COMPUTER PROGRAM FOR THE COMPUTATION OF TOTAL SEDIMENT DISCHARGE
BY THE MODIFIED EINSTEIN PROCEDURE
by Herbert H. Stevens, Jr.

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CONVERSION FACTORS

Inch-pound units used in this report may be converted to SI (International System) units by the following conversion factors:

<table>
<thead>
<tr>
<th>Multiply inch-pound units</th>
<th>By</th>
<th>To obtain SI units</th>
</tr>
</thead>
<tbody>
<tr>
<td>cubic foot per second (ft³/s)</td>
<td>0.02832</td>
<td>cubic meter per second (m³/s)</td>
</tr>
<tr>
<td>foot (ft)</td>
<td>0.3048</td>
<td>meter (m)</td>
</tr>
<tr>
<td>foot per second (ft/s)</td>
<td>0.3048</td>
<td>meter per second (m/s)</td>
</tr>
<tr>
<td>pound per foot (lb/ft)</td>
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<td>kilogram per meter (kg/m)</td>
</tr>
<tr>
<td>ton per day (t/d)</td>
<td>0.9078</td>
<td>metric ton per day (t/d)</td>
</tr>
<tr>
<td>square foot (ft²)</td>
<td>0.0929</td>
<td>square meter (m²)</td>
</tr>
<tr>
<td>square foot per second (ft²/s)</td>
<td>0.0929</td>
<td>square meter per second (m²/s)</td>
</tr>
</tbody>
</table>

To convert degree Celsius (°C) used in this report to degree Fahrenheit (°F), use the following equation:

\[ °F = \frac{9}{5}(°C + 32). \]
COMPUTER PROGRAM FOR THE COMPUTATION OF TOTAL SEDIMENT DISCHARGE

BY THE MODIFIED EINSTEIN PROCEDURE

H. H. Stevens, Jr.

ABSTRACT

Two versions of a computer program to compute total sediment discharge by the modified Einstein procedure are presented. The FORTRAN 77 language version is for use on the PRIME computer, and the BASIC language version is for use on microcomputers. The program contains built-in limitations and input-output options that closely follow the original modified Einstein procedure. Program documentation and listings of both versions of the program are included.

INTRODUCTION

The modified Einstein procedure (Colby and Hembree, 1955) computes total sediment discharge at a cross section of an alluvial stream having primarily a sand bed from measured hydraulic variables, the concentration and particle-size distribution of the measured suspended sediment, and the particle-size distribution of the bed material. The computation involves the extrapolation of the measured suspended-sediment discharge to represent the total suspended-sediment discharge and the addition of a computed bedload discharge. The procedure is applicable only if measured data are available so it cannot be used directly for design or predictive purposes. It is intended to be used only at sites where all of the bed material is finer than about 16 millimeters, and it can be used only if a significant part of the measured suspended sediment is composed of particles of the same size as particles in the bed material.

Due to the widespread use of the modified Einstein procedure, a number of programs have been written to facilitate computer computations. Programs have been presented by Burkham and others (1977), Chen (1973), and U.S. Bureau of Reclamation (1968). The program presented in this report is designed to follow the computational sequence given by Hubbell and Matejka (1959) and retains limitations implicit in the original Colby and Hembree (1955) paper. As well as being more efficient, the program incorporates several features of the earlier programs. Proper use of the computer program and interpretation of computed results is contingent on knowledge of the modified Einstein procedure. Therefore, potential program users need to familiarize themselves with the historical development and application of the procedure (Einstein, 1950; and Colby and Hembree, 1955).

Two programs are presented. Program MEPDATA allows for keyboard entry of data and storage into a data file. Program MODEIN reads the data from the data file and computes the total sediment discharge by the modified Einstein procedure.
Program listings and examples of output for programs MEPDATA and MODEIN and flow chart for program MODEIN are included in the Supplemental Information Sections A through J at the back of the report.

**PROGRAM MEPDATA INPUT**

Data are entered by keyboard and stored in a file called MEP.DATA or a user-specified file. Input data are expressed in the foot-pound-second units except for water temperature which is in degrees Celsius, D₃₅ and D₆₅ which are in millimeters, and suspended-sediment concentration which is in milligrams per liter.

For each computation of total sediment discharge by the modified Einstein procedure the following variables are entered to form a data set:

- **LOC** - Measurement location (Maximum of 80 characters).
- **DATE** - Date of measurement (MM/DD/YY).
- **TIME** - Time of measurement (2400 hour).
- **DISCH** - Water discharge, in cubic feet per second.
- **WIDTH** - Top width of cross section, in feet.
- **DEPTH** - Mean depth in cross section, in feet.
- **TEMPER** - Water temperature, in degrees Celsius.
- **ZMEAS** - Variable that indicates whether z values for one or more size ranges will be entered (0 for no or 1 for yes). If one is entered, the program sets REFSIZE = 0 and skips the query for REFSIZE.
- **REFSIZE** - Reference size selection:
  - 0 for program selection of a single size range.
  - 1-9 for number of the single size range selected by user.
  - -1 for program selection of all suitable size ranges.
- **PCTZ** - Minimum percentage of both suspended sediment and bed material in a size range for computation of a z value. This value is automatically set to 3 percent when REFSIZE is >=0. When REFSIZE = -1, user is prompted to enter minimum value.
- **D₃₅** - Particle size at which 35 percent of the bed material by weight is finer, in millimeters. Enter zero for program determination.
- **D₆₅** - Particle size at which 65 percent of the bed material by weight is finer, in millimeters. Enter zero for program determination.
- **CONC** - Concentration of measured suspended sediment, in milligrams per liter.
- **DS** - Average depth at the sampling verticals, in feet.
- **DN** - Distance between the bottom of the sampled zone and the streambed, in feet.
- **ZE(9)** - Entered z values for nine size ranges. Values entered when ZMEAS=1. Enter zero for no value.
- **PIS(9)** - Percent by weight of measured suspended sediment for nine size ranges. Enter zero for no value.
PIB(9) - Percent by weight of bed material for nine size ranges. Enter zero for no value.

Listing of a data file containing six data sets is shown in Section H of the Supplemental Data at the back of the report.

PROGRAM MODEIN OUTPUT

Output from the FORTRAN version of program MODEIN is stored on a file named MEP.OUT or a user-specified file and later printed using the line printer. The page width is 128 columns. The BASIC version directs the output directly to an 80-column line printer.

FORTRAN version outputs from six data sets are shown in Section I. Data for these runs are shown in Section H. The column headings in Section I are self-explanatory except the two columns under the heading "COMPUTATIONAL FACTORS." The heading F(J) is an abbreviation for the ratio \((P_{1J} + J_2)/(P_{1J} + J_2)\), and the heading F(I)+1 is an abbreviation for the quantity \((P_{1I} + P_{2I} + D)\). Entered z values are listed in both the ENTERED and COMP. columns. Whenever the z value for a single reference size range is computed by trial, multipliers are listed in the MULT. column (see Section I, page I 1) When z values for more than one reference size range are computed by trial and z values for the other size ranges are determined from a regression equation, the multipliers are set to zero (see Section I, page I 3). Whenever one or more z values are entered, the MULT. column is replaced by an IBQB RATIO column which lists the \(i_BQ_B\) adjustment ratios (see Section I, pages I 5 and I 6). Also when more than one z value is computed or entered, the reference size range is designated as "MULTIPLE" and "BY REGRESSION" is printed after the Z SLOPE value (see Section I, pages I 3 and I 5).

PROGRAM MEPDATA DESCRIPTION

The FORTRAN program is organized in the form of a main program called MEPDATA, five executable subroutines, and one BLOCK DATA subprogram (see Section C). The BASIC program (see Section E) contains minor variations from the FORTRAN program because of the differences between the two languages. FORTRAN and BASIC program variable definitions are presented in Section A. The main difference between the two versions is that the FORTRAN data file is random access so that data sets are read and stored individually and the maximum number of data sets in the file is not fixed; whereas, the BASIC data file is sequential access so that all of the data sets are read or stored in a single disk operation and the maximum number of data sets in a file is 30. The BASIC program automatically stores the data in memory after each addition of ten data sets to prevent loss of data.
The program is initiated by opening a data file called MEPDATA or user-named file. A program option code NC is entered which designates; (1) start a new data file, (2) add to an existing data file, (3) correct one or more data sets, (4) list data on screen, or (5) list data on printer. If NC>$1$ the number of data sets, NSET, is read from the data file, otherwise NSET is set to 0.

When NC=1 or 2, data sets are added as follows:
1. NSET is increased by 1.
2. Subroutine DAIN is called and one set of data is keyboard entered. Section "PROGRAM MEPDATA INPUT" (p. 2) describes the input variables.
3. Subroutine DALIST is called to list the data set on the screen. If the data set is correct, subroutine DWRITE is called to write the data set on the data file. Program then goes back to step 1 for another data set. When the last data set is completed, the value of NSET is written on record 1 of the data file and the run is terminated.
4. An incorrect data set is either redone by calling subroutine DAIN or corrected by calling subroutine DACORR. In subroutine DACORR, an incorrect data value number from 1 to 24 is entered (see Section H), the correct value is shown on the screen, and the correct value is entered. The program then goes back to step 3.

Correction of data sets (NC=3) is as follows:
1. The number of the data set to be corrected is entered. Subroutine DAREAD is called to input the data set from the data file, and subroutine DALIST is called to list the data set on the screen.
2. An incorrect data set is either redone by calling subroutine DAIN or corrected by calling subroutine DACORR.
3. Subroutine DALIST is called to list the corrected data set. If the data set is still not correct, step 2 is repeated. Otherwise, subroutine DWRITE is called to write the data set on the data file. The program then goes back to step 1.

Listing of data sets on the screen (NC=4) is as follows:
1. The starting and ending numbers of the data sets to be listed are entered.
2. For each data set, subroutine DAREAD is called to input the data set from the data file, and subroutine DALIST is called to list the data set on the screen. The display is held on the screen until a number is entered.

Listing of data sets on the printer (NC=5) is as follows:
1. The starting and ending numbers of the data sets to be printed are entered.
2. For each data set, subroutine DAREAD is called to input the data set from the data file. The data set is then directed to an output file called MEPDATA.LIST in the FORTRAN version of the program, or to a line printer in the BASIC version. The file MEPDATA.LIST is printed using the line printer. The output from a MEPDATA.LIST file containing six data sets is shown in Section H.

PROGRAM MODEIN DESCRIPTION

In the following description, symbols originally used by Colby and Hembree (1955) for the various variables are utilized to facilitate the explanations of the program. If the program uses a variable for which no counterpart modified Einstein procedure symbol exists, the FORTRAN variable name is used in the description. Similarly, equations used in the descriptions are the original modified Einstein procedure equations from Colby and Hembree (1955) or Hubbell and Matejka (1959) unless the equation exists only in the program. In that case, the equation is expressed using the FORTRAN variable names. Definition of all FORTRAN and BASIC variable names, and counterpart modified Einstein procedure symbols, are presented in Section B. The FORTRAN program is organized in the form of a main program called MODEIN, nine executable subprograms, and one BLOCK DATA subprogram (see Section D). Section G presents a flow chart which illustrates the computation procedure. The BASIC program (see Section F) contains minor variations from the FORTRAN program because of the differences between the two languages; however, the FORTRAN program description can be used along with the BASIC variable definitions (Section B) to understand the BASIC program.

Main Program MODEIN

The main program first opens a data file created by program MEPDATA (see p. 3) called MEP.DATA or a user-specified file, reads the number of data sets (NCOMP1) in the file, and sets the data-set counter (NCOMP2) to 0.

The computation procedure for each data set is divided into six parts. Part 1 initializes the program variables, increases the data-set counter by one, sets NRSIZE equal to REFSIZE (-1, 0, or 1-9), and sets the computation flag MODE equal to 1. MODE is a code which directs the computational sequence and determines various output notes. Subroutine INPUT is called to read and check the data from the data file, and to compute several hydraulic variables.

Whenever one or more z values have been entered (ZMEAS=1), ZMEAS is reset to the number of entered z values. Then if ZMEAS=1, NRSIZE is reset to the size range number of the entered z. Otherwise NRSIZE is reset to -1.
If NRSIZE < 1 the program selects the reference size range number having the largest value of COMP2, where:

\[ \text{COMP2} = i_{sm} + i_b \]

Size ranges having \( i_{sm} \) or \( i_b \) values less than 3 percent are rejected in the determination of COMP2. This procedure gives a reference-size range number having the optimum combined percentage of suspended sediment and bed material. NRSIZE is then given the value of the selected size range number. If the previous value of NRSIZE was -1, it is given a negative size range number.

Part 2 calls subroutine SRCOMP to compute (SR)\(_m\) with trial values of x. Whenever the number of x-value trials exceeds 15, the computation is terminated, an error message "counter for XBAL exceeded 15" is written, and the program returns to part 1 for the next data set. After a normal return to the main program, values of \( P, PCTQ, \) and \( Q_{ts}' \) are computed, where:

\[ P = 2.303 \log_{10} \frac{3.02 d x}{k_s} \]

Fraction of flow sampled (PCTQ) = \( 1 - \frac{P-1 + \ln A''}{P-1} \) and

\[ Q_{ts}' = (PCTQ) Q_{sm} \]

Part 3 computes \( Q_{s}', v_s, \) and \( i_B Q_B \) values for each size range, where:

\[ Q_{s}' = Q_{ts}' i_{sm} \]

The settling velocity of the sediment particles, \( v_s \), is computed by an equation developed by Rubey (1933). The equation has been modified to use kinematic viscosity, \( \nu \), rather than dynamic viscosity:

\[ v_s = \sqrt{\frac{36.064 D^3 + (6 \nu)^2 - 6 \nu}{D}} \]

Values of \( i_B Q_B \) for each size range are computed as follows:

\( \psi \) \(_m\) is computed from both equations

\[ \psi = \frac{1.65 D_{35}}{(SR)\_m} \quad \text{and} \quad \psi = \frac{0.66 D}{(SR)\_m} \]
and the larger value of $\psi_m$ is used to call subroutine FIG10 which
determines $\varphi$. Then $i_{Bq_B}$ is computed from:

$$i_{Bq_B} = 1200 \ i_b \ D^{3/2} \ \varphi^{*}/2$$

then

$$i_{BQ_B} = i_{Bq_B} \times 43.2 \ \text{w.}$$

Whenever the sum of $i_{BQ_B}$ values for all size ranges is greater than zero,
computation continues. Otherwise, computation is terminated, MODE is set
to 2, and the program skips to part 6 to write the partially computed
results and footnote "$i_{BQ_B}$ values equal zero. Total discharge equal to
measured suspended-sediment discharge" (see Section I, page I 2).

Part 4 determines $z$ values for each size range from 1 or more computed or
entered $z$ values. When $z$ values are not entered (ZMEAS=0) and a reference
size is selected (NRSIZE=1 to 9), then subroutine COMPZ is called to
determine one $z$ value by trial for the indicated reference size range; or, if
a reference size is not selected (NRSIZE=-1), then subroutine COMPZ is
called to compute $z$ values by trial for each size range for which both $i_{sm}$
and $i_t$ are equal to or greater than the percentage entered as the "$z$ comp
limit." If COMPZ returns an error MODE equal to 3, or if no $z$'s are
computed and MODE is set to 4, computation is terminated and the program
skips to part 6 to write the partially computed results and an error
message. The error message for 3 is "No convergence in $z$ computation" and
the message for 4 is "No overlap of bed and suspended material."

When ZMEAS>0, subroutine ZMIBQB is called to compute new $i_{BQ_B}$ values for
those size ranges having measured $z$ values and to adjust $i_{BQ_B}$ values for
other size ranges that were computed under part 3.

Next, subroutine ZFIT is called to determine $z$'s for the remaining size
ranges. When ZFIT returns an error MODE equal to 5, computation is
terminated and the program skips to part 6 to write the partially computed
results and an error message "Not enough points for a fit of $z$ values."

Part 5 computes the total sediment discharge ($Q_t$) for each size range.
First $Q_t$ is computed for size ranges smaller than the reference size range
by the following steps:

$$A''$$ and $A'$ are determined from

$$A'' = \frac{2 \ D}{d}$$ and

$$A' = \frac{d_n}{d_B}.$$  

Subroutine POWER is called using $A''$ and $z$ to determine $J_{1''}$ and $J_{2''}$.

Subroutine POWER is called using $A'$ and $z$ to determine $J_1$ and $J_2$.  

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First, $Q_t$ is computed from:

$$Q_t = FJDP \cdot Q_s' + i_bQ_B$$

where

$$FJDP = \frac{PJ''_1 + J''_2}{PJ'_1 + J'_2}.$$ 

Next, $Q_t$ is computed for the reference size range and larger size ranges having $i_b$ values greater than zero by these steps:

1. $A''$ is determined from:
   $$A'' = \frac{2D}{d}.$$ 
2. Subroutine POWER is called using $A''$ and $z$ to determine $J'_1$ and $J'_2$.
3. First $I''_1$ and $I''_2$ are computed from:
   $$I''_1 = 0.216 \frac{A''(z-1)}{(1-A'')^z} J'$$
   and
   $$I''_2 = 0.216 \frac{A''(z-1)}{(1-A'')^z} J'_2.$$ 
4. Then $Q_t$ is computed from:
   $$Q_t = FIDP \cdot i_bQ_B$$
   where
   $$FIDP = PJ''_1 + I''_2 + 1.$$ 
5. Then, the $Q_t$ value for each size range is compared with the value of $Q_{sm}$ when $Q_{sm}$. Whenever $Q_{sm}$ is greater than $Q_t$, $Q_t$ is set equal to $Q_{sm}$, a printing flag $ITLD$ is set to 2, and $MODE$ is set to 6 so that the footnote "Measured suspended-sediment discharge—which exceeds computed discharge (Review computation)" will be written (see Section I, page I 5).
6. Finally, part 6 writes the computed values. An "*" is printed after the $Q_t$ value for each size range having $ITLD = 2$ (see Section I, page I 5) and, depending on the value of $MODE$, the appropriate, previously described footnotes are written. If the data-set counter ($NCOMP2$) is less than the number of data sets ($NCOMP1$), the program returns to part 1 for the next data set. The results of the execution of 6 data sets are shown in Section I.
Subroutine INPUT

Subroutine INPUT reads a set of input data from the file called MEP.DATA or a user-specified file. The section "PROGRAM MEPDATA INPUT" (p. 2) details the input data format. The program checks and rejects any data set which contains non-entry (zero values) of six input variables that would produce numeric overflow (\( \infty \) values) in latter steps of the program. Data sets also are rejected whenever the percent-in-class-size values for either the suspended sediment or the bed material do not total 100 percent. Whenever a data set is rejected, an error message is written, MODE is set to 10, and control is returned to the main program.

Whenever values for \( D_{35} \) or \( D_{65} \) are not specified (zero was entered), they are computed using the following procedure:

For \( D_{35} \), values of \( i_b \) for each size range starting with the finest size range, are added until the sum (BM) is \( \geq 0.35 \).

Then, using values pertaining to the last included size range:
- \( X_1 \) is set equal to the logarithm of the lower limit of the size range.
- \( X_2 \) is set equal to the logarithm of the upper limit of the size range.
- Function subroutine ERRTAB is called using BM minus \( i_b \) to determine \( Y_1 \), the value of ERRTAB for the lower limit of the size range.
- Function subroutine ERRTAB is called using BM to determine \( Y_2 \), the value of ERRTAB for the upper limit of the size range.

Then

\[
D_{35} = \text{Antilog} \left[ \frac{(-0.39-Y_1)(X_2-S_1)}{(Y_2-Y_1)} + X_1 \right]
\]

where

-0.39 is the value of ERRTAB for a probability value of 0.35.

