

Re Thinking the Public Toilet of Dhaka City: An Adaptable Prototype Design Solution to Improve the Existing Situation

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ABSTRACT

Dhaka is one of the fastest-growing cities in the world with a population of 21 million. With the constantly rising inhabitants, this urbanizing hub officially only has 122 public toilets, and in reality, most of them are not functional (Sanyal, November 05, 2016). Different studies also suggested that current situations of the public toilets in the city are unusable and unhygienic. Apart from a few good ones, most toilets have filthy floors, inadequate lighting and ventilation, and unbearable odor of human waste. Although unhygienic open defecation by men is a common scene in the city, for the woman it is not an option. While the city plans to construct a few, there still will be a huge need for public toilets to meet the demand of the vast population. It is critical to realize the challenges existing and evolving from the forbidding public hygiene situation and the lack of proper public infrastructure. Understanding the user group is crucial as modern and costly toilets end up being rejected than being used. Thus the paper tries to address the problems and suggests design strategies to achieve a feasible design solution for a sustainable public toilet that supports and empowers communal hygiene. The contribution of this paper is not only to promote a design solution but how this infrastructure can integrate with the surrounding urban context. A modular prototype is proposed which is adaptable, feasible, cost-effective, easy to erect, and can be plugged into any corner of the city. Rethinking public toilets as an adaptable prototype is not only about providing proper sanitation but also encouraging people about hygiene education, awareness, and innovation. The design is conceptualized as a prefabricated self-sustainable modular unit that can be altered, increased, or decreased as per the necessity of the surrounding area.

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1. Introduction

Dhaka, the capital city of Bangladesh is one of the densely inhabited cities within the world with a population of twenty-one million (approx) individuals (Sakkhor, 2018). The city itself encompasses a density of 47,400 people per square kilometer and a minimum of 1,418 people is adding to the population of Dhaka city every day (Amin, October 14, 2018). With the expansion rate of over three percent, the population density is thus extremely high with 27,700 people living per square kilometer (Shafi, Imam, Opel & Islam, July 09, 2011). As blessed rapid urbanization, there are cursed consequences of poor quality and densely built housing, slum and squatter settlements and, non-existent or limited provision of basic public infrastructure for water, energy, sanitation, and hygiene (Mujeri & Mujeri, 2020; Roy & Sarker, 2006).

Almost half the population in urban areas have zero access to improved sanitation facilities resulting in

the creation of adverse impacts on their health, safety, dignity, and economic opportunities (WSUP, 2017). An estimate carried out in 2001 reveals that about one-third of the overall population of Dhaka city does not have access to any sanitation facilities which leads to open defecation either in roadside drains or other open places (Shafi, Imam, Opel & Islam, July 09, 2011; Hossain, Kabir, Shahjahan, Chowdhury & Arafat, 2017). On the other hand, two to three million people reside on the streets for their livelihoods (ICDDR, WaterAid Bangladesh, 2014) and about five and a half million people stay outdoor for other daily necessities for a mean of five to eight hours daily leaving little doubt that this huge population needs proper public toilet facilities to fulfill their demand (Shafi, Imam, Opel & Islam, July 09, 2011).

Dhaka officially has 122 public toilets which for its 20 million inhabitants is very insufficient, and in reality, even numerous of them are not functional

(Sanyal, November 05, 2016). As per a 2017 study by ActionAid Bangladesh, in alliance with UK Aid, over 90% of public toilets operated by the city corporations are unusable. Most of these were reported unsafe, 54% of these lacked sanitation facilities, and 91.5% were reported unhygienic and dirty (Shovon, May 16, 2019). According to the World Health Organisation, diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid, and polio are transmitted by miserable unhygienic sanitation (Shovon, May 16, 2019). Adding to the unavailability of proper sanitation facilities in public spaces, lack of safe water, sewage treatment, safe disposal of solid wastes continue to haunt Dhaka, for which the city is holding a picture of an unhygienic urban center, posing a public health risk for its millions of inhabitants (Ahamad, 2019).

The urban citizens like hawkers, rickshaw pullers, garment factory workers, shopkeepers, truckers, the individuals who cause the city work deserve to lead a decent life with proper access to public toilets. Toilets that lack running water or electricity are mostly squalid, foul-smelling, congested, and dark (Anam, 2015). People who haven't dwelled in Dhaka may not realize just how distressing it is for people especially for women when they need to use public toilets (Hridulaa, 2017). The insufficiency of public toilets affect both genders; But where some men can take to the streets, for women it is not even an option (Anam, 2015). Researchers have demonstrated that provision to public toilets constitutes the vital, missing link that enables the creation of sustainable, accessible, inclusive cities (Bichard, Hanson & Greed, 2003). Attaining a universal design approach, enhancing the quality of life for everyone and social inclusion are important issues characterizing contemporary cities (Afacan & Afacan, 2011; Sharp, Pollock & Paddison, 2005). Installation of public and mobile toilets will change this grim scenario undeniably, but without understanding the core problems and rationality of the use of public toilets and its' users; Modern and costly toilets are ending up being rejected rather than being used are leaving gaps in Bangladesh's health infrastructure as it is (Sanyal, November 05, 2016).

