

Math Field Day 2008 Short Course Event
 Symbols, Formulas, Conversion Factors, Constants, and Definitions
 (foot-pound-second system of units - USCS)

Symbols	
a	acceleration in ft/sec ²
A	area in ft ²
cfs	cubic feet per second, ft ³ /sec
d	depth or diameter
f	Darcy-Weisbach friction factor
g	gravitational acceleration in ft/sec ² = 32.2 ft/sec ²
gpm	gallons per minute
h	head in ft, height in ft, pressure head in ft
h _L	Lost head in ft
in	inch
lb	pound
n	roughness factor in Manning's formulas
p	pressure in lb/ft ² , wetted perimeter in ft
psf	lb/ft ² , gage
psi	lb/in ² , gage
Q	volume rate of flow in cfs
R	hydraulic radius
w	unit weight in lb/ft ³ (62.4 lb/ft ³ for water)
S	Slope
t	Time
v or V	velocity

Conversion Factors	
7.48 gal = 1 ft ³	
12 in = 1 ft	
60 s = 1 min	
144 in ² = 1 ft ²	
$gpm \rightarrow \frac{ft^3}{sec} \Rightarrow \frac{gal}{min} \times \frac{1 min}{60 sec} \times \frac{1 ft^3}{7.48 gal}$	
$psi \rightarrow psf \Rightarrow \frac{lb}{in^2} \times \frac{144 in^2}{1 ft^2}$	

Constants	
$g = 32.2 \frac{ft}{sec^2}$	
$w = 62.4 \frac{lb}{ft^3}$ (water)	

Equations of Fluid Flow	
1. Equation of Continuity	$Q = A_1 V_1 = A_2 V_2 = \text{constant}$
2. Energy Equation (Bernoulli Theorem)	$\frac{p_1}{w} + \frac{v_1^2}{2g} + z_1 - h_L = \frac{p_2}{w} + \frac{v_2^2}{2g} + z_2$
2a. Pressure head	$h_p = \frac{p}{w}$
2b. Velocity head	$h_v = \frac{v^2}{2g}$
2c. Static head	$h_s = z = \text{elevation above a reference}$
3. Manning formula for open channel flow (use only in the foot-pound-second system)	$Q = AV = A \left(\frac{1.486}{n} \right) R^{2/3} S^{1/2}$
3a. Hydraulic Radius formula (use to get R in the Manning formula)	$R = \frac{\text{cross sectional area of flow}}{\text{wetted perimeter}}$
4. Darcy-Weisbach formula, head loss for flow in pipes under pressure	$h_L = f \left(\frac{L}{d} \right) \left(\frac{V^2}{2g} \right)$