AD-A096 522 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG--ETC F/G 9/2
H6124 - SPECIFIC ENERGY AND SPECIFIC FORCE IN EITHER A TRAPEZOI--ETC(U)
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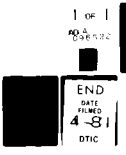

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ELECTRONIC COMPUTER PROGRAM ABSTRACT

TITLE OF PROGRAM: H6124 - Specific Energy and Specific Force in Either a Trapezoidal, Triangular, or Rectangular Open Channel

PROGRAM NO.: 722-F3-P1-6AJ2

PREPARING AGENCY: Hydraulic Analysis Division, Hydraulics Laboratory, U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, MS 39180

AUTHOR(S)	DATE PROGRAM COMPLETED	STATUS OF PROGRAM	
		PHASE	STAGE
Martin T. Hebler	Nov 73 Documented Nov 1977	Origin	Operational

A. PURPOSE OF PROGRAM

To compute the specific energy and specific force in either a trapezoidal, triangular, or rectangular open channel.

Reference: Chow, Van Te, Open Channel Hydraulics, McGraw-Hill, 1959, pp 41, 54.

B. PROGRAM SPECIFICATIONS

SEE FOLLOWING PAGE.

LEVEL II

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C. METHODS

The program is written in G635 time-sharing series, FORTRAN IV and is part of a Conversationally Oriented Real-Time Program-Generating System (CORPS). All I/O requirements are handled in the main program with the subroutine handling the computation.

D. EQUIPMENT DETAILS

The program was developed and is operational on WES G635, Vicksburg, MS. It is also operational on the HIS 66/80, Macon, GA, and Boeing CDC, Seattle, WA.

E. INPUT-OUTPUT

The required inputs which are entered at execute time are: discharge-cfs, channel bottom width (zero if triangular section)- ft, channel side slope (cotangent, zero if rectangular section), and number of flow depths and flow depths-ft. The output includes the given data, plus the specific energy, ft, and specific force, ft^3.

F. ADDITIONAL REMARKS

Complete documentation of this program is available from the Engineer Computer Program Library, Technical Information Center, WES.

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PREVIOUS EDITIONS ARE OBSOLETE.

B. PROGRAM SPECIFICATIONS:

Language: ANSI FORTRAN (FORTRAN IV)

Solution Requirements: The run command

RUN WESLIB/CORPS/H6124, R

plus the input variables defined in (E)

Method of Analysis: Solves algebraic equations for the specific energy and specific force.

Core Requirements G635: 10 K words

External Storage: None

Restrictions: Velocity distribution is uniform across the flow section and the invert slope is small (i.e., <10 degrees).

General Equations:

Specific Energy E (ft of water) $E = y + \frac{Q^2}{2gA^2}$

Specific Force F (ft^3 of water) $F = A\bar{y} + \frac{Q^2}{gA}$

where: Q is the discharge (cfs), g is acceleration of gravity (32.2 ft/sec^2), y is flow depth (ft), A is cross-section area (ft^2), and $\bar{y}$ is the distance (ft) of the centroid of the area A below the water surface.

Range of Quantities: Unlimited for practical application.

Accuracy: Governed by accuracy of input data; the specific energy and specific force are printed to $\pm$0.01 ft and ft^3.

REF: ER 1110-1-10 - ENGINEERING AND DESIGN - Engineering Computer Program Library Standards and Documentation, Appendix B

PART I: ENGINEERING DESCRIPTION

1. PROGRAM NUMBER: 722-F3-R0-6AJ

2. TITLE: H6124 - Specific Energy and Specific Force in Either a Trapezoidal, Triangular, or Rectangular Open Channel.

3. REVISION LOG: N/A

4. PURPOSE OF PROGRAM: To compute the specific energy and specific force in either a trapezoidal, triangular, or rectangular open channel.

Reference:

Chow, Ven Te, Open Channel Hydraulics, McGraw-Hill, 1959, pp 41, 54.

