Package 'hydraulics'

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Type Package

Title Basic Pipe Hydraulics

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Description Functions for basic hydraulic calculations related to water flow in circular pipes flowing full (under pressure). This includes friction loss calculations, solving the Darcy-Weisbach equation for flow or diameter, and plotting a Moody diagram.

License GPL (>= 3)

Depends R (>= 3.6.0)

Encoding UTF-8

LazyData true

Imports ggplot2, grid, reshape2

Suggests iemisc

RoxygenNote 7.0.2

R topics documented:

colebrook_f *Calculates the Darcy-Weisbach Friction Factor f*

Description

This function calculates the Darcy-Weisbach friction factor and is only provided in this package for use with water in circular pipes while the equation is technically valid for any liquid. As with many parts of this package, techniques and formatting were drawn from Irucka Embry's iemisc package, which includes some methods with similar functionality.

Usage

```
velocity(D = NULL, Q = NULL)

reynolds_number(V = NULL, D = NULL, nu = NULL)

colebrook(ks, V, D, nu)
```

Arguments

D	numeric vector that contains the pipe diameter [m or ft] which should be D >=0.0025 m (0.0082 ft).
Q	(for velocity function only) numeric vector that contains the flow rate [m^3/s or ft^3/s]
V	numeric vector that contains the average Velocity of flow in the pipe, equal to flow divided by area, Q/A [m/s or ft/s]
nu	numeric vector that contains the kinematic viscocity of water, [m2 s-1 or ft2 s-1]. Computed with a utility function in water_properties.R: kvisc(T=T, units=['SI' or 'Eng'])
ks	numeric vector that contains the 'equivalent sand roughness height sand roughness height. Units should be consistent with other input [m or ft]

Value

f Returns a numeric vector containing the Darcy-Weisbach friction factor

Author(s)

Ed Maurer

See Also

kvisc for kinematic viscosity, velocity for calculating V=Q/A, reynolds_number for Reynolds number

Examples

```
# A Type 1 problem (solve for hf): US units
D <- 20/12   #diameter of 20 inches
Q <- 4       #flow in ft^3/s
T <- 60      #water temperature in F
ks <- 0.0005 #pipe roughness in ft

f <- colebrook(ks=ks,V=velocity(D,Q), D=D, nu=kvisc(T=T, units="Eng"))
```

`darcyweisbach` *Solves the Darcy-Weisbach Equation for the either head loss (hf), flow rate (Q), or diameter (D).*

Description

This function solves the Darcy-Weisbach friction loss equation for with water in circular pipes. the function solves for either head loss (hf), flow rate (Q), or diameter (D), whichever is missing (not included as an argument). As with many parts of this package, techniques and formatting were drawn from Irucka Embry's iemisc package, which includes some methods with similar functionality.

Usage

```
darcyweisbach(
  Q = NULL,
  D = NULL,
  hf = NULL,
  L = NULL,
  ks = NULL,
  nu = NULL,
  units = c("SI", "Eng")
)
```

Arguments

`Q`	numeric vector that contains the flow rate [m^3/s or or ft^3/s]
`D`	numeric vector that contains the pipe diameter [m or ft]
`hf`	numeric vector that contains the head loss through the pipe section [m or ft]
`L`	numeric vector that contains the pipe length [m or ft],
`ks`	numeric vector that contains the 'equivalent sand roughness height sand roughness height. Units should be consistent with other input [m or ft]
`nu`	numeric vector that contains the kinematic viscocity of water, [m2 s-1 or ft2 s-1].
`units`	character vector that contains the system of units [options are `SI` for International System of Units and `Eng` for English (US customary) units. This is used for compatibility with iemisc package

Value

Returns a list including the missing parameter (hf, Q, or D):

- Q - flow rate.
- V - flow velocity.
- L - pipe length.
- hf - head loss due to friction
- f - Darcy-Weisbach friction factor
- Re - Reynolds number

Examples

```
#Type 2 (solving for flow rate, Q): SI Units
D <- .5
L <- 10
hf <- 0.006*L
T <- 20
ks <- 0.000046
darcyweisbach(D = D, hf = hf, L = L, ks = ks, nu = kvisc(T=T, units='SI'), units = c('SI'))

#Type 3 (solving for diameter, D): Eng (US) units
Q <- 37.5     #flow in ft^3/s
L <- 8000     #pipe length in ft
hf <- 215     #head loss due to friction, in ft
T <- 68       #water temperature, F
ks <- 0.0008  #pipe roughness, ft
darcyweisbach(Q = Q, hf = hf, L = L, ks = ks, nu = kvisc(T=T, units='Eng'), units = c('Eng'))
```

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moody *Creates a Moody diagram with optional manually added points*

Description

This function plots a standard Moody diagram, and allows additional points to be added by including arguments Re and f.

Usage

```
moody(Re = NULL, f = NULL)
```

Arguments

Re	(optional) numeric vector that contains the Reynolds numbers of points to be manually added
f	(optional) numeric vector (same length as Re) that contains the Darcy-Weisbach friction factors corresponding to the points to be manually added

Value

a Moody diagram, with the optional added (f,Re) points

Author(s)

Ed Maurer

Examples

```
# Draw canonical Moody diagram
moody()

# Draw Moody diagram plotting two additional points
Re = c(10000, 100000)
f = c(0.04, 0.03)
moody( Re = Re, f = f )
```

`waterprops` *Functions to calculate water properties: density, dynamic and kinematic viscosity*

Description

This function calculates the Darcy-Weisbach friction factor and is only provided in this package for use with water in circular pipes while the equation is technically valid for any liquid. As with many parts of this package, techniques and formatting were drawn from Irucka Embry's iemisc package, which includes some methods with similar functionality. function(ks,V,D,nu)

Usage

```
dvisc(T = NULL, units = c("SI", "Eng"))

dens(T = NULL, units = c("SI", "Eng"))

kvisc(T = NULL, units = c("SI", "Eng"))
```

Arguments

`T`	numeric vector that contains the water temperature [C or F]
`units`	character vector that contains the system of units [options are `SI` for International System of Units and `Eng` for English (US customary) units. This is used for compatibility with iemisc package

Value

rho, the density of water for the dens function [kg/m3 or slug/ft3].

mu, the dynamic viscocity of water for the dvisc function [Pa-s (N s m^-2) or lbf s ft^-2].

nu, the kinematic viscocity of water for the kvisc function [m2 s^-1 or ft^2 s^-1].

Author(s)

Ed Maurer

Examples

```
#Find kinematic viscocity for water temperature of 55 F
nu = kvisc(T = 55, units = 'Eng')

#Find kinematic viscocity assuming default water temperature of 68 F
nu = kvisc(units = 'Eng')

#Find water density for water temperature of 25 C
rho = kvisc(T = 25, units = 'SI')
```

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