Questions of importance to plumbing professionals would be published periodically in IPT, starting March 2019, with the view to get opinions/ clarifications.

IPA Debate Club was an established column earlier but was discontinued for some time.

Through the Debate Club, IPT wants to involve all for the benefit of the plumbing fraternity.

Answers, duly vetted by IPA Technical Committee would be published in IPT. The decision of the IPA TC would not be subject to any challenge or counter claim.

Name of the responding person, whose answer is close to the correct answer, would also be printed in IPT. The decision of the IPA TC would not be subject to any challenge or counter claim.

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Convener, IPA Technical Committee

IPA DEBATE CLUB QUESTION 3 (IPADCQ - 3)

Compiled By: BSA Narayan, Convener, IPA Technical Committee

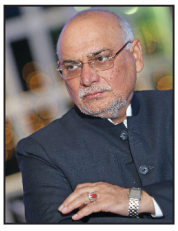
BACKGROUND: In India the multi-storied buildings are belonging common now in all cities. Be it a residential building or hotel, hostel, the central hot water system is envisaged. The hot water generation equipment is generally placed at ground level and distribution is designed into supply hot water under pressure to entire building. If the hot water generating equipment is located on the terrace of the building which is 120mts in height and hot water to be supplied to all the floors below.

QUESTION: 1. What kind of design/arrangements to be done regarding number of zoning and how it is arranged?

2. How will the return line from each zone to arranged to connect to the reverse return line which goes up to the hot water generating system located on terrace with a common re-circulation pumps located on the roof level.

RESPONSES

Response 1:



As per my experience & discussions with different stakeholders, the responses are as follows:

1) Whether the Hot Water Generation System is at Terrace Level or at Ground Floor / Basement Level, it is very important to supply the Cold Water & Hot Water to all the users especially at the farthest end with equal pressure. Therefore, zoning & looping should be done exactly in the same manner for cold water & hot water. Also, similar & parallel arrangement of pumping water system to be maintained so that there is no gap in pressure distribution.

2) The best way of connecting the hot water return line from each zone to the main reverse header is by providing the Balancing Valves at the end of the return line for each zone.

M.K. Gupta
IPA NEC Member, Delhi Chapter Chairman and Managing Editor- IPT

Response 2:

Arrangement or no of zones for hot water distribution for a building of 120 Meters cannot be independently decided. It's always on the same lines of Coldwater distribution network. As per NBC one zone can be of maximum 27 Mtrs (9 Floors). But normally in practice they are of 18 Mtrs (6 Floors). So, zones can be in between 5 to 7. But more important issue is pressure balancing in cold and hot water supply. So, selection of Pressure Reducing valve and setting for a particular PRV for designed pressure for hot as well as cold water is most important. Failing to set any PRV for correct and balanced pressure can result in accidents and as it involves hot water can be disastrous. If the hot water Generation is by Solar (No control over temp) and no thermostatic valves are planned, accidents can be fatal. Also, line sizes for cold and hot water should be properly sized so that we don't encounter thermal shocks (Intermittent hot and Coldwater streams)

2. How will the return line from each zone be arranged to connect to the reverse return line? Which goes up to the hot water generating system with a common re-circulation pump located on the terrace.

Answer- A common re-circulation pumping system is always possible irrespective of building height as in any case pressure at the terrace at pump level will be the same. Only issue is how we are going to balance flow. If the flow is not balanced, hot water for ducts near the hot water system will circulate all the water and will be full of hot water and the system will be off if automated for Temp. Even if the system is on for `4 Hrs still it will circulate water only from nearest ducts and farthest ducts will not be filled with hot water. To balance the flow from all ducts either we can increase the length of top zones and nearer ducts to such a level that frictional losses will increase and will be the same for all zones and all ducts. But in the case of a reverse return line, piping length and cost will be unnecessarily very high. Another method is to install a balancing valve on every return line for each zone in all ducts. We have already discussed in a previous debate club whether to take the return line from tap or from down take. So, considering we are connecting the return line to the down take just below the final supply connection we will require 5 to 7 balancing valves depending on no of zones designed. Return pump should always be automated in a way once the suction line for the pump gets sufficient temp, pump should be off as all the lines are filled with hot water. Without this automation we will lose and waste energy not only for running the pump but also for heat losses through pipelines. Higher the temp higher is the temp and energy loss.