For \( D_{65} \), the same procedure is used except the \( i_b \) values are summed until BM is \( \geq 0.65 \), and the constant -0.39 is replaced by 0.39 (the value of ERRTAB for a probability value of 0.65).

Five hydraulic variables are computed as follows:

\[
\nu = \frac{0.00002}{1.0334 + 0.03672 T + 0.0002058 T^2},
\]

\[
Q_{sm} = Q \cdot C_s \cdot 0.0027,
\]

\[
A_t = d \cdot w,
\]
\[
U = Q/A_t, \quad \text{and} \\
A' = d_n/d_s,
\]
and the input data plus the five computed variables are written.

Finally, \(d_{35}\) and \(d_{65}\) are converted from millimeters to feet.

**Subroutine SRCOMP**

Subroutine SRCOMP sets an initial \(x\) value of 1.54 and computes the following three variables:

\[
\sqrt{(SR)_m} = \frac{\bar{u}}{32.63 \log_{10} \frac{12.27 \, d \, x}{k_s}} \\
\]

\[
u_m = \sqrt{(SR)_m}/5.68 \\
\]

\[
\delta = \frac{11.6 \gamma}{u_m}
\]

Next, the ratio \(k_s/\delta\) is used to call subroutine FIG4 to compute a new \(x\) value. Computation of the three variables is repeated using the newly computed \(x\) value. Control returns to the main program whenever the difference between the new computed \(x\) value and the previous \(x\) value is less than 0.05. Also, if the number of \(x\)-value trials exceeds 15, MODE is set to 10, an error message "counter for XBAL exceeded 15" is written, and control is returned to the main program.

**Subroutine FIG4**

Subroutine FIG4 uses a series of semilogarithmic equations to approximate Einstein's relation of \(k_s/\delta\) versus \(x\) (Einstein, 1950, fig. 4; and Colby and Hembree, 1955, fig. 44). Based on the value of \(k_s/\delta\), the routine selects the appropriate parameters for the equation from arrays created by data statements, and computes the value of \(x\).
Subroutine FIG10

Subroutine FIG10 uses a series of power functions to approximate Einstein's relation of $\psi_\ast$ versus $\phi_\ast$ (Einstein, 1950, fig. 10; and Colby and Hembree, 1955, plate 2). Based on the value of $\psi_m$, the routine selects the appropriate parameters from arrays created by data statements, and computes the value of $\phi_\ast$. $\psi_m$ is the counterpart, in the modified Einstein procedure, of $\psi_\ast$.

Subroutine COMPZ

Subroutine COMPZ determines $z$ for a size range using trial values of $z$ until the following equation is satisfied:

\[
\text{Allowable error (TOL) = 0.216} \frac{A''(z-1)}{(1-A'')^2} \left( Pj_1' + J_2'' \right) - \frac{Q_s'}{i_{BQ_B}}.
\]

First, the values of $A''$, $Q_s'$, and TOL are computed, where:

\[
A'' = \frac{2D}{d} \quad \text{and}
\]

\[
\text{TOL} = \frac{Q_s'}{i_{BQ_B}} 0.01.
\]

An initial $z$ value (ZA) is computed from an equation based on a relation of $z$ versus $\frac{Q_s'}{i_{BQ_B}}$ (Colby and Hembree, 1955, fig. 46), where:

\[
ZA = 1.08 - 0.33 \log_{10} \frac{Q_s'}{i_{BQ_B}}.
\]

Next, subroutine POWER is called using $A'$ and ZA to determine $J_1'$ and $J_2'$, then FZA and ERROR are computed from:

\[
FZA = 0.216 \frac{A''(z-1)}{(1-A'')^2} \left( Pj_1' + J_2'' \right) \quad \text{and}
\]

\[
\text{ERROR} = FZA - \frac{Q_s'}{i_{BQ_B}}.
\]
If the absolute value of ERROR is less than TOL, \( z = ZA \) and control is returned to the main program. Otherwise, \( ZB \) is set to \( ZA \pm 0.01 \) (the sign is the same as the sign of ERROR), \( FZB \) is computed by the same procedure as \( FZA \) using \( ZB \), and a new value of \( ZA \) is determined from:

\[
Z_A = Z_A \pm ZDIFF \quad \text{(The sign is the same as the sign of ERROR)}
\]

\[
\left( \frac{Q'_s}{i_B Q_B} \right) \left( F_Z - F_Z^A \right) 0.01
\]

where

\[
ZDIFF = \frac{F_ZB - F_ZA}{F_ZB - F_ZA}.
\]

Then, new values of \( FZA \) and \( ERROR \) are computed and \( ERROR \) is again compared to TOL. This process is repeated until \( ERROR < TOL \), at which time, \( z = ZA \) and control returns to the main program. Whenever the number of \( ZA \) value trials exceeds 40, \( MODE \) is set to 3 and control reverts back to the main program.

**Subroutine ZFIT**

Subroutine ZFIT determines \( z \) values for size ranges that do not have computed or entered \( z \) values. For the usual computation when a single \( z \) value has been computed or entered for a reference size range (\( NRSIZE > 0 \)), \( ZSLOPE \) is set to 0.7. Then \( z \) values are obtained by proportioning the reference size \( z \) with multipliers that vary with the 0.7 power of fall velocity.

When \( z \) values for more than one size range have been computed or entered (\( NRSIZE < 0 \)), the remaining \( z \) values are determined from an equation that is defined by a least-squares regression of \( \log z \) against \( \log V_s \) using computed or entered \( Z \) values; \( ZSLOPE \) is set equal to the slope of the regression line. \( MODE \) is set to 5 whenever there is an inadequate number of \( z \) values to compute a regression line. Results of computations using the regression procedure for obtaining \( z \) values need to be reviewed. A flat slope can give erratic \( z \) values for the small and large size ranges. After the determination of \( z \)'s, either from multipliers or the regression equation, control is returned to the main program.

**Subroutine ZMIBQB**

Subroutine ZMIBQB computes revised \( i_B Q_B \) values whenever one or more \( z \) values are entered. First \( i_B Q_B \) values and ratios of \( i_B Q_B \) values are computed, as follows, for each size range for which \( z \) values have been entered:

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Subroutine POWER is called using $A'$ and $z$ to determine $J_1'$ and $J_2'$ and $i_BQ_B^{\text{new}}$ and ZMULT are computed from:

$$i_BQ_B^{\text{new}} = \frac{Q_s'}{A^n(z-1)} \quad \text{and} \quad 0.216 \frac{\left( PJ_1' + J_2' \right)}{(1-A^n)^z} \frac{i_BQ_B^{\text{new}}}{i_BQ_B^{\text{old}}}$$

where $i_BQ_B^{\text{old}}$ is the previous $i_BQ_B$ value computed in part 3 of the main program.

Then old $i_BQ_B$ values (computed in part 3) for the remaining size ranges are proportioned by multiplying each value by the appropriate ratio (ZMULT). When one $z$ value is available (a single reference size range is used), ZMULT is the ratio for that size (see Section I, page I 6); when $z$ values for more than one size range have been entered, size ranges finer than the size range for the first entered $z$ are multiplied by the first ZMULT ratio and size ranges coarser than the size range for the last entered $z$ are multiplied by the last ratio (see Section I, page I 5).

**Subroutine POWER**

Subroutine POWER evaluates the $J_1$ and $J_2$ integral functions by a procedure developed by Li (1974). The method, which is based on expanding the integral functions in the form of a power series, has several advantages over the Simpson's-rule method used in previous programs. First, with nearly the same accuracy, the new method requires only one-tenth of the computer time needed to apply Simpson's rule. Second, the desired degree of accuracy can be selected to satisfy the needs of a particular problem. A convergence factor of 0.001 was used in subroutine POWER.

**Function Subroutine ERRTAB**

Function subroutine ERRTAB determines the value of ERRTAB for a given percent finer value (BM), where ERRTAB is the dimensionless deviation from the mean, express as a multiple of the standard deviation, in the standardized normal probability distribution function.

If $BM=0.5$ ERRTAB is set equal to zero and control is returned to the main program.
If BM<0.5 \quad \text{BN=BM} \\
If BM>0.5 \quad \text{BN=1.0-BM} \\

then \\
\[
T = \left\{ \begin{array}{l} \log_e \left[ \frac{1.0}{\text{BN}^2} \right] \end{array} \right\}^{\frac{1}{2}} \\
\]
and \\
\[
\text{ERRTAB} = T - \left[ \frac{2.30753 + 0.27061 T}{1.0 + 0.99229 T + 0.04481 T^2} \right]. \\
\]

If BM<0.5 \text{ ERRTAB is set to } -\text{ERRTAB}. \\

**Subprogram BLOCK DATA** \\

BLOCK DATA is a nonexecutable subprogram used to enter the lower limit, upper limit and geometric mean of size ranges; limits are given in millimeters and means are expressed in feet.

**REFERENCES CITED** 

**SUPPLEMENTAL DATA--SECTION A.**

**DEFINITION OF PROGRAM MEPDATA VARIABLES**

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FORTRAN</strong></td>
<td><strong>BASIC</strong></td>
</tr>
</tbody>
</table>

### VARIABLES IN COMMON BLOCK /AA/

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
<td>DATE$ Date of measurement (MM/DD/YY)</td>
</tr>
<tr>
<td>LOC</td>
<td>LO$ Location of measurement</td>
</tr>
<tr>
<td>NREC</td>
<td>-- Random file record number</td>
</tr>
<tr>
<td>SIZE</td>
<td>SIZE Array of values for measured z values, percent suspended material, and percent bed material by size class</td>
</tr>
<tr>
<td>SIZEHI</td>
<td>SIZEHI Upper limit of a particle-size range, in millimeters</td>
</tr>
<tr>
<td>SIZELO</td>
<td>SIZELO Lower limit of a particle-size range, in millimeters</td>
</tr>
<tr>
<td>VAL</td>
<td>VAR Array of values for 10 input variables</td>
</tr>
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### VARIABLES IN MAIN PROGRAM NOT IN COMMON BLOCK /AA/

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFILE</td>
<td>DFILE$ Data file name</td>
</tr>
<tr>
<td>I</td>
<td>I Loop counter</td>
</tr>
<tr>
<td>J</td>
<td>J Loop counter</td>
</tr>
<tr>
<td>NC</td>
<td>NC Program option flag</td>
</tr>
<tr>
<td>NR</td>
<td>NR Variable number in data set (1-24)</td>
</tr>
<tr>
<td>NS</td>
<td>-- Data set counter</td>
</tr>
<tr>
<td>NS1</td>
<td>-- Start data set number to list or print</td>
</tr>
<tr>
<td>NS2</td>
<td>-- End data set number to list or print</td>
</tr>
<tr>
<td>NSET</td>
<td>NO Number of data sets—maximum is 30 in BASIC program</td>
</tr>
<tr>
<td>--</td>
<td>N Loop counter</td>
</tr>
<tr>
<td>--</td>
<td>ND Data set counter to store data after each ten entered data sets</td>
</tr>
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### VARIABLES IN SUBROUTINE DAIN NOT IN COMMON BLOCK /AA/

<table>
<thead>
<tr>
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<th>Definition</th>
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</thead>
<tbody>
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<td>DA</td>
<td>I Z computation limit option</td>
</tr>
<tr>
<td>I</td>
<td>I Loop counter</td>
</tr>
<tr>
<td>ZI</td>
<td>ZI Measured z input option</td>
</tr>
<tr>
<td>ZR</td>
<td>ZR Reference size selection option</td>
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### VARIABLES IN SUBROUTINE DAWRITE NOT IN COMMON BLOCK /AA/

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<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>I Loop counter</td>
</tr>
<tr>
<td>J</td>
<td>-- Loop counter</td>
</tr>
<tr>
<td>--</td>
<td>N Data set counter</td>
</tr>
<tr>
<td>--</td>
<td>NO Number of data sets</td>
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</table>
### DEFINITION OF PROGRAM MEPDATA VARIABLES--Continued

#### PROGRAM

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DEFINE</td>
</tr>
</tbody>
</table>

#### DEFINITION

**VARIABLES IN SUBROUTINE DAREAD NOT IN COMMON BLOCK /AA/**

| I  | --  | Loop counter |
| J  | --  | Loop counter |
| -- | N   | Data set counter |
| -- | NO  | Number of data sets |

**VARIABLES IN SUBROUTINE DACORR NOT IN COMMON BLOCK /AA/**

| I  | I   | Loop counter |
| L  | L   | Loop counter |
| NSET | N  | Data set number |
| --  | NO  | Number of data sets |

**VARIABLES IN SUBROUTINE DALIST NOT IN COMMON BLOCK /AA/**

| I  | I   | Loop counter |
| J  | --  | Loop counter |
| L1 | NR  | Variable number in data set |
| L2 | --  | Variable number in data set |
| NSET | N  | Data set number |
| --  | NO  | Number of data sets |
SUPPLEMENTAL DATA--SECTION B.
DEFINITION OF PROGRAM MODE IN VARIABLES

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>MODIFIED</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORTRAN</td>
<td>BASIC</td>
<td>EINSTEIN</td>
</tr>
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VARIABLES IN COMMON BLOCK /AA/

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<th>CONC</th>
<th>D35</th>
<th>D65</th>
<th>DEPTH</th>
<th>DISCH</th>
<th>MODE</th>
<th>PCTZ</th>
<th>QSM</th>
<th>SUM</th>
<th>UBAR</th>
<th>VISC</th>
<th>WIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>APRIME</td>
<td>AREA</td>
<td>CONC</td>
<td>D35</td>
<td>D65</td>
<td>DEPTH</td>
<td>DISCH</td>
<td>MODE</td>
<td>PCTZ</td>
<td>QSM</td>
<td>SUM</td>
<td>UBAR</td>
<td>VISC</td>
<td>WIDTH</td>
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<table>
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<tr>
<th>APRIME</th>
<th>AREA</th>
<th>CONC</th>
<th>D35</th>
<th>D65</th>
<th>DEPTH</th>
<th>DISCH</th>
<th>MODE</th>
<th>PCTZ</th>
<th>QSM</th>
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<th>WIDTH</th>
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VARIABLES IN COMMON BLOCK /BB/

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<th>PIS</th>
<th>PVALUE</th>
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</thead>
</table>

<table>
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<tr>
<th>BIBQB</th>
<th>DIAM</th>
<th>PIB</th>
<th>PIS</th>
<th>PVALUE</th>
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</table>

<table>
<thead>
<tr>
<th>BIBQB</th>
<th>DIAM</th>
<th>PIB</th>
<th>PIS</th>
<th>PVALUE</th>
</tr>
</thead>
</table>

Value of \( \frac{d_n}{d_s} \)
Cross-sectional area, in square feet
Concentration of measured suspended sediment, milligrams per liter
Particle size at which 35 percent of the bed material by weight is finer, in feet (input and output is in millimeters)
Particle size at which 65 percent of the bed material by weight is finer, in feet (input and output is in millimeters)
Mean depth in cross section, in feet
Water discharge, in cubic feet per second
Error indicating flag
Minimum percentage of both suspended sediment and bed material in a size range for computation of a z value
Measured suspended-sediment discharge of all size ranges, in tons per day
Array of sums of PIS, PIB, BIBQB, QPRIMS, and TOTALD of all sizes
Average velocity of flow, in feet per second
Kinematic viscosity, in square feet per second
Top width of cross section, in feet
Sediment discharge through the bed layer of particles of a size range, in tons per day
Geometric mean diameter of a size range, in feet
Fraction by weight of bed material in a size range (input is in percent)
Fraction by weight of measured suspended sediment in a size range, (input is in percent)
A parameter
**DEFINITION OF PROGRAM MODE IN VARIABLES**

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>MODIFIED</th>
</tr>
</thead>
<tbody>
<tr>
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<td>BASIC</td>
</tr>
<tr>
<td>EINSTEIN</td>
<td>SYMBOL</td>
</tr>
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</table>

**VARIABLES IN COMMON BLOCK /BB/--Continued**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPRIMS</td>
<td>Suspended-sediment discharge of a size range in the sampled zone, in tons per day</td>
</tr>
<tr>
<td>SIZEHI</td>
<td>Upper limit of a particle-size range, in millimeters</td>
</tr>
<tr>
<td>SIZELO</td>
<td>Lower limit of a particle-size range, in millimeters</td>
</tr>
</tbody>
</table>

**VARIABLES IN COMMON BLOCK /CC/**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRSIZE</td>
<td>Reference size range number</td>
</tr>
<tr>
<td>NSR</td>
<td>Number of size ranges</td>
</tr>
<tr>
<td>VS</td>
<td>Fall velocity of the geometric-mean particle size of a size range, in feet per second</td>
</tr>
<tr>
<td>ZC</td>
<td>Value of z for a size range computed by trial, from multipliers, or from a regression equation</td>
</tr>
<tr>
<td>ZE</td>
<td>Entered z value for a size range</td>
</tr>
<tr>
<td>MEAS</td>
<td>Option to enter z's for one or more size ranges (0 for no, or 1 for yes)</td>
</tr>
<tr>
<td>ZMULT</td>
<td>Multipliers for computing z's for each size range from a reference size z value, or a factor for adjusting $i_BQ_B$ values when z values are entered</td>
</tr>
<tr>
<td>ZSLOPE</td>
<td>Slope of a linear relation between z's and the fall velocities of the geometric mean particle size of corresponding size ranges (normally is equal to 0.7)</td>
</tr>
</tbody>
</table>

**VARIABLES IN MAIN PROGRAM NOT IN COMMON BLOCKS /AA/, /BB/, /CC/**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADP</td>
<td>Value of 2D/d</td>
</tr>
<tr>
<td>COEFF</td>
<td>Coefficient to convert J values to I values</td>
</tr>
<tr>
<td>COMP1</td>
<td>Temporary computation value</td>
</tr>
<tr>
<td>COMP2</td>
<td>Temporary computation value</td>
</tr>
<tr>
<td>CONST</td>
<td>Total suspended-sediment discharge through the sampled zone, in tons per day</td>
</tr>
<tr>
<td>DFILE</td>
<td>Data file name</td>
</tr>
<tr>
<td>FIDP</td>
<td>Abbreviation for the value of $PI_1' + I_2' + 1$ for a size range</td>
</tr>
</tbody>
</table>
## DEFINITION OF PROGRAM MODE IN VARIABLES—Continued

<table>
<thead>
<tr>
<th>PROGRAM FORTRAN</th>
<th>MODIFIED EINSTEIN SYMBOL</th>
<th>DEFINITION</th>
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<tbody>
<tr>
<td>FJDP</td>
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</tr>
<tr>
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<td>--</td>
</tr>
<tr>
<td>J</td>
<td>J</td>
<td>--</td>
</tr>
<tr>
<td>K</td>
<td>K</td>
<td>--</td>
</tr>
<tr>
<td>N1</td>
<td>N1</td>
<td>--</td>
</tr>
<tr>
<td>NCOMP1</td>
<td>NCOMP1</td>
<td>--</td>
</tr>
<tr>
<td>NCOMP2</td>
<td>NCOMP2</td>
<td>--</td>
</tr>
<tr>
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</tr>
<tr>
<td>PCTQ</td>
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<td>--</td>
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<tr>
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<tr>
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<tr>
<td>QMEAS</td>
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<td>--</td>
</tr>
<tr>
<td>RSL</td>
<td>RSL</td>
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</tr>
<tr>
<td>RSH</td>
<td>RSH</td>
<td>--</td>
</tr>
<tr>
<td>SHEAR</td>
<td>SHEAR</td>
<td>--</td>
</tr>
<tr>
<td>SR</td>
<td>SR</td>
<td>--</td>
</tr>
<tr>
<td>TOTLD</td>
<td>TOTLD</td>
<td>--</td>
</tr>
<tr>
<td>UNITBD</td>
<td>UNITBD</td>
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</tr>
<tr>
<td>VALJ1</td>
<td>VALJ1</td>
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</tr>
<tr>
<td>VALJ2</td>
<td>VALJ2</td>
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</tr>
<tr>
<td>XR</td>
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</tr>
<tr>
<td>Z</td>
<td>Z</td>
<td>--</td>
</tr>
<tr>
<td>ZS</td>
<td>ZS</td>
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</tr>
<tr>
<td>--</td>
<td>R$</td>
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</tr>
</tbody>
</table>

