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PRECISION LAND LEVELING DATA ANALYSIS PROGRAM FOR HP 9825 DESKTOP CALCULATOR

Description And User Instructions

BY

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PRECISION LAND LEVELING DATA ANALYSIS PROGRAM FOR HP9825 DESKTOP CALCULATOR

MANUAL NO.5

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ABSTRACT

A computer program for use on the HP9825 desktop computer and HP2631B printer to facilitate analyses of precision land leveling data is described. The program is limited to the case when precision leveling to dead level is planned. The program was developed following the procedures given in EWUP Manual No. 8: "Thirty Steps to Precision Land Leveling in Egypt." The present program is useful in technical evaluation of land leveling data, for evaluation of various leveling designs for a given field, for training in precision land leveling data analyses and for providing high quality, hard copy output of leveling data and analyses.

Step-by-step user instructions are given. A program listing and example are also included.

12 pages 1 Table 2 Figures

مستخلص

استخدم الحاسب الالكترونى رقم HP 9825 فى عمل البرنامج والجهاز رقم HP 2631B فى كتابته وذلك لتسهيل تحليل البيانات الدقيقه والخاصه بتسوية الاراضى هوالبرنامج الذى تم وصفه خصص للاستخدام فى التسويه الافقيه الدقيقه وقد صمم هذا البرنامج طبقا للطريقه المذكوره فى الدليل رقم ٨ والخاص بمشروع الـ EWUP تحت موضوع "الثلاثون خطوه لعملية التسويه الارضيه بمصر" وهذا البرنامج يستخدم فى اغراض تقييم عمليات تسوية الاراضى فى مصر للتصميمات المختلفه بالحقل وكذلك فى اغراض التدريب وتحليل البيانات الخاصه بتسوية الاراضى وطبع النتائج على ورق مقوى بكفاءه تحليليه عاليه للبيانات المتعلقه بعمليات التسويه الدقيقه للاراضى ٠

وقد تم شرح وتوضيح الخطوات العمليه لاستخدام الجهاز وموضح مثال تطبيقى لاستخدام هذا البرنامج ٠

١٢ صفحه　　١ جدول　　٢ شكل

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TABLE OF CONTENTS

	Page
Abstract (English)	i
Abstract (Arabic)	ii
Acknowledgements	iii
Preface	v
Introduction	1
Program Features	1
Program Limits and Constraints	2
Data Requirements	2
Program Output	3
Data Entry and Program Execution	3
Reference	8
Conversion Table	13
List of Project Technical Reports - EWUP	14

LIST OF TABLES

Table		
1	Definition of Program Variables and Constraints	7

LIST OF FIGURES

Figure		
1	Program Listing	9
2	Example	12

PREFACE

The author wishes to personally acknowledge the efforts of Mr. Niel Dimick (formerly USAID/Cairo), Mr. Ahmed Bayoumi (EWUP) and Mr. Shawky Boctor (USAID/Cairo) in the initiation and continued support of the precision land leveling programs of EWUP. Also, their production of EWUP Manual No. 8, upon which this manual is based, is acknowledged. The efforts of the entire Kafr El Sheikh Team with whom the author had the honor of working in carrying out precision land leveling on numerous farms in Abu Raya is also gratefully acknowledged. It was the result of those efforts that identified the need and eventual implementation of the work described herein. Finally, special thanks to Mrs. Pam Hobbs for typing the manuscript.

Introduction

This program was developed following the procedures outlined in EWUP Manual No. 8, "Thirty Steps to Precision Land Leveling in Egypt". The algorithm was developed for use on the HP9825 desktop computer. Data input is achieved through keyboard use. Data and results are programmed for output on the HP2631B printer. The program is presently designed only for the case of precision leveling to a horizontal plane or dead level.

Due to the obvious limitations on field usage of the HP9825, the use of this program to facilitate field calculations (i.e., at the site) is also limited. When time and other conditions allow, grid survey data for a field to be leveled can be input and analyzed to produce accurate maps and results. Technical calculations for land leveling data analysis are not complicated, but are time consuming. The program is suggested for use in technical data evaluation. The program is also a good tool for evaluating various precision land leveling designs for a given field. It is a good educational aid in conjunction with EWUP Manual No. 8. A high quality, hard copy output of the grid survey, cuts, fills, volumes of earthwork and cut/fill ratio is an added highlite. The program can be used in a review/approval process between supervisors and field personnel. Finally, the program and output are extremely useful in providing documentation of field work accomplished.

