iemisc: Comparing Other Hydraulic Software Output to iemisc's Manningtrap for Critical Conditions

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2023-02-13

Contents

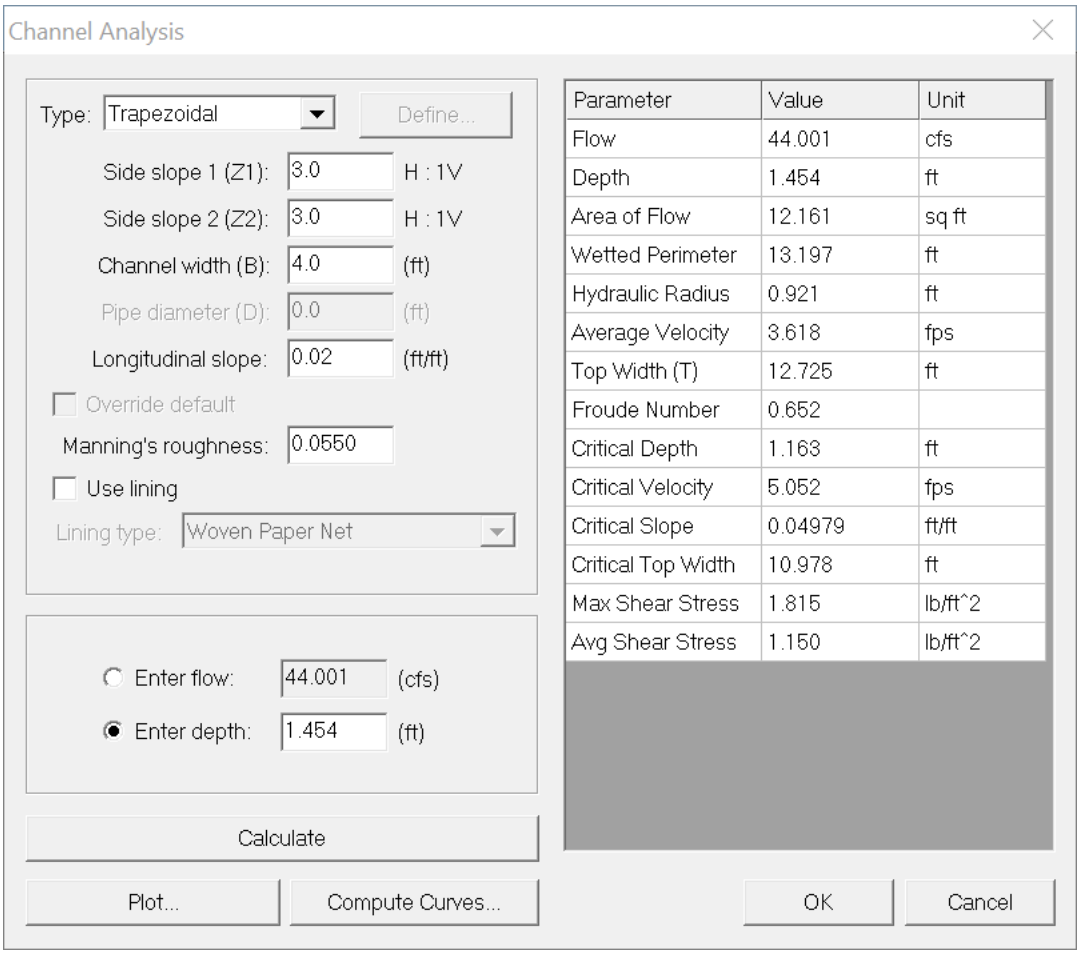
Replicate the R code without the images

Note: If you wish to replicate the R code below, then you will need to copy and paste the following commands in R first (to make sure you have all the of the required packages):

```
install.packages("iemisc", "knitr")
# install the package and its dependencies
```

