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Renovation of restroom: A challenging task

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Abstract
Emerging technologies are being frequently used in new work under the pretext of addressing the everlasting needs of human-sensitized environments. New works have laid down manual provisions, and guidelines whereas renovation works are lacking it. Renovation is a challenging task as it involves many constraints. At the same time, it is important also as it maximizes functional utility and extends the life span of the structure. First activity under renovation is mostly renovation of restroom. Toilets are part of the restroom. Sunken slabs of toilets are vulnerable areas from where leakage or dampness may happen first and call for renovation/ repair activity. Such activity is often disruptive to the occupants and causes significant disruption to daily activity. This study aimed to investigate current practices of the renovation of restrooms with a particular focus on accessibility to disabled persons, energy efficiency, and safety of public buildings. The case study was conducted and data collected through interviews and site visits. Direct observation of the renovation of the restroom project was also undertaken to acquire firsthand knowledge and to explore possible solutions associated with current practices. In a renovation of restroom projects, it is essential to provide a practical rationale for accessibility to disabled persons, energy efficiency, and structural safety of the building. This study will be very useful to those who are planning to renovate the restroom. The results presented in this study provide sufficient evidence and useful understanding to industry practitioners to focus on factors like coordination, accessibility to disabled person, energy efficiency, and safety of public buildings while planning and carrying out the work of the renovation of the restroom.

Keywords: Construction planning, disabled person, restroom, renovation

Introduction
Since 1986 India has spent over $3billion on the construction of toilets across the country and further gearing up to spend an additional $31 billion (Rs1.9 lakh crore) over the next five years through the Swachh Bharat mission (Hindu, 2016). This has generated the demand to renovate existing toilets also otherwise it used to be a neglected area in public buildings. It may be due to less budget allocated for renovation activity and less interest of the officers involved as lucrative opportunities for corruption are not available in maintenance /renovation work (Mauro, 1998) [6].
Studies are reported on repair and rehabilitation of Heritage building (Subramanian, 2016; Othman, 2015) [9, 8], design process problem in renovation project (Mitropoulos, P. and Howell, G.A., 2002) [5] but specific problems of the restroom which is an important part of the building have not been discussed. On the other hand, 58% of people in residential buildings have experienced pipeline leakage or blockage problems, and more than 15% of people have had drainage pipeline blockage or water leakage problems more than four times (Cheng *et al*., 2020) [2]. The reason maybe it occupies a small portion of the total built-up area. Toilet represents 5-10% of built-up area of building (Nadim. W. *et al*., 2010) [7]. Renovation of restroom could enhance the life span of structure. It plays an important role in maximizing the functional utility of the structure. Renovation of the existing toilets are being carried out on account of the following needs-

a) Deterioration due to leakage and seepage
b) Up-gradation of fixtures and facilities
c) Accessibility to disable person

Toilets are part of the restroom area. Restroom renovations are most common and generally the first up-gradation/renovation activity that institutional and commercial facilities undertake. These upgrades should be designed to the latest specifications keeping the accessibility, energy efficiency, and safety of the structure in mind.

Formulating plans for such work requires managers to determine the specific benefits of renovations, understand common trouble spots encountered in planning and carrying out upgrades, and taking steps to maximize the benefits and avoid the problems. If renovation is due to leakage or seepage, the root of the problem must be addressed in the planning stage. Leaking or seepage is defined as the process by which a liquid leak through a porous substance (Wiktionary, 2012) [11]. Concrete is a porous material and even minor crack in the concrete can cause water leaking due to the capillary action of water. Water leaking is a common occurrence in toilets and other wet areas which are always in direct contact with water. Such problems always pose a challenge during maintenance. Research by (Chew *et al*., 2004) [1] indicates three common types of water leakage defects in toilets. They are leakage through cracks, leakage through pipe penetration, and leakage through joints. Water leakages sometimes lead to corrosion of steel concrete reinforcement which may affect the integrity of the structure.