Architectural design in other countries today has greatly spotlighted the process, material, and solutions for prototypes to tackle these kinds of emergence issues. The analysis of the design domain in the context of ideas and technology is very important to understand (Akipek & Kozikoglu, 2007). It has become a key

research tool in interacting to design during the last twenty years (Koskinen & Frens, 2017). The building of prototypes is an important facet of the design and development process. Numerous studies have indicated that prototypes can be useful as they can help designers to create multiple ideas immediately, compare and select the most favorable concepts, test functionality, and allows different iterations (Yang, 2005; Deininger, Daly, Sienko, Lee & Kaufmann, 2019); This will provide the opportunity to achieve widespread design solution at an economical cost in the city that immediately needs suitable public infrastructure.

Therefore, the paper tries to achieve a self-sustaining public sanitation system through a modular prototype design strategy that can enhance the use of public toilets and promote public health awareness, environmental sustainability, and economic prosperity.

2. Methodology

For this research paper, a thorough study was conducted on the existing public toilets of Dhaka city. Several public toilets were selected from both the Dhaka South and North City Corporations based on the public demands and frequency of being used. The public toilets of the bus stop area, market places, parks, and other active urban places gained priority in the study. Data collections were done through reviewing different publications, studies, reports, and surveys on selected public toilets of Dhaka city. Throughout the survey, interviews and casual conversations were performed with users to know their experiences and perceptions.

From the reviews and survey, problems were identified that led to the poor sanitation situation of the existing public toilets. The needs, demands and the expectation of the users were also addressed. To have a better understanding of the scenario and to figure out the necessary strategies, related case studies of other countries were performed. Design strategies were formulated based on these issues that could eradicate the lack of hygiene problem and can evolve into proper public infrastructure meeting its demand.

Considering these, an archetype of public toilets is proposed to blur the gap in the existing situation and public demand and also to improve the urban sanitation system of Dhaka city. A modular prototype is designed to integrate the urban elements and context addressing sustainability which will support and empower communal hygiene.

3. Existing Condition of Public Toilets in Dhaka City

Although the two city corporations have built 53 public toilets, 28 in south and 25 in north Dhaka but the existing condition of most of the public toilets in Dhaka City is still unhygienic with dingy stalls, no facility to wash hands, let alone special arrangements for women and persons with disability (Ahmed, November 19, 2019). Thus the public toilets of the prominent areas

of Dhaka city was selected and surveyed. From both the physical and literature survey, we found the information regarding the condition of public toilets. The findings sorted out the physical conditions along with the pros and cons of the prevailing situation which are given in the table based on the surveyed information. The data collected can be seen in the following table which also helped to formulate design strategies in the later part of the paper.

Location	Agargaon	Badda	Banglamotor	Farmgate	Gawsia	Gulistan
Existing Condition	Civic lavatories Moderately maintained Separate gender toilet Varieties of toilet fixtures	Poorly Maintained Unusable Dirty and unhygienic	Newly Refurbished Well Maintained Clean lavatories Provision of showers, drinking water and lockers Universally accessible Satisfied Users	Civic lavatories Well maintained Separate gender toilet Shower booth Varieties of toilet fixtures Decent ventilation and lighting	Clean and hygienic Well maintained Modern fixtures and amenities Adequate security User-friendly environment especially for women	Very unhygienic & dirty Poorly maintained No security Not user friendly for the woman Lack of proper lighting and ventilation
Sources	(Author's survey)	(Shishir, November 19, 2019)	(Shishir, November 19, 2019; Shovon, May 16, 2019)	(Aka, November 28, 2019)	(Shovon, May 16, 2019; Habib, July 26, 2018) and (Author's survey)	(Aka, November 28, 2019)
Location	Hatirjheel	Kamlapur	Kathalagan	Mirpur	Moghbarar	
Existing Condition	Locked most of the time Used as store	Very filthy & unhygienic Inadequate lighting and ventilation Unbearable odor	Newly refurbished Clean Provision of showers, drinking water & lockers Universally accessible	Poorly maintained Broken fixtures No running water Not user friendly	Small huts like toilets Always locked	
Sources	(Shovon, May 16, 2019)	(Chandan, October 14, 2016)	(Shovon, May 16, 2019)	(Aka, November 28, 2019) and (Author's survey)	(Shishir, November 19, 2019)	
Location	Mohakhali	New Market	Savar (behind Bus Station)	Syedabad Bus Terminal	Tejgaon	Uttara
Existing Condition	Unhygienic and dirty No security and privacy No proper access No proper lighting and ventilation	Poorly maintained Fixtures mostly Unusable Dirty and unhygienic Not user friendly for the woman	Clean lavatories Shiny furniture and clean tiled floors Well maintained	Clean lavatories Shiny furniture and clean tiled floors Well maintained	Newly refurbished Clean lavatories Provision of showers, drinking water and lockers Universally accessible Users are satisfied	Well maintained Separate gender toilet Varieties of fixtures & amenities Hygienic Unpaved entrance
Sources	(Parvin, 2018; Shishir, November 19, 2019)	(Habib, July 26, 2018) and (Author's survey)	(Aka, November 28, 2019) and (Author's survey)	(Shovon, May 16, 2019)	(Aka, November 28, 2019)	(Aka, November 28, 2019)

4. Problems

Dhaka is straining under the pressure of its rapidly growing population and thus it confronted many problems like exponentially growing slums, poor quality housing, unreal traffic jams, nagging electrical blackouts, stifling air pollution along with inadequate clean water supply, and poor sanitation (Sapienza, Sawyer & Sawyer, 2010). Especially problems of poor sanitation worsened by the high population density and also the absence of a comprehensive policy on urbanization and urban poverty, and the lack of a well-equipped agency to implement such a policy (The World Bank, 2007).

