

# Construction of Sustainable Toilet with Low Cost for Slums

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**ABSTRACT:** This paper aims to reduce construction cost for slum toilets by replacement of conventional material with recycled plastic waste material. Main aim of this research is to recycle and reuse plastic waste material for construction purpose which helps environment free from plastic pollution. As per research conventional materials used for construction like bricks, cement, sand & aggregate is costly and requires more money and construction by conventional material takes more time so to reduce men power, money power, machineries & time of construction plastic made toilet structures are useful. It has several benefits over conventional toilets.

**KEYWORDS:** Reuse of plastic, reduction in construction cost, Replacement of material.

## I. INTRODUCTION

In India development in various sectors is continuously going on like development of various industries, construction work of railways, roadways, commercial complex, residential and in slum development. Slum development consist of rehabilitation of slums, road network development in slums and most important factor construction of slum toilets for slum peoples to make open defecation free area.

As there are 600 Million peoples are using open defecation due to lack of toilets in slums so to avoid this situation government had launched toilet construction scheme named One house one toilet (GhargharshouchalayYojana), under which government provides toilets for each individual house hold. But in some slums there is no space available for individual toilets due to large amount of population so in these areas government have constructed community toilets of 10 seated, 20 seated and more as per density of users.



Fig.No.01 Community Toilet

This toilets are constructed by using conventional methods like RCC column, brickwork, steel etc. which costs more and takes more time to construct also it requires skilled labours, machineries and skilled supervision so it requires more money, more man power and machineries with excess time so as per civil engineering industries 3M's (Men, Money, Machineries) are very important also this toilets should be sustainable means as per government rules fees collection from users is mandatory from which maintenance work can be carries out.

So basically reduction in construction cost is main aim so to overcome this issue recycling of waste construction plastic material is best solution. Up to now reuse of plastic is used in road construction which reduced 50% construction cost so slum toilets are important but structure wise it doesn't require conventional material so instead of this we can use construction waste plastic material by preparing readymade structure which will be later installed on site. This plastic Made toilets will help to reduce cost and help to contribute in reduction of plastic pollution. As per density of users these toilets have constructed as 10 seated, 20 seated, so fig.1 shows slum toilet Parvati area Pune. This toilet is 10 seated in which 5 seats are for male block and 5 for female block. So waste plastic is a big issue on earth which is increasing day by day and it is harmful for nature so recycling and reuse of plastic is a solution to prepare toilets for slums .As plastic has longer life so it will not get damaged easily and makes toilet maintenance free.

## II. METHODOLOGY

### 2.1 Data collection about existing Toilet

Data collection is a basic stage of this project which contains details about existing toilets constructed in slum areas by government. Main aim of data collection is to get material details, sizes of toilet block, condition of toilet block etc. From this an estimate can be prepared and we can get idea about cost required for construction of toilet. This audit work was carried out on community toilet in Janata Vasahat, Near Parvati Payatha, and Pune. This report gives following details

Table.no.1 Audit report

General Details of Toilet Block	
Area of toilet	Janata Vasahat, Parvati Paytha, Pune
Type Of toilet	Community Toilet
Number of Seats	10 Seats
Male	5 Seats
Female	5 Seats
Urinals	NA
Size of toilet block	1.5mX1.5m
Size of Door	0.9mX2.1m
Size of ventilator	0.75mX0.8m
Number of Users	Approx. 60 users per day

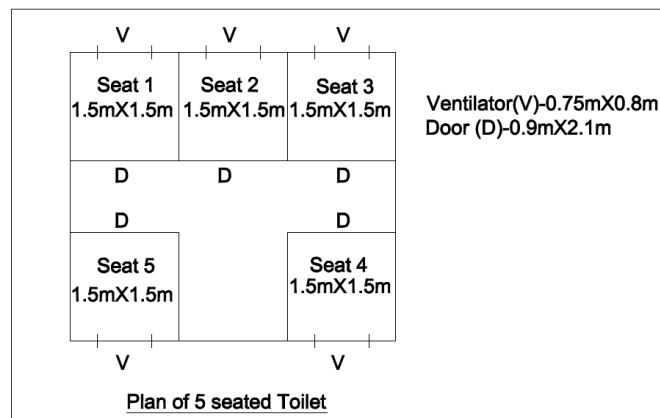


Fig.2 Plan of slum toilet

General audit data is collected to know slums toilet details, following figures (fig.3, 4, 5, 6) shows condition of this Toilet blocks.