Program Features

Survey data are assumed to have been taken on a grid that approaches square or rectangular. The field alignment in terms of major directions, i.e., north, must be noted, as program output is with north towards the top of the page. The grid interval in each direction need not be equal (i.e. other than square grids may be used).

Survey data can be either rod readings or elevations at each grid point. These values are output with the decimal point of the numbers representing the grid point. The average elevation or rod reading is determined using the summation method. The standard deviation of the grid point values from the average is also determined. The program compares the average with each grid point value, determines if it is a cut or fill, and prints the amount of cut or fill (designated with a "C" or "F", respectively) immediately below each grid point. Grid areas of non-standard size, which usually occur at one or

two field edges and corners are accounted for in determining the average grid point elevation or rod reading (see EWUP Manual No. 8).

Earthwork volumes are calculated by the summation method. The user has the option of allowing for extra fill volume (for filling drains, ditches, etc.) as necessary. The program will iterate in a calculation loop in determining cuts and fills until a cut/fill ratio between 1.30 and 1.60 is found. Iterations are performed at 0.001 m increments, while rod readings or elevations and cut-fill values are rounded to the nearest 0.01 m. The user also has the option of balancing the cuts and fills equally, in which case the cut/fill ratio will be 1.00.

Irregular shaped fields can be processed by the program also. The user must simply "fill out" the actual grid with a 0.00 value at each grid point to make a rectangular grid. It is always assumed that at least one corner of a field approaches a right angle and that it is the starting point for laying out the grid in preparation for surveying.

Program Limits and Constraints

As indicated, the actual grid must be filled out with 0.00 at each imaginary grid point to construct a rectangular field. The dimensions of the filled-out field must be specified. However, the actual field area is also specified. The starting point is specified and assumed to occur in a corner that approaches a right angle. The entire grid is limited to 26 rows by 26 columns.

Cut and fill volumes will be determined to ensure that the cut-fill ratio falls between 1.30 and 1.60. However, the user has the option of specifying a cut/fill ratio of 1.00. If "survey after planing" is specified when survey timing is input, i.e., a post-construction check survey, then the program simply determines the average elevation or rod reading and the deviations at each grid point. In this instance, the cut/fill ratio will also be 1.00.

Data Requirements

1. Field identification.
2. Survey date and timing.
3. Farmer's name.
4. The actual field area.
5. Field dimension in the East-West direction (the dimension of the field that approaches this direction most closely) (m).

6. Field dimension in the North-South direction (the dimension of the field that approaches this direction most closely) (m). Note: the longest dimensions along each of these axes should be given, i.e., for the "filled-out" rectangular field.
7. The number of rows and number of columns in the rectangular grid.
8. The grid interval (m) in each of the two directions (E-W) and (N-S).
9. The grid point values are specified as rod readings or elevations and input starting at the upper left corner with north to the top of the page. Data points are entered row by row. Values should be in (m) rounded to the nearest 0.01 m.
10. The corner point row number and column number which was the starting point for the grid setup, i.e., which represents the standard grid interval in each direction, is needed.
11. Extra fill volume required, i.e., for filling field drains, ditches, etc., must be known.

Program Output

In addition to printing all of the input data, the following results are also printed.

1. A rectangular field representing the surveyed field, with grid point values, cut or fill values and in the upper left corner of each grid the size of that grid as a percentage of the standard grid size if that grid is of non-standard size. The grid is printed in compressed mode. Due to a maximum number of spaces on the HP2631B printer in compressed mode of approximately 225, the array of rod readings or elevations is limited to 26 columns.
2. The average rod reading or elevation (m).
3. The standard deviation (cm) of the rod readings or elevations.
4. The design rod reading or elevation (m), i.e., the value used to ensure the cut/fill ratio is between 1.30 and 1.60 (if this is specified).
5. The total cut and fill volumes (m^3) and the cut volume on a unit field area basis.
6. The cut/fill ratio.

