Presentation to:

Cost Effective Ways to Control Cooling Coils and Achieve Design Delta T –

By

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What the industry has done to improve Delta T ?

- In 1973 my mentor Erwin Hansen presented a paper to IDEA conference. He stated the following:

B. INCOMPATIBILITY OF CONCEPTS

1. In obtaining design capacity.

a. Unequal Return Temperatures

The greatest impact on the cost of a large central chilled water system is provided by the temperature spread between the supply and return, usually termed the Delta T. The Central System Designer seeks to achieve a large Delta T. 14°F or 16°F is common. We have successfully designed for 20°F.

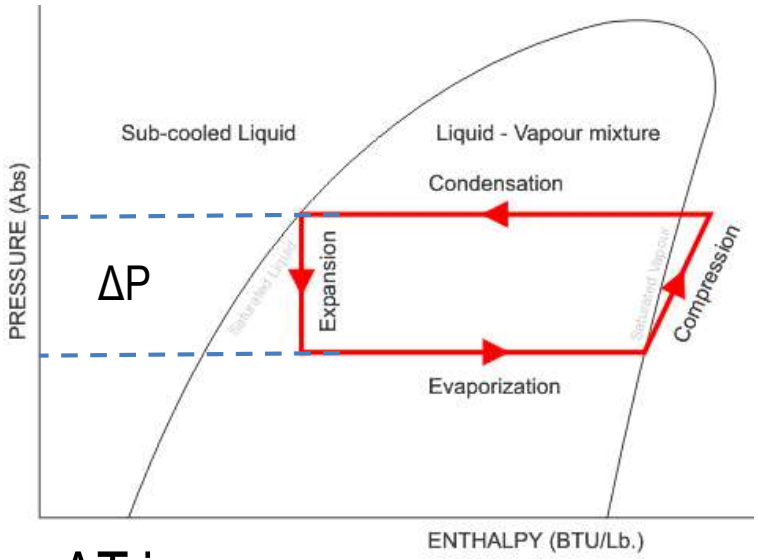
How does delta T affect Power?

- Compressor Energy (Ce):

  $Ce = m\Delta P$

- Refrigerant mass flow:

  $m = 200 / RE$



- RE: Refrigerant effect increases as ΔT increases.
- Mass flow rate decreases with increase in ΔT
- Hence compressor power decreases with increase in ΔT.
- Low ΔT reduces chiller capacity and more chillers need to

What the industry has done to improve Delta T ?

- Since 1973 there were many products to improve Delta T. Some of the products are:
  - BRDG-TNDR or “Bridge Tender”
  - Constant flow valve – Griswold
  - Pressure Independent valve
  - Industrial control valve with good control logic

BRDG-TNDR or “Bridge Tender”

- Popular during late seventies
- System Concept uses valves, flow meters and temperature and pressure transmitters
- Control the Secondary loop temperature
- Control the flow and pressure relationships between the Primary and Secondary loop
- Now the product is out of flavor

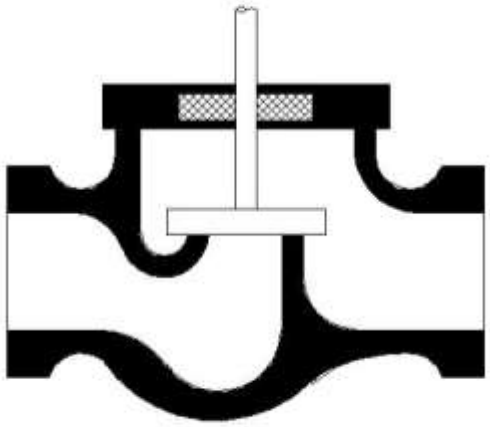
Griswold and Pressure Independent valves

- Both valves were invented to cure ”So called balancing issues”
- In my judgement manual balancing has done more harm to our industry.
- So path towards dynamic balancing is a plus.
- However, Question is the use of Pressure Independent valves are energy as well as cost efficient?

