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Water Efficiency Improvement by Sub Metering and continuous monitoring – Case study

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ABSTRACT

Monitoring of water consumed in a municipal water supply system, can give insight for improvement in water efficiency. Latest developments in communication can give cost effective solutions in this area.

If a proper monitoring system with alerts is in place, night flow studies and consumption pattern studies also can be carried out. Leak and excessive consumption can be identified without much delay.

Bulk consumers generally re-distribute the received water through an internal distribution system. Considering the location and the number of consumptions points, sub-metering and continuous monitoring at these locations are necessary.

A case study having seven sub-metering and continuous monitoring locations is presented. Results showed substantial improvement in water efficiency could be achieved within few months. This emphasise the need to install sub-metering with continuous monitoring in bulk consumer premises.

KEYWORDS: Water Efficiency, Sub metering, monitoring, Water Consumption.

1.0 INTRODUCTION

Availability of Fresh potable water is becoming scarce, and if available, is becoming costlier. According to the OECD Environmental Outlook to 2050, global water demand is expected to increase by 55% (taking 2000 as a baseline) and more than 40% of the global population may be under severe water stress by 2050[1] Water being a lifeline, is being used by various sections of the society and water utilities face a huge challenge to meet the ever expanding water demands from industries, schools hospitals and residences. Hence it is imperative that all stake holders look at ways and means of improving the water efficiency of available water. As water efficiency improvement is purely reduction of wastage, it can be implemented without any inconvenience to consumers unlike water conservation measures.

In municipal water supply system, each consumer is provided with a water meter at custody transfer location. These meters are intended for measuring monthly consumption which is generally used for billing. In order to ensure water efficiency, monitoring of water consumption becomes essential. Nowadays, water meter manufacturers supply meters with pulse output mainly to collect data continuously. These data can be transmitted to a server or mobile for online monitoring of consumption. Online monitoring with necessary alerts can lead to improvement in water efficiency.

2.0 CONTINUOUS MONITORING

Continuous monitoring of consumption has several advantages. Main advantage is the easy identification of leaks. Leaks are generally noticed in the pipe joints and through faucets. Sometimes leaks are noticed in pipelines due to corrosion or by external load. Identification of leak is generally carried out through night flow. As the pipelines are buried underground, minor leaks will not be visible above

ground and the leak may continue to remain unnoticed for a long time. Consumption monitoring overcomes these difficulties.

It may be noted that occurrence of leak will come to notice within a day and the magnitude of leak is also available through night flow study. Even though invisible leaks are considered “minor”, the quantity of water lost becomes quite significant over a long period of time. As these leaks are occurring inside consumer premises, expenditure required for treatment and conveyance is already spent and hence it cannot be considered as raw water at natural source.

Continuous monitoring gives detailed information about the consumption pattern. These patterns can be compared with similar consumptions and effective measures to curtail the excessive consumption can be carried out.

Recent developments in communication technology, including mobile phones can be effectively used for continuous monitoring of water consumption. Proper alerts like leaks or excessive consumption can also be incorporated in the software.

3.0 SUB-METERING

In the case of bulk consumers like commercial establishments, office premises, manufacturing firms, detailed monitoring is necessary. These organisations generally have a water distribution system internally to cater to requirements at various locations inside their campuses. In such cases, monitoring of consumptions at one location may not give detailed information to identify problems and taking corrective measures. Hence sub-metering becomes essential. Even though monitoring consumption at each faucet is possible, a couple of faucets can be considered as a group and cumulative consumption can be monitored. This will reduce investment required for monitoring and necessary information can be obtained reasonably. However location for monitoring or grouping the faucets may be carried out judiciously. Sometimes more than one monitoring locations may be needed in a single line itself where pipelines are too lengthy or old. In general, closer monitoring is necessary where possibility of occurrence of leak is high.

4.0 CASE STUDY

In the organization considered for the case study, water is sourced from two individual municipal supply lines. The demand for public water is made up of authorised consumption by domestic and non-domestic consumers and water losses [2]. A 4” size supply line caters to the non-domestic requirement and Office buildings. A 2” supply line caters to the residential domestic water requirements. Fig.1 shows the water distribution network inside the campus.

