IPA DEBATE CLUB QUESTION 1 (IPADCQ-1)

What is the best practice for designing the hot water return system in Hotel project for Guest room toilets, from inside the toilet or from the risers in the shaft? Are there any guidelines/most practised systems available with designers and experienced operators?

Is there any criteria to design the reverse return piping system with respect to efficiency of the hot water system?

Editor's Note:

The following answers have been received from various IPA members in response to the above question which was published in IPT January 2019.

ANSWERS TO THE DEBATE CLUB QUESTION 1 (IPADCQ-1)

Response By
Mr Sandeep Goel
(Proion Consultants), New Delhi

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 draw 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 to have 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 are 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.

Response by
Mr Sharat V. Rao
(MD, Engineering Creations Public Health Consultancy Pvt. Ltd.), Mumbai

I am not aware of any guideline or regulation which clearly states that hot water return is to be taken from within the bathroom space or from the hot water risers in shaft.

The criteria should be the quantity of water that will be lost for the end user to get the comfort temperature that he needs. Generally the return pipe for guest toilets in a hotel room is taken with a Tee connection from the riser in shaft.

However if the fixture is distanced away from the supply riser in shaft then the return pipe connection may have to be taken from the inside of the bathroom. The 2013 Green Plumbing Code Supplement – India states that the maximum volume of water contained in a hot water distribution pipe between the water heater (in our case can be read as the hot water riser) and any fixture fitting shall not exceed 1000ml (1 Litre). So if the amount of water exceeds 1 Litre, return piping to be done from within the bathroom.

Reverse Return Piping concept is not mentioned in the ASHRAE Service water heating guidelines. However it is done in most of the hotel projects in our country.

Response By
Mr. Rahul Dhadphale
(Urjal Consultants Pvt Ltd), Pune

I have not come across clear guidelines on this subject.

Return pipeline design is a crucial design as it has direct impact on efficiency of system. Taking the line from the tap inside toilet will definitely save water but will make flow balancing of return piping much more difficult. Normally return line is taken from shaft as water inside pipeline within the toilet is less than1 litre. But if the routing is such that piping inside toilet is more and holds more water you have to take return line from inside the toilet. We get balancing valves which operates on flow as well as temperature. This is the best solution for balancing but at a cost.

In Reverse Return System we add piping to balance the pressure drop from all ducts so as to balance flow. But we add to length of piping resulting in higher heat loss. The system efficiency is low because of higher piping length. Solution is to install balancing valve so as you don't add any heat loss and get technically designed solution.

Best practice would be minimum possible length of return piping with balancing valves. Whether to take the line from inside the toilet will depend on diameter of pipe and length of piping within toilet. Solution will be site specific. Instead of reverse return line direct return line with balancing valves is better option.

One more important point in Return System is sizing of piping and automation of Return Line Pumping system. A proper detailing has to be done to avoid Heat Loss.

Response By
Mr. R. Kandeepan
(S R Associates), Chennai

a) In a central heated hot water system, there is no doubt return piping with re-circulation pump is required.

b) In case of outside toilet return connections, the return can happen from the base of the shaft, with a "U" bend joining the HWS and HWR pipes OR.

c) It can happen from inside the toilet just before the toilet fixture (a wash basin or a shower mixer) and return back to connect up the HWR riser in the shaft.

d) A sample terminal HWR fitting is displayed below. This is also used for serial connection piping design.

Connect to faucet

HW Supply / HW Return

e) With correct scientific pipe sizing, the velocity may be around 0.75 to 1 mps.

f) Hence, for the outside toilet connection (item b), with pipe length of around 5 mts. from shaft to faucets, in a well-balanced (see answer for Q-2) piping system, the time lapse will be around 5 secs.

g) With inside toilet return connections (item c & d), the time lapse will be 0 secs.

h) In star hotels 5 secs is considered OK, but 0 secs is always preferred.

i) Consider a very cold area, like winter Shimla, European locations with 0^{o}C to 5^{o}C ambient, touching cold water itself may cause sickness. Hence, anything more than 0 secs will not be tolerated and "in-toilet" connections are preferred.

Criteria for Design of Reverse Return Piping System:

a) In a central heated hot water system, there will be multiple hot water circuits.

b) One circuit will comprise the HW calorifier, a length of HWS header piping, HWS branch piping, HWR branch piping, a length of HWR header piping, HW recirculation pump and HWR header piping back to calorifier.

a) While designing or sizing the HWS & HWR piping system, care should be taken so that thepressure drop in each of the circuit is the SAME.

b) This can be achieved in 2-ways. i) by adopting Reverse Return piping system OR ii) by installing balancing valve in the return pipe @ location just before the connection in to the HWR main header running back to the HW recirculation pump.

Reverse Return System:

c) The buzzword for RR piping design (or the criteria) is "FIRST IN - LAST OUT" OR "EQUAL TRAVEL DISTANCE OF PIPING FOR ALL CIRCUITS".