

Modifying input files for the Full Equations (FEQ) hydraulic model using FEQinput

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Background

The Full Equations Model (FEQ) is a computer program that solves the full, dynamic equations of motion for one-dimensional unsteady flow in open channels and through control structures. The open modular program code as led to the expansion of the applications of the program. FEQ has been used to design and operate flood control structures, delineate inundation maps and analyze peak flow impacts, and is currently being used to develop a system that uses floodplain models for real-time stream flow simulation that will aid in flood-fighting efforts.



Figure 1: Aerial view of one branch of Salt Creek, along with some parameters modeled by FEQ (black boxes). The FEQ model used by DuPage County covers hundreds of miles of river hydraulics. Aerial picture from <http://maps.google.com>


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1142 *****
1143 / BROOKWOOD TRIBUTARY - MAIN BRANCH
1144
1145 1 423          * COMPLEX WITH BROOKWOOD TRIBUTARY
1146 5 6 0422 0423 0423 116 116          446.15 / DOUBLE BOX CULVERT SPREAD RD. (STD-2/CS1-8)
1147 2 2 0423 0422          461.30 / DOUBLE BOX CULVERT SPREAD RD. (STD-2/CS1-8)ENHANC
1148 1 423          *
1149 8 1 0422 1 -29          *
1150 2 6 0 0422 1          10.0          *
1151 *****
1152 5 6 086 089 090 SC00103 SC00103          647.2          * OLD OAK BROOK DAM
1153 2 2 086 089          *
1154 5 6 097 098 098 201 201 202 202          999.00 0.8          652.5          * 31st STREET (OAK BROOK ROAD)
1155 1 39          *
1156 15 0170 0180          *
1157 21 0142 0142          *
1158 5 6 0180 090 010 SC00104 SC00104          442.04          * 31st STREET (OAK BROOK ROAD) WEIRD BRIDGE
1159 5 6 0180 090 010 SC00104 SC00104          453.17 / 31st STREET (OAK BROOK ROAD) ENHANCEMENT OVERFLOW
1160 SC00104 SC00104          461.40 / 31st STREET (OAK BROOK ROAD) LEFT CHANNEL FLOW
1161 SC00104 SC00104          459.15 / 31st STREET (OAK BROOK ROAD) RIGHT CHANNEL FLOW
1162 2 3 096 010 010          *
1163 2 3 097 010 010          *
1164 3 087 010 010          *
1165 3 087 010          *
1166 1 98          *
1167 5 6 084 097 097 211 211 210 212          999.00 0.8          450.6          * McDONALD'S PEDESTRIAN BRIDGE
1168 10 0170 0170          *
1169 10 0170 0170          *
1170 5 6 0170 097 010 SC00102 SC00102          442.07 / McDONALD'S PEDESTRIAN WEIRD BRIDGE
1171 5 6 0170 097 010 SC00102 SC00102          453.89 / McDONALD'S PEDESTRIAN ENHANCEMENT OVERFLOW
1172 SC00102 SC00102          455.82 / McDONALD'S PEDESTRIAN LEFT CHANNEL FLOW
1173 SC00102 SC00102          456.04 / McDONALD'S PEDESTRIAN RIGHT CHANNEL FLOW
1174 2 3 097 010 010          *
1175 2 3 096 010 010          *
1176 3 086 010          *
1177 3 086 010          *
1178 1 97          *
1179 3 96          *
1180 3 086 087          *
1181 2 3 086 087          *
1182 *****
1183 / Singer Creek
1184
1185 4 1 092 1 -24          *
1186 4 1 092 1 0          7.00          *
1187 2 2 091 090          446.38 / SINGER CREEK - DONALD LANE (LTH SCS)
1188 5 6 090 091 091 4403 4403          457.33 /
1189 4703 4703          459.32 /
1190 *****

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Figure 2: Sample section of an FEQ file.