Both networks are used for distribution of municipal water supply to water tanks in various buildings for industrial use, drinking, washing and sanitation purposes.

As the pressure in the municipal supply line is quite sufficient, no sump is used to store the municipal water supply. The water was directly supplied to overhead water tanks fitted with float valves. The overhead tanks in each building supply water to different locations within and near the building.

The municipal water supply consumption was monitored using the water meters provided by the municipal water supply board every month for a year. Total water requirements for the various locations in the organisation, as per IS 1172[3] was estimated to be around 20 kilo litres per day whereas that consumed was about 50 kilolitres per day. It was decided to find out the reasons for the high consumption.

It was proposed to have sub meters installed at various locations in the water supply network inside the campus to monitor the readings and identify the reasons. Accordingly sub meters were installed in various buildings and the consumption monitored continuously. Following problems were identified after fixing the sub-meters:

4.1 Float Valves

The pressure in the municipal water supply varied at different points of time and was unusually high at around 3.5 bar immediately upstream of the float valve. During night, pressure was high and the valve could not withstand the pressure, which resulted in leak through the valve and wastage of water.

4.2 Pipe Bursts and leaks

Due to the changing climatic conditions, particularly during and after the rainy season, frequent leaks in underground pipelines were taking place. They were identified only when the meter reading was taken in the next month, by which time, lot of water had been wasted. If the leaks are minor, it may remain unnoticed also. Similarly certain sections of pipes were quite old and corroded. This also resulted in leak.

4.3 Improper Selection of Fixtures

In some locations where water is used for washing purposes, isolation valves were provided instead of regulating valves.

Similarly large size valves were provided where smaller size valves were sufficient.

4.4 Solutions

Fig.2 shows the water consumption in various locations. Leakages were identified using the meter readings at either end of the main line. Isolation Valves were placed on either side of underground main lines to isolate and check the pipeline for leaks.

The float valves were modified by reducing the bore diameter, to suit the high inlet pressure and thereby reduce water wastage. The float valves were tested in the laboratory to check the pressure withstanding capacity, before installing at site.

Oversized Valves and Isolation valves were replaced with reduced size valves and control valve wherever required.

The above problems could be identified when the overall problem was segregated and water consumption in a particular area could be monitored. After identifying the problems, the corrective measures mentioned above were implemented.

A reduction of around 30% in the municipal water consumption was brought about by the use of sub metering over a period of six months. Fig 3 shows the comparison of consumption before and after sub metering over a period of one year.

4.5 Water Use

One observation that was made from the sub metering was that some locations consumed more water than the estimated values.

It was decided to find out the reasons for the same by monitoring individual outlets lines from the same supply tank of one building to understand the issues. Hence new water meters with pulse output were installed. AMR facilities which can send the consumption data to the cloud and a mobile smart phone was tried in the building. Water meters with AMR units were fitted to seven locations which were supplied from the same overhead tank in building L shown in Fig 1. Fig.4 shows the water meter installation along with the wiring, and Data acquisition units for collection, transmission to cloud server.

The water consumption through the seven locations is monitored continuously using the AMR system and data logged onto a remote server.

The logged data can be downloaded from website. This data is also instantaneously presented to the manager using a mobile application. Alarms are raised in case of excess usage or continuous leaks, so that action can be initiated to prevent water wastage.

Fig. 5 gives the details of fixtures under each of the seven monitoring locations. From the data obtained, it was possible to identify the average consumption for each location and also deviation from the

normal consumption. Fig. 6 shows the daily consumption at seven locations.

It was also possible to identify leakages by monitoring the night flow and continuous usages, which were mainly due to leakages through cisterns, taps and pipes. Fig. 7 shows hourly consumption pattern in one monitoring location for a month. Similar graphs are available for all monitoring points. Fig. 7 also shows a leakage through the cistern which was rectified.

