

# Adoption of Pre-Fabricated Bathroom Units by Real Estate Developers

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**Abstract** - PBUs can increase the manpower and time savings by about 60%, depending upon the design and materials used. There are various types of PBU and it is important to understand the characteristics of each type before its selection for use. Mainly there are two types PBU formed with concrete base and walls of concrete or other materials ex drywall, steel panel etc. and PBU with fiber reinforced walls and floor panels. As per the responses, 46.3% respondents expressed agreeableness on using prefabricated Bathroom units at their site and 50% were hesitant and only 3.7% disagree with the use of Prefabricated bathroom units for their future Projects. Hence we can say that there is a tremendous Market Potential in the Prefabricated Bathroom units. As per the survey data, majorly, the cost of construction of a traditional bathroom with all standard fittings lies between Rs. 50,000 to 100,000. Thus pricing a Prefabricated Bathroom around this Price Bracket would be advisable. In addition to this, the Government should incorporate Provisions to gauge the improvement of IGBC (Indian Green Building Council) rating as adoption of Prefabricated Bathroom Units helps in increased application of Lean Principles and reduces wastage of resources such as Labor and Time. Also relevant codal provisions have to be established by NBC (National Building Code) for design and installation of these Prefabricated Bathroom Units.

**Key Words:** Pre Fabricated Bathroom Units (PBUs), Drywall, National Building Code, Indian Green Building Council, with fiber reinforced walls.

## 1. INTRODUCTION

Building a conventional bathroom requires numerous workers to do more than 13 on-site trades. This includes waterproofing, tiling and sanitary, plumbing, electrical works etc.. On the other side, Prefabricated Bathroom Units (PBUs) will be pre-assembled in factories before being delivered to the appropriate site. This makes it possible to construct the entire bathroom needs to be streamlined and effectively carried out in the factory's controlled setting, minimizing disruption to the nearby inhabitants and ensuring a greater quality finish. Depending on the design and equipment used, PBUs can improve the labor and time savings by about 60 percent. This is not a state-of - the-art technology and has been used in the last 10 years or more in Singapore. Prefabricated bathroom units have alleviated different designs and have greatly enhanced as pioneering materials and sophisticated techniques generated to ensure that PBUs are of better quality and not compromised by handling and transportation difficulties. One example is volumetric concrete PBU aviation to lightweight concrete PBU.

### 1.1 TYPES OF PREFABRICATED BATHROOM UNITS

There are different kinds of PBU and it is essential to know each type's features before they are selected for use. There are mainly two kinds of PBU with concrete foundation and concrete walls or other materials ex drywall, steel panel etc. and PBU with strengthened fiber walls and floor boards. Each sort has its own features. Developers, constructors and consultants should assess and pick the type that meets their project criteria and incorporate this into project planning and design.

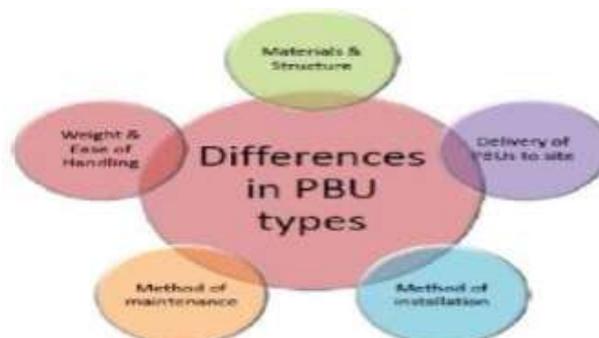


Fig-1.1: Figure representing classification of PBU unit under various category.

## 1.2 Prefabricated PBU volumetric scheme

Prefabricated concrete (PBU) systems are commonly used. Its primary benefit is its robustness and willingness for repair and maintenance, which weighs far out The drawbacks presented by its heavier weight and the installation technique of the top down (critical path). This chapter describes the design, manufacture, assembly and maintenance factors of precast concrete volumetric PBU including sequence of architectural and M&E job, transport, lifting and security, assembly and substitution.



**Fig -1.2:** Diagrammatical representation of precast concrete volumetric PBU

## 1.3 Design consideration

For any building job, design parameters are important. Generally with PBU, the design variables like architectural, structural, installation, M&E works, along with early determination of the PBU system's subsequent maintenance problems included in the general layout of the construction. A good PBU design should give practical alternatives to potential problems resulting in different phases of the life cycle of PBU, including future refurbishment.