### VARIABLES IN MAIN PROGRAM NOT IN COMMON BLOCKS /AA/, /BB/, /CC/—Continued

- **FJDP**: Abbreviation for the value of \((PJ_1^n + J_2^n) / (PJ_1 + J_2)\) for a size range
- **ITLD**: Total sediment discharge code (1 for computed or 2 for measured suspended sediment)
- **J**: Temporary counter
- **K**: Size range loop index
- **N1**: Reference size range number
- **NCOMP1**: Number of data sets
- **NCOMP2**: Counter for data sets
- **OFILE**: Output file name
- **PCTQ**: Fraction of flow in sampled zone
- **PHI**: Intensity of bedload transport for a size range
- **PSI**: Function for correlating effect of flow with intensity of sediment transport for a size range. The greater of \(1.65 D_35/(SR)_m\) or \(0.66 D/(SR)_m\)
- **QMEAS**: Suspended-sediment discharge of a size range, in tons per day
- **RSL**: Lower limit of reference size range, in millimeters
- **RSH**: Upper limit of reference size range, in millimeters
- **SHEAR**: Value of \(1.65 D_35/(SR)_m\)
- **SR**: Quantity computed from velocity equation and measured average velocity in the cross section
- **TOTLD**: Total sediment discharge of a size range, in tons per day
- **UNITBD**: Sediment discharge per unit width through the bed layer of particles of a size range, in pounds per foot of width
- **VALJ1**: Value of \(J_1^n\) or \(J_1^n\)
- **VALJ2**: Value of \(J_2^n\) or \(J_2^n\)
- **XR**: Dimensionless transition parameter
- **Z**: Value of \(z\) for a size range
- **ZS**: Sum of computed \(z\)'s for all size ranges
- **--**: Error message or footnote (formatted in FORTRAN program)
### DEFINITION OF PROGRAM MODE IN VARIABLES—Continued

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>MODIFIED</th>
<th>DEFINITION</th>
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<tbody>
<tr>
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<td>EINSTEIN SYMBOL</td>
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</tbody>
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**VARIABLES IN SUBROUTINE INPUT NOT IN COMMON BLOCKS /AA/, /BB/, /CC/**

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</tr>
<tr>
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<td>COMPL</td>
<td>--</td>
</tr>
<tr>
<td>DATE</td>
<td>DATE$</td>
<td>--</td>
</tr>
<tr>
<td>DN</td>
<td>DN</td>
<td>$d_n$</td>
</tr>
<tr>
<td>DS</td>
<td>DS</td>
<td>$d_s$</td>
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<td>X1</td>
<td>X1</td>
<td>--</td>
</tr>
<tr>
<td>X2</td>
<td>X2</td>
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<td>Y1</td>
<td>--</td>
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<tr>
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**VARIABLES IN SUBROUTINE SRCOMP NOT IN COMMON BLOCK /AA/**

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<td>NUM</td>
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</tr>
<tr>
<td>SGRAD</td>
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### VARIABLES IN SUBROUTINE SRCOMP NOT IN COMMON BLOCK /AA/—Continued

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<th>(SR)\textsubscript{m}</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>UPRIME</td>
<td>UPRIME</td>
<td>u\textsubscript{m}</td>
<td>Shear velocity, in feet per second</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>x</td>
<td>Dimensionless transition parameter</td>
</tr>
<tr>
<td>XCT</td>
<td>XCT</td>
<td>--</td>
<td>Previous value of x</td>
</tr>
</tbody>
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**PROGRAM MODIFIED EINSTEIN SYMBOL DEFINITION**

**VARIABLES IN SUBROUTINE FIG4**

| I  | --  | --  | Counter for values in array FX                                             |
| --  | I  | --  | Counter for values in array FIG4                                           |
| FA  | --  | --  | Intercept of a linear equation between FX values                          |
| FB  | --  | --  | Slope of a linear equation between FX values                              |
| FX  | --  | --  | Values of k\textsubscript{g}/\delta at endpoints of straight-line segment used to approximate Einstein's relation of k\textsubscript{g}/\delta versus x |
| --  | FIG4  | --  | Array containing values of k\textsubscript{g}/\delta at endpoints, intercepts, and slopes of straight-line segments used to approximate Einstein's relation of k\textsubscript{g}/\delta versus x |
| X  | BSDELT  | k\textsubscript{g}/\delta  | Value of D\textsubscript{65}/\delta                                      |
| Y  | X  | x  | Dimensionless transition parameter                                          |

**VARIABLES IN SUBROUTINE FIG10**

| I  | --  | --  | Counter for values in array FX                                             |
| --  | I  | --  | Counter for values in array FIG10                                           |
| FA  | --  | --  | Intercept of a linear equation between FX values                          |
| FB  | --  | --  | Slope of a linear equation between FX values                              |
| FX  | --  | --  | Values of \(\psi\)\textsubscript{m} at endpoints of straight-line segment used to approximate Einstein's relation of \(\psi\)\textsubscript{m} versus \(\phi\star\) |
| --  | FIG10  | --  | Array containing values of \(\psi\)\textsubscript{m} at endpoints, intercepts, and slopes of straight-line segments used to approximate Einstein's relation of \(\psi\)\textsubscript{m} versus \(\phi\star\) |
DEFINITION OF PROGRAM MODEIN VARIABLES--Continued

<table>
<thead>
<tr>
<th>PROGRAM MODIFIED</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORTRAN BASIC</td>
<td>EINSTEIN</td>
</tr>
<tr>
<td>SYMBOL</td>
<td></td>
</tr>
</tbody>
</table>

VARIABLES IN SUBROUTINE FIG10--Continued

| X     | PSI | $\psi_m$ | Function for correlating effect of flow with intensity of sediment transport for a size range |
| Y     | PHI | $\phi_*$ | Intensity of bed-load transport for a size range |

VARIABLES IN SUBROUTINE COMPZ NOT IN COMMON BLOCKS /AA/, /BB/:

| ADP   | ADP  | A"  | Value of 2D/d |
| COEFF | COEFF | --  | Coefficient to convert J values to I values |
| CONST | CONST | --  | Value of $Q_s/i_RQ_R$ |
| ERROR | ERROR | --  | Value of FZA-CONST |
| FCTR  | FCTR  | --  | The sign of ERROR times 1.0 |
| FZA   | FZA   | --  | Value of $I_f/J_f^1 (P_{j1} + J_{j2})$ for z value ZA |
| FZB   | FZB   | --  | Value of $I_f/J_f^2 (P_{j1} + J_{j2})$ for z value ZB |
| KOUNT | KOUNT | --  | Iteration counter |
| L     | I9    | --  | Size-range loop index |
| TOL   | TOL   | --  | Maximum allowable value of ERROR to stop z computation |
| VALJ1 | FJ1   | $J_1$ | Value of $J_1$ or $J_1''$ |
| VALJ2 | FJ2   | $J_2$ | Value of $J_2$ or $J_2''$ |
| Z     | $z_2$ | --  | Value of $z$ for a size range |
| ZA    | ZA    | --  | Value of first computed $z$ |
| ZB    | ZB    | --  | Value of second computed $z$ |
| ZDIFF | ZDIFF | --  | Value added or subtracted to the previous value of ZA to determine the new value of ZA |

VARIABLES IN SUBROUTINE ZFIT NOT IN COMMON BLOCKS /AA/, /CC/:

| AINT  | AINT | --  | Log of intercept in regression equation of the relation of $z$ versus fall velocity |
| K     | K    | --  | Size-range loop index |
| NUM   | NUM  | --  | Number of size ranges that have computed $z$ values |
| RS    | RS   | --  | Fall velocity of geometric mean size for the reference size range, in feet per second |
| SE    | SE   | --  | Value of $z$ for reference size range |
| SMALA | SMALA | --  | Antilog of AINT |
| SUMXY | SUMXY | --  | Sum of $XLN \times YLN$ values |
### DEFINITION OF PROGRAM MODE IN VARIABLES

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>MODIFIED</th>
<th>DEFINITION</th>
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#### VARIABLES IN SUBROUTINE ZFIT NOT IN COMMON BLOCKS `/AA/, `/CC`—Continued

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMXSQ</td>
<td>Sum squares of XLN values</td>
<td></td>
</tr>
<tr>
<td>XLN</td>
<td>Log of fall velocity of geometric mean size of a size range</td>
<td></td>
</tr>
<tr>
<td>XMEAN</td>
<td>Mean of XLM values</td>
<td></td>
</tr>
<tr>
<td>XZ</td>
<td>The 0.7 power of the ratio of the fall velocity for a size range to the fall velocity for the reference size range</td>
<td></td>
</tr>
<tr>
<td>YLN</td>
<td>Log of z of a size range</td>
<td></td>
</tr>
<tr>
<td>YMEAN</td>
<td>Mean of YLN values</td>
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</tbody>
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#### VARIABLES IN SUBROUTINE ZMBQB NOT IN COMMON BLOCKS `/AA/, `/BB/, `/CC`—Continued

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Variable</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ADP</td>
<td>Value of 2D/d</td>
<td></td>
</tr>
<tr>
<td>COEFF</td>
<td>Coefficient to convert J values to I values</td>
<td></td>
</tr>
<tr>
<td>COMP1</td>
<td>Temporary computation value</td>
<td></td>
</tr>
<tr>
<td>COMP2</td>
<td>Temporary computation value</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Temporary counter</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Size-range loop index</td>
<td></td>
</tr>
<tr>
<td>NZ</td>
<td>Temporary counter</td>
<td></td>
</tr>
<tr>
<td>VALJ1</td>
<td>Value of J{ or J}</td>
<td></td>
</tr>
<tr>
<td>VALJ2</td>
<td>Value of J' or J2'</td>
<td></td>
</tr>
<tr>
<td>Z1</td>
<td>Value of z for a size range</td>
<td></td>
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</tbody>
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#### VARIABLES IN SUBROUTINE POWER

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Value of ( d_{n}^{d_{s}} ) or 2D/d</td>
<td></td>
</tr>
<tr>
<td>AEX</td>
<td>Value of ( A_{E} )</td>
<td></td>
</tr>
<tr>
<td>ALG</td>
<td>Natural log of A</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Series solution term</td>
<td></td>
</tr>
<tr>
<td>CJ1</td>
<td>Absolute value of (1-XJ1/FJ1)</td>
<td></td>
</tr>
<tr>
<td>CJ2</td>
<td>Absolute value of (1-XJ2/FJ2)</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Series solution term</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Series solution term</td>
<td></td>
</tr>
<tr>
<td>FJ1</td>
<td>Value of J{ or J}</td>
<td></td>
</tr>
<tr>
<td>FJ2</td>
<td>Value of J' or J2'</td>
<td></td>
</tr>
<tr>
<td>FN</td>
<td>Real value of n</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Iteration counter</td>
<td></td>
</tr>
<tr>
<td>XJ1</td>
<td>Previous computed value of J{ or J}</td>
<td></td>
</tr>
<tr>
<td>XJ2</td>
<td>Previous computed value of J' or J2'</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>Value of z for a size range</td>
<td></td>
</tr>
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</table>

---

B 7
DEFINITION OF PROGRAM MODEIN VARIABLES—Continued

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<thead>
<tr>
<th>PROGRAM MODIFIED</th>
<th>EINSTEIN SYMBOL</th>
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<tr>
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<tr>
<td></td>
<td>BN</td>
</tr>
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<td></td>
<td>ERRTAB ERRTAB</td>
</tr>
<tr>
<td></td>
<td>T T</td>
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</table>

<table>
<thead>
<tr>
<th>VARIABLES IN SUBROUTINE ERRTAB</th>
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<tbody>
<tr>
<td>BM    BM    --</td>
</tr>
<tr>
<td>BN    BN    --</td>
</tr>
<tr>
<td>ERRTAB ERRTAB --</td>
</tr>
<tr>
<td>T T    --</td>
</tr>
</tbody>
</table>
PROGRAM MEPDATA

C ENTER MODIFIED EINSTEIN PROCEDURE DATA TO INPUT FILE MEP.DATA
C OR USER SPECIFIED FILE.
C
COMMON /AA/ LOC,DATE,VAL(13),SIZE(9,3),SIZELO(9),SIZEHI(9),
1 LABEL(15),NREC
CHARACTER*80 LOG
CHARACTER*10 DATE,DFILE
CHARACTER*5 LABEL
FORMAT (13)
2 FORMAT (1H1,'NUMBER DATA SETS = ',13 //)
3 FORMAT (1H ,2I4,4X,A5,4X,A80)
4 FORMAT (1H ,2I4,4X,A5,4X,A10)
5 FORMAT (1H ,2I4,4X,A5,4X,F10.3)
6 FORMAT (1H ,2I4,4X,F9.3,F10.3,2F6.0)
7 FORMAT (1H)
8 FORMAT (1H ,`DATA STORED ON FILE ` ,A10 / )
9 FORMAT (`ENTER SET NUMBER MAX =`,I4,** 0 TO END`)
10 FORMAT (`NUMBER DATA SETS =` ,I4)
11 FORMAT (`ENTER START SET NUMBER MAX =` ,I4)
12 FORMAT (`ENTER END SET NUMBER MAX =` ,I4)
DFILE=`MEP.DATA``
WRITE (1,*) `ENTER CODE FOR DATA FILE NAME:``
WRITE (1,*) `1 TO USE MEP.DATA`
WRITE (1,*) `2 TO ENTER FILE NAME`
READ (1,*) I
IF (I.LT.2) GO TO 50
WRITE (1,*) `ENTER FILE NAME``
READ (1,7) DFILE
50 WRITE (1,*),`ENTER: 1-START 2-ADD 3-CORRECT 4-LIST 5-PRINT``
READ (1,*) NC
IF (NC.EQ.1) GO TO 100
OPEN (10,FILE=DFILE,STATUS=``OLD`` ,ACCESS=``DIRECT`` ,RECL=40)
READ (10,REC=1) NSET
GO TO (100,70,200,300,400),NC
ADD DATA TO EXISTING FILE
70 NREC=NSET*5+1
GO TO 120
C START NEW FILE
100 NSET=0
NREC=1
OPEN (10,FILE=DFILE,STATUS=``NEW`` ,ACCESS=``DIRECT`` ,RECL=40)
GO TO 120
110 WRITE (1,*),`INPUT MORE DATA: 1 FOR YES 2 FOR NO``
READ (1,*) I
IF (I.GT.1) GO TO 180
120 NSET=NSET+1
130 CALL DAIN
140 CALL DALIST (NSET)
   WRITE (1,*), "1 FOR DATA OK"
   WRITE (1,*), "2 TO RE-ENTER COMPLETE SET OF DATA"
   WRITE (1,*), "3 TO CORRECT PART OF DATA SET"
   READ (1,*), I
   GO TO (160,130,150), I
150 CALL DACORR (NSET)
   GO TO 140
160 CALL DWRITE
   GO TO 110
180 WRITE (1,10) NSET
   READ (1,*) NS
   IF (NS.EQ.0) GO TO 190
   IF (NS.GT.NSET) GO TO 200
   NREC=(NS-1)*5+1
   CALL DAREAD
   CALL DACORR (NS)
   NREC=(NS-1)*5+1
   CALL DWRITE
   GOTO 200
300 WRITE (1,11) NSET
   READ (1,*) NS1
   IF (NS1.GT.NSET) GO TO 300
   NREC=(NS1-1)*5+1
   CALL DAREAD
   CALL DALIST (NS1)
   WRITE (1,*), "ENTER NUMBER TO CONTINUE"
   READ (1,*), I
   GOTO 190
310 WRITE (1,12) NSET
   READ (1,*) NS2
   IF (NS2.GT.NSET) GO TO 310
   DO 320 NS=NS1,NS2
   CALL DAREAD
   CALL DALIST (NS)
   WRITE (1,*), "ENTER NUMBER TO CONTINUE"
   READ (1,*), I
   GOTO 190
320 CONTINUE
   GO TO 190
C LIST DATA ON SCREEN
330 WRITE (1,11) NSET
   READ (1,*) NS1
   IF (NS1.GT.NSET) GO TO 330
   NREC=(NS1-1)*5+1
   CALL DAREAD
   CALL DALIST (NS1)
   WRITE (1,*), "ENTER NUMBER TO CONTINUE"
   READ (1,*), I
   GOTO 190
C LIST DATA ON PRINTER
C OUTPUT IS ON FILE MEPDATA.LIST
400 WRITE (1,11) NSET
   READ (1,*) NS1
IF (NS1.GT.NSET) GO TO 400
     NREC=(NS1-1)*5+1
410 WRITE (1,12) NSET
     READ (1,*) NS2
     IF (NS2.GT.NSET) GO TO 410
     OPEN (11,FILE='MEPDATA.LIST',STATUS='NEW')
     WRITE (11,2) NSET
     DO 480 NS=NS1,NS2
        CALL DAREAD
        NR=1
        WRITE (11,3) NS,NR,LABEL(1),LOC
        NR=2
        WRITE (11,4) NS,NR,LABEL(2),DATE
        DO 430 I=1,13
           NR=NR+1
           WRITE (11,5) NS,NR,LABEL(NR),VAL(I)
430 CONTINUE
        DO 450 I=1,9
           NR=NR+1
           WRITE (11,6) NS,NR,SIZELO(I),SIZEHI(I),(SIZE(I,J),J=1,3)
450 CONTINUE
480 CONTINUE
     CLOSE (11)
     GO TO 190
END

BLOCK DATA
COMMON /AA/ LOC,DATE,VAL(13),SIZE(9,3),SIZELO(9),SIZEHI(9),
1 LABEL(15),NREC
CHARACTER*80 LOG
CHARACTER*10 DATE
CHARACTER*5 LABEL
DATA LABEL /" LOG"," DATE"," TIME"," DISCH"," WIDTH"," DEPTH",
1" TEMP"," ZMEAS"," REFZ"," PCTZ"," D35"," D65"," CONC"," DS",
2" DN"/
DATA SIZELO /0.002,0.062,0.125,0.25,0.5,1.,2.,4.,8./
DATA SIZEHI /0.062,0.125,0.25,0.5,1.,2.,4.,8.,16./
END

SUBROUTINE DAIN
C
INPUT ONE SET OF DATA
COMMON /AA/ LOC,DATE,VAL(13),SIZE(9,3),SIZELO(9),SIZEHI(9),
1 LABEL(15),NREC
CHARACTER*80 LOC
CHARACTER*10 DATE

