CHAPTER V

DISCUSSION

5.1   Discussion

The algorithm of the simulator in this study consists of two major parts: Pipes and Pumps Network and Open Channel Network. The program was testing by using data from an existing network. The actual pressures and flow distribution were used to check against the simulation prediction. Advantages and disadvantages of the simulator are also discussed.

5.2   Part I: Pipes and pumps network

Table 5.1 Comparison of results of the PCN simulator (Q_{PCN}) with the data from PICCOLO code (Q_{Picc}) for flow distribution of water transmission tunnel system

I - J	$Q_{PCN}(I , J)$	$Q_{Picc}(I , J)$	% diff
1 - 2	43969.57	43814.00	0.36
2 - 3	43968.92	43814.00	0.35
3 - 4	2804.06	2649.00	5.85
3 - 5	41165.09	41165.00	0.00
4 - 17	2804.08	2649.00	5.85
5 - 6	38741.75	38742.00	0.00
6 - 7	25825.04	25825.00	0.00
6 - 8	12917.09	12917.00	0.00
7 - 9	14583.01	14583.00	0.00
7 - 1	11041.94	11042.00	0.00
8 - 15	12917.31	12917.00	0.00
9 - 10	14583.23	14583.00	0.00
11 - 12	11041.98	11042.00	0.00
12 - 13	11042.01	11042.00	0.00
13 - 14	11042.01	11042.00	0.00
15 - 16	12916.91	12917.00	0.00
17 - 18	8332.99	8333.00	0.00
17 - 19	-5529.05	5684.00	2.73

Table 5.1 (Continued)

I - J	$Q_{PCN}(I, J)$	$Q_{Picc}(I, J)$	% diff
19 - 20	-5528.83	5684.00	2.73
20 - 21	-58028.65	58184.00	0.27
20 - 24	52500.12	52500.00	0.00
21 - 22	-58028.64	58184.00	0.27
22 - 23	-58029.65	58184.00	0.27
24 - 25	17500.03	17500.00	0.00
24 - 26	34999.68	35000.00	0.00
26 - 27	35000.07	35000.00	0.00
27 - 28	5000.05	5000.00	0.00
27 - 32	30000.20	30000.00	0.00
28 - 29	5000.03	5000.00	0.00
29 - 30	5000.01	5000.00	0.00
30 - 31	4999.99	5000.00	0.00
32 - 33	29999.99	30000.00	0.00
33 - 34	14583.01	14583.00	0.00
33 - 35	15417.50	15417.00	0.00
35 - 36	15417.02	15417.00	0.00
36 - 37	15416.81	15417.00	0.00

Note: - minus sign (-) represents reverse flow direction.
- the results from PICCOLO do not show the flow direction so every value has a plus sign (+).

5.3 Part II: Open channel network

Table 5.2 Comparison of calculated flow rates from the PCN simulator (Q_{PCN}) with the data from Open Channel Flow (Q_{OCF}) for the example network

I - J	$Q_{PCN}(I, J)$	$Q_{OCF}(I, J)$	% diff
3 - 4	96.58	95.75	0.86
3 - 5	153.42	154.25	0.54
4 - 6	46.09	40.66	13.37
4 - 7	50.49	55.09	8.36
5 - 6	13.02	12.01	8.37
5 - 8	140.40	142.24	1.29
6 - 7	59.11	52.67	12.23
7 - 8	109.60	107.76	1.70

Table 5.3 Comparison of calculated depth from the PCN simulator (Q_{PCN}) with the average depths from Open Channel Flow (Q_{OCF}) for the example network

I - J	$h_{PCN}(I, J)$	avg. $h_{OCF}(I, J)$	% diff
3 - 4	4.82	4.80	0.30
3 - 5	4.82	4.80	0.30
4 - 6	4.56	4.98	8.42
4 - 7	4.56	4.90	7.02
5 - 6	4.87	4.88	0.17
5 - 8	4.87	4.93	1.17
6 - 7	5.32	4.93	7.89
7 - 8	5.03	4.98	1.10

5.4 Advantages

There are many advantages for this simulator. Some of them are listed as follow:

5.4.1 The accurate solutions from Part I

The calculated flow rates in the Part I give very small errors when compared to the actual data. Although some pipes have a somewhat larger discrepancy, they are still in an acceptable range.

5.4.2 The ability to calculate the friction factor

The program can calculate the approximate Fanning friction factor for all pipes by updating the new friction factors after the new flow rates are calculated. And the program lets the user choose the types of friction factor (fixed or calculated) during input pipe data.

5.4.3 The short time of calculation

According to the method used in Part I, a bandwidth process module can reduce the computational time for a large network.

5.4.4 The user interface

The user interface of this simulator is very user-friendly. The steps for input data are in wizard mode, which is very easy to input, check, or edit data.

5.4.5 The multiple outputs

The program will show the results in View Results' window (Figure A.17 to A.19). The user can print the results into files. The result files can also be opened in any spreadsheet program or word processor.

5.5 Disadvantages

There are some disadvantages of this simulator.

5.5.1 Open channel results

The results from Part II still have moderate discrepancies from the actual data. The reason is that the assumptions used for the case of flows in open channels are probably ideal.

5.5.2 Limitations of solving algorithm

The program cannot simulate the situation where the flow from an open channel is going back into the pipeline system, since the pressure and flow rate of the node, that is connecting to the open channel and the pipeline, needs to be specified. However, the program only allows the user to specify either the pressure or flow rate.