Fig.3 Toilet seat



Fig. 4 flooring condition



Fig.5 Broken toilet dado



Fig.6 Broken toilet ventilator

Above figures will give idea about poor condition of slum toilets and can get idea required funds for repairing of this damaged portion. Fig.3 gives an idea about condition of toilet seat poorly damaged and blocked due to lack of cleaning; fig.4 shows broken flooring of toilet which is harmful for users. Fig.5 gives an idea about dado condition of toilets



which can fall on users and may hurt them so replacement is necessary, fig.6 shows ventilator which is damaged badly and not good for user's safety it may lead to illegal activities also.

So this audit report gives idea about required funds for maintenance of these toilets so to overcome these cost a smart plastic made toilet is required.

Fig.2 shows plan of toilet under which this toilet is 5 seated Toilet seat:-1.5mX1.5m

Door size: - 0.7mX0.9m

Ventilator size: - 0.75mX0.8m

From details following table no.2 gives total costing of toilet by current market rates.

Table no.2 Costing of Existing toilet block

Measurement Sheet							
Sr.No	Description	No	L	B	H	Qty	Unit
1	<b>Excavation</b>						
	Long wall	4	6.00	0.90	0.90	19.44	Cum
	Short wall	2	5.00	0.90	0.90	8.10	Cum
						<b>Total</b>	<b>27.54</b>
2	<b>PCC</b>						
	Long wall	4	6.00	0.90	0.10	2.16	Cum
	Short wall	2	5.00	0.90	0.10	0.90	Cum
						<b>Total</b>	<b>3.06</b>
3	<b>Foundation</b>						
	Long wall	4	6.00	0.70	0.80	13.44	Cum
	Short wall	2	5.00	0.70	0.80	5.60	Cum
						<b>Total</b>	<b>19.04</b>
4	<b>DPC</b>						
	Long wall	4	6.00	0.70	0.10	1.68	Cum
	Short wall	2	5.00	0.70	0.10	0.70	Cum
						<b>Total</b>	<b>2.38</b>
5	<b>BBM for wall</b>						
	Long wall	2	5.42	0.23	3.10	7.73	Cum
	Short wall	2	4.92	0.23	3.10	7.02	Cum
	Internal walls	9	1.50	0.23	2.10	6.52	Cum
						21.27	Cum
	<b>Deductions</b>						
	Door	6	0.90	0.23	2.10	2.61	Cum
	Ventilation	5	0.75	0.23	0.80	0.69	Cum
						3.30	Cum
						<b>Total</b>	<b>17.97</b>
6	<b>Plaster for wall</b>						
	Long wall	4	6.00	-	3.10	74.40	Sqm
	Short wall	4	5.00	-	3.10	62.00	Sqm