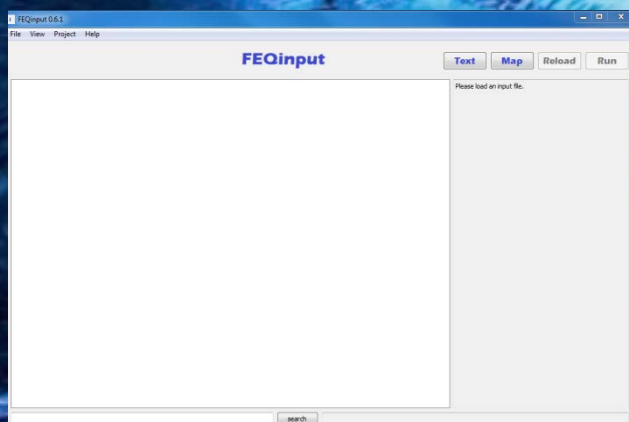


Figure 3: FEQinput interface

Introduction

Input files for the Full Equations Model are composed of text files that contain large amounts of parameters, data, and instructions written in a format exclusive to FEQ. Although documentation exists that can aid in the creation and editing of these input files, there is a steep learning curve for understanding the specific format and language of the files. FEQinput is a line editing tool that enables users to understand, modify, search, test, and save results from input files.

FEQinput provides a set of tools to help a new user create and modify input files for the FEQ hydraulic model, and for the related utility tool FEQUTL. The current capabilities of the program include: loading FEQ and FEQUTL input files into a table that interprets the contents of a given line and displays a description for a user to see; single-line and multi-line editing for the text files that updates the display descriptions; search bar that allows users to find a given string of text within an opened file; “block buttons” that allow users to easily navigate large files by jumping to a specific section of the file; “run” capability that automatically loads the input file (with the changes made by the user) into either FEQ or FEQUTL, runs the model, and displays the output of the program; ability to save new input files or modify existing ones; and links to the FEQ and FEQUTL documentation. These functionalities will be discussed in the following sections.

Opening FEQ or FEQUTL input files

To open an input file, click “File” on the menu and then click on “Open .FEQ file” or “Open .FTL file” for FEQ and FEQUTL files, respectively. Not all input files will have the same extensions (.feq or .ftl), so in the case of a different extension, select to show “All Files” by using the dropdown menu on the file selection dialog (Figure 4). Once a file is opened, its path and filename will be displayed in the bottom-right corner of the program.

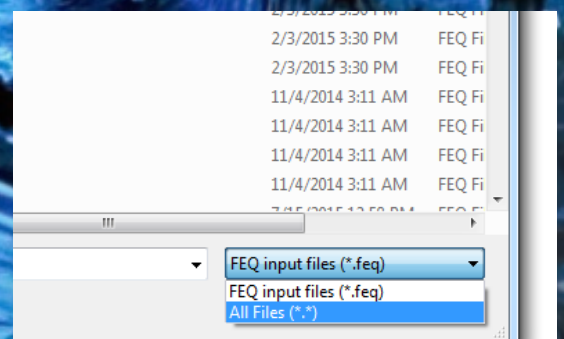


Figure 4

Reading input lines

After opening a file, its contents will display on the left-side table in the program. The table contains three columns: the number of the line, a “code” word for each line, and the contents of each line. The “code” word is a small combination of alphanumeric characters that FEQinput uses to identify and interpret the contents of a line. The code word column can help the user find lines that the program cannot read (code: “NOREAD”) and fix any mistakes within those lines.

The contents of the input file are displayed in the third column. Each line of the input file is

placed on a table row. To interpret the contents of a line, the user can click on the desired line. A description of the contents of the line, along with definitions and parameters will be displayed in the text box next to the table. For a more detailed description, a link to the FEQ or FEQUTL documentation is provided in the description box. When reopening or reloading files, the table columns may shrink in size to match the size of the visible rows. The table columns can be resized by dragging the column headers.

