International Benchmarking for Water Infrastructure

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Abstract - **The population rise, increase in per capita consumption, industrialization and change in life style is impacting the water demand for Indian cities which is showing increasing trend every decade. The potable water sources are finite. The cities are looking for more water sources which are at longer distances to meet increasing water demand. A long term planning is required for the judicious use of natural resources and sustenance of infrastructure needs. The planning of infrastructure requires the use of available standards, guidelines and existing practices. The available standards for urban utilities include IS Codes, CPHEEO Manual, MoUD guidelines for Smart Cities. The Urban population has also exposure at international level thereby increasing their expectations for global standards and better service delivery.**

Some of the international cities having better and smart infrastructure at international level includes Singapore, Song Do, Barcelona, Yokohama, Canary Wharf etc. The available norms for these cities have been studied and compared with Indian guidelines. The better guidelines have been adopted while planning the green field development like Delhi Mumbai Industrial Corridor Development Corporation (DMICDC) Dadri project.

I. INTRODUCTION

India is experiencing an extraordinary development since last decade and Indian economy is one of the world's fastest growing. At this rapid urbanization age, meeting the desired infrastructure growth is a big task keeping the Sustainability aspects and Environmentally safe design in place. The aim of these infrastructure developments is to improve the citizen's life, including the balance between ecological, cultural, political, institutional, social and economic aspects without affecting the environment. The smart city definition also calls for sustainable solutions with wise management of resources. The Central Government formulated various funds like JNNURM, Amrut, Smart City initiatives, external funding from ADB, World Bank etc to support the infrastructure demand of urban areas.

The key infrastructure components considered for discussions includes water supply, sewerage storm water management and coverage of these services to citizens. The objective of this study is to review the existing practices on planning the water utilities along with MoUD Benchmarks for Smart cities and Best practices at International level.

Some of the international cities studied for best practices are described below.

Brief on Cities

Barcelona is the capital of Spain. It is the second most populous municipality of Spain. Barcelona has been a leading smart city in Europe. It has a population of 1.6 million within city limits. Its urban area includes many neighboring municipalities within the Province of Barcelona and has around 4.8 million people.

The estimated average level of NRW is 24% as per a survey carried out by the National Statistical Institute during 2007. Is includes real (physical) losses of 16% and apparent losses of 8% due to metering inaccuracies and other factors. Water rates are charged as consumption, i.e. the tariff per cubic meter increases as consumption increases.

Yokohama is Japan's prominent Port city. **It** is the second largest city in Japan after Tokyo. In terms of by population, it is the most populous municipality of Japan. It is a major commercial hub of the Greater Tokyo Area.

The economic base of the city includes shipping, biotechnology and semiconductor industries. The water consumption by the customers is very high, however NRW level is less than 10%.

Cannes is a host city of the annual Cannes Film Festival. In addition, Cannes hosts other major annual events such as the MIPIM, MIPTV, MIDEM, Cannes Lions, and the NRJ Music Awards. It is located on the French Riviera. The city is known for its association with the rich and famous, its luxury hotels and restaurants, and for several conferences.

The economy of the city is based on tourism, business fairs, trade and aviation. Cannes has about 6,500 companies. This includes traders, artisans and service providers. The water supply level is little more compared to Indian norms and NRW is also more compared to permissible norms as per CPHEEO Manual.

Singapore is an island city. The boundaries of the city have grown due to land reclamations projects. The land area has gone up from 581.5 km2 in the 1960s to 721.5 km2 in 2018.

Singapore has integrated water management approach. The reuse of reclaimed water is being dome for potable and non-potable use. The urban rainwater catchments are protected, and the use of estuaries as freshwater reservoirs have been introduced along with seawater desalination. This reduces

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Singapore's dependence on water being imported from neighboring Malaysia.

Singapore receives an average rainfall of 2,400mm annually which is well above the global average of 1,050mm. However, the land area of Singapore is small due to densely settled land. There are no natural aquifers and lakes. Therefore, Singapore relies on four water sources, called "the four taps":

a) Rainfall, collected in artificial reservoirs that collect water from carefully managed catchment areas.

b) Imported water from Malasia

c) Reclaimed Water (NEWater) from wastewater after treatment

d) Seawater Desalination

The NRW level is 5% for Singapore making it a Benchmark to be adopted.

SongDo is located about 56 km from the capital Seoul. Songdo district is the largest private real estate development. It is spread over 600 hectares (1,500 acres) of land reclaimed from the Yellow Sea off Incheon.

The pneumatic waste disposal system has been provided in Songdo. There are no garbage collection bins on street corners and no garbage trucks for transportation. The garbage is thrown into vertical pipes and then it is sucked with pressure underground up to disposal location and recycling is done for the suitable material.

Songdo IBD was designed as Smart City and known to be a "ubiquitous city". The water pipes are designed to minimize leakage & wastage and to prevent drinkable water from being wasted in showers and toilets. The planned Leakage level is 2% for this city.