Data Entry and Program Execution

1. Load program in HP9825 memory. Turn HP2631B printer on and "on-line".

2. Press RUN, press CONTINUE after each data entry.
3. User is prompted to specify if grid point values are rod readings or elevations. (1 = rod readings, 2 = elevations).
4. Enter site descriptor or site identification number. A maximum of 25 spaces is allowed.
5. Enter survey date. Ten spaces are allowed. Suggested format is DD.MM.YR.
6. Enter survey timing. A maximum of 25 spaces is allowed. Format should be "Survey before (or after) scraping (or planing)". "Initial grid survey" is also appropriate, if this is the case. "Survey after planing" indicates a check survey and the program will automatically use a cut/fill ratio = 1.00.
7. Enter farmer's name. Up to 30 spaces allowed.
8. Enter calculation method for cuts and fills. Input 1 to have the C/F ratio adjusted or 2 for C/F ratio of 1.00.
9. Enter actual field area (feddans).
10. Enter field dimension in East-West direction (m).
11. Enter field dimension in North-South direction (m).
12. Enter grid interval in E-W direction (m).
13. Enter grid interval in N-S direction (m).
14. Enter number of rows.
15. Enter number of columns. At this point, all of the input data thus far is printed out, check to make sure it is correct. If not, start with step 2 again. If it is okay, press CONTINUE.
16. Each of the following line messages will appear in the calculator display for about 3 seconds:

    "Enter array of (rod readings or elevations) (m)."
    "North is at top of page."
    "Enter data row by row."
    "1st pt. is upper left corner."
    "Enter 0.0 for pts. outside bdy."
    "To make input grid rectangular."

At this point the calculator prompts the user to input each grid pt., R [I, J], starting at the upper left corner with north to the top of the page. Enter data points across each row and then row by row. Values should be (m) rounded to the nearest 0.01 m. If an incorrect value is input, note the location, i.e., R [I, J], where I is the column number and J is the row number. After last grid point, the calculator prompts the user to indicate if all points are correct. If yes, enter 1 and press CONTINUE (go to step 17); if no, enter 2 and press CONTINUE . The calculator will display "make corrections." Do so using the following as an example; typing as shown: 1.06 → R[2, 9], which stores the value 1.06 in the grid point at column 2, row 9. Type all corrections on same line, separated by ";", then press EXECUTE and CONTINUE.

17. Enter the row number of the corner point which is at the standard grid interval in both directions, i.e., the starting corner point for the grid layout as explained in EWUP Manual No. 8.

18. Enter the column number of the same corner point. At this point the calculator assumes control and performs the following calculations: the size of the standard grid; the size of grid areas at the end row and end column away from the starting corner point and their proportion to the standard size grid area; the average rod reading or elevation by the summation method, with each value adjusted for the area it represents; the standard deviation of the rod readings or elevations from the mean; and the initial design level which is the average rod reading rounded up to the nearest (cm) or the average elevation rounded down to the nearest (cm).

19. The calculator prompts the user to specify if extra fill volume is required (1 = yes, 2 = no).

20. If yes, enter the extra fill volume required (m^3). At this point, the calculator assumes control. The initial cuts and fills are calculated and the cut-fill ratio determined. If this value is not between 1.30 and 1.60, the design level is adjusted and the calculations repeated (when this option is specified). Otherwise, the cut/fill ratio is 1.00. If there is extra fill volume required, it is included in this process. Once the proper cut/fill ratio is obtained the results are printed:

a. The field and representative grid, with each grid pt. value and cut or fill value.

b. The average rod reading or elevation (m).

c. The design level (m).

d. The standard deviation of the grid point values from the mean (cm).

e. The total cut volume (m^3) and (m^3/feddan).

f. The total fill volume (m^3).

g. The extra fill volume specified (m^3).

h. The cut/fill ratio.