During renovation automatic fixtures like sensor-operated flushers, touch-free automatic hand dryers, etc are also being included. Renovation work is also supposed to include energy efficiency measures like Light-emitting diode (LED) fixtures to save upon electricity.

Today accessibility for all is recognized as a basic necessity, and there are attempts all over the world to ensure this. Wiseman (2019) [12] has explored the complex relationship between citizenship, bodies and toileting through the experiences of disabled person. Barrier-free features are now becoming fundamental to all design concepts. Provisions to make toilets accessible to disabled persons are to be incorporated. Detailed guidelines are available in (NBC) National Building Code and renovation authority is supposed to incorporate it. NBC is a rational instrument for regulatory building construction activities across India. It is published by the Bureau of Indian Standards (BIS) which is under the Department of Consumer Affairs, Ministry of Consumer Affairs, Foods & Public Distribution. NBC was first published in 1970 and then revised in 1983, 2005, and finally in 2016 (Third revision). This has two volumes and 12 parts. It is worthwhile to note that the Person with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act 1995 in its chapter VIII Non-Discrimination, section 44 to 46 mandates accessibility in public building and transportation systems. National policy for persons with disabilities also emphasizes the role of barrier free environment as one that enables people with disabilities to move about safely and freely and use the facilities within the built environment. India has also signed and ratified the UN convention on the right of persons with Disabilities that puts an obligation on the member states in its Article 9 'Accessibility' to the person with disabilities to live independently and participate fully in all aspects of life. Along with a recommendation on lift, ramps, footpath, pathways, other amenities, it recommends the provision of at least one accessible toilet near accessible parking. All doors, windows & fixtures including water closet (WC), urinals, washbasin, mirror, and all other accessories for use by persons with disabilities shall be so installed/ located that they have proper access with appropriate width, height, space, centrelines, and ease of operation.

NBC para-B.5.2.3 also requires that the manoeuvring zone required for a wheelchair to make $90°$ turn shall be designed so that it shall have no gradient and it shall not be less than 1500 mm wide & 1500 mm long in the direction of travel. CPWD (Central Public Works Department) had published guidelines and space standards for barrier-free built environment for disabled and elderly persons in 1998 and now has published a CPWD manual on the accessible built environment in July 2019 (https://cpwd.gov.in/Publication). In this manual under Chapter 7, toilet, shower and change room, fixture, and accessories related specification of barrier-free accessibility has been covered.

The general framework for restroom renovation has been explained in figure1 below-

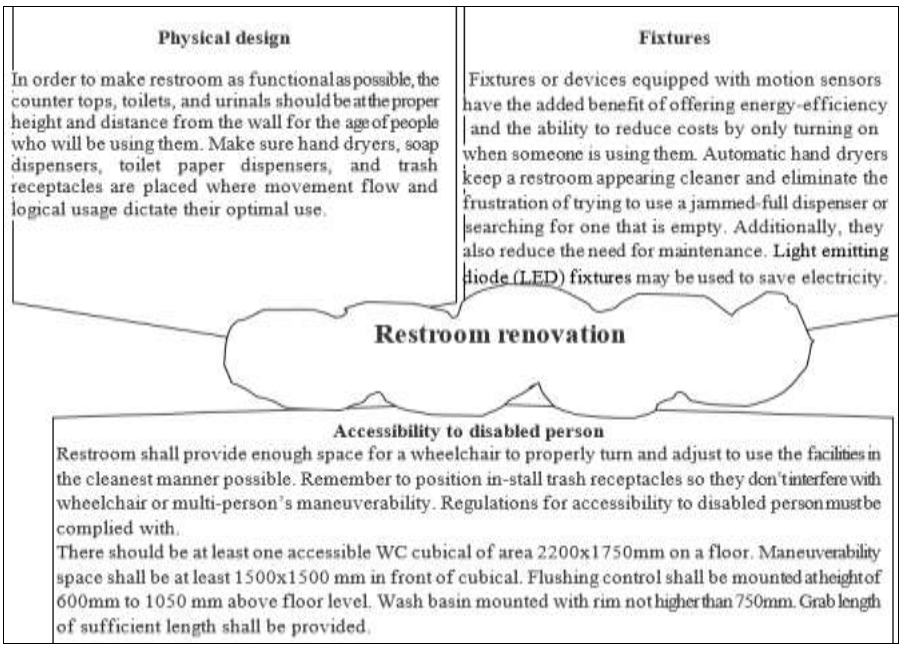

Fig 1: Toilet Renovation Framework

Detailing of fixtures as per CPWD manual on accessible audit environment is shown in figure 2, below-

