TASK COMPLETION REPORT FOR UPDATE FXGRAV

Robert G. Steinke, TSA-10
TASK COMPLETION REPORT
FOR UPDATE FXGRAV

by

Robert G. Steinke

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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

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

for interface $j+1/2$ between cells $j$ and $j+1$ where $\text{DX}_j$ is the length of cell $j$. Physically,

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

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 TRCMSE 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 (TRCMSEG) 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 change 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 */
47 */   change because of this update? YES ___ NO _X_
48 */   If yes, then submit the necessary manual changes.
49 */
```

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<th>CHANGED DESCRIPTION OF CHANGE</th>
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ELGR

Checks that all GRAVs evaluated from ELEVs lie in the range -1.0 to 1.0 for 1D-hydraulic components.

subroutine elgr changes

check that grav is in the range -1.0 to 1.0 for each interface

ibad=0

do 105 j=js,ncp

if ( (gr(j).ge.-1.001).and.(gr(j).lt.-1.0)) gr(j)=-1.0

if ( (gr(j).le.1.001).and.(gr(j).gt.1.0)) gr(j)= 1.0

if ( (gr(j).lt.-1.0).or.(gr(j).gt.1.0) ) then

if (ibad.eq.0) then

write(imout,101)

write(iout,101)

endif

ibad=1

write(imout,102) gr(j),j,num

write(iout,102) gr(j),j,num

*if -def,unicos,1

write(itty,101)

*if def,unicos,1

write(*,101)

101 format('')

endif

ibad=1

write(imout,102) gr(j),j,num

write(iout,102) gr(j),j,num

*if -def,unicos,1

write(itty,102) gr(j),j,num

*if def,unicos,1

write(*,102) gr(j),j,num

102 format(' grav =',f9.5,' at interface',i3,' of component',i4)

endif

105 continue

if (ibad.eq.1) then

jflag=1

call error(2,'*elgr* grav is outside range (-1.0, 1.0)',4)

endif

*compile elgr

*
Appendix B

UTUBE Test Problem Modified ELEV Input and Output Results

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<tr>
<td>100</td>
<td>*</td>
<td>101</td>
<td>elev</td>
<td>2.5000e+00</td>
<td>3.6000e+00</td>
<td>4.5000e+00</td>
<td>5.5000e+00</td>
<td>6.5000e+00</td>
<td>6.5000e+00</td>
<td>6.5000e+00</td>
<td>6.5000e+00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

input data is being processed
h2o properties are used

number of title cards is:  4
*--*--TEST PROBLEM UTUBE , Time = 50.0 s
******************************************************************************
a 12-inch diameter u-tube standpipe model *
******************************************************************************
graphics data is defined in si units
input data is defined in si units
output data is defined in SI units

system components 700 702 701

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)

UTUBEOUT (TRCOUT) File Output Result of Interest

---

component number 702, type = break, id = 702, ctitle = $702$ atm pressure bc
junl = 702, lDty = 0, isat = 0, ioff = 0
dxin = 1.0000E+00, volin = 7.2966E-02, alpin = 1.0000E+00, tin = 2.9830E+02, pin = 1.0000E-05
pain = 0.0000E+00, concin = 0.0000E+00, rmx = 0.0000E+00, poff = 0.0000E+00, belv = 7.5000E+00

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

*elgr* grav is outside range (-1.0, 1.0)

height change across component 700 from cell 1 to cell 15 is -8.88178E-16 m

elevation to grav conversions for component 700 (pipe) faces 1 through 16

grav -1.0000E+00 -1.10000E+00 -9.00000E-01 -1.00000E+00 -1.00000E+00 -1.00000E+00 -1.00000E+00 -3.86400E+00 3.86400E+00 1.00000E+00 1.00000E+00 1.10000E+00 9.00000E-01 1.00000E+00 1.00000E+00 1.00000E+00

k factor to fric conversions for component 700 (pipe) faces 1 through 16

crac 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 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

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