Extra printouts can be obtained by using the following procedure:

advance the paper in the printer,

type: cont 0,2

press EXECUTE (a beep and error signal will occur, ignore this).

type: cont 12,

press EXECUTE

type: cont 32

press EXECUTE

go to step 16 of the instructions

A program listing is provided in Figure 1. An example is provided in Figure 2. This is the same example given in EWUP Manual No. 8. Program variables and constants are identified and defined in Table 1. The program requires 5598 bytes of calculator memory for storage and execution. The program is presently not designed for storage of the input data on tape or disk. Thus, when a new run is initiated (by pressing "RUN"), the previous input data is lost.

Table 1. Definition of Program Variables and Constants

R[25,25]	- array of rod readings or elevations at grid points (m)
A[25,25]	- array of individual grid area's proportion to standard grid area size
C[25,25]	- array of cuts at grid points (m)
F[25,25]	- array of fills at grid points (m)
S$[25]	- string variable for site descriptor
D$[35]	- string variable for survey date
T$[25]	- string variable for survey timing
F$[30]	- string variable for farmer's name
E$,R$,Z$	- dummy string variables used internally
W	- field dimension in E-W direction (m)
L	- field dimension in N-S direction (m)
G	- grid interval in E-W direction (m)
T	- grid interval in N-S direction (m) Note: G x T establishes the standard grid area size.
R	- number of rows in grid pt. array
C	- number of columns in grid pt. array
r1,r4 - r7, r10 - r12	- dummy variables used internally
r2	- row number of corner point at the standard grid interval (starting point)
r3	- column number of the same point as r2
r8	- actual field area (feddans)
A	- end column grid area proportion to standard grid size
B	- end row grid area proportion to standard grid size
S	- sum of the rod readings or elevations at grid pts. adjusted by the area they represent, i.e.,

$$S = \sum_{J=1}^{R} \sum_{I=1}^{C} (A[I,J] \times R[I,J]) \qquad (m)$$

Table 1. Continued.

N - sum of the individual grid area proportions, i.e.,

$$N = \sum_{J=1}^{R} \sum_{I=1}^{C} A[I,J]$$

M - average rod reading or elevation, equal to S/N (m)

D - design level (m), initially equal to M rounded up to nearest (cm) if grid point values are rod readings, or M rounded down to nearest (cm) if grid point values are elevations. Adjusted in increments of 0.001 m to obtain cut/fill ratio between 1.30 and 1.60 (if this option is specified).

Z - standard deviation of grid point values from mean (cm)

E - extra required fill volume (m^3).

V - sum of the cuts adjusted for the area represented, i.e.,

$$V = \sum_{J=1}^{R} \sum_{I=1}^{C} (C[I,J] \times A[I,J])$$

and then multiplied by the standard grid size to obtain total cut volume (m^3)

r9 - cut volume per unit area, equal to V/r8

F - sum of the fills adjusted for the area represented, i.e.,

$$F = \sum_{J=1}^{R} \sum_{I=1}^{C} (F[I,J] \times A[I,J])$$

and then multiplied by the standard grid area size and incremented by E to obtain total fill volume (m^3).

P - cut/fill ratio, equal to V/F.

I,J,K,N,X - dummy variables used internally

Reference

EWUP Manual No. 8, "Thirty Steps to Precision Land Leveling in Egypt," by A. Bayoumi, S. Boctor and N. Dimick. Egypt Water Use and Management Project, Cairo, ARE. June, 1982.

