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TASK COMPLETION REPORT FOR UPDATE FXGRAV

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FOR UPDATE FXGRAV**

by

Robert G. Steinke

September 4, 1997

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TASK COMPLETION REPORT FOR UPDATE FXGRAV

Robert G. Steinke

ABSTRACT

Update FXGRAV checks that GRAVs evaluated from input ELEVs for one-dimensional hydraulic components lie in the value range of -1.0 to 1.0.

1.0. INTRODUCTION

The Namelist-variable IELV = 1 option inputs ELEV cell-centered elevations for one-dimensional (1D) hydraulic and HTSTR components. TRAC-P then internally evaluates interface-centered GRAVs defined by

$$\text{GRAV}_{j+1/2} = (\text{ELEV}_{j+1} - \text{ELEV}_j) / ((\text{DX}_{j+1} - \text{DX}_j) / 2)$$

for interface $j+1/2$ between cells j and $j+1$ where DX_j is the length of cell j . Physically,

$$|\text{ELEV}_{j+1} - \text{ELEV}_j| \leq (\text{DX}_{j+1} - \text{DX}_j) / 2 \text{ such that } -1.0 \leq \text{GRAV}_{j+1/2} \leq 1.0 .$$

If incorrect ELEV_j or DX_j values are input for any cell j , nonphysical $\text{GRAV}_{j+1/2} < -1.0$ or $\text{GRAV}_{j+1/2} > 1.0$ could be evaluated. TRAC-P checks that GRAVs evaluated from input ELEVs for the HTSTR component and GRAVs input directly under the Namelist-variable IELV = 0 option for 1D hydraulic and HTSTR components lie within the range of -1.0 to 1.0. TRAC-P, however, does not check that GRAVs evaluated from ELEVs input for 1D hydraulic components lie in this range. Knolls Atomic Power Laboratory requested that TRAC-P Version 5.4.28 be programmed to perform this GRAV value check.

2.0. UPDATE FXGRAV

Update FXGRAV, a listing of which is shown in Appendix A, programs subroutine ELGR to check during the initialization stage of the TRAC-P calculation that GRAVs evaluated from input ELEVs for 1D hydraulic components lie in the value range of -1.0 to 1.0. To avoid round-off or input data having three or less significant digits of precision causing the evaluated GRAVs to be slightly less than -1.0 or slightly greater than 1.0, GRAVs in the range of $-1.001 \leq \text{GRAV}_{j+1} < -1.0$ are reset to -1.0, and GRAVs in the range $1.0 < \text{GRAV}_{j+1} \leq 1.001$ are reset to 1.0. Then if any GRAV

lies outside the range of -1.0 to 1.0, its value and its interface and component location are output with a warning message to the terminal and to the TRCMSG and TRCOUT files followed by an abort of the TRAC-P calculation after all component initialization has been completed.

3.0. TESTING

Update FXGRAV was tested using the UTUBE standard test problem, with results of that testing shown in Appendix B. With the UTUBE test problem's correct ELEV and DX input data, TRAC-P Version 5.4.28 with and without update FXGRAV gave the same output results. Then three cell-centered elevations of U-shaped PIPE component 700 were changed (as shown on page B-1 by bold-faced values) in TRACIN file UTUBEIN to cause four evaluated GRAV values to have magnitudes >1.0. These out-of-range values were detected by TRAC-P in subroutine ELGR. Information about these GRAVs lying outside the value range of -1.0 to 1.0 is shown as output to the terminal and to the UTUBEMSG (TRCMSG) and UTUBEOUT (TRCOUT) files on pages B-2 and B-3. A fatal-error abort occurred in subroutine ICOMP after all component initialization had been completed.

4.0. CONCLUSIONS

Update FXGRAV for TRAC-P Version 5.4.28 has been programmed to check that GRAVs evaluated from input ELEVs for 1D hydraulic components lie in the value range of -1.0 to 1.0. A modified version of the UTUBE standard test problem tested the correct functioning of this check and the warning message and abort that it generates.

ACKNOWLEDGMENT

The author wishes to thank Richard J. Smith for valuable discussions during the development and testing of this TRAC-P update.

