Design And Cost Comparison For Single Stack System And Two Pipe System For Domestic Drainage Using New Techniques

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Abstract- *Plumbing is a challenging job for an engineer. His challenges increase with the constraints of the project. In case for the plumbing of a residential building, one faces the shortage of space in the duct area. New technologies in the field of plumbing are helping designers to reduce the size of pipes and their numbers, ultimately leading to reduction in area required in the ducts. Sovent is one of such technologies recently invented. The paper throws light on what can be achieved by using sovent in domestic drainage plumbing system.*

Keywords- Sovent, single stack system, two pipe system, domestic drainage.

I. INTRODUCTION

The cost of construction material such as sand, cement and steel cannot be reduced as they should be of standard specification and quality. Therefore, the only alternative left is the use of plumbing and sanitation material. Most of the plumbing and sanitation material is concealed, therefore these materials in its initial period do not show any sign of malfunctioning in maintenance. Conventional drainage system recommended in Municipal Bye-laws for a building involves use of two separate pipes, the soil pipe taking discharge from water closet and urinals while the waste pipe takes discharge from baths, sinks and wash basins. In addition, vent pipes are fitted to both the stacks to prevent unsealing of the traps of different appliances It is known as 'Two-pipe fully ventilated system'. The other system is 'One -pipe fully ventilated system' wherein a single soil waste pipe conveys both soil and waste and the various appliances are ventilated. A recent development is the single stack system, wherein all the appliances are connected to one pipe which itself provides all the vent requirements. It is simple, economical and functionally efficient.

II. LITERATURE REVIEW

Sudesh Kumar Sharma [1] in his research note about ‘single stack system of building drainage’ recommend that the appliances should be grouped as closely as possible around the main stack so as to keep the branch pipe short and to reduce the noise. The maximum distance of W.C. branch pipe should be 1.5m from main stack. The W.C. branch should be 100 mm diameter and waste branch from floor trap should be 75 mm dia. The slope of waste branches should vary between 1 in 10 and 1 in 50 and no waste branch should be connected within 20 cm below the centre line of W.C. branch. The depth of water seal in W.C. and floor traps should be 50 mm and 40 mm respectively. Other appliances need not have water seal t raps, when connected through a floor trap. Large radius bends 92~o or two bends of 1350 should be used at the foot of the stack to avoid back pressure. It has been estimated that there is saving of 54 per cent in overall cost of piping by adoption of single stack system as compared to two-pipe system in a five storeyed building having twin o units on either side of the stack.

N.K. Verma, S.P. Chakrabharti, P. Khanna [2] ‘Modified One-Pipe System of Drainage for Tall Buildings’, in his research work writes Single stack system of plumbing provides a simple solution for drainage in multi-storeyed buildings but limits the discharge in stack. Higher discharge loads necessitate a larger diameter stack. Modified one-pipe system may prove to be cheaper in such cases. Performance study of the systems reveals that the permissible capacity of a 100 mm stack can be increased by 30% incorporating a 50 mm vent stack connected to W.C. branch at each floor, a simplified and rational method of design for vented drainage system has also been proposed. And he recommends, the limiting capacity of a 100 mm stack has been found to be 2601/min under SS-system for an allowable stack suction of 40 mm (w.g.). The capacity of the stack can be increased to 340 l/min by connecting the W.C. branch at each floor to a 50 mm vent stack. This added capacity not only offsets the cost of the separate vent stack but also results in appreciable economy for tall buildings in Indian conditions compared to SS system. Recommendations for limiting discharge carrying capacity of stack have been presented below Table for various conditions of vent connection. Number of storeys to be served corresponding to the limiting discharge may be worked out from simultaneous flow discharge unit relationships.