Following are the design consideration of any prefabricated bathroom unit:

1. Architectural Design Consideration
2. Structural Design Consideration
3. M & E Design Consideration

## 1.4 Production of PBU

Good design and formwork mold specification is essential to the production of high-quality prefabricated concrete PBU. The thickness of the steel plate for the prefabricated concrete mold must be designed to withstand the concreting pressure. Bonding between the finished concrete and the interaction agent increases the use of checker plate formwork (for concrete surface receiving finishes). During the concreting process, appropriate support should be given.

Production of two types of PBU are explained here. They are:-

- i) Fully precast concrete volumetric PBU
- ii) Steel panel wall with concrete floor tray PBU

## 1.5 Protection, transportation and lifting

A well-designed transport, lifting, safeguarding and storage space system for the PBU is important to ensure that the finished product is minimally damaged before and after installation of the PBU on site. Proper organization and scheduling of PBU delivery can assist to solve the logistical problem of inadequate storage room, dual processing and access control to the PBU.



**Fig -1.3:** Lifting of PBU at site

### 1.6 Installation of PBU

The building site's readiness to accept the PBU is critical to the effective establishment of the PBU. Recognizing the multiple structural systems intended to obtain the PBU on site is also important:

- i) Double slab system
- ii) Single slab system



**Fig -1.4:** Positioning PBU

## 2. OBJECTIVES

The main aim of this research is understand the global financial viability of the pre-fabricated bathroom units and their suitability in Indian construction industries. The objectives set for this purpose is as follows.

- To check the viability of PBU for use in multi storey construction.
- Determine whether the PBU are effective tool for cost reduction and quality finishing.

- Determine the degree of cost reduction achieved by using PBU its associated economies of scale.
- Determine whether the market is readily accepting the concept of PBU.

### **3. METHODOLOGY**

For this thesis, a questionnaire was developed to satisfy the research objectives keeping the reference of the literature survey.

A prelisting or pilot study was done for a select sample size of 7 and based on their reviews; the questionnaire was enhanced with necessary modifications and then floated for collecting all other responses.

The Layout of the questionnaire in this thesis is as follows

- Introduction
- Instructions
- Opening questions
- Main Sections
  - a) General Respondent information
  - b) Demographic Description
  - c) Information about Site
  - d) Design & Style Description
  - e) Constructional Description of Traditional Bathroom
  - f) Constructional Description of Prefabricated Bathroom Units
  - g) Design requirements & Concerns for Prefabricated Bathroom Units

#### **3.1 Sample Design**

- Type of Universe – Professionals from the real estate and construction industry having a prior work experience in multi storey construction of dwelling units as well as hospitality and commercial retail spaces
- Source – Responses collected via the opinions expressed in the questionnaire
- Size of sample – As per the convenience, actual number of responses collected was 54.
- Sampling procedure – Focus Group Survey

#### **3.2 Tools for Analysis**

For the Purpose of this Thesis and based on the type of responses collected, use of advanced statistical methods of analysis seems to be redundant.

Analysis was done on quantitative and qualitative basis using

- a) Pi Charts
- b) Bar Charts
- c) Percentages
- d) Linkert Scale

#### 4. ANALYSIS AND RESULTS

The following chart represents the country wise spread of the respondents.

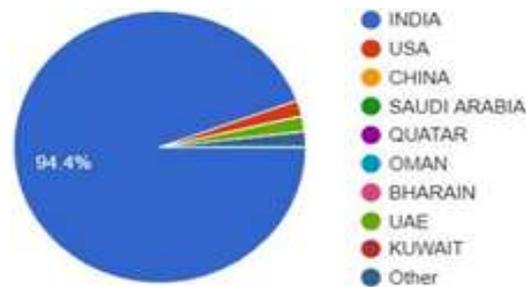


Fig 4.1: Country wise spread of respondents

4.2 The following chart represents the State wise Geographic spread of the respondents from India

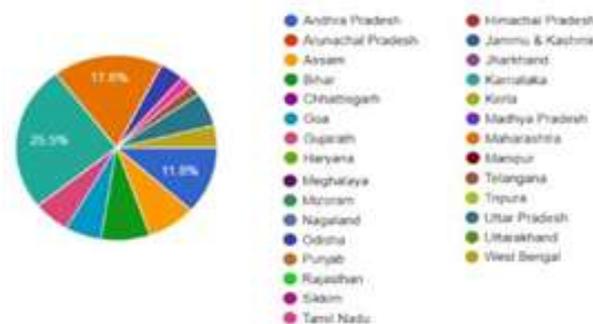


Fig 4.2: State wise geographic spread of respondents from India.