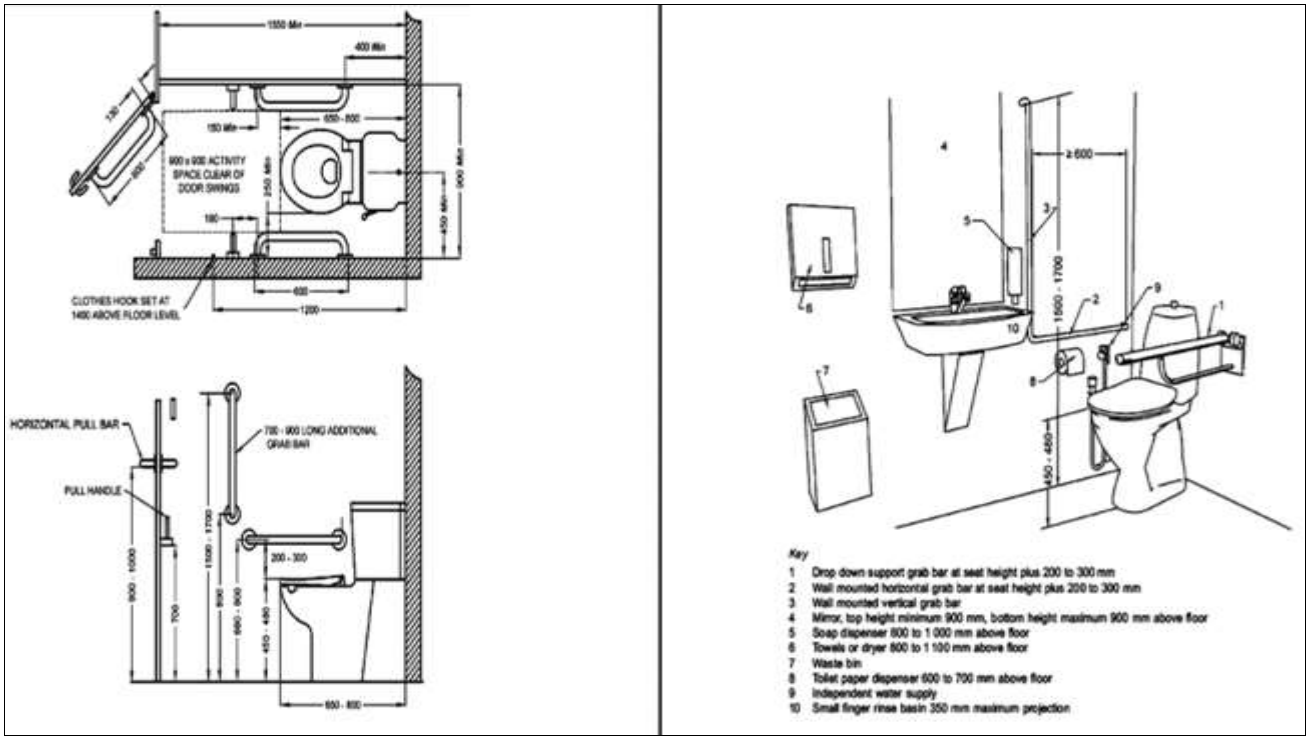

Fig 2: Placement of fixture, grab bars, water supply and other accessories in toilet for disabled (Source: CPWD Manual on accessible built environment 2019)

Construction methods

Two methods of construction are used for restroom particularly toilets. Toilets area is constructed either by in-situ method or prefab construction. In-situ construction is conventional method and construction using raw material is done at the site. It is labour intensive and cost-effective as raw materials are cheap, the design is flexible and adaptable during construction at the site. Prefab construction is an off-site method and fabrication of components are done in a factory as per pre-defined dimensions and assembly is done at the site. This makes the construction process fast as the construction of toilets done concurrently with the work on the site. For individual toilet, it will be a costly proposition but with mass production of factory-made product, the cost saving can be achieved. Cost in-situ method has been used in most of the buildings requiring renovation.

