

# MODEL DESIGN

*For*

50 TPD MATERIAL RECOVERY FACILITY

Swachh Bharat Mission - Urban 2.0

Central Public Health and Environmental  
Engineering Organisation (CPHEEO)



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## Abbreviations

ABS	:	Acrylonitrile Butadiene Styrene
ADB	:	Asian Development Bank
AMC	:	Annual Maintenance Contract
ANSI	:	American National Standards Institute
BOQ	:	Bill of Quantity
C&D	:	Construction and Demolition
CCTV	:	Closed-Circuit Television
CE	:	Conformite Europeenne
CFM	:	Cubic Feet per Minute
CMC	:	Comprehensive Service Contract
CPCB	:	Central Pollution Control Board
CPHEEO	:	Central Public Health & Environmental Engineering Organisation
CTE	:	Consent to Establish
DJB	:	Delhi Jal Board
ELCB	:	Earth Leakage Circuit Breaker
EPA	:	Environmental Protection Agency
ERT	:	Emergency Response Team
ERW	:	Electric Resistance Weld
EVA	:	Ethylene Vinyl Acetate
GI	:	Galvanized Iron
GSM	:	Gram per Square Metre
GST	:	Goods and Services Tax
HFL	:	Highest Flood Level
HMI	:	Human Machine Interface
HP	:	Horse Power
HSE	:	Health, Safety and Environment
ID	:	Inner Diameter
IP	:	Ingress Protection
ISO	:	International Organization for Standardization
ISWM	:	Integrated Solid Waste Management
ITI	:	Industrial Training Institute
KL	:	Kilo Litre
KLD	:	Kilo Litre per Day
kW	:	Kilo Watts
LED	:	Light Emitting Diode
LPM	:	Litre Per Minute
LT	:	Low Tension
MLP	:	Multi Layered Plastic
MoEF&CC	:	Ministry of Environment, Forest and Climate Change
MoHUA	:	Ministry of Housing and Urban Affairs
MRF	:	Material Recovery Facility
MS	:	Mild Steel
MSW	:	Municipal Solid Waste
MT	:	Metric Tonne
MTS	:	Multi Tasking Staff
NBC	:	National Building Code

NCR	:	National Capital Region
NFPA	:	National Fire Prevention Association
NOC	:	No Objection Certificate
NRR	:	Noise Reduction Rating
O&M	:	Operation and Maintenance
OD	:	Outer Diameter
On-SEMP	:	On-Site Emergency Management Plan
PCC	:	Pollution Control Committee
PET	:	Polyethylene Terephthalate
PLC	:	Programmable Logic Controller
PPE	:	Personal Protective Equipment
PVC	:	Polyvinyl Chloride
RDF	:	Refuse Derived Fuel
RPM	:	Revolution Per Minute
RRC	:	Resource Recovery Centre
RTO	:	Regional Transport Office
SBM	:	Swachh Bharat Mission
SLF	:	Sanitary Landfill
SOP	:	Standard Operating Procedure
SPCB	:	State Pollution Control Board
SS	:	Stainless Steel
SUP	:	Single-Use Plastic
SWM	:	Solid Waste Management
TPD	:	Tonnes Per Day
TPH	:	Tonnes Per Hour
TSDF	:	Treatment, Storage and Disposal Facility
ULB	:	Urban Local Body
UPS	:	Uninterrupted Power Supply
UV	:	Ultraviolet
VFD	:	Variable Frequency Drive



## Executive Summary

India is one of the fastest-developing economies in the world, leading to a rise in per capita incomes. Due to the increase in disposable income, changing lifestyles, rapid urbanization, and population growth, the generation of Municipal Solid Waste (MSW) is increasing across India. Solid Waste Management (SWM) is an essential service provided by urban local bodies (ULBs) to maintain cleanliness in urban areas. However, most ULBs are yet to develop infrastructure for segregated processes of waste.

Government of India, through the Ministry of Housing and Urban Affairs (MoHUA), has initiated various steps to address the issue of scientific SWM. With major initiative is the Swachh Bharat Mission (SBM), launched on October 2, 2014, to fulfill the vision of a 'Cleaner Bharat'. SBM-Urban aims at making urban India clean with 100% scientific management of Municipal Solid Waste (MSW) in 4800+ statutory towns across the country. On October 1, 2021, the Hon'ble Prime Minister launched the continuing mission of SBM-Urban 2.0 with a mission to make all Indian cities 'Garbage Free.'

SBM-U 2.0 seeks to address the gaps in the management of MSW. A crucial intervention is that of Material Recovery Facilities (MRFs) for recovering commercially valuable materials like plastics, paper, metals, glass, e-waste, etc., from dry/non-biodegradable waste for recycling. SWM Rules 2016 prescribe duties and responsibilities of ULBs to set up MRFs or secondary storage facilities with sufficient space for sorting materials. The goal is to set up at least one MRF in every city/town.

Depending on the ULB's population, MRF requirements may vary in capacity and process. This model document focus on the requirements of ULBs with a population in the range of 2,00,001 to 5,00,000 and approximate waste generation of 100 to 250 TPD, of which about 30% - 35% is generally dry waste.

This document provides brief information on the process requirements, area requirements, infrastructure requirements, essential equipment/instruments, etc. It also covers manpower requirements, water demand, power consumption, personal protective equipment, etc. Other issues covered include brief SOP, Record Keeping, Annual Maintenance Contract, Emergency Response Plan, Statutory Requirements, and Siting Requirements for an MRF.

In a nutshell, it also provides details on CAPEX, OPEX, engineering drawings, and BoQ. ULBs would be able to develop their tender document and BoQ using this document as a reference, in compliance to the SWM Rules 2016, and the Manual on Municipal Solid Waste Management of CPHEEO, MoHUA.



Table A. Abstract of Cost Estimate including O&amp;M and Sustainability

Sl. No	Description	As per detailed Estimates (Rs in Lakhs)
A	<b>CAPEX</b>	
	1. Civil Cost	938.37
	2. Electromechanical & Firefighting equipment Cost	157.90
	<b>Total CAPEX</b>	<b>1096.27</b>
B	<b>OPEX (Yearly)</b>	<b>174.80</b>
<b>O&amp;M Sustainability Details</b>		
	➤ <b>Recyclables per day</b>	<b>20 TPD</b>
	➤ <b>Annual Operation</b>	<b>365 days</b>
	➤ <b>Annual Recyclables</b>	<b>7300 MT</b>
	➤ <b>Approx. Sale Price for Recyclables</b>	<b>Rs. 6000 per MT</b>
	➤ <b>Annual turnover</b>	<b>Rs. 438 lakh</b>
	➤ <b>Annual Expenditure</b>	<b>Rs. 174.80 lakh</b>
The effective operation and maintenance of MRF is likely to generate revenue to meet the day to day expenditure. However, ULB may consider levying some user fees on households and bulk generators, which will further enhance revenue collection and would facilitate repayment of loan, if any, apart from proper upkeep of plant and replacement of machineries and equipment as and when necessitated.		

**Disclaimers:**

1. This Guideline has been prepared considering the best suited/appropriate material and capacities for ideal situation. However, guidelines may be modified/changed/replaced by the ULBs as per any available resources (already procured) and suitability as per soil, site and local conditions. ULB's must take prior approvals of the competent authority of ULB's / department concerned before implementing the MRF project.
2. This design can be suitable for plain areas. It can be used for hilly regions if adequate land is available.
3. The model design is subjected to continuous developments/improvements over time hence applicable revisions may be considered accordingly.

## 1. Introduction

Urban India is facing the challenge of providing basic infrastructural needs of a growing urban population. There is a massive challenge in waste management due to rapid urbanization. Urban India generates approximately 55 million tonnes of municipal solid waste per annum. Out of this, about 30-35% is dry waste comprising paper, plastics, glass, metals, e-waste, etc which can be sorted and recovered as valuable recyclable materials.

The SWM Rules 2016 prescribes duties and responsibilities on ULBs for setting up MRFs or secondary storage and storage facilities with sufficient space for sorting recyclable materials.

## 2. Need for MRF

For recovery of commercially valuable materials from non-biodegradable waste, Material Recovery Facilities (MRFs) are required to be established in each ULB with adequate capacity to sort the dry waste. Depending on the scale of operation and level of mechanization in the facility, MRFs may be classified as manual or mechanized. At small MRF, manual sorting is the usual practice which is suitable for smaller ULBs. To suit the requirements of a bigger population say between 1 lakh to 5 lakh, a semi automated MRF is required. Fully mechanized systems are suitable for very large ULBs having population such as 10 lakh and above.

MRFs fulfill the followings:

- ♻️ Reduce the amount of waste being disposed / dumped.
- ♻️ Maximize resource recovery to promote circular economy.
- ♻️ MRF serve as intermediate processing step between the collection of recyclable materials from waste generators and the sale of recyclables and RDF to the recycling market and for other processes and industries.
- ♻️ Generate the revenues from the waste and promote waste to wealth.

## 3. Advantage of MRF

The advantages of having MRF in the municipal solid waste services of ULBs are:

- ♻️ Segregation, sorting and salvaging of recycling waste materials prevents a significant fraction of municipal waste from being dumped or disposed in landfills.
- ♻️ MRF ensures longer life span for landfills/reduced requirement of land and subsequent environmental management efforts.
- ♻️ Recovery of recyclables generates revenue and help in cost recovery.
- ♻️ MRF help the ULBs in reducing the waste volumes.
- ♻️ Help in generating livelihood opportunities for informal workers, local vendors/recyclers and promote circular economy.
- ♻️ Help in reducing environmental impacts and the burden of waste management on public authorities.

- ♻️ Cost savings in the collection, transportation and disposal infrastructure for MSW.

#### 4. Design Factors

A 50 TPD MRF is suitable for serving population ranging between 2,00,001 to 5,00,000 in a ULB alone or waste catchment/cluster area with similar population. Semi automated MRF of 50 TPD are a better choice as a sustainable solution for such ULB's. Typical MRF will be a warehouse-type design with roofing. The warehouse design minimizes the placement of columns that would interfere with the efficient movement of material, equipment, staff and vehicles.

MRF layout should have dedicated space for:

- ♻️ Receiving area
- ♻️ Sorting/processing area
- ♻️ Storage area for recyclables, residual storage area
- ♻️ Equipment area: Shredder, baler, magnetic separator.
- ♻️ Bins for sorted materials
- ♻️ Loading area for residuals and processed recyclables
- ♻️ Space for Offices/Admin/Record room
- ♻️ Washroom/changing room

##### 4.1. Waste characterization

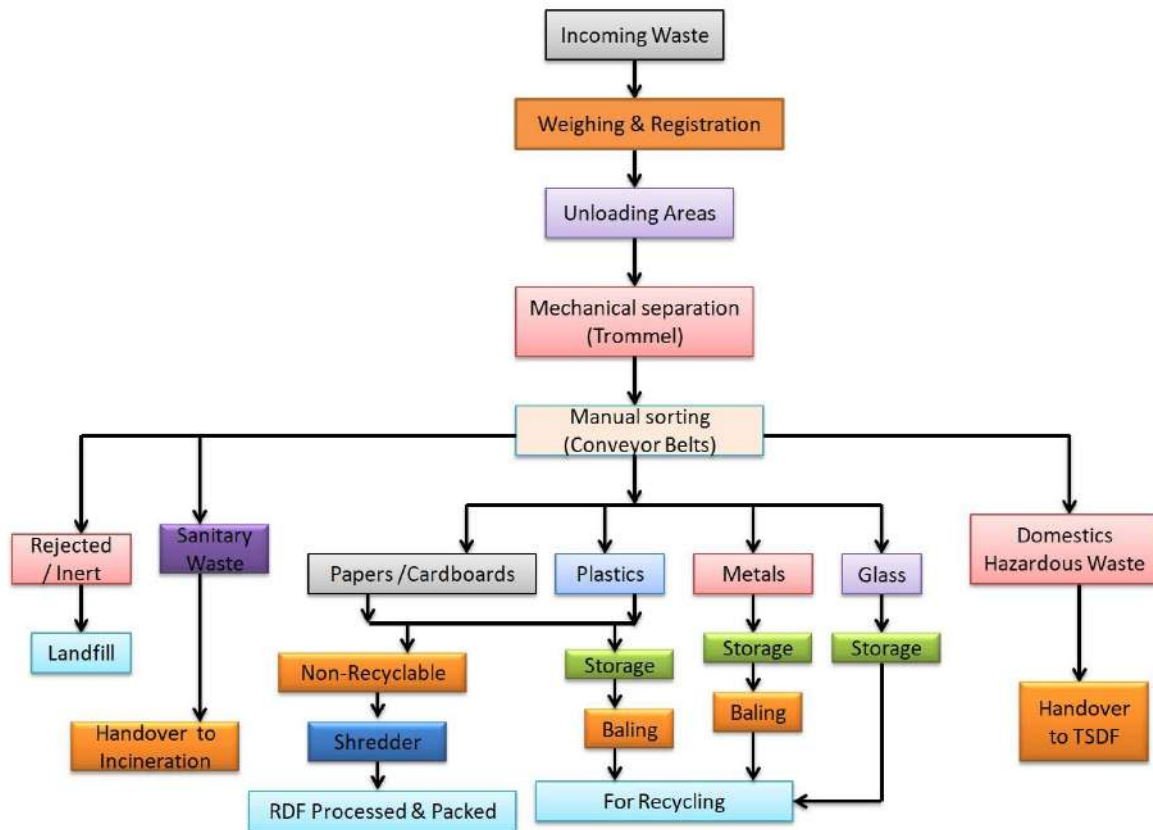
MSW composition and characteristics vary considerably across the country. The heterogeneous nature of MSW necessitates the requirement of characterization prior to the design of MRF. Waste characterization shall be done as per the Municipal Solid Waste Management Manual of Central Public Health and Environmental Engineering Organisation (CPHEEO), MoHUA.

#### 5. MRF Process Description

Dry fraction of solid waste received from door to door collection will be gathered and transported to MRF unit. Upon reaching the MRF, vehicles will be weighed and recorded at the weighing bridge. The vehicles will then move to unloading area and empty vehicles will be weighed again to determine the quantity of waste delivered. *Gathari* and dumpster bags shall be unbundled at receiving area. Discarded furniture, blankets, empty tins, etc. shall be physically removed. From the receiving area, the dry waste is fed onto a slow-moving conveyor belt for sorting through a trommel.

Items not suitable for the trommel, such as glass bottles, metal container, any hazardous material like paint containers, etc. are taken out manually and put in appropriate bins. The depth of the waste layer on the conveyor belt leading to trommel should remain less than 10 cm. The trommel separates waste based on size which will be further sorted manually at the tail end conveyor lines. Waste shall be further sorted as recyclables, sanitary waste, coconut shell and hazardous waste into vats or large containers.

After completion of sorting, rejects/inert will be sent for land filling while domestic hazardous waste for treatment and sanitary waste for incineration will be handed over to respective common facilities. Baling will be required for sorted fractions of cardboard, metal cans, and plastics. The bales of different materials shall be stored in the designated storage area to be handed over for further recycling. The glass fractions shall be stored separately for recycling. The general process flow diagram for a 50 TPD MRF is shown in **Figure 1**.



**Figure 1: Process Flow Diagram**

To get better price, the recyclable materials recovered at MRF must meet the needs of market. The recovered materials should be clean, adhering to quality parameters acceptable to market, in bulk package, uniformly compacted/baled etc. to facilitate and meet the market demand. If not, the segregated materials will fetch lower prices or rejection by recyclers.

## 6. Infrastructure

The plot area requirement for this typical 50 TPD MRF is 6391 sqm say 6400 sqm / (1.6 Acre (approx.)) including green belt and internal roads with overall plot size of 83 m x 77 m. The space required for establishing a processing & storage warehouse building and utility is approx 3100 sqm. The supportive infrastructure includes access roads, utility area, office space and parking area. Depending on the actual plot size and

dimensions thereof, the general arrangement/layout can be changed to suit the land available.

Essential facilities include adequate space for receiving & unloading, sorting & processing, storage space for recyclables, equipment area, space for office/admin/record room, space for loading of residual and processed recyclables, wash room, changing room, parking and utility areas. The area statement as per the typical layout plan is given in the **Table 1**.

**Table 1: Area Statement**

Sl. No	Description	Area in sq. metre (approx.)	Remarks
<b>I Processing, storage and equipment area</b>			
a.	Processing & circulation area	1569	Processing area includes sorting area, conveyor systems, trommels, and passages for vehicular and material/personnel movement
b.	Receiving area	445	Receiving area is for receiving waste from the tippers/collection vehicles and space for operation of handling units
c.	Storage for recyclables	96	10 store room: one each for different material
d.	Baler machine	25	-
e.	Shredder machine	25	-
f.	Shredded RDF storage area	46	-
g.	Store room	22	For safe custody of spares of equipments and tools.
h.	Bales storage area	363	-
<b>II Office area</b>			
1	Office space	140	Includes space for reception, project manager cabin, pantry, toilet and conference hall
2	Changing Room (Male)	49	Spaces with locker facility and changing space
3	Changing Room (Female)	49	
4	Toilet (Male)	23	--
5	Toilet (Female)	23	
<b>III Utility Spaces</b>			
1	Pump house	20	For fire pumps as per NBC
2	Water tank	23	To meet the fire demand (As per NBC guidelines for a Category H building)



Sl. No	Description	Area in sq. metre (approx.)	Remarks
3	Transformer & Current Transfer Potential Transfer (CTPT)	24	--
4	Security Room	22	--
5	Weigh Bridge Office	22	Space for operator & records
<b>Total</b>		<b>≈ 6400</b>	

## 7. Equipment

For effective handling of the day to day operations of sorting and storage of dry waste at MRF, the following equipment and machinery would be needed. The capital cost of equipments are also estimated. The equipment are classified as given below:

- ♻️ Process Equipment
- ♻️ Electrical Equipment
- ♻️ Firefighting Equipment

### 7.1. Process Equipment

The process equipment/machinery and their technical specifications are detailed below:

#### 7.1.1. Weighbridge

A weighbridge is used to weigh the vehicles and the contents they deliver. By weighing the vehicle both loaded and when empty, the load carried/ delivered by the vehicle can be calculated. The specifications of a weighbridge are given in **Table 2**.

**Table 2: Weigh Bridge**

Parameters	Specifications
Weigh Bridge Type	Surface mounted Electronic Weigh Bridge
Platform material	Mild Steel meeting requirements under IS : 2062 Anti-skid type (chequered), Thickness of platform plate not less than 10 mm (7.5 metre long and 3 metre width) with proper MS beams
Weighing Capacity	30 Tonne
Load cell	4 Load cell with Nickel plated alloy steel body
UPS	½ hour backup.
Printer	Laser
Weighment & printouts	Attached as <b>Annexure 2 (1)</b>
Display modes	a) Indicate weight b)Indicate calibration-Auto zero tracking and calibration to be checked automatically every 5 minutes
Indicator Units	Kg
Type/capacity of load cell	Digital Double Ended Shear Beam load cells, pre-calibrated load cells - 10000kg (04 No.) with mounting

Parameters	Specifications
	kits
ABS Junction Box : 01 Set with IP 65 protection class for connection	Cables : Home run cable 12 metre & inter connections cable between load cell and junction box & weighing electronics 02 metre
Least count	2 Kg
Acceptable error	± 1 Kg
Electric supply	3 Phase (440 V, 50Hz)
The Machine metal part	powder /paint coated
Installation & Demonstration	Yes

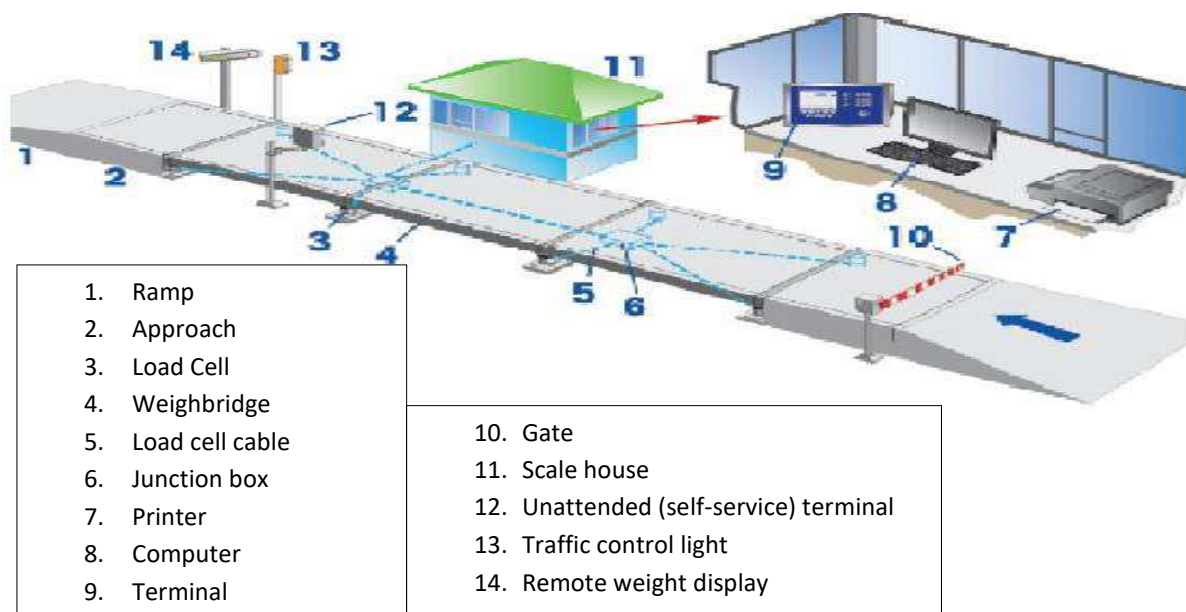


Figure 2: Representative picture of Weighbridge

### 7.1.2. Conveyor Belt System

Conveyor belts are used at MRF for feeding waste to trommel and also for taking away different fractions for sorting and segregation. Belt conveyor shall conform to IS : 11592 : 2000 and material of belt i.e., rubber conveyor shall conform to IS : 1891-4. Efficiency of a MRF is greatly enhanced by using conveyor system to move waste from the receiving area through to sorting. Different pieces of waste such as PET bottles, glass bottles, plastics, metals, polythene, paper and inert materials are separated manually on the belt conveyors. The specification of a conveyor belt system is given in **Table 3**.

Table 3: Conveyor Belt System

Parameter	Specifications
<b>Conveyor Belts 1 (Feeding waste to Trommel)</b>	
Type	Flat roller type belt conveyor
Motor	3.75 kW (5 HP), 1440 RPM, TEFC (Totally Enclosed Fan

Parameter	Specifications
	Cooled) copper wire, conforming to IS : 13730, 3-phase, 4- pole
Inclination	20° Inclined flat
Length of Conveyor	Approx. 9 m from End to End of conveyor
Size of belt	1200 mm wide ( working width 1000 mm)
<b>Conveyor Belts 2 (Line below trommel for fraction &lt; 60 mm reject to air blower)</b>	
Type	Flat roller type belt conveyor
Motor	3.75 kW (5 HP), 1440 RPM, TEFC (Totally Enclosed Fan Cooled) copper wire conforming to IS : 13730, 3- phase, 4- pole
Inclination	0°
Length of Conveyor	Approx. 7 m from End to End of conveyor
Size of belt	1000 mm wide ( working width 800 mm)
<b>Conveyor Belts 3 (Line below trommel for fraction &lt; 60 mm)</b>	
Type	Flat roller type belt conveyor
Motor	3.75 kW (5 HP), 1440 RPM, TEFC (Totally Enclosed Fan Cooled) copper wire conforming to IS : 13730, 3- phase, 4- pole
Inclination	0°
Length of Conveyor	Approx. 6 m from End to End of conveyor
Size of belt	1000 mm wide ( working width 800 mm)
<b>Conveyor Belts 4 (Line below trommel for fraction &gt; 60 mm)</b>	
Type	Flat roller type belt conveyor
Motor	2.25 kW (3 HP), 1440 RPM, TEFC (Totally Enclosed Fan Cooled) copper wire conforming to IS : 13730, 3- phase, 4- pole
Inclination	0°
Length of Conveyor	Approx. 4.5 m from End to End of conveyor
Size of belt	1000 mm wide ( working width 800 mm)
<b>Conveyor Belts 5 (Feeder line for sorting line no. 1 )</b>	
Type	Flat roller type belt conveyor
Motor	2.25 kW (3 HP), 1440 RPM, TEFC (Totally Enclosed Fan Cooled) copper wire conforming to IS : 13730, 3- phase, 4- pole
Inclination	0°
Length of Conveyor	Approx. 4.5 m from End to End of conveyor
Size of belt	1000 mm wide ( working width 800 mm)
<b>Conveyor Belts 6 (Sorting lines for 250 mm down fraction from Trommel)</b>	
Type	Flat roller type belt conveyor
Motor	5.63 kW (7.5 HP), 1440 RPM, TEFC (Totally Enclosed Fan Cooled) copper wire conforming to IS : 13730, 3- phase, 4- pole



Parameter	Specifications
Inclination	0°
Length of Conveyor	Approx. 13 m from End to End of Conveyor
Size of belt	1000 mm wide ( working width 800 mm)
<b>Conveyor Belt 7 (Sorting lines for oversized fraction from Trommel)</b>	
Type	Flat roller type belt conveyor
Motor	7.50 kW (10HP), 1440 RPM, TEFC (Totally Enclosed Fan Cooled) copper wire conforming to IS : 13730, 3-phase, 4- pole
Inclination	0°
Length of Conveyor	Approx. 17.6 m from End to End of Conveyor
Size of belt	1000 mm wide ( working width 800 mm)
<b>Conveyor Belts 8 (Sorting line 2, for &gt; 250 mm material)</b>	
Type	Flat roller type belt conveyor
Motor	2.3 kW (3HP), 1440 RPM, TEFC (Totally Enclosed Fan Cooled) copper wire conforming to IS : 13730, 3- phase, 4- pole
Inclination	0°
Length of Conveyor	Approx. 2 m from End to End of conveyor
Size of belt	1000 mm wide ( working width 800 mm)
<b>Other details (Common for above conveyor belts from 1 to 8)</b>	
Belt Specification	Plain rubber belt, 3 ply, 3 mm top, 1.5 mm bottom rubber covering, total belt thickness 10 mm, nylon cord conforming to M 24 grade
Side Guard	2 mm thick MS sheet with supporting structure
Side guard skirting	2 mm thick rubber belt
Conveyor body	Framing structure of square pipe with ISI mark (IS : 4923:1997) standard 49.5 x 49.5 x 4.5 mm & 75 x 75 x 4.9 mm sections
Drive pulley for conveyor	Ø 290 mm OD with crowning surface with 70 mm shaft with rubber coating and hearing bone design
Rear pulley for conveyor	Ø 290 mm OD with crowning surface with 70 mm shaft with rubber coating and hearing bone design
Rear pulley cover	2 mm thick MS sheet
Bearing for roller	6205 2RS type
Shaft	Precise Machined from EN-8 Shaft Material
Guide rollers	Ø 50 mm pipe with bright bar spindle and sealed with single roll anti friction deep grooved ball bearing
Carrying & return roller	76.1 mm inch ID ERW pipe with CI housing, bright bar spindle and sealed with single roll anti friction deep grooved ball bearing
Bearing	Angular contact type with fitted in split housing
Idler Spacing confirming to IS 9295-1983	Carrying Idler - 800 mm, Impact Idler - 400 mm, Return Idler - 1500 mm

Parameter	Specifications
Belt joint	Endless type belt
Scrappers	Driver side: Flat Scrapper Rear Pulley: V plough type
Take up	Screw type take up design
Gear Box	Worm type, 20:1 ratio, Hollow input & output
Belt speed	1.2 m/sec
Pulley RPM	72 RPM
Conveyor direction	Uni- direction (One side)
VFD specification	VFD suitable for speed control of conveyor belt motor ranging from 5% to 100% of rated speed
Speed Control	0.3 to 1.2 m/sec ( using gear & VFD)



Figure 3: Representative picture of Flat Conveyor Belt System

### 7.1.3. Trommel

Trommel screens are perforated, rotating, horizontal cylinders that are used in MRFs to tear off trash bags, segregate wastes of different sizes and remove abrasive items such as stones and dirt. The trommel will screen materials on the basis of size through a cascading action. Material smaller than the grate fall through and material with larger size than the grate pass through the trommel. The specifications of a trommel are given in the **Table 4**.

Table 4: Trommel

Parameter	Specification
Capacity	08 TPH
Material	Mild Steel (confirming to IS:2062)
Length (mm)	10000
Shell Diameter (mm)	2500

Parameter	Specification
Ring Diameter (mm)	2000
Hole Size (mm)	60 and 250 ( minimum 90 hole of 60 mm and 10 hole of 250 mm in per m <sup>2</sup> of screen)
Shell thickness 10 mm	MS confirming to IS:2062
Screen thickness 08 mm	MS confirming to IS:2062
Screen type	Bolted & Replaceable (if damage during operations)
Inclination	5°
RPM	8-14 (controlled through Variable Frequency Drive)
Knives	Should be effective in tearing bags, installed inside the trommel screen in the first 3 (three) m after the material feeding point. High Carbon Steel (Confirming to IS 7226:1974) knives may be easily replaceable. Bolted design is preferred. Different configurations (positions) of knives inside the trommel are possible as per requirement.
Power supply	Electric (3 phase), 440V, 50 Hz, 4-pole
Motor(02 numbers)	5.5 kW (7.5 HP), 1440 rpm, copper winding, 3 phase, 4 poles
Surface Finish	Epoxy Paint Coated
Stand/Legs & material	Minimum 06 MS legs (Confirming to IS: 808-1989)



Figure 4: Representative picture of Trommel

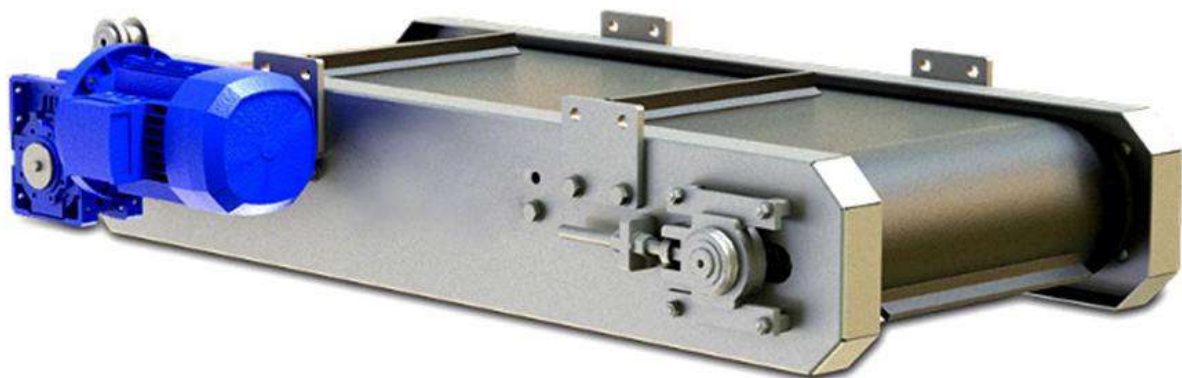
#### 7.1.4. Magnetic Separator

Magnetic separator is used to separate materials having magnetic constituent from a moving stream of waste when passed through an electromagnetic field. It is important

that the materials should be passed through as a thin layer in order that all the particles are subjected to a field of same intensity and that the free movement of individual particles is not impeded. The technical specification for a magnetic separator is given in **Table 5**.