4.3 Number of bathrooms in each flat

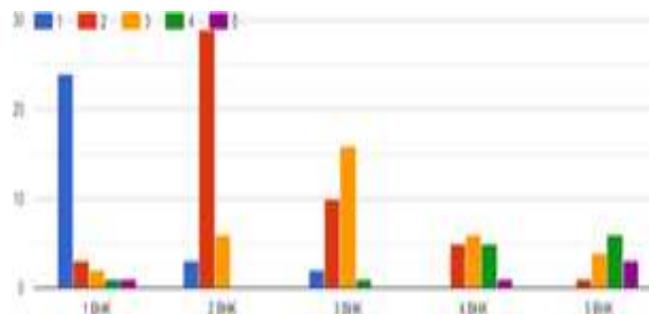


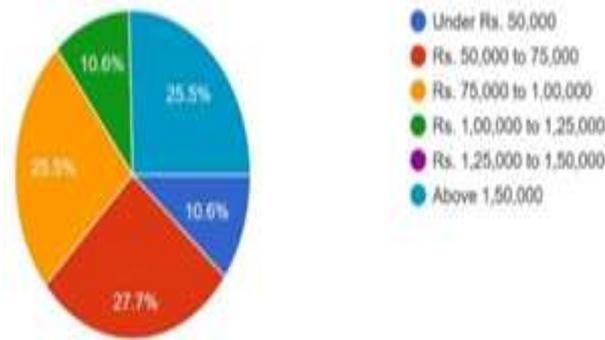
Fig 4.3: Number of bathrooms in each flat

From the above information, we can infer that on an average, the number of units in each of the type of dwelling units are:

Table 4.1 Number of bathroom per flat

Type of Unit	Avg No: of Bathrooms
1 BHK	1.07
2 BHK	2.19
3 BHK	2.64
4BHK	3.12
5 BHK	5.10

**4.4. General cost for construction of a bathroom at your projects? (with all finishing & sanitary fittings)**

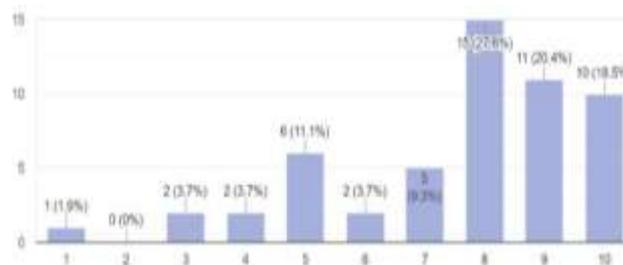


**Fig 4.4: Cost for construction of bathroom at your projects**

With the data from the foregoing chart, it can be inferred that majorly, the cost of construction of a traditional bathroom with all standard fittings lies between Rs. 50,000 to 100,000. Thus pricing a Prefabricated Bathroom around this Price Bracket would be advisable.

Also, 25.5% of respondents showed that the cost of Bathroom at their sites was above Rs. 1.5 Lakh, thus indicating the market share of Premium Category to be 25.5% of the total Population. This Data can be used to determine the type of 'Marketing Mix' to be adopted for Production and sale of Prefabricated Bathroom Units.

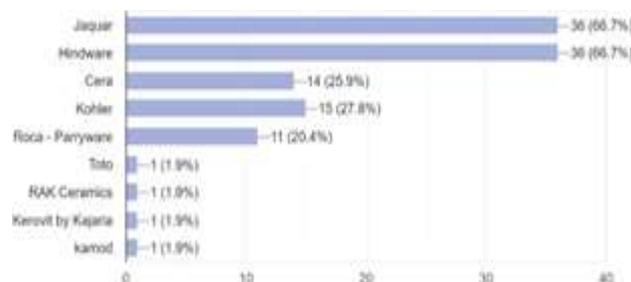
**4.5. On a scale of 1 to 10, how important would a bathroom be a factor to attract a customer/ Narrow down to a particular project during home buying?**



**Fig 4.5: On a scale of 1to10 how important bathroom would be a factor**

From the above representation, we can infer that on a scale of 1 to 10 with 1 being least important and 10 being most important, the importance of a bathroom for narrowing down on to a particular project would be 7.11

**4.6. Brands do you prefer for sanitary fitting**



**Fig 4.6: Brands you prefer for sanitary fitting** Based on the information gathered from the respondents, from the above graph it is evident that 66.7% of the people preferred Jaguar and Hindware brands for sanitary fittings in Bath pods. Most of the remaining respondents considered the brands Cera, Kohler and Roca – Parry ware for sanitary fittings.