The main concerns regarding public toilets are more broadly discussed as follows:

4.1. *The Unhygienic Conditions of Public Toilets*

The overall scenario is kind of tragic despite the fact of some newly renovated or built public toilets. Most toilets are unhygienic, unsafe, and lacked proper sanitation facilities (Shishir, November 19, 2019). Among the prevailing toilets, most are non-operational with dirty wet floors, inadequate lighting, and ventilation. Lack of proper security and particularly unbearable odor of human waste compels people to avoid public toilets and defecate outside (Chandan, October 14, 2016). Even the fully or partly operational public toilets are very filthy and don't possess separate facilities for women (Shafi, Imam, Opel & Islam, July 09, 2011). The lavatory units sometimes have broken or no doors and the absence of cleaning equipment such as soap, toilet paper, and poor maintenance have made the toilets repulsive to the users (Chandan, October 14, 2016). Basic facilities such as flush and running water in these toilets are almost nonexistent (Malik, November 19, 2018). On the other hand, the few toilets which are located within the markets and shopping malls, in reality, are also in deplorable shape and not user-friendly (United News of Bangladesh, 2019; Hossain, Kabir, Shahjahan, Chowdhury & Arafat, 2017).

4.2. *Accessibility*

Access to the public toilet within the walkable distance from any major hub of the city is deficient. Above 50% of the population lacks proper access to basic sanitation: that's around 85 million people (WaterAid Bangladesh, n.d.). The total number of existing public toilets is minimal considering the approximately two crore city population

(Shovon, May 16, 2019). Recently some public toilets were rather demolished as these were constructed blocking the footpath. Ensuring toilet provision is accessible and available to all is essential to ensure that people can move freely around the city (Ramster & Bichard, 2011).

4.3. *Lack of Social Norms*

Public health experts said that for the lack of hygiene practices and measures to maintain those, people living in Dhaka are frequently exposed to different waterborne diseases including cholera, diarrhea, dysentery, typhoid, and so on (Ahmad, 2019). Failing to gain access to any proper sanitation facilities most people especially men and kids defecate either in roadside drains, side of footpaths, or other open places (Shafi, Imam, Opel & Islam, July 09, 2011; Hasan, Basak & Rayhan, 2018). Many campaigns like painting up notices in Arabic in the street walls are launched that are appealing to people's piousness to prevent public urination (Shovon, May 16, 2019). It is rather important to educate people about sanitation and hygiene practices. Adequate and proper sanitation facilities along with knowledge and practices of hygiene can play a critical role in avoiding open defecation and the spread of transmittable diseases (Rahman, Ali, Parvez, Shahriar, Rahman & Shameem, 2019).

4.4. *Inappropriate Ratio*

Nearly one-third of the overall inhabitants living in Dhaka does not have any access to sanitation services (Shafi, Imam, Opel & Islam, July 09, 2011). While the number of public toilets itself is evidently low, the existing toilets also lack in providing an appropriate ratio for separate male and female toilets (Mahmud, 2017). A survey carried out by Bhumijo co-founder and Architect Farhana Rashid in Dhaka in 2016-2017 concluded that 80% of women before leaving the house to avoid drinking water worrying about not finding a decent toilet. It was also found that Dhaka will need at least 3,000 toilets to meet the population demand by 2020 (Farhin, November 19, 2017).

4.5. *Active and Inactive Public Toilets*

Due to lack of proper maintenance more often the ratio of the inactive toilet to active toilets increases where the public suffers the insufficiency to the number of public toilets. Existing toilets that are located in the

different markets are closed after the market period is over or some other public toilets are used as storage units (United News of Bangladesh, 2019). Thus the inactive toilets add up to the public demands in times of desperate needs. For this reason, even though quite a few public toilets are existing around the city, in terms of useability, the number is minimal.

4.6. Lack of Security

Lack of security is one of the foremost issues that users consider in determining whether to use a restroom or not. However, an assessment done by the Centre of Urban Studies shows that a good number of toilets don't seem to be very safe and secure, especially after dusk. Furthermore, the majority of these toilets do not have any safety services like lockers or rickshaw/bicycle stand. So in cases when a rickshaw puller or a street hawker wants to use a public toilet, there is no such provision where they can park their vehicles or keep their business items safe (Shafi, Imam, Opel & Islam, July 09, 2011).

4.7. Absence of Universal Accessibility

Most of the public toilets lack the provision of universal accessibility and are not user friendly to people with special needs; Even the newly built public toilets ignore the concern for physically challenged people (Chandan, October 14, 2016). The toilets are not wheelchair friendly; in fact, a ramp for easy access is not even considered. Thus, for a person with a disability, it is a challenge to move from their wheelchair to the toilet (Malik, November 19, 2018). There are, however, a few accessible public toilets in the capital established by WaterAid and H&M Foundation in association with Dhaka South City Corporations (DSCC) and Dhaka North City Corporations (DNCC) but there is an urgent need for more inclusive public toilets where all kind of people can access (Malik, November 19, 2018).