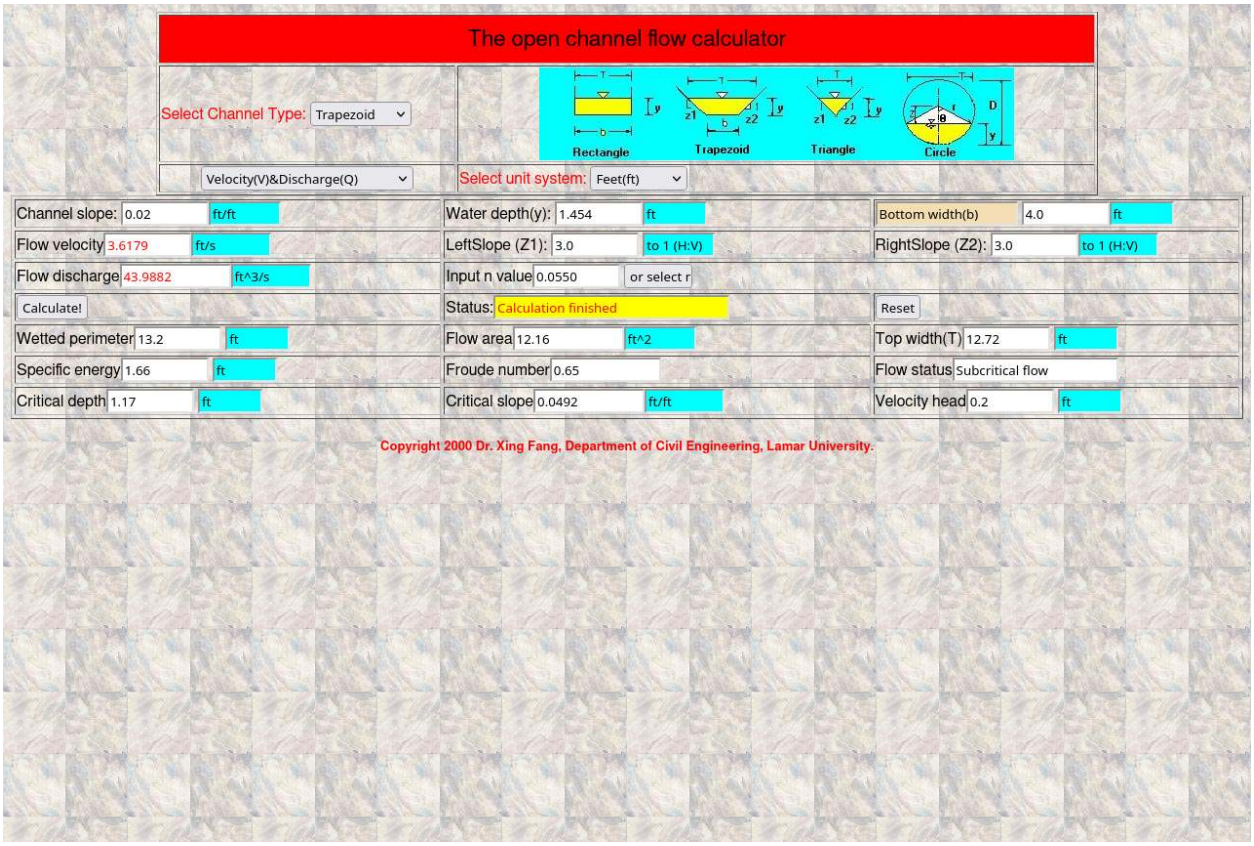
```
# load the required package
library("iemisc")
```

FHWA Hydraulic Toolbox Example 1



Parameter	Value	Unit
Flow	44.001	cfs
Depth	1.454	ft
Area of Flow	12.161	sq ft
Wetted Perimeter	13.197	ft
Hydraulic Radius	0.921	ft
Average Velocity	3.618	fps
Top Width (T)	12.725	ft
Froude Number	0.652	
Critical Depth	1.163	ft
Critical Velocity	5.052	fps
Critical Slope	0.04979	ft/ft
Critical Top Width	10.978	ft
Max Shear Stress	1.815	lb/ft^2
Avg Shear Stress	1.150	lb/ft^2