Figure 1. Program Listing

```
0: wtb 701,27,38,107,49,83
1: fmt c27,4/;wrt 701,"LAND LEVELING DATA ANALYSIS"
2: wtb 701,27,38,107,48,83
3: dim R[30,30],A[30,30],C[30,30],F[30,30],S$[25],D$[10]
4: dim E$[12],R$[12],Z$[12],F$[30],T$[25]
5: ent "Rod readings(1)or elevations(2)?",r1;"rod readings"→R$
6: "elevations  "→E$;ent "Site descriptor",S$;ent "Survey date",D$
7: ent "Survey timing",T$;ent "Farmer's name",F$
8: ent "Method(1=C/F:1.3-1.6,2=C/F:1.0)",r7;ent "Actual Field Area(Fed)",r8
9: ent "Field dim. in E-W dir.(m)",W;ent "Field dim. in N-S dir.(m)",L
10: ent "Grid interval(m) in E-W dir.",G;ent "Grid interval(m) in N-S dir.",T
11: ent "Number of rows",R;ent "Number of columns",C
12: fmt c;wrt 701,S$;wrt 701,F$,wrt 701,D$;fmt c,/;wrt 701,T$
13: fmt f10.2,1x,c;wrt 701,"Actual Field Area=",r8,"Fed"
14: fmt f10.2,1x,c,5x,f10.2,1x,c
15: wrt 701,"Field dimension(E-W)=",W,"m","Field dimension(N-S)=",L,"m"
16: fmt f10.2,1x,c,;wrt 701,"Grid interval (E-W) dir.=",G,"m"
17: wrt 701,"Grid interval (N-S) dir.=",T,"m";fmt 2/;wrt 701
18: if r1=1;R$→Z$;jmp 2
19: E$→Z$
20: fmt 1,c21,x,c12,10x,c;wrt 701.1,"Grid point values are",Z$,"↑N";stp
21: dsp "Enter array of",Z$,"(m)";wait 3000;dsp "North is at top of page"
22: wait 3000
23: dsp "Enter data row by row";wait 3000
24: dsp "1st pt. is upper left corner";wait 3000
25: dsp "Enter 0.0 for pts. outside bdy.";wait 3000
26: dsp "to make input grid rectangular";wait 3000
27: for J=1 to R
28: for I=1 to C;ent R[I,J];next I;next J
29: ent "All points correct?(1=y,2=n)",r6;if r6=2;dsp "make corrections";stp
30: ent "corner pt. row no. at std. int.",r2
31: ent "corner pt. col. no. at std int.",r3
32: (W-GC+G)G/C↑2→A;(L-TR+T)T/T↑2→B
33: if r2=1 and r3=1;gto "1-1"
34: if r2=1 and r3=C;gto "1-C"
35: if r2=R and r3=1;gto "R-1"
36: if r2=R and r3=C;gto "R-C"
37: "1-1":for J=1 to R
38: for I=1 to C
39: if I=C and J=R;AB→A[I,J];gto "AVE"
40: if I=C;A→A[I,J];next J
41: if J=R;B→A[I,J];next I
42: 1→A[I,J];next I;gto "AVE"
43: "1-C":for J=1 to R
44: for I=1 to C
45: if I=1 and J=R;AB→A[I,J];next I
```

Figure 1. Cont'd

```
46: if I=1;A→A[I,J];next I
47: if J=R;B→A[I,J];next I;gto "AVE"
48: 1→A[I,J];next I;next J
49: "R-1":for J=1 to R
50: for I=1 to C
51: if I=C and J=1;AB→A[I,J];next J
52: if J=1;B→A[I,J];next I
53: if I=C;A→A[I,J];next J;gto "AVE"
54: 1→A[I,J];next I
55: "R-C":for J=1 to R
56: for I=1 to C
57: if I=1 and J=1;AB→A[I,J];next I
58: if J=1;B→A[I,J];next I;next J
59: if I=1;A→A[I,J];next I
60: 1→A[I,J];next I;next J
61: "AVE":0→S→N→r11→r12;RC→r10;for J=1 to R
62: for I=1 to C;if R[I,J]=0;0→A[I,J];r10-1→r10
63: A[I,J]+N→N;R[I,J]A[I,J]+S→S;R[I,J]↑2+r11→r11;R[I,J]+r12→r12;next I;next J
64: (r10r11-r12r12)/r10(r10-1)→Z;√Z×100→Z
65: S/N→M;if T$[1]="Survey after planing";M→D;jmp 4
66: if r7=2;M→D;jmp 3
67: if r1=1;int(M×100+1)/100→D;jmp 2
68: int(M×100)/100→D
69: ent "Drain or other fill vol?(1=y,2=n)",r4
70: if r4=1;ent "Extra fill volume(m↑3)",E;jmp 2
71: 0→E
72: gsb "C/F"
73: "CHECK":if T$[1]="Survey after planing";gto "PRINT"
74: if r7=2;gto "PRINT"
75: if P>=1.3 and P<=1.6;gto "PRINT"
76: if P<=1.3;jmp 2
77: if P>=1.6;jmp 5
78: if r1=1;D+.001→D;jmp 2
79: D-.001→D
80: gsb "C/F"
81: gto "CHECK"
82: if r1=1;D-.001→D;jmp 2
83: D+.001→D
84: gsb "C/F"
85: gto "CHECK"
86: "C/F":0→V→F;for J=1 to R;for I=1 to C
87: if R[I,J]=0;0→C[I,J]→F[I,J];jmp 6
88: D-R[I,J]→X;if r1=1;jmp 3
89: if X<0;abs(X)→C[I,J];0→F[I,J];jmp 4
90: X→F[I,J];0→C[I,J];jmp 3
91: if X<=0;abs(X)→F[I,J];0→C[I,J];jmp 2
92: X→C[I,J];0→F[I,J]
93: C[I,J]A[I,J]+V→V;F[I,J]A[I,J]+F→F
94: next I;next J
95: VGT→V;FGT+E→F;V/F→P;V/r8→r9;ret
96: "PRINT":wtb 701,27,38,107,50,83;wtb 701,27,38,108,56,68
97: fmt 15x,z;wrt 701;wtb 701,27,49;wtb 701,13;wtb 701,9
```

