
IP 09	28.73500	47.62450	204.1	979149.70	2	0.014	–
IP 10	28.76317	47.86417	154.2	979170.88	1	–	–
IP 11	28.68250	47.98183	132.5	979177.76	10	0.095	0.00
TP 19	28.97817	48.13383	46.2	979211.91	1	–	–
TP 44	29.35667	47.67833	9.3	979248.43	1	–	–
TP 62	29.20250	48.00217	67.3	979230.97	2	0.141	–
TP 73	29.16667	48.04583	103.0	979221.12	1	–	–
TP 97	29.39533	47.68933	19.0	979249.58	5	0.074	–
BM 004	29.36500	47.95867	4.1	979258.93	2	0.000	–
BM 182	29.34000	47.94750	6.0	979254.81	2	0.191	–
BM 256	28.95950	48.11850	58.9	979209.03	3	0.026	0.10
ABDL	30.08083	47.52383	73.3	979289.45	1	–	0.10
NWSB	28.54666	48.11850	7.4	979183.49	2	0.113	-0.09

indicated by the standard deviations, which are generally smaller than 0·15 mgal. A comparison of LR and Worden values at common points shows a close agreement, with average absolute difference of less than 0·1 mgal. Although differences between the pairs of values are small, Worden values are mostly higher than LR values (Table 4). This bias could result from the use of a slightly larger dial constant for the Worden gravimeter. However, well constrained observations (Table 2, Fig. 4) show that the dial constant used is appropriate. The higher values of Worden observations possibly result from a non-linear drift due to rough rides in the desert. In spite of the best care it was not always possible to avoid jumps during driving.

CONCLUDING REMARKS

A comprehensive network of gravity bases has been established in the State of Kuwait. The new gravity tie has allowed determination of absolute gravity values for this net in the IGSN71 system. Regular regional gravity measurements are now underway which are referred to these bases.

ACKNOWLEDGEMENTS

My sincere thanks are due to Professor J. Makris for lending the LR-gravimeter and to Mr J. Thomas for assisting in the gravity tie. Valuable field and laboratory assistance of Mr Mohammad Fandi is gratefully acknowledged. I am thankful to Professor D. C. Almond for a critical reading of the manuscript. A four-wheel drive field vehicle was provided by the Faculty of Science, University of Kuwait. Mr Azhar Ali Shah typed the manuscript. Financial support for this study was received from the University of Kuwait through Research Grant No. SG018.

REFERENCES

Longman, I.M. 1959. Formulas for computing the tidal acceleration due to Moon and the Sun. Journal of Geophysical Research **64**: 2351–55.

Morelli, C., Gantar, C., Honkasalo, T., McConnell, R.K., Tanner, I.G., Szabo, B., Uotilla, V. & Whalen, C.T. 1974. The International Gravity Standardisation Net 1971 (IGSN71). Special Publication 4, International Union of Geodesy and Geophysics, Paris, 116 pp.

Warsi, W.E.K. 1988. A new gravity tie for Kuwait. Bulletin d' Information, Bureau Gravimetrique International **61**: 160–5.

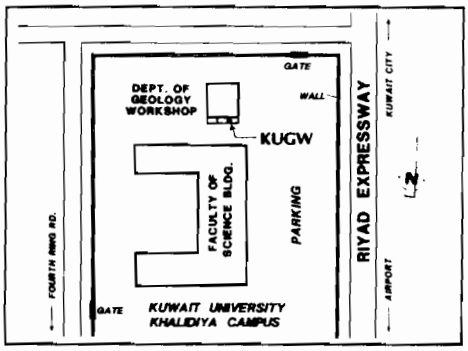
Warsi, W.E.K. & Ali, H.O. 1987. Gravity traverses in the State of Kuwait. Journal of the University of Kuwait (Science) **14**: 175–81.

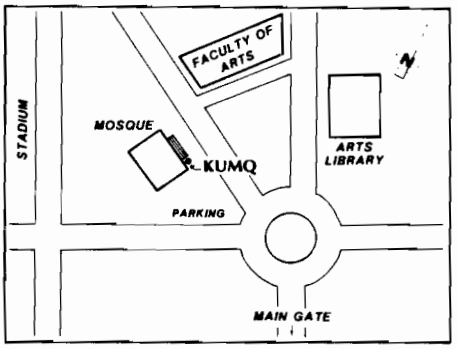
Woollard, G.P. & Rose, J.C. 1963. International gravity measurements. Special Publication, Society of Exploration Geophysicists, Tulsa, Oklahoma.