5. STEP SOLUTION:

a. Enter inputs:

(1) Discharge (Q), cfs
(2) Channel bottom width (b), ft (zero if triangular section)
(3) Channel side slope (Z) expressed as the cotangent (zero if rectangular section)
(4) Flow depth (y), ft

b. The computational steps are:

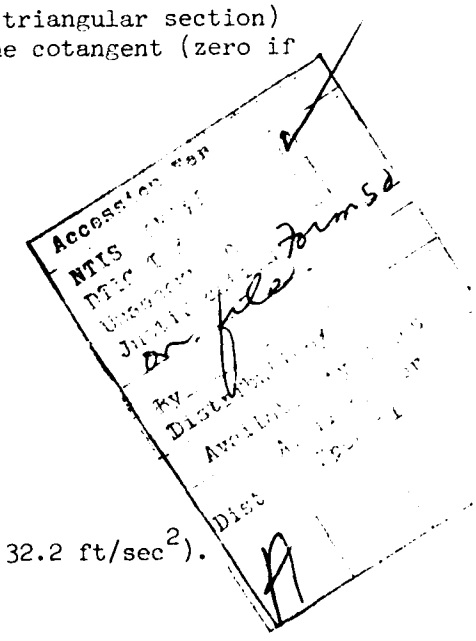
(1) Area (A), ft^2

$$A = (b + yZ)y$$

(2) Specific Energy (E), ft of water

$$E = y + \frac{Q^2}{2gA^2}$$

where g is acceleration of gravity (32.2 ft/sec^2).



(3) Moment ($A\bar{y}$), ft^3, of area with respect to the surface

$$A\bar{y} = \frac{y^2 b}{2} + \frac{y^3 Z}{3}$$

(4) Specific force (F), ft^3 of water

$$F = A\bar{y} + \frac{Q^2}{gA}$$

c. The given data and specific energy and specific force are printed.

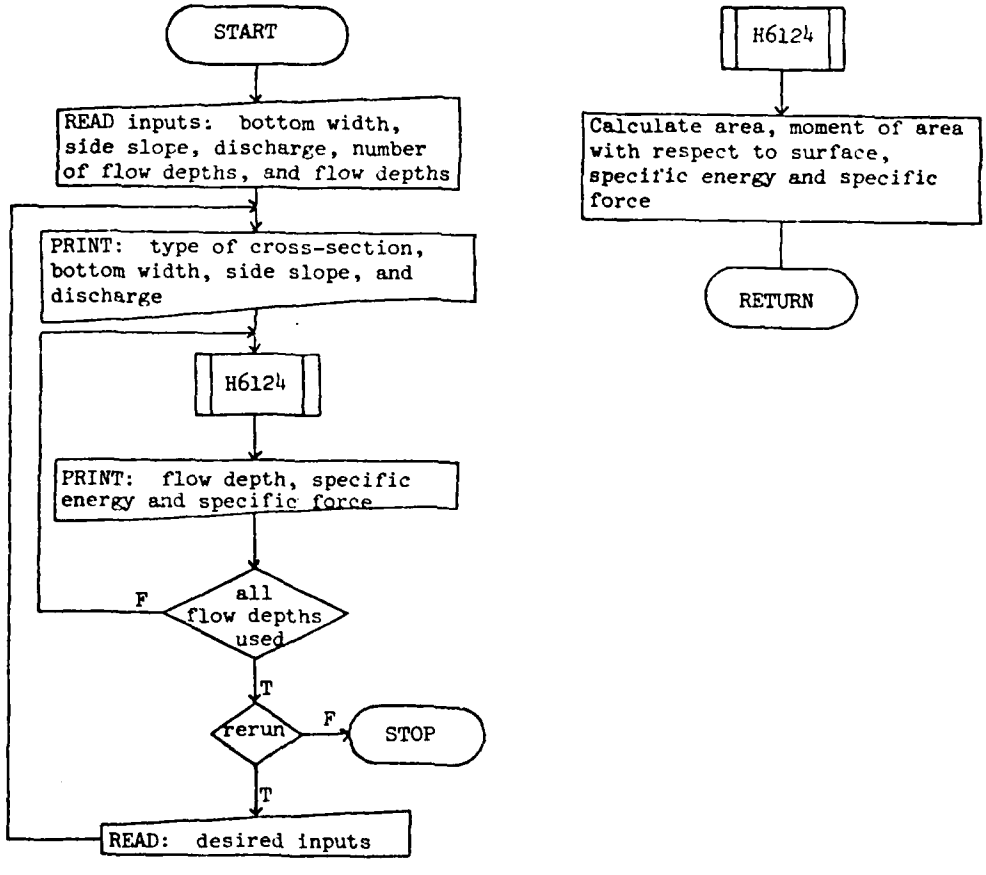
6. ACCURACY: Governed by accuracy of input data. The specific energy and the specific force are printed to $\pm$0.01 ft and ft^3.