Renovation Benefits

Among the many benefits of the renovation of the restroom are improved sanitation, greater comfort, and easier access for all, and lower operating costs.

A fresh, attractive restroom provides a more comfortable environment for the user and eases concerns that accompany using unsanitary or stale-smelling facilities. It also reflects well on the building owner and manager, as well as the organization in general.

Many people take for granted the fact that restroom facilities are available and accessible in all modern buildings. This was not always true for those with disabilities, especially in older buildings not subject to post-accessibility rules. As organizations upgrade older buildings, ease of access is becoming more accepted and even expected. Accessible restrooms generally are more attractive and comfortable for all users. Many organizations even go beyond the letter of the law as owners and managers benefit from the resulting positive public relations.

Besides improving sanitation and minimizing odours, restroom renovations also can help control costs. For example, they can reduce water use, due to better-controlled flow times and volumes or the installation of waterless fixtures. Cleaner restrooms can lower costs by improving user health.

Methodology

The main intention of this paper is to review the current renovation practice and create awareness about the critical areas needing attention. In this investigation process, an exploratory case study approach was used as the main research strategy (Yin, 2014) [14], One restroom renovation project taken up on large scale was selected that had ongoing construction projects that included renovation and redesigning of an existing restroom. The case study of this project enables a detailed review of current renovation approaches, with particular attention to the safety of building, energy efficiency and accessibility to a disabled person.

Data were collected through a series of meetings, phone calls and face to face interviews. Interview data were used to collect the necessary information to describe the workflow of different parties in the restroom renovation. Project engineer and owner of the project were interviewed. Method of data collection is summarized in Table I.

To select the case study, the following criteria were used: -

- Current renovation project
- Interest in accessibility compliant and energy efficiency measures
- Availability of data
- Rapport with the key participant involved in the renovation.

Table 1: Method of data collection and significance.

Method	Significance
Visit & meeting	Learned about renovation scope
	Identified stakeholders and principal contact
	Recognized the ongoing renovation projects
Face to Face interview	Provided answers to the open-ended question
	Identified the main criteria of renovation
	Recognized main challenges
	Approach of the team to identify, prioritize and manage problems
	Highlighted major sources of safety risks
	Distinguished unforeseen circumstances
	Recognized characteristics of accessibility
	Identified guidelines/standards related to renovation
	Identified potential hazardous situations and precaution methods during renovation
Phone interview	Conducted follow up question
	Collected the required data whenever face to face interview was difficult to arrange, inconvenient or unnecessary
	Obtained information or specific issues
Focus group	Shared ideas
	Learned different approaches
	Learned the opinion of team related to the research outcome

The findings of the case study presented using two main methods: A thick description narrative of the case studies and cross-case analysis. Thick description can be used to interpret findings. Cross-case analysis can be used to discover underlying themes (Donaldson and Mohr, 2001) [3]. Broadly following data were collected from the case study to discuss the issues involved for better understanding-

1. General information, contract type, and project specification
2. Technical details such as plans and objectives
3. Up-gradation of fixtures and facilities
4. Accessibility to the disabled person

Case Study

This case study was selected to demonstrate the current methods in toilet renovation as the common approach in the local construction industry. This case study pertains to the renovation of all the restroom in a 10-story building having 4631 square meter area. The scope of work covers the renovation of 10 toilets and 18 restroom areas. The sunken floors were refilled after waterproofing treatment. The area was finished with granite stone and ceramic glazed tiles. An electrically operated sensor fitted washbasin and toilets were provided.