Appendix A

Listing of Update FXGRAV

```

1 *ident fxgrav
2 */ -----Update Header Rev. 02-01-96-----
3 */
4 */   File & Update Ident name (must be the same): fxgrav
5 */   TSHOOTER identifier:
6 */
7 */   Code developer: Bob Steinke           Date developed: 7/28/97
8 */   Acknowledgements: KAPL requested this input-data check
9 */   Update reviewer: Rich Smith           Date reviewed: 8/xx/97
10 */
11 */   Update to be applied to MOD2 _X_ or other :
12 */
13 */   CFS file path: /073417
14 */
15 */   Purpose of update: Update fxgrav (FiX GRAV) checks that all
16 */                       GRAVs evaluated from the IELV=1 input of
17 */                       ELEVs lie in the range -1.0 to 1.0. A
18 */                       calculation abort occurs after input
19 */                       processing when any such GRAV has an
20 */                       out-of-range value.
21 */
22 */   Basis for update:  Checking that all GRAVs lie in the range
23 */                       -1.0 to 1.0 assures physical reality in
24 */                       modeling gravity and provides a partial
25 */                       check on the ELEV values input.
26 */
27 */   Dependencies on other updates: none
28 */
29 */   Justification of non-ANSI coding: N.A.
30 */
31 */   Is this a NULL update?  YES _X_ NO ____
32 */
33 */   Does this update generate new unit labels?  YES____ NO _X_
34 */   If yes, path and /name of LABNEW file: N.A.
35 */
36 */   Does the TRAC I/O change because of this update?  YES ____ NO _X_
37 */   TRAC I/O includes input, dump, output, and graphics files.  If
38 */   yes, then submit the necessary manual changes.
39 */
40 */   Does this changer require that any of the TRAC support codes, e.g.
41 */   EXTRACT, GOCNVRT, or EXCON, be changed?  YES ____ NO _X_
42 */   If yes, then include a description of the necessary changes.
43 */   This description will be passed onto the custodian of the TRAC
44 */   support codes.
45 */
46 */   Does the TRAC User's Guide, Theory Manual, or Programmer's Guide
47 */   change because of this update?  YES ____ NO _X_
48 */   If yes, then submit the necessary manual changes.
49 */
50 */   NAME OF
51 */   SUBROUTINE
52 */   OR COMDECK
53 */   CHANGED      DESCRIPTION OF CHANGE
54 */

```

```

55 */      ELGR          Checks that all GRAVs evaluated from ELEVs
56 */
57 */      lie in the range -1.0 to 1.0 for 1D-hydraulic
58 */      components.
59 */ -----
60 */
61 */  subroutine elgr changes
62 */  insert units.611
63 c
64 c      check that grav is in the range -1.0 to 1.0 for each interface
65 c
66       ibad=0
67       do 105 j=js,ncp
68         if ((gr(j).ge.-1.001).and.(gr(j).lt.-1.0)) gr(j)=-1.0
69         if ((gr(j).le. 1.001).and.(gr(j).gt. 1.0)) gr(j)= 1.0
70         if ((gr(j).lt.-1.0).or.(gr(j).gt.1.0)) then
71           if (ibad.eq.0) then
72             write(imout,101)
73             write( iout,101)
74 *if -def,unicos,1
75           write( itty,101)
76 *if def,unicos,1
77           write(      *,101)
78 101      format(' ')
79           endif
80           ibad=1
81           write(imout,102) gr(j),j,num
82           write( iout,102) gr(j),j,num
83 *if -def,unicos,1
84           write( itty,102) gr(j),j,num
85 *if def,unicos,1
86           write(      *,102) gr(j),j,num
87 102      format(' grav =',f9.5,' at interface',i3,' of component',i4)
88           endif
89 105 continue
90           if (ibad.eq.1) then
91             jflag=1
92             call error(2,'*elgr* grav is outside range (-1.0, 1.0)',4)
93           endif
94 */
95 */  compile elgr
96 */
97 */ -----

```


Appendix B

UTUBE Test Problem Modified ELEV Input and Output Results

UTUBE Test Problem PIPE 700 Elevations

```

83 ***** type          num          id          ctitle
84 pipe          700          700 $700$ u-tube standpipe
85 *          ncells          nodes          jun1          jun2          epsw
86 *          15          0          701          702          3.0000e-06
87 *          ichf          iconc          iacc          ipow
88 *          0          0          0          0
89 *          radin          th          houtl          houtv          toutl
90          1.5240e-01          1.2700e-02          0.0000e+00          0.0000e+00          2.9830e+02
91 *          toutv
92          2.9830e+02
93 *
94 * dx          * f          1.0000e+00e
95 * vol          * f          7.2966e-02e
96 * fa          * f          7.2966e-02e
97 * fric          * f          0.0000e+00e
98 * elev          *          6.5000e+00          5.5000e+00          4.5000e+00          3.5000e+00          2.5000e+00
99 * elev          *          1.5000e+00          5.0000e-01          -3.3640e-01          5.0000e-01          1.5000e+00
100 * elev          *          2.5000e+00          3.5000e+00          4.5000e+00          5.5000e+00          6.5000e+00
101 * elev          * e
102 * hd          * f          3.0480e-01e
103 * icflg          * f          0e
104 * nff          * f          0e
105 * alp          * r06 1.0000e+00 r04 0.0000e+00r05 1.0000e+00e
106 * vl          * f          0.0000e+00e
107 * vv          * f          0.0000e+00e
108 * tl          * f          2.9830e+02e
109 * tv          * f          2.9830e+02e
110 * p          * r05 1.0000e+05          1.0400e+05          1.1400e+05          1.2200e+05          1.1400e+05
111 * p          *          1.0400e+05r05 1.0000e+05e
112 * pa          * f          0.0000e+00e