7. REMARKS: Velocity distribution is uniform across flow section and the invert slope is small (i.e., <10 degrees).

PART II: COMPUTER FUNCTIONAL DESCRIPTION

1. REVISION LOG: N/A

2. FUNCTIONAL FLOW CHART:



3. EQUIPMENT AND OPERATING SYSTEM: The program was developed on a G635 time-share system in which input/output equipment consisted of a Model 33 remote teletype. It is now operational on the WES G635, Vicksburg, MS; HIS 66/80, Macon, GA; and Boeing CDC, Seattle, WA.

4. INPUT REQUIREMENTS: The required inputs are entered via the user's time-share terminal device in free format. All input cues and reads are performed in the main program. The subroutine handles the computations. Since computations are done in the subroutine, the necessary inputs to subroutine H6124 are passed via the CALL statement. The calling sequence is:

$$\text{CALL} \quad \text{H6124}(\text{arg}_1,\ldots,\text{arg}_6)$$

where:

arg_1 - discharge, cfs

arg_2 - bottom width, ft

arg_3 - side slope, cotangent

arg_4 - flow depth, ft

arg_5 - specific energy, ft of water

arg_6 - specific force, ft^3 of water

All values are floating point. Arguments 1-4 are inputs and arguments 5 and 6 are output.

5. SECONDARY STORAGE INPUT: None

6. INPUT DATA DESCRIPTION: The following names are used for the input variables in program H6124.

DISCH - discharge, cfs (arr$_1$)

BWID - channel bottom width, ft (arr$_2$)

SSLOPE - channel side slope, cotangent (arr$_3$)

NDEPTHS - number of flow depths, integer

Y - flow depth, ft (arr$_4$)

7. OUTPUT DATA DESCRIPTION: The following names are used for the output variables in program H6124:

ENERGY - specific energy, ft of water (arr$_5$)

FORCE - specific force, ft^3 of water (arr$_6$)

8. PROGRAM ERROR MESSAGES: None

9. VARIABLE DEFINITIONS:

AREA - flow depth area, ft^2

AY - moment of area with respect to surface, ft^3

BWID - channel bottom width, ft

NDEPTHS - number of flow depths, $0 < NDEPTHS \leq 25$

Y - flow depth, ft; dimensioned max 25

DEPTH - flow depth, ft; equal to Y(I) for I = 1,...,NDEPTHS

DISCH - discharge, cfs

ENERGY - specific energy, ft of water

FORCE - specific force, ft^3 of water

G - acceleration of gravity, 32.2 ft/sec^2

HFILE - five character name of program; passed to WESLIB count routine HACCT

JKL - direct return from RERUN to desired input read

KKK - total number of inputs, passed to RERUN

LQX - equal 1, print instructions from RERUN; equal 3, no print

LQZ - equal 1, execute all input cues and reads; equal 2, call WESLIB routine RERUN and enter only desired inputs

SSLOPE - channel side slope, cotangent

TYPE - character; type of cross section, either trap, rect, or tria.

ZZZZZ - character; equal RE, rerun; equal ST, stop

10. EXAMPLE CASE: Compute the specific energy and specific force for 6 given flow depths of a rectangular channel cross section.

a. Input data:

Bottom width (0 if tria sect) (BWID) = 3.51 ft

Side slope (0 if rect sect) (SSLOPE) = 0

Discharge (DISCH) = 100 cfs

Number of depths (NDEPTH) = 6

Flow depth(s) (Y(I) for I = 1, NDEPTHS) = 1, 1.43, 2.5, 4, 5.27, 6.5 ft

b. Output:

```
INPUT H6124 - SPECIFIC ENERGY AND FORCE-TRAP,RECT,TRIA-OPEN CHANNEL

AA-ENTER CHANNEL BOTTOM WIDTH IN FT(ZERO IF TRIA SECT).
=3.51
AB-ENTER CHANNEL SIDE SLOPE(ZERO IF RECT SECT).
=0
AC-ENTER DISCHARGE IN CFS.
=100
AD-ENTER THE NUMBER OF DEPTH(S) FOR WHICH SPECIFIC FORCE AND ENERGY ARE
TO BE CALCULATED.  MUST NOT EXCEED 25 DEPTHS.
=6
AE-ENTER THE  6 DEPTH(S) SEPARATED BY COMMAS.
=1,1.43,2.5,4,5.27,6.5

OUTPUT H6124 - SPECIFIC ENERGY AND FORCE OF A RECT. OPEN CHANNEL

BOTTOM WIDTH =       3.51 FT.
SIDE SLOPE =         0.   H:1V
DISCHARGE =        100.00 CFS.

   DEPTH     SPECIFIC     SPECIFIC
              ENERGY       FORCE
    (FT)       (FT)       (FT**3)
    1.00      13.60         90.23
    1.43       7.59         65.46
    2.50       4.52         46.36
    4.00       4.79         50.20
    5.27       5.72         65.53
    6.50       6.80         87.76

ENTER RERUN OR STOP
=STOP
```