This shows that Jaguar and Hind ware have a competitive advantage in the market over other brands.

#### 4.7. Choice of Electrical fittings

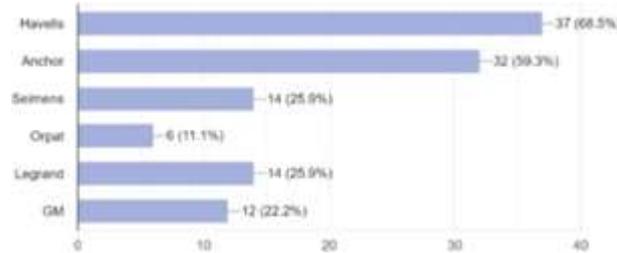


Fig 5.7: Choice of electrical fittings

According to the survey information gathered, majority of the people preferred Havells and Anchor brand for the electrical fittings to be used in the bathroom. So, we can say that these brands have competitive advantage over their competitors in the market.

#### 4.8. Choice of Flooring material

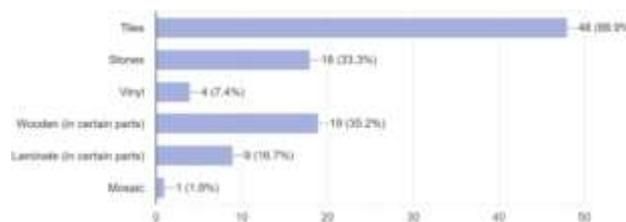


Fig 4.8: Choice of flooring material

From the above information it can be inferred that approximately 90% of the respondents prefer Tiles as flooring material over other materials available in the market. So, the companies can provide different varieties of tiles based on the customer requirement. This can be one of the major criteria for positioning of the prefabricated bath pods.

#### 4.9 .Requirements of Geyser in bathroom

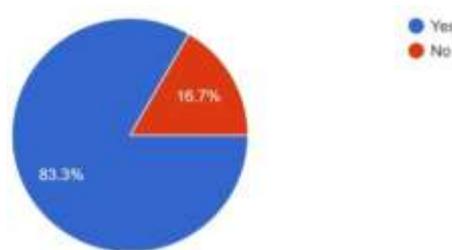


Fig 4.9: Requirements of geyser in bathroom From the above observation we come to the conclusion that there will be 24\*7 hot water supply connection to all the prefabricated bathroom units provided by the supplier.

#### 4.10. Provision of solar heating in bathroom

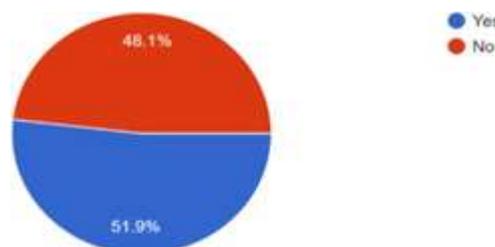


Fig 4.10: Provision of solar heating in bathroom From the pie chart above, it can be inferred that more than 50% of the consumers would prefer a solar heater for hot water supply and around 48% said they would prefer a geyser

installed in their bathrooms.

#### 4.11. Provision of bathtubs

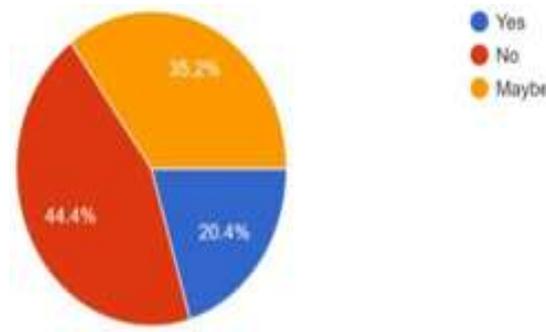


Fig 4.11: Provision of bathtubs

From the responses collected as shown in the pie chart above, we can say that 44.4% people would prefer a bathtub in their bath pods. Inclusion of bathtubs would increase the cost significantly and these consumers are ready to pay for it. This falls under premium segment and so it would also increase the profits for the bath pod manufacturing companies.