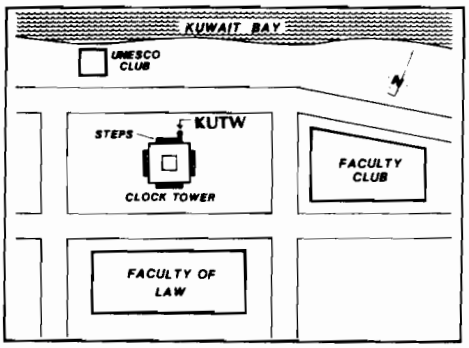
(Received 13 April 1988, revised 11 September 1988)

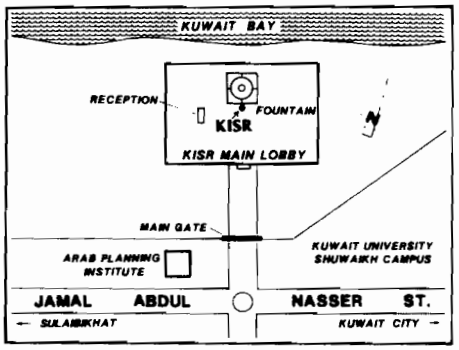
APPENDIX

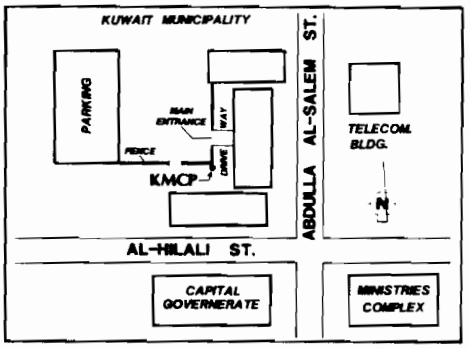
SCHEMATIC LOCATION AND DESCRIPTION OF GRAVITY BASES



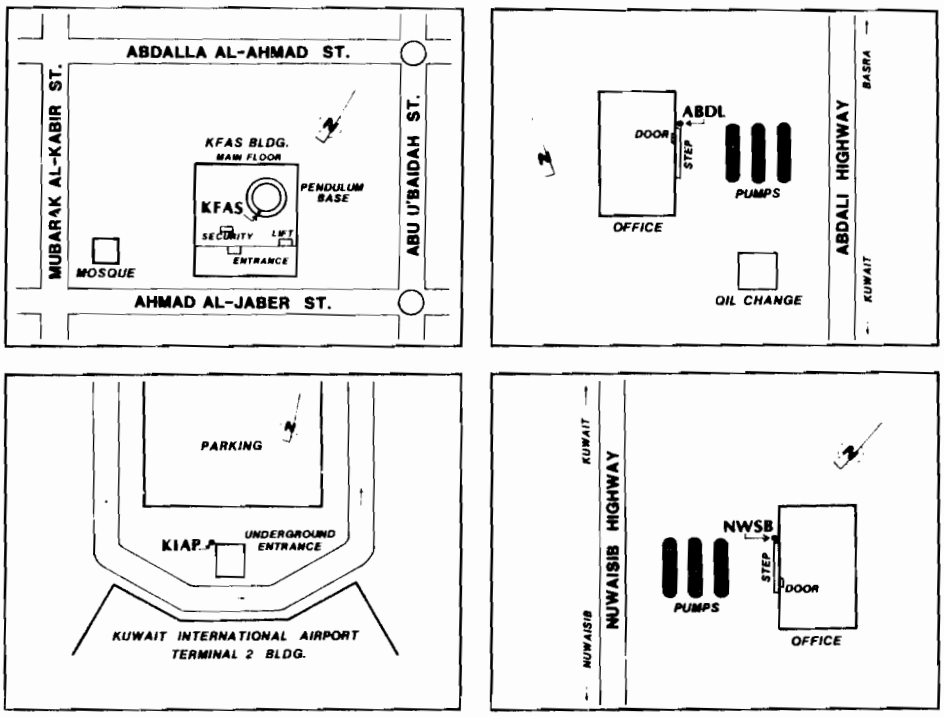


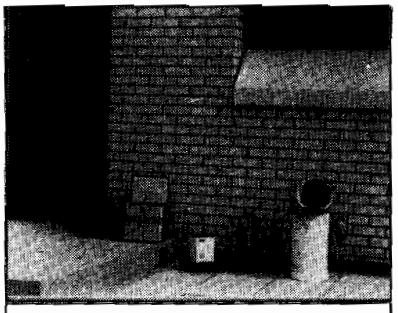




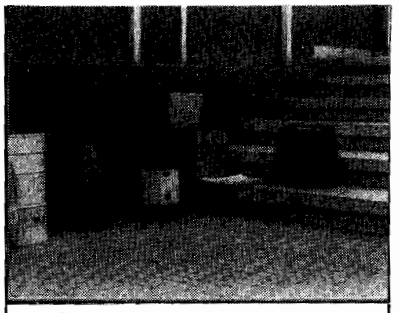


SCHEMATIC LOCATION AND DESCRIPTION OF GRAVITY BASES (cont.)