REF: ER 1110-1-10 - ENGINEERING AND DESIGN - Engineering and Computer Program Library Standards and Documentation, Appendix C

PART III: FILE DOCUMENTATION

1. REVISION LOG: N/A

2. TITLE: H6124 - Specific Energy and Specific Force in Either a Trapezoidal, Triangular, or Rectangular Open Channel

3. SOURCE PROGRAM LISTING: See pages 9-11.

4. NUMERICAL AND LOGICAL ANALYSIS: No special numerical techniques used.

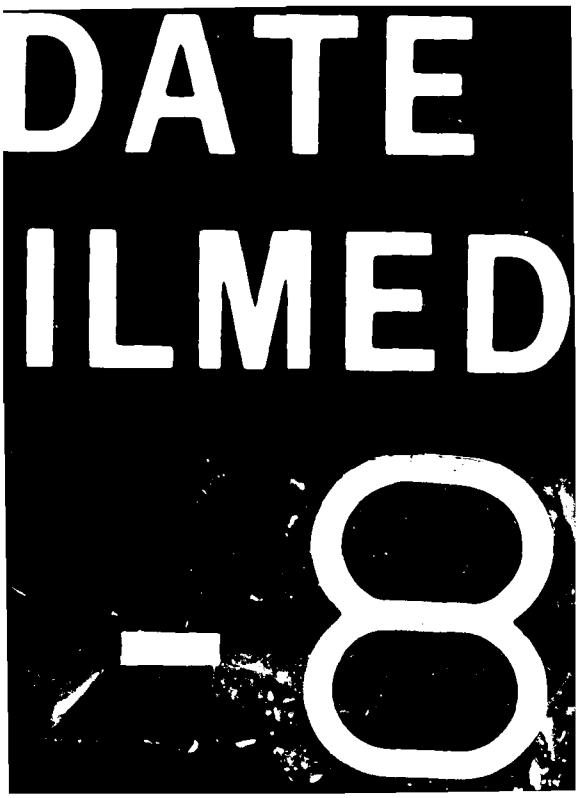
5. SUBROUTINES NOT DOCUMENTED IN ABSTRACT: None