Analysis & discussion

Surrounding areas

In this particular building, the corridors & surrounding area was covered with false ceiling and restroom was only dismantled and waterproof treatment was carried out inside the sunken slab. After thorough treatment, the sunken floor was filled and fixtures were fixed. But seepage which has percolated and caused rusting to the reinforcement was not checked by removing the false ceiling below the slab. On the complaint of peeling of the ceiling plaster, the false ceiling was removed and it was observed that bottom side of the sunken slab, which was covered by the false ceiling, was rusted as shown in Figure 3 below. It is advisable that whenever renovation of an existing restroom is carried out the bottom side of the sunken slab shall be checked by removing the false ceiling and structural strength of the nearby beams and columns be assessed.

Fig 3: Sunken slab with false ceiling and without false ceiling

W.P. Treatment

This was done by a specialized agency with proper guarantee bond. The involvement of specialized agency which is expert in the area has been good practice and client has also appreciated the work. The sense of responsibility among the workers was also of high degree as they were to provide a guarantee bond of 10 years duration for any kind of leakage, seepage and dampness.

Coordination

In a running office building, the renovation of a restroom is a big challenge. Coordination among speciality contractors and with the owner/users was very important. The coordination issues which were handled in this project are discussed in the following table 2.

Table 2: Coordination Issues

Renovation induced problem	Source	Action
Coordination related to renovation activities	Demolition	Cordon off the area and put relevant information on notice board to provide real-time information
	Inadequate planning	Plan everything before the start of work
	Insufficient communication	Update about activities in advance
	Duration of activity	Update in advance and coordinate with the construction company in advance and provide real-time information.
Delay or change of sequence	Lack of information	Inform the concerned group in advance

Accessibility

Suitable signs must be placed at prominent and required positions inside and outside a building to indicate the exact locations of facilities that are available for use by persons with a disability. But it is observed that such effective signage system, is not included in the estimate of renovation work. Though the provision of minimum distances for a toilet, washbasin grab rails and urinals were made but a provision of the emergency call bell was missing. An emergency call bell shall be equipped with a weatherproof push-button for activating the alarm. The push-button shall be installed below the vertical grab rail inside the WC cubicle adjacent to the water closet at a height between 600mm to 650mm above the finished floor level. A notice "Emergency Call" in English, Hindi and Braille shall be fitted next to the emergency pushbutton.

Fixtures and Lighting

An electrically operated sensor fitted washbasin and toilets were provided. There was a shift from fluorescent lamps to light-emitting diode (LED) fixtures through the installation of new lighting technology. This reduced the amount of electricity and cost related to energy corruption.

Summary and Conclusions

This case study exploratory reviewed the case of renovation of restroom carried out is a ten-story building. The case was selected to enable a detailed review of renovation project from the safety of building, energy efficiency measures and accessibility. It explored various dimensions of renovation and conclusion related to the study are articulated as follows

- It was evident that renovation activity had a direct impact on the safety of a building.
- Coordination is recognized as the main issue during the renovation process.
- Coordination and early warning /notification of activities will help and found necessary
- Because the procurement method adopted for the renovation project was design–bid-build, the input from end-users was not collated and work was taken up immediately after sanction of the project.
- The inclusion of proper signage system should be considered from the beginning and the needs of different types of users in a building and the complexity of the building layout must be considered.
- The provision of emergency call bell shall be stipulated in the renovation work.
- There is a need to interpret safety of structure in any renovation project. Developing an integrated framework will be beneficial if incorporated within the life cycle of a renovation project. It is essential to assure that structure audit of all structural element surrounding the restroom areas be carried out and if needed be included in the planning of renovation project.
- This study has enhanced understanding of current issues relating to the renovation of restrooms particularly toilets in a general building from a qualitative point of view. Synergistic approaches to structural safety and energy efficiency are beneficial in such works.
- There are currently no standards or guidelines for integrating structural safety, energy efficiency and accessibility in renovation work. Developing an integrated framework will be beneficial if incorporated within the lifecycle of renovation projects.

This study will be very useful to those who are planning to renovate restroom.

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