Pressure Independent Valve

- Pressure Independent Valve provide,
  - Dynamic balancing
  - Requires a minimum of 5 psi pressure drop

Pressure Independent Valve



Conventional Control Valve

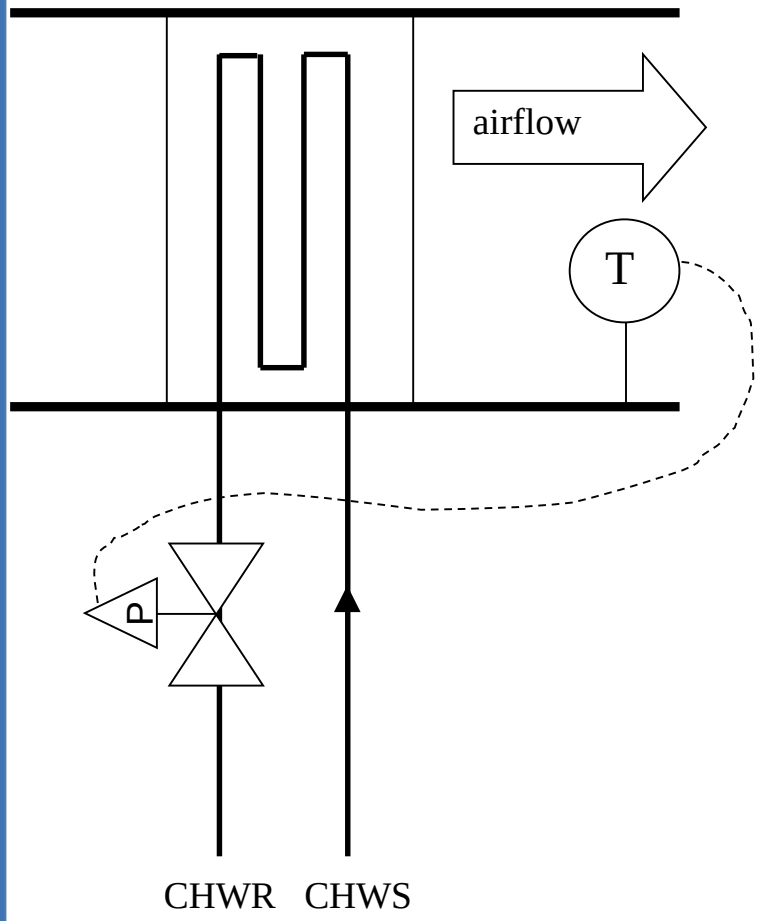
Flow varies as differential pressure varies

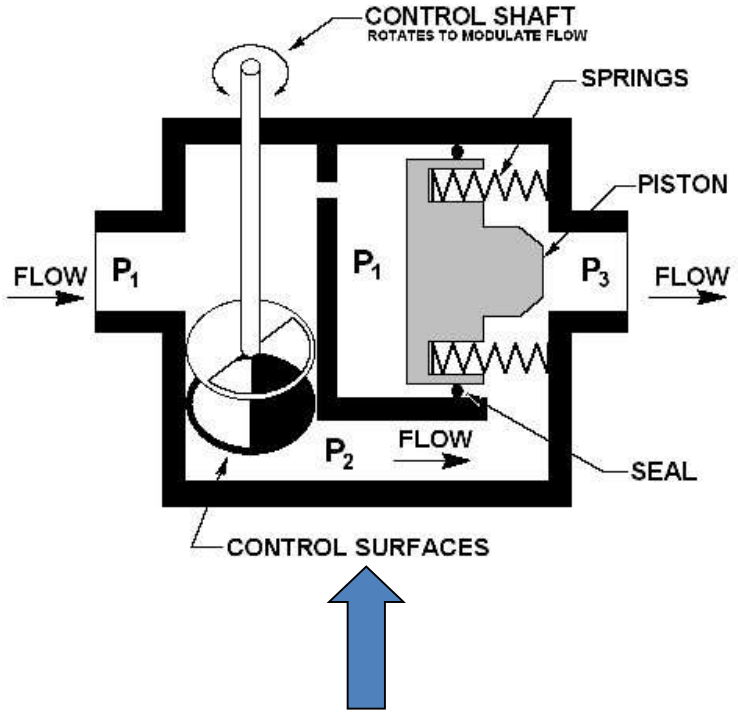
Conventional control valves must react to both load and pressure changes