Around 35.2% of the people said they are unsure if they want a bathtub in their bath pods. This creates a huge prospective market for the cross selling of bathtubs.

#### 4.12. Choice of moving walls, doors and windows

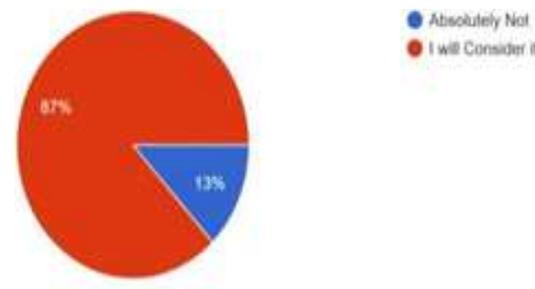


Fig 4.12: Choice of moving walls, doors and windows

87% respondents are considering to make changes to their floor plans to incorporate a Prefabricated Bathroom Unit, this shows that the public is very much willing to welcome the concept of Prefabricated Bathroom Unit.

#### 4.14. Reasonable price for prefabricated bathroom unit

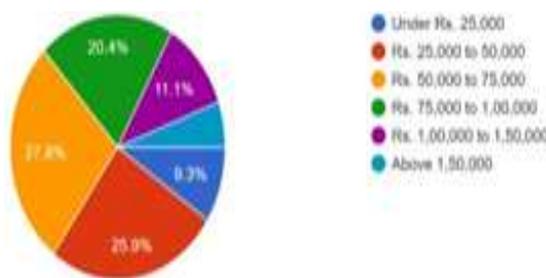


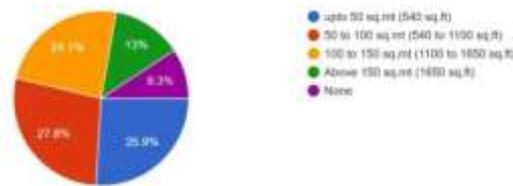
Fig 4.14: Reasonable price for PBU

From this data, we can infer that majorly, the expected cost of a Prefabricated Bathroom Unit in the minds of the respondents is between 50,000 to 75,000. Hence while deciding the Price categories, the market share of each category can be estimated from this data.

**Table 4.2 Price of prefabricated bathroom unit**

Price Category	Market Share
<25,000	5.6 %
25,000 to 50,000	25.9 %
50,000 to 75,000	27.8 %
75,000 to 1,00,000	20.4 %
1,00,000 to 1,50,000	11.1 %
>1,50,000	9.3 %

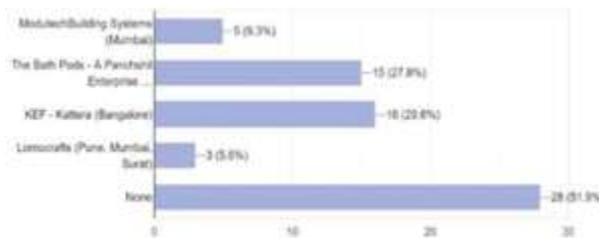
**4.15. Availability of required space at site**



**Fig 4.15: Availability of required space at site**

From the above data it can be work out that 52% of the contractors are willing to provide sufficient storage facility for storing the bath pods at the site itself. So, this can reduce the burden of the logistics team and can also solve the problem of shortage of prefabricated units at the site.

**4.16. Brand awareness of PBU**



**Fig 4.16: Brand awareness of PBU**

From the data collected in the above chart, it can be inferred that the most well known companies involved in Modular Construction are KEF-Kattera and Panchshil Enterprises.

It was also found that 52% of the respondents were unaware of any of the companies listed above. So, the companies involved in the modular construction need to promote themselves better in the market.

**4.17. Choice of PBU for Future project**



**Fig 4.17: Choice of PBU for future project** with the above data, it can be inferred that 46.3% of the market would be interested in using/installing prefabricated bathroom units immediately or in the near future.

Further, we can say that 50% of the market consumers are interested in installing Bath pods but are reluctant due to some or the other reason.

So, we come to a conclusion that we have a tremendous market potential for using Bath pods.

