

Royal University of Bhutan
Jigme Namgyel Polytechnic, Dewathang

Fabrication of Waste Segregation Station

A Project Report

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Abstract

Waste is the unwanted substance (plastic, paper, glass, cloth etc...) that are dump anywhere causing unhygienic environment. Waste does not exist in nature rather they are created by humans. The SJI has identified the consequences of the improper management of waste and came up with the idea of this project.

Some of consequences from improper waste management are land filling, producing of hazardous metals, pollutions, economic losses. In order to overcome these consequences, along with to improve and to educate about the proper waste management, the designing and fabrication of Waste Segregation Stations were carried out as project. The fabrication works were done using the institute facilities with complementary support from SJI. The segregation stations were erected at Chokyi Gyatsho Institute, Dewathang.

Acknowledgement

Our special thanks go to Royal University of Bhutan for making project as a part of our syllabus.

The project member would like to take this opportunity in expressing immense gratitude to our project guide Mr.Norden Wangchuk, associate lecturer in Mechanical Department without whose guidance this project will not have been possible. We are highly indebted for his constant inspiration, useful criticism and the hard work he had put into producing the project.

We would also like to pay our sincere gratitude to Samdrup Jongkhar Initiative for giving us their project, Mrs.Tenzin Wangmo, Mr. Sonam Tobgay and Mr. Sangay Dorji (technicians) for their technical supports, Mr.Kala Tshering (Senior Instructor) for his guidance in material estimation and costing, Mr.Samten Lhendrup (HOD, Mechanical Department) for providing moral support and suggestions. We are also thankful to Chokyi Gyatso Institute for their immense support in installation.

So lastly we are very grateful to the institute for giving us an opportunity to do this project work and for making the all facilities like various mechanical workshops, the library and internet available. We are indebted to the institute for providing such a forum where we can utilize and in a way gain practical knowledge and skills acquired over the complete curriculum.

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List of Abbreviations

1. JNP.....Jigme Namgyel Polytechnic
2. SJI.....Samdrup Jongkhar Initiative
3. HOD.....Head of Department
4. MS.....mild steel
5. mm.....millimeter
6. kg.....kilogram
7. Hrs.....hours
8. nos.....numbers
9. cm.....centimeter
10. amps.....ampere

1. Introduction

The project title is the “The Fabrication of Waste Segregation Stations”. Two types of waste segregation stations were fabricated based on the design provided. The design is the winning design of the competition, which was organized by Samdrup Jongkhar Initiative, Dewathang. The competition was open to all the students and faculties of our institute. And two of our civil engineering students won the competition. However, the stations could not be produce as exactly as the winning design and had to undergo some the necessary modifications for minimal material lost and fabrication capabilities adaptation.

There are two types of Waste Segregation stations in the design. The first one is pentagonal type and the second one is simple type.

The Pentagonal type has five collection bins and has the provision to rotate about the main base column. The bin can be also tilted for easy unloading of waste. Unloading can be done without removing from its hinge. At the base of the bin, a bell is attached to get attention of the children to throw the waste in it. The height of the bin from the ground is appropriately maintained to prevent scavenging by the animals like dogs and also it is not too high for children to dispose. The rotation is achieved by placing one ball bearing and one tapered bearing. The bearings can withstand the load of the bin axially and radially.

The simple type station was designed with two support columns and two horizontally placed beam frames. Both pillar and beam are fabricated from mild steel circular tube. Each station is provided with the five removable bins. The hole is provided in one of the detachable beam frame for locking the bins to protect from the thieves. The unloading can be done only if the station unit is unlocked.

1.1 Objective

- The main objective of this project is to maintain the surrounding clean and to dump the waste by sorting out (i.e. degradable, non degradable, plastics, bottles, etc.).
- To fulfill the need of segregation stations for Chokyi Gyatso Institute
- To benefit the group members in terms of knowledge, skills and experience in doing estimations, fabrication, time management, team work, and drafting.
- To implement the theoretical knowledge in to real structure.

1.2 PROJECT REPORT STRUCTURE

- i. Modification of original design
- ii. Estimating and costing
- iii. Fabrication
- iv. Conclusion
- v. Recommendation
- vi. Reference

1.3 Work plan

In the beginning of our project, we made a work plan for five months as given below and then we carried out our tasks accordingly.