4.8. Environmental Pollution

Dhaka has been struggling with its poor infrastructure and unhygienic public health services for many years. The existence of filthy public toilets, poor sewerage and drainage systems, inadequate water supply, and the public's habit of open defecation are the leading reasons for the air and water pollution in the city. According to Water Aid, no more than 2% of city sludge is managed through sewerage systems as well as treated properly

whereas the rest of untreated excretion is polluting the environment severely (WaterAid Bangladesh, n.d.). Avoiding filthy toilets, the pedestrians, rickshaw pullers, day laborers, and other men have often been seen urinating in the open (Shishir, November 19, 2019). Not only this leads to unimaginable odor that adds up to air pollution but also a prime factor in the spreading of disease and contamination of the environment.

4.9. The Urgency of the Rational Project

The most common features of nearly all the public toilets in the city are unhygienic and unpleasant environments and sadly, the authorities in charge always ignored these concerns (Hossain, Kabir, Shahjahan, Chowdhury & Arafat, 2017). Installation of public toilets is imperative, however not understanding how different users use these public toilets, the modern and expensive toilet facilities could be excluded instead of being included in the usage, leaving the gap as it is (Sanyal, November 05, 2016). Thus understanding the rationality of this infrastructure is crucial to install and meet the demands of urban hygienic sanitation.

5. Public Toilets Demand

Although the government and many NGOs are taking initiatives to tackle the situation for now by setting up 200 toilets in different parts of the city. According to the project Manager of WaterAid Bangladesh ABM Mobasher Hossain, the opening of 26 new public toilets in the city, welcomed 50 lakh people users till now. So far more public toilets have been constructed at various places in the capital, including Gulshan-2, Gabtoli Bus Stand, Tejgaon Truck Stand, Farmgate Indira Road, Shyamoli Park, Mohakhali Wasa Water Pump, Osmani Udyan, Panthakunj Park, Mukhtangan Park, Bahadur Shah Park. Although there is a plan to set up 200 Public toilets more, 600 more toilets will still be in need to meet the demand of millions of walkers and floating people daily in the city (Ullah, March 11, 2018). Mayors of North Dhaka and South Dhaka have assured of building more modern and standard public toilets. Dhaka North City Corporation has taken a plan under which 53 modern public toilets will be built. It is also mentioned to develop the toilets at city corporation markets, CNG, and gas pump stations to make them more hygienic and user-friendly (Shovon, May 16, 2019).

6. Design Analysis

The study done so far concisely portrays a fairly obvious notion of the lack of hygienic, proper public infrastructure, and its high demand. Where many initiatives are being taken to diminish the gap, except a few, most of the projects turned out as discarded developments due to the lack of understanding of the rationality of proper design of public toilets, hygiene maintenance, and its promotion. It is crucial to realize and determine the objectives by developing appropriate design strategies and techniques for a sustainable public toilet that supports and empowers communal hygiene. Thus the paper tried to address the problems, possibilities, and opportunities illustrated in figure 1 and figure out the tangible goals and objectives needed to translate a proper design solution for a public toilet. These design objectives are presented as follows: To address the design problems and figure out the possibilities that it can offer to plan a proper public toilet.

- To propose an archetype for the public toilet that can reduce the demand gap in Bangladesh’s health infrastructure.
- To design a modular prototype, that can be easily assembled, alternated, and expanded according to the need of the public demand in the particular area.
- Suggesting the prototype to be more integrated into the urban elements and context, a model acting as an essential urban annex.
- To incorporate modular canopy units for both ecological, environmental, community involvement purposes. Again, these units can also be assembled, alternated, and expanded, or placed according to contextual need.
- To use cost-effective local material to have a tradition imprinted solution to make it more convivial to all groups of people.
- Considering social inclusivity by determining the needs, demands, and expectations of diverse people and shaping toilet and communal function accordingly.
- Providing a system for ample lighting and ventilation to create a more feasible functioning modular prototype.
- To devise strategies to achieve a self-sustainable project.



Figure 1: Problems, Possibilities, and Opportunities.

7. Design Proposal

For this purpose, this article tried to look into how architecture can create change in users’ behavior and achieve health hygiene promotion by proposing a design that is adaptable, feasible, and cost-effective. The proposal involves a prototype with simple construction techniques that can be assembled, plugged in, and modified concerning the site. The concept for the prototype also encompasses the idea of imitating the urban pathways and alleys, it incorporates urban canopy and integrates traditional material with the modern one (Figure 2). The proposal is further summarized in detail in the following sections for a better understanding of the design and its new idea that would both meet user needs and urban demand.

7.1. Location

The public toilets are suggested to be located in such public places where the rate of activities is more. Public toilets should be placed where it is needed, more visible to the public eye, and easily accessible. It can be located by the footpath of a busy road or alongside the bus stoppage, marketplaces, or in proximity to any other public function where people travel frequently and the or gets crowded for most of the day.

7.2. Identifiable

Taking into account practical considerations such as security and hygiene the aim was to create a prototype structure with a sculptural form that can be easily identifiable. A module is adopted which can be easily

detectable as the public toilet infrastructure around the city and can be planned and assembled easily according to public need and site location. This could be something iconic, highly visible, and familiar built form, that integrates modern amenity well into the visual context.

