PLATE & FRAME HEAT EXCHANGER SIZING

FORMULAS

CFM (ft3/min) x 7.48052 = GPM (gals/min)

GPM / 7.48052 (ft3/lb) x D (lbs/ft3) x 60 (min/hr) = M (lbs/hr)

or GPM x 8.021 x D = M

Q (mbh) = M x SH x (Ti - To) / 1000 =

(GPM x 8.021 x D) x SH x (Ti - To) /1000 =

GPM x 0.008021 x D x SH x (Ti - To)

Ti1 = Fluid-1 - In

To1 = Fluid-1 - Out

Ti2 = Fluid-2 - In

To2 = Fluid-2 - Out

LMTD (Log Mean Temp Diff) =

[(To2-Ti1) - (Ti2-To1)] / [LN{(To2-Ti1) / (Ti2-To1)}]

where (To2-Ti1) > (Ti2-To1)

LMTD = (DT1- DT2) / (LN (DT1/DT2))

where DT1 > Dt2

DT1 = ABS (Ti1 - To2)

DT2 = ABS (Ti2 - To1)

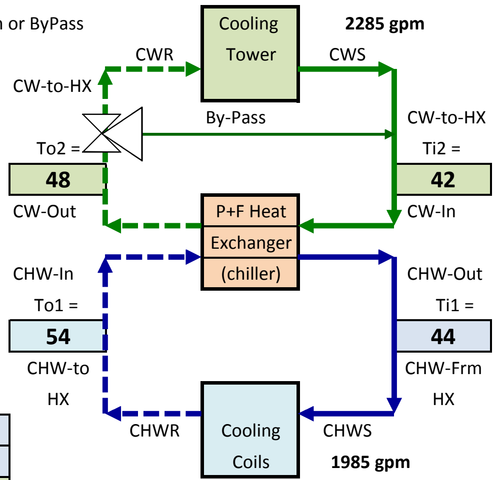
Q = A x U x LMTD Surface Area (**A**) = Q / (U x LMTD)

WATERSIDE ECONOMIZER (WSE)

Operates from Nov-Mar when WB <= 40 F

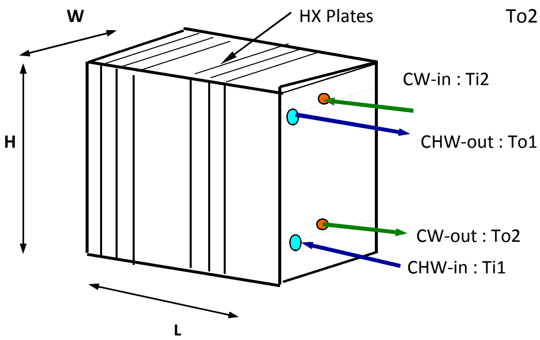
Heater in Clg Twr Basin or ByPass

to prevent freezing ??

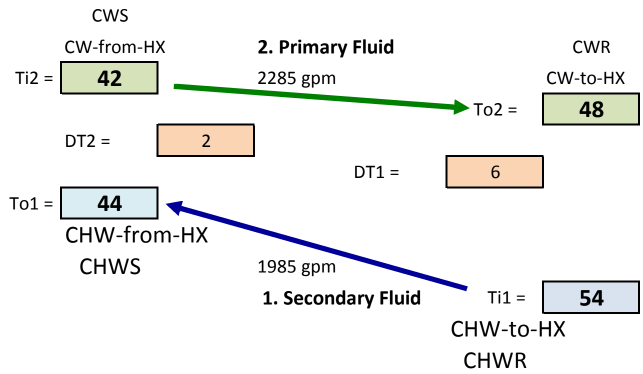


To1 =	CHW-In	54
Ti1=	CHW-Out	44
Ti2 =	CW-In	42
To2 =	CW-Out	48

Log Mean Temperature Difference (LMTD)