It takes TIME for a conventional control valve actuator to react to pressure changes, with or without a load change

Pressure Independent Valve (PIV)

Pressure Independent Valves don't care about pressure fluctuations or their location in the system





Flow is steadied by maintaining constant differential pressure across the control surface

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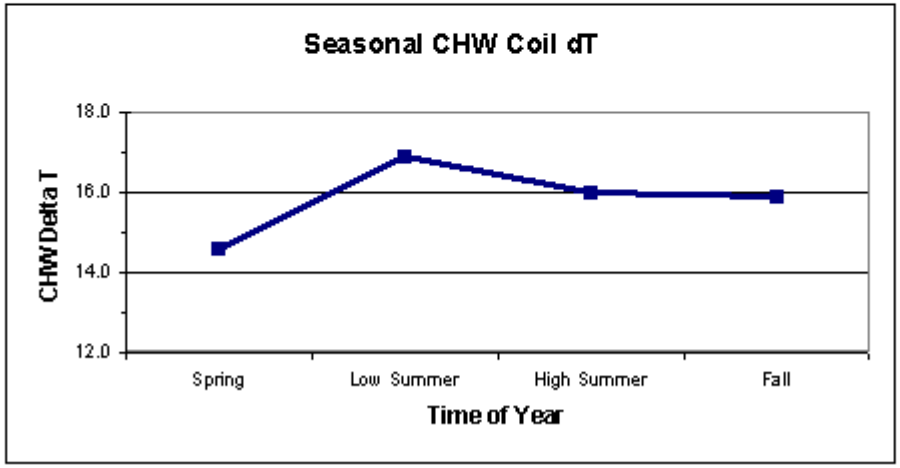
Let's Review Coil Performance

- Maintain constant leaving air temperature

Season	EAT (deg F) DB	EAT (deg F) WB	LAT (deg F) DB	LAT (deg F) WB	CHW Flow (gpm)	CHWS (deg F)	CHWR (deg F)	CHW ΔT (deg F)	
High Summer	95.0	78.0	54.6	54.6	206.4	44.0	60.0	16.0	<== Coil design selection
Low Summer	85.0	74.0	55.2	55.2	150.0	44.0	60.9	16.9	Note 1
Fall	75.0	68.0	55.3	55.3	100.0	44.0	59.9	15.9	Note 1
Spring	70.0	63.0	55.0	55.0	65.0	44.0	58.6	14.6	Note 1

Note 1: Maintain about 55 deg F DB LAT with 44 deg F CHWS temp by reducing CHW flow.
This is similar to how the CHW control valve would throttle the CHW flow at part load to maintain a LAT setpoint.