Sl No.	Activities	Feb	March	April	May	June
1	Design, modification and drawing					
2	Estimation and costing for material requirement and machining.					
3	i. Cutting and preparing of job piece ii. Machining of bearing hub					
4	Fabrications i. Cutting of raw materials as per the required dimension, ii. Preparing of parts for welding, iii. Welding of different parts as per the drawing,					
5	i. Grinding and post finishing of welds ii. Sanding and painting of finished stations iii. On- site installation					
6	Project Presentation					

2 Modification

The original design given was modified depending on the technical and fabrication capabilities in the institute. Some adjustment in the sizes and shapes were also done to minimize the raw materials wastage, because in the original design, the standard and convention sizes were not accounted. The limited capacity of the machineries and the changes desired by the client, compelled to design to modify. However, while modifying, the main objectives of waste segregation was not affected.

2.1 Bearing and Bearing Hub relocation

In the original design, the bearings are located at the base of the support column, below the ground level. As the segregations are going to be erected in open places, the ground water, soils, clays and other material can easily get into the bearing, thereby increasing the wear and tear of bearing. This will require the frequent maintenance.

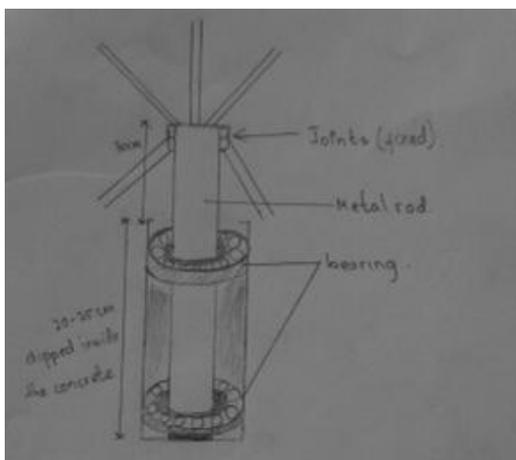


Fig 2.1(a) Bearing arrangement before modification

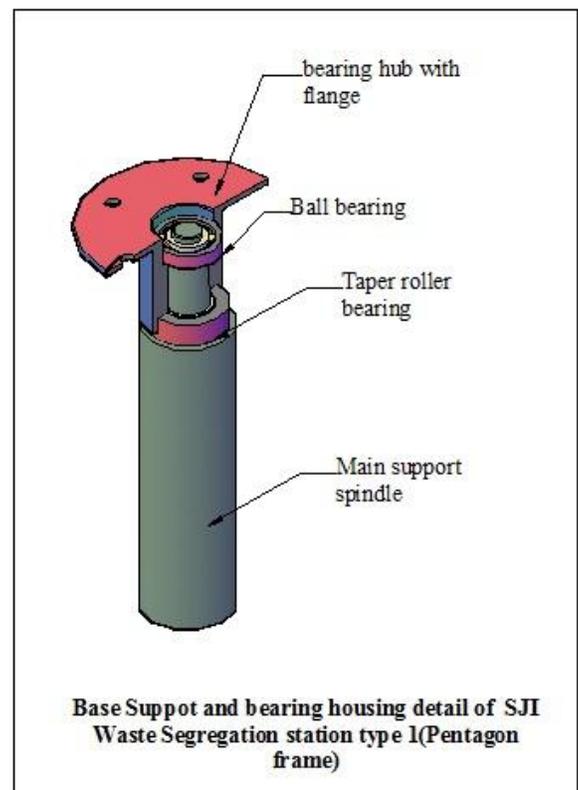


Fig. 2.1(b) Bearing arrangement after modification

2.2 Resizing of the bins

As per their requirement, each bin should be approximately 1.5-2 times the size of a common ‘USE ME ‘oil tin which has huge volume. Because of the huge size the bin might collide with each other while unloading and the bearings cannot withstand the axial and radial load of the bins. Moreover for the reduction of waste produced by the excess leftover of the wire mesh, the height was reduced as per the standard size of wire mesh available in market. Therefore the bin size was changed from original size of 400mm diameter and 500 mm height to new size of 300mm diameter and 450mm height. And also the frame sizes of the bins were reduced for easy unloading and to reduce the load to the shaft.