6. MISCELLANEOUS: The program is part of the CORPS computer system. CORPS is an acronym standing for Conversationally Oriented Real-Time Program-Generating System. The program is now operational on the WES G635, Vicksburg, MS; HIS 66/80, Macon, GA; and Boeing CDC, Seattle, WA. The source listing on page 9 contains the first line run command and brief for H6124. This first line run command runs the binary H6124B of the source listing on pages 10-11 (Fortran source of H6124) and attaches the WESLIB routines HACCT and RERUN.

```
0001*#RUN WESLIB/CORPS/H6124B,R;WESLIB/RERUN,R;WESLIB/HACCT,R
0800 63THIS PROGRAM COMPUTES THE SPECIFIC FORCE AND ENERGY FOR A TRAP-
0810 62EZOIDAL, TRIANGULAR, OR RECTANGULAR CROSS-SECTION.  INPUTS RE-
0820 61QUIRED ARE BOTTOM WIDTH IN FT(ZERO IF TRIANGULAR), SIDE SLOPE
0830 61EXPRESSED AS THE COTANGENT OF THE ACUTE ANGLE WITH RESPECT TO
0840 63THE HORIZONTAL(ZERO IF RECTANGULAR), DISCHARGE IN CFS, THE NUM-
0850 63BER OF DEPTHS FOR WHICH THE SPECIFIC FORCE AND ENERGY ARE TO BE
0860 60COMPUTED, AND THE DEPTH(S).  OUTPUT INCLUDES THE GIVEN DATA,
0870 62TYPE OF CROSS-SECTION, AND A TABLE OF DEPTH(S) AND CORRESPOND-
0880 30ING SPECIFIC FORCE AND ENERGY.
0999*06FINISH
```

```
00001*#RUN *=;/CORPS/H6124B(NOGO)
10000 CHARACTER TYPE*4,HFILE*5
10010 DIMENSION Y(25)
10020 HFILE=5HH6124
10030 LQX=1;LQZ=1
10040 15000 CALL HACCT(HFILE)
10050 PRINT 15111
10060 15111 FORMAT(/"INPUT H6124 - SPECIFIC ENERGY AND FORCE-TRAP,RECT,
10070&TRIA-OPEN CHANNEL"//)
10080 GO TO(10,15),LQZ
10090 10 PRINT 20
10100 20 FORMAT(48HAA-ENTER CHANNEL BOTTOM WIDTH IN FT(ZERO IF TRIA
10110&7H SECT).)
10120 25 READ,BWID
10130 GO TO(30,15),LQZ
10140 30 PRINT 35
10150 35 FORMAT(47HAB-ENTER CHANNEL SIDE SLOPE(ZERO IF RECT SECT).)
10160 40 READ,SSLOPE
10170 GO TO(45,15),LQZ
10180 45 PRINT 50
10190 50 FORMAT(26HAC-ENTER DISCHARGE IN CFS.)
10200 55 READ,DISCH
10210 GO TO(60,15),LQZ
10220 60 PRINT 65
10230 65 FORMAT(49HAD-ENTER THE NUMBER OF DEPTH(S) FOR WHICH SPECIFI
10240&22HC FORCE AND ENERGY ARE/33HTO BE CALCULATED.  MUST NOT EXCEE
10250&12HD 25 DEPTHS.)
10260 70 READ,NDEPTHS
10270 IF(NDEPTHS-25) 75,75,80
10280 80 PRINT,"NUMBER DEPTHS > 25,RE-ENTER NUMBER < OR = 25"
10290 GO TO 70
10300 75 GO TO(85,15),LQZ
10310 85 PRINT 90,NDEPTHS
10320 90 FORMAT("AE-ENTER THE ",I2," DEPTH(S) SEPARATED BY COMMAS.")
10330 95 READ,(Y(I),I=1,NDEPTHS)
10340 GO TO(100,15),LQZ
10350 15 KKK=5
10360 CALL RERUN(KKK,LQX,JKL)
10370 GO TO(25,40,55,70,95,100),JKL
10380 100 TYPE=4HTRAP
10390 IF(BWID) 105,110,105
10400 110 TYPE=4HTRIA
10410 105 IF(SSLOPE) 115,120,115
10420 120 TYPE=4HRECT
10430 115 PRINT 125,TYPE,BWID,SSLOPE,DISCH
10440 125 FORMAT(/46HOUTPUT H6124 - SPECIFIC ENERGY AND FORCE OF A ,
10450&A4,". OPEN CHANNEL"//15HBOTTOM WIDTH = ,F9.2,4H FT.
10460&/13HSIDE SLOPE = ,F11.2,4HH:1V/12HDISCHARGE = ,F12.2,5H CFS.//
10470&4X,5HDEPTH,2(4X,8HSPECIFIC)/14X,6HENERGY,6X,5HFORCE/5X,4H(FT),
10480&6X,4H(FT),6X,7H(FT**3))
```

```
10490 DO 140 I=1,NDEPTHS
10500 DEPTH=Y(I)
10510 CALL H6124(DISCH,BWID,SSLOPE,DEPTH,ENERGY,FORCE)
10520 140 PRINT 130,DEPTH,ENERGY,FORCE
10530 130 FORMAT((F9.2,F11.2,F12.2))
10540 PRINT," "
10550 LOZ=2
10560 CHARACTER ZZZZZZ*2
10570 16000 PRINT, "ENTER RERUN OR STOP"
10580 READ 16001, ZZZZZZ
10590 16001  FORMAT(A2)
10600 IF(ZZZZZZ.EQ.2HRE) GO TO 15000
10610 IF(ZZZZZZ.EQ.2HST) GO TO 20000
10620 PRINT,"ERROR *** RETYPE"
10630 GO TO 16000
10640 20000  STOP;END
20000 SUBROUTINE H6124(DISCH,BWID,SSLOPE,DEPTH,ENERGY,FORCE)
20010 G=32.2
20020 AREA=DEPTH*(BWID+SSLOPE*DEPTH)
20030 ENERGY=DEPTH+DISCH**2/(2.*G*AREA**2)
20040 FORCE=BWID*DEPTH**2/2.+SSLOPE*DEPTH**3/3.+DISCH**2/(G*AREA)
20050 RETURN
20060 END
```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