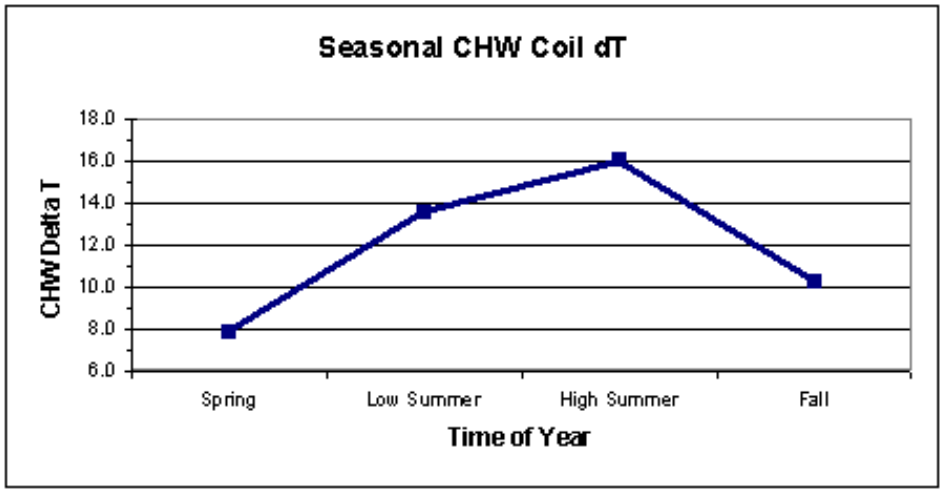


Let's Review Coil Performance

- Maintain design CHW flow

Season	EAT (deg F) DB	EAT (deg F) WB	LAT (deg F) DB	LAT (deg F) WB	CHW Flow (gpm)	CHWS (deg F)	CHWR (deg F)	CHW ΔT (deg F)	
High Summer	95.0	78.0	54.6	54.6	206.4	44.0	60.0	16.0	<== Coil design selection
Low Summer	85.0	74.0	52.6	52.6	206.4	44.0	57.6	13.6	Note 2
Fall	75.0	68.0	50.0	50.0	206.4	44.0	54.3	10.3	Note 2
Spring	70.0	63.0	48.4	48.4	206.4	44.0	51.9	7.9	Note 2

Note 2: Maintain design CHW flow (206.4 gpm). LAT lower than design; hence coil has spare capacity.



WM Group Solution

- No need for PIV at each coil consuming 5 PSI of pressure drop for balancing
- Three components of the system with required pressure drop
  - Plant ~ 45 ft
  - Distribution ~ 100 ft. (Large system)
  - Generation ~ 45 ft
- PIV takes care of the additional distribution pressures for buildings closer to the plant

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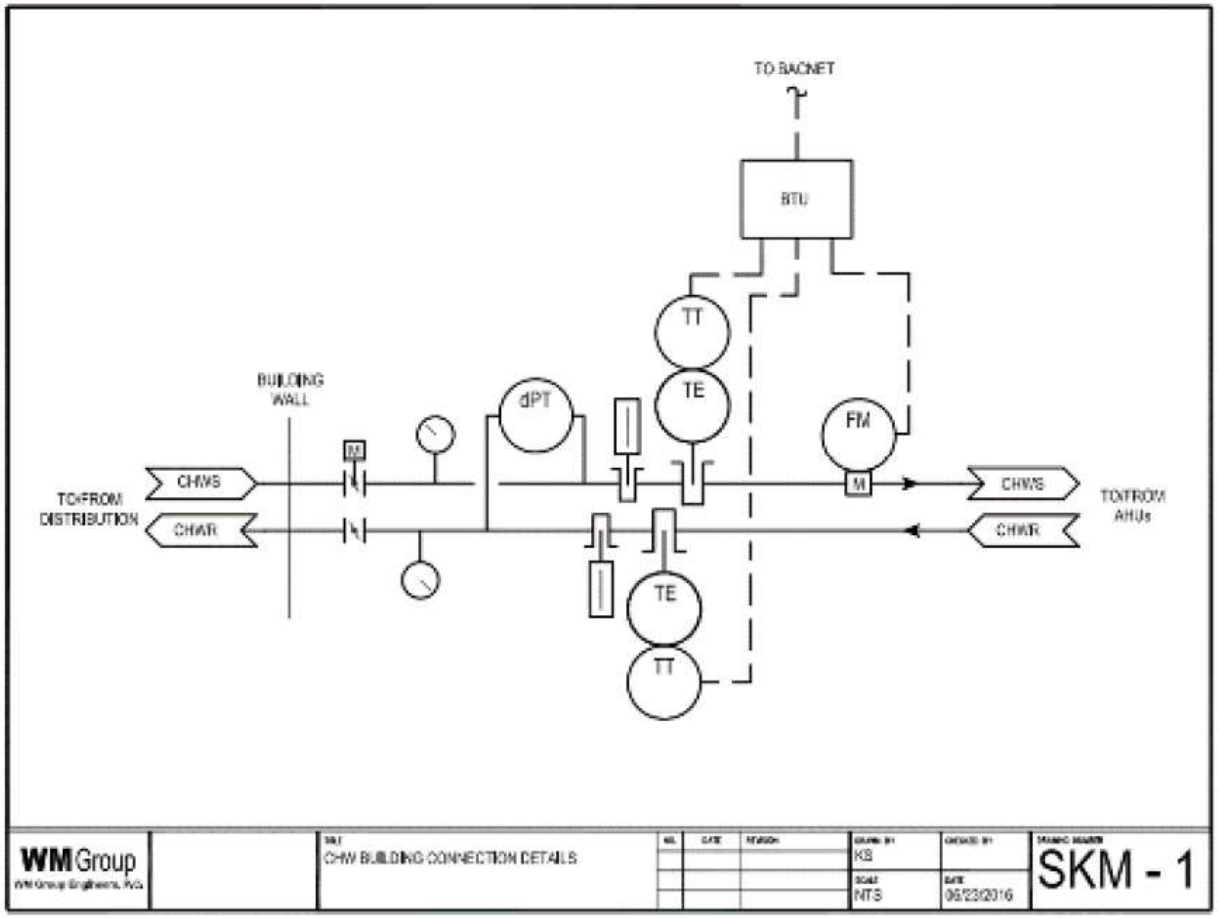
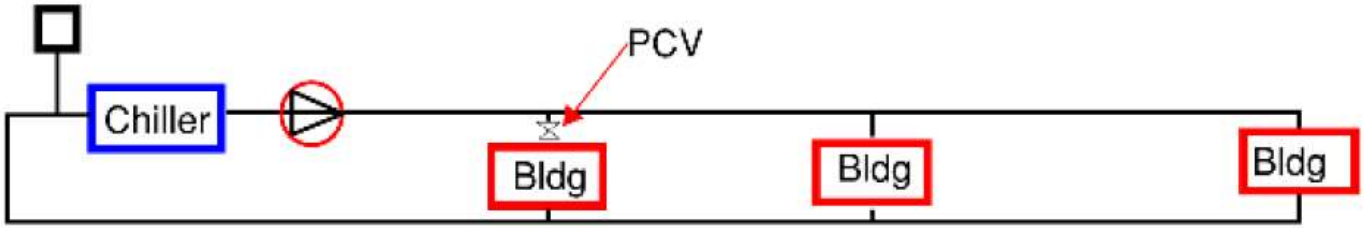
WM Group Solution

