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

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Contents

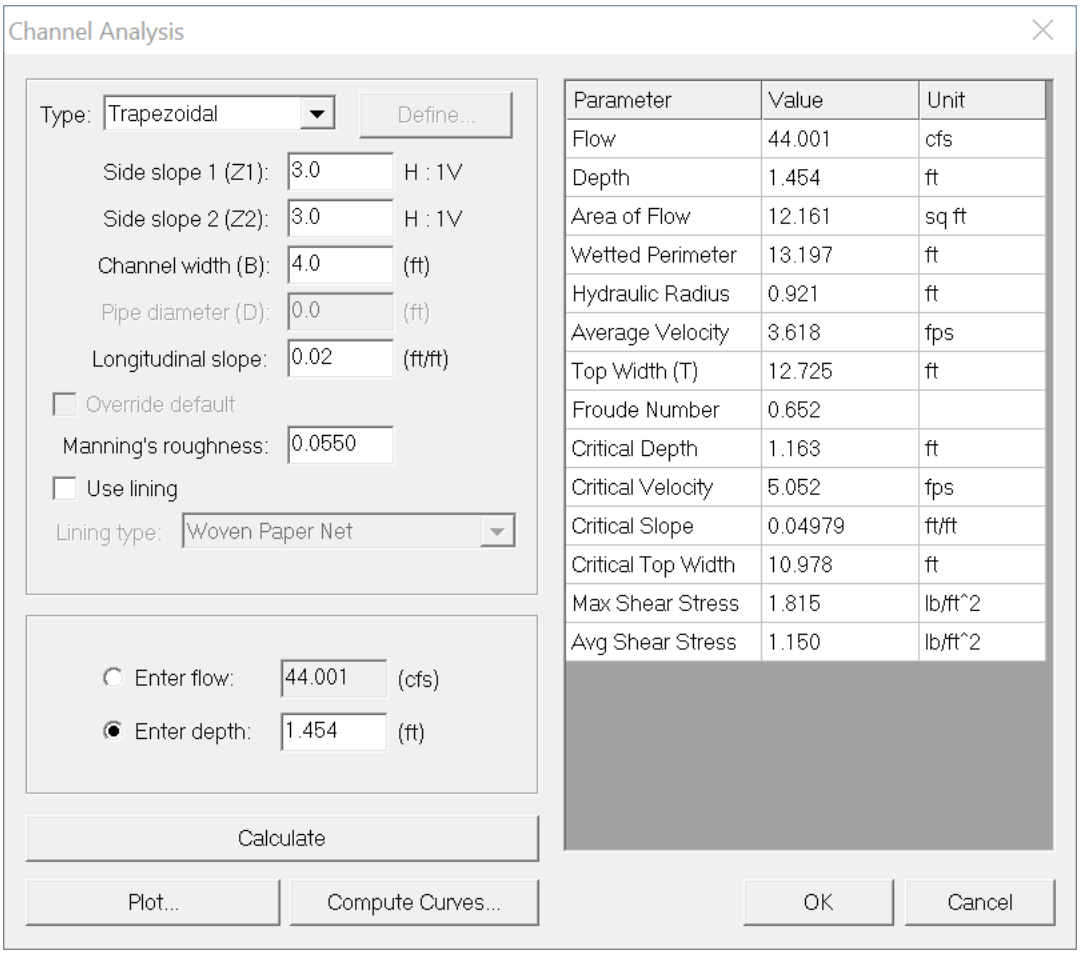
Replicate the R code without the images

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(c("install.load", "iemisc", "pander"))
# install the packages and their dependencies
```

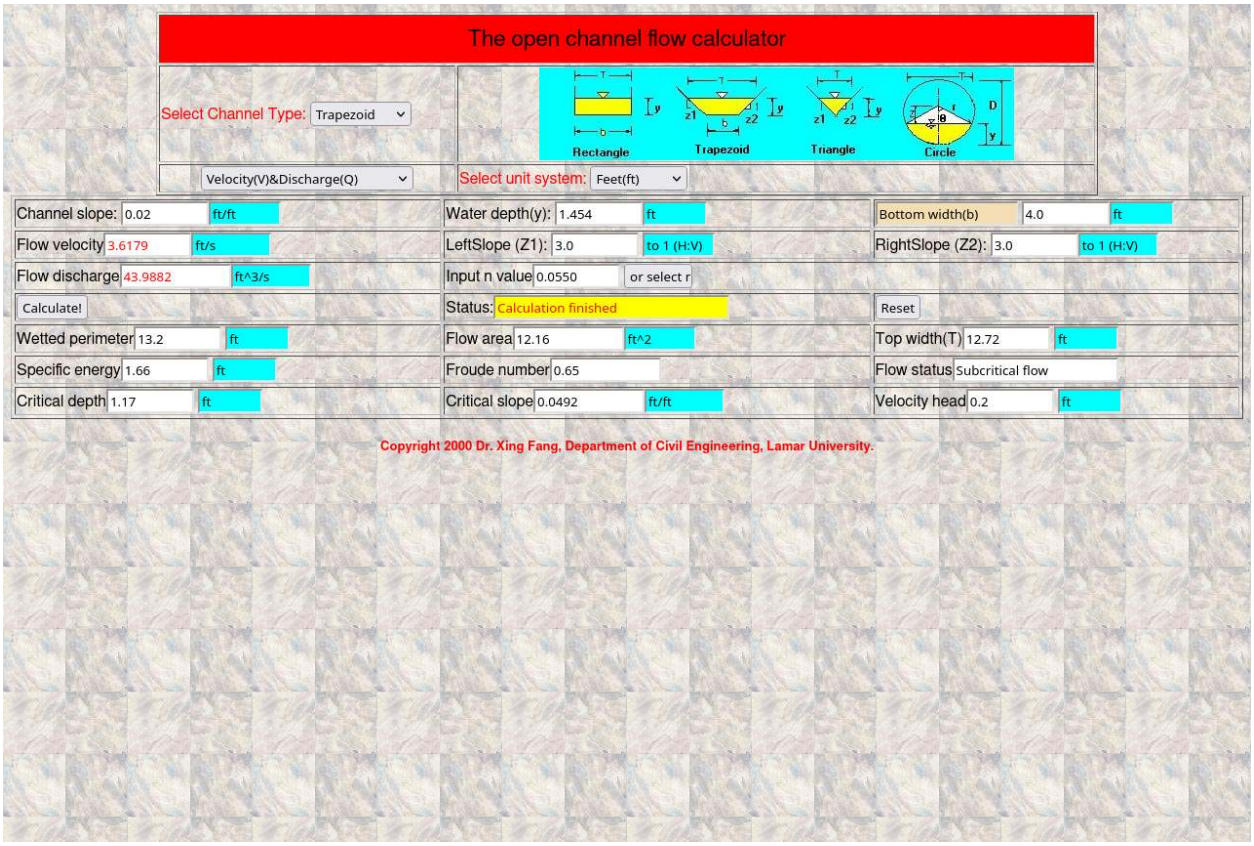