FEQinput 0.6.1

File View Project Help

Run Ctrl Branch Tributary Matrix Special Out Input

Output Structures Function Tables Free Node Backwater

FEQinput

Text Map Reload Run

	Code		Text
5015	MX1	1 81	
5016	MX1	1 80	
5017	MX3	3 D79 U80	
5018	MXC	; 5 6 D79 U80 D79 500 501	650.04
5019	MX3	3 U80 D76	
5020	MX2	2 3 D79 U80 D76	
5021	MX1	1 76	
5022	MXC	; 5 4 D75 U76 U76 351 351 350 352 352	50 1330.0 999.00 0.8 663.50
5023	MX15	15 F113 F114	0.000001 200.0
5024	MX15	15 F115 F116	0.000001 200.0
5025	MX2	2 3 F113 F115 D75	
5026	MX3	3 D75 F113	
5027	MX3	3 D75 F115	
5028	MX2	2 3 F114 F116 U76	
5029	MX5	5 6 F114 U76 F114 SCSC7134 SCSC7134	645.75 ' ROOSEVELT ROAD (IL ROUTE
5030	MX5	5 6 F116 U76 F116 SCSC8134 SCSC8134	662.00 ' ROOSEVELT ROAD (IL ROUTE
5031	MX1	1 75	
5032	MX5	5 4 D74 U75 U75 361 361 360 362 362	50 1330. 999.00 0.8 999.00
5033	MX15	15 F109 F110	
5034	MX15	15 F111 F112	
5035	MX2	2 3 D74 F109 F111	
5036	MX3	3 D74 F109	
5037	MX3	3 D74 F111	
5038	MX2	2 3 U75 F110 F112	

U74: upstream node
U75: downstream node
U75: node at which the flow through the structure is specified.
361: number of the table specifying the bridge-loss coefficient as a function of water-surface height at the bridge opening for positive flow.
361: number of the table specifying the bridge-loss coefficient as a function of water-surface height at the bridge opening for negative flow.
360: number of the table specifying the area of bridge opening as a function of water-surface height.
362: number of the table specifying flow over the roadway as a function of head for positive flow.
362: number of the table specifying flow over the roadway as a function of head for negative flow.
50: number of the table specifying the submergence effect as a function of head ratio for flow over the roadway.
1330.: maximum flow area through the bridge.
999.00: elevation of the high point of the bridge opening.
0.8: submerged-flow discharge coefficient for the bridge.
999.00: elevation for computing head on the roadway.
Comments:
' BUTTERFIELD ROAD (IL ROUTE 56)
Manual

search

C:/Users/ancalle/Documents/FEQinput/test_files/Lsg.feq

Figure 5: FEQinput interface with opened file. The left side displays the input file, while the right panel displays definitions and interpretations of the selected (blue) line.

Navigating and Searching within input files

While some input files can be as short as a few hundred lines, other files can range between thousands and tens of thousands of lines. To expedite navigation through these files, FEQinput includes options, in addition to using the scrollbar or arrow keys, to navigate within input files. For FEQ files only, the program provides navigation buttons on the top left corner of the window. When clicked, these buttons navigate to a specific section of the input file. If the input file does not contain a section, the button for that section will be disabled to avoid confusion.

Another way to navigate within the input files is to do a Search. The search bar (located at the bottom left corner) provides an easy way to find a desired line of input, such as: section headers, parameters, or comments. To use the search bar, type the desired phrase to find and click on “search”. A dialog with extra options will open with the option to “search within a block” (for FEQ files only). This option limits the search to only a specific section of the file. The search is not case-sensitive.

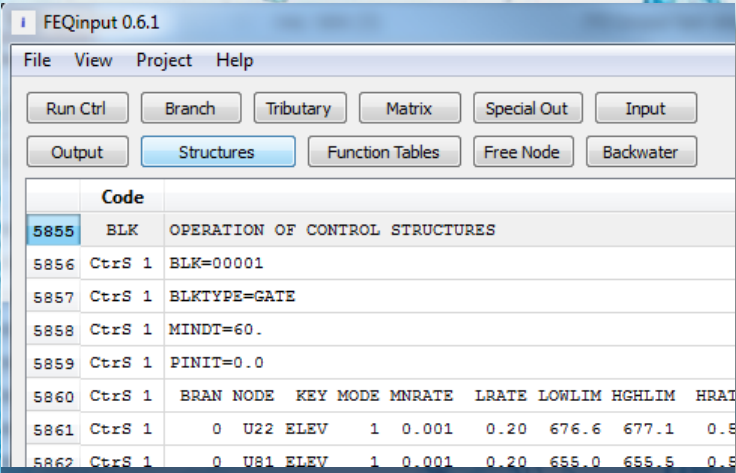


Figure 6: Navigation buttons. This feature is only available for FEQ files (not available for FEQUTL files).