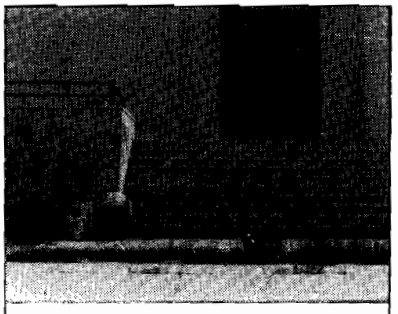




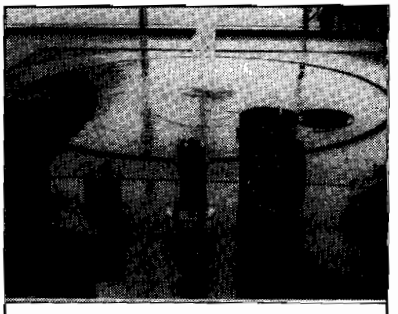
KUGW : Located at entrance of the Department of Geology workshop on Khaldiya campus of the University of Kuwait. Observation was made outside,to the right of the entrance below the step.



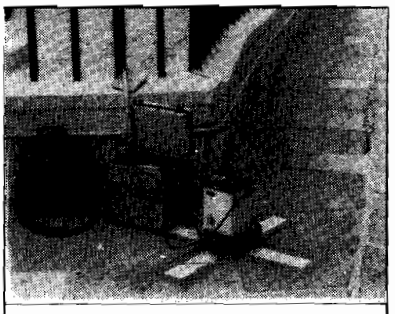
KUMQ : Located at mosque on Shuwaikh campus of the University of Kuwait. Observation was made at ground level, below steps in the corner south of the entrance.



KUTW : Located at clock tower on Shuwaikh campus of the University of Kuwait. Observation was made at ground level below steps on the north side.



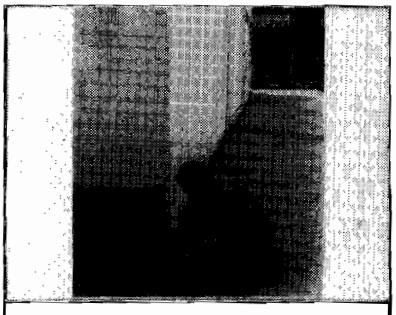
KISR : Located inside the main reception lobby of the Kuwait Institute for Scientific Research, south of water fountain.



KMCP : Located at Demo Control Point inside the fence within the main office complex of the Kuwait Municipality.

KFAS : Located in the main hall of the Kuwait Foundation for Advancement of the Sciences building. Observation was made on top of circular pendulum base at the point marked 'south'.

ABDL : Located at petrol station near Abdali border. Observation was made below the step outside the office on north of the door.



KIAP : Located at NW corner of underground entrance to the Kuwait International Airport Terminal 2. Observation was made at ground level.

NWSB : Located at petrol station near Nuwaisib border. Observation was made below the step outside the office on north side of the door.

قواعد الثقالة (الجاذبية الأرضية) في دولة الكويت

وارث . أ . خ . وارثي
قسم الجيولوجيا بجامعة الكويت ،
ص . ب . ٥٩٦٩ ، الصفاة ١٣٠٦٠ ، الكويت

خلاصة

ضمن برنامج جديد لقياسات الثقالة الأقليمية في دولة الكويت ، تم انشاء قاعدة جديدة للثقالة المطلقة في مبنى الجامعة بالخالدية بدولة الكويت . وحددت قيمة الثقالة لهذه القاعدة الأولية بربطها بالمحطة هامبورج P وذلك باستخدام النوع G من جهاز لاكوست ورمبورج (ل ر) لقياس الثقالة . ان قيمة الثقالة في هذه القاعدة الجديدة هي ٩٧٩٢٥١,٠٦ ± ٠١,٠ م جال وفق نظام IGSN71 .

أخذت أيضا قياسات إضافية بجهاز ل ر في ٣٧ محطة بمدينة الكويت وفي المناطق الصحراوية المحيطة ، شملت مجموعة من القواعد تقع على خط يمتد من شمال البلاد إلى جنوبها . وباستخدام جهاز وردن لقياس الثقالة تم انشاء شبكة مكونة من ٩٧ قاعدة ثابتة في صحراء الكويت ، تبعد كل قاعدة عن الأخرى ١٥-٢٠ كيلو مترا ، وتضم هذه الشبكة الكثير من محطات ل ر .