MegaControls

Energy Balancing Zone Valve Working Principles

An energy balancing zone valve (EBZV) maintains optimal system efficiency by ensuring each zone receives exactly the right amount of energy (heating or cooling) it needs, no more and no less. It achieves this through two fundamental operating principles: dynamic flow regulation and load-based temperature control.

Controlling a fan coil unit (FCU) valve based on return water temperature, while also using a standard on/off room thermostat, is an unconventional but unique strategy. Standard systems typically use the thermostat directly to control both the valve and the fan. Here's how the strategy would function and how it differs from conventional methods.

Pressure Independence:

The EBZV acts like a traditional pressure independent control valve (PICV), both maintaining constant dynamic flow through the valve. The EBZV isolates a zone from pressure changes caused when other zones open or close, guaranteeing that each zone always receives its design flow rate.

How Dual-Control Strategy Works:

In this setup, the on-off room thermostat and the return water temperature controller, the latter being built into and forming an integral part of the valve actuator, serve two distinct, hierarchical purposes:

Master Control (The Room Thermostat): This device is the primary decision-maker. Its only job is to determine if the room needs conditioning. When the room temperature deviates from the setpoint, the thermostat closes its contact, sending a simple "ON" or "OPEN" command. When the setpoint is satisfied, it sends an "OFF" or "CLOSE" command. It does not perform any modulating or proportional control.

Slave Control (The Return Water Temperature Controller): The return water temperature controller waits for the "OPEN" command from the room thermostat. Once received, this controller takes over and begins to throttle the valve position based on the return water temperature sensor located at the valve outlet.

The logic would be as follows:

Thermostat OFF: The return controller is disabled. The valve remains fully closed. No water flows through the FCU coil.

Thermostat ON, Defines the Mode: The thermostat closes its contact, signaling a demand. The system must also know if it should be in heating or cooling mode. In a 2-pipe system, this is also determined by the return water temperature sensor at the valve outlet.

Controller Modulates Flow: With the call for heating or cooling in action, the return water temperature controller begins its proportional integral (PI) control function. For example:

In Heating Mode: If the return water is colder than the target setpoint (e.g., 50°C), indicating the water is giving up its heat to the room, and the controller opens the valve further to increase flow. If the return water is at or above the target, the controller throttles the valve closed.

In Cooling Mode: The logic is reversed. A return water temperature that is warmer than the target (e.g., 12°C) would signal a demand for more cooling, causing the valve to open.

The fixed return temperature setpoints of 50°C in heating mode and 12°C in cooling mode for the valve's return water temperature controller are picked based on the following most common central plant design criteria:

	Supply Water Temperature	Return Water Temperature
Hot Water Boilers	70°C	50°C
Chillers	6°C	12°C

In essence, the thermostat acts as a simple "enable/disable" switch, while the return water controller performs the precise, modulating flow control to maintain the coil's thermal efficiency.

Summary

A system where an on/off room thermostat enables a return water temperature-based modulating valve is technically feasible. In this setup, the thermostat acts as a simple occupancy or demand switch, delegating the precise flow control to the return water temperature controller. This dual approach ensures energy is delivered efficiently and comfortably, exactly where and when it is needed.

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