COLMAC COIL
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Technical Bulletin

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RUN-AROUND COIL LOOP HEAT RECOVERY

Introduction

With the recent increase in energy costs, heat recovery devices can offer lower utility payments and quick payback. One popular method of heat recovery is a run-around coil loop. A run around coil loop simply moves heat from one air stream to another via two heat exchangers and a heat transfer medium, usually water or glycol. A pump is required to move the medium through the system. Although there are several other methods of air-to-air heat recovery, a run around coil loop may be the only option when airstreams are not adjacent to each other.

To start a design on a run-around coil loop, you must first determine the design conditions. To properly design and price a run-around coil loop, you must have the following information:

1) Supply CFM
2) Exhaust CFM
3) Supply air temp (DB/WB) summer and winter
4) Exhaust air temp (DB/WB) summer and winter
5) Physical space available for exhaust and supply coils

In addition to knowing the physical space available for coils, you must also determine the logistics of installing a coil. Usually, a single coil will be too large to install due to handling and/or coil location. Quite often, the available space will be filled with a bank of coils stacked in parallel flow. Although a single coil is more inexpensive, you may avoid costly building modifications by using multiple coils.

Example

For demonstration purposes, we will use the following design conditions.

- 20,000 CFM Supply, 95/82 Summer, 10 Winter
- 20,000 CFM Exhaust, 72 (50% RH) all year
- Max coil air pressure drop 1.5 in H_2O
- 25% Ethylene Glycol
- Supply and exhaust duct opening 6' x 8'
- For simplicity the exhaust and supply ducts are the same size, but quite often they may not be identical.

The first thing that must be calculated is the individual coil size. In our example, the location of the exhaust and supply ducts will not allow coils more than four feet tall or six feet long due to doorways and elevators. The 6' x 8' duct will be filled with a bank of coils. Each coil will have one fourth of the 6' x 8' duct, or a 3' x 4' section. Use the new submittal feature in the CoilPRO selection software program to determine the maximum coil that can fit inside of a 3' x 4' opening. Remember that the headers and casing must also fit in this area. Always leave some room to account for tolerances and to make installation easier. Using CoilPRO, we have found the coil size to be 33 inches high x 39.5 inches long (finned area). By using 1-1/4" S1 and S2 (sidepans) dimensions and 2" headers, we still have 1/2" in both the height and length for ease of installation. This gap will be flashed and sealed after the coils are installed. The important dimensions to watch when determining coil size are H and OA.

Now that we have our individual coil size, we can go to CoilPRO and design our coils. Open CoilPRO and bring up one hot water/sensible cooling module and one chilled water module. In both sizing screens, enter the coil data. Rows and FPI will be optimized later to give us the best performance. Before we optimize the rows and FPI, we need to determine approximate flow rate.

To do this, we must determine the BTUH's available in the exhaust air. How much energy must be taken out of 20,000 CFM to cool it from 72°F 50% RH down to 10°F? This can be determined a couple of different ways. You can use

CoilPRO to give you this number. Go to the Chilled Water Sizing module and create a coil that will cool 20000 CFM from 72°F (50% RH) down to 10°F. This gives us 2016000 BTUH available. You may also obtain this number by taking the enthalpy of the two points on the psychrometric chart and subtracting. This gives us 2010950 BTUH available.

Now that we have the available BTUH, we must decide how much of that available energy we want to recover. A practical value is between 30 and 60%. We will use 40% for our example. We must also know the temperature difference (TD) of the water as it passes through the coils. Typical TD's are 5 to 15 degrees. The lower the TD, the higher the required flow rate. The higher flow rate will increase pump horsepower and line sizes, but will generally yield higher heat recovery. We will choose a 10° TD for our example. The following formula gives us estimated GPM:
BTUH = CONS x GPM x TD, (.40 x 2016000 = 450 (450 for glycol, 500 for water) x GPM x 10). GPM = 179.

Now that we have determined the flow rate, we can go to CoilPRO and design our coils. Input all of the design information and everything we have calculated up to this point. Since we are using a bank of four coils, each coil will see 5000 CFM and 45 GPM. We have been given the supply and exhaust air temps and we have calculated the maximum coil face (33 x 39.5).

There are four main variables that will affect coil performance:
1) Rows
2) Fins per inch (FPI)
3) Circuiting
4) Waffle or flat fins

Usually, waffle fins will return the most cost effective coil. The goal of our design is to balance the BTUH's that both coils transfer. To do this, we must switch between the chilled water and hot water coil modules and iterate until the entering water temp from one matches the leaving water temp of the other.

Remember that the chilled water coil will be the air that is being cooled, the hot water coil is the air stream being heated. In other words, you will use the chilled water module to model the supply air in the summer and the exhaust air in the winter.

To start our design, we need an initial guess for our water temperatures. We have calculated our flow rate to give us a 10° TD and we know the glycol will be running somewhere between 10 and 72 degrees (winter operation). From this we can guess that the chilled water (exhaust coils in this case) entering glycol temp will be 35°F and the hot water coil will be 45°F.

Now we can go to CoilPRO with these initial guesses and adjust them until the coils balance. Keep in mind that you will have to play with the number of rows, fins per inch and circuiting until you get a good design (one that gives the performance without an unacceptable air pressure drop). Adjust your circuiting (especially important with glycol) to give tube velocities above 3 FPS. After balancing the rows, FPI, circuiting and glycol temperature, we have chosen an 8 row, 8 FPI coil, 11 feed, 16 pass coil that provides 190000 BTUH of heat recovery.

In total, the bank of coils is recovering 760 MBH, or 37% of the heat available. The air pressure drop through the coils is 1 ¼" inH2O. Usually, this is a higher number than the system fans can handle, but for this example it is acceptable. You may have to accept a lower recovery efficiency to get a coil air pressure drop that the system can support.

Keep in mind that less rows and more FPI make a less expensive coil, but the penalty is air pressure drop. Remember that the system fans must overcome the air pressure drop of the new run around coil system so we need to minimize the air pressure drop as much as possible.

Final System Design

	EXHAUST		SUPPLY	
	WINTER	SUMMER	WINTER	SUMMER
EWT	40	85	49	82
LWT	49	82	40	85
WPD	16.2	14.1	15.9	14.1
EAT	72/50%	72/50%	10	95/82
LAT	46/45.5	84	45	83.5/79.3
APD	1.25	.75	0.75	.75
BTUH	760000	256000	760000	256000

(4) BWL-33x39.5-8R-8F per duct

The system will require a pump estimate Hp= (gpm x total system pressure loss in feet of water x specific gravity of fluid if other than water)/3960, a surge tank, and misc. valves and fittings to complete the installation.

Heat recovery systems typically utilize 4 to 8 row coils. To keep air pressure drop low, always maximize the face area of your coil. Typical face velocities should run between 300-600 FPM. Velocity over 600 FPM will result in substantial water carry-over from the coil to the ductwork.

Since the system will rarely operate at design conditions, you may have to run several different design conditions to estimate yearly energy recovery.

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