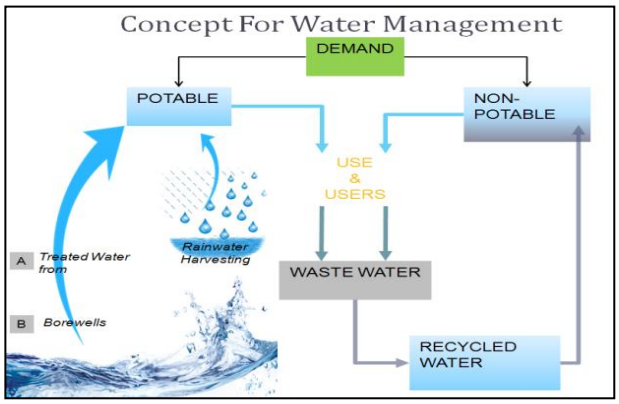
Canary Wharf is a commercial area in United Kingdom located in London. It is one of the main financial centers of the Country. It has many of Europe's tallest buildings. One Canada Square, the second tallest in the UK is located in Canary Wharf.

Water, Waste water and Storm Drainage Management

The scarcity of water is increasing due to limited availability of fresh water sources and increasing population. Also, waste water generated after use of water is causing pollution of existing streams. The flooding of urban areas has become common due to reduction in earth cover and increase in building footprints, roads and paved areas. The relationship between the three components leads to the Concept of Water Management.

All the three components (water, waste water and storm water) are inter-connected and need to handle together for overall water management for a sustainable development. The planning of these three components in an integrated manner is required.

The prevailing standards on various parameters like per capita water supply, leakage level, service level, coverage, recycle and reuse, quality standards, sustainable drainage system for the above international cities have been studied and compared with Indian norms. The service levels and area coverage is better in these international cities. The water supply rate is very high for a city of Yokohama whereas leakage rate is as low as 5% in Singapore. The reuse of waste water and rainwater has been adopted in all cities. The benchmarking for water system is given in attached Table -1.



II. Result

From the comparison with other international cities, it is visible that the water supply level is optimum in India considering the less water availability. However, system planning needs to have re-look with respect to better practices in other cities and bench marks. The reduction in water loss by active leakage control, better metering and automation need to be addressed at planning stage itself. Also reuse of waste water, rain water management has been adopted in all international cities to meet the water demand. The service level and coverage is better is all these international cities.

III. Conclusion

A broad review of various water infrastructure components for an urban development and its sustainability aspects are studied. The information on other well planned cities like Singapore, Sang do, Barcelona, Yokohama, Canary Wharf has been collected. The Indian Codes, MoUD guidelines on Smart Cities have been taken for comparison. The Best practices available at global level give future guidelines for water infrastructure planning leading to sustainable planning of cities and wise use of resources. These Best Practices are of paramount importance in view of large demand on infrastructure provisions, limited availability of natural resources and pressure to maintain Green, Clean environment leading to livable cities. The selection of Best practices will ensure long term system sustainability and better service delivery to consumers.

IV. References

Manual on Water Supply and Treatment : Central Public Health and Environmental Engineering Organization.

Design Report by Tata Consulting Engineers on Integrated Industrial Township, Greater Noida for Delhi Mumbai Industrial Corridor Development Corporation

TABLE 1
Best Practices / Benchmarks / Codes / Manuals / Cities

Water	CPHEEO Manual	MoUD Benchmarks	Singapore	Barcelona	Cannes	Song Do	Canary Wharf	Yokohama	Indian Cities (Status)
Per Capita Supply lpcd	135-150	135	153	165	DNA	DNA	DNA	314	Inadequate
Duration of Supply	24x7	24x7	24x7	24x7	24x7	24x7	24x7	24x7	Mostly intermittent
Active leakage control & NRW	15	15	5	24	19	2 (Target)	DNA	7.3	Very High NRW
Metering & Smart meters		100%	100%	100%	100%	100%	100%	100%	No or partly covered
Recycle & Reuse		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Limited
Water Quality	CPHEEO	CPHEEO	WHO/US EPA	European Std	European Std	WHO/US EPA	European Std	WHO/US EPA	CPHEEO

Sewerage and Storm Water	CPHEEO Manual	MoUD Benchmarks	Singapore	Barcelona	Cannes	Song Do	Canary Wharf	Yokohama	Indian Cities (Status)
100% coverage and connection of sewer	100%	100%	100%	100%	100%	100%	100%	100%	Inadequate
Wastewater Treatment meeting effluent standards as per European, US EPA/WHO a) Potable Quality	--	--	Yes	--	--	--	--	--	--
b) Non-Potable (Landscape, Irrigation, Flushing etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recycling of reclaimed water	Yes (20%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Limited
Sustainable Wastewater Treatment Plants (Using Renewable Energy e.g. Solar, wind, sludge digestion etc.)	Yes	Yes	--	Yes	--	Yes	--	Yes	40 Mld STP at Chennai
Sustainable Drainage System – Permeable Pavements, City Green, landscaping etc	WSUD	Yes	Yes	Yes	Yes	Yes	Yes	NA	Green areas under smart city initiatives Bangalore and Chennai
Ground Water Recharge	Yes	Yes	Yes	Yes			Yes	NA	Limited
Green Roofs			Yes	Yes		Yes	Yes	NA	Nil