Rahul Dhadphale
IPA National Joint Secretary

Response 3:

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Dinesh Shah, IPA NEC Member

Response 4:

Designing the optimal system for hot water circulation

In hot water circulation applications, there is a need for instant hot water as soon as the tap is open. The traditional solution is to use a constant speed pump to provide the needed pressure in the hot water and circulation pipeline. Typically, the pump runs at maximum speed and is usually throttled by a valve. This results in high energy consumption and pumps that cannot adapt to changes in the system.

Our solution:

A more efficient solution for hot water recirculation is to use a constant temperature-controlled pump. The constant temperature control mode on the TPE3 will always maintain the desired water temperature at the taps and in the circulation pipe. If the temperature increases the pump ramps down and if temperature decreases the pump will increase its performance. This eliminates the need for pump throttling valves and means overflow will never occur, resulting in substantial energy savings.

The intelligent solution:

1. A temperature-controlled pump

i. Fixed-speed pump

A constant speed pump ensures instant hot water but increases energy consumption. To ensure immediate hot water when needed, a separate circulation pipeline is installed. Traditionally, a constant speed pump is used for the continuous circulation of hot water. Here a constant and unnecessarily high pressure is provided, which is why a pump throttling valve is required. This increases both the investment costs as well as energy consumption.

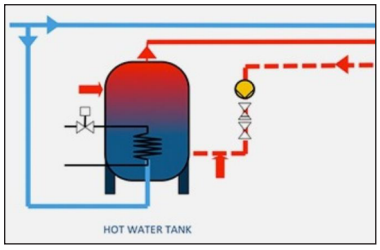


Fig: Fixed-speed pump

ii. Temperature controlled pump ensures performance always matches demand

Instead of throttling the flow from a fixed-speed pump you can install a temperature-controlled pump such as the MAGNA3 or TPE3. The pumps' constant temperature control modes ensure the desired water temperature is always kept. If the water temperature increases, the pump will ramp down and if the temperature decreases, the pump ramps up. Wireless technology and integrated sensors ensure seamless control and a continual match between performance and demand. This allows you to cut down on energy use and save the cost of throttling valves.

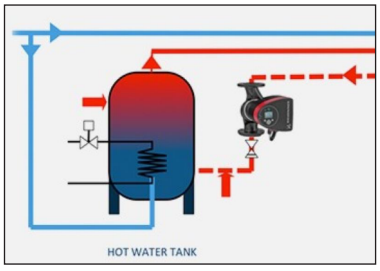


Fig: Temperature controlled pump

Advantages

- High efficiency commercial heating and cooling circulators
- Constant temperature control mode allows the pump to adapt to the actual water temperature

Zones:

- Bath or shower
- Drinking foundation
- Kitchen
- Washbasin

1) Make sure there is always enough flow to meet the Thermostatic valve **minimum flow** GPM requirement. All control valves need enough flow to work properly. A correctly sized, constantly running recirculation pump will usually assure enough flow.

2) A master point-of-distribution mixing valve that does not have 100% close-off on its inlet ports (most thermostatic mixing valves) can cause creep or droop if not properly piped.

3) **Figure: 1 in** shows proper piping with a **return valve,** which throttles the amount of recirculation water going back to the cold inlet of the mixing valve, and a **bypass valve** which.

Tomesh Sahu
IPA Member, Nagpur

Response 5:

Hot water return is required to be provided based on the accepted criteria of the cold water draw out time factor (beyond which hot water will be delivered).

It is required to establish the time factor, and, in my understanding, this is accepted to be 10 to 15 seconds. While the end user may desire to be least (tending zero seconds) time factor however having drawn out time less than 10 seconds requires return piping to be coming closest to the fitting which requires more than just extra piping, the aspect of balancing the effective return and engineers more deeper understanding and detailing of the flow balancing.