Dr. Xing Fang's Open Channel Flow Calculator's Solution of Example 1



iemisc's Manningtrap Solution of Example 1

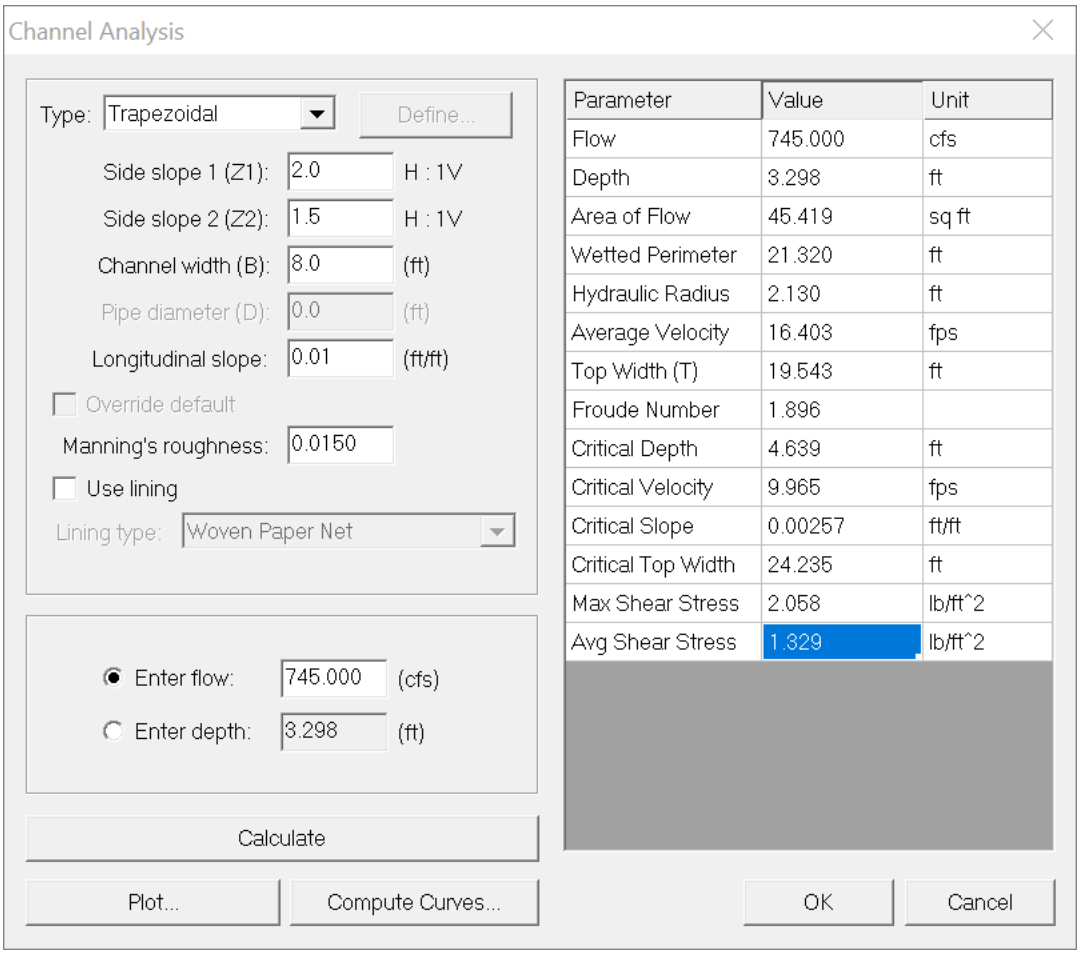
```
uuc1 <- Manningtrap_critical(y = 1.454, b = 4, m = 3, Sf = 0.02, n = 0.055, units = "Eng",
    type = "symmetrical", critical = "accurate", output = "data.table")

##
## Flow IS in the rough turbulent zone so the Gauckler-Manning-Strickler equation
##  is acceptable to use.
##
##
## This is subcritical flow.
```

```
knitr::kable(uuc1)
```