C 3
FORTRAN PROGRAM MEPDATA LISTING—Continued

CHARACTER*5 LABEL
1 FORMAT (A80)               DAIN 70
2 FORMAT (A10)               DAIN 80
3 FORMAT (F10.0)             DAIN 90
4 FORMAT ('ENTER Z VALUE FOR ',F6.3,' TO ',F6.3, (0 FOR NONE)') DAIN 100
5 FORMAT ('ENTER % SUSP MATERIAL FOR ',F6.3,' TO ',F6.3, DAIN 110
1  (0 FOR NONE)')          DAIN 120
6 FORMAT ('ENTER % BED MATERIAL FOR ',F6.3,' TO ',F6.3, DAIN 130
1  (0 FOR NONE)')          DAIN 140
WRITE (1,*) 'ENTER LOCATION NAME (MAX 80 CHARACTERS)' DAIN 150
READ (1,1,ERR=999) LOG     DAIN 160
WRITE (1,*) 'ENTER MEASUREMENT DATE (MM/DD/YY)' DAIN 170
READ (1,2,ERR=999) DATE     DAIN 180
WRITE (1,*) 'ENTER MEASUREMENT TIME (2400 HR)' DAIN 190
READ (1,3,ERR=999) VAL(1)   DAIN 200
WRITE (1,*) 'ENTER WATER DISCHARGE (CFS)' DAIN 210
READ (1,3,ERR=999) VAL(2)   DAIN 220
WRITE (1,*) 'ENTER TOP WIDTH (FEET)' DAIN 230
READ (1,3,ERR=999) VAL(3)   DAIN 240
WRITE (1,*) 'ENTER AVERAGE DEPTH (FEET)' DAIN 250
READ (1,3,ERR=999) VAL(4)   DAIN 260
WRITE (1,*) 'ENTER WATER TEMPERATURE (DEG C)' DAIN 270
READ (1,3,ERR=999) VAL(5)   DAIN 280
WRITE (1,*) 'INPUT Z VALUES: ENTER 0 FOR NO OR 1 FOR YES' DAIN 290
READ (1,3,ERR=999) ZI       DAIN 300
VAL(6)=ZI                   DAIN 310
ZR=0                       DAIN 320
IF (ZI.GT.0.0) GO TO 70     DAIN 330
WRITE (1,*) 'REFERENCE SIZE SELECTION. ENTER:' DAIN 340
WRITE (1,*) ' 0 FOR PROGRAM SELECTION OF A SINGLE SIZE RANGE' DAIN 350
WRITE (1,*) ' 1-9 FOR NUMBER OF THE SELECTED SIZE RANGE' DAIN 360
WRITE (1,*) '-1 FOR PROGRAM SELECTION OF ALL SUITABLE SIZE RANGES' DAIN 370
READ (1,3,ERR=999) ZR      DAIN 380
70 VAL(7)=ZR                DAIN 390
DA=3                       DAIN 400
IF (ZR.GE.0.0) GO TO 80     DAIN 410
WRITE (1,*) 'ENTER Z COMP LIMIT (1-3%)' DAIN 420
READ (1,3,ERR=999) DA      DAIN 430
WRITE (1,*) 'ENTER D35 (MM) - 0 FOR PROGRAM DETERMINATION' DAIN 440
READ (1,3,ERR=999) VAL(9)  DAIN 450
WRITE (1,*) 'ENTER D65 (MM) - 0 FOR PROGRAM DETERMINATION' DAIN 460
READ (1,3,ERR=999) VAL(10) DAIN 470
WRITE (1,*) 'ENTER SUSPENDED SEDIMENT CONC. (MG/L)' DAIN 480
READ (1,3,ERR=999) VAL(11) DAIN 490
WRITE (1,*) 'ENTER AVERAGE DEPTH AT SAMPLED VERTICALS (FT)' DAIN 500
READ (1,3,ERR=999) VAL(12) DAIN 510
C 4
WRITE (1,*) 'ENTER DISTANCE BETWEEN BOTTOM SAMPLED ZONE AND BED (FDAIN 550 IT)' DAIN 560
READ (1,3,ERR=999) VAL(13) DAIN 570
DO 110 I=1,9 DAIN 580
SIZE(I,1)=0.0 DAIN 590
IF (ZI.EQ.0.0) GO TO 90 DAIN 600
WRITE (1,4) SIZELO(I),SIZEHI(I) DAIN 610
READ (1,3,ERR=999) SIZE(I,1) DAIN 620
90 WRITE (1,5) SIZELO(I),SIZEHI(I) DAIN 630
READ (1,3,ERR=999) SIZE(I,2) DAIN 640
WRITE (1,6) SIZELO(I),SIZEHI(I) DAIN 650
READ (1,3,ERR=999) SIZE(I,3) DAIN 660
110 CONTINUE DAIN 670
RETURN DAIN 680
999 WRITE (1,*) 'STOPPED ON INPUT ERROR' DAIN 690
ENDFILE (10) DAIN 700
CLOSE (10) DAIN 710
CALL EXIT DAIN 720
END DAIN 730

SUBROUTINE DWRITE WRIT 10
WRITE ONE SET OF DATA TO FILE WRIT 20
COMMON /AA/ LOC,DATE,VAL(13),SIZE(9,3),SIZELO(9),SIZEHI(9), WRIT 30
1 LABEL(15),NREC WRIT 40
CHARACTER*80 LOC WRIT 50
CHARACTER*10 DATE WRIT 60
CHARACTER*5 LABEL WRIT 70
NREC=NREC+1 WRIT 80
WRITE (10,REC=NREC) LOC WRIT 90
NREC=NREC+1 WRIT 100
WRITE (10,REC=NREC) DATE WRIT 110
NREC=NREC+1 WRIT 120
WRITE (10,REC=NREC) (VAL(I),I=1,13) WRIT 130
NREC=NREC+1 WRIT 140
WRITE (10,REC=NREC) ((SIZE(I,J),J=1,3),I=1,5) WRIT 150
NREC=NREC+1 WRIT 160
WRITE (10,REC=NREC) ((SIZE(I,J),J=1,3),I=6,9) WRIT 170
RETURN WRIT 180
END WRIT 190

SUBROUTINE DAREAD READ 10
READ ONE SET OF DATA FROM FILE READ 20
COMMON /AA/ LOC,DATE,VAL(13),SIZE(9,3),SIZELO(9),SIZEHI(9), READ 30
1 LABEL(15),NREC READ 40
CHARACTER*80 LOC READ 50
SUBROUTINE DACORR (NSET)
C CORRECT ONE SET OF DATA
COMMON /AA/ LOC,DATE,VAL(13),SIZE(9,3),SIZELO(9),SIZEHI(9),
1 CHARACTER*80 LOC
2 CHARACTER*10 DATE
3 CHARACTER*5 LABEL
4 FORMAT (A80)
5 FORMAT (T10.3)
6 FORMAT (T10.0)
100 CALL DALIST (NSET)
WRITE (1,*)'ENTER VALUE NUMBER (1-24) 0 TO END'
READ (1,*) L
IF (L.EQ.0) RETURN
IF (L.GT.24) GO TO 100
IF (L.GT.1) GO TO 120
WRITE (1,*)'OLD LOCATION NAME IS '
WRITE (1,2) LOC
WRITE (1,*)'ENTER NEW LOCATION NAME'
READ (1,2) LOC
GOTO 100
120 IF (L.GT.2) GO TO 130
WRITE (1,*)'OLD MEASUREMENT DATE IS '
WRITE (1,3) DATE
WRITE (1,*)'ENTER NEW MEASUREMENT DATE'
READ (1,3) DATE
GO TO 100
130 IF (L.GT.15) GO TO 140
I=L-2
WRITE (1,*), 'OLD VALUE IS'
WRITE (1,4), VAL(I)
WRITE (1,*), 'ENTER NEW VALUE'
READ (1,5), VAL(I)
GO TO 100
140 I=L-15
150 WRITE (1,*), 'ENTER: 1-Z VAL 2-% SUSP 3-% BED OR 0 TO END'
READ (1,*), L
IF (L.EQ.0) GO TO 100
IF (L.GT.3) GO TO 150
IF (L.GT.1) GO TO 160
WRITE (1,*), 'OLD VALUE IS'
WRITE (1,4), SIZE(I,L)
WRITE (1,*), 'ENTER NEW VALUE'
READ (1,5), SIZE(I,L)
GO TO 150
160 WRITE (1,*), 'OLD VALUE IS'
WRITE (1,5), SIZE(I,L)
WRITE (1,*), 'ENTER NEW VALUE'
READ (1,5), SIZE(I,L)
GOTO 150
END

SUBROUTINE DALIST (NSET)
LIST ONE SET OF DATA ON SCREEN
COMMON /AA/ LOC,DATE,VAL(13),SIZE(9,3),SIZELO(9),SIZEHI(9),
LABEL(15),NREC
CHARACTER*80 LOG
CHARACTER*10 DATE
CHARACTER*5 LABEL
1 FORMAT ('SET NUMBER',14)
2 FORMAT (I2,2X,A5,1X,A80)
3 FORMAT (I2,2X,A5,4X,A10,6X,I2,2X,A5,F10.0)
4 FORMAT (I2,2X,A5,F10.3,10X,I2,2X,A5,F10.3)
5 FORMAT (I2,2F9.3,F8.2,2F6.0)
WRITE (1,1) NSET
L1=1
WRITE (1,2) L1,LABEL(L1),LOC
L1=2
L2=3
WRITE (1,3) L1,LABEL(L1),DATE,L2,LABEL(L2),VAL(1)
DO 50 I=2,13,2
L1=L1+2
C7
L2 = L2 + 2
WRITE (1,4) L1, LABEL(L1), VAL(I), L2, LABEL(L2), VAL(I+1)
LIST 210
LIST 220
50 CONTINUE
LIST 230
DO 60 I = 1, 9
LIST 240
L2 = L2 + 1
LIST 250
WRITE (1,5) L2, SIZELO(I), SIZEHI(I), (SIZE(I, J), J = 1, 3)
LIST 260
LIST 270
60 CONTINUE
LIST 280
RETURN
LIST 290
END
SUPPLEMENTAL DATA—SECTION D.

FORTRAN PROGRAM MODEIN LISTING

PROGRAM MODEIN

COMPUTE TOTAL SEDIMENT DISCH BY THE MODIFIED EINSTEIN PROCEDURE

INPUT DATA IS READ FROM FILE MEP.DATA OR USER NAMED FILE

OUTPUT IS WRITTEN ON FILE MEP.OUT OR USER NAMED FILE

SUBPROGRAMS CALLED:

INPUT

SRCOMP

FIG4

FIG10

COMPZ

ZFIT

ZMIBQB

POWER

ERRTAB

COMMON /AA/ APRIME, AREA, CONC, D35, D65, DEPTH, DISCH, MODE, PCTZ, QSM, SUM(5), UBAR, VISC, WIDTH

COMMON /BB/ BIBQB(9), DIAM(9), PIB(9), PIS(9), PVALUE, QPRIMS(9), SIZEHI(9), SIZELO(9)

COMMON /CC/ NRSIZE, NSR, VS(9), ZC(9), ZE(9), ZMEAS, ZMULT(9), ZSLOPE

DIMENSION FIDP(9), FJDP(9), ITLD(9), TOILD(9)

CHARACTER*10 DFILE, OFILE

PROGRAM VARIABLES ARE INITIALIZED.

DFILE = 'MEP.DATA'

WRITE (1, *) 'ENTER CODE FOR DATA FILE NAME'

WRITE (1, *) '1 TO USE MEP.DATA'

WRITE (1, *) '2 TO ENTER FILE NAME'

READ (1,*) I

IF (I.LT.2) GO TO 2

WRITE (1,*) 'ENTER DATA FILE NAME'

READ (1,620) DFILE

2 OPEN (5, FILE = DFILE, STATUS = 'OLD', FORM = 'UNFORMATTED')

WRITE (1, *) 'ENTER CODE FOR OUTPUT FILE NAME'

WRITE (1, *) '1 TO USE MEP.OUT'

WRITE (1, *) '2 TO ENTER FILE NAME'

READ (1,*) I

IF (I.LT.2) GO TO 5

WRITE (1,*) 'ENTER OUTPUT FILE NAME'

READ (1,620) OFILE

5 OPEN (6, FILE = OFILE, STATUS = 'NEW')

READ (5) NCOMP1
NCOMP2=0
10 NCOMP2=NCOMP2+1
MODE = 1
ZSLOPE = 0
DO 20 K = 1,9
BIBQB(K) = 0.0
FIDP(K) = 0.0
FJDP(K) = 0.0
ITLD(K) = 1
PIB(K) = 0.0
PIS(K) = 0.0
QPRIMS(K) =0.0
TOTLD (K) = 0.0
VS(K) =0.0
ZC(K) = 0.0
ZE(K) = 0.0
ZMULT(K) =0.0
20 CONTINUE
DO 30 I=1,5
SUM(I) =0.0
30 CONTINUE
CALL INPUT (DFILE)
IF (MODE.EQ.10) GO TO 455
DETERMINE REFERENCE SIZE IF NOT SUPPLIED
IF (ZMEAS.EQ.0.0) GO TO 50
NRSIZE = -1
ZMEAS =0.0
DO 40 K=1,NSR
IF (ZE(K).EQ.O.O) GO TO 40
ZC(K) = ZE(K)
ZMEAS = ZMEAS + 1.0
J = K
40 CONTINUE
IF (ZMEAS.LT.2.0) NRSIZE = J
50 IF (NRSIZE) 70,60,90
60 NRSIZE = 1
70 COMP1 = 0
DO 80 K=2,NSR
IF (PIS(K).LT.3.0.OR.PIB(K).LT.3.0) GO TO 80
COMP2 = PIS(K)+PIB(K)
IF (COMP2.LT.COMP1) GO TO 80
J = K
80 CONTINUE
COMP1 = COMP2
80 CONTINUE
NRSIZE = ISIGN(J,NRSIZE)
C
C COMPUTE SRM BY ITERATION

FORTRAN PROGRAM MODEIN LISTING--Continued

C

90 CALL SRCOMP (SR,XR)
IF (MODE.EQ.10) GO TO 455
COMP1 = 30.2 * XR * DEPTH / D65
PVALUE = 2.302594 * ALOG10 ( COMP1 )
COMP1 = PVALUE - 1.0
PCTQ = 0.0
IF (COMP1.EQ.0.0) GO TO 100
PCTQ = 1.0 - APRIME * (COMP1 + ALOG (APRIME)) / COMP1
100 CONST = PCTQ * QSM * 0.01
SHEAR = 0.0
IF (SR.LE.0.0) GO TO 110
SHEAR = 1.65 * D35 / SR
C

C COMPUTE QPRIMS, IBQB, AND SED FALL VEL FOR EACH SIZE RANGE
C

110 COMP2 = 6.0 * VISC
DO 140 K=1,NSR
QPRIMS (K) = CONST * PIS(K)
SUM(4) = SUM(4) + QPRIMS(K)
VS(K) = ((36.064*DIAM(K)**3 + COMP2**2)**0.5 - COMP2) / DIAM(K)
IF (PIB(K).EQ.O.O) GO TO 140
COMP1 = 0.66 * DIAM(K) / SR
IF (COMP1.LT. SHEAR) GO TO 120
PSI = COMP1
GO TO 130
120 PSI = SHEAR
IF ( PSI .GE. 25.0 ) GO TO 140
130 CALL FIG10 (PSI,PHI)
UNITBD = 12.0*DIAM(K)**1.5 * PIB(K) * PHI/2.0
BIBQB(K) = AINT(UNITBD*43200.0*WIDTH) / 1000.0
SUM(3) = SUM(3) + BIBQB(K)
CONTINUE

140 CONTINUE
IF (SUM(3).GT.0.0) GO TO 190
DO 170 K=1,NSR
TOTLD(K) = QSM * PIS(K) * 0.01
SUM(5) = SUM(5) + TOTLD(K)
CONTINUE
MODE = 2
170 CONTINUE
NRSIZE = 0
GO TO 290
C

C COMPUTE AND FIT Z VALUES
C

190 IF (ZMEAS.GT.0.0) GO TO 220
IF (NRSIZE.LE.0) GO TO 200
CALL COMPZ (Z,NRSIZE)
IF (MODE.EQ.3) GO TO 290
ZC(NRSIZE) = Z
D 3
FORTRAN PROGRAM MODEIN LISTING--Continued

GO TO 230

200 ZS = 0.0
DO 210 K=2,NSR
   J = K
   IF (BIBQB(K).EQ.0.0) GO TO 210
   IF (PIS(K).LT.PCTZ) GO TO 210
   IF (PIB(K).LT.PCTZ) GO TO 210
   CALL COMPZ (Z, J)
   IF (MODE.EQ.3) GO TO 290
   ZC(K) = Z
   ZS = ZS + Z
210 CONTINUE
IF (ZS.GT.0.0) GO TO 230
   MODE = 4
   GO TO 290
220 CALL ZMIBQB
230 CALL ZFIT
IF (MODE.EQ.5) GO TO 290

C
C COMPUTE TOTAL DISCHARGE FOR EACH SIZE RANGE
C
N1 = IABS(NRSIZE)
DO 270 K=1,NSR
   ADP = 2.0 * DIAM(K) / DEPTH
   Z = ZC(K)
   COMP1 = 0.0
   VALJ1 = 0.0
   VALJ2 = 0.0
   IF (PIS(K).EQ.0.0) GO TO 240
   CALL POWER ( APRIME , Z , VALJ1 , VALJ2 )
   COMP1 = PVALUE * VALJ1 + VALJ2
   COMP2 = 0.0
   VALJ1 = 0.0
   VALJ2 = 0.0
   CALL POWER ( ADP , Z , VALJ1 , VALJ2 )
   COMP2 = PVALUE * VALJ1 + VALJ2
   FJDP(K) = COMP2 / COMP1
   IF (FJDP(K).LT.1.00) FJDP(K) = 1.00
   TOTLD(K) = FJDP(K) * QPRIMS(K) + BIBQB(K)
240 IF (K.LT.N1) GO TO 270
   IF (PIB(K).EQ.0.0) GO TO 270
   FIDP(K) = 1.00
   IF (Z.GE.10.0) GO TO 260
   COEFF = 0.216 * ADP **(Z- 1.0) / (1.0 - ADP) ** Z
   IF (VALJ1.GT.0.0) GO TO 250
   CALL POWER ( ADP , Z , VALJ1 , VALJ2 )
   FIDP(K) = COEFF * ( PVALUE * VALJ1 + VALJ2 ) + 1.0
250 FIDP(K) = TOTLD(K) = FIDP(K) * BIBQB(K)
260 TOTLD(K) = FIDP(K) * BIBQB(K)
270 CONTINUE
FORTRAN PROGRAM MODEIN LISTING—Continued

N1 = 0
DO 280 K=1,NSR
QMEAS = QSM * PIS(K) * 0.01
IF (TOTLD(K).GE.QMEAS) GO TO 280
N1 = N1 + 1
TOTLD(K) = QMEAS
ITLD(K) = 2
280 SUM(5) = SUM(5) + TOTLD(K)
IF (N1.GT.O) MODE = 6
PRINT RESULTS
290 RSL = 0.0
RSH = 0.0
IF (NRSIZE) 320,310,300
300 RSL = SIZELO(NRSIZE)
RSH = SIZEHI(NRSIZE)
310 WRITE (6,460) RSL,RSH,PVALUE
GO TO 330
320 WRITE (6,470) PVALUE
GO TO 330
330 COMP1 = DEPTH/D65
PCTQ = PCTQ*100.0
WRITE (6,480) PCTQ,XR,COMP1,ZSLOPE
IF (NRSIZE.LT.O) WRITE (6,550)
IF (ZMEAS.EQ.0.0) GO TO 340
GO TO 350
340 WRITE (6,500)
GO TO 350
350 DO 380 K=1,NSR
IF (ZE(K).EQ.0.0) GO TO 370
360 WRITE (6,510) SIZELO(K),SIZEHI(K),PIS(K),PIB(K),BIBQB(K),
1 QPRIMS(K),ZMULT(K),ZE(K),ZC(K),FJDP(K),FIDP(K),TOTLD(K)
GO TO 375
370 WRITE (6,520) SIZELO(K),SIZEHI(K),PIS(K),PIB(K),BIBQB(K),
1 QPRIMS(K),ZMULT(K),ZC(K),FJDP(K),FIDP(K),TOTLD(K)
375 IF (ITLD(K).EQ.2) WRITE (6,525)
380 CONTINUE
WRITE (6,530) (SUM(K), K = 1,5)
GO TO (455,390,420,430,440,450),MODE
390 WRITE (6,540)
GO TO 455
420 WRITE (6,570)
GO TO 455
430 WRITE (6,580)
GO TO 455
440 WRITE (6,590)
GO TO 455
450 WRITE (6,600)
455 IF (NCOMP2.LT.NCOMP1) GO TO 10
ENDFILE (6)
CLOSE (5)
CLOSE (6)
WRITE (1,630) OFILE
WRITE (1,*) 'END OF RUN'
CALL EXIT