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	<i>Internal walls 1</i>	18	1.50	-	2.10	56.70	Sqm
						193.10	Sqm
	<b>Deductions</b>						
	<i>Door</i>	5	0.90	-	2.10	9.45	Sqm
	<i>Ventilation</i>	5	0.70	-	0.90	3.15	Sqm
						12.60	Sqm
					<b>Total</b>	<b>180.50</b>	<b>Sqm</b>
<b>7</b>	<b>Daddo</b>	20	1.5	-	1.0	30.0	Sqm
	Passage	1	14.7	-	1.0	14.7	Sqm
						<b>Total</b>	<b>44.7</b>
	<b>Deduction</b>						
	<i>Door</i>	5	0.90	-	2.10	9.45	Sqm
						<b>Total</b>	<b>35.24</b>
<b>8</b>	<b>Slab</b>	1	6.0	5.0	0.1	<b>3.6</b>	<b>Cum</b>
<b>9</b>	<b>Flooring</b>	1	6.0	5.0	-	<b>30.0</b>	<b>sqm</b>
<b>10</b>	<b>Painting</b>						
	Primer						
	<i>Long wall</i>	4	6.00	-	3.10	74.40	Sqm
	<i>Short wall</i>	4	5.00	-	3.10	62.00	Sqm
	<i>Internal walls 1</i>	22	1.50	-	3.10	102.30	Sqm
						238.70	Sqm
	<b>Deductions</b>						
	<i>Door</i>	5	0.90	-	2.10	9.45	Sqm
	<i>Ventilation</i>	5	0.70	-	0.90	3.15	Sqm
						12.60	Sqm
						<b>Total</b>	<b>226.10</b>
	<b>Painting</b>						
	<i>Long wall</i>	4	6.00	-	3.10	74.40	Sqm
	<i>Short wall</i>	4	5.00	-	3.10	62.00	Sqm
	<i>Internal walls 1</i>	22	1.50	-	3.10	102.30	Sqm
						238.70	Sqm

<i>Deductions</i>							
	<i>Door</i>	5	0.90	-	2.10	9.45	Sqm
	<i>Ventilation</i>	5	0.70	-	0.90	3.15	Sqm
						12.60	Sqm
					<b>Total</b>	<b>226.10</b>	<b>Sqm</b>

<b>Abstract Sheet</b>					
<b>Sr.No</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Rate</b>	<b>Amount</b>
1	Excavation	27.54	Cum	1500.00	41310.00
2	PCC	3.06	Cum	3000.00	9180.00
3	Foundation	19.04	Cum	2000.00	38080.00
4	DPC	2.38	Cum	1500.00	3570.00
5	BBM for wall	841.00	Sqft	20.00	16820.00
6	Plaster for wall	1942.90	Sqm	20.00	38858.04
7	Dado	379.32	Sqft	50.00	18966.17
8	Slab	3.60	Sqft	20.00	72.00
9	Flooring	322.92	Sqft	45.00	14531.40
10	Painting	2433.74	Sqft	18.00	43807.33
11	Cement	60.00	Bags	350.00	21000.00
12	Sand	2.89	Brass	8500.00	24565.00
13	Aggregate	1.88	Brass	4500.00	8460.00
14	Steel	0.50	MT	48000.00	24000.00
15	Bricks	9435.00	Nos	10.00	94350.00
16	Stones	19.04	Cum	1000.00	19040.00
17	Tiles	475.00	Sqft	100.00	47500.00
18	Toilet Pan	5.00	Nos	2200.00	11000.00
19	Door	5.00	Nos	3000.00	15000.00
20	Ventilator	5.00	Nos	2000.00	10000.00
21	Labor				25000.00
22	Transport				10000.00
				<b>Total</b>	<b>535109.94</b>
Contractors Profit (10%)					53510.99
Tools & Plants (5%)					26755.50
<b>Total Amount</b>					<b>615376.43</b>

As per table no.2 estimate shows construction cost for 5 seated slum toilet is Rs. 6,15,376/-with conventional material and technique also this method takes much time for construction following table no.3 shows duration required for construction

Table no.3 Duration required for construction of Existing toilet block

Sr.No	Work	Duration required
1	Excavation	2 days
2	PCC	2 days
3	Foundation	2 days
4	BBM wall	3 days
5	Shuttering making	1 day
6	Shuttering	1 day
7	Steel cutting	1 day
8	Steel binding	1 day
9	Concreting	1 day
10	Curing	21 days
11	Plaster	3 days
12	Dado	3 days
13	Toilet pan fitting	2 days
14	Flooring	2 days
15	Painting	4 days
16	Door & ventilator	2 days
	Total duration	51 days

From above table no.3 it is easy to get an idea about duration required for construction of 5 seated toilets. It requires at least 51 days for constructing a 5 seated toilet and which is long duration.