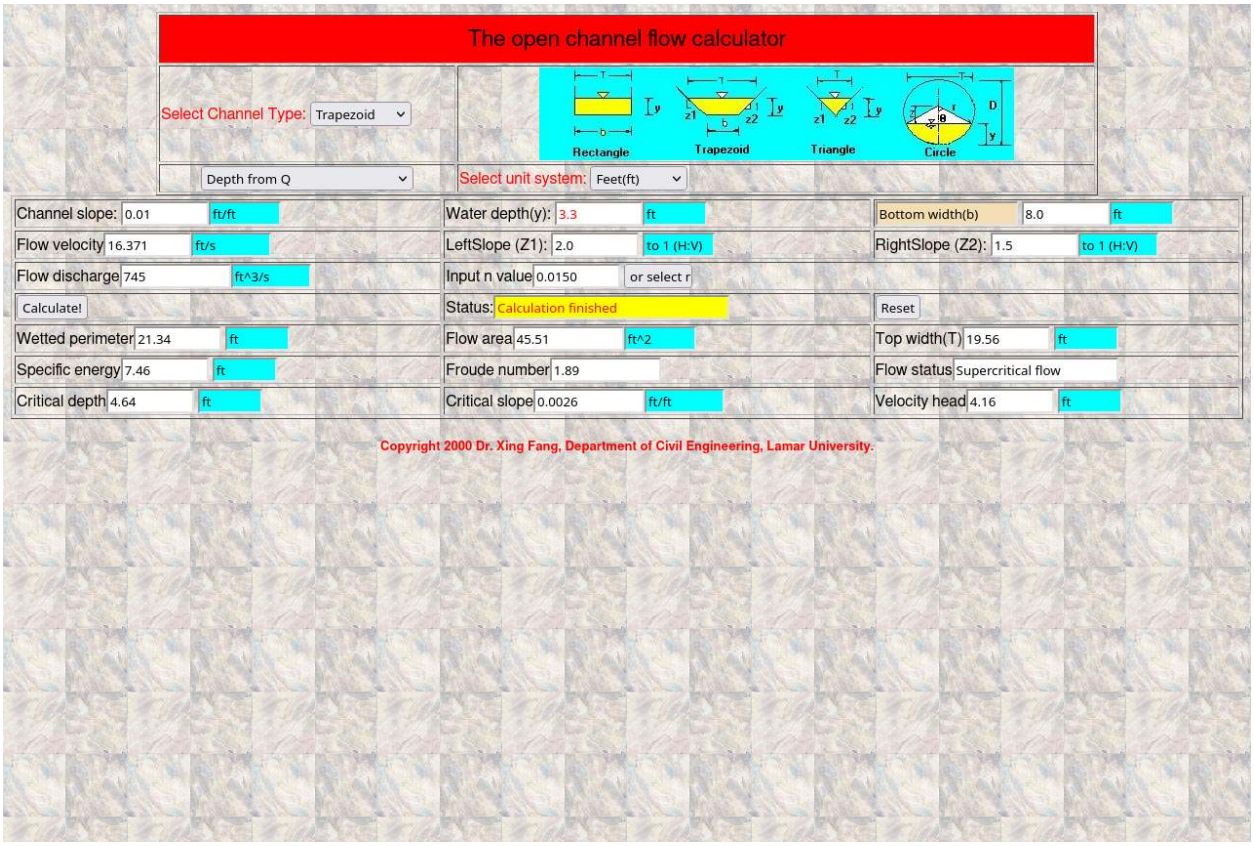
Parameters	Normal Value	Critical Value	Units
Flow depth (y)	1.454	1.551	ft
Flow area (A)	12.158	13.417	ft^2
Wetted Perimeters (P)	13.196	13.808	ft
Top Width (B)	12.724	13.304	ft