7.3. Form Evolution and Plan

Toilets are proposed as permeable pavilions derived from traditional slanted roof forms as can be seen in the initial stage of form derivation in Figure 3. The two separate male and female toilets are designed to be practical. In figure 3 the structure can be seen divided into separated forms to create an interactive

community space within connecting the spatial surrounding or pathway and the detailed plan of the built form can be seen in Figure 4. Each divided mass has its separate entry is split into units of wash area, toilets area, and its maintenance section. The units are positioned apart to provide natural lighting and ventilation, and space as per minimum toilet standards. These units can be added or removed as per the requirement of a particular site. To ensure privacy the slit openings are obscured by the perforated sheets, whereas the entrance is hidden from the busy street or surrounded by perforated green planes. The interactive pocket space is favored in the design shaded with the canopy.

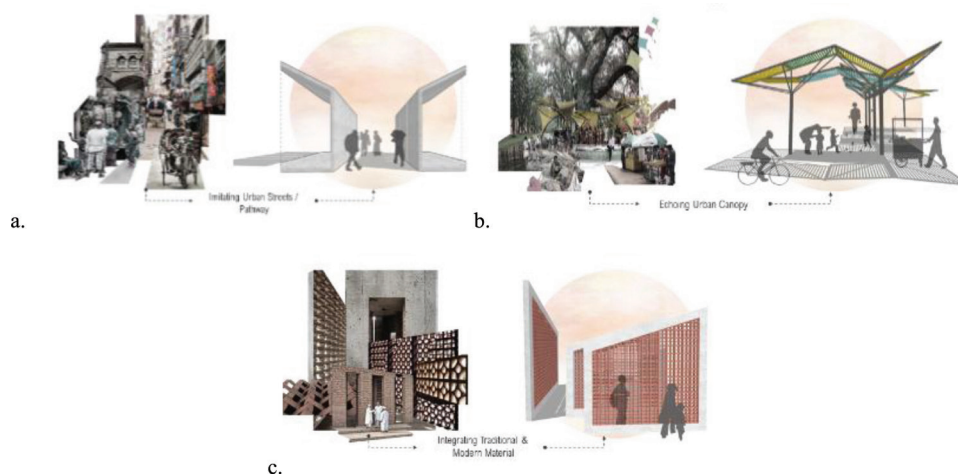


Figure 2: (a) Conceptual Elements Ideograph: Imitation of Urban Pathways (b) Echoing of Urban Canopy and (c) Integration of Traditional and Modern Material.

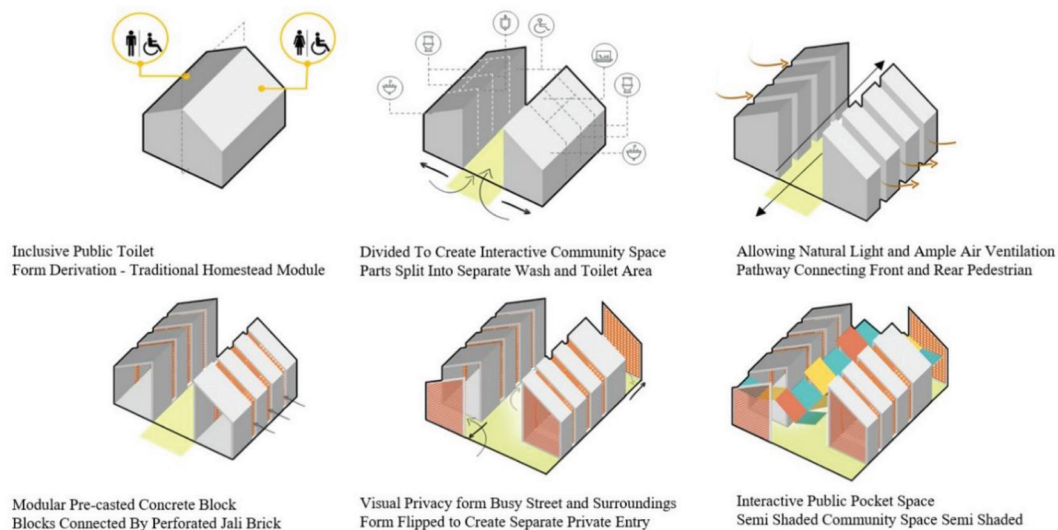


Figure 3: Form Evolution.