5.0 ECONOMICS

The monitoring of the water consumption was carried out in two phases. The first phase was with sub metering using domestic water meters where the readings were collected noted daily. These were entered into spreadsheet and the consumption patterns monitored. Any deviation was immediately looked into. The cost involved in this process was the meter cost, labour cost for noting the reading, data entry and analysis. Since existing man power was used labour costs were nil and only the domestic meter costs were spent.

In the second phase, water meters with pulse output were procured and additional equipment for data acquisition and transmission to cloud was obtained. Though this was a little bit costly, time spent in reading, data entry and analyzing the trend was avoided and any unusual consumption was indicated by alarms.

In the first phase cost of installation was very less compared to the savings obtained and was recovered within a short period of 2 months. The second phase cost was a little higher and though the savings were lesser, it helped in earlier identification of the sources of leak and their rectification. The cost of installation was recovered in about 12 months.

6.0 CONCLUSION

Sub metering and continuous monitoring have helped identify and reduce water wastage and improve water efficiency. The costs of implementation of these technologies are small compared to the benefits obtained by them and it has been decided to have AMR based water sub metering included in buildings having higher consumption. Hence it is recommended that all bulk consumers implement such technologies to save water and improve water efficiency.

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REFERENCES

[1] OECD (The Organisation for Economic Co-operation and Development), OECD Environmental Outlook to 2050: The Consequences of Inaction, OECD Publishing. http://dx.doi.org/10.1787/9789264122246-en, 2012.

[2] Twort's Water Supply - 6th Edition - Butterworth–Heinemann publications

[3] IS 1172: 1993 Code of Basic requirements for Water Supply, Drainage and Sanitation [CED 24: Public Health Engineering.]