**Table 5: Magnetic Separator**

Parameters	Specifications
Type	Automatic Cross Belt Overhead Magnetic Separator
Application	Separation of ferrous material from Municipal Solid Waste
Magnet Unit	Permanent Magnet of High Intensity Strontium Ferrite Magnets without power requirement
Magnetic Poles	Covered with non-magnetic stainless steel plates confirming to IS : 10632
Bottom plate	Heavy, wear resistant manganese steel confirming to IS:276
Suspension	Four point suspension
Construction	Two U section pieces fixed on magnet with fastening ears supporting bearing drums
Bearing Drums	With shaft mounted on removable hubs
Belt driven	Reduction gear coupled to electric motor
Working distance (mm)	300 - 390
Belt width – Across (mm)	1200
Motor kW	3.0
Belt type	Belt with 35 mm high studs
Length of magnet (mm)	1100
Width of magnet (mm)	1520
Depth of magnet (mm)	250



**Figure 5: Representative picture of Magnetic Separator**

### 7.1.5. Shredder

Shredders are used at MRFs for shredding the waste materials (Plastic sheets/flexibles, SUP, MLP etc.) into smaller pieces by tearing and impact action. Shredding of solid waste is done to improve the quality and acceptability of RDF. The specifications of a heavy duty twin shaft shredder are given in the **Table 6**.

**Table 6: Heavy Duty Twin Shaft Shredder**

Parameter	Specification
Type of Shredder	Twin Shaft
Shape of Shaft	Horizontal Hexagonal Shaped
Material of Housing Enclosure	Mild Steel (confirming to IS:2062)
Capacity	2 TPH
Motor specification	44.7kW (66HP), copper wiring, 4 pole, 3 phase
Hopper	Mild Steel (confirming to IS: 2062)
Base Frame	Mild Steel wide-flange beam of welded construction
Material of Construction of Mulcher	Shredder blades of tool steel having high wearing resistance and shock proof
Mulcher Cleaner	Made of alloy steel to clean the shredder knives.
Painting	Primer Coated with gloss finishing
Housing	Outdoor weather protection metal sheet Housing c/w double layer panel's door.
Inside dimensions of shredder chamber in mm x mm with tolerance $\pm 10$ mm (W x H)	1218 x 250
Opening of loading hooper in mm x mm with tolerance $\pm 10$ mm	600 x 800
Material of Shaft	Mild Steel confirming to IS: 3688- 2004 (1990)
Rotation Speed (Max)	200 RPM
Over all Dimensions of shredding machine in LxWxH in mm	3757 x 1050 x 2054
Advanced Control Panel	Includes slow start VFD control, full function control panel, run/trip indicating light, start/stop push button, emergency push button stop, yellow light indicator on reverse motion, optical indicator to show operation, main switch, auto-reverse and stop in case of overfeeding, control panel, manual push button to reverse and forward motions, low power consumption yet high output, robust construction and easy maintenance design, minimum cutting knife wear, operator friendly, etc.



Figure 6: Representative picture of Shredder

### 7.1.6. Baling Machine

The baling of MSW involves the compaction of waste (plastic waste/PET bottles, cardboards, small aluminum cans, etc) to reduce its volume into higher-density blocks that are stacked and transferred for reuse/recycling etc. Baling wastes helps to reduce the volume considerably. A single cylinder double chamber vertical baler machine proposed. It helps in simultaneous baling and loading of materials resulting saving of time. Specifications are given in **Table 7**.

**Table 7: Vertical Baler Machine**

Parameter	Specification
Length x Width x Height	2895 X 914 X 3175 (mm x mm x mm)
Motor	7.5 kW (10HP), 3 phase, 4-pole, copper winding
Machine body material	Mild Steel (confirming to IS : 2062)
Number of Rope ties (around bale)	3
Capacity of Machine	40 tonne (Jack force)
Thickness of body plate	8 mm
Chamber size in mm	812 x 660 x 1371
Number of doors	4
Day light gap	1371 mm
Thickness of Clamping plate	30 mm (confirming to IS : 2062)
Weight of Bale (kg)	100-150
Type of pump	Hydraulic system
Cycle time per bale (minute)	10-15
Number of Cylinder	1
Cylinder size	160(bore)*180(od)*100(ram)*1100(stroke) mm
Electric supply	3 Phase (440 V 50Hz)
Hydraulic Oil tank capacity (L)	150
Operation	Hand Lever Operation system
Bale size L x W (mm x mm)	812 x 660
Drainage system for residue fluid/liquid	Yes

Parameter	Specification
Machine powder coated	Yes
Bale Ejection	By side door
Material for pressing/compressing	Plastic bottles, aluminum cans, disposal plastic and cardboards

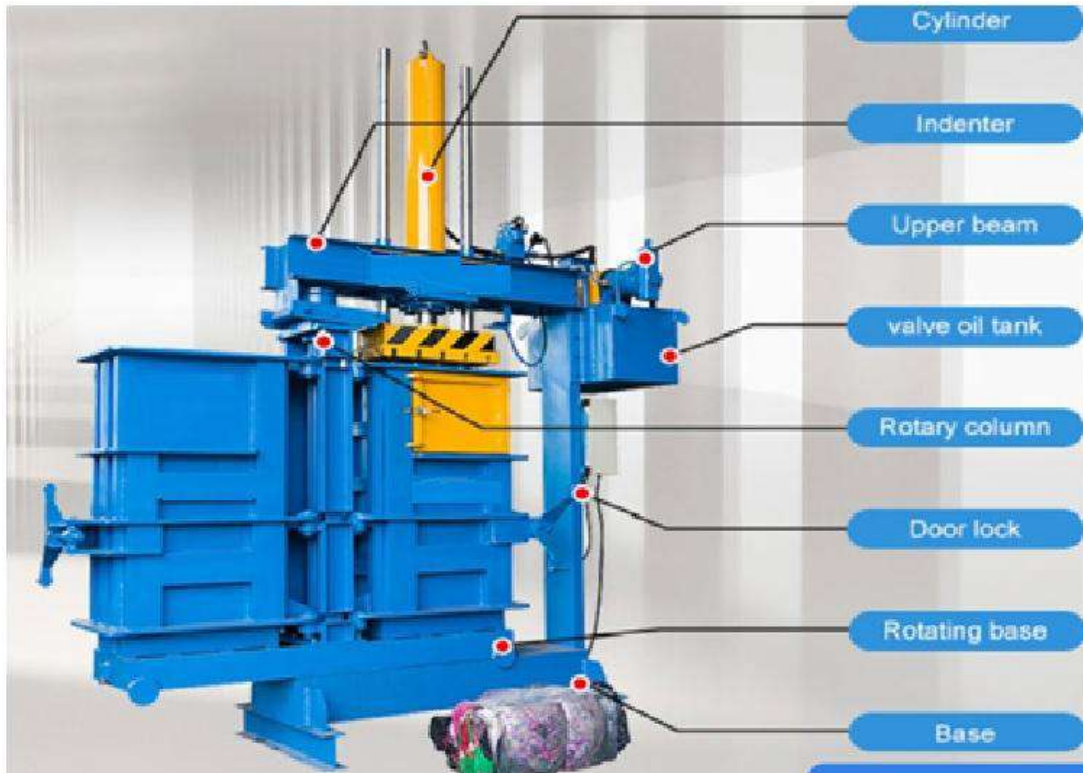


Figure 7: Representative picture of Baler Machine

### 7.1.7. Air Blower

Air blower is utilized to separate light materials from heavier materials through the use of an air stream of sufficient velocity to carry away the lighter materials such as for separating out lightweight plastic and paper from the base waste stream. The technical specification for an air blower is given in the **Table 8**.

Table 8: Air Blower

Parameter	Specification
Capacity	1500 CFM
Working temperature	30° C
Pressure	750 mm WC
Drive	Direct foot mounted fan
Recommended motor power	11kW or 15 HP, 3 phase, 4-pole, copper winding, Confirming to IS 12615:2011
Blower RPM	2900
MoC of Casing	3 mm MS fabricated

Parameter	Specification
MoC of Impeller	MS fabricated
Balancing	As per IS 1940, grade 6.3
Standard accessories	Set of both ends companion matching flanges, Duly painted with epoxy primer and synthetic paint / HR paint.
Power Supply	440 V, 50 Hz
Electric Motor	Standard IE2 rating ABB or BBL or CG make or equivalent



Figure 8: Representative picture of Air Blower

### 7.1.8. Tractor with Loader

Tractor with loaders is essential for loading the trommel. They are used at the receipt area where the door to door non biodegradable waste arrives. The specification for a tractor with loader is given in the **Table 9**.

**Table 9: Tractor with Loader**

Parameter	Specification
Description	Self-propelled wheeled machine which has front-mounted equipment primarily designed for multi utility operation
Type of loader	Tractor with loader
Engine	40 HP (3 cylinder)
Engine Capacity	2400 cc
Engine rated RPM	2599 RPM
PTO HP	34 HP
PTO type	6 Spline
PTO RPM	540
PTO Power	34 HP
Wheel drive	2 wheel



Parameter	Specification
Forward Gears	8
Reverse Gears	2
Brake type	Multi disc oil Immersed
Turning radius with brake (mm)	2850 - 3100
Number of cylinder	3 nos
Air filter	3 steps oil bath type with pre cleaner
Clutch type	Dual
Transmission type	Partial Constant Mesh
Steering type	Power steering
Hydraulic controls	Draft, position and response
Bucket Capacity	0.3 cubic metre
Dump angle	45°
Dump height	2252 mm
Max Operating weight	3000 kg
Lifting capacity	500 kg
Horse Power	45 HP



Figure 9: Representative picture of Tractor with Loader

### 7.1.9. Forklift

Use of electric forklift is recommended to lift, shift and stack material. Electrical operated forklifts can lift weight in the range of 1.5 to 6 tonne. The technical specifications for an electrical operated forklift are given in **Table 10**. Forklift shall confirm to IS 10517-1983.

Table 10: Forklift

Parameter	Specification
Power	Battery Power (Electric )
Load Capacity	1500 kg

Parameter	Specification
Load Centre	500 mm
Tilt Angle	6° - 12°
Travel Speed (laden/Unladen)	10/12 kmph
Lifting Speed (laden/Unladen)	300/430 mm
Gradeability	16 %
Drive Motor	8 kW
Hydraulic Motor	10 kW
Battery Rating	48/440 V/Ah
Lifting Height (Std)	3000 mm
Fork length	920 mm
Fork width	100 mm
Fork thickness	40 mm
Operating Weight (Max)	2950 kg
Standard requirements	Wide view mast, load backrest, standard forks, power steering, retaining rollers, overhead guard, standard seat, return hydraulic filter, battery discharge indicators, discharge lift cutoff, turn indicator lights, hour meter, halogen head lights, rear combination lights, rear view mirrors, reverse buzzer, electric horn, rubber floor mat, safe load indicator, biometric access system and tool kit



Figure 10: Representative picture of Electric Forklift

**7.1.10. Storage Bins**

Storage bins of 1000 litre capacity are considered at the sorting area beside the conveyor belts for holding the sorted waste. The specifications for a storage bin are given in **Table 11**.

**Table 11: Storage Bin**

Parameter	Specification
Capacity (Volume)	1000 liter

Parameter	Specification
Material	GI/Metal
Wheel locking device	Yes
Frontal & ventral grip	Yes
Lid	Yes
Container dimension and making	As per IS 12402
Class conforming to IS : 12402	Class B – Normal Type

*Note: Capacity and material of storage bins may vary depending on availability and suitability.*

### 7.1.11. Wheel Barrow

Wheel barrows are for shifting of sorted waste from storage sheds to shredder/bailer units. They are also used for transporting the shredded materials from shredder to store rooms. The technical specification of a wheel barrow is given in the **Table 12**.

**Table 12: Wheel Barrow**

Parameter	Specification
Capacity (Volume)	140 litre
Load carrying capacity	450 kg
Sheet Material	Steel sheets confirming to IS: 2062
Sheet thickness	1.8 mm
Wheel material	MS with solid/cushioned rubber tyre
Type of bearing/bush	CI bearing
Hand grips	Yes
Leg Support	Yes
Steel tube	Light tube confirming to IS:1239
Grey Iron Castings	Conform to IS: 210
Metal part finish	Two coats of black bituminous paint
Wheel diameter	500 mm
Tyre width	50 mm
GeM Product ID	5116877-24324484266

## 7.2. Electrical Equipment

Technical specifications of electrical equipments are given in the following sections.

### 7.2.1. Solar Power Panels

Solar power is a sustainable solution for energy usage. ULB's must utilize the available schemes by Government of India for the purposes to promote such renewable energy source. The specification of a solar panel is given in the **Table 13**. However, solar panel shall confirm to IS 14286-1&2, as applicable.

**Table 13: Solar Power Panel**

Parameter	Specification
Cell Type	Polycrystalline
Rated Power	315 W
Max Power Voltage	36.92 V
Max Power Current	8.55 A
Open circuit voltage	46.15 V
Short circuit current	8.91 A
Minimum Module efficiency	16.26%
Number of cells	6 x 12
Module dimension	1956 mm x 990 mm
Module thickness	35 mm
Junction Box	IP 67
Frame	Silver Anodized Aluminum Alloy
Encapsulation	Ethylene Vinyl Acetate film ( EVA)
PV connectors	MC4 compatible
Front Cover	3.2 mm thick low iron, high transmission tempered glass
Ambient operating temperature	-40°C to +85°C
Maximum surface load capacity	5400 Pascals
Maximum relative humidity	85%
Temp. Co-efficient of voltage	-0.30%/°C
Temp. Co-efficient of current	0.05%/°C
Temp. Co-efficient of power	-0.40%/°C
Output cable CSA/length	4 mm <sup>2</sup> /1000 mm



**Figure 11: Representative picture of Solar Panels**

**7.2.2. Lighting and Ventilation Equipment**

Proper lighting and ventilation are essential for the healthy and safe working environment. The lighting and ventilation equipment includes LED lights, tube lights, ceiling fans, exhaust fans etc. The specifications of equipment including number of units required are given in **Table 14**.

**Table 14: Lighting and Ventilation Equipment**

Sl. No	Equipments	Specifications	No of Units
1.	LED Street light	Rectangular LED lights with luminaire system wattage of 250 W confirming to IS : 10322 (Part 5): 2012, with lumen output greater than 120 lumen/watt. UV stabilized polycarbonate optic lens and with IK07 impact resistance, mounting shall be of metallic adjustable bracket (SS) with eye bolt and fitted with 3 core connecting cable of ISI mark, including necessary accessories.	17
2.	LED light	Round LED light with luminaire system wattage of 100 W confirming to IS: 16103-2: 2012, with lumen output greater than 120 lumen/watt, UV stabilized polycarbonate optic lens and with IK07 impact resistance. Mounting shall be of metallic adjustable bracket (SS) with eye bolt and fitted with 3 core connecting cable of ISI mark including necessary accessories.	16
3.	LED Tube Light	T-5 LED tube light of 1200 mm length and 22 W power rating confirming to IS: 16103-2: 2012,. With minimum lamp efficiency of 100 lumen/W and shell material made of polycarbonate lamp. Tube light should be of inbuilt driver type.	33
4.	Wall Mounted Fan	Heavy duty AC wall fan of 24 inch made of aluminum with a rated power of 180 W for operating at 230 V single phase supply confirming to IS: 2997(B) -1964. Wall fan shall be of single speed setting with 3 blades and an air delivery of 270 cmm. Operating frequency as 50 Hz and sweep of 600 mm.	10
5.	Ceiling Fan	Three blade ceiling fan with a rated power of 75 W and operating at a speed of 380 RPM confirming to IS: 374 2019. Sweep size as 1200 mm.	15
6.	Exhaust Fan	Five (plastic) blade exhaust fan with a rated power of 60 W and single speed control. Exhaust fan shall be with a speed in the range of 2200 – 2400 RPM and with a size of 250 mm confirming to IS : 12080:1987.	4

### 7.2.3. Earth Leakage Circuit Breaker

The technical specifications of earth leakage circuit breakers confirming to IS/IEC 60947-2 are given in the **Table 15**.

**Table 15: Earth Leakage Circuit Breaker**

Parameter	Specification	
	For 3 HP Motor	For 5 HP Motor
Compliance to ISO certification	ISO 9001	ISO 9001
Conformity to Standards	IEC 61008-1	NA
Certification	CE	NA

Parameter	Specification	
	For 3 HP Motor	For 5 HP Motor
Leakage action current, mA	100	30
Nominal Frequency	50 Hz	50 Hz
Pole	2	4
Voltage (AC)	220 V	460 V
Tripping curve	C type	C type
Protection degree	IP 20	IP 20
Current rating, Ampere	25	60
Rated Sensitivity, mA	100	50
Breaking capacity, (kA)	125	60
Leakage Action Time (max)	0.1 second	0.1 second
Rated impulse withstand voltage U <sub>imp</sub> (kV)	4 kV	4 kV
Electricity	3 phase	3 phase

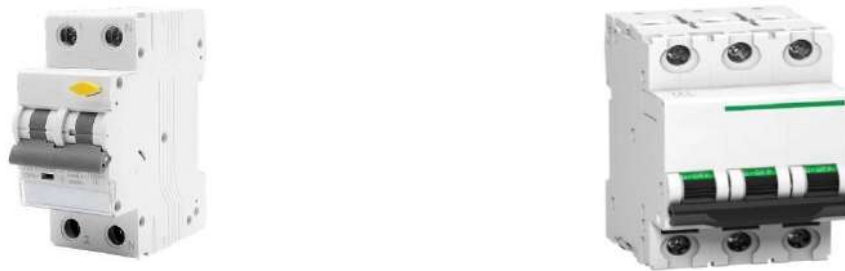


Figure 12: Representative picture of Earth Leakage Circuit Breaker

### 7.3. Fire Fighting Equipment

Fire fighting installations are designed as per NBC. The selection of equipments are with the consideration of a storage type building with height less than 15 m and covered area more than 250 m<sup>2</sup>. Technical specifications of fire fighting equipments are given in the following sections.

#### 7.3.1. Fire fighting system

Fire fighting system consists of electrical fire pump, diesel fire pump, jockey pump and control panel is to be installed at the fire pump house. The duty conditions of pumps are selected from NBC requirements and from tentative drawing prepared. The specification for a fire fighting system is given in the **Table 16**.

Table 16: Fire Fighting System

Parameter	Specification
(i) Motor- 22kW/30 HP	
Power Source	Electric
Pump Type	Non self priming, single stage, centrifugal volute pump with axial suction port,

Parameter	Specification
	radial discharge port and horizontal shaft.
Flow rate	1620 LPM
Head	50 m
Rated Speed	2900 RPM
Material of Construction of Pump Casing	Cast Iron
Material of Construction of Shaft	SS 410 confirming to ISO: 15510
Material of Construction of Impeller	Bronze -LTB 2
Sealing method	Mechanical Seal
Protection	IP 55
Motor type	3 phase squirrel cage induction motor
Voltage	415+/- 10%
Frequency	50 Hz +/- 5%
Starter	DOL starter
<b>(ii) Motor- 3.7 kW/5 HP</b>	
Power Source	Electric
Pump Type	Non self priming, single stage, centrifugal volute pump with axial suction port, radial discharge port and horizontal shaft
Flow rate	180 LPM
Head	50 m
Rated Speed	2900 RPM
Material of Construction of Pump Casing	Cast Iron
Material of Construction of Shaft	SS 410 confirming to ISO: 15510
Material of Construction of Impeller	Bronze -LTB 2
Sealing method	Mechanical Seal
Protection	IP 55
Motor type	3 phase squirrel cage induction motor
Voltage	415+/- 10%
Frequency	50 Hz +/- 5%
Starter	DOL starter
<b>(iii) D.G. Engine- 36 HP (Confirming to MoEF&amp;CC emission standards and CPCB type approval)</b>	
Power Source	Diesel
Pump type	Non self priming, single stage, centrifugal volute pump with axial suction port, radial discharge port and horizontal shaft
Flow rate	1620 LPM
Head	50 m
Rated Speed	2100 RPM
MoC of Pump Casing	Cast Iron
MoC of Shaft	SS 410 confirming to ISO: 15510
MoC of Impeller	Bronze -LTB 2
Sealing method	Mechanical Seal



Figure 13: Representative picture of Fire Fighting System

### 7.3.2. Fire Alarm System

The technical specification for a fire alarm system is given in the Table below:

Table 17: Fire Alarm System

Parameter	Specifications
Feature	Programmable logic Controller (PLC) shall be located inside a control panel made of mild steel of suitable thickness and shall be powder coated
Power Source	Electric
Detector	Smoke detector (confirming IS 11360:1985)
User programmable	Front key pad
Desktop HMI monitoring system with monitor size	24 inch LED
ISO certification	ISO 9001: 2015
Air pressure differential (inches of water)	1
Air velocity rating (ft/min)	2000
Material	ABS
Nominal sound output	90 dBA at 10 feet (3m)
Sound/noise level (min)	92 dB and multiple frequencies
Frequency	400 Hertz
Indicator	LED
Electronic hooter	24 V DC nominal
For Loop/Speaker	PVC covered armored cable. Approximate



Parameter	Specifications
	length- 10000 m
Power	PVC covers armored cable. Approximate length – 200 m
GeM Portal Id	5116877- 77151804545

### 7.3.3. Fire Extinguisher

Fire extinguishers are handheld active fire protection device used to extinguish or control small fires. Two types of fire extinguishers are considered for the plant of which ten units are of ABC class and four units are of CO<sub>2</sub> class. The locations of fire extinguishers are indicated in the drawing at **Annexure 1**. The technical specifications for fire extinguishers are given in the table below.

**Table 18: Fire Extinguisher**

Parameter	Specification
<b>ABC based Extinguisher</b>	
Capacity	6 Kg
Extinguisher Media	Powder Based ( as per IS: 4308)
Extinguisher Class	ABC
Gross weight of the unit without bracket	8.7 Kg
Operating Temperature	-10°C to +60°C
Minimum efficient discharge time	8 second
Type of extinguisher	Low pressure extinguisher
Expellant medium	N2 based (Stored pressure)
Max. travel distance	22.86 m ( NFPA 10 Section- 2018)
MoC of body for Low Pressure Extinguisher	Welded low carbon cylinder (as per clause 9.2.5 of IS 15683)
Additional features	With carrying handle, safety devices, suitable for recharge and with hose assemblies
Applications	For use in ordinary combustibles like wood, vegetable, fibers, rubber, plastic, papers etc.
Product Id at GeM Portal	5116877- 90932096240
<b>CO<sub>2</sub> based Extinguisher</b>	
Quantity of condensed aerosol	6.5 Kg
Type	Hot
Gross Weight of the unit without bracket	10.33 Kg
Extinguishing Media	Powder based ( as per IS 4308)
Operating Temperature	-10°C to +60°C
Minimum efficient discharge time	8 second
Type of Extinguisher	Low Pressure Extinguisher
Class of fire for which is suitable	Electrical
Expellant medium	CO <sub>2</sub> Based

Parameter	Specification
MoC of body for Low Pressure Extinguisher	Welded low carbon cylinder (as per clause 9.2.5 of IS: 15683)
Effective space volume covered	7.47 m <sup>3</sup>
Material of aerosols housing	Mild steel
Additional features	With carrying handle, safety devices, suitable for recharge and with hose assemblies
GeM Portal Id	5116877- 32421068855



Figure 14: Representative picture of Fire Extinguisher

### 7.3.4. Fire Bucket

Fire buckets are for manually fighting small fires. Twenty four fire buckets are considered for the MRF and the location of the fire buckets are indicated at **Annexure 1**. Fire buckets shall be always be full of fine sand. The technical specifications for fire buckets are given in the table below.

Table 19: Fire Bucket

Parameter	Specification
Nominal Capacity	7 litre
Shape and essential dimensions	Yes, as per clause 3.1 of IS: 2546
Anti corrosive treatment	Zinc coating of 0.06 mm minimum
Top Handle	MS rod 10 mm diameter
Outside paint	Fire red
Top rim	MS wire conforming to IS: 280
Top and bottom handles	MS rod conforming to IS: 226
Material of Construction of buckets	MS black sheets conforming to Grade St 34 or Grade St 42 of IS : 2062
Body	Two halves joined together by butt welding, top rim wired and uniformly beaded fully formed without gaps.

Parameter	Specification
	Thickness of body shall be 1 mm and diameter of beading wire of 3.55 mm.
Bottom	Dished bottom joined to the body by butt welding without raw edge or crevice inside the bucket. The thickness of sheet as 1 mm
Ears	MS sheet fitted to the body by welding with flat head on the side. The thickness of sheet as 2.8 mm.



Figure 15: Representative picture of Fire Bucket

### 7.3.5. Fire hydrant pipes

The specification for a fire hydrant pipe is given in the table below:

Table 20: Fire Hydrant Pipe

Parameter	Specification
Thickness	4.85 mm
Diameter	25 mm - 150 mm
Material	Mild Steel
Pressure rating	15 kg/cm <sup>2</sup>
Grade	C grade
Colour	Red
Certificate	ISI
Usage/Application	Fire fighting

## 8. Power Requirement

Total load per day for the MRF plant is calculated as 715 kWh. Monthly power consumption cost, by considering Rs. 10 per unit, is estimated as Rs. 2.18 Lakh/month. The annual power consumption charges come to Rs. 26.15 Lakh/annum. The indicative

expenditure on annual electricity consumption is presented as **Annexure 3**. The detail of equipment and machinery with their power rating are given in **Table 21**

**Table 21: Estimated Power Consumption**

Sl. No.	Equipment Details	Power Rating (W)	Duration of operation (Hr)	Quantity (Nos)	Critical power load (W)	Per day Power consumption (W)
1	Weighbridge	500	5	1	500	2000
2	Conveyor belt system	31180*	6.5	1	31180	218260
3	Trommel	11250	6.5	1	11250	67500
4	Magnetic Separator	2250	6.5	1	2250	13500
5	Twin Shaft Shredder	44700	4	1	-	134100
6	Baler machine	7500	4	2	-	45000
7	Air Blower	11190	6.5	1	11190	89520
8	Electric forklift machine	18000	1	1	-	18000
9	Fire pump-2 no.	25700	0.03	1	-	771
10	LED street light	250	12	17	-	51000
11	LED light	100	4	16	1600	12800
12	LED tube lights	24	8	33	792	6336
13	Wall mounted fan	180	8	10	1800	14400
14	Ceiling fan	75	5	15	1125	9000
15	Exhaust fan	60	8	4	240	1920
16	Desktop PC	250	8	2	500	4000
17	Water cooler	300	4	1	300	1200
18	Other load	100	4	1	-	400
					Critical power load in W	62727
					Expected power consumption in W/day	714507
					Expected power consumption per day in kWh/day	714.51
					Expected power consumption per month in kWh	21,792.50
					Expected power consumption per year in kWh	2,61,510.00

\* Considered as cumulative rating & inclusive of all the belt conveyors

## 9. Manpower Requirement

The manpower requirement is envisaged as 42 person per day for an 8 hour operational shift. For calculating the number of sorting workers, yield of a worker is assumed as 1 – 1.5 tonne per eight hour operation. The qualification of staffs/workers is presented in **Table 22**. The annual expenses as wages including the individual wages for staffs/workers are presented as **Annexure 3**

**Table 22: Manpower, Qualification and Daily Wages**

Sl.No	Manpower	Qualification	Number	Responsibility
1.	Manager In-charge (Skilled)	Engineering Degree/Diploma (Civil / Environmental/Chemical/Mechanical) with minimum three years of experience in Operations and Maintenances of plants for MSW processing/Used Water or Sewage treatment/Water treatment	1	<ul style="list-style-type: none"> <li>☑ Maintain all administrative and inventory records.</li> <li>☑ Maintain Interactions with the ULB officials</li> <li>☑ Maintain communications with local authorities like health departments, police, fire brigade etc.</li> <li>☑ Overseeing all the operational activities at MRF including daily/weekly checks, ensure defects and breakdowns are promptly attempted.</li> <li>☑ Ensure that machinery is maintained properly</li> <li>☑ Checking of incoming waste, reporting contamination or non-conforming wastes delivered to site.</li> <li>☑ Site Incident Controller during emergency at the MRF.</li> <li>☑ To perform other tasks including weekly/monthly reporting to ULB officials and/or supervisory duties.</li> </ul>
2.	Safety Supervisor	12 <sup>th</sup> class with Diploma in Industrial safety course and minimum three years of experience in Environmental Health and Safety	1	<ul style="list-style-type: none"> <li>☑ Ensure the safety of worker and staff in the plant</li> <li>☑ Ensure appropriate safety equipment and PPEs used at all times</li> <li>☑ Reviewing accidents, incidents, and near misses, environmental hazards, health &amp; safety breaches.</li> <li>☑ Conduct training and mock drills for worker and staff.</li> <li>☑ Periodic checking at the MRF for red spots(Spiting spots) and cleanliness of the plant</li> </ul>



Sl.No	Manpower	Qualification	Number	Responsibility
3.	Weigh bridge operator	12 <sup>th</sup> class with 1 year operating experience of weigh bridge	1	<ul style="list-style-type: none"> <li>♻️ Operate and maintain the weigh bridge.</li> <li>♻️ Notify maintenance and calibration requirements with the MRF in charge.</li> <li>♻️ Prepare records of materials received and dispatched from the MRF</li> <li>♻️ Ensure weighbridge is clean after day's operation.</li> </ul>
4.	Electrician cum baler operator (skilled)	ITI Electrician with 2 years of experience	1	<ul style="list-style-type: none"> <li>♻️ Operate and maintain the baler machine to compress and bind the sorted waste.</li> <li>♻️ Notify maintenance requirements with the MRF in charge.</li> <li>♻️ Troubleshooting electrical issues in the plant.</li> <li>♻️ Ensure all the electrical equipments/machinery are switched off before leaving the plant</li> <li>♻️ Keep equipment in a clean and orderly condition and maintain the work area.</li> <li>♻️ Run the day to day activities of the plant in the absence of Plant In charge</li> </ul>
5.	Electrician cum Shredder operator (skilled)	ITI Electrician with 2 years of experience	1	<ul style="list-style-type: none"> <li>♻️ Operate and maintain the shredder machine.</li> <li>♻️ Notify maintenance requirements with the Manager.</li> <li>♻️ Troubleshooting electrical issues in the plant like reversal of polarity, checking the continuity of the earthing etc..</li> <li>♻️ Ensure all the electrical equipments/machinery are switched off before leaving the plant</li> <li>♻️ Keep equipment in a clean and orderly condition and maintain the work area.</li> </ul>

Sl.No	Manpower	Qualification	Number	Responsibility
6.	Office Staff (skilled)	12 <sup>th</sup> class	1	<ul style="list-style-type: none"> <li>🔄 Keeping records of materials received, sorted, and dispatched from the MRF</li> <li>🔄 Keeping records of attendance, visitors, feedbacks, and complaints received.</li> </ul>
7.	Electric Fork lift operator (Skilled)	10 <sup>th</sup> class with the applicable driving license and with one year experience of such equipments.	1	<ul style="list-style-type: none"> <li>🔄 Operate and maintain the forklift for shifting of materials.</li> <li>🔄 Check tyre conditions and oil leakage on a daily basis</li> <li>🔄 Keep the forklift clean after the day's operation</li> <li>🔄 Notify maintenance requirements with the Manager</li> <li>🔄 Ensure the forklift are put in charging after the day's operation</li> </ul>
8.	Skip loader operator (Skilled)	10 <sup>th</sup> class with the applicable driving license and with one year experience of such equipments.	1	<ul style="list-style-type: none"> <li>🔄 Operate and maintain the loader machine to feed the hopper of infeed conveyor.</li> <li>🔄 Check the tyre pressure and oil leakage on a daily basis</li> <li>🔄 Keep the loader clean after the day's operation</li> <li>🔄 Notify maintenance requirements with the Manager</li> </ul>
9.	Security# (Skilled)	10 <sup>th</sup> class, physically fit with three years of experience as a security staff.	3	<ul style="list-style-type: none"> <li>🔄 Regular patrolling (thrice in a shift) and protect the MRF from intruders.</li> <li>🔄 Control facility access for employees, visitors, vendors, and contractors (have visitors sign in/out, issue and collect visitor badges, occasionally escort visitors from one area to another, etc).</li> <li>🔄 Periodically conduct security checks (surveillance) of specified areas.</li> <li>🔄 Maintain a security log register and write reports on what was observed while on</li> </ul>



Sl.No	Manpower	Qualification	Number	Responsibility
				duty.
10.	Safai mitra Cleaner# (unskilled)	Not applicable	2	<ul style="list-style-type: none"> <li>♻️ Cleaning wash room/toilets and keeping all emergency exits and walkways clear from obstructions.</li> <li>♻️ Reporting at MRF two hours before commencement of operations and keeping working area neat and tidy</li> <li>♻️ Maintain and water the garden around the MRF daily</li> <li>♻️ Switch on the fans half an hour before the commencement of MRF operations</li> <li>♻️ Should engage in the sorting activity as and when required</li> </ul>
11.	Person at tipping area (unskilled )	Not applicable	4	<ul style="list-style-type: none"> <li>♻️ Tearing of dumpster bags and feeding the segregated waste into hopper.</li> <li>♻️ Identify and remove the domestic hazardous waste, discarded blankets, furniture and empty cans from dry waste.</li> <li>♻️ Keep tipping area clean.</li> <li>♻️ Should engage in the sorting activity on clearing the receiving area</li> </ul>
12.	Sorting workers# (unskilled)	Not applicable	25	<ul style="list-style-type: none"> <li>♻️ Sort and separate recyclable materials based on type, such as paper, plastic, glass, or metal and keep the sorted waste in respective storage area/bins.</li> <li>♻️ Maintain cleanliness and orderliness in the recycling facility by regularly cleaning work areas.</li> </ul>
Total			42	

*\*Wages of staff are indicative. Wages shall be paid as per the norms of concern State Government.*

*# Possibility of integration of informal sector may also be explored by ULBs at MRF Plant*





## 10. Water Demand

Minimum water requirement for the MRF is calculated as per guidelines of NBC 2016 for factory building with bath room 45 litres per day/head (30 litres per day/head for domestic requirement and 15 litres per day/head for flushing) is used for the calculation of water quantity. The table below gives details of water requirement for a 50 TPD MRF facility.