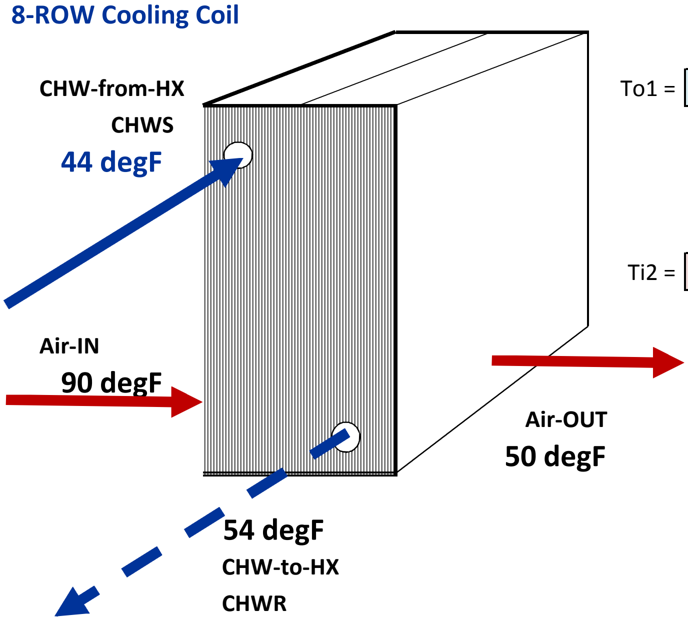
P&F HX - COUNTER FLOW

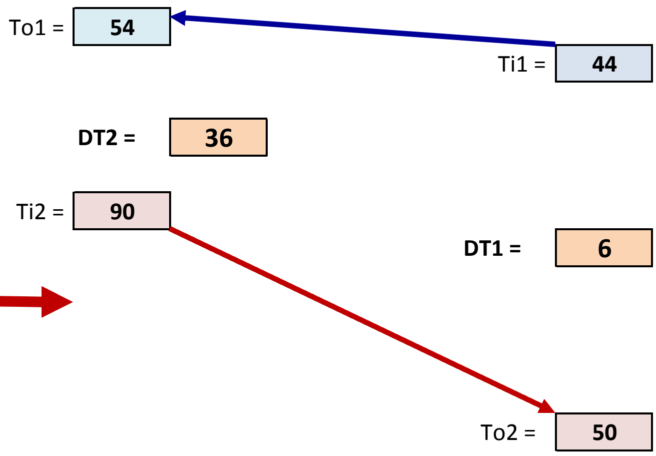


Air Handling Unit (AHU) Cooling Coil

COILING-COIL - CROSS-FLOW

8-ROW Cooling Coil





Heat Exchanger Calculations

Two basic formulas are used in all heat exchanger calculations. These are:

Heat transfer Btu/hr = lbs/hr x sp ht x temp. change °F

In the case of water, the specific heat can usually be considered as 1.0
and the formula expressed as:

Btu/hr = flow rate in GPM x 500 x temp. change °F (1)

where: **500 = 8.33 lbs/gal x 60 min/hr** conversion to lbs/hr

Heat transfer in Btu/hr = (U)(A)(LMTD) (2)

where: **U = overall heat transfer coefficient A = heat transfer area in sq. ft.**

U = overall heat transfer coefficient A = heat transfer area in sq. ft.

LMTD = log mean temperature difference = (large temp. diff.) - (small temp. diff.)
all divided by: the natural log of (large temp. diff - small temp. diff)

The range of the heat transfer coefficient "U" varies widely, depending upon the physical conditions such as the solution viscosities, surface fouling, fluid velocities and turbulence, involved, constant or change of state, and metal resistance.

For example, water-to-water heat exchangers typically have "U" value ranges like:

Plate-frame: 500 to 1,200 Btu/(hr x sq ft x°F)

Shell and tube: 150 to 350 Btu/(hr x sq ft x°F)

Plate-coil: 50 to 250 Btu/(hr x sq ft x°F)

These can be contrasted to "U" values of 4 to 8 for air-to-air or steam-to-air heat transfer, which is why these are usually plate-fin coils with very large surface areas

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Q = U x A x LMTD x Cf where: Q = Heat load in Btu/hr
U = Overall heat transfer coefficient in Btu/hr·ft2 oF A = Area (ft2)
LMTD = Log mean temperature difference (oF)
Cf = LMTD correction factor (0.85 - 1.0 for most geothermal applications).

Example selection: Application - radiant floor heating in 350,000 ft2 factory
Resource temperature - 170 °F Available geothermal flow - 375 gpm
Load - 7,500,000 Btu/hr Building loop supply water temperature - 135 °F max.
Geothermal temperature drop: = 7,500,000 Btu/hr ÷ (500 · 375 gpm) = 40 °F.
Geothermal exit temperature: = 170 °F - 40 °F = 130 °F.
Geothermal side 170 °F to 130 °F Building side 135 °F to 120 °F

Dt1 = 170 °F - 135 °F = 35 °F **Dt2 = 130 °F - 120 °F = 10 °F**

$$LMTD = \frac{35 - 10}{\ln(\frac{35}{10})}$$

Q = U x A x LMTD x Cf

Using a LMTD convection factor of 0.90, required heat exchanger area is:
Area = 7,500,000 Btu/hr ÷ (19.9 °F · 0.90 · 950 Btu/hr·ft2 °F) = 441 ft2