2.3 Locking system

In their design there was only one pole and a hook to hang the bins which is not very convenient to lock the bins. So, we added one more pole which can slide and lock the bins.

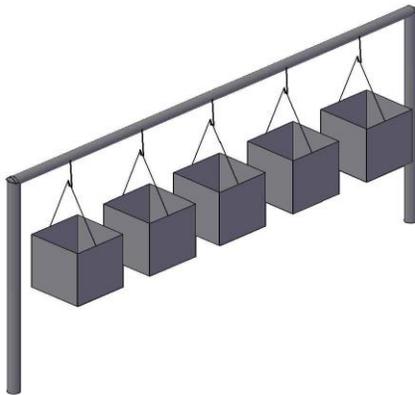


Fig. 2.3(a) Simple type station before modification

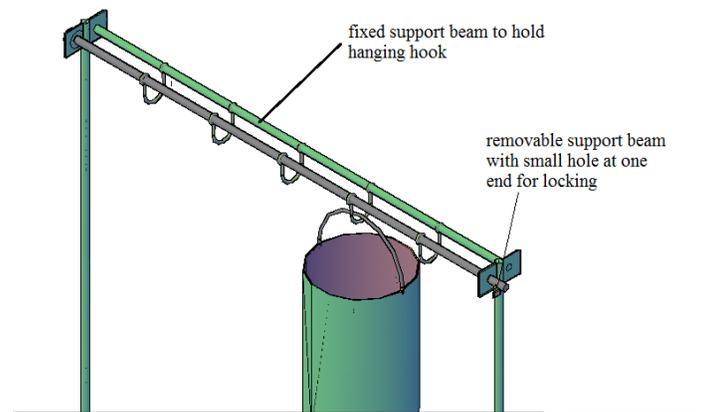


Fig. 2.3(b) Simple type station after modification

2.4 Frame of the station

In the original design of pentagonal type waste segregation stations, on the opening end of the collection bins, there was a support frame across its diagonal, which would give problem in unloading. So to unload easily and avoid the colliding of the bin with the frame, the required changes were made and thereby reducing the weight of the station.

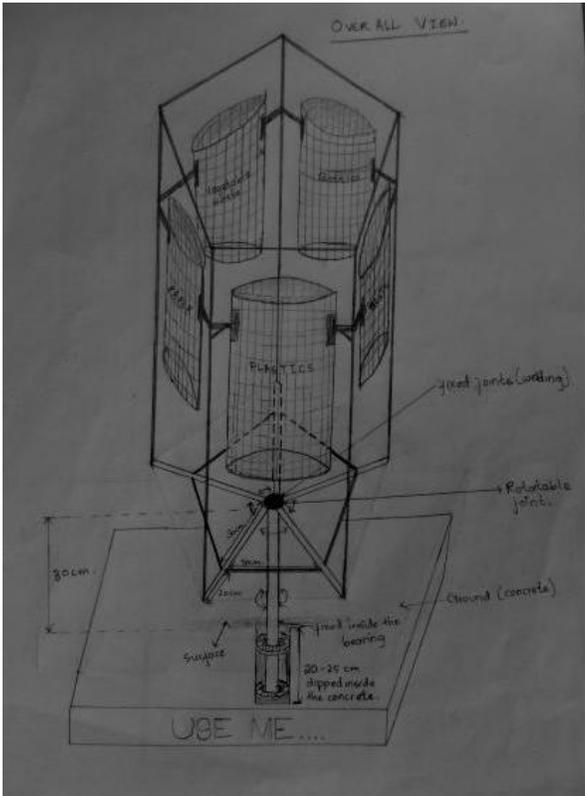


Fig 4.4(a) Pentagonal type Waste Segregation (original design)