Figure 1. Cont'd

```
98: if C<=20;10C+1→r5;fmt 1,"-",z;for N=1 to r5;wrt 701.1;next N;jmp 2
99: 8C+1→r5;fmt 1,"-",z;for N=1 to r5;wrt 701.1;next N;gto "Eight"
100: for J=1 to R
101: fmt 2,/,15x,"|",z;wrt 701.2
102: for I=1 to C
103: if A[I,J]≠1;if A[I,J]≠0;fmt f4.2,5x,"|",z;wrt 701,A[I,J];next I;jmp 2
104: fmt 3,9x,"|",z;wrt 701.3;next I
105: wrt 701.2;for K=1 to C;fmt 4,z,9x,"|";wrt 701.4;next K
106: wrt 701.2;for I=1 to C;fmt 5,3x,f4.2,2x,"|",z;wrt 701.5,R[I,J]
107: next I
108: wrt 701.2;for I=1 to C;fmt 6,2x,c,f.2,2x,"|",z
109: if C[I,J]=0 and F[I,J]=0;fmt 3x,4"-",2x,"|",z;wrt 701;jmp 3
110: if C[I,J]=0;wrt 701.6,"F",F[I,J];jmp 2
111: wrt 701.6,"C",C[I,J]
112: next I
113: wrt 701.2;for K=1 to C;fmt 4,z,9x,"|";wrt 701.4;next K
114: wrt 701.2;for K=1 to C;fmt 4,z,9x,"|";wrt 701.4;next K
115: wtb 701,13;wtb 701,9;for N=1 to r5;wrt 701.1;next N;next J;gto "Cont"
116: "Eight":for J=1 to R
117: fmt 2,/,15x,"|",z;wrt 701.2
118: for I=1 to C
119: if A[I,J]≠1;if A[I,J]≠0;fmt f4.2,3x,"|",z;wrt 701,A[I,J];next I;jmp 2
120: fmt 3,7x,"|",z;wrt 701.3;next I
121: wrt 701.2;for K=1 to C;fmt 4,z,7x,"|";wrt 701.4;next K
122: wrt 701.2;for I=1 to C;fmt 5,2x,f4.2,1x,"|",z;wrt 701.5,R[I,J]
123: next I
124: wrt 701.2;for I=1 to C;fmt 6,1x,c,f.2,1x,"|",z
125: if C[I,J]=0 and F[I,J]=0;fmt 2x,4"-",1x,"|",z;wrt 701;jmp 3
126: if C[I,J]=0;wrt 701.6,"F",F[I,J];jmp 2
127: wrt 701.6,"C",C[I,J]
128: next I
129: wrt 701.2;for K=1 to C;fmt 4,z,7x,"|";wrt 701.4;next K
130: wrt 701.2;for K=1 to C;fmt 4,z,7x,"|";wrt 701.4;next K
131: wtb 701,13;wtb 701,9;for N=1 to r5;wrt 701.1;next N;next J;gto "Cont"
132: "Cont":wtb 701,27,51;wtb 701,27,38,107,48,83;wtb 701,27,38,108,54,68
133: fmt /;wrt 701
134: fmt 3,c,/
135: wrt 701.3,"A value of 0.0 means point is outside of field boundary"
136: fmt c
137: wrt 701,"When a number appears in upper left corner of grid square"
138: wrt 701,"it represents the size of that grid square as a fraction of the"
139: wrt 701.3,"standard grid size"
140: wrt 701.3,"Grid pt. cut/fill values are rounded to nearest (cm)."
141: fmt 7,/,c16,1x,c12,c,f6.3,1x,c,10x,f6.3,1x,c
142: wrt 701.7,"Adjusted average",Z$,"=",M,"m","Design value= ",D,"m"
143: fmt 7,c21,1x,c12,c,f6.2,1x,c
144: wrt 701.7,"Standard deviation of",Z$,"=",Z,"cm"
145: fmt 8,f10.2,1x,c,10x,f10.2,1x,c
146: wrt 701.8,"Total cut vol.=",V,"m↑3","Total fill vol.=",F,"m↑3"
147: fmt 8,f10.2,1x,c;wrt 701.8,"Cut Volume=",r9,"m↑3/Feddan"
148: fmt 9,f10.2,1x,c;wrt 701.9,"Extra fill vol. required(drains)=",E,"m↑3"
149: fmt c;wrt 701,"This extra fill  vol. was included in the calculations"
150: fmt c,f4.2;wrt 701,"Cut/fill ratio= ",P
151: end
*15722
```