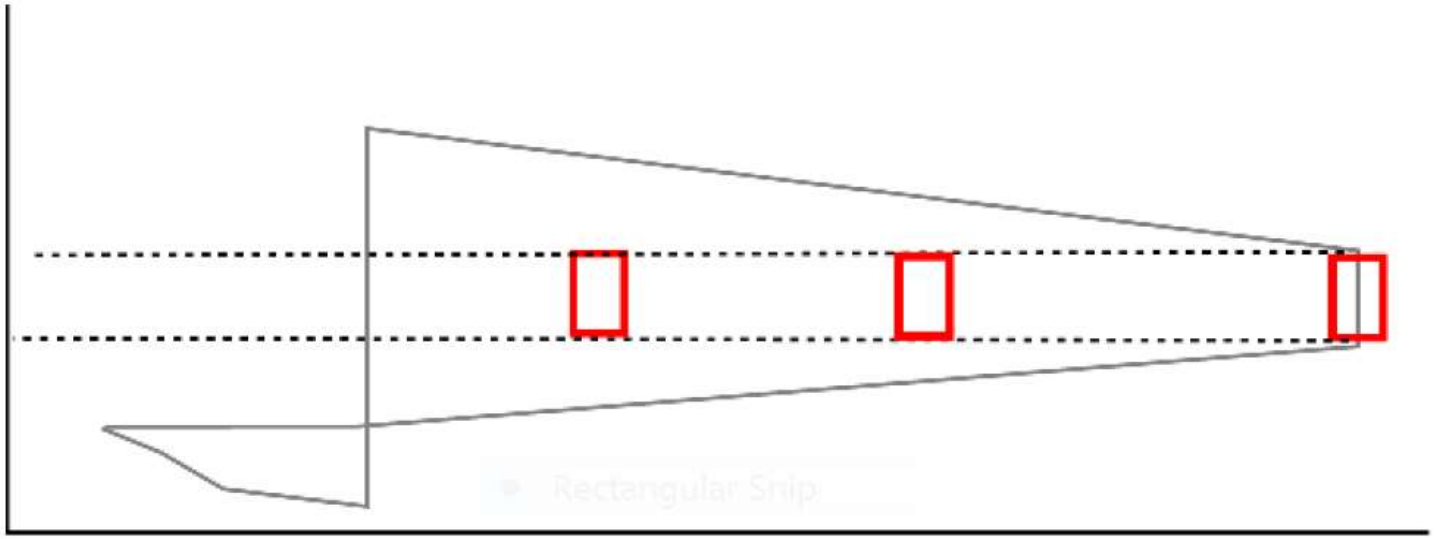
- WM Group solution is to install
  - Control valve at each building entrance and maintain required head for the building.
  - Install good quality control valve at each coil
  - Control valve controls discharge air temperature as well as chilled water return temperature.
  - Vary the discharge air temperature based on outdoor dew point.
    - Remember chilled water is for dehumidification not for cooling