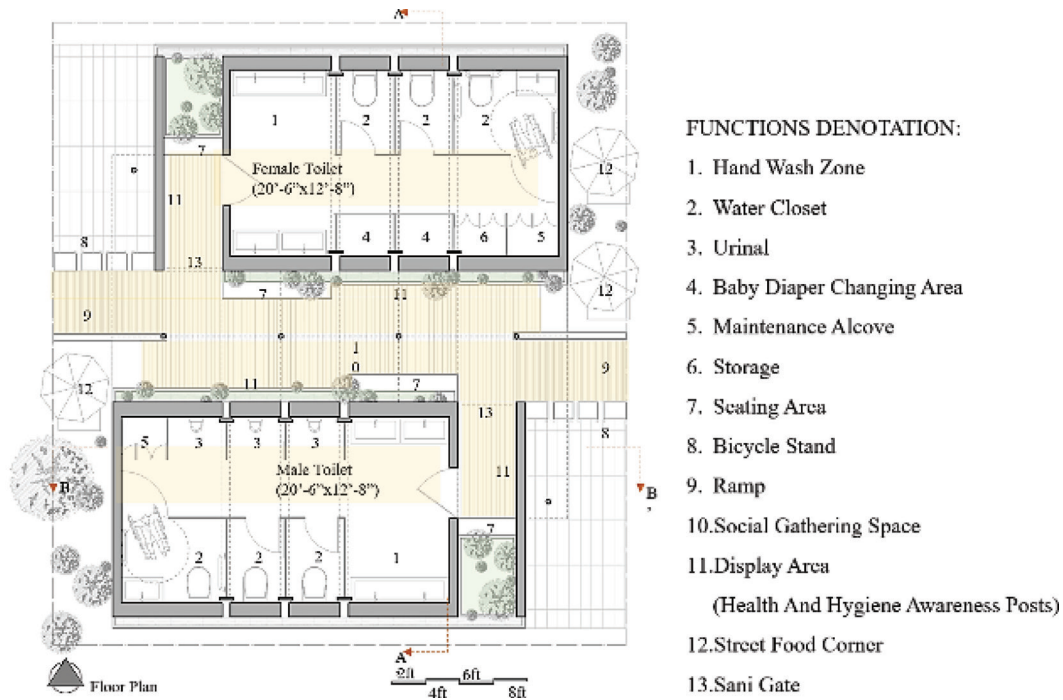


Figure 4: Floor Plan of the Proposed Public Toilet Prototype.

7.4. Accessibility

Universal accessibility, ease of access from the public street, and entrance with privacy are attempted within the design. The ramp runs adjacent to the stairs. Clean circulation with a standard accessible toilet for differently-abled people is designed for ease of movement which is color-coded in Figure 4. Separate male and female toilet entrances are hidden against the free-standing perforated green wall also ensure no visual connection from the street or community space within.

7.5. Spatial Relationship

Each modular prototype can be arranged as such there is a subtle gradation between interior and exterior functions. The extremely simple program with the adjoining shaded public space welcomes the vibrancy and variability uses of life and the surroundings. The entrances also have the provision of designed vertical steel for parking of users' bike or rickshaw, which will ensure the structure usage by the city's working community as well.

7.6. Modular Strategy

The module size is derived from the standard size of each toilet cubicle and wash area and is multiplied

to evolve into the form depicted in Figure 5(a). Each module consists of a prefabricated concrete envelope. The gap between each module is intentionally provided and furnished with a running perforated screen that allows for light and ventilation but not letting any passer-by peek inside. The modular unit not only can be added with the needs but this prototype can be arranged in different configurations and Figure 5(b) portrays the possibilities of few such options, which can be installed, in variations, throughout the city according to site-specific needs. The adjoining public facility will follow the structure to expand into its own space which can be open or shaded.

7.7. Internal Layout

The internal layout of the toilet is designed as an individual gender-based toilet each with clean circulation and separate wash area, toilet area, and maintenance section. The zones are divided as such, the wash area is at the anterior part of the mass, and the toilet area lies next adjacent to the straight circulation with maintenance at the corner end of one side. The female toilet comprises water closet cubicles, washbasins, maintenance alcoves, diaper changing area for the baby as can be observed in Figure 6(a) and the male toilet comprises water closet cubicles, multiple

urinals, washbasins, maintenance alcoves as per Figure 6(b). Other facilities such as soap dispensers, paper towel dispensers, hand-dryer, sanitary napkin dispensers, hand sanitizers, and universal disposal bins are also being provided. To ensure universal accessibility, both female and male areas have barrier-free cubicles

designed with proper fixtures like handrails, special water closets, and washbasin. To maintain the proper ergonomics for kids, low height basins are provided in both female and male toilets. Evac vacuum toilets are promoted in design to ensure less water consumption because it uses much less water than gravity toilets.

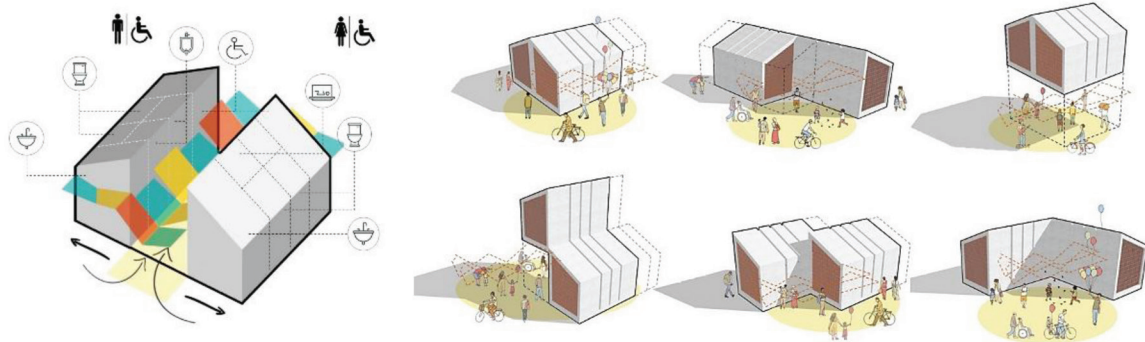


Figure 5: (a) Modular Units (b) Alternative Modular Block Arrangement



Figure 6: (a) Internal Layout of Male Toilet (b) Internal Layout of Female Toilet.