Figure 2. Example

LAND LEVELING DATA ANALYSIS

EWUP Manual No. 8 Example
Bayoumi, Boctor and Dimick
1982
Initial grid survey

Actual Field Area= 2.86 Fed
Field dimension(E-W)= 105.00 m Field dimension(N-S)= 115.00 m
Grid interval (E-W) dir.= 20.00 m
Grid interval (N-S) dir.= 20.00 m

Grid point values are rod readings ↑N

0.75 1.25 C0.16	0.75 1.35 C0.06	0.75 1.30 C0.11	0.75 1.40 C0.01	0.94 1.64 F0.23
1.22 C0.19	1.30 C0.11	1.26 C0.15	1.37 C0.04	1.25 1.55 F0.14
1.33 C0.08	1.34 C0.07	1.33 C0.08	1.43 F0.02	1.25 1.72 F0.31
1.34 C0.07	1.37 C0.04	1.43 F0.02	1.39 C0.02	1.25 1.52 F0.11
1.40 C0.01	1.39 C0.02	1.37 C0.04	1.31 C0.10	1.25 1.45 F0.04
1.43 F0.02	1.40 C0.01	1.34 C0.07	1.33 C0.08	1.25 1.46 F0.05

A value of 0.0 means point is outside of field boundary

When a number appears in upper left corner of grid square
it represents the size of that grid square as a fraction of the
standard grid size

Grid pt. cut/fill values are rounded to nearest (cm).

Adjusted average rod readings= 1.399 m Design value= 1.410 m
Standard deviation of rod readings= 10.77 cm
Total cut vol.= 574.00 m↑3 Total fill vol.= 435.25 m↑3
Cut Volume= 200.70 m↑3/Feddan
Extra fill vol. required(drains)= 0.00 m↑3
This extra fill vol. was included in the calculations
Cut/fill ratio= 1.32

AMERICAN EQUIVALENTS OF EGYPTIAN ARABIC TERMS AND MEASURES COMMONLY USED IN IRRIGATION WORK

LAND AREA	IN SQ METERS	IN ACRES	IN FEDDANS	IN HECTARES
1 acre	4,046.856	1.000	0.963	0.405
1 feddan	4,200.833	1.038	1.000	0.420
1 hectare (ha)	10,000.000	2.471	2.380	1.000
1 sq. kilometer	100×10^4	247.105	238.048	100.000
1 sq. mile	259×10^6	640.000	616.400	259.000