Recommended installation of pressure control valve



Buildings with same pressure drops





Coil Performance Provided by York

CFM	Ent Air Temp DB	Ent Air Temp WB	Dew Point	Lvg Air Temp DB	Lvg Air Temp WB	GPM	Ent water Temp	Lvg water Temp
10000	92	77	71	55	54.73	129.5	42	54
10000	92	77	71	54.4	54.14	142.5	42	53.1
10000	92	77	71	53.43	53.18	168.4	42	51.7
10000	92	77	71	52.69	52.48	194.3	42	50.6

- Additional flow hardly makes difference in the air temp, however, reduces Delta T substantially
- Controlling the valve ensures required air temperature with minimum flow

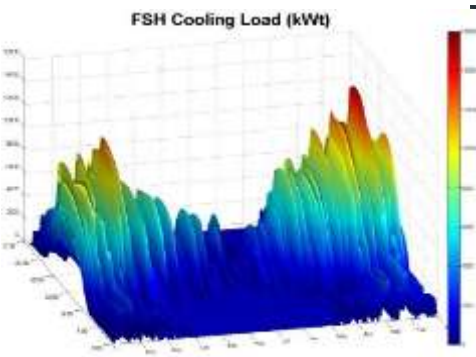
Coil Performance Provided by Trane

CFM	Ent Air Temp DB	Ent Air Temp WB	Dew Point	Lvg Air Temp DB	Lvg Air Temp WB	GPM	Ent water Temp	Lvg water Temp
10000	80	67	61	43.06	43.02	134	40	50
10000	80	67	61	43.58	43.55	119.4	40	51
10000	80	67	61	44.22	44.18	106.3	40	52
10000	80	67	61	44.87	44.8	96.1	40	53
10000	80	67	61	45.54	45.46	87.4	40	54
10000	80	67	61	46.35	46.25	78.6	40	55
10000	80	67	61	47.05	46.95	72.1	40	56
10000	80	67	61	47.87	47.76	65.5	40	57
10000	80	67	61	48.69	48.57	59.7	40	58
10000	80	67	61	48.99	48.58	62.5	41	58
10000	80	67	61	49.36	49.24	65.5	42	58
10000	80	67	61	49.77	49.65	68.4	43	58
10000	80	67	61	50.24	50.11	71.3	44	58
10000	80	67	61	50.62	50.49	75.7	45	58
10000	80	67	61	51.08	50.94	80.1	46	58
10000	80	67	61	51.59	51.45	84.5	47	58
10000	80	67	61	52.08	51.93	90.3	48	58

WM Group Solution Summary

- Great Delta T can be achieved by
  - Installing one pressure control valve at each building rather than for all coils
  - Good quality control valves at coils
  - Controlling discharge air temperature as well as discharge chilled water return temperature
  - Further energy and delta T improvement by raisng discharge supply air temperature based on out door Dew Point.
  - Dew Point control also minimizes reheat coil requirements

Thank You





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