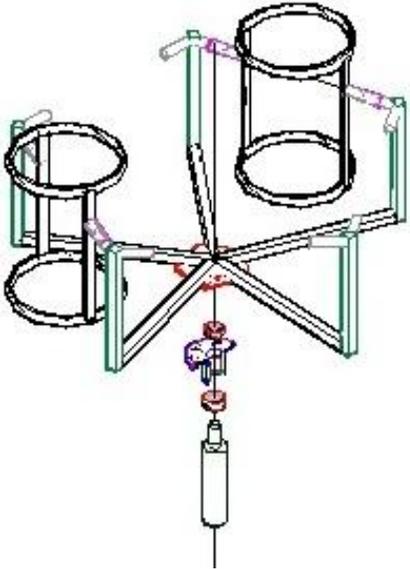


Fig. 4.4(b) Pentagonal type Waste Segregation station (modified)

2.5 Fixing with nut and bolt

In the pentagonal type, the base and the body was supposed to weld together to make one solid unit. If welded together, there will be difficulty in replacing of worn-out bearing and to do any other necessary maintenance in the base. To overcome those problems, the station is fabricated in three separated units and all these are assembled together with nuts and bolts.

3 Estimating and costing

Table 3.1: Fabrication cost estimates of Pentagonal Type Waste Segregation Station

SI No.	Description	specification	Length (m)	allowance (15%)	Quantity	unit	Rate (Nu.)	Cost (Nu.)
1	MS flat bar	(17x3) mm	18	20.7	7.804	kg	75.00	585.30
2	MS flat bar	(40x4)mm	5	5.75	5.146	kg	75.00	385.97
3	MS square tube	(40x40)mm	6	6.9	13.662	kg	82.00	1,120.28
4	MS circular tube	(22 x 3) mm	2	2.3	3.312	kg	65.00	215.28
5	MS round bar	dia- 22 mm	2	2.3	6.854	kg	65.00	445.51
6	MS round bar	dia-64 mm	0.5	0.575	14.979	kg	110.00	1,647.66
7	wire mesh	Wire dia- 1 mm, grid size- 20x20 mm, breadth- 900mm	5	5.75		m	190.00	1,092.50
8	MS plate	(500x500x3)mm		0	5.9	kg	110.00	649.00
9	Red oxide	same brand as thinner			4	litres	270.00	1,080.00
10	Green Paint	same brand as thinner			4	litres	400.00	1,600.00
11	Ducco thinner				3	litres	410.00	1,230.00
12	Paint brush	3 inches size			1	nos	55.00	55.00
13	Speed Cutter wheel	355mm x 28mm x 25.4 mm			1	nos	975.00	975.00
14	Emery paper	Grain size			5	pieces	30.00	150.00
15	MS electrode				2	packets	525.00	1,050.00
16	Cotton waste				1	kg	295.00	295.00
17	Bell				1	nos	200.00	200.00
18	Gloves				1	pairs	350.00	350.00
19	Bearings				2	nos	600.00	1,200.00
20	Machining overhead cost	Inclusive of equipments charge						2,000.00
21	welding overhead cost	Inclusive of welder and equipments charge	0.6					1,200.00
22	Labour cost				5	days	175.00	875.00
	On-site erection cost							500.00
23	Administrative overhead cost							2,000.00

Total Cost  **20,901.51**

Table 3.2: Fabrication cost estimate of simple type Waste segregation station

SI No.	Description	specification	Length (m)	allowance (15%)	Quantity	unit	Rate (Nu.)	Cost (Nu.)
1	MS flat bar	(17x3) mm	18	20.7	7.804	kg	75.00	585.30
2	MS flat bar	(40x4)mm	5	5.75	5.146	kg	75.00	385.97
4	MS circular tube	(50 x 3) mm	3.5	4.025	13.001	kg	65.00	845.05
5	MS circular tube	(22x3)	4.5	5.175	7.452	kg	65.00	484.38
	MS round bar	dia-10mm	5	5.75	4.991	kg	65.00	324.42
7	wire mesh	Wire dia- 1 mm, grid size- 20x20 mm, breadth- 900mm	5	5.75		m	190.00	1,092.50
8	MS plate	(500x500x3)mm		0	5.9	kg	110.00	649.00
9	Red oxide	same brand as thinner			2	litres	270.00	540.00
10	Green Paint	same brand as thinner			2	litres	400.00	800.00
11	Ducco thinner				1.5	litres	410.00	615.00
12	Paint brush	3 inches size			1	nos	55.00	55.00
13	Speed Cutter wheel	355mm x 28mm x 25.4 mm			1	nos	975.00	975.00
14	Emery paper	Grain size			4	pieces	30.00	120.00
15	MS electrode				1	packets	525.00	525.00
16	Gloves				1	pairs	350.00	350.00
17	Machining overhead cost	Inclusive of equipments charge						1,000.00
18	welding overhead cost	Inclusive of welder and equipments charge	0.62					1,000.00
19	Labour cost				5	days	175.00	875.00
20	On-site erection cost							300.00
21	Administrative overhead							1,000.00