FORMAT STATEMENTS

460 FORMAT (' REFERENCE SIZE RANGE 'F8.4,' -','F8.4,' MM',11X,
1 'P-FACTOR',7X,F7.2 )
470 FORMAT (' REFERENCE SIZE RANGE - MULTIPLE',22X,'P-FACTOR',7X,F7.2)
480 FORMAT (' PERCENT OF FLOW SAMPLED','F6.2,' %',22X,'X-FACTOR',F9.2 )
1 ' DEPTH/KS ',F10.1,34X,'Z SLOPE','F8.2 )
490 FORMAT (' SIZE RANGE PERCENT IN RANGE IBQB 
1MEASURED SUSPENDED BED T/D RATIO ENTERED COMP. F(J ) F(I )+1 DISCH MAIN2610
4(T/D) '/ )
500 FORMAT (' SIZE RANGE PERCENT IN RANGE IBQB QPRIMAIN2580
1ME MULT. Z - VALUES COMPUTATIONAL FACTORS COMP TMAIN2590
2TOTAL '/ IN MILLIMETERS SUSPENDED BED T/D SUBSMAIN2600
3(T/D) RATIO ENTERED COMP. F(J ) F(I )+1 DISCH MAIN2610
4(T/D) '/ )
1 F13.2,F12.1 )
1 F12.1 )
525 FORMAT (1H+,125X,'*')
540 FORMAT ('/ 1HO,'IBQB VALUES EQUAL ZERO. TOTAL DISCHARGE EQUAL TO MAIN2740
1MEASURED SUSPENDED-SEDIMENT DISCHARGE. ')
550 FORMAT (1H+,72X,'BY REGRESSION')
560 FORMAT (1H+,72X,'BY REGRESSION')
570 FORMAT (1H+,72X,'BY REGRESSION')
580 FORMAT ('/ 46HO**** EXECUTION ABORTED FOR THIS JOB BECAUSE / MAIN2770
11H ´ NO CONVERGENCE IN Z COMPUTATION ´)
590 FORMAT ('/ 46HO**** EXECUTION ABORTED FOR THIS JOB BECAUSE / MAIN2810
11H ´ NO CONVERGENCE IN Z COMPUTATION ´)
590 FORMAT ('/ 46HO**** EXECUTION ABORTED FOR THIS JOB BECAUSE / MAIN2810
11H ´ NO CONVERGENCE IN Z COMPUTATION ´)
600 FORMAT ('/ 1HO, ´ * MEASURED SUSPENDED-SEDIMENT DISCHARGE -- WHICH MAIN2830
1EXCEEDS COMPUTED DISCHARGE (REVIEW COMPUTATION). ´)
610 FORMAT (13)
620 FORMAT (A10)
630 FORMAT (1H ,'OUTPUT ON FILE ',A10 / )
END
FORTRAN PROGRAM MODEIN LISTING—Continued

```
BLOCK DATA

INPUT SIZE RANGE LIMITS IN MM AND GEOMETRIC MEAN DIAMETERS IN FT.

COMMON /BB/ BIBQB(9),DIAM(9),PIB(9),PIS(9),PVALUE,QPRIMS(9),
  SIZEHI(9),SIZELO(9)

DATA SIZELO / 0.002, 0.0625, 0.125, 0.25, 0.5, 1., 2., 4., 8. /
DATA SIZEHI / 0.0625, 0.125, 0.25, 0.5, 1., 2., 4., 8., 16. /
DATA DIAM / 0.000036, 0.00029, 0.00058, 0.00116, 0.00232, 0.00464,
  0.00928, 0.01856, 0.03712 /

END

SUBROUTINE INPUT (DFILE)

THIS SUBROUTINE READS DATA FROM INPUT FILE MEP.DATA

COMMON /AA/ APRIME,AREA,CONC,D35,D65,DEPTH,DISCH,MODE,PCTZ,QSM,
  SUM(5),UBAR,VISC,WIDTH

COMMON /BB/ BIBQB(9),DIAM(9),PIB(9),PIS(9),PVALUE,QPRIMS(9),
  SIZEHI(9),SIZELO(9)

COMMON /CC/ NRSIZE,NSR,VS(9),ZC(9),ZE(9),ZMEAS,ZMULT(9),ZSLOPE
CHARACTER*80 LOG
CHARACTER*10 DATE,DFILE

READ (5,ERR=80,END=90) LOG
READ (5,ERR=90,END=90) DATE
READ (5,ERR=80,END=90) TIME,DISCH,WIDTH,DEPTH,TEMPER,ZMEAS,
  REFSIZE,PCTZ,D35,D65,CONC,DS
READ (5,ERR=80,END=90) (ZE(K),PIS(K),PIB(K),K=1,5)
READ (5,ERR=80,END=90) (ZE(K),PIS(K),PIB(K),K=6,9)
WRITE (6,240) LOG
ITIME=INT(TIME)
WRITE (6,250) DATE, ITIME
NRSIZE=INT(REFSIZE)
NSR=0
IF (DN.EQ.O.O.OR.DS.EQ.O.O) GO TO 120
IF (DEPTH.EQ.O.O.OR.WIDTH.EQ.O.O) GO TO 140
DO 20 K=1,9
  SUM(1) = SUM(1) + PIS(K)
  SUM(2) = SUM(2) + PIB(K)
  IF (SUM(2).GE.100.0) GO TO 30
20 CONTINUE
30 NSR = K
  IF (SUM(2).NE.100.0) GO TO 130
  IF (SUM(1).NE.100.0) GO TO 130
50 IF (D35.GT.O.O) GO TO 68
```

D 7
IND=1
PCT=0.35

52 SUMBED=0.0
DO 66 K=1,NSR
  SUMBED=SUMBED+PIB(K)/100.0
  IF (SUMBED.EQ.PCT) GO TO 62
  IF (SUMBED.LT.PCT) GO TO 66
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
54 BM=SUMBED-PIB(K)/100.0
  IF (BM.LE.0.0) GO TO 64
  Y1=ERRTAB(BM)
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54
  X2=ALOG10(SIZEHI(K))
  X1=ALOG10(SIZELO(K))
  IF (K.NE.1) GO TO 54

64 Y1=-1.0
  GO TO 56
66 CONTINUE
  GO TO 150

68 IF (D65.GT.0.0) GO TO 70
  IND=2
  PCT=0.65
  GO TO 52
70 COMP1 = 1.0334 + 0.03672*TEMPER + 0.0002058*TEMPER*TEMPER
  VISCI = 0.00002 / COMP1
  QSM = DISCH * CONC * 0.0027
  AREA = DEPTH * WIDTH
  UBAR = DISCH / AREA
  APRIME = DN/DS
  WRITE (6,320) DISCH,D65,AREA,D35,WIDTH,DS,UBAR,DISCH,DEPTH,CONC,
  TEMPER,QSM,VISC,APRIME
  D35 = D35 / 304.8
  D65 = D65 / 304.8
  RETURN
C
C ERROR MESSAGES FOR THIS SUBROUTINE ARE GENERATED HERE
C
80 WRITE (6,260) DFILE
  GO TO 110
90 WRITE (6,270) DFILE
110 ENDFILE 6
  CLOSE (5)
CLOSE (6)
WRITE (1,330) OFILE
WRITE (1,*) 'END OF RUN'
CALL EXIT
120 WRITE (6,280)
GO TO 160
130 WRITE (6,290)
GO TO 160
140 WRITE (6,300)
GO TO 160
150 WRITE (6,310)
160 MODE=10
RETURN

FORMAT STATEMENTS

200 FORMAT ( A80 )
210 FORMAT ( A10 )
220 FORMAT ( F10.3 )
230 FORMAT ( F10.3,2F10.0 )
240 FORMAT ( 1H1,' U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION '/\n
11H0,22X,'** DETERMINATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED\n
2IED EINSTEIN PROCEDURE **' / 1H0,25X,A80 // )
250 FORMAT (' DATE OF MEASUREMENT ',A10,22X,'TIME OF MEASUREMENT ', INPT1070
1 15 )
260 FORMAT ( // 46HO***** EXECUTION ABORTED FOR THIS JOB BECAUSE / INPT1080
11H , OF READ ERROR ON INPUT FILE ',A10 )
270 FORMAT ( // 46HO***** EXECUTION ABORTED FOR THIS JOB BECAUSE / INPT1090
11H , OF END-OF-FILE ON INPUT FILE ',A10 )
280 FORMAT ( // 46HO***** EXECUTION ABORTED FOR THIS JOB BECAUSE / INPT1100
11H , EITHER DSUBS OR DSUBN IS EQUAL TO ZERO')
290 FORMAT ( // 46HO***** EXECUTION ABORTED FOR THIS JOB BECAUSE / INPT1110
11H , SUM OF MATERIAL IN BED OR SUSPENSION IS NOT 100')
300 FORMAT ( // 46HO***** EXECUTION ABORTED FOR THIS JOB BECAUSE / INPT1120
11H , EITHER DEPTH OR WIDTH ARE EQUAL ZERO')
310 FORMAT ( // 46HO***** EXECUTION ABORTED FOR THIS JOB BECAUSE / INPT1130
11H , CANNOT CALCULATE EITHER D35 OR D65")
320 FORMAT ( ` WATER DISCHARGE ',F9.1,' CFS',24X,'D65 ',F8.3,' MM ' INPT1140
1 / ' AREA',8X,F10.2,' SQFT',26X,'D35 ',F8.3,' MM ' / INPT1150
2 ' WIDTH ',10X,F7.1,' FT ',26X,'DISTANCE BETWEEN BOTTOM SAMPLED ZO INPT1160
3NE AND BED',F7.2,' FT '/ ' AVERAGE VELOCITY ',F6.2,' FT/SEC',23X,INPT1170
4 'AVERAGE DEPTH AT SAMPLED VERTICALS ',F7.2,' FT '/ ' AVERAGE DEPTH INPT1180
5H ',F10.2,' FT ',25X,'MEASURED SUSP-SED CONC ',F9.0,' MG/L'/ INPT1190
6 ' WATER TEMPERATURE ',F7.1,' C',27X,'MEASURED SUSP-SED DISCH ',F12.1,INPT1200
7,' T/D '/ ' KINEMATIC VISCOSITY ',F13.7,' SQFT/SEC',12X,'APRIME ',FINPT1210
89.3 )
330 FORMAT ( 1H , OUTPUT ON FILE ',A10 / )
END
SUBROUTINE SRCOMP (SR,X)

THIS SUBROUTINE COMPUTES X, SR, SHEAR VELOCITY, AND THICKNESS
OF LAMINAR SUBLAYER

SUBPROGRAMS CALLED:
  Fig4

COMMON /AA/ APRIME,AREA,CONC,D35,D65,DEPTH,DISCH,MODE,PCTZ,QSM,
  SUM(5),UBAR,VISC,WIDTH

BSDELT = 0.0
X = 1.54
NUM = 0
XCK = 0.0

10 IF ((12.27*X*DEPTH/D65).LE.0.000009) GO TO 60
  COM1 = 32.63 * ALOG10 (12.27 * X * DEPTH / D65 )
  SGRAD = UBAR / COM1
  SR = SGRAD * SGRAD
  UPRIME = SGRAD * 5.68
  IF (((UPRIME).EQ.0.0) GO TO 40
  DELTA = 11.6 * VISC / UPRIME
  IF (((DELTA) .EQ.0.0) GO TO 50
  BSDELT = D65 / DELTA
  XCK = X
  CALL FIG4 (BSDELT,X)
  ERROR = ABS (X - XCK)
  IF (ERROR.GT.0.05) GO TO 20
  WRITE (6,110) DELTA, UPRIME
  RETURN

20 NUM = NUM + 1
  IF (NUM.LT.15) GO TO 10
  ERROR MESSAGES FOR THIS SUBROUTINE ARE GENERATED HERE
  WRITE (6,70)
  30 MODE = 10
  RETURN
  40 WRITE (6,80)
  GO TO 30
  50 WRITE (6,90)
  GO TO 30
  60 WRITE (6,100)
  GO TO 30

ERROR MESSAGES FOR THIS SUBROUTINE ARE GENERATED HERE

WRITE (6,70)

30 MODE = 10
RETURN

40 WRITE (6,80)
GO TO 30

50 WRITE (6,90)
GO TO 30

60 WRITE (6,100)
GO TO 30

FORMAT STATEMENTS

70 FORMAT (///46H0**** EXECUTION ABORTED FOR THIS JOB BECAUSE /
11H ," COUNTER FOR XBAL EXCEEDED 15")
SUBROUTINE FIG4 (X,Y)
C
THIS SUBROUTINE APPROXIMATES EINSTEIN'S FIGURE 4 WHERE;
X = F (KS / DELTA)
C
DIMENSION FX(8),FA(8),FB(8)
DATA FX /0.5,0.65,0.9,1.15,1.4,3.2,5.0,8.4/
DATA FA /1.9,1.75,1.62,1.61,1.63,1.72,1.42,1.25/
DATA FB /1.72,1.23,0.57,0.0,-0.47,-1.11,-0.52,-0.27/
I = 0
Y = 0.4
IF (X.LT.0.135) RETURN
IF (X.LT.8.4) GO TO 10
Y = 1.0
RETURN
10 I = I+1
IF (X.GT.FX(I)) GO TO 10
Y = FB(I)*ALOG10(X)+FA(I)
RETURN
END

SUBROUTINE FIG10 (X,Y)
C
THIS SUBROUTINE APPROXIMATES EINSTEIN'S FIGURE 10 WHERE;
PHI = F (PSI)
C
DIMENSION FX(7),FA(7),FB(7)
DATA FX /0.77,2.12,4.1,6.1,11.0,16.7,22.5/
DATA FA /7.56,5.35,4.1,4.6,5.66,9.28/
DATA FB /1.01,1.19,1.67,2.3,3.23,4.26,7.81/
I = 0
IF (X.LT.22.5) GO TO 10
Y = (13.1/X)**12.66
RETURN
10 I = I+1
FORTRAN PROGRAM MODEIN LISTING—Continued

IF (X.GT.FX(I)) GO TO 10

Y = (FA(I)/X)**FB(I)
RETURN
END

SUBROUTINE COMPZ (Z, L)
THIS SUBROUTINE COMPUTES Z BY TRIAL-AND-ERROR.
SUBPROGRAMS CALLED:
   POWER
COMMON /AA/ APRIME,AREA,CONC,D35,D65,DEPTH,DISCH,MODE,PCTZ,QSM,
   1 SUM(5),UBAR,VISC,WIDTH
COMMON /BB/ BIBQB(9),DIAM(9),PIB(9),PIS(9),PVALUE,QPRIMS(9),
   1 SIZEHI(9),SIZELO(9)
KOUNT = 0
ADP = 2.0 * DIAM(L) / DEPTH
CONST = QPRIMS(L) / BIBQB(L)
TOL = 0.01 * CONST
ZA = 1.08 - 0.33*ALOG10(CONST)
10 KOUNT = KOUNT + 1
IF (KOUNT.GE.40) GO TO 30
COEFF = 0.216 * ADP **(ZA - 1.0) / (1.0 - ADP) ** ZA
VALJ1 = 0.0
VALJ2 = 0.0
CALL POWER ( APRIME , ZA , VALJ1, VALJ2 )
FZA = COEFF * ( PVALUE * VALJ1 + VALJ2 )
ERROR = FZA-CONST
IF (ABS(ERROR).LT.TOL) GO TO 20
FCTR = SIGN(1.0,ERROR)
ZB = ZA + 0.01*FCTR
COEFF = 0.216 * ADP **(ZB - 1.0) / (1.0 - ADP) ** ZB
VALJ1 = 0.0
VALJ2 = 0.0
CALL POWER ( APRIME , ZB , VALJ1, VALJ2 )
FZB = COEFF * ( PVALUE * VALJ1 + VALJ2 )
ZDIFF = (CONST-FZA)*0.01 / (FZB-FZA)
ZA = ZA + ZDIFF*FCTR
GO TO 10
20 Z = ZA
RETURN

ERROR MESSAGES FOR THIS SUBROUTINE ARE GENERATED HERE

MODE = 3
SUBROUTINE ZFIT

C THIS SUBROUTINE COMPUTES Z-MULTIPLIERS OR FITS Z\'S BY REG. LINE

COMMON /AA/ APRIME, AREA, CONC, D35, D65, DEPTH, DISCH, MODE, PCTZ, QSM,
1 SUM(5), UBAR, VISC, WIDTH

COMMON /CC/ NRSIZE, NSR, VS(9), ZC(9), ZE(9), ZMEAS, ZMULT(9), ZSLOPE

IF (NRSIZE) 10, 40, 40

10 SUMXY = 0.0

SUMXSQ = 0.0

XMEAN = 0.0

YMEAN = 0.0

NUM = 0

DO 20 K = 1, NSR

IF (ZMEAS.EQ.0.0) ZMULT(K) = 0.0

IF (ZC(K).EQ.0.0) GO TO 20

NUM = NUM + 1

YLN = ALOG10 (ZC(K))

XLN = ALOG10 (VS(K))

YMEAN = YMEAN + YLN

XMEAN = XMEAN + XLN

SUMXY = SUMXY + YLN * XLN

SUMXSQ = SUMXSQ + XLN * XLN

20 CONTINUE

IF (NUM.LE.1) GO TO 60

RNUM = NUM

XMEAN = XMEAN / RNUM

YMEAN = YMEAN / RNUM

ZSLOPE = SUMXY - RNUM * XMEAN * YMEAN

ZSLOPE = ZSLOPE / (SUMXSQ - RNUM * XMEAN * XMEAN)

AINT = YMEAN - ZSLOPE * XMEAN

SMALA = 10.0 ** AINT

DO 30 K = 1, NSR

IF (ZC(K).EQ.0.0) ZC(K) = SMALA * VS(K)**ZSLOPE

30 CONTINUE

RETURN

40 ZSLOPE = 0.7

RS = VS(NRSIZE)

SE = ZC(NRSIZE)

DO 50 K = 1, NSR

XZ = (VS(K)/RS)**0.7

IF (ZC(K).EQ.0.0) ZC(K) = SE*XZ

IF (ZMEAS.EQ.0.0) ZMULT(K) = XZ

RETURN
SUBROUTINE ZMIBQB

THIS SUBROUTINE COMPUTES IBQB VALUES FOR SIZE RANGES THAT HAVE
MEASURED Z VALUES AND DETERMINES IBQB RATIOS TO ADJUST IBQB
VALUES FOR THE REMAINING SIZE RANGES.