```
# load the required package
install.load::load_package("iemisc", "pander")
```

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

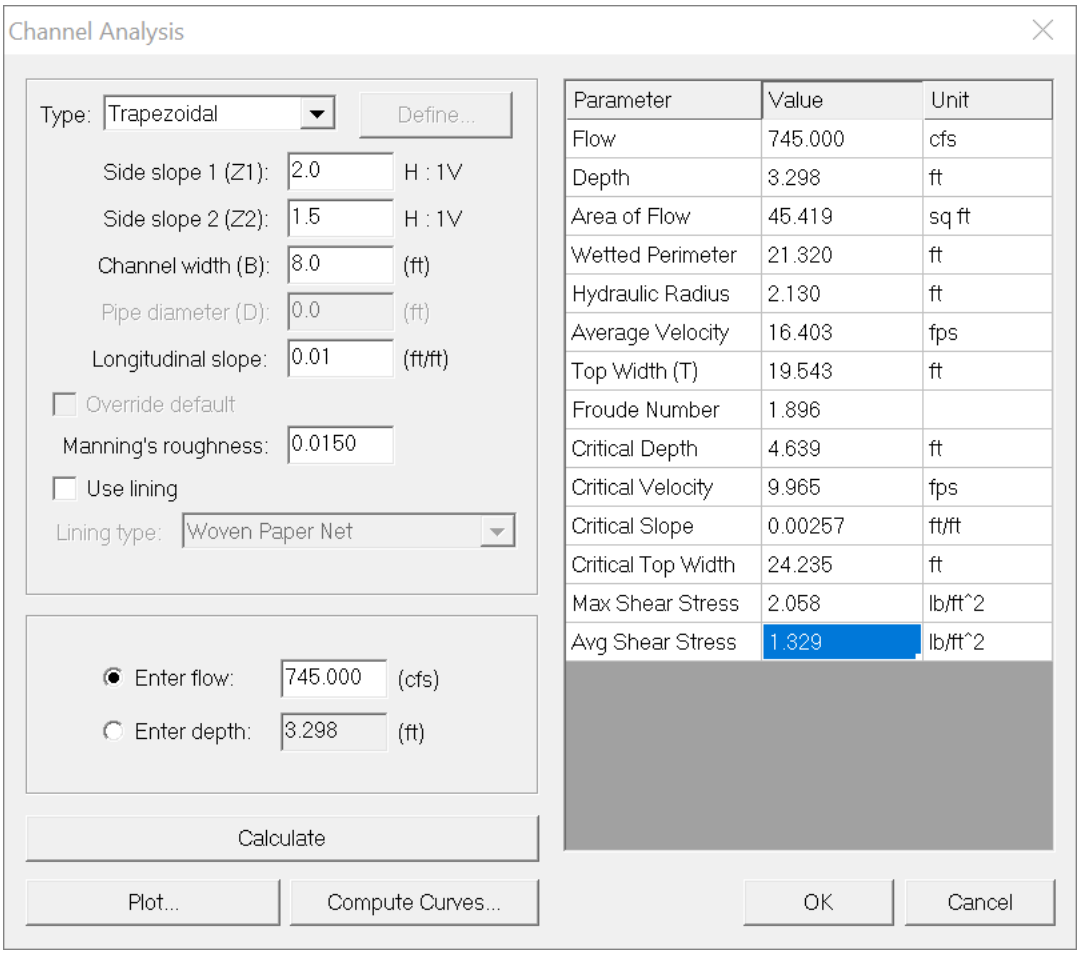
```
uuc1 <- Manningtrap_critical(y = 1.454, b = 4, m = 3, Sf = 0.02, n = 0.055, units = "Eng",
    type = "symmetrical", critical = "accurate", output = "data.table")