7.8. Economical Viability

These modern public toilets are sustainably designed with durable local materials that have a low environmental impact, need lower maintenance which is cost-effective in the long run. The simplified construction process not only reduces the time but also reduces cost. The on-site rainwater harvesting system and the options chosen for fixtures reduce water consumption and energy use and also contributes to lower utility cost. The provision of natural lighting and ventilation also reduces the electric cost. There is also the provision of a digital interactive display system which could be rented to different NGO's and Health Organization to promote hygiene education along with the rent money that can be used for security and maintenance costs.

7.9. Hygiene Education

Many initiatives are considered in the design to promote hygiene education. Amidst public gathering space, interactive displays are designed adjacent to the wall. There is also provision for different exhibitions based on hygiene education which can make the passer-by and the toilet users aware of the health and hygiene system portrayed in Figure 7(b). Interior display boards designed can convey many awareness messages. Design solutions such as Sani Gates are also provided here considering the current health hazards which can be observed in Figure 7(a). The universal disposal bins with pictures can also make people aware of the waste management system can be seen in Figure 7(c) along with the interior of the female toilet with the provision of hand sanitizer dispense and hygiene visual posts.



Figure 7: (a) Entrance to the toilet with Sani Gate (b) Adjacent Community Space and Display Area (c) Interior Perspective view

7.10. Materials

These public toilets are designed to be practical and modest with local materials and easy construction techniques which will bring efficiency in the process of erection and replication. Precast concrete is used in the design of modular shell structure. Precast concrete work requires negligible earthwork, and is preferred as it can be manufactured off-site and assembled quickly, provide superior resistance to rain, fires, natural disasters, wind damage, earthquakes, decay, and insects and mold (WELLS, 2020). Figure 8 is the exploded axonometric of the form which illustrates different materials used in making this structure. Jali Brick is being used in the exterior openings, slits, and freestanding walls which not only act as semi-permeable lighting and ventilation screens with green pots filling specific positions and heights to ensure privacy. Glass is used in the slanted-roof slits and mechanized pre-fabricated louvered panels are being used in the vertical slits. The canopy in the public space is designed with colored jute fiber panels of specific sizes and branched metal posts.

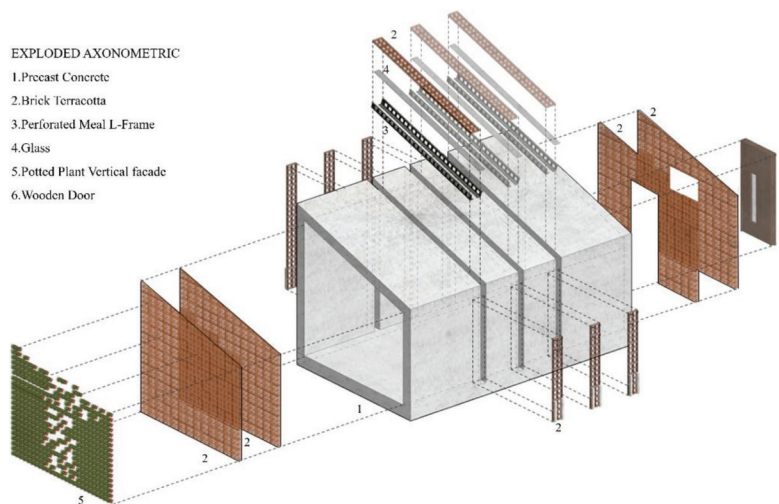


Figure 8: Exploded Axonometric showing Elements of Prototype and Materials.

7.11. Lighting and Ventilation

The toilet module is permeable, encouraging natural light and air to infiltrate the interiors. As rendered in Figure 9(a) the section shows the segmented building form that allows the utmost daylight. The daylight and

air can penetrate and flow through the form's slits and jali brick screen to keep the interior lighted and dry. Natural ventilation can provide an odor-free space and gives a good air circulated system. The design also proposes a motion sensor terracotta brick mechanized with kinetic wings which can be seen in Figure 9(b).

This is designed to improve natural ventilation and privacy responding to the user's motion and allowing

natural air movement throughout the interior space when not being occupied by the user.

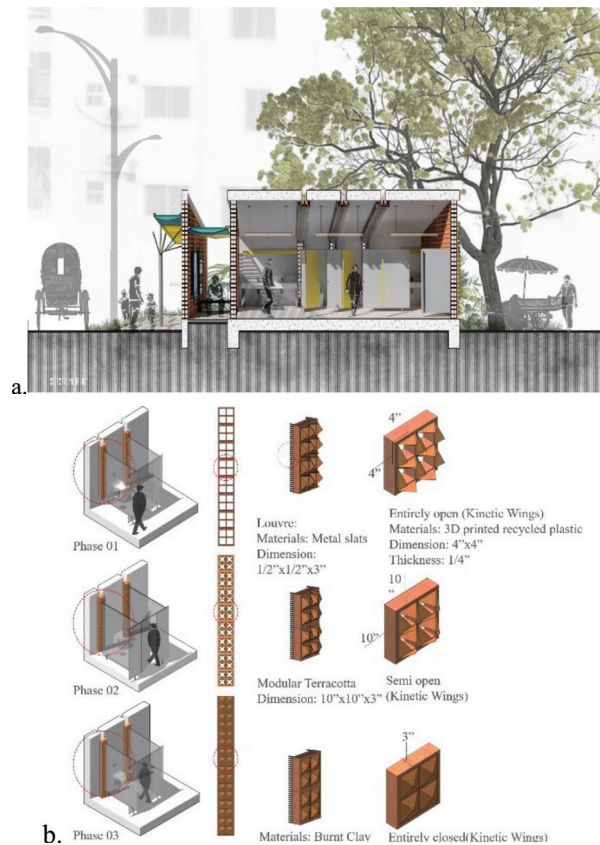


Figure 9: (a) Section of the Toilet (b) Mechanism of Motion Sensor Kinetic Wing

7.12. Rain Water Harvest

Rainwater harvesting is the most traditional and sustainable method, which could reduce the pressure on processed supply water. Figure 10(a) and 10(b) show the details adopted in the design to harvest rainwater. The prefabricated concrete shell's sloped roof and the internal groove within the vertical wall