SUBPROGRAMS CALLED:

POWER

COMMON /AA/ APRIME, AREA, CONC, D35, D65, DEPTH, DISCH, MODE, PCTZ, QSM,
1 SUM(5), UBAR, VISC, WIDTH
COMMON /BB/ BIBQB(9), DIAM(9), PIB(9), PIS(9), PVALUE, QPRIMS(9),
1 SIZEHI(9), SIZELO(9)
COMMON /CC/ NRSIZE, NSR, VS(9), ZC(9), ZE(9), ZMEAS, ZMULT(9), ZSLOPE

DO 10 K = 1, NSR
IF (ZE(K).EQ.0.0) GO TO 10
NZ = K
Z1 = ZE(K)
ADP = 2.0 * DIAM(K) / DEPTH
COEFF = 0.216 * ADP **(Z1- 1.0) / (1.0 - ADP) ** Z1
COMP1 = 0.0
COMP2 = 0.0
VALJ1 = 0.0
VALJ2 = 0.0
CALL POWER (APRIME, Z1, VALJ1, VALJ2)
COMP2 = PVALUE * VALJ1 + VALJ2
COMP1 = QPRIMS(K) / (COEFF * COMP2)
ZMULT(K) = COMP1 / BIBQB(K)
BIBQB(K) = COMP1
GO TO 20

10 CONTINUE

J = NZ-1
DO 30 K = 1, J
IF (PIB(K).EQ.0.0) GO TO 30
ZMULT(K) = ZMULT(NZ)
BIBQB(K) = BIBQB(K) * ZMULT(NZ)
30 CONTINUE
J = NZ + 1
DO 40 K = J, NSR
   IF (ZE(K).EQ.0.0) GO TO 40
   NZ = K
   Z1 = ZE(K)
   ADP = 2.0 * DIAM(K) / DEPTH
   COEFF = 0.216 * ADP **(Z1 - 1.0) / (1.0 - ADP) ** Z1
   COMP1 = 0.0
   COMP2 = 0.0
   VALJ1 = 0.0
   VALJ2 = 0.0
   CALL POWER (APRIME, Z1, VALJ1, VALJ2)
   COMP2 = PVALUE * VALJ1 + VALJ2
   COMP1 = QPRIMS(K) / (COEFF * COMP2)
   ZMULT(K) = COMP1 / BIBQB(K)
   BIBQB(K) = COMP1
40 CONTINUE
J = NZ + 1
DO 50 K = J, NSR
   IF (PIB(K).EQ.0.0) GO TO 50
   ZMULT(K) = ZMULT(NZ)
   BIBQB(K) = BIBQB(K) * ZMULT(NZ)
50 CONTINUE
RETURN
END

SUBROUTINE POWER ( A, Z, FJ1, FJ2 )
THIS SUBROUTINE EVALUATE J1 AND J2 INTEGRALS
N=1
FJ1=0.0
FJ2=0.0
ALG= ALOG(A)
C=1.0
D=-Z
E=D+1.0
FN=1.0
AEX=A**E
GO TO 20
10 N=N+1
   C=C*D/FN
   D=E
   E=D+1.0
   FN=FLOAT(N)
   AEX=A**E
20 IF (ABS(E).LE.0.001) GO TO 30
POWR 10
FORTRAN PROGRAM MODEIN LISTING--Continued

FJ1=FJ1+C*(1.0-AEX)/E
FJ2=FJ2+C*((AEX-1.0)/E**2-AEX*ALG/E)
GO TO 40
30  FJ1=FJ1-C*ALG
    FJ2=FJ2-0.5*C*ALG**2
40  IF (N.EQ.1) GO TO 50
    CJ1=ABS(1.0-XJ1/FJ1)
    CJ2=ABS(1.0-XJ2/FJ2)
    IF (CJ1.LE.0.001.AND.CJ2.LE.0.001) RETURN
50  XJ1=FJ1
    XJ2=FJ2
    GO TO 10
END

FUNCTION ERRTAB (BM)
BN=BM
IF (BM-.50) 20, 30,10
10  BN=1.0-BM
20  T=SQR(ALOG(1.0/BN**2))
    ERRTAB=T-((2.30753+0.27061*T)/(1.0+.99229*T+.04481*T*T))
    IF (BM.LT.0.50) ERRTAB=-ERRTAB
    RETURN
30  ERRTAB=0.0
    RETURN
END
SUPPLEMENTAL DATA--SECTION E.

BASIC PROGRAM MEPDATA LISTING

10 REM PROGRAM MEPDATA
20 REM ENTER MODIFIED EINSTEIN PROCEDURE DATA TO INPUT FILE
30 REM MAXIMUM NUMBER OF DATA SETS IN A FILE IS 30.
40 REM STORES DATA ON SEQUENTIAL FILE DFILE$ AFTER EACH 10 ENTERED DATA SETS
50 DIM VAR(30,13),SIZE(30,9,3),LO$(30),DATE$(30),SIZELO(9),SIZEHI(9)
60 LABEL$=" LOC DATE TIME DISCH WIDTH DEPTH TEMP Z MEAS REF Z pctZ D35 D65 CONC D S DN"
70 DATA 0.002,0.062,0.062,0.125,0.125,0.25,0.25,0.5,0.5,1,1,2,2,4,4,8,8,16
80 FOR I=1 TO 9 : READ SIZELO(I),SIZEHI(I) : NEXT I
90 PRINT CHR$(27)"*" : PRINT : INPUT "ENTER DATA FILE NAME";DFILE$
100 PRINT : PRINT
110 INPUT "ENTER: 1-START 2-ADD 3-CORRECT 4-LIST 5 PRINT";NC
120 NO=0 : ND=0
130 IF NC=1 GOTO 280
140 REM LOAD DATA FROM DISK
150 OPEN "I",#1,DFILE$
160 INPUT #1,NO
170 FOR N=1 TO NO
180 INPUT #1,LO$(N) : INPUT #1,DATE$(N)
190 FOR I=1 TO 13 : INPUT #1,VAR(N,I) :
200 FOR I=1 TO 9 : INPUT #1,SIZE(N,I,1),SIZE(N,I,2),SIZE(N,I,3) : NEXT I
210 NEXT N
220 CLOSE
230 ON NC GOTO 280,280,910,1240,1300
240 REM ENTER DATA
250 IF NO=30 THEN 960
260 PRINT CHR$(27)"*" : PRINT : INPUT "ENTER MORE DATA 1 FOR YES OR 2 FOR NO" ;I
270 IF I>1 THEN 960
280 NO=NO+1 : ND=ND+1
290 IF ND<11 THEN 320
300 GOSUB 800
310 ND=0
320 PRINT : PRINT "DATA SET NO. ";NO ; PRINT " MAX = 30" : PRINT
330 PRINT : PRINT "ENTER LOCATION NAME (MAX 80 CHARACTERS)"
340 LINE INPUT LO$(NO)
350 PRINT : INPUT "ENTER MEASUREMENT DATE (MM/DD/YY)";DATE$(NO)
360 PRINT : INPUT "ENTER MEASUREMENT TIME (2400 HR)";VAR(NO,1)
370 PRINT : INPUT "ENTER WATER DISCHARGE (CFS)";VAR(NO,2)
380 PRINT : INPUT "ENTER TOP WIDTH (FT)";VAR(NO,3)
390 PRINT : INPUT "ENTER AVERAGE DEPTH (FT)";VAR(NO,4)
400 PRINT CHR$(27)"*"
410 PRINT : INPUT "ENTER WATER TEMPERATURE (C)";VAR(NO,5)
420 PRINT : INPUT "ENTER Z VALUES: ENTER 0 FOR NO OR 1 FOR YES";ZI
430 VAR(NO,6)=ZI : ZR=0
440 IF ZI>0 THEN 500
450 PRINT : PRINT "REFERENCE SIZE SELECTION."
460 PRINT " 0 FOR PROGRAM SELECTION OF A SINGLE SIZE RANGE"
470 PRINT " 1-9 FOR NUMBER OF THE SELECTED SIZE RANGE"
480 PRINT " -1 FOR PROGRAM SELECTION OF ALL SUITABLE SIZE RANGES"
490 PRINT : INPUT "ENTER NUMBER";ZR
500 VAR(NO,7)=ZR
510 I=3 : IF ZR>=0 THEN 530
520 PRINT : INPUT "ENTER Z COMP LIMIT (1-3%)";I
530 VAR(NO,8)=I
540 PRINT : INPUT "ENTER D35 (MM) 0 FOR PROGRAM DETERMINATION";VAR(NO,9)
550 PRINT : INPUT "ENTER D65 (MM) 0 FOR PROGRAM DETERMINATION";VAR(NO,10)
560 PRINT : INPUT "ENTER SUSPENDED SEDIMENT CONC. (MG/L)";VAR(NO,11)
570 PRINT : INPUT "ENTER AVERAGE DEPTH AT SAMPLED VERTICALS (FT)";VAR(NO,12)
580 PRINT : INPUT "ENTER DISTANCE BETWEEN BOTTOM SAMPLED ZONE AND BED (FT)";VAR(NO,13)
590 PRINT CHR$(27)
600 FOR I=1 TO 9
610 FOR J=1 TO 3
620 SIZE(NO,I,J)=0
630 NEXT J
640 NEXT I
650 FOR I=1 TO 9
660 IF ZI=0 THEN 680
670 PRINT : PRINT USING "ENTER Z VALUE FOR ##.### TO ##.### (0 FOR NON";SIZELO(I),SIZEHI(I) : INPUT SIZE(NO,I,1)
680 PRINT USING "ENTER % SUSP MATERIAL FOR ##.### TO ##.### (0 FOR NON";SIZELO(I),SIZEHI(I) : INPUT SIZE(NO,I,2)
690 PRINT USING "ENTER % BED MATERIAL FOR ##.### TO ##.### (0 FOR NON";SIZEL0(I),SIZEHI(I) : INPUT SIZE(NO,I,3)
700 IF I>3 AND SIZE(NO,I,3)=0 THEN 720
710 NEXT I
720 N=NO : GOSUB 1510
730 PRINT
740 PRINT " 1 FOR DATA SET OK"
750 PRINT " 2 TO RE-ENTER COMPLETE DATA SET"
760 PRINT " 3 TO CORRECT PART OF DATA SET"
770 PRINT : INPUT "ENTER NUMBER";I
780 IF I>3 THEN 720
790 ON I GOTO 250,330,1000
800 REM STORE DATA ON DISK
810 OPEN "0",#1,DFILE$
820 WRITE #1,NO
830 FOR N=1 TO NO
840 WRITE #1,LO$(N) : WRITE #1,DATE$(N)
850 FOR I=1 TO 13 : WRITE #1,VAR(N,I) : NEXT I
860 FOR I=1 TO 9 : WRITE #1,SIZE(NO,I,1),SIZE(NO,I,2),SIZE(NO,I,3) : NEXT I
870 NEXT N
880 CLOSE
890 RETURN
900 END
BASIC PROGRAM MEPDATA LISTING—Continued

910 REM CORRECT DATA ****************************
920 PRINT CHR$(27)"*" : PRINT
930 PRINT USING "ENTER SET NUMBER MAX = #";NO; : PRINT " 0 TO END RUN"; : INPUT N
940 IF N>NO THEN 920
950 IF N>0 THEN 1000
960 GOSUB 800
970 PRINT CHR$(27)"*" : PRINT : PRINT "DATA STORED ON FILE ";DFILE$
980 PRINT : PRINT : PRINT "NO. DATA SETS = ";NO
990 PRINT : PRINT : PRINT "END OF RUN" : END
1000 GOSUB 1510
1010 PRINT : INPUT "ENTER VALUE NUMBER (1-24) 0 FOR NEW SET";L
1020 IF L>24 THEN 1000
1030 IF L>0 THEN 1060
1040 IF NC=3 THEN 920
1050 GOTO 720
1060 IF L>1 THEN 1110
1070 PRINT : PRINT "OLD NAME IS ": PRINT LO$(N)
1080 PRINT "ENTER NEW NAME (MAX 80 CHARACTERS)"
1090 LINE INPUT LO$(N)
1100 GOTO 1000
1110 IF L>2 THEN 1140
1120 PRINT : PRINT "OLD MEASUREMENT DATE IS ";DATE$(N) : INPUT "ENTER NEW MEASUREMENT DATE";DATE$(N)
1130 GOTO 1000
1140 IF L>15 THEN 1180
1150 I=L-2
1160 PRINT : PRINT "OLD VALUE IS ";VAR(N,I) : INPUT "ENTER NEW VALUE";VAR(N,I)
1170 GOTO 1000
1180 I=L-15
1190 PRINT : INPUT "ENTER: 1-Z VAL 2-% SUSP 3-% BED OR 0 TO END";L
1200 IF L=0 THEN 1000
1210 IF L>3 THEN 1190
1220 PRINT : PRINT "OLD VALUE IS ";SIZE(N,I,L) : INPUT "ENTER NEW VALUE";SIZE(N,I,L)
1230 GOTO 1190
1240 REM LIST DATA ON SCREEN *************************
1250 FOR N=1 TO NO
1260 PRINT 1000
1270 PRINT USING "###";VAR(N,1)
1280 NEXT N
1290 PRINT CHR$(27)"*" : PRINT : PRINT "END OF RUN" : END
1300 REM LIST DATA ON PRINTER *************************
1310 FOR N=1 TO NO
1320 LPRINT : LPRINT : LPRINT "SET NUMBER ";LOC$(N)
1330 LPRINT " 1 LOG ";LO$(N)
1340 LPRINT " 2 DATE ";DATE$(N)
1350 LPRINT " 3 TIME";LPRINT USING "###";VAR(N,1)
1360 NR=3 : NL=1
1370 FOR I=2 TO 13 STEP 2
1380 NR=NR+1 : NL=NL+5
1390 LPRINT USING "##";NR; : LPRINT MID$(LABEL$,NL,5); : LPRINT USING "########.###";VAR(N,I);
1400 NR=NR+1 : NL=NL+5
1410 LPRINT SPC(10); : LPRINT USING "##";NR; : LPRINT MID$(LABEL$,NL,5); : LPRINT USING "########.###";VAR(N,I+1)
1420 NEXT I
1430 FOR I=1 TO 9
1440 NR=NR+1
1450 LPRINT USING "##";NR; : LPRINT USING "#####.###":SIZELO(I),SIZEHI(I);
1460 LPRINT USING "####.##":SIZE(N,I,1);
1470 LPRINT USING "######":SIZE(N,I,2),SIZE(N,I,3)
1480 NEXT I
1490 NEXT N
1500 PRINT : PRINT : PRINT "END OF RUN" : END
1510 REM LIST ONE SET OF DATA ON SCREEN
1520 PRINT CHR$(27)*"**": PRINT "SET NUMBER "N
1530 PRINT " 1 LOC ";LO$(N)
1540 L=9-LEN(DATE$(N))
1550 PRINT " 2 DATE ";SPC(L);DATE$(N); : PRINT SPC(10)" 3 TIME" : PRINT USING "###########":VAR(N,I)
1560 NR=3 : NL=11
1570 FOR I=2 TO 13 STEP 2
1580 NR=NR+1 : NL=NL+5
1590 PRINT USING "##";NR; : LPRINT MID$(LABEL$,NL,5); : PRINT USING "########.###";VAR(N,I);
1600 NR=NR+1 : NL=NL+5
1610 PRINT SPC(10); : PRINT USING "##";NR; : LPRINT MID$(LABEL$,NL,5); : PRINT USING "########.###";VAR(N,I+1)
1620 NEXT I
1630 FOR I=1 TO 9
1640 NR=NR+1
1650 PRINT USING "##";NR; : PRINT USING "#####.###":SIZELO(I),SIZEHI(I);
1660 PRINT USING "####.##":SIZE(N,I,1);
1670 PRINT USING "######":SIZE(N,I,2),SIZE(N,I,3)
1680 NEXT I
1690 RETURN
1700 END
10 REM PROGRAM MODEIN
20 REM COMPUTE TOTAL SEDIMENT DISCH BY THE MODIFIED EINSTEIN PROCEDURE
30 DIM SUM(5),BIBQB(9),DIAM(9),PIB(9),PIS(9),QPRIMS(9),SIZEHI(9),SIZEL0(9),VS(9),
 ZC(9),ZE(9),ZMULT(9),FIDP(9),FJDP(9),ITLD(9),TOTLD(9),FG4(24),FG10(21)
40 DEF FNL(X)=LOG(X)/2.30259
50 PS=""
60 DATA 0.000036,0.00029,0.00058,0.00116,0.00232,0.00464,0.00928,0.01856,0.03712
70 FOR I=1 TO 9 : READ DIAM(I) : NEXT I
80 DATA 0.002,0.0625,0.0625,0.125,0.125,0.25,0.25,0.5,0.5,1,1,2,2,4,4,8,8,16
90 FOR I=1 TO 9 : READ SIZELO(I),SIZEHI(I) : NEXT I
100 DATA 0.5,1.9,1.72,0.65,1.75,1.23,0.9,1.62,0.57,1.15,1.61,0.14,1.63,-0.47,3.
 2,1.72,-1.11,5,1.42,-0.52,8.4,1.25,-0.27
110 FOR I=1 TO 24 : READ FG4(I) : NEXT I
120 DATA 0.77,7.56,1.01,2.12,5.35,1.19,4.1,4.1,1.67,6.1,4.1,2.3,11,4.6,3.23,16.7,
 .56,4.26,22.5,9.28,7.81
130 FOR I=1 TO 21 : READ FG10(I) : NEXT I
140 PRINT CHR$(27)"*" : PRINT : INPUT "ENTER DATA FILE NAME";DFILE$
150 REM LOAD DATA FROM DISK & INITIALIZE VARIABLES **************
160 OPEN "I",#1,DFILE$
170 INPUT #1,NCOMP1
180 NCOMP2=0
190 NCOMP2=NCOMP2+1
200 MODE=1 : ZSLOPE=0
210 FOR K=1 TO 9
220 BIBQB(K)=0 : FIDP(K)=0 : FJDP(K)=0 : ITLD(K)=1 : PIB(K)=0 : PIS(K)=0 : QPRIM
S(K)=0 : TOTLD(K)=0 : VS(K)=0 : ZC(K)=0 : ZE(K)=0 : ZMULT(K)=0
230 NEXT K
240 FOR I=1 TO 5 : SUM(I)=0 : NEXT I
250 INPUT #1,LO$: INPUT#1,DATES$
260 INPUT#1,TIME,DISCH,WIDTH,DEPTH,TEMPER,ZMEAS,NRSIZE,PCTZ,D35,D65,CONC,DS,DN
270 FOR K=1 TO 9 : INPUT #1,ZE(K),PIS(K),PIB(K) : NEXT K
280 PRINT CHR$(27)"*" : PRINT LO$: PRINT
290 L=LEN(DATES$)
300 PRINT "DATE OF MEASUREMENT ";DATES$; : PRINT SPC(22-L)"TIME OF MEASUREMENT"
 ; : PRINT USING "####";TIME
310 IF NCOMP2>1 THEN LPRINT CHR$(12)
320 LPRINT "TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE"
330 LPRINT : LPRINT LO$: LPRINT
340 LPRINT "DATE OF MEASUREMENT ";DATES$; : LPRINT SPC(22-L)"TIME OF MEASUREMENT"
350 IF DS>0 AND DN>0 THEN 380
360 RS="EITHER DSUBS OR DSUBN EQUAL ZERO"
370 GOTO 4520
380 IF DEPTH>0 AND WIDTH>0 THEN 410
390 RS="EITHER DEPTH OR WIDTH EQUAL ZERO"
400 GOTO 4520
410 FOR K=1 TO 9
BASIC PROGRAM MODE IN LISTING—Continued