**Table 23: Water Requirement**

Sl. No.	Details	Workers ( No)	Per capita demand (L) per day	Requirement /day (L)
1	Manpower	42	45	1,890
2	Visitors to the facility (average)	40	15	600
3	Water for cleaning requirement			3,500
	Total water requirement per day			5,990
			Say	6,000
	Water for firefighting as reserves			50,000
	Minimum total storage required in the sump tanks			56,000

The water demand is calculated as 6 KLD and monthly demand would be 180 KL. The volumetric charges for industrial use if consumption exceeds 100 KL are at Rs. 146.4/KL by Delhi Jal Board (DJB). Rates may vary from one State to State. The annual water charges are presented as **Annexure 3**.

## 11. Wastewater Generation

As per CPHEEO manual, 80 % of water consumed would be generated as waste water. The wastewater quantity is expected as 4792 Litre per day. In case, public sewer connection is available within a distance of 100 metre, wastewater should be disposed off in public sewer otherwise on-site sanitation (septic tank followed with soak pit) may be adopted.

Sewer charges are calculated as per DJB recommended rates and equals to 60% of volumetric charges of water consumption. Monthly and annual sewer charges are presented as **Annexure 3**.

## 12. Personal Protective Equipment

Use of Personal Protection Equipment (PPE) is mandatory requirements for workers at MRF to ensure safety and hygiene. Essential PPE's likely to be required annually is presented in **Table 24**.

**Table 24: Specification for various PPEs**

Name of PPE	Specification	Annual requirement (Nos)
Nose Mask (Surgical)	Size (L x W) 5.5" x 3.5", plain cloth fabric, cotton (10% Poplin). As per standards: IS: 9473-2002, and IS: 15323-2003	20075
Safety goggles	Polycarbonate lens with soft PVC frame & body, fully adjustable headband, light, resilient & durable, anti-fog coating etc. As per standards: EU 86/686/EFC, EN166/2002 and ANSI/SEA Z87.1-2010 or equivalent	110
Chemical resistant gloves, multi-use	CE Marked fully nitrile rubber hand gloves (In pair) with inside soft cotton flocked lining, overall length not be less than 12 Inches. Confirming to IS: 4770- 1991, EN-388 & EN-374 (2016)	165
Safety (High visibility/warning) Jacket	100% mesh polyester, high gloss reflective tape, confirming to IS: 15809 -2017	55
Bouffant Caps	Lightweight, water repellent and confirming to IS: 2925- 1984, CE-EN-397, ANSI Z891-2003	20075
Safety shoes	A protective toecap that can withstand a 200 Joule impact 12 with antistatic protection, etc. confirming to IS: 5852-2004, IS: 15298 (Part 2)-2011	55
Ear Plugs / Canal caps	Ear plug for protection against noise (NRR to be minimum 29db), made of soft sponge material or silicone, polyurethane confirming to IS: 6229- 1980	220
Apron	Width of 80cm (+/-10cm), thickness of 150-300 microns confirming to as per standards: IS: 4501- 1981	55

Note:

- i. Apron having reflective stripe both (Apron & Safety jacket) may be preferred instead having separately.
- ii. Annual requirement is based on considered manpower in this guideline.

### 13. Standard Operating Procedure (SOP)

MRF is designed with the assumption that only dry waste shall be received at the receiving area. In case of mixed waste/domestic hazardous waste/sanitary waste are arriving at the receipt area a checklist need to be filled by the weigh bridge operator. The checklist is attached as **Annexure 2(2)**. The mixed waste/domestic hazardous waste/sanitary waste should to be channelized separately at the receiving area and the segregated materials shall be deposited in the bins. SOP for all the activities with do's and don'ts are described in the following sections.

### 13.1. Morning Protocol

While starting operations in the morning, plant in-charge or, his/her assistant may take a round of facility apart from a roll call. Information may be noted as per **Annexure 2 (3)**.

- ♻️ Swachhata Mitras will wear the uniform and put on the required PPE.
- ♻️ Switch on the fans for proper ventilation half an hour before the operations start
- ♻️ Maintaining and watering the garden around the MRF
- ♻️ The premises of the facility shall be cleaned before starting the operations.
- ♻️ Waste transfer points shall be kept clear.

### 13.2. Receipt of waste

- I. Dry waste after weightment shall be unloaded in the Waste Receipt area at MRF.
- II. After unloading the waste, empty vehicles shall be weighed again.
- III. Dumpster bags and *gathari* would be unbundled and oversized materials like blankets furniture, empty tins etc. shall be taken out physically by dedicated deployed staff for further process.
- IV. Sample format for the Receipt of Material/waste is provided at **Annexure 2 (4)**.

**Do's**

*Only dry waste collected at receiving area.*

*Items like glass bottles, metal containers and hazardous materials like containers of paints should be removed from the waste at the receipt area itself.*

**Don'ts**

*Littering in the premises.*

### 13.3. Waste Feeding

- I. Once waste is received in receiving area then the waste will feed on the *infeed conveyor belt* Nos. 1 or 2 for processing at trommel.

**Do's**

*Compulsory usage of PPE's by workers.*

**Don'ts**

*Accumulation of unnecessary waste at receiving area.*

#### a) Waste Loader

- I. Loader shall be deployed for pushing of waste to the Infeed conveyor belts using the clamshell bucket.
- II. Waste at the Receiving area shall be cleared before arrival of next consignment.
- III. In case of breakdown of loader, in feed belt/trommel waste shall be heaped to accommodate new consignment.

**Do's**

*Check the coolant, fuel level, engine oil, tyre pressure and hydraulic oil levels before starting the loader.*

*Check for the lubrication of moving parts.*

*Make sure the loader is operated by authorized personnel only.*

*Maintain the log book.*

*Make sure all persons and vehicles are clear of the danger zone before operating the loader.*

*Operator shall communicate with workers deployed at receiving area to ensure safe, efficient and easy loading into the conveyor belts.*

*Ensure proper lighting at the operational area.*

*Clean the loader daily after the work.*

**Don'ts**

*Shut off the engine while fueling is done.*

**b) Conveyor belts**

- I. Be operated at an average speed to ensure proper sorting of waste.
- II. Waste be spread to a thickness less than 10 cm on the conveyor belts for sorting of waste.

**Do's**

*Check for rotation and unusual sounds of the conveyor system.*

*Check for any oil leakage from the motor or gears.*

*Compulsory use of protective gears.*

*Ensure each belts are clean and no waste is blocking the rotation of the belt before each operation.*

*Maintain log book for the conveyor belts daily.*

*Ensure uniform loading on the conveyor belts.*

*Keep hands away from moving parts of machinery.*

**Do not**

*Wear loose clothing around machinery.*

**13.4. Screening**

- I. Received waste will be screened on the basis of size.

**Do's**

*Compulsory use of protective gears.*

*Keep hands away from moving parts of machinery.*

**Don'ts**

*Don't keep bundle of bags in waste.*

**Magnetic Separator**

Materials having magnetic constituents will be separated through magnetic separators

*Materials should be supplied in thin layers so that all the particles are subjected to a field of same intensity.*

**a) Trommel**

- I. Waste received from infeed conveyor belt shall move through the trommel.
- II. Waste materials be segregated in the trommel as fine (below 60mm), mid (above 60 mm and

**Do's**

*Check of the rotation and unusual sounds from the trommel or motors before each operation commence.*

*Check for any leakage of oil from the motor or gears.*

- below 250 mm) and oversized (more than 250mm) fractions.
- III. Fine fraction of the waste be collected at conveyor belt nos. 3 or 4 in the form of inert, earth mixed with flaky material like paper, plastic and MLP.
- IV. Mid-sized materials consisting of recyclables and shall be collected through belts no 5 or 6.
- V. Oversized materials suitable for RDF consisting of bulk packing material, MLP and SUP shall be collected through conveyor belt no 9.
- VI. Each trommel should be operated to a maximum of 4 hr/day.

*Compulsory use of protective gears. Ensure that entire trommel is clean and no waste is left or stuck in screen before each operation. Maintain the log book. After each operation, operator should ensure to switch off power buttons and clean the trommel and sieve holes. Keep hands away from moving parts of machinery.*

**Don'ts**

*Wear loose clothing around machinery.*

**b) Air blower**

- I. Air blower be placed at conveyor belt no. 3 and 04.
- II. Flaky materials of paper, plastic, MLP and SUP shall be blown out of the conveyor belts using the 'Air Blower' at conveyor belts 3 & 4.
- III. The blown out materials shall be shifted to the storage unit or shredded in the shredding machine.

**Do's**

*Check for loose nuts, bolts and screws before each operation of the unit. Switch on the air blower for checking the unusual sounds before the commencement of every operation. Workers working near the air blower must wear dust mask and goggles while the blower in operation. Operator should check the operation of conveyor belts 3 & 4 prior to the commencement of operation. Keep hands away from moving parts of machinery.*

**Don'ts**

*Wear loose clothing around machinery.*

**13.5. Sorting and Storage**

- I. Workers are engaged at conveyor belt nos. 5, 6 & 9 for manual sorting into allotted bins.
- II. Recyclable sorted materials are stored in temporary storage area/compartments.
- III. Material be shredded/baled regularly when the storage compartments are full.

**Do's**

*Keep sorting and storage area dry and free from pest and flies. Regularly spray disinfection liquid as better prevention practices. Ensure that compartments are not stored beyond their capacity.*

**Don'ts**

*Longer storage of RDF. Stock glass material at height.*



- IV. Domestic hazardous and sanitary waste be stored and handed over to common hazardous waste management facility and Bio-medical waste facility respectively.
- V. Rejects/inert be stored and send to sanitary landfill site.
- VI. Plastic/cardboards be bailed and handed over to recyclers.
- VII. Metals/glass be stored and handed over to recyclers.
- VIII. Plastic/paper be shredded and stored for handing over to recyclers.
- IX. Aluminum metals cans be bailed and stored for handing over to recyclers.

### 13.6. Post Processing Unit

#### a) Shredder

- I. The materials for shredding be shifted near shredder from the recyclable storage area one by one.
- II. Materials to be shredded shall be loaded from the top of the shredder.
- III. Ensure positioning of empty container/jumbo bags to capture the shredded material.
- IV. Container/jumbo bags should be shifted shredded RDF storage area using forklift.
- V. Shredder be operated as per instruction manuals.

#### Do's

*Good housekeeping and cleaning all machinery after use.  
Switch on the shredder and check for any abnormal noise during operation and stop the machine if necessary.  
Maintain the log register for the shredder daily.  
The operator should wear PPE before operating the shredder.  
Lubricate all moving parts with a light machine oil and check for smooth operation.  
The blockage if any in the shredder unit shall be cleared after disconnecting the power supply.  
The machine shall be disconnected from the power supply at the end of operations of the day.  
Clean the shredder surface using brush after every use.*

#### Don'ts

*Put hand on moving parts of machinery.*

#### b) Baler

- I. Operate the baler as per Manual.

#### Do's

*Good housekeeping and cleaning all machinery after use.  
Ensure power key in the switch off position.*

*Check the bale chamber is clean and lay a flat piece of cardboard at the bottom of the bale chamber over top of the ejector straps or chain if cardboards are to be baled.  
Close and latch the bale chamber door  
Special care be taken of safety lock on doors.*

**Don'ts**

*If safety lock is broken/jam, baler not to be operated.*

**13.7. Dispatch and Sales**

- a) Sorted materials must be dispatched at regular frequency.
- b) Dispatch procedures shall also be initiated if the allotted space for a particular material is occupied by 90%.
- c) During dispatch, outgoing materials shall be weighed and be recorded along with signature of plant in charge.
- d) Formats for material dispatch and sale is provided at **Annexure 2 (5) & Annexure 2 (6)**.
- e) Bales of paper, pet bottles and metal cans shall be handed over to recyclers after weighment.
- f) RDF shall be transferred to cement plants, thermal power plants once truck load is available.
- g) Sorted cloths would be handed over to recycler.
- h) Tender coconut shell would be handed over for coco peat manufacturers, waste to energy plant as per available options.
- i) Rejects and inert shall be collected and taken to landfill for disposal.

**13.8. General Do's & Don'ts**

- 🌿 Compulsory use of personal protective equipment/gears by the workers
- 🌿 Ensure provision of suitable exhausts/vents/scrubbers etc.
- 🌿 Ensure adequate fire protection measures.
- 🌿 Regular inspection of fire extinguishers and equipment setup.
- 🌿 Follow good hygiene and sanitation practices including safe drinking water at MRF.
- 🌿 MRF should be kept clean and tidy all the time. Internal and external sweeping to be done 3 times minimum (Morning, before lunch break and before closing).
- 🌿 Keep the detailed logbook of MRF.
- 🌿 Good housekeeping and cleaning all machinery after use.
- 🌿 Ensure proper stock of first aid medicines.
- 🌿 Electrical equipments should be connected through ELCB's.
- 🌿 Ensure earthing of all electrical equipments.
- 🌿 Flywheel and belt of motors should be covered with guards.

### Advisable

- ♻️ Periodic meetings of workers for mock drills (electrical, mechanical and firefighting) training etc..
- ♻️ Compartments are to be cleaned once in a month and after the dispatch of material to resource recovery centre or identified recycler.
- ♻️ Electrical device shall be unplugged after completing the work every time.
- ♻️ Before changing a light LED/tube light/bulb, switch off the connections.
- ♻️ Weekly receipt of material shall be reported to the officer in charge.
- ♻️ Attendance of the staff shall be reported monthly to the ULB.
- ♻️ Quantity of material dispatched shall be reported weekly.

### General Don'ts at a MRF-Mandate

- ♻️ No child labor (below 18 years of age).
- ♻️ No smoking.
- ♻️ No littering in the premises
- ♻️ Do not fuel/oil change of any engine while the engine is switched on.
- ♻️ Wearing loose clothes near the machineries
- ♻️ Don't put hands on moving parts of machineries
- ♻️ Do not burn any waste.
- ♻️ Pregnant women not to be deployed for operating machinery or lifting/shifting of bales etc..
- ♻️ Never use a defective electrical device or switch etc.
- ♻️ No inflammable objects permitted in the premises.
- ♻️ No explosives or firearms inside MRF.

### Advisable

- ♻️ No animals allowed inside the MRF.
- ♻️ Do not dispose waste inside or near storm water drains, drainage, ditches of any other location where they can damage the environment, cleanliness and aesthetics of the premises.
- ♻️ Avoid wastage of water and electricity.
- ♻️ Never use a damaged plug/extension cord.

### 13.9. Evening Protocol

- ♻️ All workers shall change their uniform to personal dress and keep PPE in locker at MRF before leaving the plant. **Annexure 2(7)** may be followed.
- ♻️ All workers must wash their hands and face before leaving the plant. They may bath as well.
- ♻️ Ensure all the machinery/equipments (fans/lights etc.) are switched off before leaving the MRF



### 13.10. Documentation and Reporting

- ❋ Officer in Charge shall maintain a soft copy of the consolidated figures of receipt and dispatch of materials at the MRF.
- ❋ Receipt & dispatch details including photographs shall be documented digitally. In case of manual entry, in charge MRF/weighbridge operator should sign the receipt in the format given at **Annexure 2 (4) & (5)**.
- ❋ Attendance of staff shall be reported bi-weekly to the Officer in Charge.
- ❋ Attendance & visitor log details shall be maintained at the MRF and monthly wages should be processed based on attendance register.
- ❋ Quantity of materials received or sorted or baled shall be reported category wise to Officer in Charge monthly in the format given at **Annexure 2(8)**. The date of submission of details shall be decided by Officer in Charge as per his peer review schedule.
- ❋ The total number of visitors shall be reported to Officer in Charge once in a month for review.
- ❋ Feedback on quality of waste material received shall be shared with the Officer in Charge.
- ❋ A complaint, suggestion and feedback register shall be maintained at the MRF.

### 14. Maintenance

Format of maintenance checklist are presented as **Annexure 2(9)**

- ❋ Storage compartments shall be cleaned after the dispatch of materials.
- ❋ The structural soundness of floor, roof, and sidewalls to be checked quarterly and the necessary requests shall be forwarded to Officer in Charge for carrying out repair work.
- ❋ All equipments shall be cleaned and greased as required. Lubrication of equipments shall be carried out after the shutdown.
- ❋ The functioning of all utilities like drinking water, toilet facilities, electrical fittings, rainwater harvesting system (if any) and solar panel shall be checked for faults. Necessary requests shall be submitted to officer in charge for required repairs.

### 15. Annual Maintenance Contracts (AMC)

Various machines such as trommel, conveyor belts, weigh bridge, baling machine, desktop computer, fans etc would be installed at MRF. Each machine has a warranty associated with its fresh procurement. On expiry of warranty period, maintenance contract would be a necessity. The officer in charge shall maintain a warranty register of equipment and thereafter AMC for the same equipment.

An Annual Maintenance Contract (AMC) to cover basic service on products or a Comprehensive Service Contract (CMC) covering additional spare parts, labour, travel cost of technician etc. need to be maintained with the contractor who supplied and commissioned MRF for a further period of three years after warranty period.

## 16. Safety Practices

Safety practices should be adopted as per **Table 25** and checklist for electric & mechanical safety and fire prevention & protection. Check list for machine safety and format for electrical safety is attached as **Annexure 2(10 &11)**.

**Table 25: Safety Practices**

Sl. No.	Hazard	Precaution	Cure
1	Cuts and injuries due to presence of broken glass, sharps, needles which may lead to septic wounds and tetanus	Use of safety Gloves	Use of first aid kit, medical help be sought immediately in case of injury
2	Direct contact with sanitary waste and domestic hazardous waste	Wearing gloves, sanitizers shall be used always.	Seek physicians advice
3	Direct contact with used sanitary napkins and soiled diapers	Gloves should be worn and avoid direct contact with any waste.	Seek medical help in case of allergy
4	Callosities on the fingers observed	---	Should immediately contact a doctor
5	Exposure to fumes causing irritation of nose, throat and lungs	Suitable masks be used by the Safai Mitra while working	Medical help to be sought immediately

### 16.1. Display of Information under The Factories Act, 1948

Format of display of information under The Factories Act is presented as **Annexure 2(12)**

- ❋ Working hours shall be displayed at main gate of the facility.
- ❋ Display “OPEN” and “CLOSED” signboards during and after working hours respectively.
- ❋ Display Bilingual signboard mentioning “Child Labour Prohibited” at main gate of facility.
- ❋ Display Campaign posters on segregation, recyclability, composting, and hazards of burning mixed waste/incineration etc.
- ❋ Display the contact number of the Plant-in-Charge, police, fire department and other public authorities.

### 16.2. Hygiene Practices

It is mandatory to provide a safe working environment for workers and visitors at the MRF. The following points shall be considered for hygiene practices.

- ❋ Medical examination shall be for all staff/workers (for Hepatitis B, AIDS).
- ❋ Keep sorting & storage area dry and free from pests and flies.

- ❋ Regularly spray disinfection liquid as better prevention practices.
- ❋ All working personnel at the MRF must wear uniform and PPEs while at work in MRF plant.
- ❋ Hands should be washed with soap before entering/leaving/eating.
- ❋ Monthly cleaning and “pest-control treatment” routine has to be fixed at MRF and should be strictly followed.
- ❋ Rodent control measures shall be in place.

## 17. Safety Training

### 17.1. Refresher Training

The training may be conducted on a quarterly basis to ensure that all workers are updated with safety requirement on site as per work requirements.

### 17.2. Toolbox Talk

At least one toolbox talk should be organized once a week. These talks will be designed to highlight relevant safety and industrial health issues to the workforce on a regular basis to raise their level of awareness in vernacular language. A safety pledge will be developed and it should be a part of toolbox talks.

## 18. Emergency Response Plan

An emergency response plan is for the effective management of an accident to minimize the losses to the people and property. On-site Emergency Management Plan (On-SEMP) details how major accidents will be dealt with and includes the details on responsibilities for taking actions in accordance with the plan. The response plan may be in place to deal in fire hazard. Depending upon the seriousness and response requirements during emergencies, they are classified into two levels and are listed as below:

- ❋ Level 1: Emergencies that can be effectively and safely managed and contained within the site, location or installation by the available resources. These incidents have no impacts outside the site, location or installation site of the machineries.
- ❋ Level 2: Emergencies that cannot be effectively and safely managed or contained at the location or installation by available resource and additional supports is alerted or required. These incidents have an effect beyond the site, location or installation and where external support of district authorities may be involved. The level 2 incidents may be danger to life, environment or to industrial assets or reputation.

ULB’s shall make an up to date On Site Emergency Plan according to their manpower allocations. For level 2 emergencies, the On-Site Emergency Plan shall work in coordination with nearest fire brigades and medical services. The schematic

representation of onsite emergency management plan upto level 2 emergency is presented in the figure given below:

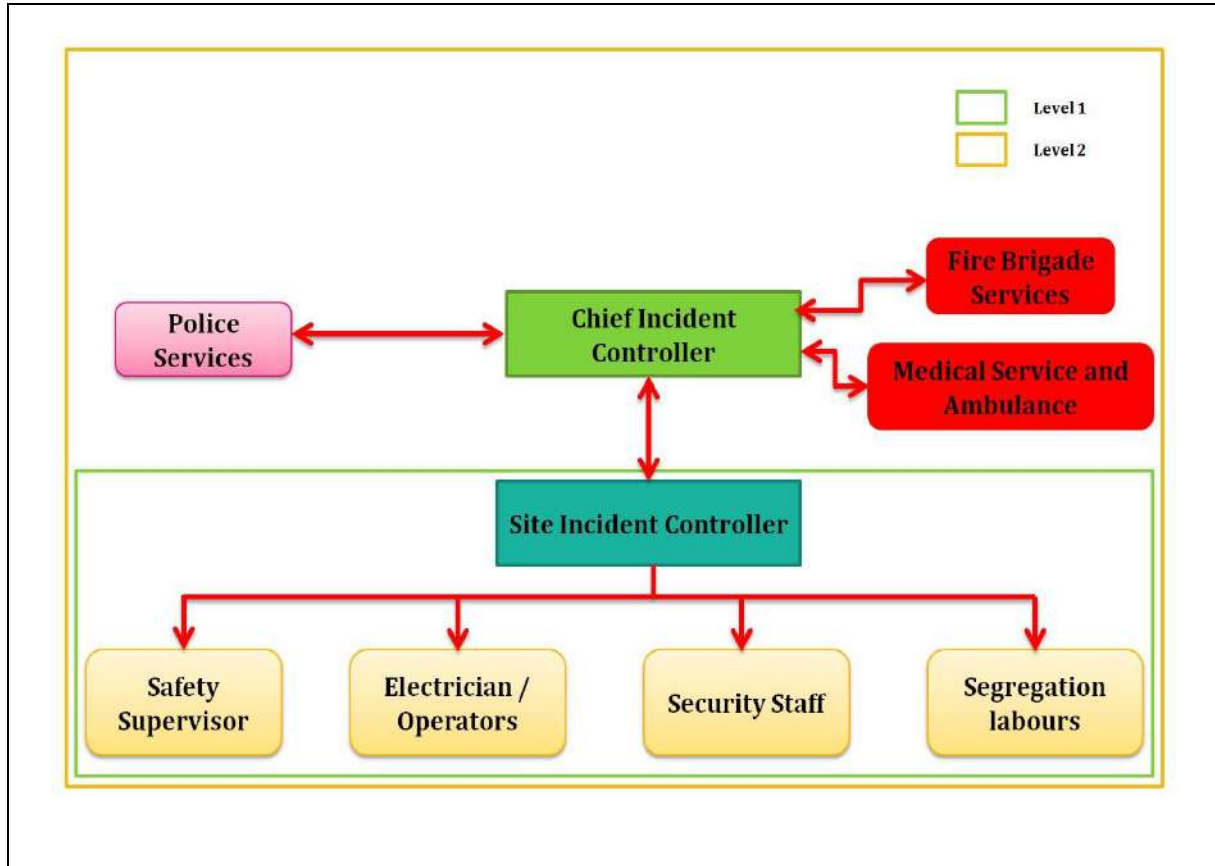


Figure 16: Emergency Response Plan

### 18.1. Roles and Responsibilities of Emergency Response Team

The roles and responsibility of responding staff during a Level 1 fire incident are described below:

Table 26: Roles and Responsibility of Emergency Response Team

Sl. No.	Position Held	Staff Deployed	Responsibility
1.	Chief Incident Controller	Health Supervisor/Sanitation Officer of ULB	<ul style="list-style-type: none"> <li>Act as the coordinating point for transfer of information between District administration and SIC</li> <li>Extend all the supports to SIC through external assistance regarding technical resources/equipment/medical supports as deemed necessary</li> </ul>

Sl. No.	Position Held	Staff Deployed	Responsibility
			<ul style="list-style-type: none"> <li>Ensure round the clock operation, with shift personal being prepared to take charge of emergency control function, emergency shutdown of system if needed</li> </ul>
2.	Site Incident Controller	Manager In Charge	<ul style="list-style-type: none"> <li>Ensure essential HSE equipment are availed with ERT</li> <li>Lead response team and start response activities without any delay</li> <li>Take quick decisions on priority of operation – life saving requirements/ response requirements</li> <li>Ensure that medical aid has been made available as early as possible</li> <li>Updating CIC about the incident and supporting him for taking decisions</li> </ul>
3.	Safety Supervisor	Safety Supervisor	<ul style="list-style-type: none"> <li>Responsible for monitoring and assessing hazardous, unsafe act and conditions</li> <li>Conduct safety training program for works and arrange mock drills as a preparedness for handling emergency situations</li> <li>Watches out for the safety of all workers and protect them from entering hazardous situations</li> </ul>
4.	Electrician/Operators	Electricians and operators	<ul style="list-style-type: none"> <li>Ensure power supply in the plant</li> <li>Take orders from SIC regarding the evacuation of forklift and wheeled skid loader</li> <li>Switch off the machines as per directions from SIC</li> </ul>
5.	Security staff	Security staff	<ul style="list-style-type: none"> <li>Controls and directs traffic in the Plant</li> <li>Shall supervise evacuation</li> </ul>

Sl. No.	Position Held	Staff Deployed	Responsibility
			of personnel from the scene
6.	Sorting labours	Sorting labours	<ul style="list-style-type: none"> <li>♻ Will take orders from the site incident controllers</li> <li>♻ Will respond to the incident with</li> </ul>

## 18.2. Emergency Contact Numbers

The emergency contact numbers are given in **Table 27**

**Table 27: Emergency Contact Numbers**

Sl. No.	Particulars	Contact Numbers
1	In- Charge	-
2	On duty supervisor	-
3	Disaster helpline	1077
4	Women helpline	1091
5	Police	100
6	Fire & Rescue	101
7	Ambulance	102, 108
8	Nearest Govt. Hospital	-
9	Disaster Management	-
10	Nearest snake bite antivenam centre	-

## 19. First Aid Box

It is important to have a well-stocked first aid kit at MRF to deal with minor accidents and injuries. It should be accessible all the time. A basic first aid kit should contain, bandages of different sizes, small, medium and large sterile gauze dressings, adhesive bandages, crepe rolled bandages, safety pins, disposable sterile gloves, tweezers, scissors, micro-porous, sticky tape, thermometer, cream or spray to receive insect bites and stings, antiseptic cream, antiseptic liquid, painkillers spray/cream etc.

## 20. Statutory Requirements

Various applicable clearances under different rules and acts need to be obtained by the ULB prior to the commencement of work or operation of the MRF. A generic requirement of clearances is described in **Table 28**.