On practical aspect, the engineer should calculate the hot water pipe length T connection from the main supply and check the hot water volume based on pipe diameter and length up to fitting. Compute the discharge and check the time taken to have cold water draw beyond which hot water will be obtained.

In my working, I would consider having the return of the main hot water down-take (or riser) which will be more practical to have flow balance. Hot water return from the inside of the bathroom requires better balancing and pressure adjustment. If only in case of resort hotel where the bathroom is distanced from the main supply pipes, it would be required to have the return from the inside of the bathroom however for business and high rise hotel project (where the bathroom and shaft are much adjacent), the most practical and effective approach would be to agree 10-15 sec cold water draw out and plan down-take (or riser) return.

Sandeep Goel
IPA NEC Member

Clarifications from Technical Committee (TC)

Plumbing Engineers consider the prompt delivery of hot water to fixtures careful planning and design on the best of all available data will ensure adequate hot water of desired temperature available at any fixtures as needed.

Proper sizing of the circulation is essential for efficient and economical operation of hot water system. Experience of the designers and installer using empirical methods of sizing circulation piping are usually adequate and satisfactory for majority of installations.

When the system is designed with hot water and cold-water supply, the pressure should be maintained in both the. The use of pumping system with constant speed, temperature-controlled works well to control pressure and temperature at the use point.

The zoning is very clearly defined is the NBC. The zoning is very important to avoid excess of pressure operating on the system. The normally practiced system is to consider 27mts to 30mts or approximately of 9 floors, which is equivalent to 3kg/cms2 (3-Bars) pressure. Proper design and sizing of circulation pumps shut off valves and balancing value shall avoid delay is delivering hot water to fixtures.

It is extremely important to maintain velocities in the piping system especially hot water return piping sizing in order to maintain a controlled velocity. High velocities in system can cause pin holes and cavitation.

Equally important that the system to be balanced for its specified flows in the main and individual loops in the circulation system.

The designing of hot water return piping system shall be designed keeping is mind the total developed length of piping, velocities is the system and of course prompt delivery of flow and pressure temperature. Balancing value on the hot water return system to balance the flow.

CONCLUSION

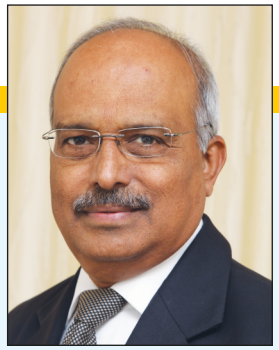
- Zoning design to be carried out as per NBC-2016 for supply of hot water and coldwater supply.
- Pressure and temperature balancing is both hot and cold water system is important in the design.
- Provision of PRV if required to balance pressure. On the return hot water lines which are connected to hot water reverse return line.
- The domestic hot water system is closed one and hot water return from each loop is connected a common reverse return line with suitable valves. The system considered as closed one and designer should not include static head where it is not exiting. The hot water circulation pump has to overcome only the friction loss is the hot water return piping and not due to static head.

In conclusion on inappropriate hot water recirculation system can have serious repercussions on the system, equipment and wastage of vast amount of water and energy.

Thumb rule to be followed for a quick sizing. it's not recommended without detailed engineered design of the system.

To size the recirculation piping and circulation pumps, following thumb rule methods (Normally practiced and published in several books) can be followed.

1. An allowance of 2.25 Hs per minute can be assigned for 20mm to 25mm dia risers, 4.45 lpm for 32mm to 40 mm dia and 9 lpm for 50mm and above.
2. An allowance of 4.5 lpm is assigned for each group of 20 fixtures supplied with hot water.



BSA Narayan

IPA National Vice- President and Convener, IPA Technical Committee

BSA Narayan is a member of the America Society of Plumbing Engineers – USA, Fellow of Institute of Plumbing and Heating Engineering – USA, Fellow of Institute of Plumbing Association of Consulting Civil Engineers India. He is also one of the founder members of Indian Plumbing Association. In 2007, he was awarded the prestigious "Lifetime Achievement Award" by IPA.