420 SUM(1)=SUM(1)+PIS(K)
430 SUM(2)=SUM(2)+PIB(K)
440 IF SUM(2)>=100 THEN 460
450 NEXT K
460 NSR=K
470 IF SUM(1)=100 AND SUM(2)=100 THEN 500
480 R$="SUM OF MATERIAL IN BED OR SUSPENSION IS NOT 100"
490 GOTO 4520
500 IF D35>0 THEN 880
510 IND=1 : PCT=.35
520 SUMBED=0
530 FOR K=1 TO NSR
540 SUMBED=SUMBED+PIB(K)/100
550 IF SUMBED=PCT THEN 700
560 IF SUMBED<PCT THEN 740
570 X2=FNL(SIZEHI(K)) : X1=FNL(SIZELO(K))
580 BM=SUMBED-PIB(K)/100
590 IF BM<=0 THEN 720
600 GOSUB 770
610 Y1=ERRTAB
620 BM=SUMBED
630 GOSUB 770
640 Y2=ERRTAB
650 ON IND GOTO 660,680
660 D35=10^(((.39-Y1)*(X2-X1)/(Y2-Y1))+X1)
670 GOTO 880
680 D65=10^(((.39-Y1)*(X2-X1)/(Y2-Y1))+X1)
690 GOTO 910
700 X2=FNL(SIZEHI(K)) : X1=FNL(SIZELO(K))
710 IF K<>1 THEN 580
720 Y1=-1
730 GOTO 620
740 NEXT K
750 R$="CANNOT CALCULATE EITHER D35 OR D65"
760 GOTO 4520
770 REM SUBROUTINE ERRTAB  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
780 BN=BM
790 ON SGN(BM-.5)+2 GOTO 810,850,800
800 BN=1-BM
810 T=SQR(LOG(1/BN^2))
820 ERRTAB=T-((2.30753+.27061*T)/(1+.99229*T+.04481*T*T))
830 IF BM<.5 THEN ERRTAB=-ERRTAB
840 RETURN
850 ERRTAB=0
860 RETURN
870 END
880 IF D65>0 THEN 910
890 IND=2 : PCT=.65
900 GOTO 520
BASIC PROGRAM MODEIN LISTING--Continued

910 COMP1=1.0334+.03672*TEMPER+.0002058*TEMPER*TEMPER
920 VISC=-0.0002/COMP1
930 QSM=DISCH*CONC*.0027
940 AREA=DEPTH*WIDTH
950 UBAR=DISCH/AREA
960 APRIME=DN/DS
970 L=LEN(DATES)
980 PRINT USING "WATER DISCHARGE #######.# CFS";DISCH; : PRINT USING "D65 ####.### MM";D65
990 LPRINT USING "WATER DISCHARGE #######.# CFS";DISCH; : LPRINT USING "D65 ####.### MM";D65
1000 PRINT USING "AREA  ###############.## SQFT";AREA; : PRINT USING "D35 ####.### MM";D35
1010 LPRINT USING "AREA  ###############.## SQFT";AREA; : LPRINT USING "D35 ####.### MM";D35
1020 PRINT USING "WIDTH  ###############.# FT";WIDTH; : PRINT USING "D15  ####.### FT";DN
1030 LPRINT USING "WIDTH  ###############.# FT";WIDTH; : LPRINT USING "D15  ####.### FT";DN
1040 PRINT USING "AVERAGE VELOCITY ###.## FT/SEC";UBAR; : PRINT USING "AVER. DEPTH AT SAMP. VERT. ###.## FT";DS
1050 LPRINT USING "AVERAGE VELOCITY ###.## FT/SEC";UBAR; : LPRINT USING "AVER. DEPTH AT SAMP. VERT. ###.## FT";DS
1060 PRINT USING "MEAS SUSP-SED CONC. ##### MG/L";CONC
1070 LPRINT USING "MEAS SUSP-SED CONC. ##### MG/L";CONC
1080 PRINT USING "WATER TEMPERATURE ####.# C";TEMPER; : PRINT USING "MEAS SUSP-SED DISCH #############. T/D";QSM
1090 LPRINT USING "WATER TEMPERATURE ####.# C";TEMPER; : LPRINT USING "MEAS SUSP-SED DISCH #############. T/D";QSM
1100 PRINT USING "KIN. VISCOSITY  ###############.### SQFT/SEC";VISC; : PRINT USING "APRIME  #####.###";APRIME
1110 LPRINT USING "KIN. VISCOSITY  ###############.### SQFT/SEC";VISC; : LPRINT USING "APRIME  #####.###";APRIME
1120 D35=D35/304.8
1130 D65=D65/304.8
1140 REM DETERMINE REF SIZE AND COMPUTE SRM BY ITERATION
1150 IF ZMEAS=0 THEN 1240
1160 NRSIZE=-1 : ZMEAS=0
1170 FOR K=1 TO NSR
1180 IF ZE(K)=0 THEN 1220
1190 ZC(K)=ZE(K)
1200 ZMEAS=ZMEAS+1
1210 J=K
1220 NEXT K
1230 IF ZMEAS<2 THEN NRSIZE=J
1240 ON SGN(NRSIZE)+2 GOTO 1260,1250,1350
1250 NRSIZE=1

F 3
BASIC PROGRAM MODE IN LISTING—Continued

1260 COMP1=0
1270 FOR K=2 TO NSR
1280 IF PIS(K)<3 OR PIB(K)<3 THEN 1330
1290 COMP2=PIS(K)+PIB(K)
1300 IF COMP2<COMP1 THEN 1330
1310 J=K
1320 COMP1=COMP2
1330 NEXT K
1340 NRSIZE=SGN(NRSIZE)*J
1350 GOSUB 1920
1360 IF MODE=10 THEN 4520
1370 COMP1=30.2*XR*DEPTH/D65
1380 PVALUE=LOG(COMP1)
1390 COMP1=PVALUE-1
1400 PCTQ=0 : SHEAR=0
1410 IF COMP1=0 THEN 1430
1420 PCTQ=1-APRIME*(COMP1+LOG(APRIME))/COMP1
1430 CONST=PCTQ*QSM*.01
1440 IF SR<=0 THEN 1460
1450 SHEAR=1.65*D35/SR
1460 REM COMPUTE QPRIMS, IBQB, AND SED FALL VEL **********
1470 COMP2=6*VISC
1480 FOR K=1 TO NSR
1490 QPRIMS(K)=CONST*PIS(K)
1500 SUM(4)=SUM(4)+QPRIMS(K)
1510 VS(K) = ((36.064*DIAM(K)^3+COMP2^2-.5-COMP2)/DIAM(K)
1520 IF PIB(K)=0 THEN 1630
1530 COMP1=.66*DIAM(K)/SR
1540 IF COMP1<SHEAR THEN 1570
1550 PSI=COMP1
1560 GOTO 1590
1570 PSI=SHEAR
1580 IF PSI>=.25 THEN 1630
1590 GOSUB 2330
1600 UNITBD=12*DIAM(K)^1.5*PIB(K)*PHI/2
1610 BIBQB(K)=INT(UNITBD*43200!*W1DTH)/1000
1620 SUM(3)=SUM(3)+BIBQB(K)
1630 NEXT K
1640 IF SUM(3)>0 THEN 1720
1650 FOR K=1 TO NSR
1660 TOTLD(K)=QSM*PIS(K)*.01
1670 SUM(5)=SUM(5)+TOTLD(K)
1680 NEXT K
1690 MODE=2 : NRSIZE=0
1700 R$="IBQB VALUES EQUAL ZERO. TOTAL DISCH EQUAL TO MEAS SUSP-SED DISCH"
1710 GOTO 3930
1720 REM COMPUTE Z VALUES **********
1730 IF ZMEAS>0 THEN 2720
1740 IF NRSIZE<=0 THEN 1780
BASIC PROGRAM MODEIN LISTING—Continued

1750 I9=NRSIZE : GOSUB 2420
1760 PRINT P$; : PRINT CHR$(11)
1770 GOTO 3150
1780 ZS=0
1790 FOR I9=2 TO NSR
1800 IF BIBQB(I9)=0 THEN 1860
1810 IF PIS(I9)<PCTZ GOTO 1860
1820 IF PIB(I9)<PCTZ THEN 1860
1830 GOSUB 2420
1840 IF MODE=3 THEN 3930
1850 ZS=ZS+1
1860 NEXT I9
1870 PRINT P$; : PRINT CHR$(11)
1880 IF ZS>0 THEN 3150
1890 MODE=4
1900 R$="NO OVERLAP OF BED AND SUSPENDED MATERIAL"
1910 GOTO 3930
1920 REM SUBROUTINE SRCOMP ****************************
1930 BSBDELT=0 : X=1.54 : NUM=0 : XCK=0
1940 COMP2=12.27*X*DEPTH/D65
1950 IF COMP2<=.000009 THEN 2200
1960 COMP1=32.63*FNL(COMP2)
1970 SGRAD=UBAR/COMP1
1980 SR=SGRAD*SGRAD
1990 UPRIME=SGRAD*5.68
2000 IF UPRIME=0 GOTO 2140
2010 DELTA=11.6*VISC/UPRIME
2020 IF DELTA=0 THEN 2180
2030 BSDELT=D65/DELTA
2040 XCK=X
2050 GOSUB 2230
2060 ERROR=ABS(X-XCK)
2070 IF ERROR>.05 THEN 2120
2080 XR=X
2090 PRINT USING "LAMINAR SUBLAYER THICK ##.####### FT";DELTA; : PRINT SPC(8); :
2100 PRINT USING "SHEAR VELOCITY ##.###### FT/SEC";UPRIME
2110 RETURN
2120 NUM=NUM+1
2130 IF NUM<15 THEN 1940
2140 R$="COUNTER FOR SRCOMP EXCEEDED 15"
2150 GOTO 3930
2160 R$="UPRIME EQUAL TO ZERO"
2170 GOTO 3930
2180 R$="DELTA EQUAL TO ZERO"
2190 GOTO 3930
2200 R$="THE PRODUCT OF 12.27, X, DEPTH, AND 1/D65 IS ZERO"
2210 MODE=10
2220 RETURN
2230 REM SUBROUTINE FIG4 *****************************************
2240 I=-2 : X=.4
2250 IF BSDELT<.135 THEN RETURN
2260 IF BSDELT<8.4 THEN 2290
2270 X=1
2280 RETURN
2290 I=I+3
2300 IF BSDELT>FG4(I) THEN 2290
2310 X=FG4(I+2)*FNL(BSDELT)+FG4(I+1)
2320 RETURN
2330 REM SUBROUTINE FIG10 *****************************************
2340 I=-2
2350 IF PSI<22.5 THEN 2380
2360 PHI=(13.1/PSI)^12.66
2370 RETURN
2380 I=I+3
2390 IF PSI>FG10(I) THEN 2380
2400 PHI=(FG10(I+1)/PSI)^FG10(I+2)
2410 RETURN
2420 REM SUBROUTINE COMPZ *****************************************
2430 KOUNT=0
2440 ADP=2*DIAM(I9)/DEPTH
2450 CONST=QPRIMS(I9)/BIBQB(I9)
2460 TOL=.01*CONST
2470 ZA=1.08-.33*FNL(CONST)
2480 KOUNT=KOUNT+1
2490 IF KOUNT>=40 THEN 2690
2500 COEFF=.216*ADP^(ZA-1)/(1-ADP)^ZA
2510 A=APRIME : Z=ZA : FJ1=0 : FJ2=0
2520 PRINT " COMPZ ";I9;" GO POWER 1 ";KOUNT; : PRINT CHR$(11)
2530 GOSUB 4600
2540 FZA=COEFF*(PVALUE*FJ1+FJ2)
2550 ERR=FZA-CONST
2560 IF ABS(ERR)<TOL THEN 2670
2570 FCTR=1*SGN(ERR)
2580 ZB=ZA+.01*FCTR
2590 COEFF=.216*ADP^(ZB-1)/(1-ADP)^ZB
2600 Z=ZB : FJ1=0 : FJ2=0
2610 PRINT " COMPZ ";I9;" GO POWER 2 ";KOUNT; : PRINT CHR$(11)
2620 GOSUB 4600
2630 FZB=COEFF*(PVALUE*FJ1+FJ2)
2640 ZDIFF=(CONST-FZA)*.01/(FZB-FZA)
2650 ZA=ZA+ZDIFF*FCTR
2660 GOTO 2480
2670 ZC(I9)=ZA
2680 RETURN
2690 MODE=3
2700 R$="NO CONVERGENCE IN Z COMPUTATION"
2710 RETURN
2720 REM SUBROUTINE ZMIBQB ****************************
2730 PRINT " ZMIBQB "; : PRINT CHR$(11)
2740 FOR K=1 TO NSR
2750 IF ZE(K)=0 THEN 2870
2760 NZ=K : Z=ZE(K)
2770 ADP=2*DIAM(K)/DEPTH
2780 COEFF=.216*ADP^Z/(1-ADP)^(Z-1)
2790 A=AVERAGE : FJ1=0 : FJ2=0
2800 PRINT " ZMIBQB GO POWER ";K; : PRINT CHR$(11)
2810 GOSUB 4600
2820 COMP2=PVALUE*FJ1+FJ2
2830 COMP1=QPRIMS(K)/(COEFF*COMP2)
2840 ZMULT(K)=COMP1/BIBQB(K)
2850 BIBQB(K)=COMP1
2860 GOTO 2880
2870 NEXT K
2880 J=NZ-1
2890 FOR K=1 TO J
2900 IF PIB(K)=0 THEN 2930
2910 ZMULT(K)=ZMULT(NZ)
2920 BIBQB(K)=BIBQB(K)*ZMULT(NZ)
2930 NEXT K
2940 J=NZ+1
2950 FOR K=J TO NSR
2960 IF ZE(K)=0 THEN 3080
2970 NZ=K : Z=ZE(K)
2980 ADP=2*DIAM(K)/DEPTH
2990 COEFF=.216*ADP^Z/(1-ADP)^(Z-1)
3000 A=AVERAGE : FJ1=0 : FJ2=0
3010 PRINT " ZMIBQB GO POWER ";K; : PRINT CHR$(11)
3020 GOSUB 4600
3030 COMP2=PVALUE*FJ1+FJ2
3040 COMP1=QPRIMS(K)/(COEFF*COMP2)
3050 ZMULT(K)=COMP1/BIBQB(K)
3060 BIBQB(K)=COMP1
3070 PRINT P$; : PRINT CHR$(11)
3080 NEXT K
3090 J=NZ+1
3100 FOR K=J TO NSR
3110 IF PIB(K)=0 THEN 3140
3120 ZMULT(K)=ZMULT(NZ)
3130 BIBQB(K)=BIBQB(K)*ZMULT(NZ)
3140 NEXT K
3150 REM SUBROUTINE ZFIT ****************************
3160 PRINT " ZFIT "; : PRINT CHR$(11)
3170 IF NRSIZE>=0 THEN 3440
3180 SUMXY=0 : SUMXSQ=0 : XMEAN=0 : YMEAN=0 : NUM=0
3190 FOR K=1 TO NSR
3200 IF ZMEAS=0 THEN ZMULT(K)=0
3210 IF ZC(K)=0 THEN 3290
3220 NUM=NUM+1
3230 YLN=FNL(ZC(K))
3240 XLN=FNL(VS(K))
3250 YMEAN=YMEAN+YLN
3260 XMEAN=XMEAN+XLN
3270 SUMXY=SUMXY+YLN*XLN
3280 SUMXSQ=SUMXSQ+XLN*XLN
3290 NEXT K
3300 IF NUM>1 THEN 3340
3310 MODE=5
3320 RS="NOT ENOUGH POINTS FOR A FIT OF Z VALUES"
3330 GOTO 3930
3340 XMEAN=XMEAN/NUM
3350 YMEAN=YMEAN/NUM
3360 ZSLOPE=SUMXY-„NUM*XMEAN*YMEAN
3370 ZSLOPE=ZSLOPE/(SUMXSQ-„NUM*XMEAN*XMEAN)
3380 AINT=YMEAN-ZSLOPE*XMEAN
3390 SMALA=10^„AINT
3400 FOR K=l TO NSR
3410 IF ZC(K)=0 THEN ZC(K)=SMALA*VS(K)^ZSLOPE
3420 NEXT K
3430 GOTO 3510
3440 ZSLOPE=.7
3450 RS=VS(NRSIZE) : SE=ZC(NRSIZE)
3460 FOR K=l TO NSR
3470 XZ=(VS(K)/RS)^.7
3480 IF ZC(K)=0 THEN ZC(K)=SE*XZ
3490 IF ZMEAS=0 THEN ZMULT(K)=XZ
3500 NEXT K
3510 REM COMPUTE TOTAL SEDIMENT DISCHARGE **********
3520 N1=ABS(NRSIZE)
3530 FOR K=l TO NSR
3540 ADP=2*DIAM(K)/DEPTH
3550 Z=ZC(K) : A=A„PRIME
3560 FJ1=0 : FJ2=0
3570 IF PIS(K)=0 THEN 3670
3580 PRINT " TOTLD GO POWER " ;K ; PRINT CHR$(11)
3590 GSUB 4600
3600 COMP1=PVALUE*FJ1+FJ2
3610 A=ADP : FJ1=0 : FJ2=0
3620 PRINT " TOTLD GO POWER " ;K ; PRINT CHR$(11)
3630 GSUB 4600
3640 COMP2=PVALUE*FJ1+FJ2
3650 FJDP(K)=COMP2/COMP1
3660 IF FJDP(K)<1 THEN FJDP(K)=1
3670 TOTLD(K)=FJDP(K)*QPRIMS(K)+BIBQB(K)
3680 IF K<N1 THEN 3790
3690 IF PIB(K)=0 THEN 3790
3700 FIDP(K)=1
3710 IF Z>=10 THEN 3780
3720 A=ADP
3730 COEFF=.216*ADP^(Z-1)/(1-ADP)^Z
3740 IF FJ1>0 THEN 3770
3750 PRINT " TOTLD GO POWER ";K; : PRINT CHR$(11)
3760 GOSUB 4600
3770 FIDP(K)=COEFF*(PVALUE*FJ1+FJ2)+1
3780 TOTLD(K)=FIDP(K)*BIBQB(K)
3790 NEXT K
3800 PRINT P$; : PRINT CHR$(11)
3810 Nl=0
3820 FOR K=1 TO NSR
3830 QMEAS=QSM*PIS(K)*.01
3840 IF TOTLD(K)>=QMEAS THEN 3880
3850 N1=N1+1
3860 TOTLD(K)=QMEAS
3870 ITLD(K)=2
3880 SUM(5)=SUM(5)+TOTLD(K)
3890 NEXT K
3900 IF Nl=0 THEN 3930
3910 MODE=6
3920 RS$="MEAS SUSP-SED DISCH -- WHICH EXCEEDS COMP DISCH (REVIEW COMP)"
3930 REM PRINT RESULTS ****************************
3940 RSL=0 : RSH=0
3950 ON SGN(NRSIZE)+2 GOTO 4000,3970,3960
3960 RSL=SIZELO(NRSIZE) : RSH=SIZEHI(NRSIZE)
3970 PRINT USING "REFERENCE SIZE RANGE ###.#### - ###.#### MM";XSL,RSH; : PRINT USING "P-FACTOR ####.##";PVALUE
3980 LPRINT USING "REFERENCE SIZE RANGE ###.#### - ###.#### MM";RSL,RSH; : LPRINT USING "P-FACTOR ####.##";PVALUE
3990 GOTO 4020
4000 PRINT "REFERENCE SIZE RANGE - MULTIPLE"; PRINT USING SPC(13); PRINT USING "P-FACTOR ###.##";PVALUE
4010 LPRINT "REFERENCE SIZE RANGE - MULTIPLE"; LPRINT SPC(13); LPRINT USING "P-FACTOR ###.##";PVALUE
4020 PRINT USING "PERCENT OF FLOW SAMPLED ###.## %";PCTQ*100; PRINT SPC(12); PRINT USING "X-FACTOR #######.##";XR
4030 PRINT USING "PERCENT OF FLOW SAMPLED ###.## %";PCTQ*100; LPRINT SPC(12); LPRINT USING "X-FACTOR #######.##";XR
4040 PRINT USING "DEPTH/KS ########.##";DEPTH/D65; PRINT SPC(25); PRINT USING "Z SLOPE ###.##";ZSLOPE;
4050 LPRINT USING "DEPTH/KS ########.##";DEPTH/D65; LPRINT SPC(25); LPRINT USING "Z SLOPE ###.##";ZSLOPE;
4060 IF NRSIZE>=0 THEN 4080
4070 PRINT " BY REGRESSION"; LPRINT " BY REGRESSION"
4080 PRINT ; PRINT ; PRINT ; LPRINT ; LPRINT ; LPRINT
4090 PRINT " SIZE RANGE PERCENT IN RANGE IBQB QPRIME"
BASIC PROGRAM MODEIN LISTING--Continued