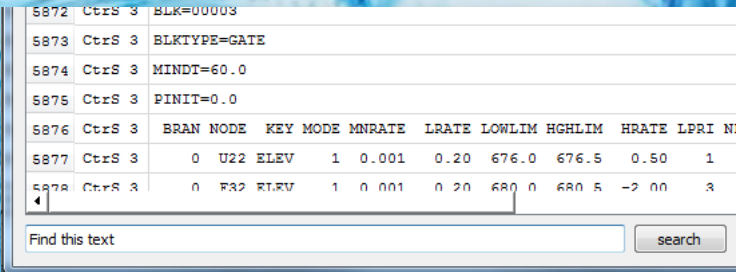


Figure 7: The search bar is located on the bottom left corner of the program window.

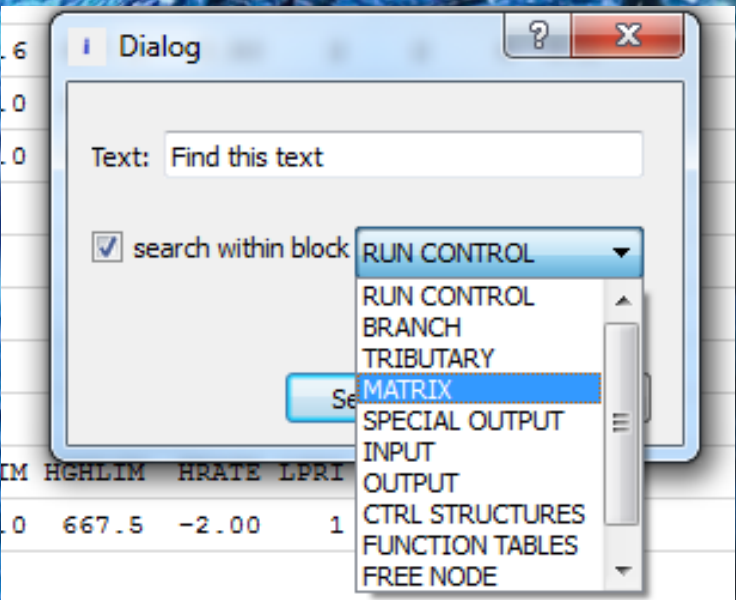


Figure 8: Search dialog with “search within block” option.

Modifying input files: single-line editor

Additional to helping the user understand the contents of an input file, FEQinput also allows the user to modify the file and see how the modifications will be interpreted by FEQ or FEQUTL. This can be done in two ways. The first is to edit a line directly in the display table. To edit a single line, the user can double-click on it. After modifying the contents of the line, the changes will be interpreted when pressing enter and selecting the line again. If the line does not provide the required or expected results (for example, when inserting or removing comments), the user can click on the “Reload” button (located at the top right corner, or by selecting from the menu Project >> Reload, or by pressing CTRL+SHIFT+R), which loads the edited input file again, to display the correct information on the display box. This single-line edit functionality is good for first-time users, or to modify simple parameters. It is important to note that because the FEQ format alternates between using spaces, variable types, headers, and code words as part of the formatting parameters, when editing a line, the user should keep in mind the position, number of characters and variable-type of the object to edit within the line.