##
## Flow IS in the rough turbulent zone so the Gauckler-Manning-Strickler equation
##  is acceptable to use.
##
##
## This is subcritical flow.
pander(uuc1, missing = "")
```

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

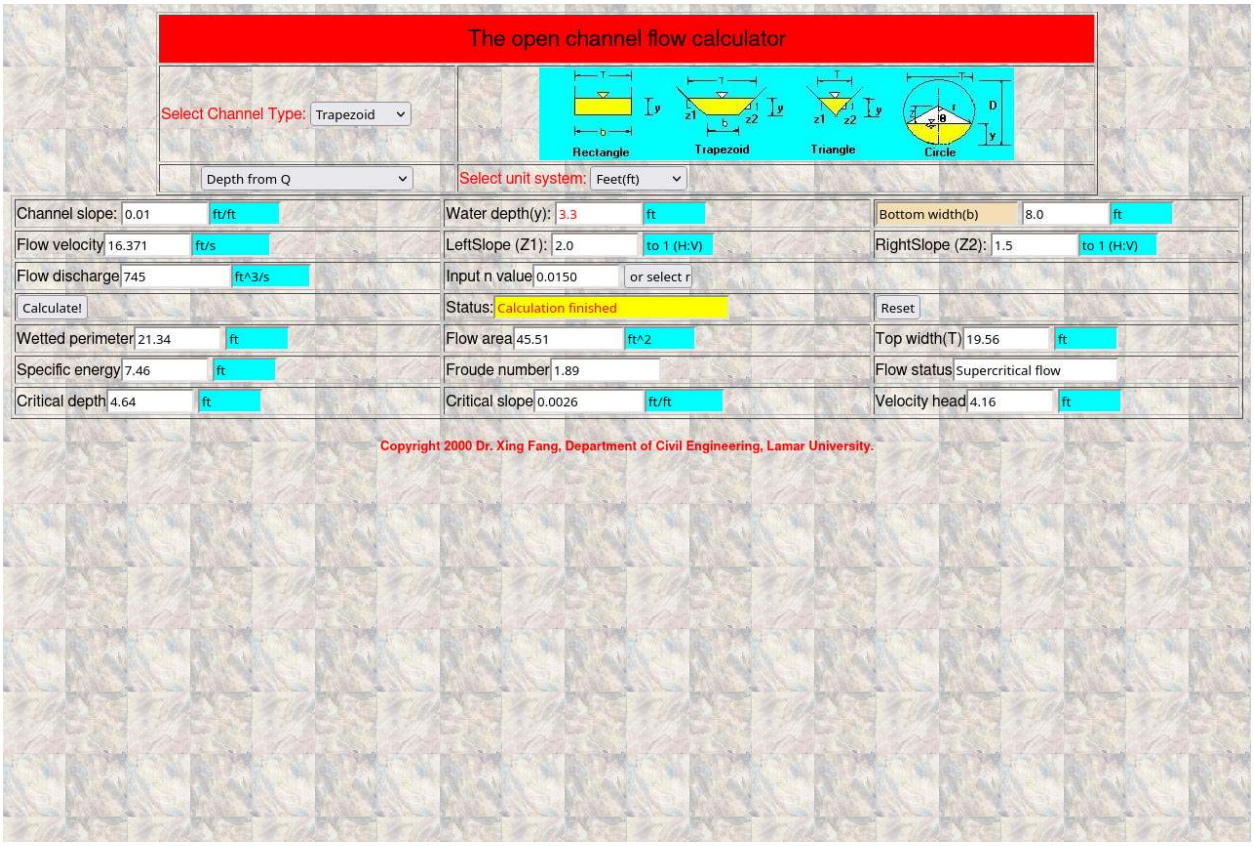
Parameters	Normal Value	Critical Value	Units
Bottom width (b)	4		ft
Hydraulic Radius (R)	0.921	0.972	ft^2
Hydraulic Depth (D)	0.956	1.008	ft
Flow Mean Velocity (V)	3.618	7.064	ft
Flow Discharge (Q)	43.986	67.414	ft
Manning's roughness coefficient (n)	0.055		ft
Slope (Sf)	0.02	0.015	ft
Temperature	68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

Units
ft
ft
ft
ft
ft^3/sec (cfs)
ft
ft
lb/ft^2
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.
pander(uuc2, missing = "")
```

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

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

Units
ft
ft
ft
ft
ft^3/sec (cfs)
ft
ft
lb/ft^2
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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