4100 LPRINT " SIZE RANGE PERCENT IN RANGE IBQB QPRIME"
4110 PRINT " IN MILLIMETERS SUSPENDED BED T/D SUBS(T/D)"
4120 LPRINT " IN MILLIMETERS SUSPENDED BED T/D SUBS(T/D)"
4130 PRINT : LPRINT
4140 FOR K=1 TO NSR
4150 PRINT USING "###";K; : PRINT USING "###.####";SIZELO(K); : PRINT USING "####.####";SIZEHI(K); : PRINT USING "#######.##";PIS(K),PIB(K); : PRINT USING "#########.#";QPRIMS(K)
4160 LPRINT USING "###";K; : LPRINT USING "###.####";SIZELO(K); : LPRINT USING "#####.####";SIZEHI(K); : LPRINT USING "#######.##";PIS(K),PIB(K); : LPRINT USING "########.##";IBQB(K); : LPRINT USING "#########.#";QPRIMS(K)
4170 NEXT K
4180 PRINT : LPRINT
4190 PRINT " TOTALS"; : PRINT SPC(13); : PRINT USING "#######.##";SUM(1),SUM(2); : PRINT USING "########.##";SUM(3); : PRINT USING "#########.#";SUM(4)
4200 LPRINT " TOTALS"; : LPRINT SPC(13); : LPRINT USING "#######.##";SUM(1),SUM(2); : LPRINT USING "########.##";SUM(3); : LPRINT USING "#########.#";SUM(4)
4210 PRINT : PRINT : LPRINT : LPRINT
4220 IF ZMEAS=0 THEN 4280
4230 PRINT " IBQB Z - VALUES COMPUTATIONAL FACTORS COMP TOTAL"
4240 PRINT " IBQB Z - VALUES COMPUTATIONAL FACTORS COMP TOTAL"
4250 PRINT " RATIO ENTERED COMP. F(J) F(I)+1 DISCH (T/D)"
4260 PRINT " RATIO ENTERED COMP. F(J) F(I)+1 DISCH (T/D)"
4270 GOTO 4320
4280 PRINT " MULT Z - VALUES COMPUTATIONAL FACTORS COMP TOTAL"
4290 PRINT " MULT Z - VALUES COMPUTATIONAL FACTORS COMP TOTAL"
4300 PRINT " ENTERED COMP. F(J) F(I)+1 DISCH (T/D)"
4310 PRINT " ENTERED COMP. F(J) F(I)+1 DISCH (T/D)"
4320 PRINT : LPRINT
4330 FOR K=1 TO NSR
4340 IF ZE(K)=0 THEN 4380
4350 PRINT USING "###";K; : PRINT USING "###.##";ZMULT(K); : PRINT USING "#####.##";ZE(K);
4360 LPRINT USING "###";K; : LPRINT USING "###.##";ZMULT(K); : LPRINT USING "#####.##";ZE(K);
4370 GOTO 4400
4380 PRINT USING "###";K; : PRINT USING "###.##";ZMULT(K); : PRINT SPC(9);
4390 LPRINT USING "###";K; : LPRINT USING "#####.##";ZMULT(K); : LPRINT SPC(9);
4400 PRINT USING "#####.##";ZC(K); : PRINT USING "";TOTLD(K);
4410 LPRINT USING "#####.##";ZC(K); : LPRINT USING "";TOTLD(K);
4420 IF ITLD(K)=2 THEN 4450
4430 PRINT : LPRINT
4440 GOTO 4460
4450 PRINT " " : LPRINT " "
4460 NEXT K
4470 PRINT : LPRINT
4480 PRINT " TOTAL"; : PRINT SPC(41); : PRINT USING "";SUM(5)

F 10
BASIC PROGRAM MODE IN LISTING—Continued

4490 LPRINT " TOTAL"; : LPRINT SPC(41); : LPRINT USING "############.#"; SUM(5)
4500 PRINT : PRINT : LPRINT : LPRINT
4510 ON MODE GOTO 4560,4550,4520,4520,4520,4550
4520 PRINT : PRINT : LPRINT : LPRINT
4530 PRINT; : PRINT "**** EXECUTION ABORTED FOR THIS JOB BECAUSE"
4540 LPRINT; : LPRINT "**** EXECUTION ABORTED FOR THIS JOB BECAUSE 
4550 PRINT R$: LPRINT R$
4560 PRINT : PRINT "PUSH KEY TO CONTINUE"; : S$=INPUT$(1)
4570 IF NCOMP2<NCOMP1 THEN 190
4580 PRINT CHR$(27)"*" : PRINT : PRINT " END OF RUN"
4590 END
4600 REM SUBROUTINE POWER **************************
4610 N=1 : FJ1=0 : FJ2=0
4620 ALG=LOG(A)
4630 C=1
4640 D=-Z
4650 E=D+1
4660 NN=1
4670 AEX=A^E
4680 GOTO 4750
4690 N=N+1
4700 C=C*D/NN
4710 D=E
4720 E=D+1
4730 NN=N
4740 AEX=A^E
4750 IF ABS(E)<.001 THEN 4790
4760 FJ1=FJ1+C*(1-AEX)/E
4770 FJ2=FJ2+C*((AEX-1)/E^2-AEX*ALG/E)
4780 GOTO 4810
4790 FJ1=FJ1-C*ALG
4800 FJ2=FJ2-.5*C*ALG^2
4810 IF N=1 THEN 4850
4820 CJ1=ABS(1-XJ1/FJ1)
4830 CJ2=ABS(1-XJ2/FJ2)
4840 IF CJ1<.001 AND CJ2<.001 THEN RETURN
4850 XJ1=FJ1
4860 XJ2=FJ2
4870 GOTO 4690
4880 END

F 11
SUPPLEMENTAL DATA--SECTION G.
FLOW CHART OF PROGRAM MODEIN

Start

Read number data sets in data file
Set NCOMP2=0

NCOMP2=NCOMP2+1
Initialize variables
Set MODE=0

Enter subroutine INPUT
Read data set

Input data check OK?

yes
Compute v, Qem, area, u, and A'

no
Set MODE=10

D35 and/or D65=0?

yes
Compute D35 and/or D65

no
Computed values D35 and/or D65 OK?

yes
Set MODE=10

no

D35 and/or D65?

yes
Compute D35 and/or D65

no

Write input data set, v, Qem, area, u, A', D35, & D65

1
FLOW CHART OF PROGRAM MODEIN--Continued

1

2 MEAS = 0

yes

REFSIZE > 0

yes

Determine REFSIZE No.

no

Number x's > 1

yes

Enter sub FIG4 for k_s/δ vs X

no

No

Set MODE = 10

c

Number X value trials > 15

yes

Enter sub SRCOMP trial X values & compute (SR)m', u_m, δ, k_s/δ'

no

Write δ and u_m

Compute F, pct flow sample zone and Qts

Enter Sub FIG10 for V_m vs q_m

Compute Q^', V_s', & _igQg for each size range and sum _igQg

Set MODE = 2 and Q'sw=Q'sm for each size range

yes

Sum _igQg > 0

no

B

2
FLOW CHART FOR PROGRAM MODEIN—Continued

Enter Sub COMPZ
compute z by trial for
reference size range
Set MODE=3 if number
of trials > 40

Enter Sub COMPZ
compute z by trial for
each size range i &
i > min Z. Set MODE
=3 if NO. trials > 40
Set MODE=4 if no Z comp

Enter Sub ZMIBQB
compute iQB for size
ranges having meas Z's
and adjust other iQB
values

Enter Sub POWER
compute J1 & J2

Enter Sub POWER
compute J1 & J2

Enter Sub POWER
compute J1 & J2

Enter Sub ZFIT
compute Z's from
regression line.
Set MODE=5 if NO.
Z's < 2.

Enter Sub ZFIT
Z's proportioned
by mult. that vary
with 0.7 power of
fall velocity.

Compute A"", PJ' + J'
P1" + I" + 1, and Qts
for each size range.
Set MODE=6 if Qts<Qsm

G 3
FLOW CHART OF PROGRAM MODEIN--Continued

Write computed values

MODE=1?

yes

Write footnote number MODE

no

NCOMP2 = number data sets?

yes

Stop

no

A

C

B
**SUPPLEMENTAL DATA--SECTION H.**

**EXAMPLES OF PROGRAM MEPDATA OUTPUT**

**NUMBER DATA SETS = 6**

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<tr>
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<td>239.000</td>
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<tr>
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EXAMPLES OF PROGRAM MEPDATA OUTPUT--Continued

3 1 LOC  COLUMBIA RIVER AT VANCOUVER, WA - MAIN CHANNEL
3 2 DATE  6/8/64
3 3 TIME  1045.000
3 4 DISCH  447000.000
3 5 WIDTH  2900.000
3 6 DEPTH  39.000
3 7 TEMP  13.300
3 8 ZMEAS  0.000
3 9 REFZ  -1.000
3 10 PCTZ  3.000
3 11 D35  0.000
3 12 D65  0.000
3 13 CONC  114.000
3 14 DS  39.000
3 15 DN  0.300
3 16  0.002  0.062  0.000  0.000  55   0.
3 17  0.062  0.125  0.000  0.000  8   1.
3 18  0.125  0.250  0.000  0.000  27  18.
3 19  0.250  0.500  0.000  0.000  10  43.
3 20  0.500  1.000  0.000  0.000  0  24.
3 21  1.000  2.000  0.000  0.000  0  10.
3 22  2.000  4.000  0.000  0.000  0  4.
3 23  4.000  8.000  0.000  0.000  0  0.
3 24  8.000 16.000  0.000  0.000  0  0.

4 1 LOC  FEATHER RIVER NR GRIDLEY, CA
4 2 DATE  2/2/65
4 3 TIME  1203.000
4 4 DISCH  11420.000
4 5 WIDTH  304.000
4 6 DEPTH  11.920
4 7 TEMP  6.700
4 8 ZMEAS  0.000
4 9 REFZ  5.000
4 10 PCTZ  3.000
4 11 D35  0.505
4 12 D65  0.740
4 13 CONC  56.000
4 14 DS  15.220
4 15 DN  0.300
4 16  0.002  0.062  0.000  0.000  43   0.
4 17  0.062  0.125  0.000  0.000  10   0.
4 18  0.125  0.250  0.000  0.000  11   3.
4 19  0.250  0.500  0.000  0.000   9  31.
4 20  0.500  1.000  0.000  0.000  27  50.
4 21  1.000  2.000  0.000  0.000   0  14.
4 22  2.000  4.000  0.000  0.000   0  2.
4 23  4.000  8.000  0.000  0.000   0  0.
4 24  8.000 16.000  0.000  0.000   0  0.
EXAMPLES OF PROGRAM MEPDATA OUTPUT--Continued

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SUPPLEMENTAL DATA--SECTION I.
EXAMPLES OF PROGRAM MODEIN OUTPUT

Run number 1. Reference size range selected by program and corresponding z value computed by trial. Z values for other size ranges computed from multipliers which vary with the 0.7 power of fall velocity.

U. S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

** DETERMINATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE **

NIORARA RIVER NR CODY, NE - SECT C2

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<td>AVERAGE DEPTH</td>
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<td>PERCENT OF FLOW SAMPLED</td>
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<th>COMPUTATIONAL FACTORS</th>
<th>COMP TOTAL</th>
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EXAMPLES OF PROGRAM MODEIN OUTPUT—Continued

Run number 2. Sum of \( i_Q b \) values equal to zero.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

** DETERMINATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE **

FEATHER RIVER NR GRIDLEY, CA

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<tr>
<td>AVERAGE DEPTH</td>
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<tr>
<td>WATER TEMPERATURE</td>
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<tr>
<td>KINEMATIC VISCOSITY</td>
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<td>LAMINAR SUBLAYER THICKNESS</td>
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<td>REFERENCE SIZE RANGE</td>
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<td>PERCENT OF FLOW SAMPLED</td>
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<th>COMPUTATIONAL FACTORS</th>
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TOTALS                  | 100.00                      | 100.00| 0.00 | 16.2   |      |            |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      | 16.4                  |

\( i_Q b \) VALUES EQUAL ZERO. TOTAL DISCHARGE EQUAL TO MEASURED SUSPENDED-SEDIMENT DISCHARGE.
Run number 3. Three reference sizes selected by program and corresponding z values computed by trial. Z values for other size ranges obtained from regression line defined by trial z's.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

** DETERMINATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE **

COLUMBIA RIVER AT VANCOUVER, WA - MAIN CHANNEL

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<td>KINEMATIC VISCOSITY</td>
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<th>QPRIME</th>
<th>MULTI.</th>
<th>Z - VALUES ENTERED</th>
<th>COMPUTATIONAL FACTORS</th>
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<td>136929.5</td>
<td>0.00</td>
<td></td>
<td>169756.0</td>
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</tbody>
</table>

TIME OF MEASUREMENT: 1045
D65 0.540 MM
D35 0.333 MM
DISTANCE BETWEEN BOTTOM Sampled ZONE AND BED: 0.30 FT
AVERAGE DEPTH AT SAMPLED VERTICALS: 39.00 FT
MEASURED SUSP-SED CONC: 114. MG/L
APRIME: 0.008
SHEAR VELOCITY: 0.122443 FT/SEC
P-FACTOR: 13.84
X-FACTOR: 1.54
Z SLOPE: 0.50 BY REGRESSION

4648.23 T/D
136929.5 T/D
75775.4 T/D
11326.4 T/D
42648.5 T/D
24913.1 T/D
5.58 T/D
3.40 T/D
2.62 T/D
169756.0 T/D
EXAMPLES OF PROGRAM MODEIN OUTPUT—Continued

Run number 4. Reference size range selected by user and corresponding z value computed by trial. Z values for other size ranges computed from multipliers which vary with the 0.7 power of fall velocity.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

** DETERMINATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE **

FEATHER RIVER NR GRIDLEY, CA

<table>
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<tr>
<th>DATE OF MEASUREMENT</th>
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<tr>
<td>WATER DISCHARGE</td>
<td>11420.0 CFS</td>
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<tr>
<td>AREA</td>
<td>3623.68 SQFT</td>
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<tr>
<td>WIDTH</td>
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</tr>
<tr>
<td>AVERAGE VELOCITY</td>
<td>3.15 FT/SEC</td>
</tr>
<tr>
<td>AVERAGE DEPTH</td>
<td>11.92 FT</td>
</tr>
<tr>
<td>WATER TEMPERATURE</td>
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</tr>
<tr>
<td>KINEMATIC VISCOSITY</td>
<td>0.0000155 SQFT/SEC</td>
</tr>
<tr>
<td>LAMINAR SUBLAYER THICKNESS</td>
<td>0.0016302 FT</td>
</tr>
<tr>
<td>REFERENCE SIZE RANGE</td>
<td>0.5000 - 1.0000 MM</td>
</tr>
<tr>
<td>PERCENT OF FLOW SAMPLED</td>
<td>98.71 %</td>
</tr>
<tr>
<td>DEPTH/KS</td>
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<table>
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<th>SIZE RANGE</th>
<th>PERCENT IN RANGE</th>
<th>IBQB</th>
<th>QPRIME</th>
<th>MULT.</th>
<th>Z - VALUES</th>
<th>COMPUTATIONAL FACTORS</th>
<th>COMP TOTAL DISCH (T/D)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUSPENDED</td>
<td>BED</td>
<td>T/D</td>
<td></td>
<td>ENTERED</td>
<td>F(J)</td>
<td>F(I) +1</td>
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</table>
EXAMPLES OF PROGRAM MODEIN OUTPUT—Continued

Run number 5. Z values entered for two size ranges. Z values for other size ranges obtained from regression line defined by entered z's.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

** DETERMINATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE **

RIO GRANDE CONV. CHANNEL AT SAN ACACIA, NM

DATE OF MEASUREMENT 12/15/76
WATER DISCHARGE 767.0 CFS
AREA 159.49 SQFT
WIDTH 46.5 FT
AVERAGE VELOCITY 4.81 FT/SEC
AVERAGE DEPTH 3.43 FT
WATER TEMPERATURE 33 C
KINEMATIC VISCOSITY 0.0000173 SQFT/SEC
LAMINAR SUBLAYER THICKNESS 0.0011742 FT
REFERENCE SIZE RANGE - MULTIPLE
PERCENT OF FLOW SAMPLED 93.31 %
DEPTH/KS 4215.6

<table>
<thead>
<tr>
<th>SIZE RANGE IN MILLIMETERS</th>
<th>PERCENT IN RANGE</th>
<th>IBQ</th>
<th>QPRIME</th>
<th>IBQ</th>
<th>Z - VALUES</th>
<th>COMPUTATIONAL FACTORS</th>
<th>COMP TOTAL</th>
</tr>
</thead>
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<td>BED</td>
<td>SUBS(T/D)</td>
<td>RATIO</td>
<td>ENTERED</td>
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<td>F(I)</td>
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* MEASURED SUSPENDED-SEDIMENT DISCHARGE -- WHICH EXCEEDS COMPUTED DISCHARGE (REVIEW COMPUTATION).
Examples of program mode in output—Continued

Run number 6. Z value entered for one size range. Z values for other size ranges computed from multipliers which vary with 0.7 power of fall velocity.

U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

** DETERMINATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE **

NIORABA RIVER NR CODY, NE - SECT C2

DATE OF MEASUREMENT 6/19/52
WATER DISCHARGE 239.0 CFS
AREA 115.64 SQFT
WIDTH 118.0 FT
AVERAGE VELOCITY 2.07 FT/SEC
AVERAGE DEPTH 0.98 FT
WATER TEMPERATURE 17.8 C
KINEMATIC VISCOSITY 0.0000114 SQFT/SEC
LAMINAR SUBLAYER THICKNESS 0.0015643 FT
REFERENCE SIZE RANGE 0.1250 - 0.2500 MM
PERCENT OF FLOW SAMPLED 78.98 %
DEPTH/KS 942.4
TIME OF MEASUREMENT 1200
D65 0.317 MM
D35 0.226 MM
DISTANCE BETWEEN BOTTOM SAMPLED ZONE AND BED 0.30 FT
MEASURED SUSP-SED CONC 262. MG/L
MEASURED SUSP-SED DISCH 169.1 T/D
APRIME 0.246
SHEAR VELOCITY 0.084639 FT/SEC
P-FACTOR 10.67
X-FACTOR 1.52
Z SLOPE 0.70

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<th>SIZE RANGE (IN MILLIMETERS)</th>
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<th>IBQB</th>
<th>QPRIME</th>
<th>IBQB</th>
<th>Z - VALUES</th>
<th>COMPUTATIONAL FACTORS</th>
<th>COMP TOTAL</th>
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</thead>
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</table>
SUPPLEMENTAL DATA--SECTION J.

LOADING AND RUNNING THE PROGRAM ON THE PRIME COMPUTER

After the FORTRAN source code for the 2 programs (MEPDATA.F77 and MODEIN.F77) have been entered into the Prime computer, they must be compiled and loaded before they can be run.

Compiled programs MEPDATA.BIN and MODEIN.BIN are created by entering and executing in sequence, the commands F77 MEPDATA and F77 MODEIN.

The compiled programs are loaded by entering and executing the following command sequences:

```
SEG -LOAD
$ LO MEPDATA
$ LI
LOAD COMPLETE
$ Q
```

```
SEG -LOAD
$ LO MODEIN
$ LI
LOAD COMPLETE
$ Q
```

Files MEPDATA.SEG and MODEIN.SEG are created.

Lastly, the command SEG MEPDATA or SEG MODEIN is entered and executed to run the desired program.