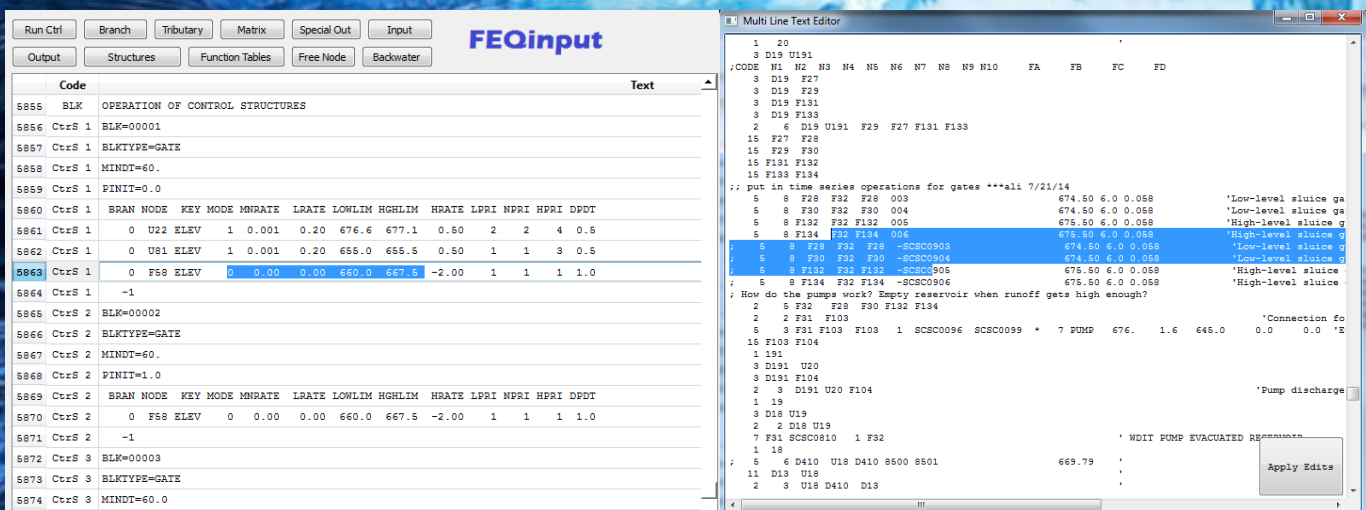


Figure 9: Editing a line with the single line editor (left) or with the multi-line editor (right).

Modifying input files: multi-line editor

The second form of editing input files is by using a provided multi line editor. This tool allows users to edit the input text file in its raw format, through a simple text editing interface. This is similar to editing a file in Windows Notepad. To load the multi-line editor, the user must click on the “Text” button in the top right corner, or select from the menu View >> Text Mode. After editing the text file using the multi-line editor, clicking on the “Apply Edits” button at the bottom right corner of the editor will load the changes into the main table to display and interpret the modified text. This function is useful for experienced users of FEQ, as well as to copy and paste large lines of text, and to add or remove lines from the input file.

Performing a model run

Once an input file is properly modified or inspected, the user can run this file with FEQ or FEQUTL by clicking the “Run” button at the top right corner, or by selecting from the menu Project >> Run, or by pressing CTRL+R. If the program runs correctly, the output of the model will open in a new window. This output is saved in the same folder as the FEQinput executable with the name “output”. In order for a model to run correctly, the following conditions must be met: the FEQinput executable file should be in the same directory as the FEQ or FEQUTL executable files; and (for FEQUTL only), the executable files must be located in the same directory as the input file. The former is done in order to avoid including both FEQ and FEQUTL executables inside the FEQinput executable, which would’ve made FEQinput considerably slower. The latter has to be done to prevent errors from relative paths within the FEQUTL input file.

Saving input files

If the user is satisfied with the changes made to the input file, FEQinput can save the changes into the original file by selecting from the menu File >> Save, or by pressing CTRL+S. If the user prefers to have different files of the different versions, the program can save the changes into a new file by selecting from the menu File >> Save As, or by pressing CTRL+SHIFT+S. It should be noted that even though changes are made to an input file and the model is run or reloaded through FEQ or FEQUTL, these changes will not be written into the file until the user chooses to save the file. This enables testing of the changes prior to committing them as a user option.

Conclusion

Both new and experienced users can benefit from the capabilities of FEQinput. Different ways to edit input files give the user enough flexibility to work at any desired pace. FEQinput provides a simple and quick solution for users to work with in order to get familiarized and experienced with FEQ models.

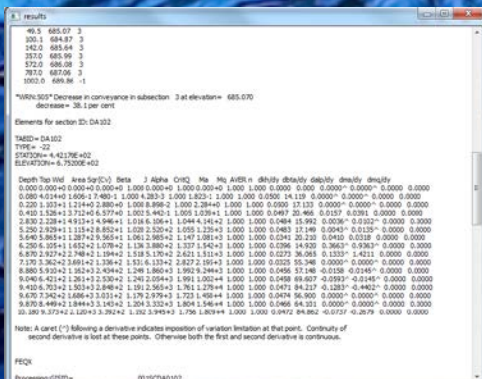


Figure 10: Sample FEQUTL output.

Questions and Feedback

Questions and comments relating to the program can be directed to the developers:

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