## 2.2 Material Replacement & Review

5 seated toilet cost by conventional method requires Rs. 6,15,376/- and 51 days duration so as to reduce this cost and duration of construction conventional toilets should be replaced by plastic made toilets so it will help to build toilets easily in low cost and within small duration.

Recycling of plastic for toilet construction is done by using following material,

1. PVC material
2. HDPE material
3. LDPE material

Table no.4 Properties of plastic material

Material	Density	Melting Point	Recycling Product
Polyvinyl chloride	1300-1450 Kg/m <sup>3</sup>	60 <sup>0</sup> C	Wall Sheets & Door's
High density Polyethylene (HDPE)	930-970 Kg/m <sup>3</sup>	130 <sup>0</sup> C	Column
Low density Polyethylene (LDPE)	917-930 Kg/m <sup>3</sup>	105 <sup>0</sup> C	Slab or roof cover

### 2.2.1 Recycling Process

Recycling process of plastic material is simple firstly it is collected from various sources, then collected plastic is segregated as per norms then cleaning process of segregated material is to be done. Once material gets cleaned then it go through scrap making material in which plastic is converted into thin single layers. Then finally it is poured into heating machine and melted plastic liquid is poured into formwork prepared as per requirement in which plastic gets desired shape.

1. Collection of material: - Collection of waste from various sources is done by man power.
2. Segregation: - Segregation of material is necessary and it is made as per symbol marked on product.
3. Cleaning; - Separated material is then get cleaned and washed by various methods so it should be get cleaned and free from any other impurities.

4. Scrap making: - Cleaned material then poured into scrap making machine which converts product into small particles which then poured into heating machine.
5. Moulding: - Scrap material then finally goes into moulding machine which is set to different temperatures according to material. This melted plastic is then poured into readymade mould as per design for desired shape. Once it will get cool then the product is getting polished or final touch and then it is ready to assemble.

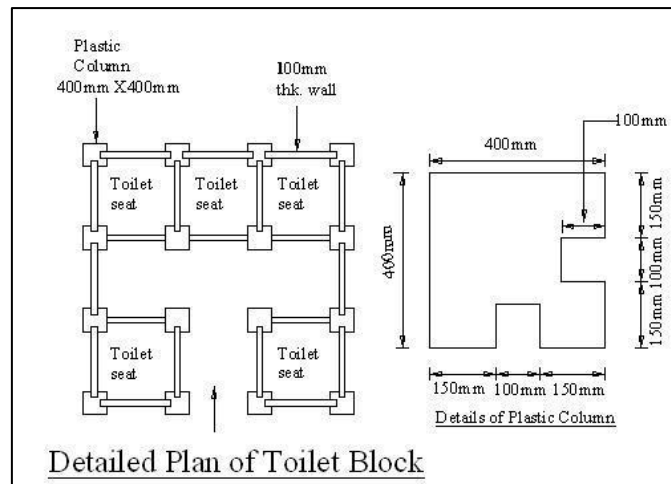
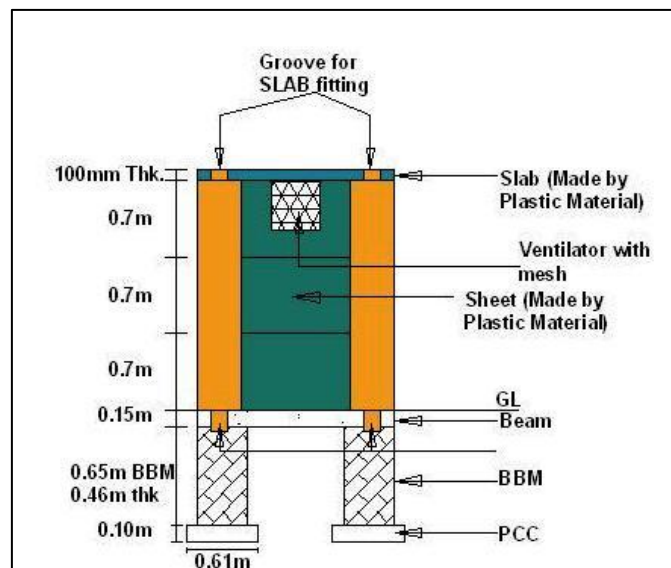