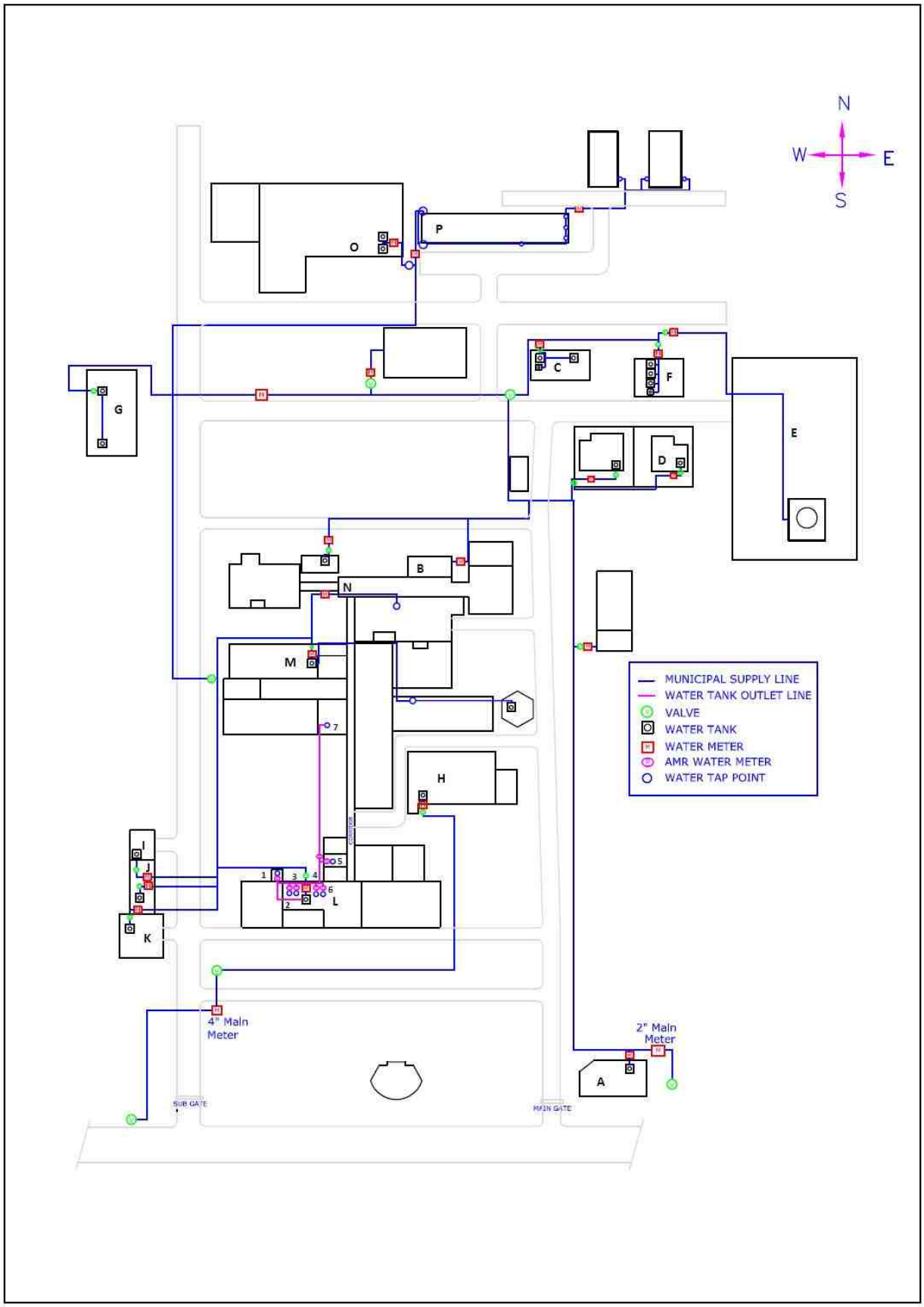

Fig.1 Water Distribution Network inside Campus

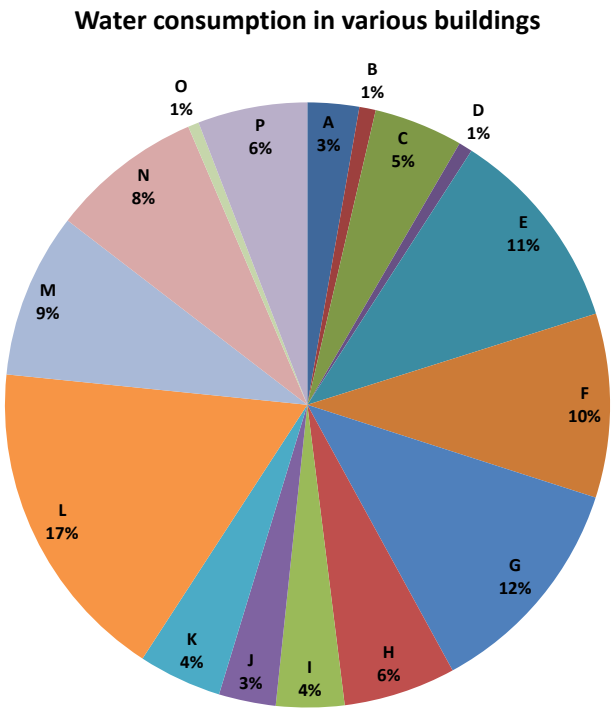

Fig.2. Water consumption in various buildings

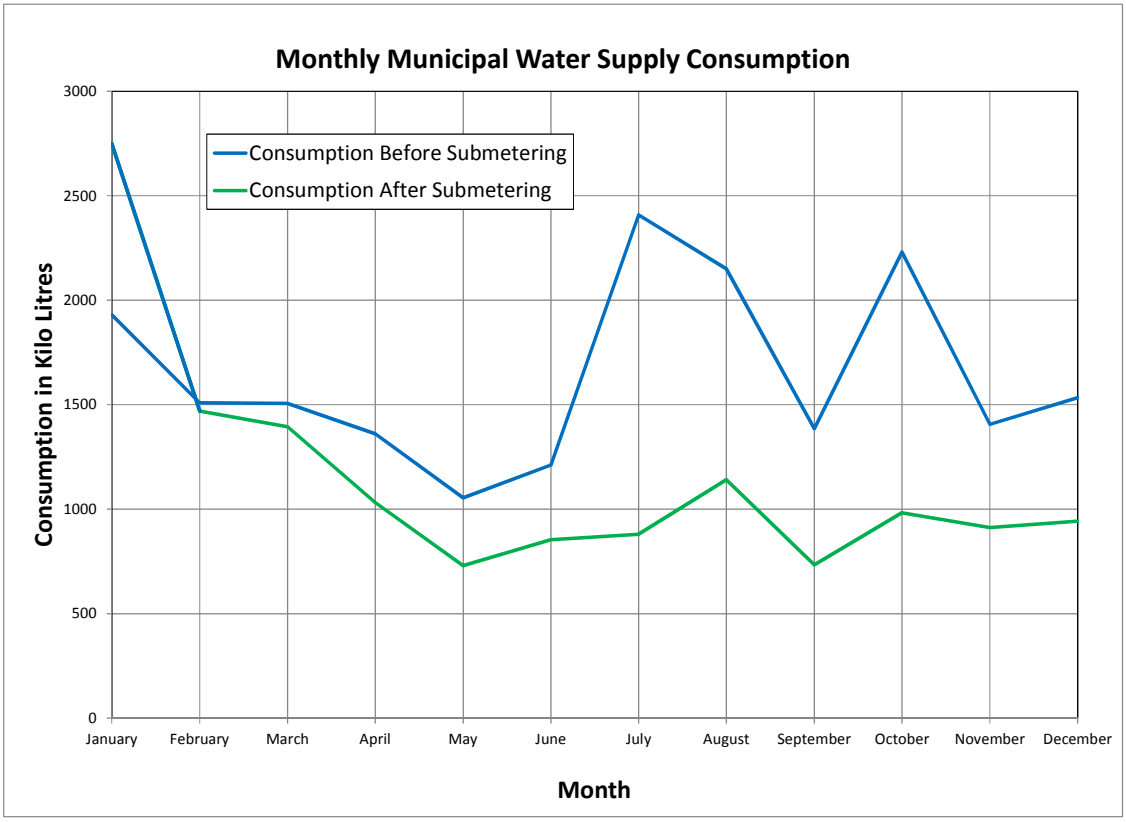

Fig. 3 Comparison of consumption before and after sub metering

Fig.4. Sub metering using AMR Water metering system

Location	Fixture Quantity in Building L (nos)				
	Washbasin with Tap	Closet	Tap	Urinal with Push cock	Hand Shower
1	3	4	4	0	1
2	1	1	1	0	0
3	1	1	2	0	0
4	1	1	1	0	1
5	3	4	9	4	0
6	2	1	1	4	0
7	1	1	7	1	1