Parameters	Normal Value	Critical Value	Units
Bottom width (b)	4	NA	ft
Hydraulic Radius (R)	0.921	0.972	ft
Hydraulic Depth (D)	0.956	1.008	ft
Flow Mean Velocity (V)	3.618	7.064	ft/sec (fps)
Flow Discharge (Q)	43.986	67.414	ft^3/sec (cfs)
Manning's roughness coefficient (n)	0.055	NA	dimensionless
Slope (Sf)	0.02	0.015	ft/ft
Temperature	68	NA	degrees Fahrenheit
Absolute Temperature	293.15	NA	Kelvin
Saturated Liquid Density	1.937	NA	slug/ft^3
Absolute or Dynamic Viscosity	2.092885e-05	NA	slug/ft*s
Kinematic Viscosity	1.080619e-05	NA	ft^2/s
Froude number (Fr)	0.652	1	dimensionless
Reynolds number (Re)	308461	NA	dimensionless
symmetric side slope (m)	3	NA	ft/ft
non-symmetric side slope (m1)	NA	NA	ft/ft
non-symmetric side slope (m2)	NA	NA	ft/ft
Wetted Length (w)	4.598	NA	ft
Wetted Length for a non-symmetric trapezoid (w1)	NA	NA	ft
Wetted Length for a non-symmetric trapezoid (w2)	NA	NA	ft
Section Factor (Z)	11.512	11.885	ft
conveyance (K)	311.026	NA	ft^3/sec (cfs)
Specific Energy (E)	1.657	1.718	ft
Velocity Head (Vel_Head)	0.203	NA	ft
Maximum Shear Stress (taud)	1.812	NA	lb/ft^2
Average Shear Stress (tau0)	1.148	NA	lb/ft^2

FHWA Hydraulic Toolbox Example 2



Dr. Xing Fang's Open Channel Flow Calculator's Solution of Example 1



iemisc's Manningtrap Solution of Example 2

```
uuc2 <- Manningtrap_critical(Q = 745, b = 8, m1 = 2, m2 = 1.5, Sf = 0.01, n = 0.015,
    units = "Eng", type = "non-symmetrical", critical = "accurate", output = "data.table")

##
## Flow IS in the rough turbulent zone so the Gauckler-Manning-Strickler equation
##  is acceptable to use.
##
##
## This is supercritical flow.
```

```
knitr::kable(uuc2)
```

Parameters	Normal Value	Critical Value	Units
Flow depth (y)	3.298	6.442	ft
Flow area (A)	45.423	74.086	ft^2
Wetted Perimeters (P)	21.321	34.019	ft
Top Width (B)	19.544	30.548	ft

Parameters	Normal Value	Critical Value	Units
Bottom width (b)	8	NA	ft
Hydraulic Radius (R)	2.13	2.178	ft
Hydraulic Depth (D)	2.324	2.425	ft
Flow Mean Velocity (V)	16.401	14.397	ft/sec (fps)
Flow Discharge (Q)	745	392.789	ft^3/sec (cfs)
Manning's roughness coefficient (n)	0.015	NA	dimensionless
Slope (Sf)	0.01	0.004	ft/ft
Temperature	68	NA	degrees Fahrenheit
Absolute Temperature	293.15	NA	Kelvin
Saturated Liquid Density	1.937	NA	slug/ft^3
Absolute or Dynamic Viscosity	2.092885e-05	NA	slug/ft*s
Kinematic Viscosity	1.080619e-05	NA	ft^2/s
Froude number (Fr)	1.897	1	dimensionless
Reynolds number (Re)	3233520	NA	dimensionless
symmetric side slope (m)	NA	NA	ft/ft
non-symmetric side slope (m1)	2	NA	ft/ft
non-symmetric side slope (m2)	1.5	NA	ft/ft
Wetted Length (w)	NA	NA	ft
Wetted Length for a non-symmetric trapezoid (w1)	7.375	NA	ft
Wetted Length for a non-symmetric trapezoid (w2)	5.946	NA	ft
Section Factor (Z)	58.585	69.248	ft
conveyance (K)	7449.995	NA	ft^3/sec (cfs)
Specific Energy (E)	7.479	8.014	ft
Velocity Head (Vel_Head)	4.181	NA	ft
Maximum Shear Stress (taud)	2.055	NA	lb/ft^2
Average Shear Stress (tau0)	1.328	NA	lb/ft^2

Works Cited

FHWA Hydraulic Toolbox Version 4.4. https://www.fhwa.dot.gov/engineering/hydraulics/software/toolbox404.cfm

The open channel flow calculator. Dr. Xing Fang, Department of Civil Engineering, Lamar University, 2000. https://eng.auburn.edu/~xzf0001/Handbook/Channels.html

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