Fig.7 Plan of plastic made toilet structure



### 2.2.2 Details of toilet and installation procedure

Plastic made toilet is easy to install and doesn't require heavy machineries and skilled laborers.

1. Foundation: - It consists of individual footing under each column which is built by brick masonry having size of 460mm X 460mm X 800mm which gives base for column. Above this brick work a singly reinforced beam of size 450mm X 150mm is to be casted to act as a support for wall.
2. Column: - Column made by High density polyethylene (HDPE) material is having size 400mm X 400mm which is having hollow section for installation of wall sheets. This column has a groove at the bottom and at the top.





Bottom groove of this column should be inserted into Beam before casting so after casting it will be stable and strong.

3. Sheet: - Sheets are made up of PVC material. It act as a wall which is in plate form each wall contains 3 number of separate sheets each of size 1.2m X0.7m with 100mm thickness. It is just installed into hollow section provided into column.
4. Slab: - Slab is made up of low density polyethylene material (LDPE). Which having 100mm thickness and installed into top groove of column.

**2.2.3 Estimation and costing of plastic made toilet**

Table.No.5costing of plastic made structure

Sr.No	Desc.	N	L	B	H	Qty.	Unit
1	Column	16	0.40	0.40	2.10	5.38	Cum
2	Sheet (Wall)	45	1.20	0.10	0.70	3.78	Cum
3	Slab	1	3.00	3.00	0.10	0.90	Cum
						<b>Total</b>	10.06
						Say	11 Cum
				<b>Density Plastic</b>	<b>of</b>	<b>900</b>	<b>Kg/m3</b>
				<b>Total Weight of Chamber</b>	<b>of</b>	<b>9900</b>	<b>Kg</b>

Rate Analysis				
Particulars	Qty	Rate	Unit	Amount
Scrap	9900	12.00	Kg	118800
Moulding	9900	25.00	Kg	247500.00
<b>Total costing of Toilet Block</b>				<b>366300.00</b>

Abstract Sheet					
Sr.No	Description	Quantity	Unit	Rate	Amount
1	Excavation	5.36	Cum	1500.00	8037.36
2	PCC	0.60	Cum	760.00	452.47
3	Foundation	2.20	Cum	1000.00	2200.64
4	Beam	1.57	Cum	850.00	1331.10
5	Flooring	123.14	Sqft	45.00	5541.31
6	Cement	7.00	Bags	350.00	2450.00
7	Sand	0.23	Brass	8500.00	1955.00
8	Aggregate	0.46	Brass	4500.00	2070.00
9	Steel	0.50	MT	48000.00	24000.00
10	Tiles	123.14	Sqft	80.00	9851.21
11	Toilet structure				366300.00
12	Toilet Pan	5.00	Nos	1000.00	5000.00
	Door	5.00	Nos	1000.00	5000.00
13	Labor				5000.00



14	Transport				2500.00
				<b>Total</b>	441689.09
Contractors Profit (10%)					44168.91
<b>Total Amount</b>					<b>485858.00</b>

As per above estimate plastic made toilet structure costs Rs.4, 85,858/- (Four Lack Eighty Five thousand Eight hundred Fifty Eight only)