**Table 28: Statutory Requirement for a 50 TPD MRF Facility**

Sl. No.	Statutory Requirement	Regulatory Authority	Responsibilities	Remarks
1	Consent to Establish (CTE)	Concerned State/ Union territory	ULB/Contractor/ Occupier	To be obtained under The Water Act 1974 and The Air Act 1981 through



Sl. No.	Statutory Requirement	Regulatory Authority	Responsibilities	Remarks
		Pollution Control Board		online application at the respective SPCB/PCC with necessary supporting documents like layout plan, key plan, project report and project fee before the commencement of works at site
2	Consent to Operate (CTO)	Concerned State/ Union territory Pollution Control Board	ULB/Contractor/ Occupier	To be obtained under The Water Act 1974 & The Air Act 1981 through online application at the respective SPCB/PCC with necessary supporting documents like Key plan, actual layout plan, project report and consent fee before the commencement of operation of plant
3	Building permit/building number	Concerned Urban Local Body	ULB/Contractor/ Occupier	Building number may be obtained
4	LT power connections	Concerned State Electricity Board/Electrical Company	ULB/Contractor- /Occupier	Occupier may submit an application with necessary fees at the concerned electricity board/company along with documents as per checklist including test report from competent electrical contractor, layout plan, authority letter in favor of applicant official and clear title of should be submitted prior to the commencement of operation of the plant.
5	Water Connection	Concerned State Water Supply and Sewerage Department	ULB/Contractor/ Occupier	Occupier may submit a new application of water connection with necessary fees and supporting documents to the concerned water supply and sewerage department prior to the commencement of operation of the unit

Sl. No.	Statutory Requirement	Regulatory Authority	Responsibilities	Remarks
6	Sewer Connection	Concerned State Water Supply and Sewerage Department	ULB/Contractor/ Occupier	A new application for connecting the outlet lines with the sewerage network system with necessary fees may be submitted and supporting documents to the concerned water supply and sewage department prior to the commencement of operation of the unit
7	NoC/Clearance from Fire Department	Concerned State Fire Department	ULB/Contractor/ Occupier	NoC/Clearance from respective fire department may be obtained prior to the operation of the plant






## 21. Signage

Signage is proposed at the workplaces for accident prevention, fire protection, health hazard information and emergency evacuation. Safety signage are prepared by using the appropriate safety colour, contrast colour and geometric shapes as per IS 9457:2005. Table below describes the different signage that can be adopted for MRF plants across the country.

**Table 31: Signage for MRF**

SL. No	Geometric shape and description		Signage purpose	Practical applications at MRF
1.		Circle with Diagonal Bars	Prohibition	No Smoking No Unauthorized Vehicles Do not Drink No entry Do not touch Do not litter
2.		Circle	Mandatory Action	Wear Eye Protection Wear Personal Protective Equipment Switch off mobile Use Forklift Wash your hands Keep clean Switch off light



SL. No	Geometric shape and description		Signage purpose	Practical applications at MRF
3.			Equilateral Triangle Warning	Danger High Voltage Conveyor may start without warning Don't block door Forklift in Use Hazardous material storage area Rotating parts
4.			Square/Rectangle Safe condition, Means of Escape, Safety Equipments	First Aid Room Fire Exit Fire Assembly Point Emergency exit
5.			Square/Rectangle Fire safety	Fire alarm Fire Alarm Call Point Fire Fighting Equipment Fire Extinguisher Fire hydrant & hose reel Fire Phone

## 22. Other Important Guidelines

- a. The minimum safe distance/clearance between two machines as advised by the manufacturer and in case of doing maintenance or future replacements
- b. MRF should be certified by a structural engineer/local ULB engineer and the fire department as per rules
- c. Emergency numbers should be displayed at prominent locations
- d. Regular checking of PPEs and maintained replacement records
- e. Fitness certification of machines/equipment, frequency of certification need to be recorded in file
- f. Regular inspection, medical fitness record of personals and workmen, tied up with the nearby hospitals
- g. Emergency stop switches on conveyer belts and various electrical machines, ensuring adequate earthing and regular maintenance of earth pits with display of earth resistance value
- h. Different type of mock-drills to check the effectiveness of the system
- i. CCTV installation at various locations

### 23. Important points in Civil Works

Sequence of civil works for MRF construction

- ❋ Clearing out the site (As per drawings & layout)
- ❋ Setting out the MRF building
- ❋ Excavations for isolated footing and flooring
- ❋ Construction of isolated footing and column upto the plinth beam level- All works
- ❋ Leveling and compacting of the earth upto the GSB layer following the IRC guidelines
- ❋ Vibratory rollers of 8 - 10 capacity should be engaged for compacting the soil and sub base layers
  1. Granular Sub Base (GSB) layer
  2. Wet Mix Macadam (WMM) layer
- ❋ Laying and compacting of GSB/WMM layers to the recommended thickness
- ❋ Laying of Cement Concrete layer 1:2:4 over the WMM layer, duly vibrated
- ❋ Construction of plinth beam and superstructure including columns, brick walls etc. say to a height 1 m above the plinth level
- ❋ Laying of flooring using vibrated M30 grade concrete. Care should be given for preventing cracks on the floor by providing expansion joints at a recommended size of 3 X 4 m as per design
- ❋ The concreting of floors should be done in staggered bays, laying diagonally

Best practices to be adopted

- ❋ The State Government/State Mission Director should develop a technical team for implementing MRFs across the State including quality control of civil works in all ULBs
- ❋ Ensure proper construction & expansion joints for the building where concrete flooring and concrete road works are required.
- ❋ Tendering of works may be done at the State level - ULB wise and agreements for finalized bids may be executed by the ULB and Contractor and monitored
- ❋ ULBs may take support of State PWD for implementing civil works for proper setting out and quality control.

### 24. Siting of MRF

Accessibility, land use and geology need to be considered when siting MRF. MRF shall be located close to the source of the MSW generation for minimization of travel distances for cost effectiveness. Centralized/decentralized MRF can be developed as per site suitability. In order to locate a MRF near residential areas, the facility must be environmentally and aesthetically acceptable. The plantation of trees/shrubs in the periphery of MRF will improve aesthetics and decrease in odour and noise pollution. Some of the suggestions for siting of MRF are given below.

- I. MRF need to be located close to existing roads, but traffic resulting from the movement of waste collection trucks should be considered. These facilities must

be near or within urban areas that generate the inputs to be processed for recyclables.

- II. MRF may be preferably located in an industrial zone or close to a sanitary landfill to facilitate efficient movement of waste from various generators and disposal of residual or biodegradable materials.
- III. MRF should be sited in flat or gently sloping, stable areas to reduce excavation cost and avoid problems of slope stability.
- IV. The plinth level of MRF may be kept 1.0 metre above HFL.

## 25. Lightning Protection System

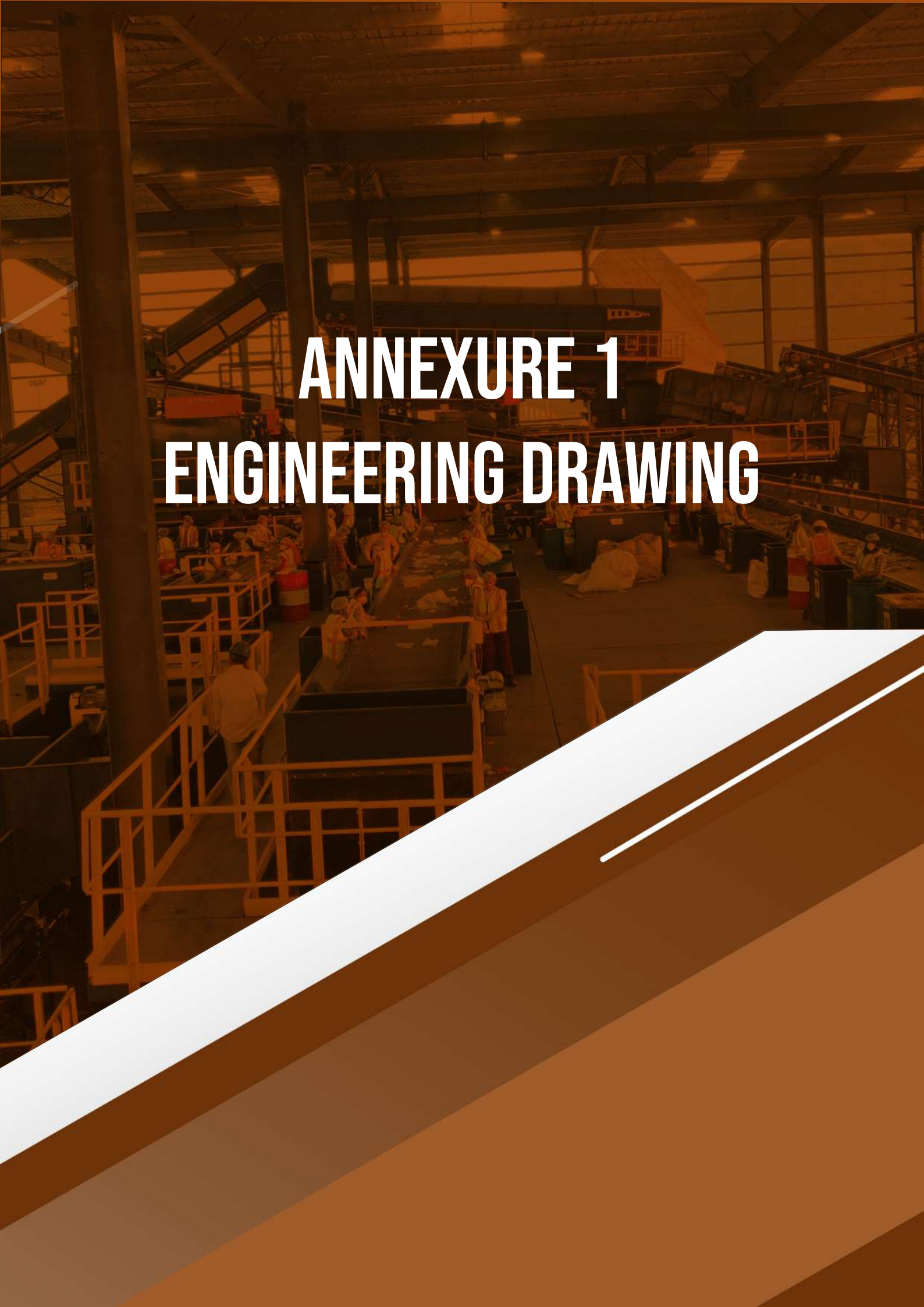
A lightning arrestor conforming to IS 2309:1989 may be provided to protect the shed and machinery/equipment.

## Reference

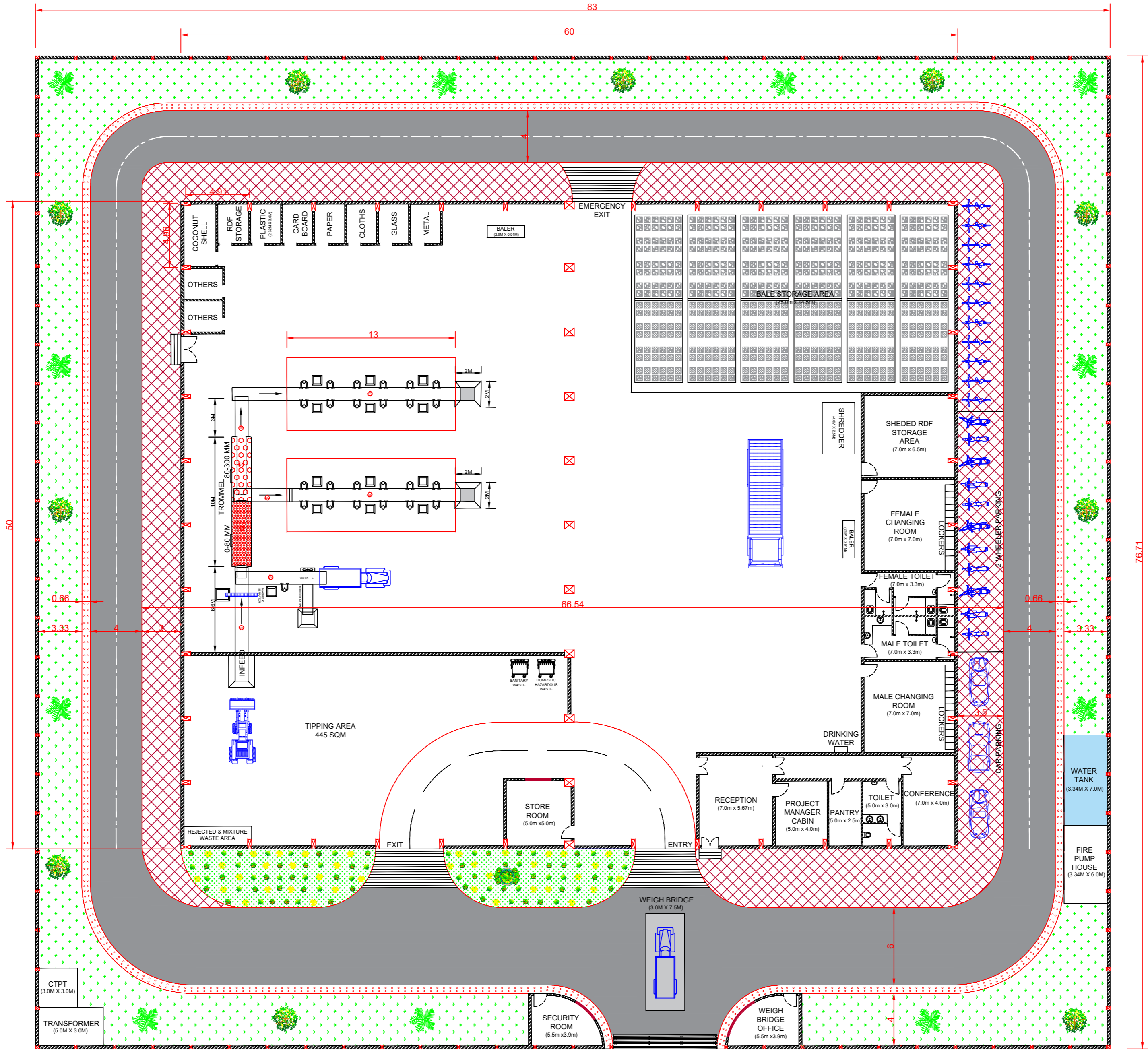
- “Advisory on Material Recovery Facility (MRF) for Municipal Solid Waste” by Central Public Health and Environmental Engineering Organization(CPHEEO)
- “Municipal Solid Waste Management Manual, Part” 1, 2 & 3, 2016 by Central Public Health and Environmental Engineering Organization(CPHEEO)
- “Guidelines for Disposal of Plastic Waste”, Central Pollution Control Board, 2017
- The Municipal Solid Waste Management Rule, 2016
- The Plastic Waste Management Rules, 2016
- National Building Code of India 2016 Volume 1 & 2
- Delhi Schedule of Rates Volume 1 & 2, 2023



# ANNEXURE



# ANNEXURE 1 ENGINEERING DRAWING



DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULBS AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

SR. NO.	EQUIPMENTS	QUANTITY(NO.)	DIMENSIONS(M)
01	WEIGH BRIDGE	1	3.0 X 7.5
02	TROMMEL	1	2.0 X 10.0
03	CONVEYOR BELTS	8	TOTAL LENGTH : 64.6M
04	BALER	2	2.9 X 0.9
05	SHREDDER	1	2.5 X 4.0
06	MAGNETIC SEPRATOR	1	

Client:  Ministry of Housing and Urban Affairs  
Government of India  
MINISTRY OF HOUSING AND URBAN AFFAIRS

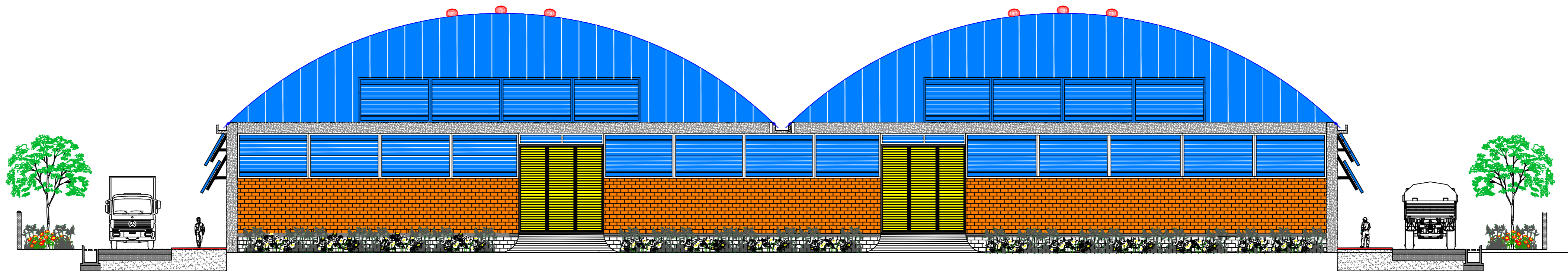
Consultant:  RITES Ltd. (A Government of India Enterprise)

Project: MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE: TYPICAL LAYOUT FOR 50 TPD MRF PLANT



DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
DRAWN BY :	RAHUL ARYA
CHECKED BY :	SANJAY RAUT
REVIEWED BY :	CPHEEO, MoHUA
Date :	1st Mar. 2024

DISCLAIMER - MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULBS AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
 NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED



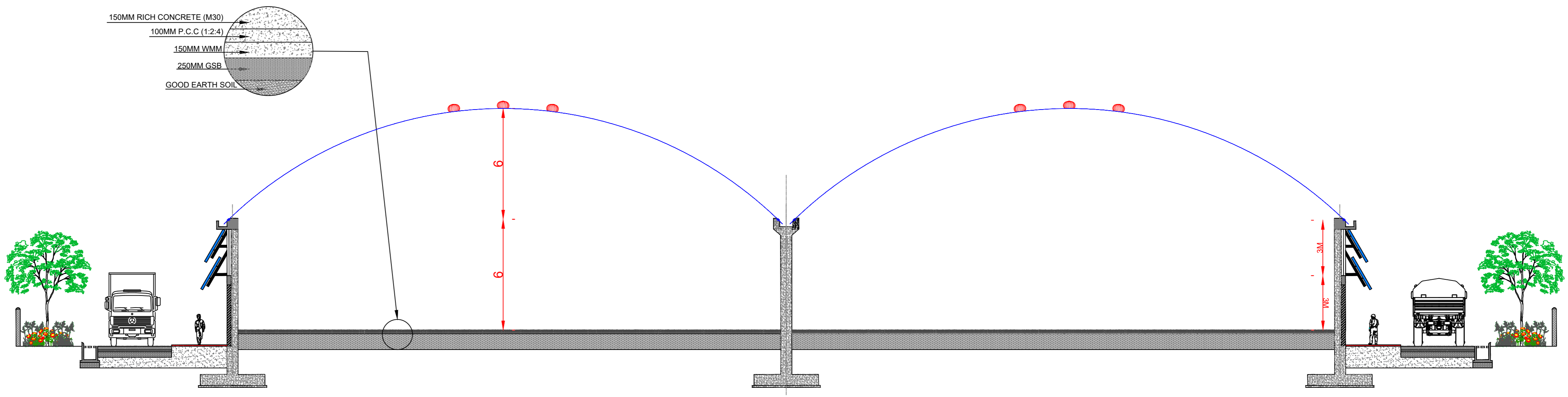
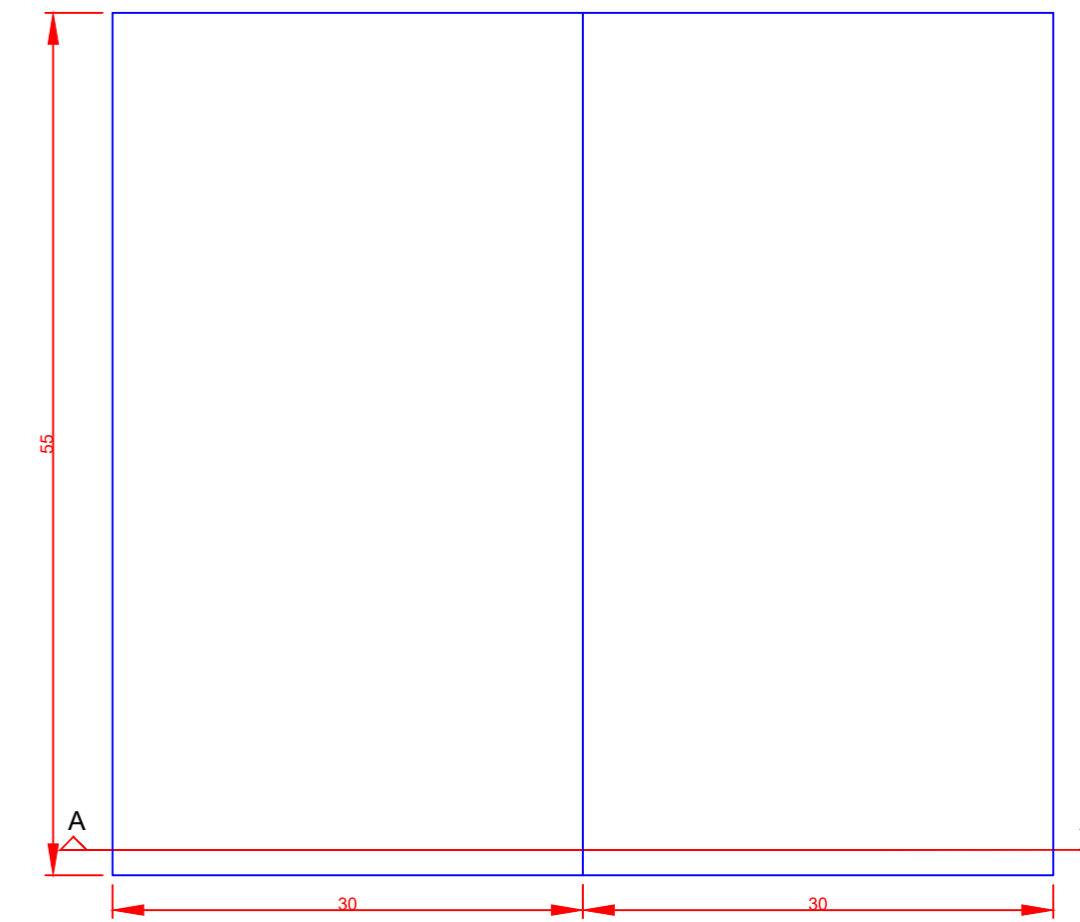
## ELEVATION

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client:   <p><b>Ministry of Housing and Urban Affairs</b> Government of India</p> <p>MINISTRY OF HOUSING AND URBAN AFFAIRS</p>	Consultant:   <p><b>RITES</b> THE INFRASTRUCTURE PEOPLE</p> <p>RITES Ltd. (A Government of India Enterprise)</p>	Project: MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0  TITLE: TYPICAL ELEVATION OF 50 TPD MRF	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">DESIGNED BY :</td> <td style="width: 60%;">CHETAN A. PATIL &amp; DR. ANAND SONAWANE</td> <td style="width: 25%;"></td> </tr> <tr> <td>DRAWN BY :</td> <td>RAHUL ARYA</td> <td></td> </tr> <tr> <td>CHECKED BY :</td> <td>SANJAY RAUT</td> <td></td> </tr> <tr> <td>REVIEWED BY :</td> <td>CPHEEO, MoHUA</td> <td>Date : 1st Mar. 2024</td> </tr> </table>	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE		DRAWN BY :	RAHUL ARYA		CHECKED BY :	SANJAY RAUT		REVIEWED BY :	CPHEEO, MoHUA	Date : 1st Mar. 2024
DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE														
DRAWN BY :	RAHUL ARYA														
CHECKED BY :	SANJAY RAUT														
REVIEWED BY :	CPHEEO, MoHUA	Date : 1st Mar. 2024													





DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
 NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED

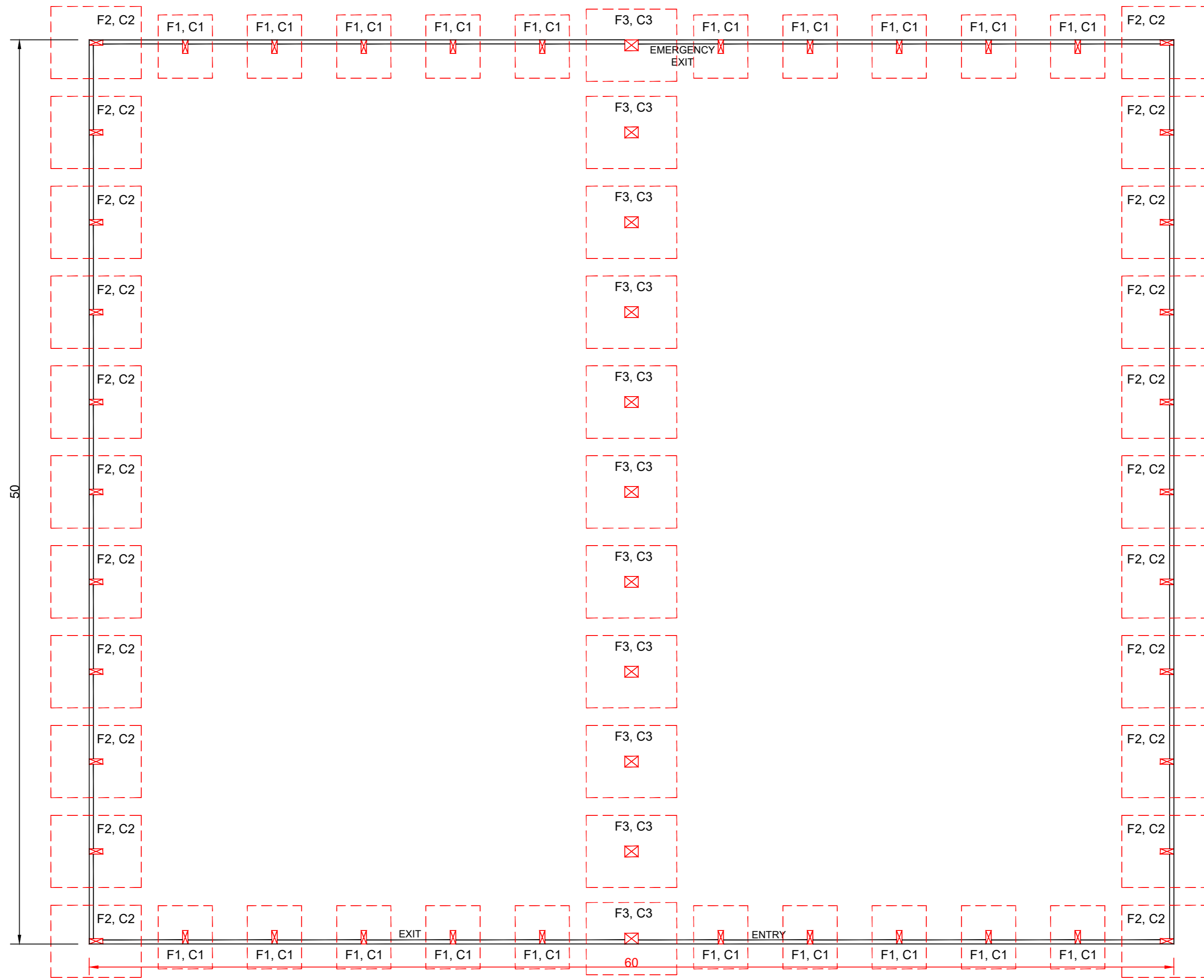


**SECTION A-A**

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

<p>Client:</p>  <p>MINISTRY OF HOUSING AND URBAN AFFAIRS</p>	<p>Consultant:</p>  <p>RITES Ltd. (A Government of India Enterprise)</p>	<p>Project:</p> <p>MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0</p> <p>TITLE:</p> <p>TYPICAL CROSS SECTION FOR 50 TPD MRF</p>	<p>DESIGNED BY :</p> <p>DRAWN BY :</p> <p>CHECKED BY :</p> <p>REVIEWED BY :</p>	<p>CHETAN A. PATIL &amp; DR. ANAND SONAWANE</p> <p>RAHUL ARYA</p> <p>SANJAY RAUT</p> <p>CPHEEO,MoHUA</p>	<p>Date :</p> <p>1st Mar. 2024</p>
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DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULBS AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED



### COLUMN & FOOTING PLAN

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

- NOTES:-
1. SBC assumed for design of foundation is 10ton/m2 at 2m below the natural ground level.
  2. Building is assumed to be situated in Seismic Zone IV.
  3. Grade of concrete as M30.
  4. Reinforcement bars shall be TMT Fe-500D grade conforming to IS:1786 of 2006 reinforcement shall be clean and free from oil, mill scale etc, and shall be bent cold to the shapes and dimensions indicated and shall be placed exactly as shown.
  5. Wind load at top of the RCC frame and wind pressure applicable on the RCC frame is taken as per profflex loading provided.
  6. The walls are assumed to be made up of block work (200mm thick) having a density of 11kN/m3.
  7. All RCC works to be done as per IS 456-2000.
  8. All reinforcement work to conform to IS-456-2000 & IS-13920-2003.
  9. All intersections of bars shall be securely bound with n0.18 gauge pliable wire.
  10. The lap length shall not be less than 50Ø and anchorage length of bars shall not be less than 52Ø. not more than 50% of bars shall be lapped at same location . lap shall be staggered as per Clause 7.2.1 of IS 13920-1993.