can catch rainwater and store it in the underground storage tank. The spatial public spaces can be covered with the proposed canopy design of plastic sheets and metal slats which during rain can catch water and pass it through the channel running inside the metal post to the storage tank. The harvested water can be used to water plants, clean toilets, and water closet flush.

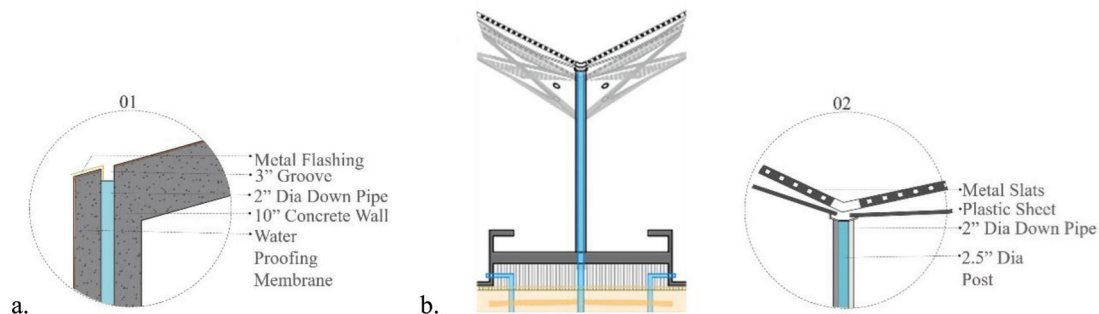


Figure 10: (a) Details of the Sloped Roof (b) Canopy Structure Details

7.13. Self Sustainability

The design proposed also pursues to be eco-friendly, innovative, and self-contained and the process is presented in the section in Figure 11. The prototype comprises locally sourced and sustainable materials. Not only there is a provision for catching and storing

rainwater but also the water used in the toilet can be treated on the site. The treated water can be reused in flushing, cleaning, and watering green areas. The toilets are equipped with EVAC Vacuum water closets which save water by using less water in each flush than gravity toilets.

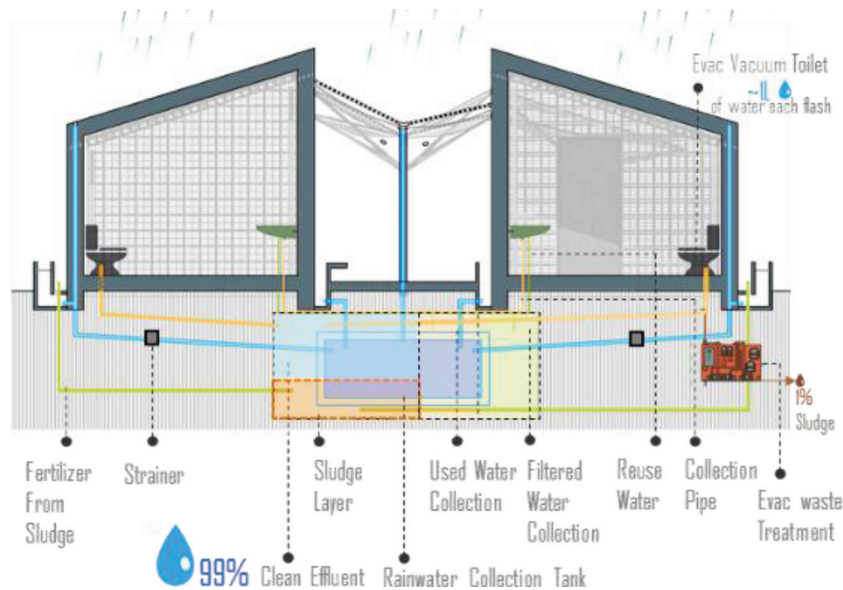


Figure 11: Section showing Sustainable Mechanism.

Conclusion

“Public Toilet”-an area that has long been neglected in urban design, in fact, has a lot of opportunities to generate a good communal public infrastructure. A user-friendly and logical working infrastructure is always a viable addition to the urban development of the rapidly growing Dhaka city. Properly designed and well-maintained public toilets are one of the major demands of the people of Dhaka. This paper tried to propose a design solution that addresses the important issues related to the public toilet. The proposed form which is a modular system is not aggressive to the context. It is designed to incorporate traditional and modern material and technology. This prototype does not impose itself or predominate the surrounding vicinity rather it is trying to create a constant dialogue with the surroundings and the people. The proposed self-sustaining prototype toilet targets to increase its use, provide a satisfactory impression to both genders, and promote health awareness. Implementation of this solution can reduce design and construction costs. This study aims to support the improvement process

of the overall situation and assist the Government to take necessary policies for a better public toilet infrastructure system.

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