CHOOSING A FLUID BALANCING DESIGN STRATEGY

Theories of balancing

Presently, there are a number of approaches to hydronic fluid flow balancing. These include:

- **Pipe Stretching** - the practice of choosing pipe lengths/diameters and components of various sizes to appear (to the pump) to be of equal resistance for all parallel circuits, regardless of actual length.
- **Reverse Return** – the practice of running equal physical pipe lengths for all parallel circuits, regardless of proximity to the mechanical room.
- **One Pipe Load Pumps** – using a small variable-speed circulator per terminal unit to deliver the diverted flow required from a one pipe circuit.
- **Circuit Balancing** – the practice of adjusting flow regulating valves to balance the pressure drop of all circuits within the system, to ensure design flow is available to each terminal unit.

- **Auto Flow Limiting** – the practice of using valves in each circuit, capable of self-regulating flow over a range of differential pressure conditions.

As discussed in "Yes, Balancing Is Important," (*Mechanical Business*, December 2007) every hydronic system, whether for heating or cooling, must be properly balanced to achieve maximum system performance, optimum operating efficiency, and to ensure building occupant comfort.

Without hydronic fluid flow balancing, most favoured circuits (typically on the lowest floor and closest to the mechanical room) will receive the majority of flow and least favoured will receive less. The heating or cooling capabilities of the HVAC system terminal units are dependant on the hydronic fluid flow through them. The fluid balancing process assures that at least design flow is available to every terminal unit in the building, under any normal operating conditions.

A common misconception is that design conditions are rarely encountered as "design days" are few and far between. In reality, design conditions are commonly encountered every time a night setback resets, and the system immediately calls for heating or cooling throughout the building.

While most in the industry will agree that some form of balancing is important, the debate over which method of HVAC system balancing is "best" will likely never be solved to everyone's satisfaction. The reason for this is that system designers, project managers, equipment manufacturers, distributors, installers, and owners, have differing mandates and preferences.

Ultimately, the best solution for HVAC system balancing is the best combination of solutions that will achieve the desired ends, while providing the best compromise of the key interests of all disciplines involved.

In the next issue, we'll look at complete system balancing using the proportional balancing method.

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There are many strategies that can be employed to balance a hydronic system. The key to deciding which is the best approach will depend on the system you are building, and the budget you have to work with.

WHO'S INVOLVED?... and their motives

We must recognize that everyone involved in the design, development, construction, operation, maintenance, and ownership of an HVAC system is interested in realizing maximum return on investment. However, for the various disciplines involved this means different things and each discipline has their own key interests.

1 System Designers: Ensure design achieves performance objectives to build reputation and command higher fees per project. Use proven designs/techniques to limit time spent on each project and avoid design errors/litigation. Adopt technology as required to achieve desired level of design elegance and competitiveness.

2 Project Managers: Develop relationships with engineering firms, contractors and suppliers, and liaise with the building owner/purchaser to assure all required equipment deliveries and installation/commissioning activities are staged as required to complete the project on time and on budget.

3 Equipment/Component Suppliers: Promote the product solution that will maximize sales volume, dollar value, and/or gross margin per project. Develop relationships and provide support to maintain engineer and contractor loyalty for repeat business. Introduce new technology to gain/maintain market share.

4 Contractors: Develop relationships with suppliers to receive favourable pricing and service. Consolidate suppliers to leverage purchasing power and reduce administration costs. Use products and installation techniques that match available labour skill sets. Promote options that speed building release for earlier payment.

5 Commissioning Engineers: Ensure the system, as installed and set-up, can be started successfully and operated within the defined design parameters. Identify and report any design or construction deficiencies and/or corrective measures required to achieve required performance.

6 Building Owner: Ensure the system is capable of providing a level of comfort that will maximize occupancy and minimize tenant turnover. Balance initial cost with operating and maintenance costs to achieve the lowest possible cost of ownership for the useful life of the building.

Relative costs of balancing

Category	Pipe Stretching	Reverse Return	Load Pumps	Circuit Balancing	Flow Limiting
Piping	Moderate	High	Low	Low	Low
Components	Low	Low	Moderate	Moderate	High
Installation	Low	Moderate	Moderate	Moderate	Moderate
Integration	Low	Low	High	Moderate	Moderate
Commissioning	Low	Low	High	High	Moderate
Design Change	High	High	Moderate	Low	Moderate
Mods / Fixes	High	High	Moderate	Low	Moderate
Energy	Moderate	Low	High	Low	Moderate
Maintenance	Low	Low	High	Moderate	Moderate
Occupant Turnover	High	Moderate	Moderate	Low	Low