Fig.5. Fixtures in various locations of the same supply tank

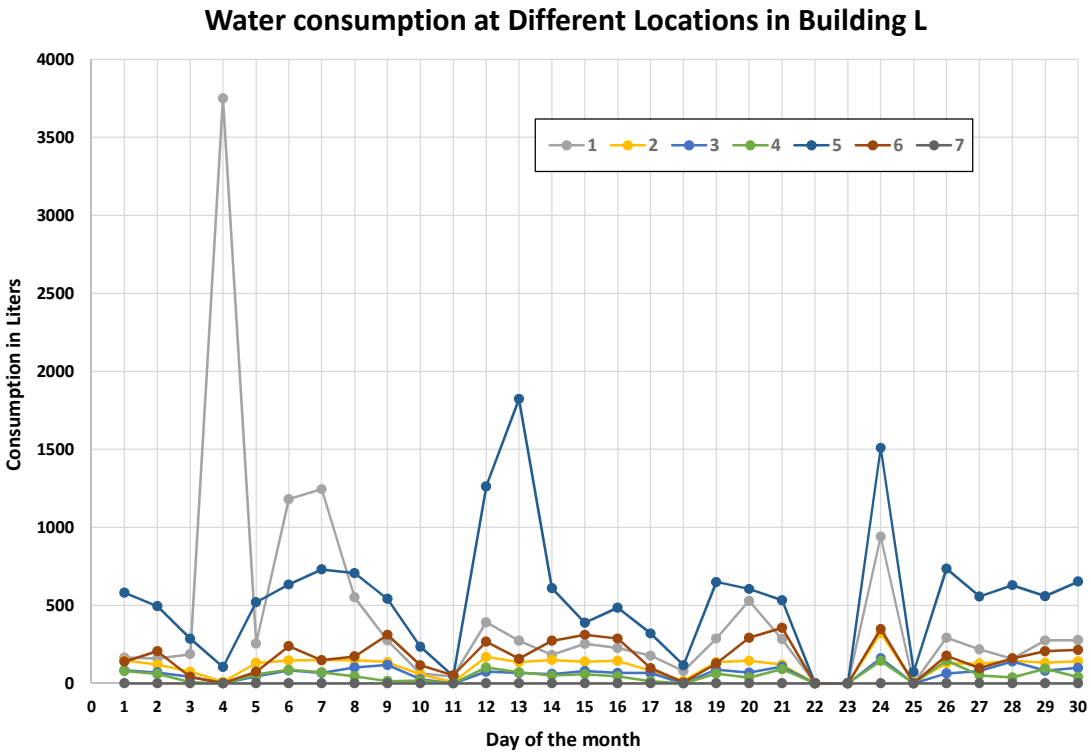

Fig.6. Day wise consumption pattern in the seven locations

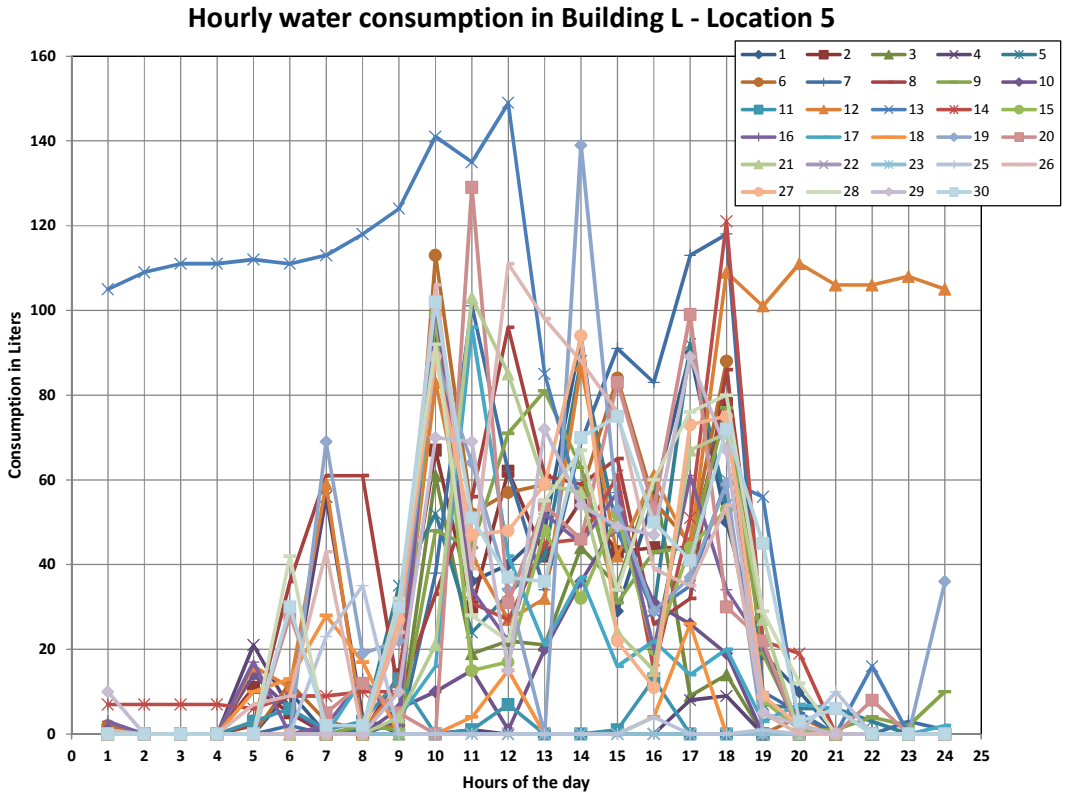

Fig.7. Daily hour-wise consumption pattern for one location