Table.No.6Required duration for plastic made structure

Sr.No	Work	Duration required
1	Excavation	2 days
2	PCC	1 days
3	Foundation	1 days
4	Beam & Column	2 days
5	Walls	1 day
6	Slab	1 day
7	Toilet pan fitting	1 days
8	Flooring	1 days
9	Door	1 days
	Total duration	11 days

Duration for installation of plastic made toilet requires 11 days but conventional toilet requires 51 days duration so this is time saving method and cost reducing structure with low maintenance

### III. COMPARATIVE STATEMENT

Comparative statement shows difference between costs of same 5 seated toilet in slum areas. From fig.9 conventional toilet requires Rs 6, 15,376/- and Plastic made toilet structure requires Rs. 4, 85, 858/- fig.10 shows duration required for construction in which conventional method requires 51 days and plastic made toilet requires 11 days.

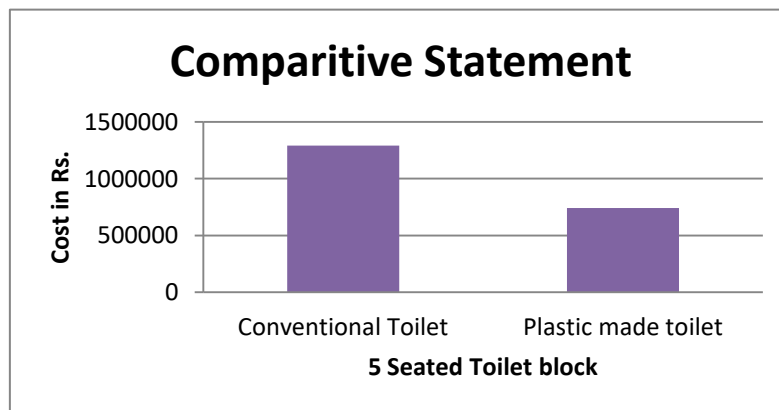


Fig.9 Comparative statement for Construction cost

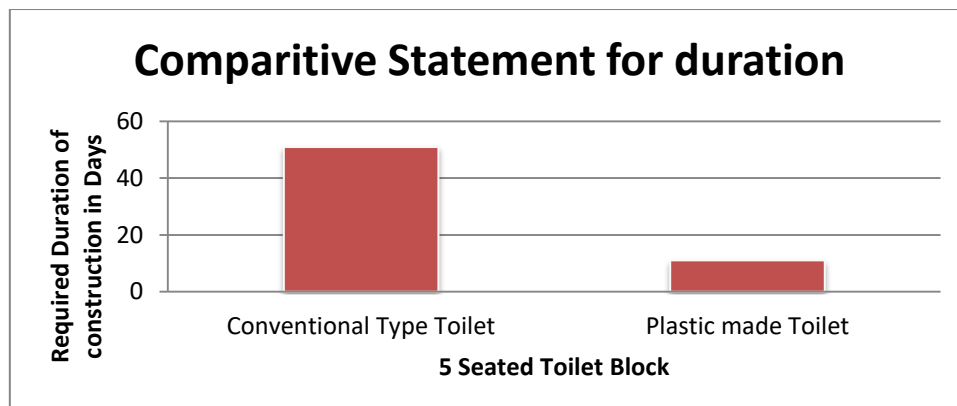


Fig.10 Comparative statement for Duration of construction

#### IV. CONCLUSION

This project report concluded that 5 seated toilet construction by conventional method requires Rs. 6, 15,376/- and plastic made toilet structure costs Rs. 4, 85, 858/- so it reduces amount of construction by Rs Rs1, 29, 518/- so plastic made toilet is more profitable than existing one with less maintenance. Also plastic made toilet structure doesn't requires heavy machineries or skilled labors for assembly and installation process also it is easy to install so it is time saving structure and recycling and reuse of plastic waste helps to reduce plastic pollution from earth which is currently necessary. So, plastic made toilet structure is one of best solution for slum toilets.

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