Total Cost **12,521.61**

3.1 Total cost

1. Direct material cost of fabricating 1 no. of pentagonal type and 4 nos. of simple type

$$= 20901.51 + (4 \text{ nos.} \times 12521.61)$$

$$= \text{Nu. } 70987.95$$

2. Direct labor cost

Total time taken to complete the project = 105 hrs

Considering 6 hours of working hrs per days, the days taken to complete the project

$$= (105 \text{ hrs} / 6) = 18 \text{ days.}$$

There are six persons involved in completing the project and considering the wage rate of Nu.175 per day for general worker;

the total wage = Number of days x number of person x daily wage rate

$$= 18 \text{ day} \times 6 \text{ persons} \times 175/- = \text{Nu. } 18900/-$$

3. Direct cost

Therefore the direct cost = direct material cost + direct labor cost

$$= \text{Nu. } 70987.95 + \text{Nu. } 18900.00$$

$$= \text{Nu. } 89887.95$$

4 Fabrication

4.3 Fabrication of Pentagonal type bin

4.3.1 Bin

The five numbers of bins was made by using wire mesh and the ms flat in each station. In each bin three numbers of ring made of ms flat (17x3mm) was welded for the strength. To weld pin, the two numbers of ms flat (40x4mm) of length 450mm was welded on the side of the wire mesh.

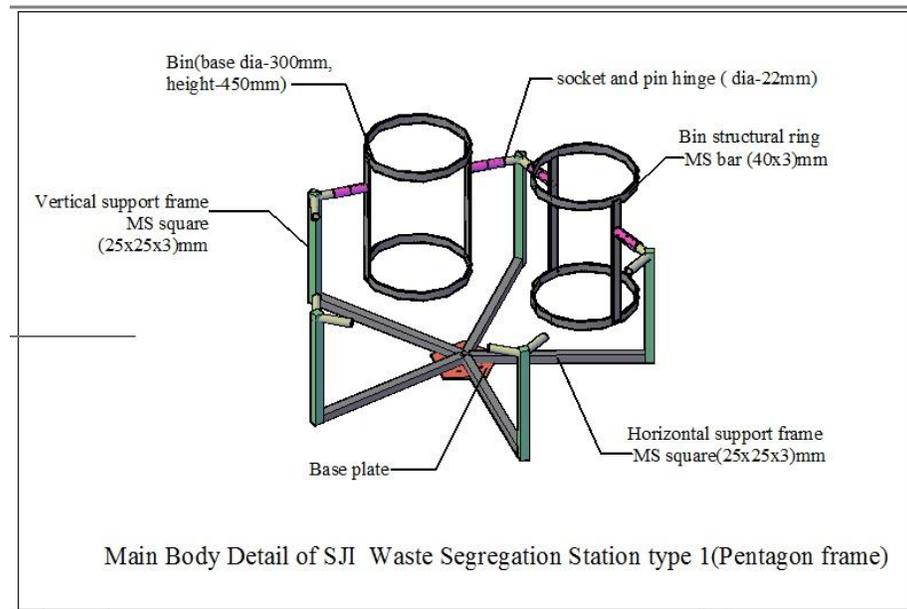


Fig. 4.3(a): Main Body detail of Waste Segregation Station (Pentagon frame)

4.3.2 Frame

The five numbers ms square tube of size 25x25x3mm length 5500mm and another five numbers of size 25x25x3mm of length 4500mm was cut and welded perpendicularly to each other. On the vertical part of the frame the ms round (diameter-22mm) of length 200mm was attached as the socket of the bin. Therefore this part is attached to the pentagonal base.

4.3.3 Bearing housing and Main Support spindle

In the pentagonal type of bin, the rotating base was fabricated. The components of the base are one roller bearing, one tapered bearing, the spindle and the bearing seat.