```

UTUBE Test Problem PIPE 700 Modified Elevations in file UTUBEIN

```

83 ***** type          num          id          ctitle
84 pipe          700          700 $700$ u-tube standpipe
85 *          ncells          nodes          jun1          jun2          epsw
86 *          15          0          701          702          3.0000e-06
87 *          ichf          iconc          iacc          ipow
88 *          0          0          0          0
89 *          radin          th          houtl          houtv          toutl
90          1.5240e-01          1.2700e-02          0.0000e+00          0.0000e+00          2.9830e+02
91 *          toutv
92          2.9830e+02
93 *
94 * dx          * f          1.0000e+00e
95 * vol          * f          7.2966e-02e
96 * fa          * f          7.2966e-02e
97 * fric          * f          0.0000e+00e
98 * elev          *          6.5000e+00          5.4000e+00          4.5000e+00          3.5000e+00          2.5000e+00
99 * elev          *          1.5000e+00          5.0000e-01          -3.3640e+00          5.0000e-01          1.5000e+00
100 * elev          *          2.5000e+00          3.6000e+00          4.5000e+00          5.5000e+00          6.5000e+00

```

```

101 * elev * e
102 * hd * f 3.0480e-01e
103 * icflg * f 0e
104 * nff * f 0e
105 * alp * r06 1.0000e+00 r04 0.0000e+00r05 1.0000e+00e
106 * vl * f 0.0000e+00e
107 * vv * f 0.0000e+00e
108 * tl * f 2.9830e+02e
109 * tv * f 2.9830e+02e
110 * p * r05 1.0000e+05 1.0400e+05 1.1400e+05 1.2200e+05 1.1400e+05
111 * p * 1.0400e+05r05 1.0000e+05e
112 * pa * f 0.0000e+00e

```

Terminal Output Results of Interest

input data is being processed

h2o properties are used

```

grav = -1.1000 at interface 2 of component 700
grav = -3.8640 at interface 8 of component 700
grav = 3.8640 at interface 9 of component 700
grav = 1.1000 at interface 12 of component 700

```

```

*****
** warning **
*****

```

elgr grav is outside range (-1.0, 1.0)

```

*****
** fatal error **
*****

```

icomp fatal input error(s)

UTUBEMSG (TRCMSG) File Output Results of Interest

```

207
208 input data is being processed
209
210 h2o properties are used
211
212 number of title cards is: 4
213 *--*TEST PROBLEM UTUBE , Time = 50.0 s
214 *****
215 * a 12-inch diameter u-tube standpipe model *
216 *****
217
218 graphics data is defined in si units
219
220 input data is defined in si units

```

```

221
222 output data is defined in si units
223
224 system components 700 702 701
225
226 grav = -1.1000 at interface 2 of component 700
227 grav = -3.8640 at interface 8 of component 700
228 grav = 3.8640 at interface 9 of component 700
229 grav = 1.1000 at interface 12 of component 700
230
231
232 *****
233 ** warning **
234 *****
235
236 *elgr* grav is outside range (-1.0, 1.0)
237
238
239 *****
240 ** fatal error **
241 *****
242
243 *icomp* fatal input error(s)

```

UTUBEOUT (TRCOUT) File Output Result of Interest

```

390 -----
391
392 77777 00000 22222
393          7 0 0 2
394          7 0 0 22222
395          7 0 0 2
396          7 00000 22222
397 -----
398 component number 702,      type = break      id = 702,      ctitle = $702$ atm pressure bc
399      jun1 = 702,      ibty = 0,      isat = 0,      ioff = 0
400      dxin = 1.0000E+00,      volin = 7.2966E-02,      alpin = 1.0000E+00,      tin = 2.9830E+02,      pin = 1.0000E+05
401          m          m3          -          k          pa
402      pain = 0.0000E+00,      concin = 0.0000E+00,      rbmx = 0.0000E+00,      poff = 0.0000E+00,      belv = 7.5000E+00
403          pa          -          pa/s          pa          m
404
405 system components 700 702 701
406
407 grav = -1.1000 at interface 2 of component 700
408 grav = -3.8640 at interface 8 of component 700
409 grav = 3.8640 at interface 9 of component 700
410 grav = 1.1000 at interface 12 of component 700
411
412 *****
413 ** warning **
414 *****
415
416 *elgr* grav is outside range (-1.0, 1.0)
417
418 height change across component 700 from cell 1 to cell 15 is -8.88178E-16 m
419
420 elevation to grav conversions for component 700 ( pipe ) faces 1 through 16
421
422 grav      -1.00000E+00 -1.10000E+00 -9.00000E-01 -1.00000E+00 -1.00000E+00 -1.00000E+00 -1.00000E+00 -3.86400E+00
423      3.86400E+00 1.00000E+00 1.00000E+00 1.10000E+00 9.00000E-01 1.00000E+00 1.00000E+00 1.00000E+00
424
425
426 k factor to fric conversions for component 700 ( pipe ) faces 1 through 16
427
428 fric      0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
429      0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
430

```