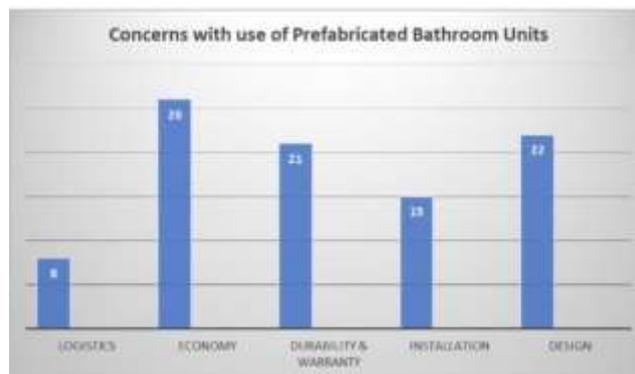
From the survey, the data related to concerns with the use of prefabricated bathroom units was collected. The concerns raised by the respondents have been classified into majorly 5 categories i.e.

1. Logistics
2. Economy
3. Durability & Warranty
4. Installation
5. Design

**Table 4.3 Concerns for PBU**

Logistics	Economy	Durability & Warranty	Installation	Design
Transit Damages & Insurance cover	Amount of Time saved	Leakage, Cracks & Quality of Finishing	slight dimension errors	User Comfort & Ergonomics
Difficulty of storage at smaller sites	Cost Effectiveness compared to traditional method	Warranty of sanitary ware & Electricals	Level of flooring with true flooring for flawless water flow	Aesthetics & choice of material
Cost of transportation in case the site is far from the place of manufacturing	Additional costs for erection & hoisting machinery or crane	Post Maintenance & replacement	Precision of plumbing & Sanitary mains to match with the connections of bathroom	Lighting & Ventilation
		Waterproofing of connections, Joints, Flooring & Side Panels	Need of skilled labour with training	Last minute changes to floor Plan by specific clients

Total Responses in Each Category				
8	26	21	15	22



**Fig 4.18: Concerns with use of PBU units** from the above chart; we can conclude that the most common concern was regarding the Economy of using prefabricated Bathroom units.

The concerns can be ranked on priority as follows

**Table 4.4 Ranking of Major Concerns**

CONCERN	RANKS
Economy	1
Design	2
Durability and warranty	3
Installation	4
Logistics	5

In addition to these, some more concerns raised were

1. Negative Stigma by Contractors and builders
2. Reusability of the prefabricated units
3. Safety

Requirement of the extent of BIM to be implemented in the project for use of Prefabricated Bathrooms Units.

## 5. CONCLUSIONS

1. As per the responses, 46.3% respondents expressed their willingness about using prefabricated Bathroom units at their site and 50% were hesitant due to and only 3.7% disagree with the use of Prefabricated bathroom units for their future Projects. Hence we can say that there is a tremendous Market Potential in the Prefabricated Bathroom units.
2. As per the survey data, the major cost of construction of a traditional bathroom with all standard fittings lies between Rs. 50,000 to 100,000. Thus pricing a Prefabricated Bathroom around this Price Bracket would be advisable.
3. About 25.5% of respondents estimated the cost of Bathroom at their sites was above Rs. 1.5 Lakh, thus indicating the market share of Premium Category to be 25.5% of the total Population. This data can be used to determine the type of 'Marketing Mix' to be adopted for Production and sale of Prefabricated Bathroom Units
4. A study reveals that 87% respondents are considering to make changes to their floor plans to incorporate a Prefabricated Bathroom Unit; this implicit about public is very much willing to welcome the concept of Prefabricated Bathroom Unit.
5. As per the present study survey conducted for the project work, the most well-known companies involved in Modular Construction are KEF-Kattera and Panchshil Enterprises. It was noted that 52% of the respondents were unaware of any of the companies listed in the survey. So, these companies involved in the modular construction need to promote themselves better in the market.

In addition to this, the Government should incorporate Provisions to gauge the improvement of IGBC (Indian Green Building Council) rating as adoption of Prefabricated Bathroom Units helps in increased application of Lean Principles and reduces wastage of resources such as Labor and Time. Also relevant codal provisions have to be established by NBC (National Building Code) for design and installation of these Prefabricated Bathroom Units.

Implementation of BIM in the Project would greatly streamline the process of installation and plumbing works related to making connections of the prefabricated bathroom to the fresh water and sanitary mains. Effective training of the installation team/skilled labor will also help solve this problem.

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