Client:



Ministry of Housing and Urban Affairs  
Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:



RITES Ltd. (A Government of India Enterprise)

Project:

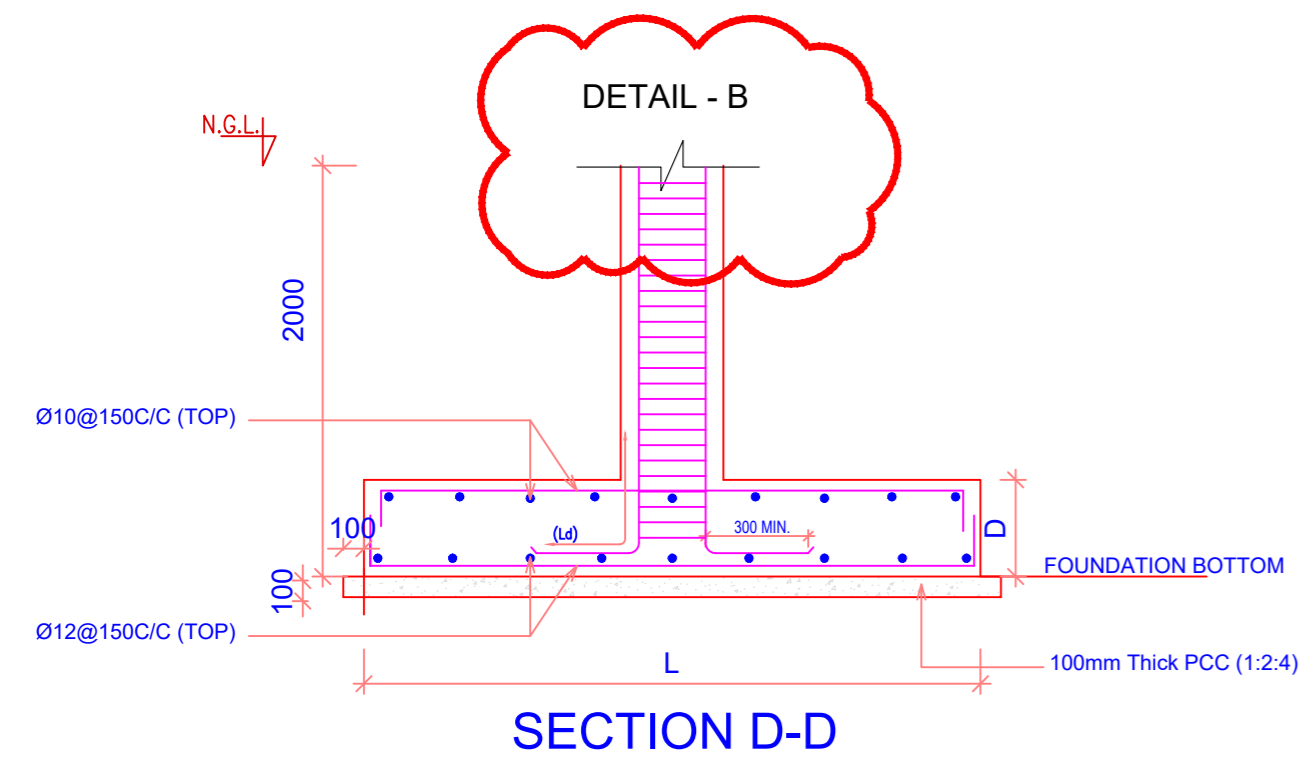
**MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0**

TITLE:

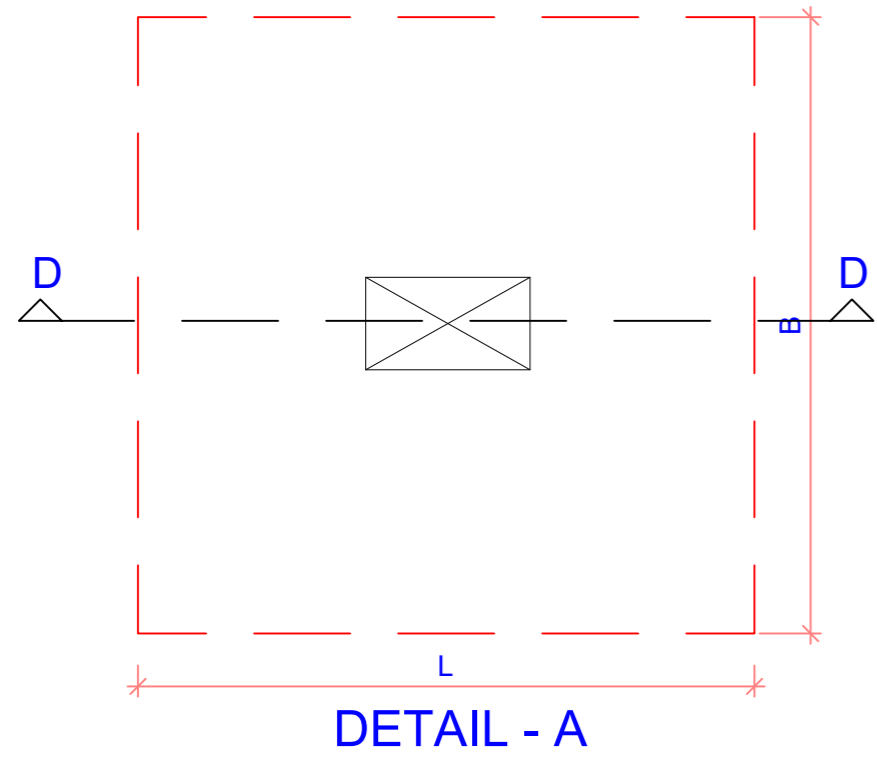
**TYPICAL FOUNDATION & REINFORCEMENT DETAILS FOR STRUCTURAL MEMBER FOR 50 TPD MRF PLANT**

DRAWN BY :	RAHUL ARYA	
CHECKED BY :	CHETAN A. PATIL & ANTONY JOSE	
APPROVED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	Date : 1st Mar. 2024

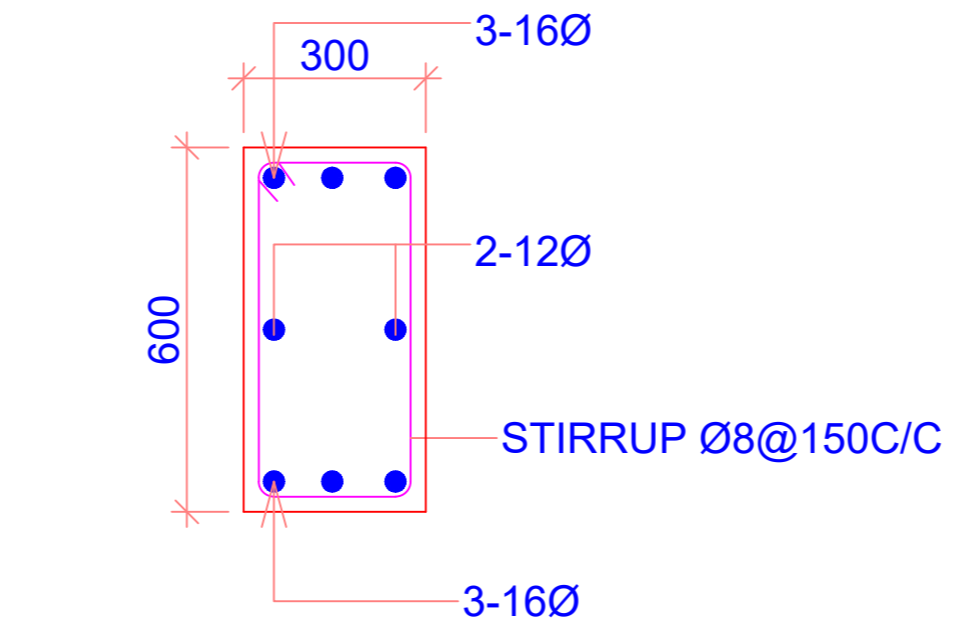
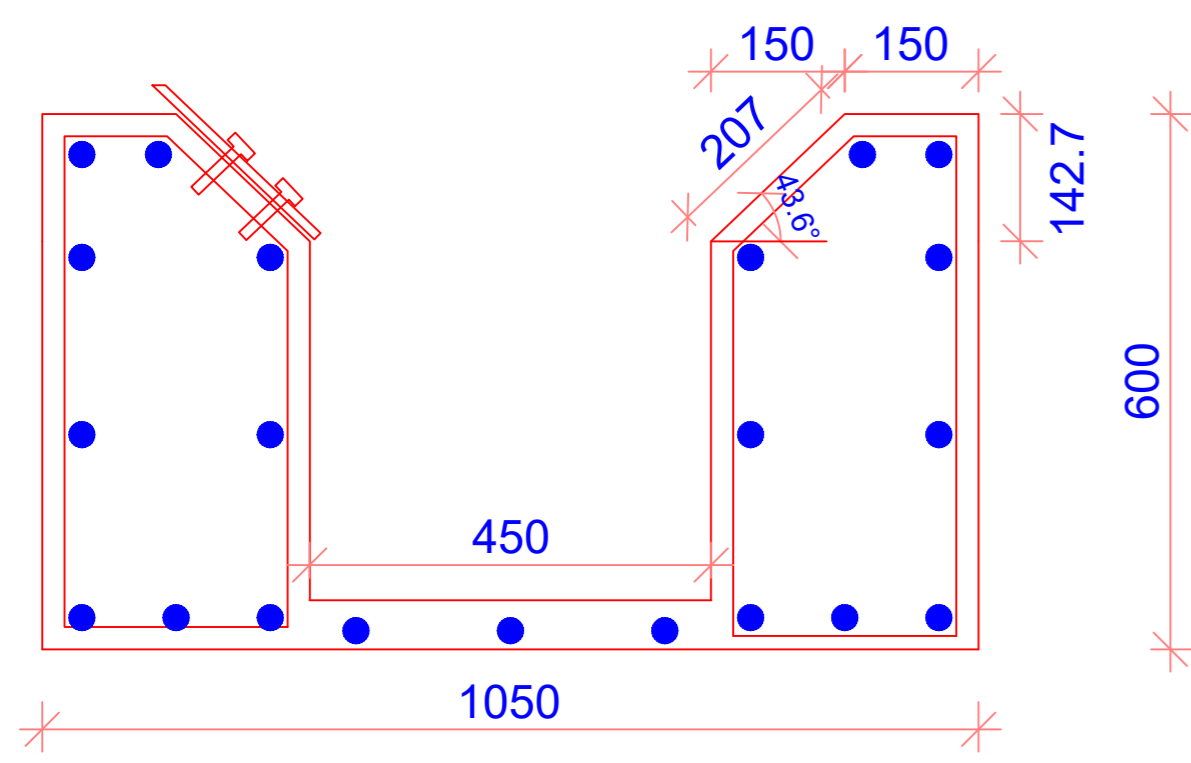
DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL. NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED



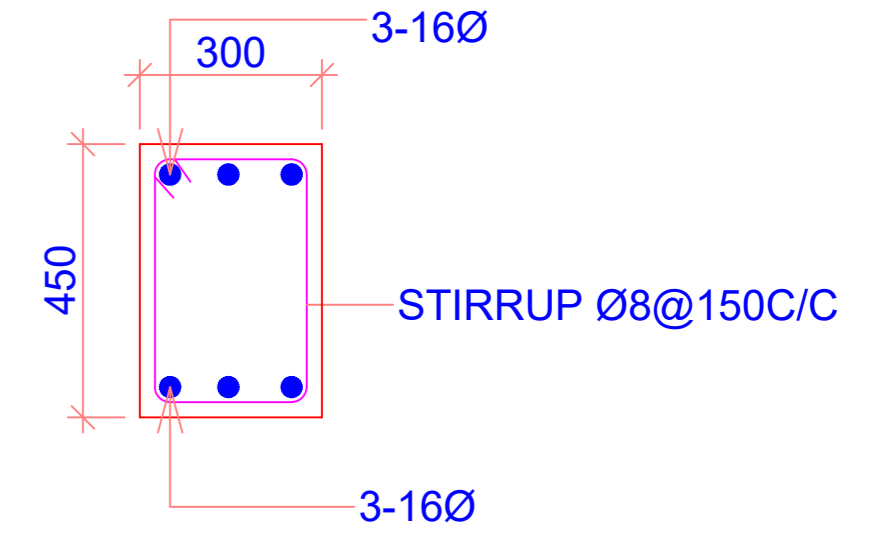
SECTION D-D



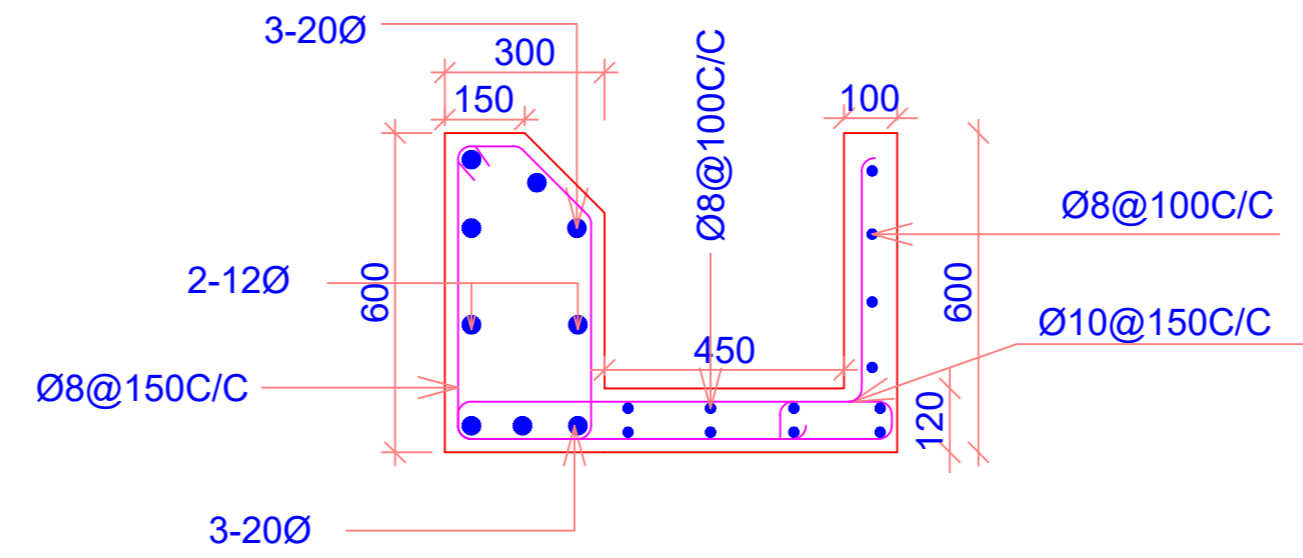
DETAIL - A



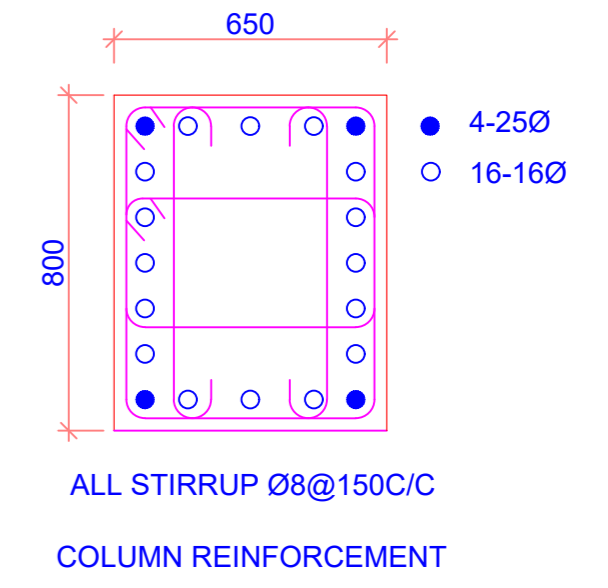
PLINTH BEAM REINFORCEMENT



MIDDLE BEAM REINFORCEMENT



TERRACE BEAM+GUTTER REINFORCEMENT



DETAIL - B

STRUCTURAL MEMBER	DIMENSIONS (m)			NO.
	L	B	D	
FOUNDATION -1 (F1)	4	3	0.6	20
FOUNDATION -2 (F2)	3	3.5	0.6	22
FOUNDATION -3 (F3)	4	3.5	0.6	11

STRUCTURAL MEMBER	DIMENSIONS (m)		NO.
	L	B	
COLUMN -1 (C1)	0.45	0.8	20
COLUMN -2 (C2)	0.45	0.8	22
COLUMN -3 (C3)	0.65	0.8	11

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

- NOTES:-
- SBC assumed for design of foundation is 10ton/m2 at 2m below the natural ground level.
  - Building is assumed to be situated in Seismic Zone IV.
  - Grade of concrete as M30.
  - Reinforcement bars shall be TMT Fe-500D grade conforming to IS:1786 of 2006 reinforcement shall be clean and free from oil, mill scale etc, and shall be bent cold to the shapes and dimensions indicated and shall be placed exactly as shown.
  - Wind load at top of the RCC frame and wind pressure applicable on the RCC frame is taken as per proffex loading provided.
  - The walls are assumed to be made up of block work (200mm thick) having a density of 11kN/m3.
  - All RCC works to be done as per IS 456-2000.
  - All reinforcement work to conform to IS-456-2000 & IS-13920-2003.
  - All intersections of bars shall be securely bound with n0.18 gauge pliable wire.
  - The lap length shall not be less than 50Ø and anchorage length of bars shall not be less than 52Ø. not more than 50% of bars shall be lapped at same location . lap shall be staggered as per Clause 7.2.1 of IS 13920-1993.

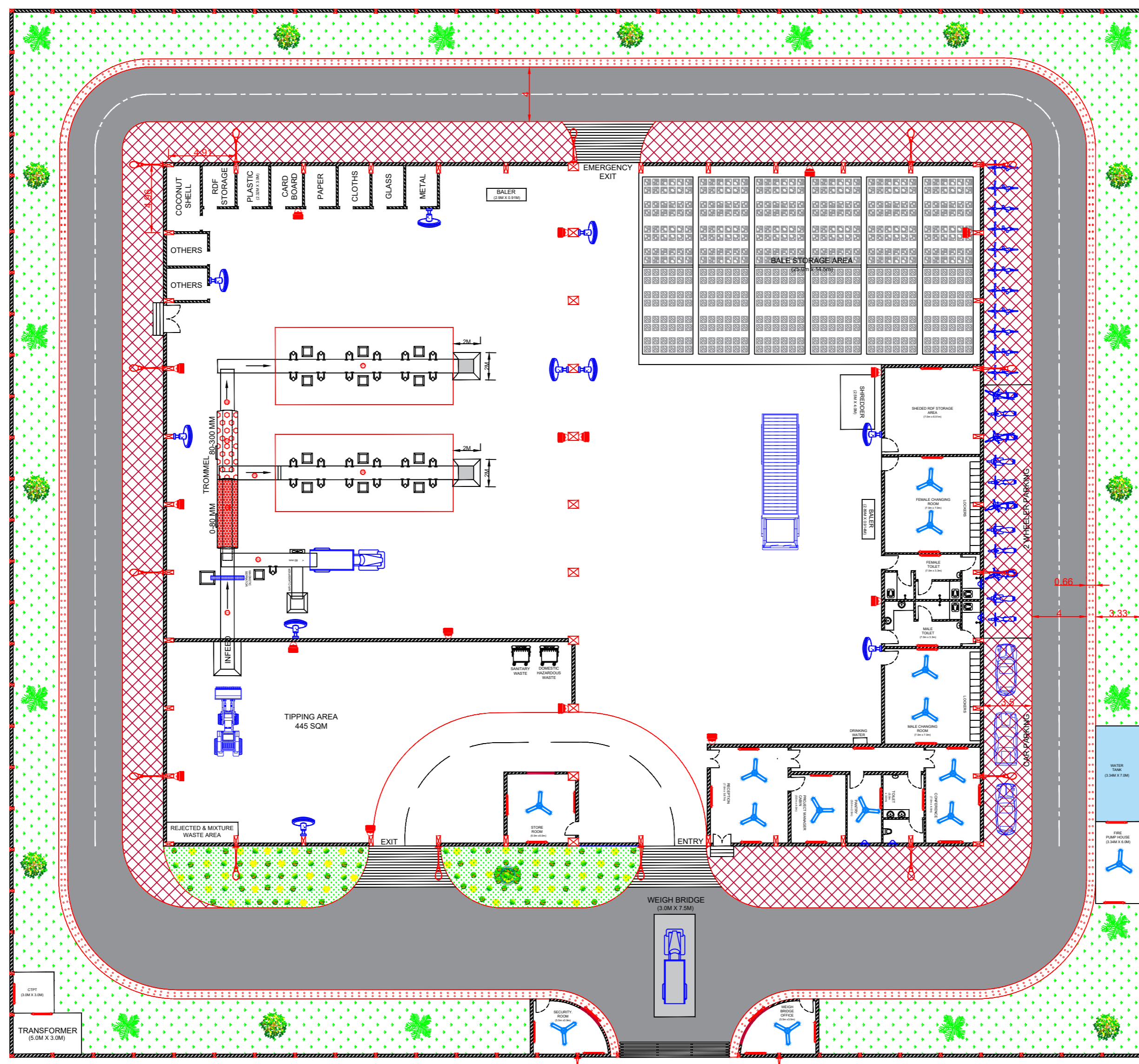
Client: Ministry of Housing and Urban Affairs Government of India  
MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant: RITES Ltd. (A Government of India Enterprise)

Project: MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

Title: TYPICAL FOUNDATION & REINFORCEMENT DETAILS FOR STRUCTURAL MEMBER FOR 50 TPD MRF PLANT

DRAWN BY :	RAHUL ARYA	
CHECKED BY :	CHETAN A. PATIL & ANTONY JOSE	
APPROVED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	Date : 1st Mar. 2024

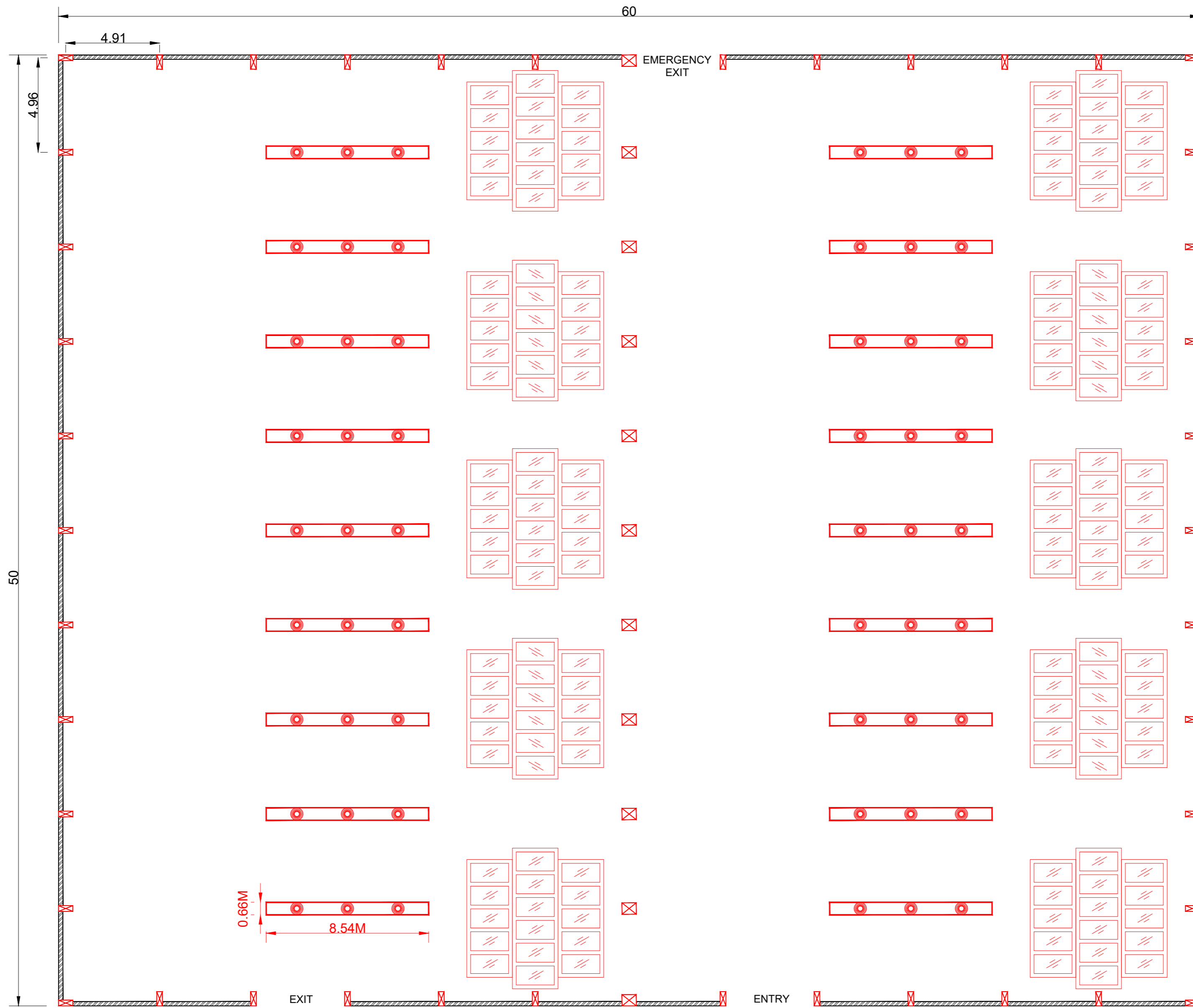


### ELECTRICAL LAYOUT

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
 NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED

SR. NO.	ITEMS	QUANTITY(NO.)	SYMBOL	Client:	Project:	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
01	STREET LIGHT (250W)	17		 MINISTRY OF HOUSING AND URBAN AFFAIRS	MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0	DRAWN BY :	RAHUL ARYA
02	LED LIGHT (100W)	16					Consultant:  RITES Ltd. (A Government of India Enterprise)
03	LED TUBE (24W)	31		TYPICAL ELECTRICAL LAYOUT FOR 50 TPD MRF PLANT	CHECKED BY :	CPHEEO, MoHUA	
04	WALL MOUNTED FAN (180W)	10			REVIEWED BY :	Date :	1st Mar. 2024
05	CELLING FAN (75W)	14					
06	TOILET EXHAUST FAN (60W)	04					




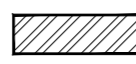





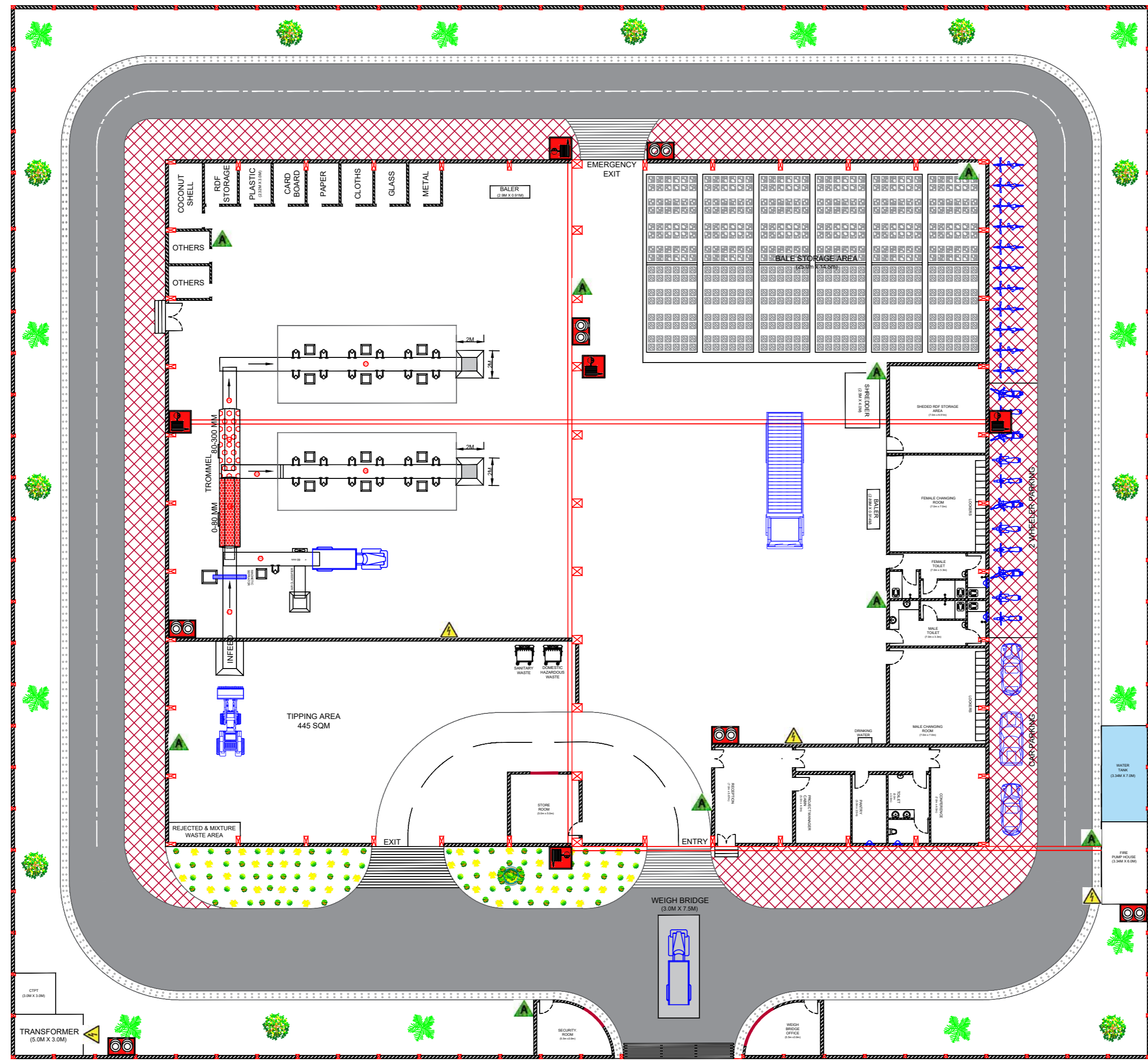
DISCLAIMER I : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL

DISCLAIMER II : DRAWINGS FOR THE INSTALLATION OF SOLAR PANELS NEED TO BE CHECKED AND APPROVED BY CONCERNED EXPERTS BEFORE INDIVIDUAL PROJECT TO GET THE ACTUAL NUMBER OF PANELS AS PER THE AVAILABILITY OF SUNLIGHT IN THAT AREA

NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

SR. NO.	ITEMS	SYMBOLS	Client:	Project:	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
01	COLUMN (HT - 6M) DIMENSION : 450 X 800 MM, 600 x 800 MM	 	 <b>Ministry of Housing and Urban Affairs</b> Government of India MINISTRY OF HOUSING AND URBAN AFFAIRS	<b>MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0</b>	DRAWN BY :	RAHUL ARYA
02	BRICK WORK (230 MM THICK) 3M HT				 <b>RITES</b> THE INFRASTRUCTURE PEOPLE RITES Ltd. (A Government of India Enterprise)	TITLE:
03	SOLAR PANEL (16 x 10 = 160 Nos.)					CHECKED BY :
04	SKYLIGHT SHEET WITH ROOF EXHAUST FAN (8.54 X 0.66M)				REVIEWED BY :	Date : FEB. 2024



