53:171 Water Resources Engineering
Spring 2014

UNITS AND MEASURES

Fundamental measures (and their units in the SI and English systems) are:

Length	(m - meters; ft - feet)
Mass	(kg - kilograms)
Time	(s - seconds)
Temperature	(K - Kelvin; °F - degree Fahrenheit)

Derived measures (and their SI and English equivalents) are:

Area	(m^2 - square meters; ft^2 - square feet)
Volume	(m^3 - cubic meters; ft^3 - cubic feet)
Flow	($m^3\ s^{-1}$ - cms; $ft^3\ s^{-1}$ - cfs [volume per time])
Force	(Newton (N) = 1 kg m s^{-2}; lb - pound)
Energy	(Joule (J) = 1 kg $m^2\ s^{-2}$ = 1 N m ; foot pound (ft lb))
Power	(Watt (W) = J s^{-1} or kg $m^2\ s^{-3}$; horsepower (HP))
Pressure	(Pascal (Pa) = 1 N m^{-2} ; pounds per sq in (psi) - lb in^{-2})

Prefixes used to construct decimal multiples of metric units

10^{-1} deci (d)	10^{1} deca (da)
10^{-2} centi (c)	10^{2} hecto (h)
10^{-3} milli (m)	10^{3} kilo (k)
10^{-6} micro (μ)	10^{6} mega (M)
10^{-9} nano (n)	10^{9} giga (G)
10^{-12} pico (p)	10^{12} tera (T)
10^{-15} femto (f)	10^{15} peta (P)
10^{-18} atto (a)	10^{18} exa (E)

Physical Constants:

Standard Gravity	g = 9.807 m s^{-2} = 32.174 ft s^{-2}
Density of water (4°C)	1000 kg m^{-3} = 1 g cm^{-3}
Specific Weight of Water (15°C)	62.4 lb ft^{-3} = 9800 N m^{-3}
Kinematic Viscosity (15°C)	1.141×10^{-6} $m^2\ s^{-1}$ = 1.217×10^{-5} $ft^2\ s^{-1}$

Conversion formulas:

°C = (5/9) (°F - 32)	K = °C + 273.15
°F = (9/5) °C + 32	

Useful Conversions:

- Length:
  1 inch (in) = 2.540 cm
  1 foot (ft) = 0.3048 m
  1 mile (mi) = 5280 feet
  1 nautical mile (nmi) = 1852 m
  1 furlong = 110 fathoms = 660 feet = 1/8 miles

- Mass - Weight - Force:
  1 kg = 2.204623 pounds (lbs)
  1 lb = 4.448 N
  1 ton = 2000 lbs
  1 metric ton = 1000 kg

- Time
  1 day = 86400 seconds

- Area
  1 acre (ac) = 43560 ft^2
  1 square mile (mi^2) = 640 acres = 2.59 km^2

- Volume
  1 cubic centimeter (cc) = 1 milliliter (ml)
  1 liter = 0.264179 gallons (gal)
  1 gallon = 231 cubic inches
  1 cubic foot = 7.481 gallons
  1 acre-foot (ac-ft) = 43560 ft^3 = (43560/86400) or .504167 cfs-days
  1 cfs-day (cfsd) = 86400 ft^3 = (86400/43560) or 1.983471 acre-feet

- Flow
  1 cms = 35.315 cfs
  1 gal/min = 0.002228 cfs
  1 MGD (10^6 gal day^{-1}) = 1.547 cfs

- Pressure
  100 Pa = 1 millibar (mb)
  1 lb in^{-2} = 6895 Pa
  1 Standard Atmosphere = 1013.25 mb = 101.325 kPa
  = 14.696 lb in^{-2}
  = 760 mm Hg = 29.92 in Hg

- Energy
  1 foot-pound = 1.35582 J
  1 calorie (cal) = 4.186 J
  1 BTU = 252.08 cal
  1 Langley = 1 cal cm^{-2}

- Power
  1 horsepower = 550 ft lb s^{-1} = 745.7 W