WATER MEASUREMENTS	FEDDAN-CM	ACRE-FEET	ACRE-INCHES
1 billion m^3	23,809,000.000	810,710.000	
1,000 m^3	23.809	0.811	9.728
1,000 m^3/Feddan (= 238 mm rainfall)	23.809	0.781	9.372
420 m^3/Feddan (= 100 mm rainfall)	10.00	0.328	3.936

OTHER CONVERSTION		METRIC	U.S.
1 ardab	=	198 liters	5.62 bushels
1 ardab/feddan	=		5.41 bushels/acre
1 kg/feddan	=		2.12 lb/acre
1 donkey load	=	100 kg	
1 camel load	=	250 kg	
1 donkey load of manure	=	0.1 m^3	
1 camel load of manure	=	0.25 m^3	

EGYPTIAN UNITS OF FIELD CROPS

CROP	EG. UNIT	IN KG	IN LBS	IN BUSHELS
Lentils	ardeb	160.0	352.42	5.87
Clover	ardeb	157.0	345.81	5.76
Broadbeans	ardeb	155.0	341.41	6.10
Wheat	ardeb	150.0	330.40	5.51
Maize, Sorghum	ardeb	140.0	308.37	5.51
Barley	ardeb	120.0	264.32	5.51
Cottonseed	ardeb	120.0	264.32	8.26
Sesame	ardeb	120.0	264.32	
Groundnut	ardeb	75.0	165.20	7.51
Rice	dariba	945.0	2081.50	46.26
Chick-peas	ardeb	150.0	330.40	
Lupine	ardeb	150.0	330.40	
Linseed	ardeb	122.0	268.72	
Fenugreek	ardeb	155.0	341.41	
Cotton (unginned)	metric qintar	157.5	346.92	
Cotton (lint or ginned)	metric qintar	50.0	110.13	

EGYPTIAN FARMING AND IRRIGATION TERMS

fara = branch
marwa = small distributer, irrigation ditch
masraf = field drain
mesqa = small canal feeding from 10 to 40 farms
qirat = cf. English "karat", A land measure of 1/24 feddan, 175.03 m^2
qaria = village
sahm = 1/24th of a qirat, 7.29 m^2
saqia = animal powered water wheel
sarf = drain (vb.), or drainage. See also masraf, (n.)

EGYPT WATER USE AND MANAGEMENT PROJECT

PROJECT TECHNICAL REPORTS

NO.	TITLE	AUTHOR
PTR#1	Problem Identification Report for Mansuriya Study Area, 10/77 to 10/78.	By: Egyptian andAmerican Field Teams.
PTR#2	Preliminary Soil Survey Report for the Beni Magdul and El-Hammami Areas.	By: A. D. Dotzenko, M. Zanati, A. A. Abdel Wahed, & A. M. Keleg.
PTR#3	Preliminary Evaluation of Mansuriya Canal System, Giza Governorate, Egypt.	By: American and Egyptian Field Teams.
PTR#7	A Procedure for Evaluating the Cost of Lifting Water for Irrigation in Egypt.	By: H. Wahby, M. Quenemoen, and M. Helal.
PTR#9	Irrigation & Production of Rice in Abu Raya, Kafr El-Sheikh Governorate.	Compiled By: R. Tinsley.
PTR#10	Soil Fertility Survey in Kafr El-Sheikh, El Mansuriya and El-Minya Pilot Projects.	By: Zanati, Soltanpour, Mostafa, & Keleg.
PTR#11	Kafr El-Sheikh Farm Management Survey Crop Enterprise Budgets and Profitability Analysis.	By: M. Haider & F. Abdel Al.
PTR#12	Use of Feasibility Studies in the Selection and Evaluation of Pilot Studies for Alternative Methods of Water Distribution in Egypt.	By: R. McConnen, F. Abdel Al, M. Skold, and G. Ayad.
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MANUALS

NO.	TITLE	AUTHOR
MAN.#1	Trapezoidal Flumes for the Egypt Water Use Project.	By: A. R. Robinson.
MAN.#2	Programs for the HP Computer Model 9825 for EWUP Operations.	By: M. Helal, D. Sunada, J. Loftis, M. Quenemoen, W. Ree, R. McConnen, R. King, A. Nazr and R. Stalford.

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