Swastik Sungare [3] has mainly focused on comparison of various plumbing material and cost comparison of plumbing system considering time factor an also discuss about Issues and investigation of plumbing system in Public and Residential Buildings. Despite the rapid technological evolution of the systems used for sanitary water installations, as a result of the recent emergence of new piping systems that seek the high performance with the low installation time and cost, we can conclude that there is no perfect water piping systems. There are, however, systems that seem to be more suitable or appropriate for a particular type of installation. In fact, if it is intended to install a sanitary piping network with high extension, subjected to a high thermal gradient, for which the mechanical resistance to external loads is an important issue, a metallic water piping system, as copper, galvanized steel or stainless steel, is a solution almost unbeatable. However, if it is intended to install a sanitary piping network with a complex design, with low thermal losses, for which the cost of a skilled installation has a considerable weight, the plastic water piping systems are easier to install. It is expected, in future, that the evolution of the sanitary water piping installations won't be at the level of the materials and technologies, but especially at the level of the installation methods. Leaks in piping behind walls or partitions or under floors may be troublesome to locate, because moisture indicating a break may not appear near the place where the water is being lost. Water from a leak will often run along a horizontal run of pipe, or a beam, and drip off a long distance from where it started. Water naturally runs down a vertical section of piping, perhaps to appear far below the actual leak. The water piping networks without any kind of accessibility for the repair are doomed to failure. All water piping systems should be installed inside an accessible duct, or inside a false ceiling that covers up the exposed piping network. The construction of technical galleries, ducts or removable ceilings in buildings requires a straight coordination between the various agents that operates in building design, with particular emphasis on the architect, a fundamental part in the design of spaces, and the civil engineer, that designs the water piping systems. It can't be excluded from this team, the municipal services. These entities have, in many cases, their own legislation that rules beyond the requirements contained in the national regulations. From the understanding that this "triangle" can achieve in this field, the quality of construction can be enhanced.

III. DESIGN OF TWO PIPE PLUMBING SYSTEM

Calculation of discharge units(DU) for a 14 storeyed taking 2 toilet blocks in consideration on each floor as per Geberit HDPE dimensioning manual is calculated as follows:

Description	DU (l/s)	Dimension DN (mm)
Non-water urinals	0.1	50
Lavatory (Washbasin)	0.5	
Bidet	0.5	
Urinals (electronic flush)	0.5	
Shower	0.6	
Bathtub	0.8	56
Kitchen Sink (Single/Double)	0.8	
Washing machine to 6Kg	0.8	
Washing machine to 7-12Kg	1.5	70
W.C., up to 6 liter flush	2.0	100
W.C., up to 9 liter flush	2.5	100

The flow for the pipe is calculated for each floor as

A	Total DU For Waste Pipe per floor	1.1
B	Total DU For Soil Pipe per floor	2.5

A	Total DU For Waste Pipe For Total Building	15.4
B	Total DU For Soil Pipe For Total Building	32.5

Maximum discharge for total building by using the equation

$$Q_{max} = K.\sqrt{\sum DU}$$

here, K= 0.5 for residential building, was found out to be: 1.96 lps for waste pipe and 2.85lps for soil pipe.

As discharge is 1.96 l/s which was less than 2.6 l/s we have used 75mm diameter pipe for the waste pipe with Direct and Indirect side vent system with Swept-entry, Ball-fitting. The discharge is 2.96 l/s which is less than 7.3 l/s we can use 110mm diameter pipe for soil pipe. (As we connecting the water closet to this pipe minimum diameter should be 110mm)

IV. DESIGN OF SINGLE STACK PLUMBING SYSTEM

Calculation of discharge units(DU) for a 14 storeyed taking 2 toilet blocks in consideration on each floor as per

Geberit HDPE dimensioning manual is calculated similar to design of two pipe system.

The flow for the single stack system is calculated as follows

Sr.No.	Drainage Component	Number	DU(l/s)
1	Wash Basin	1	0.5
2	Shower	1	0.6
1	Water Closet (9L)	1	2.5
Total		3.6	
Total DU per floor		7.2	

Total DU For Single Stack For Total Building	100.8

Maximum discharge for total building by using the equation

$$Q_{max} = K.\sqrt{\sum DU}$$

Where, K= 0.5 for residential building

The maximum discharge is calculated to be- 5.02 lps.

As discharge is 5.02 l/s which was less than 12.0 l/s so we have used 110 mm diameter pipe for single stack system with sovent fitting.

V. COST COMPARISION

	Ashriwad SWR fitting (INR)	Ashriwad Silent fitting (INR)
Two pipe system	154372.79	269546.2
Single stack system	118273.50	185722.51

VI. CONCLUSION

1. As per National Building code 2016, it is suggested that use single pipe system up 5 stories economically over two pipe system. But it was observed that the by use of Sovent we can use single pipe system for high-rise building economically.
2. Sovent single vertical stack, the Sovent eliminates a separate vent stack and an intermediate vent. This saves plumbing material, on average, 30% to 45% on total material cost. With less materials needed, storage space and shipping costs are reduced.
3. Sovent single stack system needs less pipe and fittings. This allows designs to be completed quicker. Because there is one stack and no additional vents, plumbing designers do not have as many coordination issues in walls or drop ceiling spaces. There is additional space to allow for other needs.

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