The bearing seat is machined out of solid MS plate and the MS rod of 64 mm diameter. A centre hole for spindle is drilled and bored in the rod by using the lath machine. On the flange of the bearing hub, four holes of 10 mm diameter are provided for M10 nuts and bolts.

The spindle is fixed as base on the foundation. The bearing hub with flange is assembled over the spindle. The frictional interference between the bearing hub and spindle is taken care by providing one taper bearing for axial load and another radial bearing for radial load. The spindle is machined by step turning. The external thread for check nut is also machine by using lath machine and die respectively.

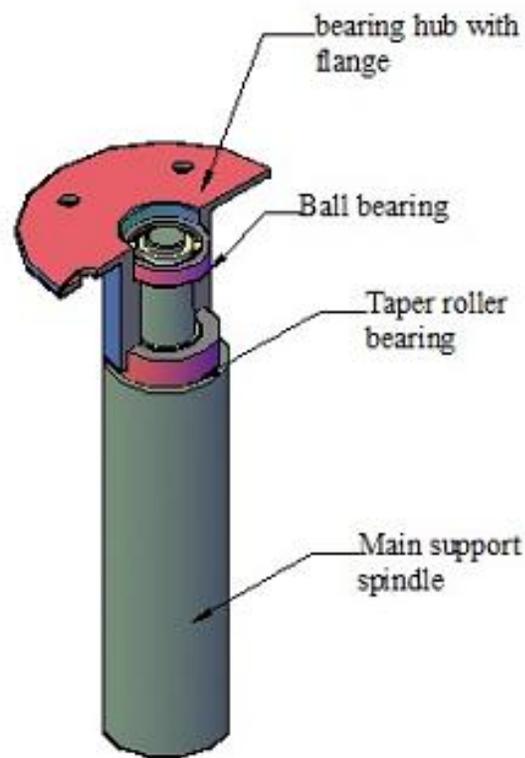


Fig. 4.3(b): Bearing housing and spindle base detail

4.3.4 Name plaque

The 20 numbers of sheet metal of length 300 mm and bread 120 mm were cut into rectangular shape by using guillotine machine. The name plaque is then pop riveted to the side of bin. This is mainly provided for information dissemination.

4.3.5 Painting

All the rusted part of the materials was cleaned by using emery paper. To prevent from rust the red oxide was applied twice. After 24hours the desired paint was applied. In painting, the compressor was chosen to paint it uniformly and to make the work faster.

4.4 Simple type bin fabrication

There are four sets of simple type station. In one station there are five bins, to hold the bins the frame is the main structure of station. The frame consists of four poles (two vertical and two horizontal). At the ends of the horizontal poles, two MS flat plates with hole are welded and five U-shaped hooks with eyes are provided for hanging bins.

MS rod of diameter 20mm and length 200mm is made into u-shape by using the bending machine. To make eye of the hook, MS tube was welded at the two end of the u-shape rod

Out of two horizontal poles one is fixed permanently and other one, which is little longer than the fixed one, can slide through the eye of the hooks, for removing the bins.

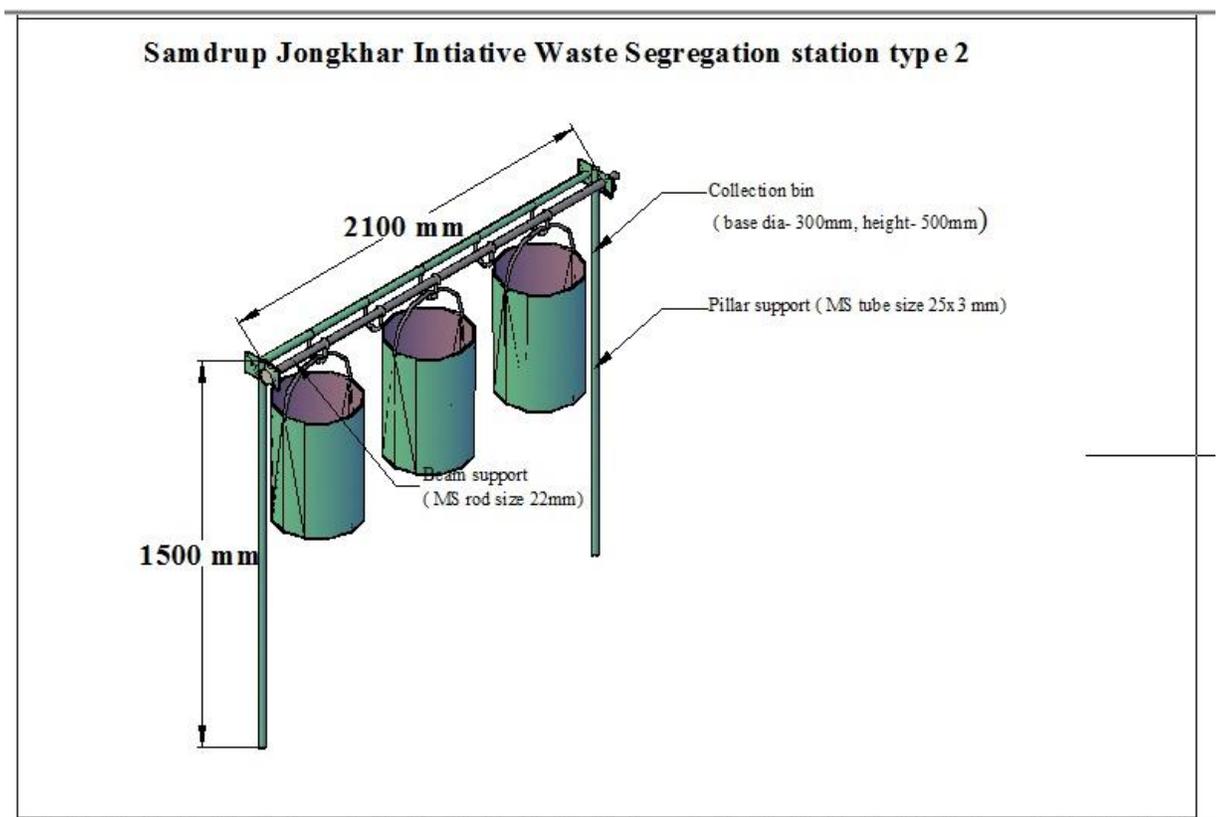


Fig. 4.4(a): Waste Segregation station (Simple type) detail

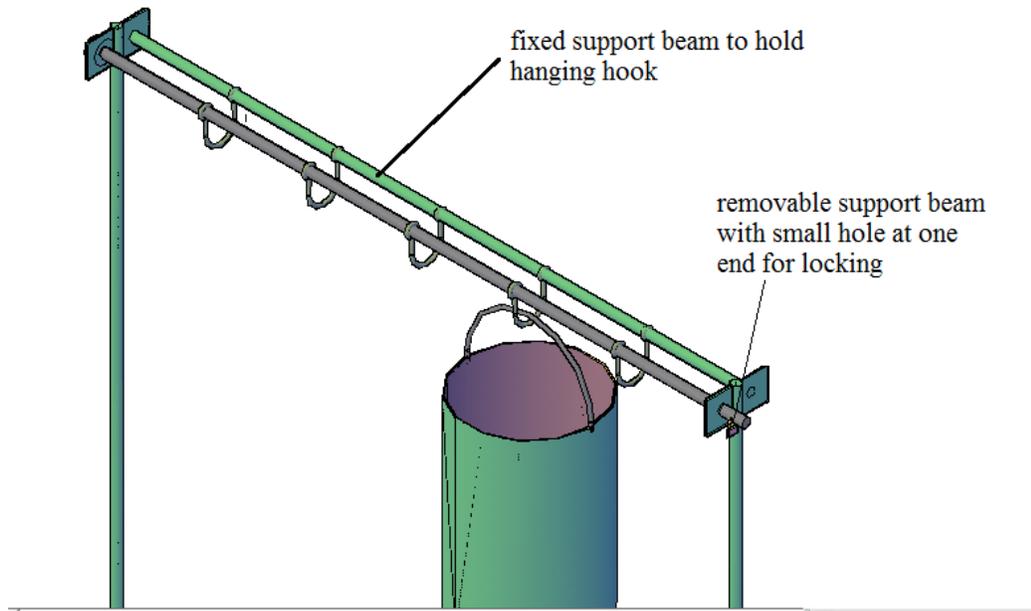


Fig. 4.4(b): Waste Segregation station (Simple type)-horizontal support detail

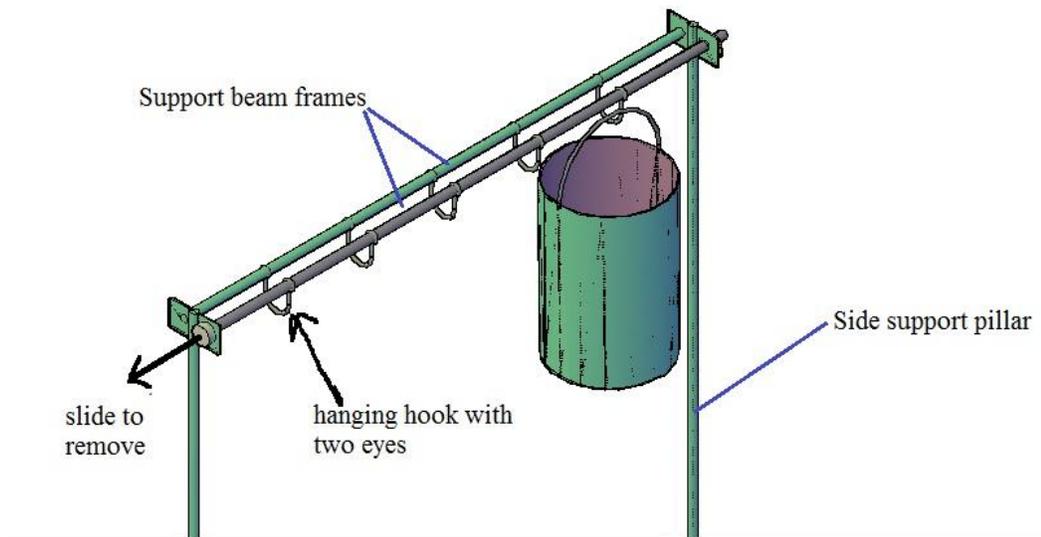


Fig. 4.4(c): Waste Segregation station (Simple type)- removable frame detail

Sl.no	Name of the items	Specification	Quantity
1	Welding machine	63 amps,50 Hz.3 phase, current range 50-400amps	2
2	Drilling machine		2
3	Grinding machine	150mm wheel dia,1919rpm	1
4	Guillotine machine	Motor driven, capacity 3mm	1
5	Power hacksaw		1
6	Speed cutting machine		1
7	Lathe machine		3

Table 4.1 : Machines used for fabrication

Sl no.	Name of the items	Specification	Quantity
1	Measuring tape	10m	1
2	Hacksaw blade		4
3	Welding screen		3
4	Ball pin hammer	300gm	2
5	Try square		2
6	Sprite level		1
7	Chipping hammer		2
8	Hand sharing machine		1
9	Riveter		1
10	Die		2

Table 4.2 : Tool used for fabrication

5 Conclusion

Our project was on fabrication of waste segregation bins. The required materials (wire mesh, ms flat, ms round tube) was issued and cut into specified length with the help of hand sharing and gelato machines. It was welded to make pentagonal shape and simple horizontal shape dustbin with each shaft holding five bins each. The bearing was used to able the pentagonal shape to rotate and a bell is hung on one of the bin on the shaft. Horizontal dustbin is provided with lock system to prevent from stealing the bin. Emptying of bin is possible only through the unlocking and sliding the tube.

After completion of the project we have gained extra skills, learnt the management of materials, energy, time and money. Never the less we also have experienced and understood the working conditions in and around the world especially in the engineering field.

It will maintain the surrounding clean and to dump the waste by sorting out wastes (i.e. degradable, non degradable, plastics, bottles, etc.). The fabrication work was all based on field related which able us to work confidently in near future.

6 Recommendation

To fabricate similar product in near future we would like to suggest and recommend the following;

- i. Gained the skills in operating several types of machines
- ii. The project period was clashed with other practical classes
- iii. Time was fruitfully used.
- iv. It was also equally important to learn the other department's subject i.e we have done the concrete work.
- v. The waste was properly segregated.

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