### FIRE FIGHTING LAYOUT

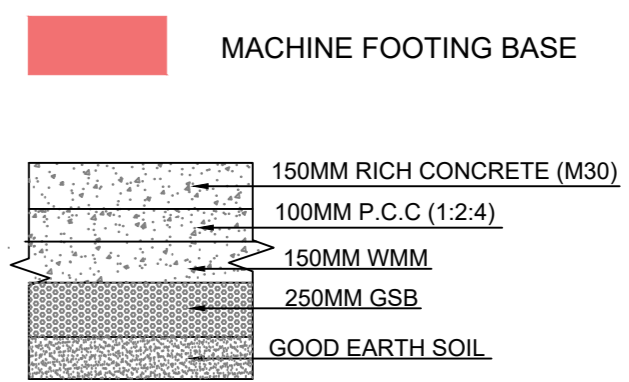
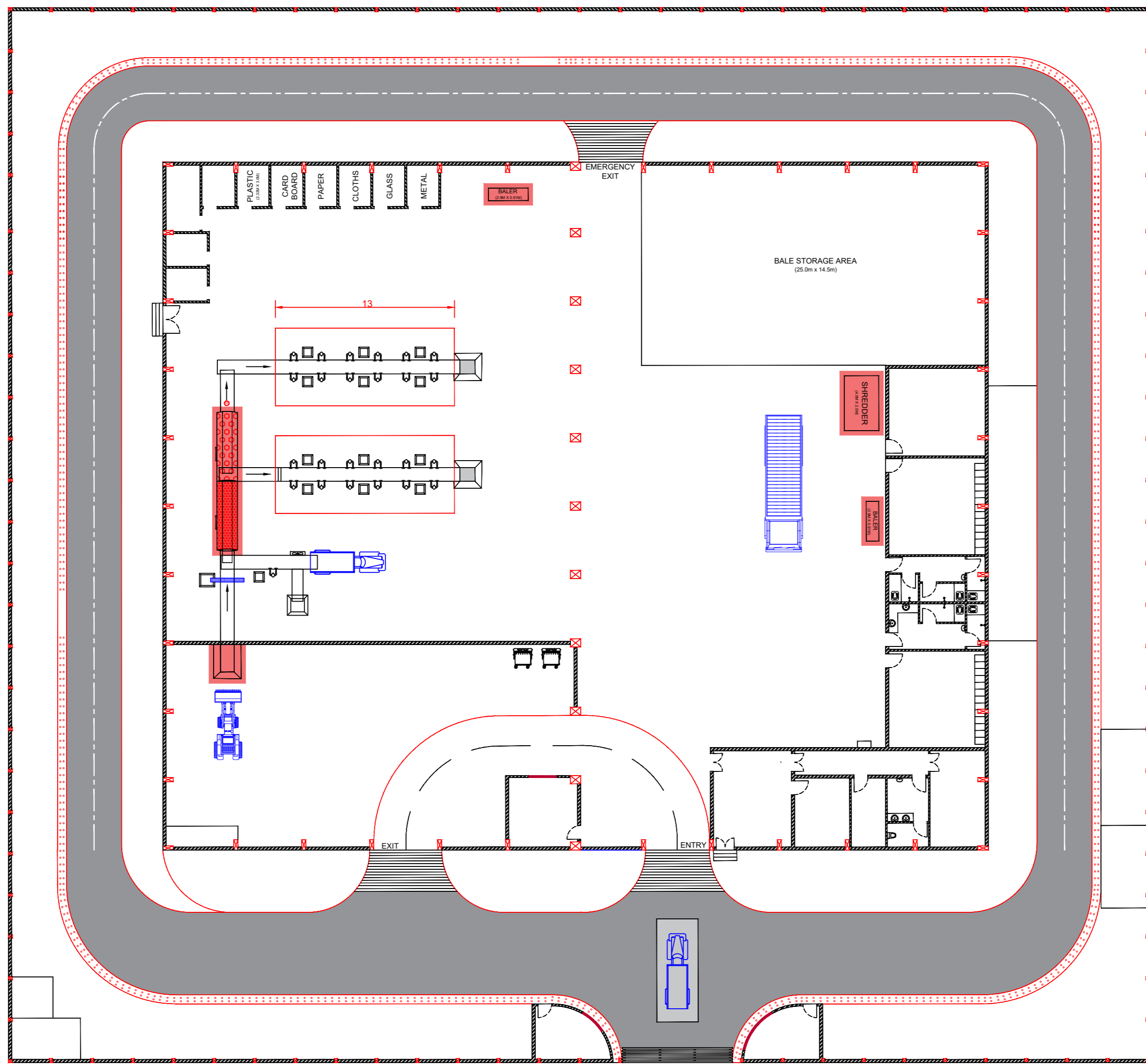
	FIRE BUCKETS
	CO-2 TYPES
	ABC FIRE EXTINGUISHER
	FIRE FIGHTING HYDRANT BOX

DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

SR. NO.	ITEMS	QUANTITY(No.)	SYMBOL	Client:	Project:	DESIGNED BY :	CHETAN A. PATIL & DHARMBER PRAJAPAT
01	ABC FIRE EXTINGUISHER	12		 MINISTRY OF HOUSING AND URBAN AFFAIRS Consultant:  RITES Ltd. (A Government of India Enterprise)	MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0  TITLE: TYPICAL FIRE FIGHTING LAYOUT FOR 50 TPD MRF PLANT	DRAWN BY :	RAHUL ARYA
02	CO-2 TYPES	04				CHECKED BY :	SANJAY RAUT
03	FIRE FIGHTING BOXES	05				REVIEWED BY :	CPHEEO, MoHUA
04	FIRE BUCKETS STAND	06				Date :	1st Mar. 2024



DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
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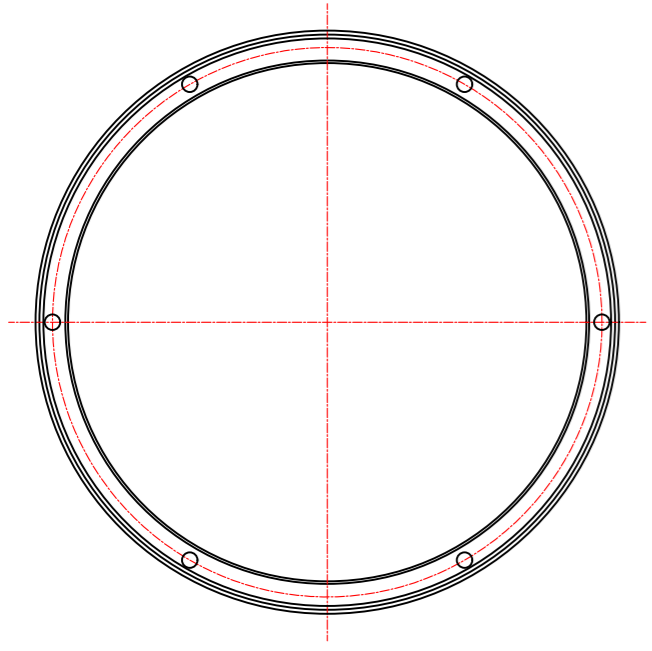
MACHINE FOOTING SECTION

### MACHINE FOOTING PLAN

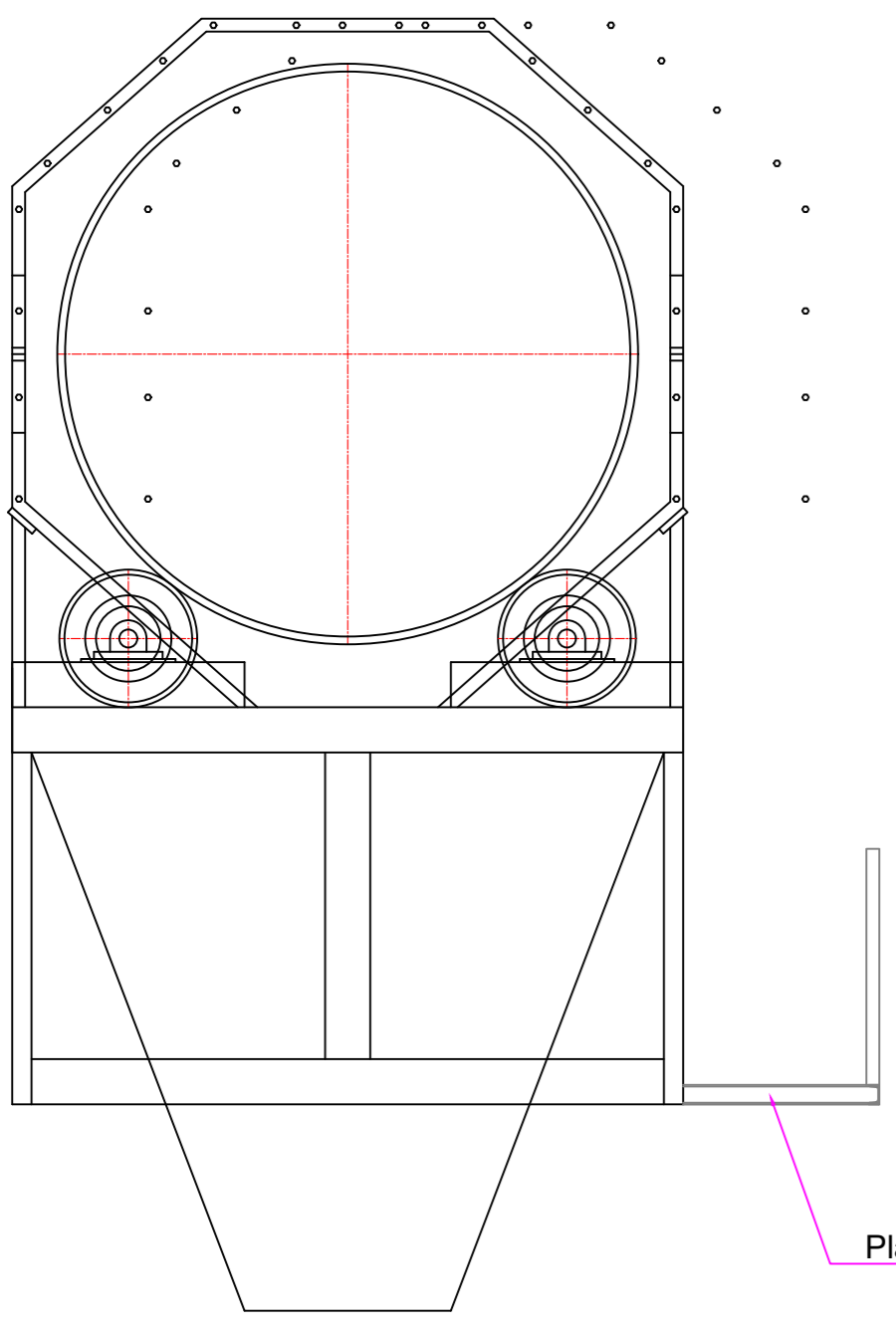
NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

<p>Client:</p>  <p>MINISTRY OF HOUSING AND URBAN AFFAIRS</p>	<p>Consultant:</p>  <p>RITES Ltd. (A Government of India Enterprise)</p>	<p>Project:</p> <p>MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0</p> <p>TITLE:</p> <p>TYPICAL MACHINE FOOTING PLAN</p>	<p>DESIGNED BY :</p> <p>DRAWN BY :</p> <p>CHECKED BY :</p> <p>REVIEWED BY :</p>	<p>CHETAN A. PATIL &amp; DR. ANAND SONAWANE</p> <p>RAHUL ARYA</p> <p>SANJAY RAUT</p> <p>CPHEEO, MoHUA</p>	<p>Date :</p> <p>1st Mar. 2024</p>
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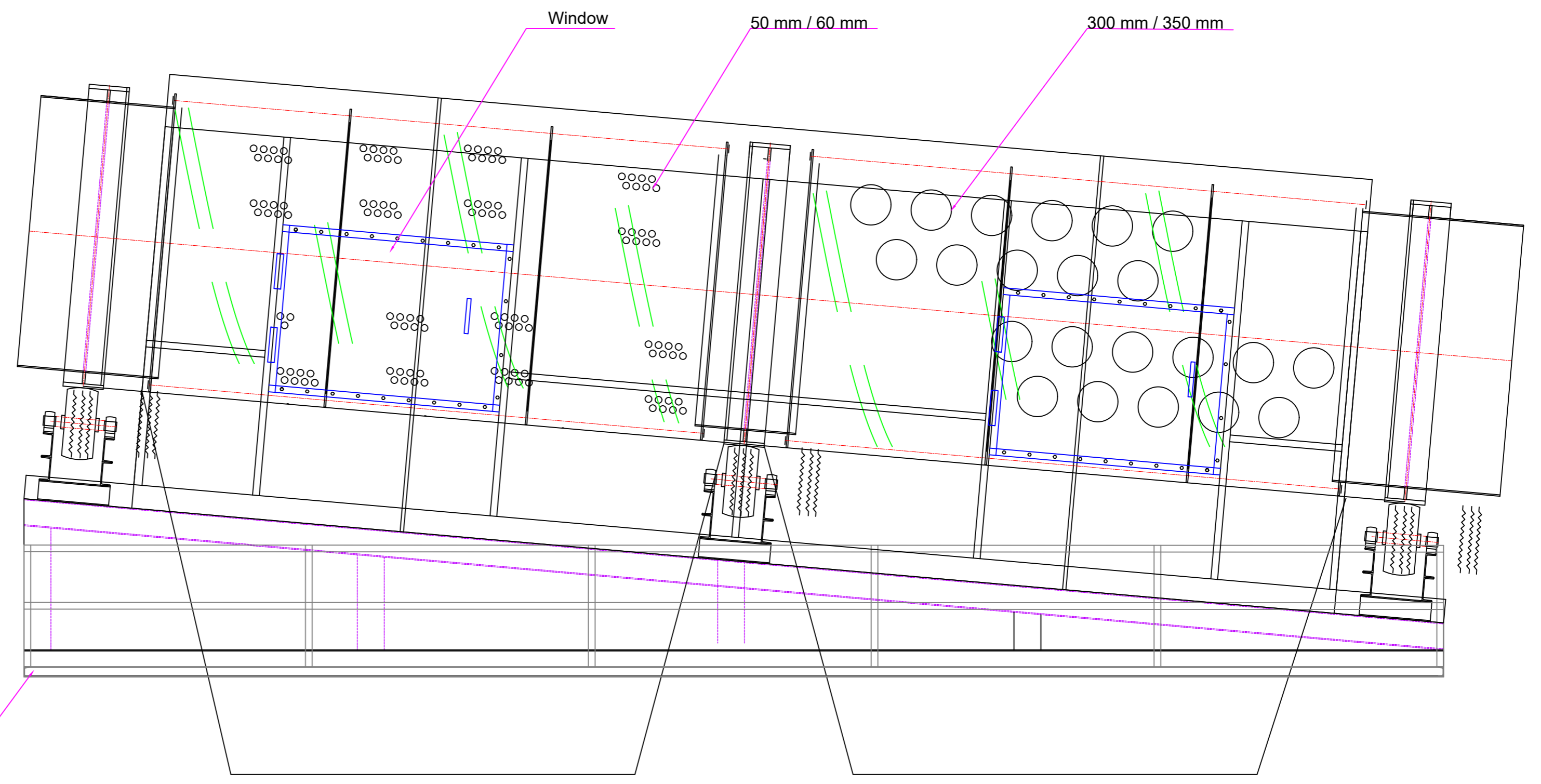
DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULBS AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED



S.NO.	EQUIPMENTS	QUANTITY (NO.)	DIMENSIONS(M)
1	TROMMEL	1	1.0 X 8.0



FRONT ELEVATION



SIDE ELEVATION

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client:



**Ministry of Housing and Urban Affairs**  
Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:



**RITES**  
THE INFRASTRUCTURE PEOPLE

RITES Ltd. (A Government of India Enterprise)

Project:

MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

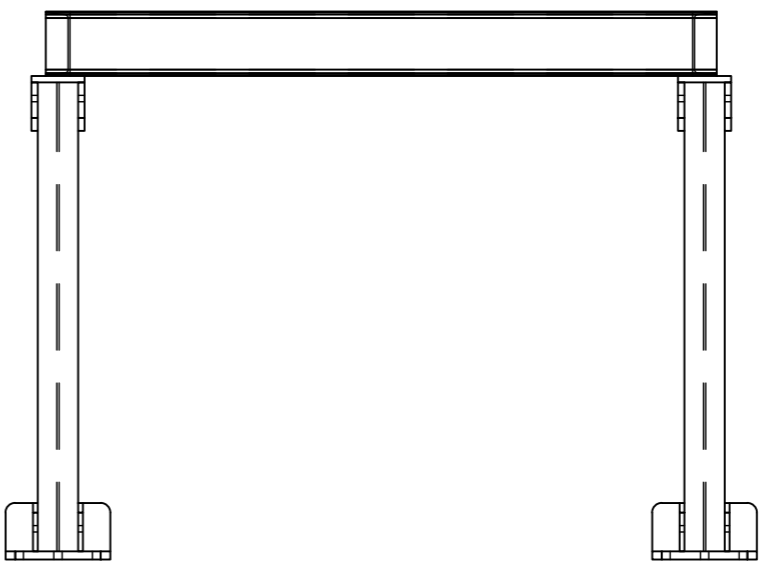
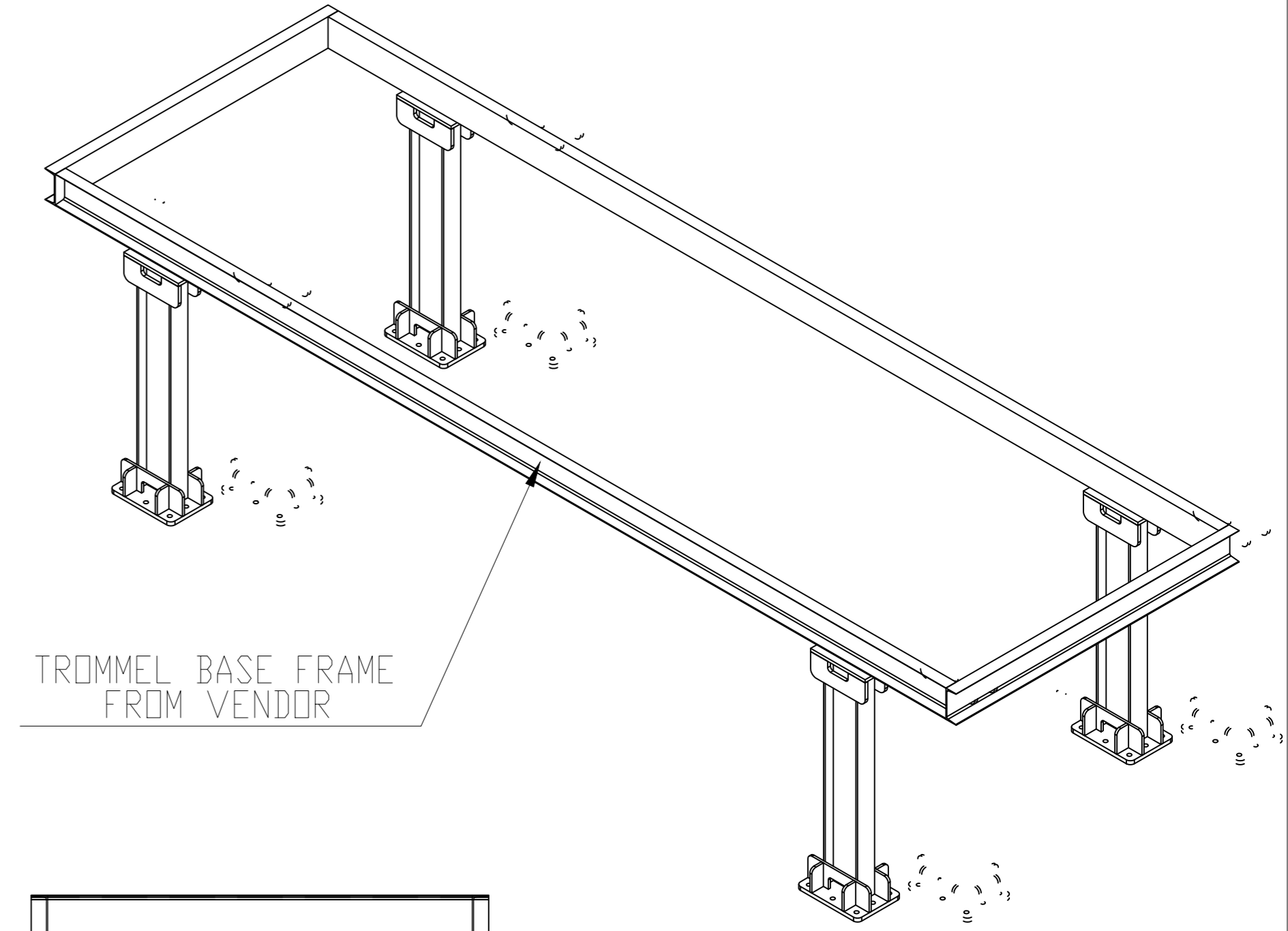
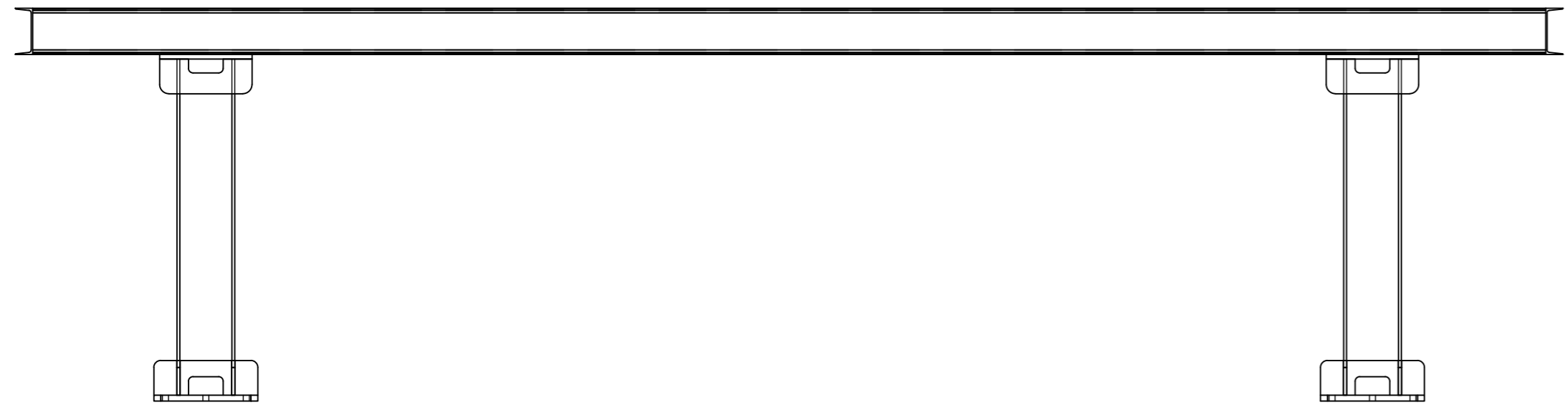
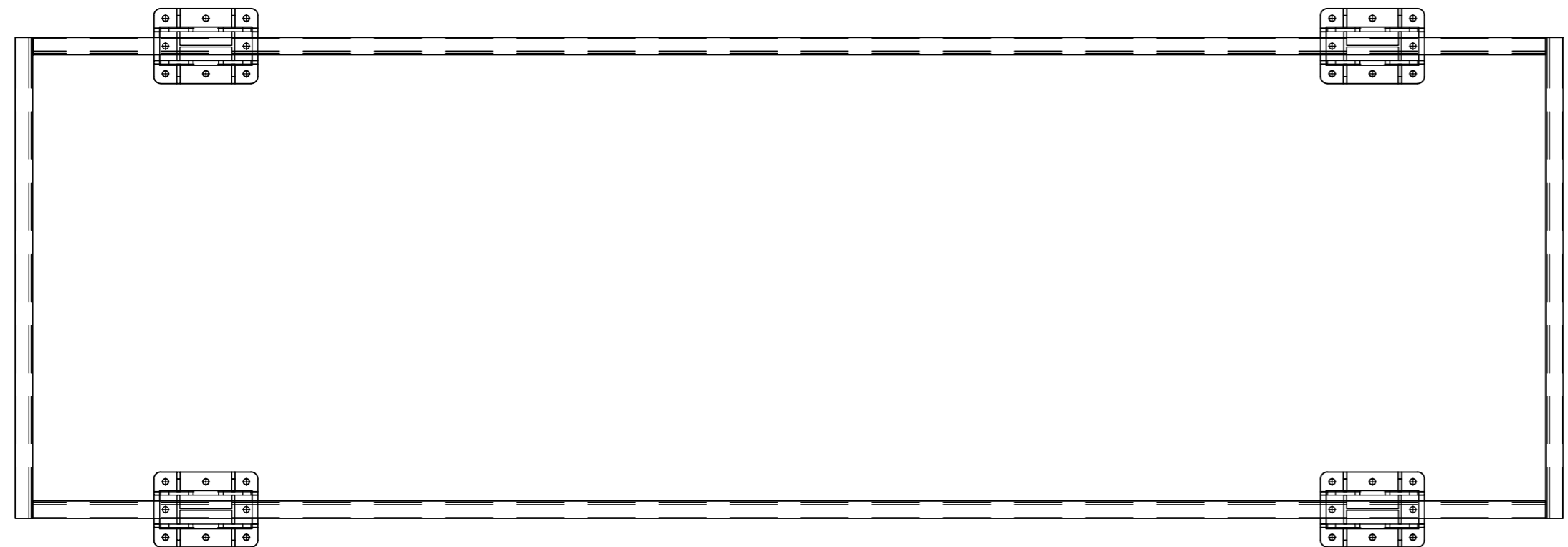
TITLE:

TYPICAL TROMMEL DETAILS

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
DRAWN BY :	RAHUL ARYA
CHECKED BY :	SANJAY RAUT
REVIEWED BY :	CPHEEO, MoHUA
Date :	1st Mar. 2024



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Client:



**Ministry of Housing and Urban Affairs**  
 Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:



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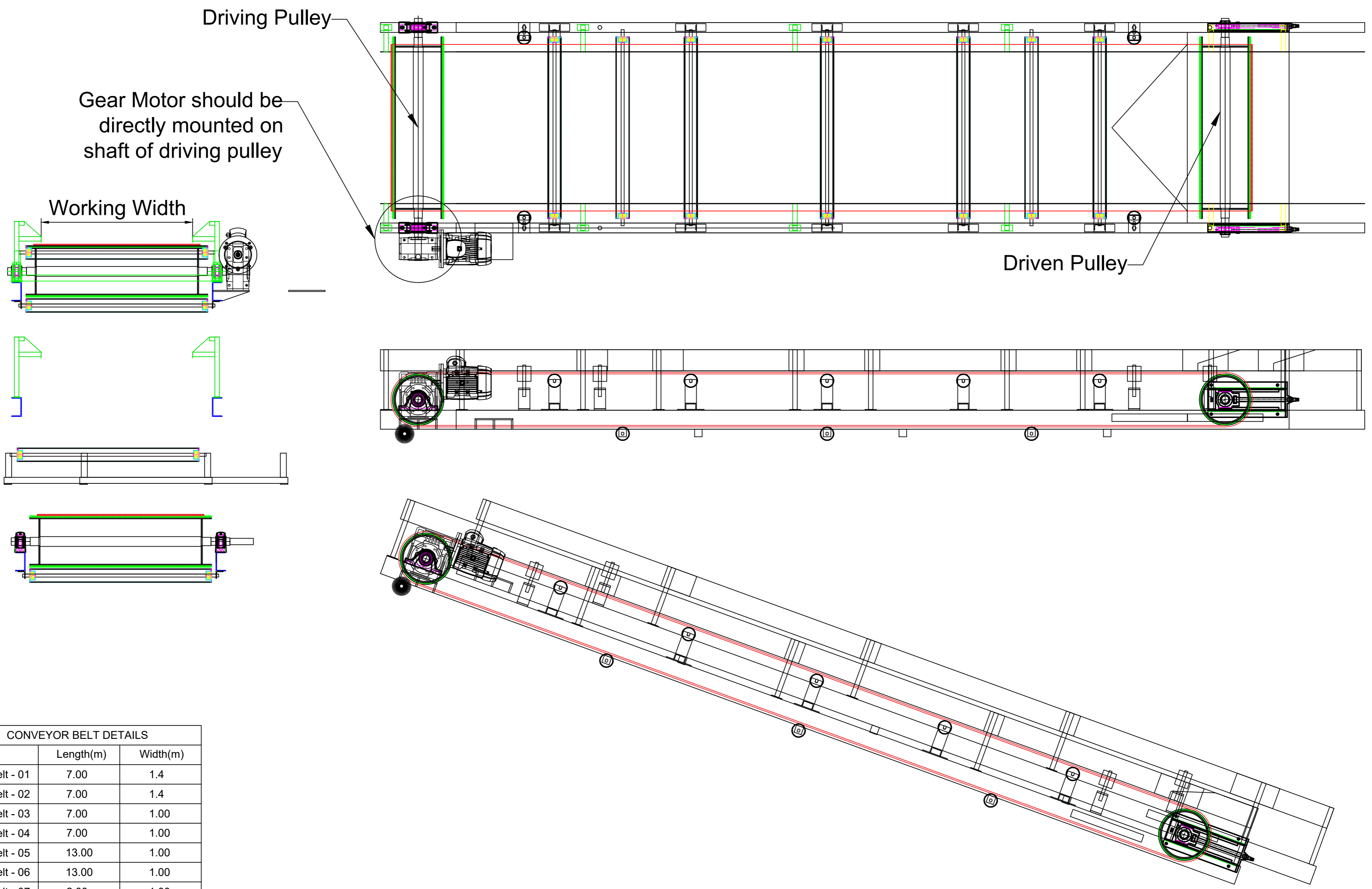
RITES Ltd. (A Government of India Enterprise)

Project:  
 MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:  
 TYPICAL TROMMEL FOOT DETAILS

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
DRAWN BY :	RAHUL ARYA
CHECKED BY :	SANJAY RAUT
REVIEWED BY :	CPHEEO, MoHUA
Date :	1st Mar. 2024

DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
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CONVEYOR BELT DETAILS		
Item	Length(m)	Width(m)
Conveyor Belt - 01	7.00	1.4
Conveyor Belt - 02	7.00	1.4
Conveyor Belt - 03	7.00	1.00
Conveyor Belt - 04	7.00	1.00
Conveyor Belt - 05	13.00	1.00
Conveyor Belt - 06	13.00	1.00
Conveyor Belt - 07	2.00	1.00
Conveyor Belt - 08	2.00	1.00
Conveyor Belt - 09	16.00	1.00

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client:



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MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:



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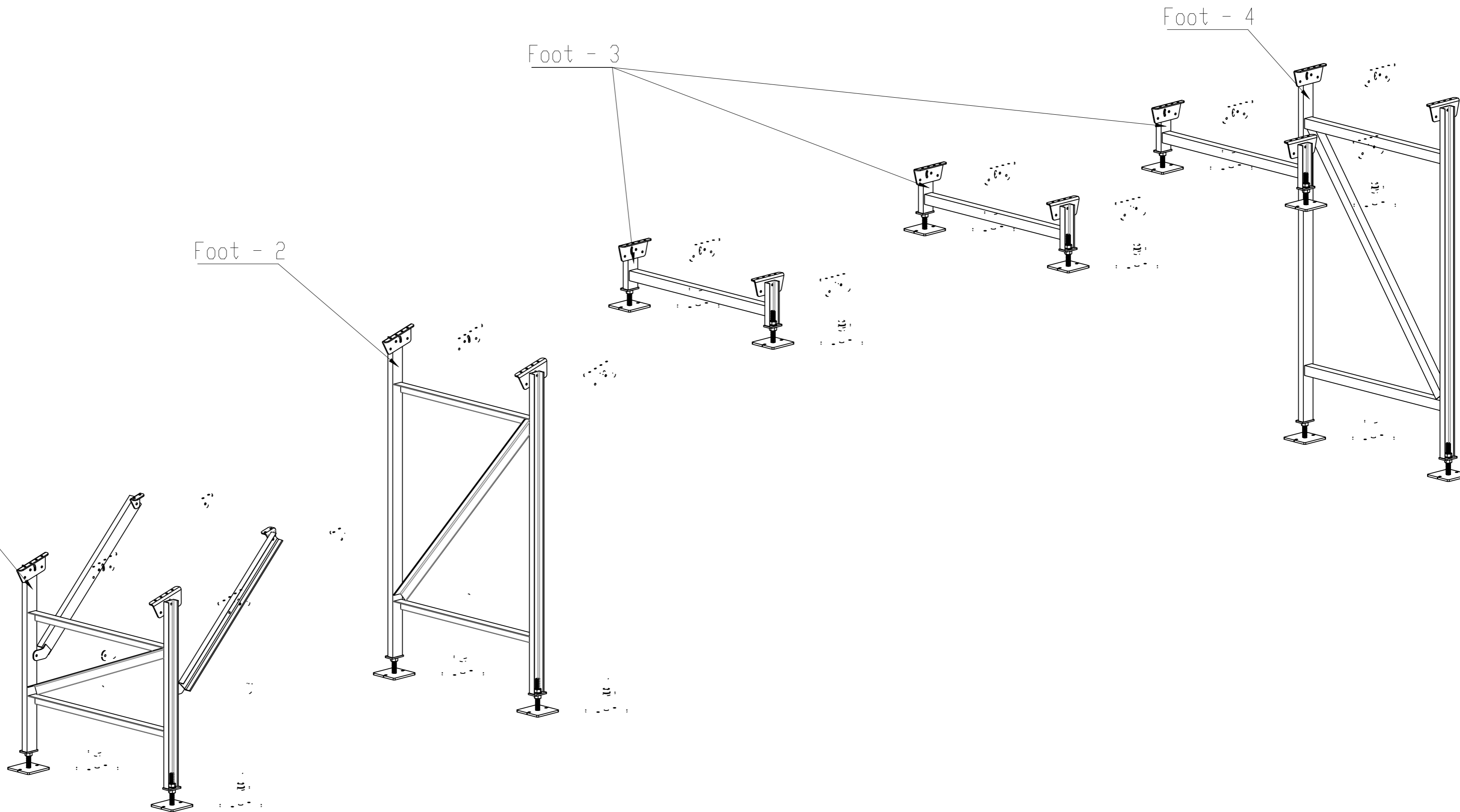
Project:  
MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:  
TYPICAL PLAN & SECTION CONVEYOR BELT FOR 50 TPD MRF



DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
DRAWN BY :	RAHUL ARYA
CHECKED BY :	SANJAY RAUT
REVIEWED BY :	CPHEEO, MoHUA
Date :	1st Mar. 2024

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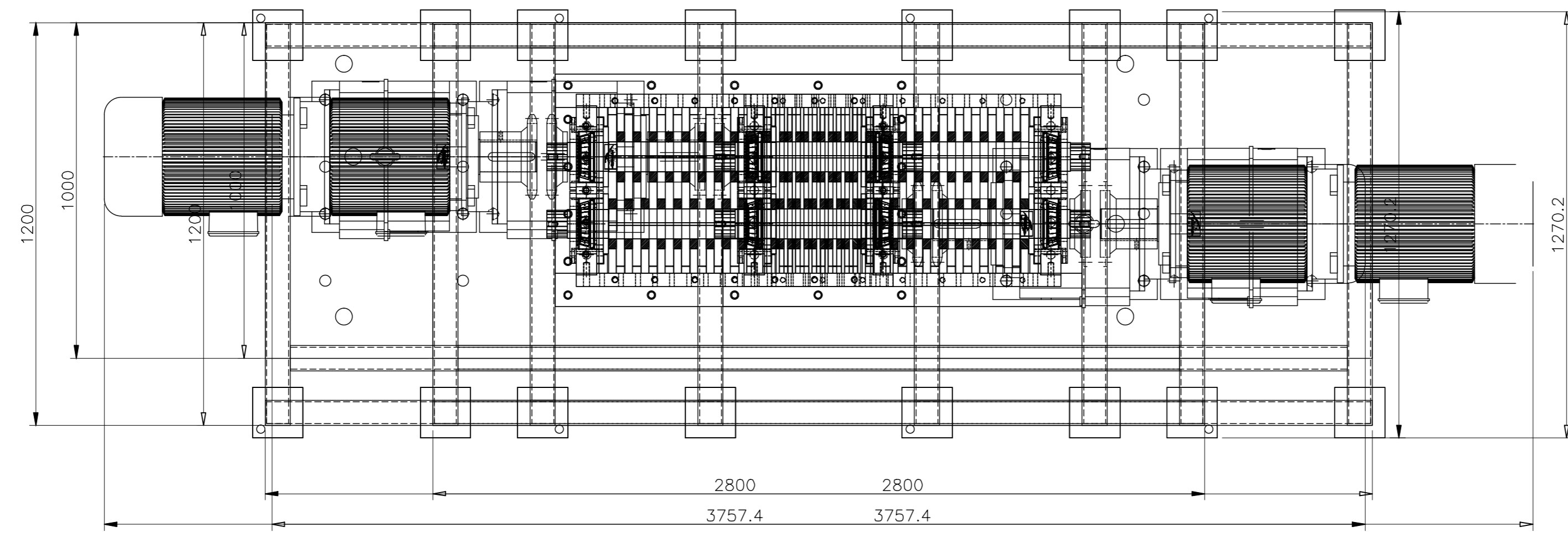
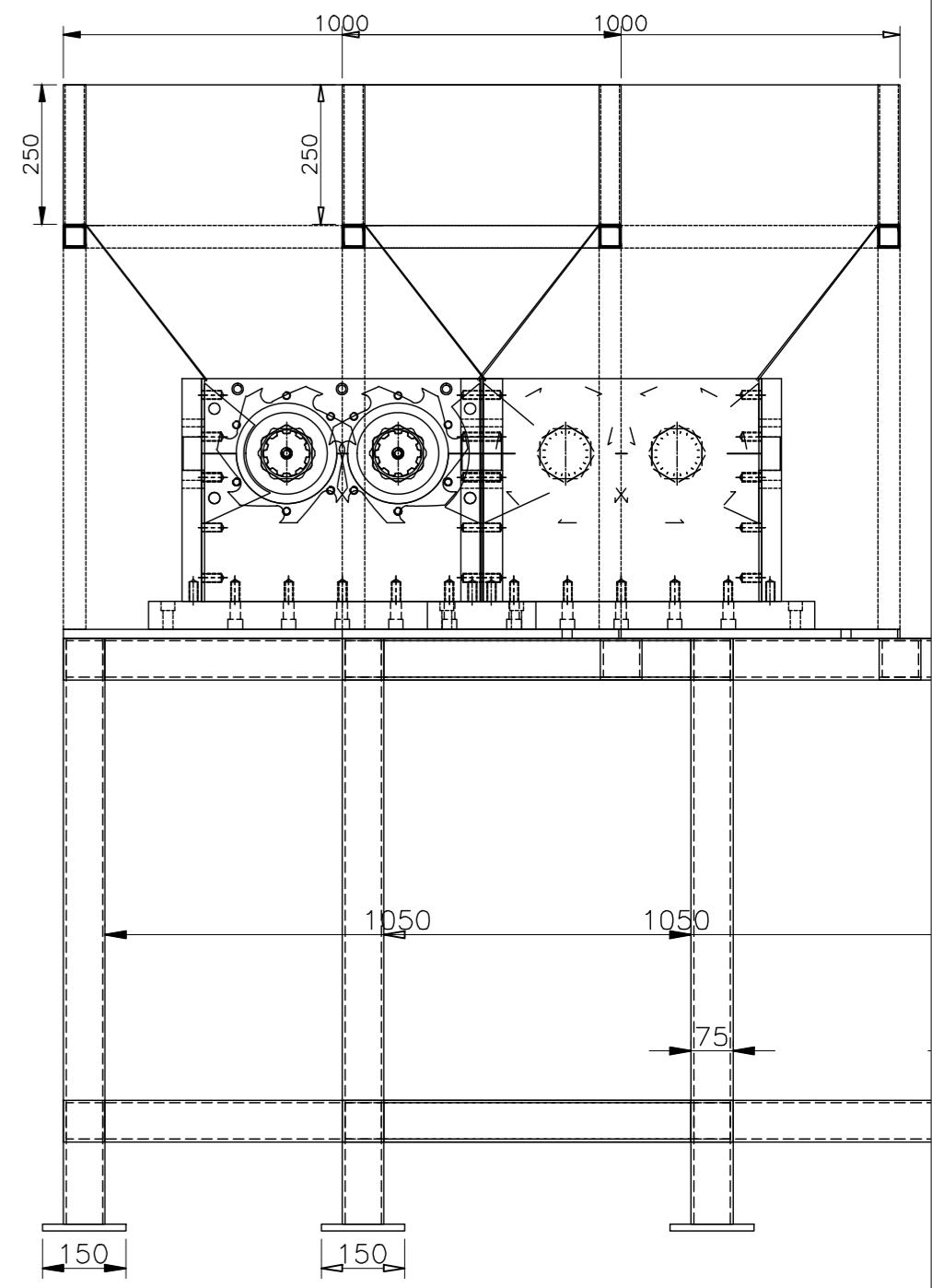
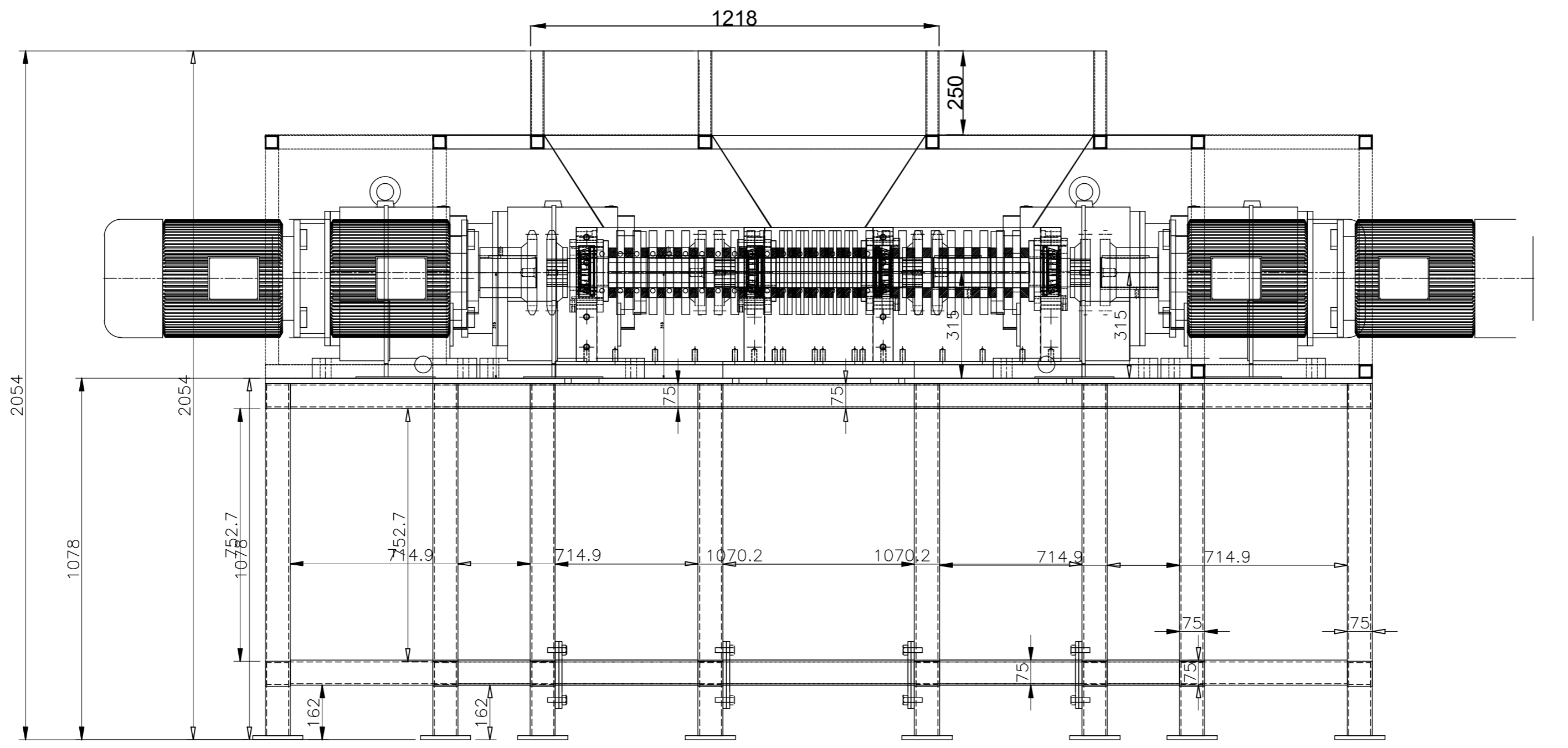
TROMMEL BASE FRAME FROM VENDOR



NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

<p>Client:</p>  <p><b>Ministry of Housing and Urban Affairs</b> Government of India</p> <p>MINISTRY OF HOUSING AND URBAN AFFAIRS</p>	<p>Consultant:</p>  <p><b>RITES</b> THE INFRASTRUCTURE PEOPLE</p> <p>RITES Ltd. (A Government of India Enterprise)</p>	<p>Project:</p> <p>MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0</p> <p>TITLE:</p> <p>TYPICAL CONVEYOR FOOT DETAILS</p>	<p>DESIGNED BY :</p> <p>DRAWN BY :</p> <p>CHECKED BY :</p> <p>REVIEWED BY :</p>	<p>CHETAN A. PATIL &amp; DR. ANAND SONAWANE</p> <p>RAHUL ARYA</p> <p>SANJAY RAUT</p> <p>CPHEEO, MoHUA</p>	<p>Date :</p> <p>1st Mar. 2024</p>
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Client:

**Ministry of Housing and Urban Affairs**  
 Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:

**RITES**  
 THE INFRASTRUCTURE PEOPLE

RITES Ltd. (A Government of India Enterprise)

Project:

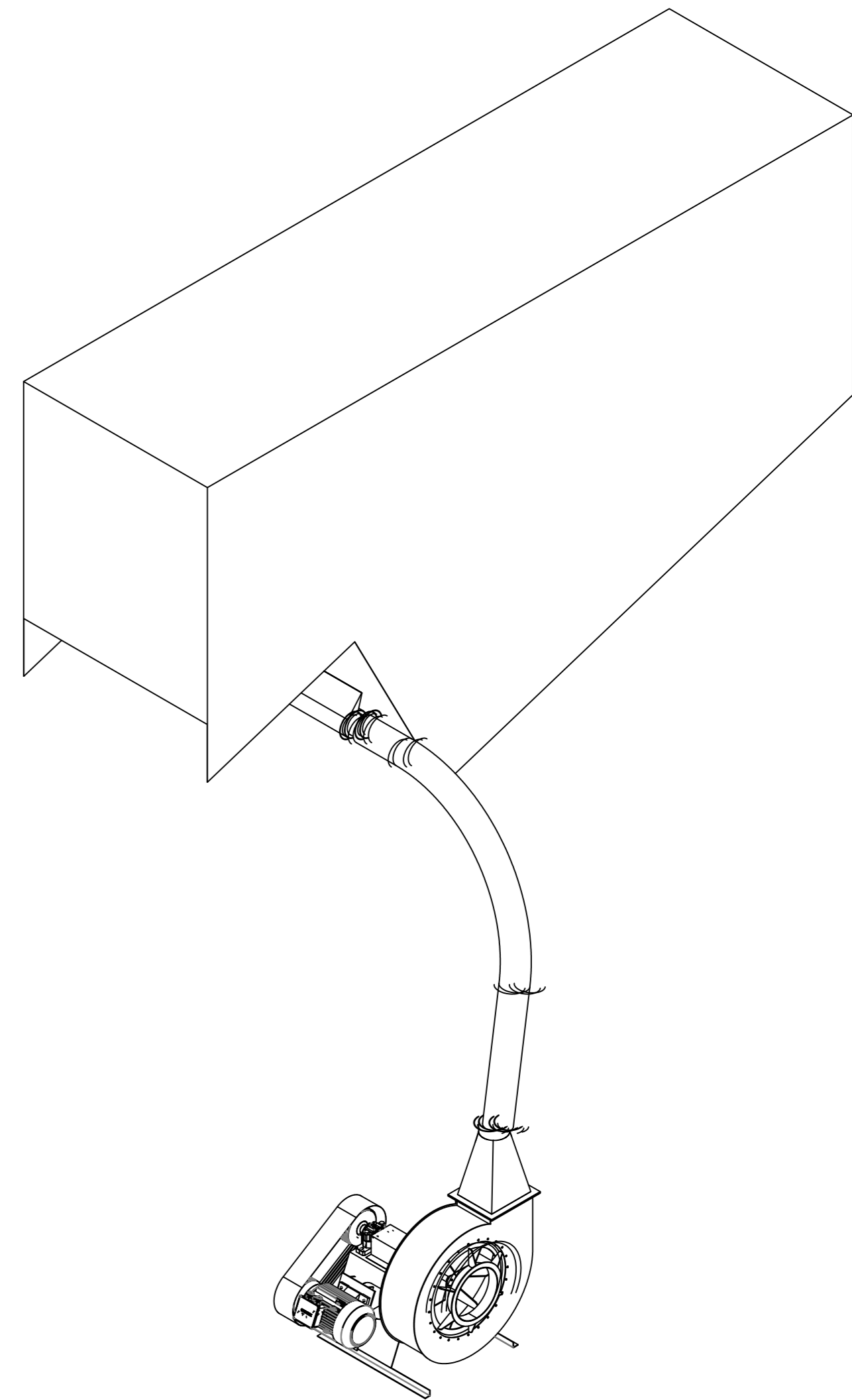
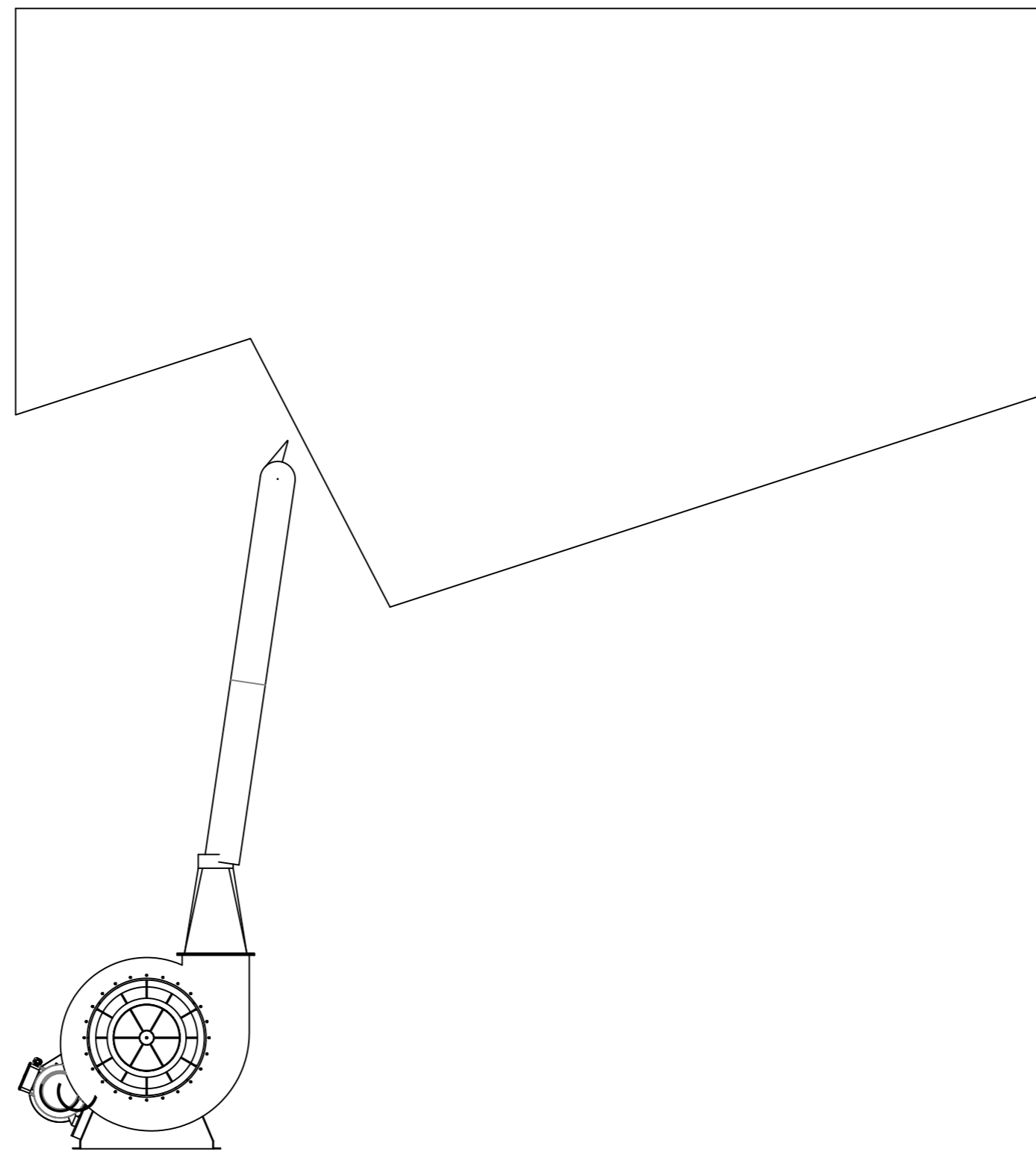
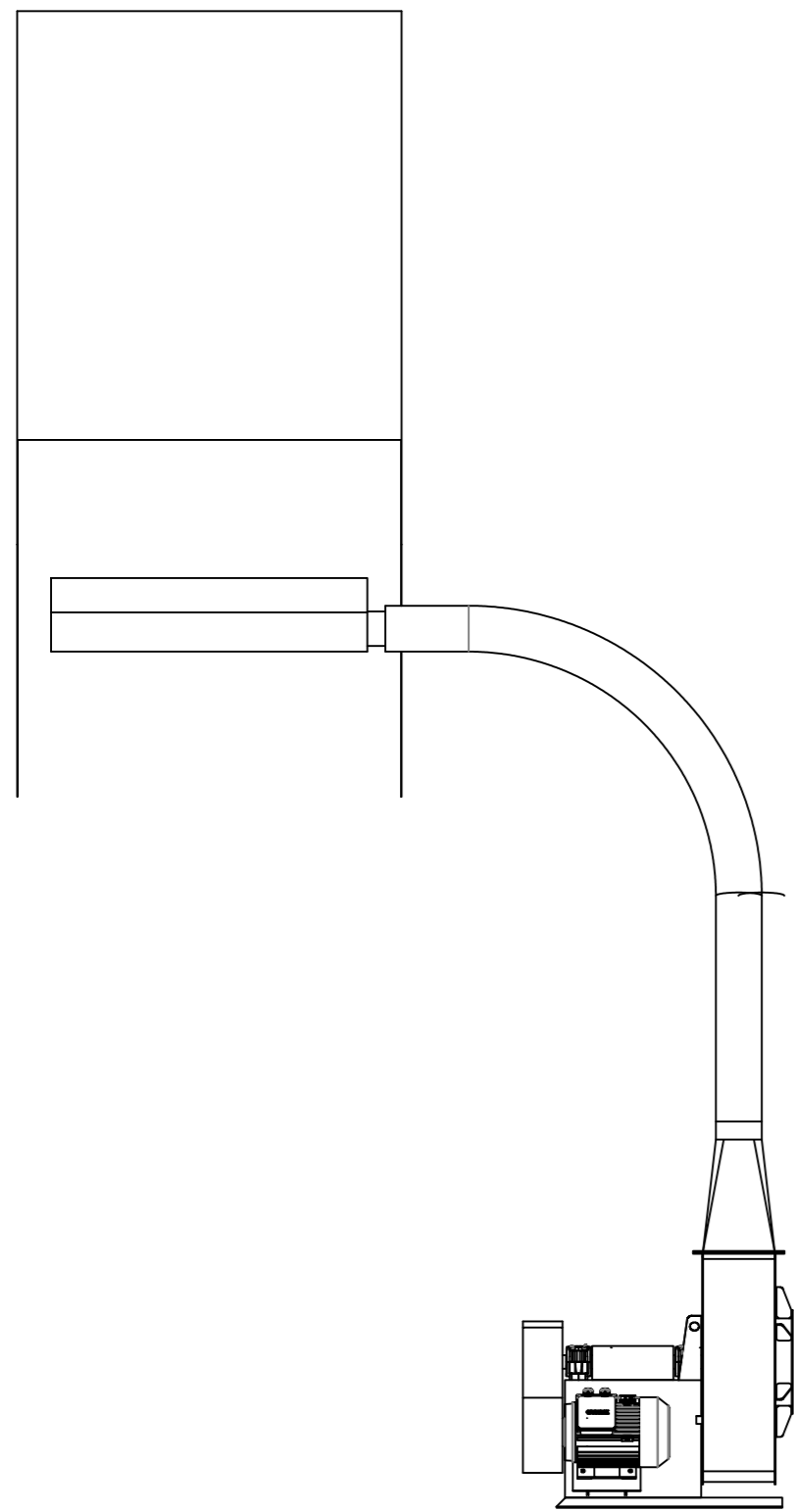
**MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0**

TITLE:

**TYPICAL SHREDDER DETAILS**

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
DRAWN BY :	RAHUL ARYA
CHECKED BY :	SANJAY RAUT
REVIEWED BY :	CPHEEO,MoHUA
Date :	1st Mar. 2024

DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
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NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client:



**Ministry of Housing and Urban Affairs**  
 Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:



**RITES**  
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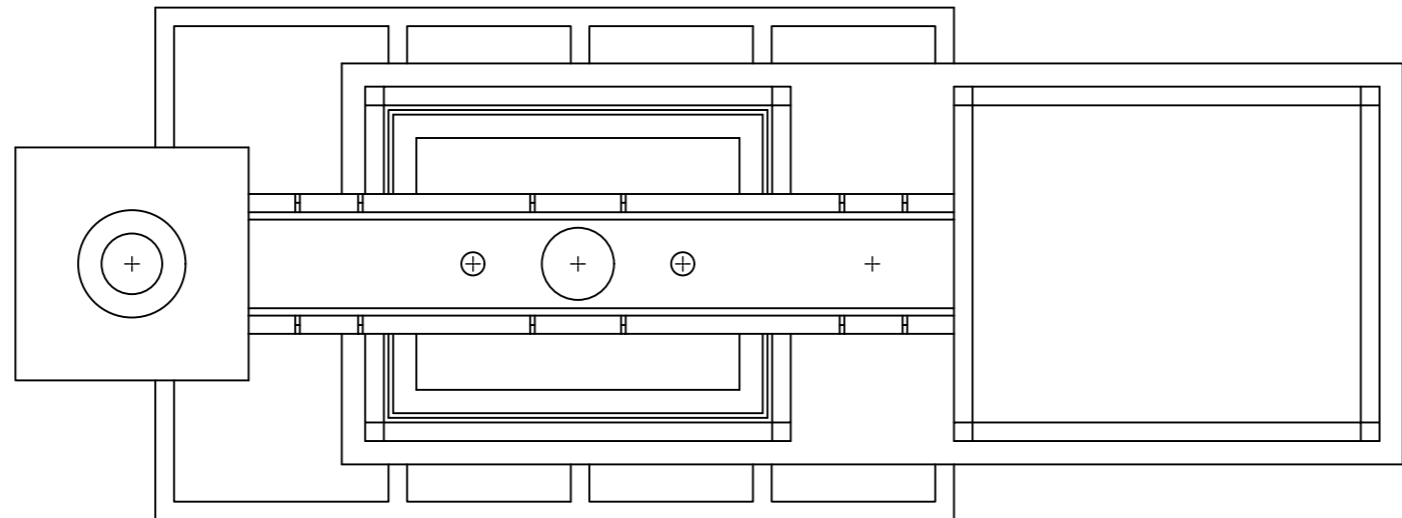
Project:  
 MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:  
 TYPICAL AIR CLASSIFIER DETAILS

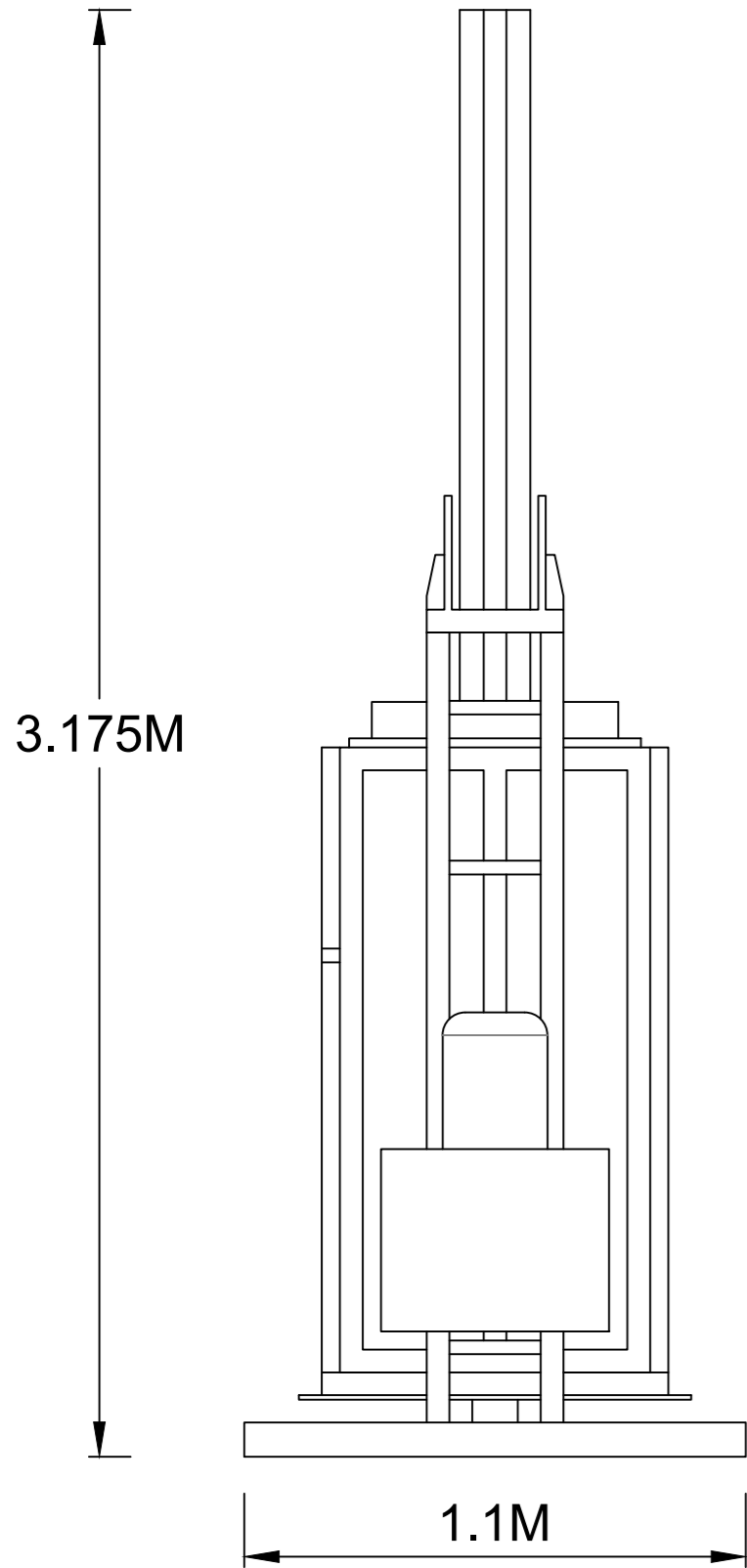
DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO, MoHUA	Date : 1st Mar. 2024

DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL  
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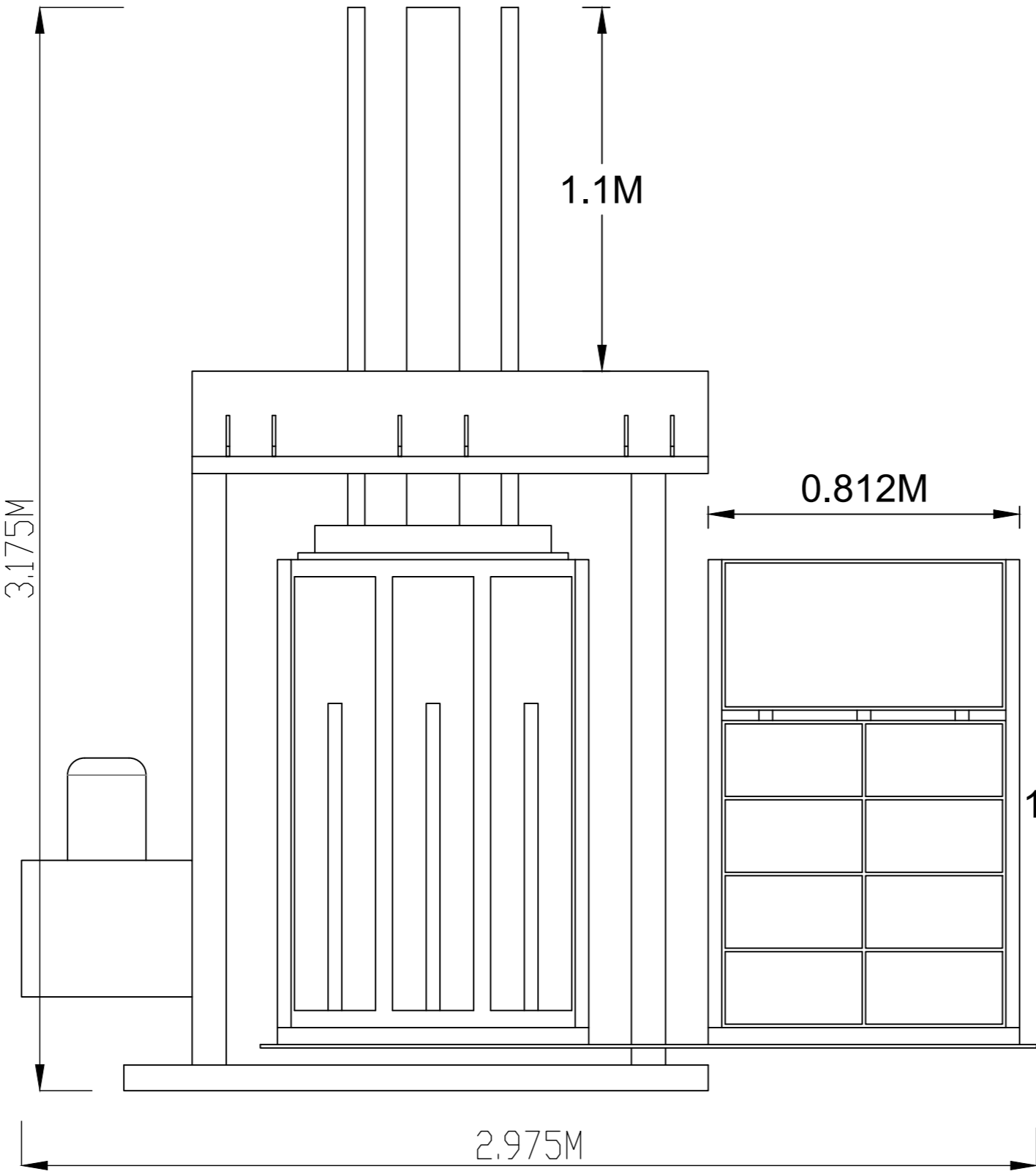
# DOUBLE BUCKET SINGLE CYLINDER BALER MACHINE



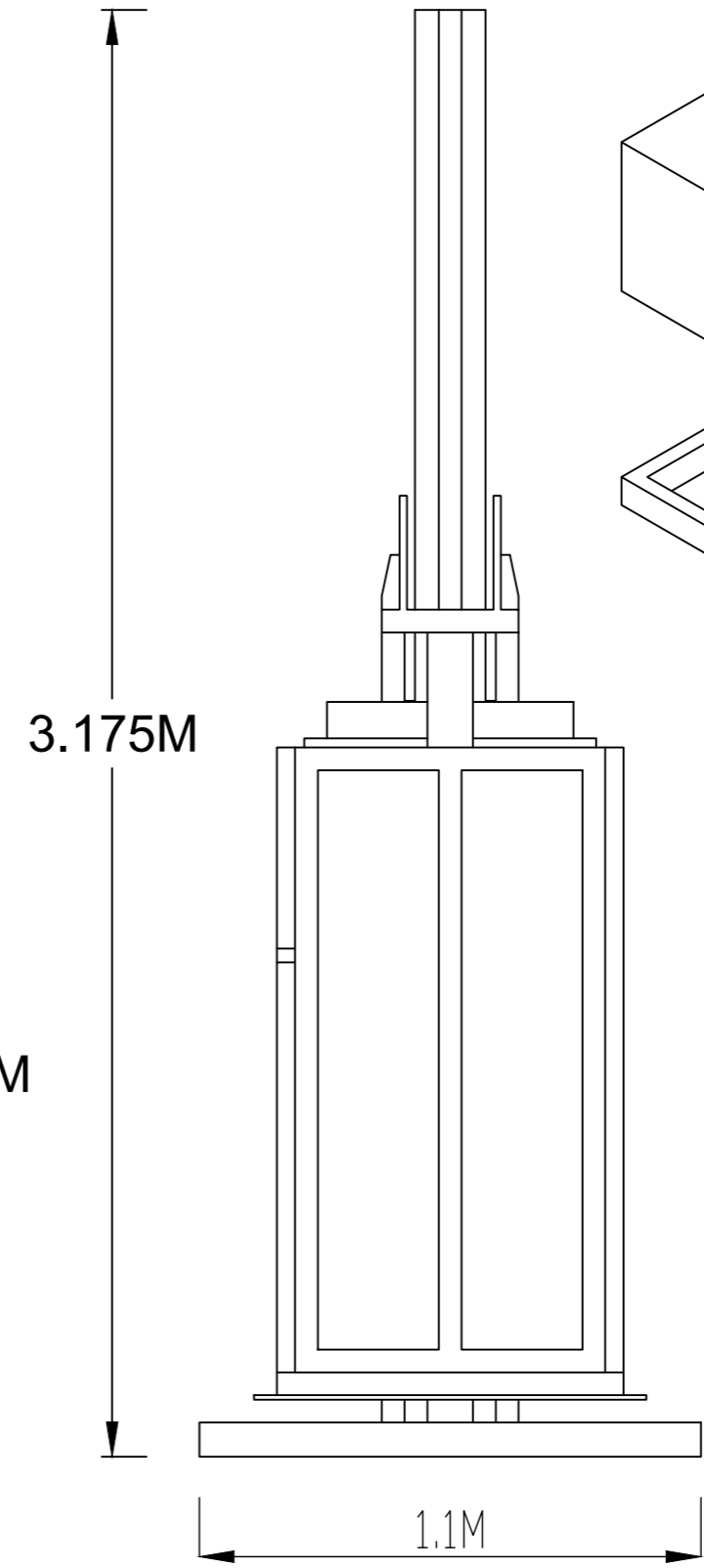
TOP VIEW



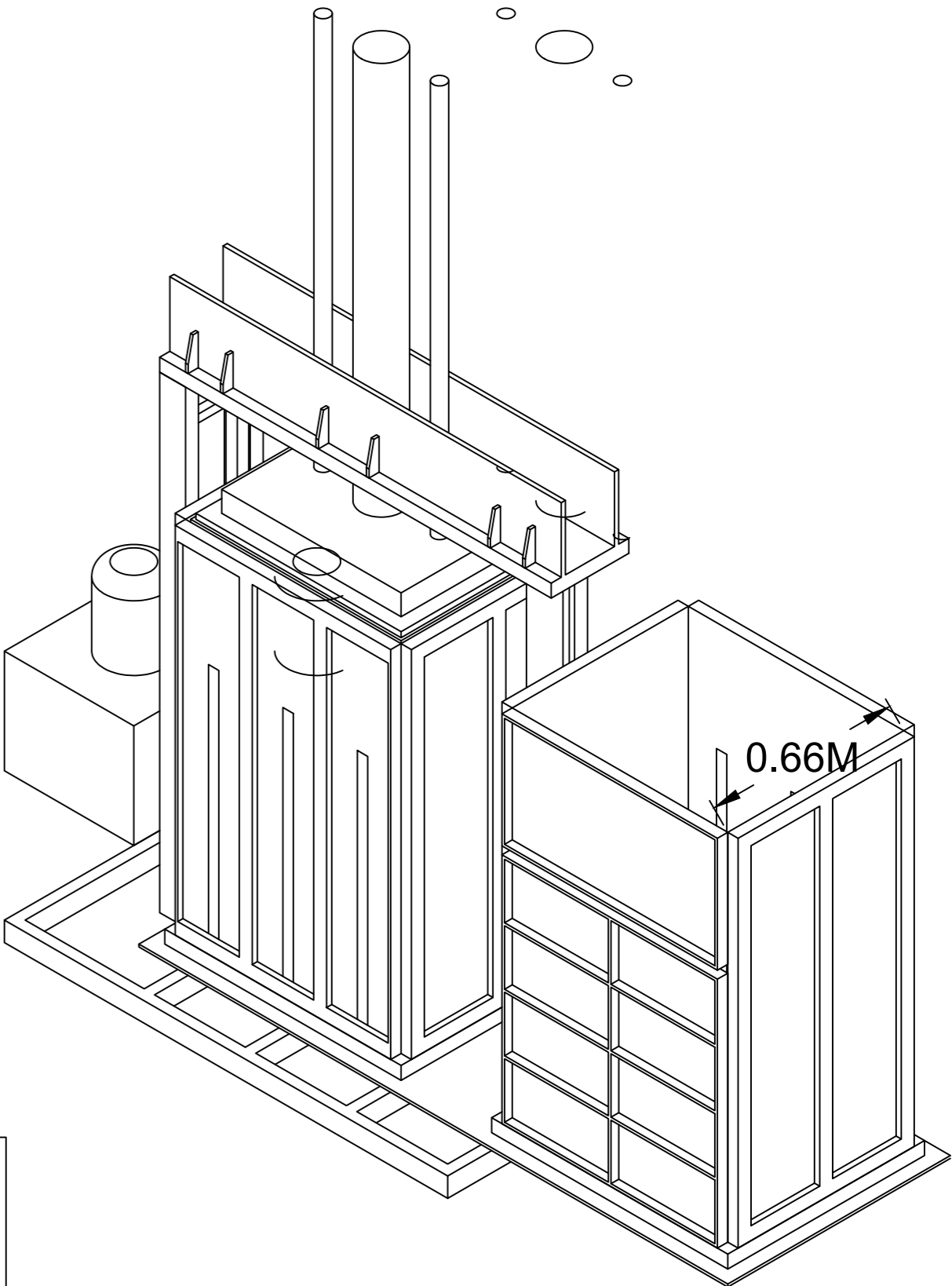
SIDE VIEW



FRONT VIEW



SIDE VIEW



NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client:



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and Urban Affairs**  
Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:



**RITES**  
THE INFRASTRUCTURE PEOPLE

RITES Ltd. (A Government of India Enterprise)

Project:

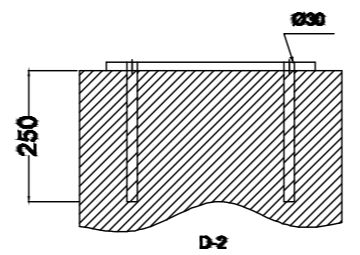
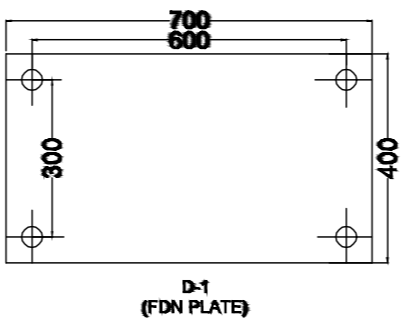
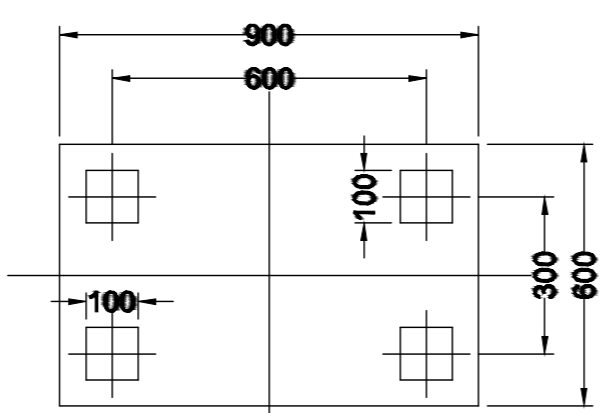
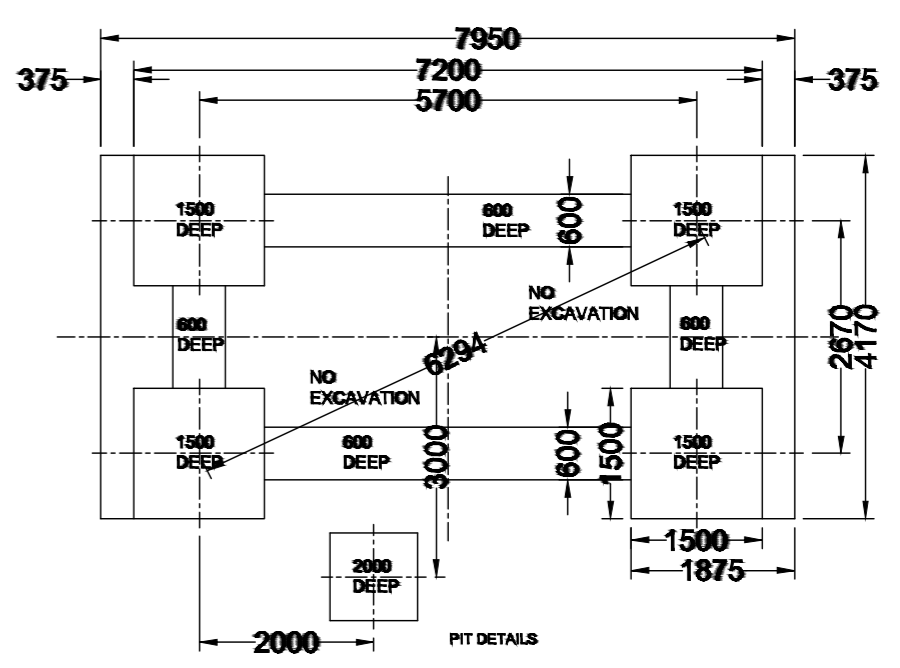
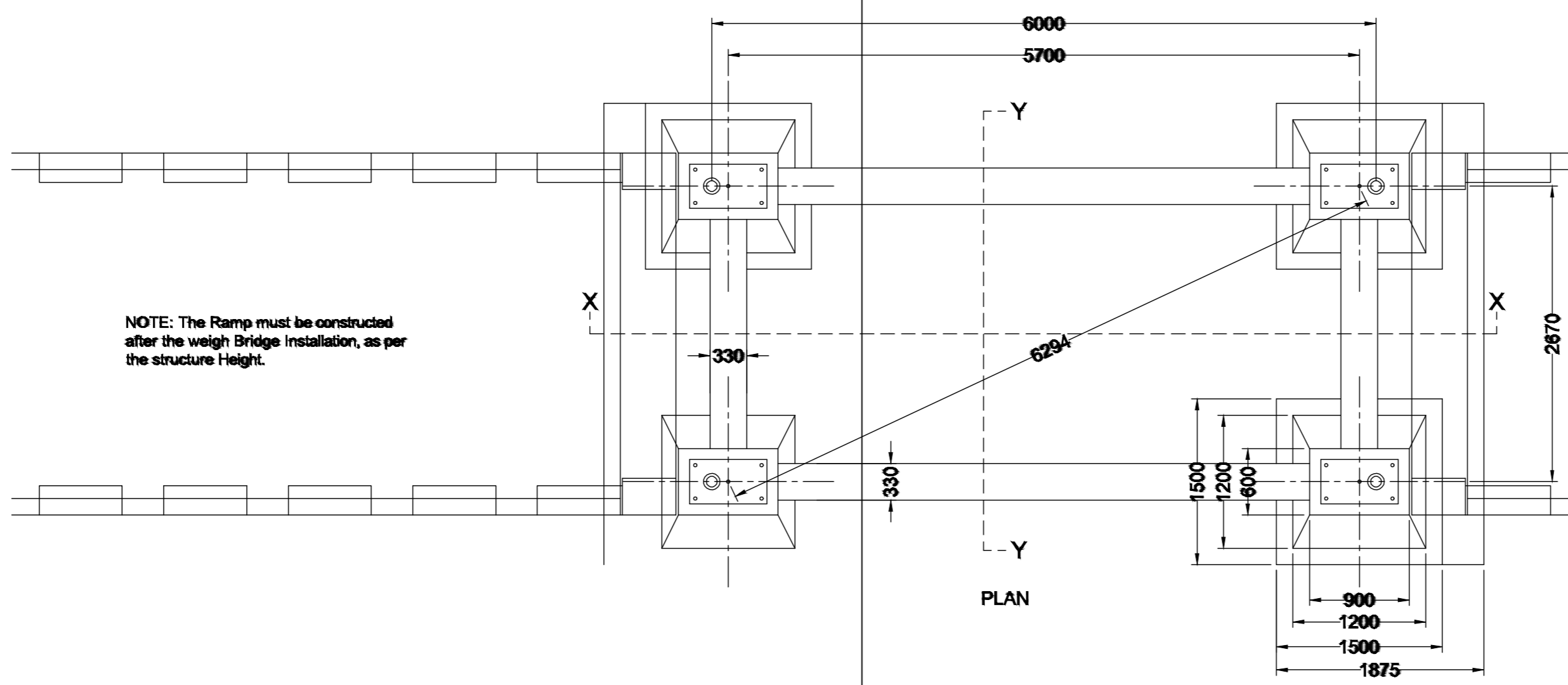
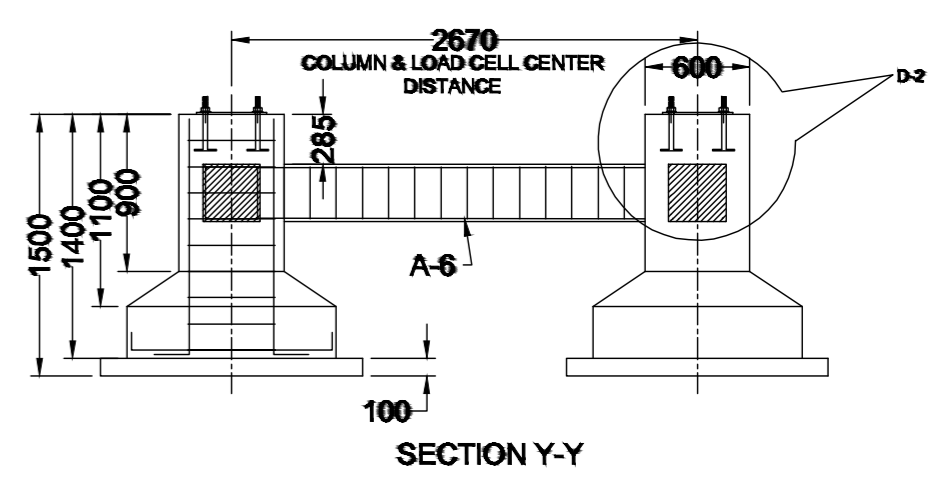
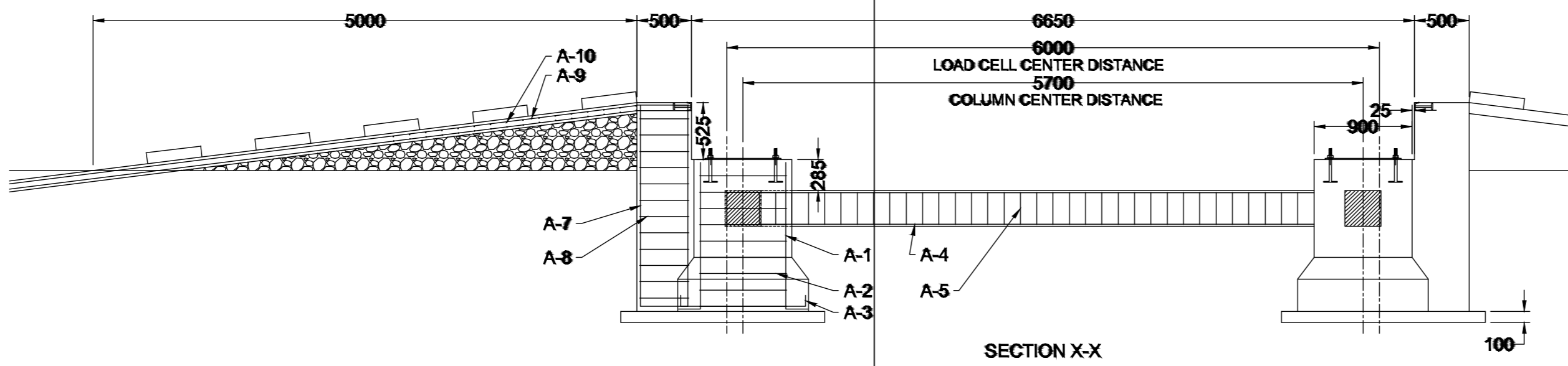
MODEL DESIGN FOR 50 TPD MATERIAL  
RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:

TYPICAL BALER DETAILS

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO, MoHUA	Date : 1st Mar. 2024

DISCLAIMER : MODIFICATIONS BASED ON THE SUITABILITY AS PER SOIL, SITE AND LOCAL CONDITIONS, MAY BE DONE BY ULB'S AT THEIR LEVEL WITH PROPER DEPARTMENTAL APPROVAL. NOTE : IT MUST BE VETTED FOR INDIVIDUAL PROJECT BY THE COMPETENT ENGINEER/AUTHORITIES OF THE ULB'S/DEPARTMENT CONCERNED



- A. REFERENCE STANDARDS :-**
- |                                   |           |
|-----------------------------------|-----------|
| 1. CONCRETE AND ITS CONSTRUCTION  | IS : 546  |
| 2. CEMENT                         | IS : 269  |
| 3. AGREGATES                      | IS : 383  |
| 4. REINFORCEMENT BARS             | IS : 1786 |
| 5. ASSEMBLY OF REINFORCEMENT BARS | IS : 2502 |
| 6. SKIRTING ANGLES                | IS : 808  |
| 7. CONDUIT PIPES                  | IS : 1161 |
- B. NOTES :-**
- ALL DIMENSIONS ARE IN mm. AND LEVELS ARE METERS.
  - EL. 0.000 DENOTES FINISHED ROAD LEVEL/G.L. (REFERENCE LEVEL).
  - SOIL BEARING CAPACITY OF 10 TONS/SQ.M ASSUMED AT FOUNDATION LEVEL.
  - GROUND WATER TABLE IS ASSUMED TO BE BELOW FOUNDATION LEVEL.
  - ADEQUATE RUBBLE SOLING TO BE DONE BELOW P.C.C. SKIRTINGS AS REQUIRED.
  - MINIMUM CONCRETE COVER TO MAIN REINFORCEMENT TO BE AS FOLLOWS RAFTS - 25MM, WALLS - 25MM, COLUMNS - 40MM.
  - ADEQUATE CONCRETE TEST CUBES TO BE TAKEN AND TESTED FOR STRENGTH.
  - REINFORCEMENT BARS NOT TO BE WELDED TO EACH OTHER FOR RETAINING PURPOSES, BUT TO BE TIED TOGETHER ONLY. LAP LENGTH = 500 (D = DIA OF BAR TO BE LAPPED.)
  - NON SHRINKING GROUTING MATERIAL (SUCH AS SHRINCOM - H FROM ACC) TO BE USED FOR GROUTING.
  - SOIL IS CONSIDERED AS NORMAL.
  - THE REINFORCEMENT BARS SHALL NOT COME ON THE POCKET LOCATION.

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client:



**Ministry of Housing and Urban Affairs**  
Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant:



**RITES**  
THE INFRASTRUCTURE PEOPLE

RITES Ltd. (A Government of India Enterprise)

Project:

MODEL DESIGN FOR 50 TPD MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:

TYPICAL WEIGH BRIDGE DETAILS (50 TON)

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO, MoHUA	Date : 1st Mar. 2024



# ANNEXURE 2 CHECKLIST AND FORMAT



1. **Weighing Bridge demo slip**

**Demo Company 1**

[DUPLICATE-PRINT]

Add1

Add2

**Print Date: 30/08/2018 12:55:11**

Ticket No	: 11	Supplier_Name	: Supplier - 1
Party_Name	: Customer -1	Order_No	: User Define Field - 5
Vehicle_No	: GJ 1020	Field05_Name	: User Define Field - 6
Item_Name	: Product - 1	Field06_Name	: User Define Field - 7
Field01_Name	: User Define Field - 1	Charges	: 100
Field02_Name	: User Define Field - 2	Pcs	: User define Field - 4
Fiedl03_Name	: User Define Field - 3	User Name	: 1st-Admin 2nd-

Gross Weight	: 25000 Kg	30/08/2018	12:53:00
Tare Weight	: 15000 Kg	30/08/2018	12:53:00
Net Weight	: 10000 Kg		

**OPERATOR'S SIGNATURE**

2. **Pre-assessment checklist for waste received at MRF plant**

Date :

Vehicle No :

Location name & Ward No :

Driver Name :

Time :

Vehicle code:

Sl. No.	Particulars	Whether acceptable		Remarks
		Yes	No	
1.	Whether mixed waste (dry waste with significant quantity of wet waste) is received at the MRF?			
2.	Whether the received waste contains a higher fraction of C&D waste/silt/inert?			
3.	Whether the received waste contains a higher/substantial fraction of hazardous waste?			
4.	Whether the received waste contains a higher/substantial fraction of sanitary?			

*Note: Weighbridge operator should be responsible to fill the checklist during the receipt of waste at the plant with the help of security guards.*

*In the above checklist if any of the answer is yes the same should be reported to the plant manager/Plant in Charge to take further decision on the acceptance of the material.*



### 3. Morning Protocol

Date:

Location:

Part -A

Sl. No.	Procedural Steps	Nos.	Remarks
1.	Total workers		
2.	Workers present		
3.	Workers absent		
4.	No. of workers with PPE		
5.	Worker running fever, coughing or with down syndrome		

Part-B

Sl.No.	Procedural Steps	Yes	No	Comments
1.	Any abnormal odour experienced			
2.	Any sign of smoke or fire			
3.	Any sign of oil spillage on floor			
4.	If trommel screen chocked			
5.	a. Spilled solid waste lying below belt conveyors or on floor b. If spilled solid waste causing obstacle in movement of vehicles, wheel barrow etc.			
6.	Any spark observed while switching on fan, lights or machines			
7.	Any abnormal sound from moving parts /machine of plant (Motor, Bearing, trommel, belt conveyor, baler etc.)			
8.	Is belt conveyor are clear of spilled solid waste			

### 4. Material Receipt

Sl. No	Locality Name/Ward No	Name of Driver & Vehicle number	Date	Time		Weight of waste (Kilogram)	Signature	Remarks
				In	Out			

### 5. Material Dispatch

Sl. No	Name & Address (of Receiver)/ULB	Name of Driver & Vehicle number	Date	Time		Material Weight (Kilogram)	Signature	Remarks
				In	Out			

### 6. Material Sale

Sl. No	Name & Address (of Receiver)	Date	Material	Material Weight (Kilogram)	Unit Rate	Amount Paid	Out Time	Signature	Remarks

### 7. Evening Protocol

Part A

	Procedural Steps	Nos.	Remarks



i.	Total Strength of workers		
ii.	Worker presence		
iii.	Worker left during half day		
iv.	Any health issue reported by workers		
v.	Whether workers changed their dress before leaving and kept PPE in respective lockers allotted to them		

**Part B**

S.N.	Procedural Steps	Yes	No	Remarks
1.	Proper shutdown of machines done			
2.	All fans & Lights Switched off			
3.	Spilled solid waste removed from belt conveyor pits			
4.	If solid waste is strewed here and there on floors			
5.	If any materials left in trommel/belt conveyor /baler			
6.	Any spark observed during shunting switching off machines, fans and light			

Checked by:

Supervisor:

**8. Monthly Report**

Sl. No	Name & Address (of Receiver)	Month	Material	Material		In Stock (in kg)	Sale processed (Rs.)	Signature	Remarks
				Segregated (Kg)	Dispatched (Kg)				

**9. Maintenance/Lock out Tag (LOTO Checklist)**

**Lockout/Tag out (LOTO)**

**INSPECTION CHECKLIST FOR CONTROL OF HAZARD ASSOCIATED WITH POWER SUPPLY**

Employee Name:			
Equipment:		Date:	
Procedure:		Location:	

Hazards Involved:

- a) Electrical Voltage: \_\_\_\_      b) Pressure (pneumatic/hydraulic) \_\_\_\_      c) Spark \_\_\_\_  
 d) Signify smoke: \_\_\_\_      e) Feasibility of doing \_\_\_\_      f) Mechanical \_\_\_\_

**TO LOCK OUT THE EQUIPMENT**

Sl.No	Procedural Steps	Yes	No	Comments
1.	Whether affected workers & employees are notified?			
2.	Whether all the power disconnect points were identified?			
3.	Whether equipments are switched off?			
4.	Whether all the equipments/machines connected to the samesource were listed and isolated?			
5.	Whether LOTO tag attached for locking the machine?			
6.	Whether the machinery re-start/re-energize attempted throughnormal position (Off position)?			
7.	Whether test equipment/meters were identified?			

**TO RE-ENERGIZE THE EQUIPMENT/MACHINES**

1.	Whether all guard and safety controls are checked and properly replaced?			
2.	Whether all locks and tags from energy control points are removed?			



3.	Whether personnel are cleared from the affected of the machine?			
4.	Whether the equipment is restart/re-energize?			
5.	Whether the affected employees are notified on completion of LOTO?			

**10. Check list for Machine Safety**

Sl. No	Equipment Safeguarding (in proper working condition)	Yes/No	Remarks
<b>A</b>	<b>General</b>		
1.	Whether machine guards are in place and functional to prevent contact with moving parts?		
<b>B</b>	<b>Tools</b>		
1.	Whether all tools and equipment are formally inspected on a quarterly basis and tagged properly?		
2.	Whether all tools are visually inspected prior to use and defective one tagged properly?		
<b>Remarks if any:</b>			
<b>Name, Signature and Date of Checking Officials</b>			

**11. Format for Electrical Safety Checklist (weekly basis)**

Sl. No.	Checklist for Electrical Safety	Yes/ No	Remarks
1.	Whether all plugs, sockets and electrical fittings sufficiently robust for use?		
2.	Whether all electrical fuse/junction boxes in the factory securely fixed, closed and undamaged?		
3.	Whether fuses, circuit breakers and other electrical devices correctly rated for the circuit they protect?		
4.	Main switches readily accessible and clearly identified, with all workers know use them in an emergency.		
5.	All electrical installations checked periodically, and repairs carried out by a competent electrician.		
6.	There are any cables or wires without proper casing, found in the area.		
7.	Any electrical wires improperly spliced or taped.		
8.	Electrical equipment properly grounded to prevent electrocution or fire.		
9.	Any electrical wires found in damp areas or standing water.		
10.	Any electrical wires obstructing aisles or passageways.		
11.	All visible electrical wires securely fixed.		
12.	Electrical fittings and installations checked once in month.		
<b>Remarks if any:</b>			
<b>Name, Signature and Date of Checking Officials</b>			

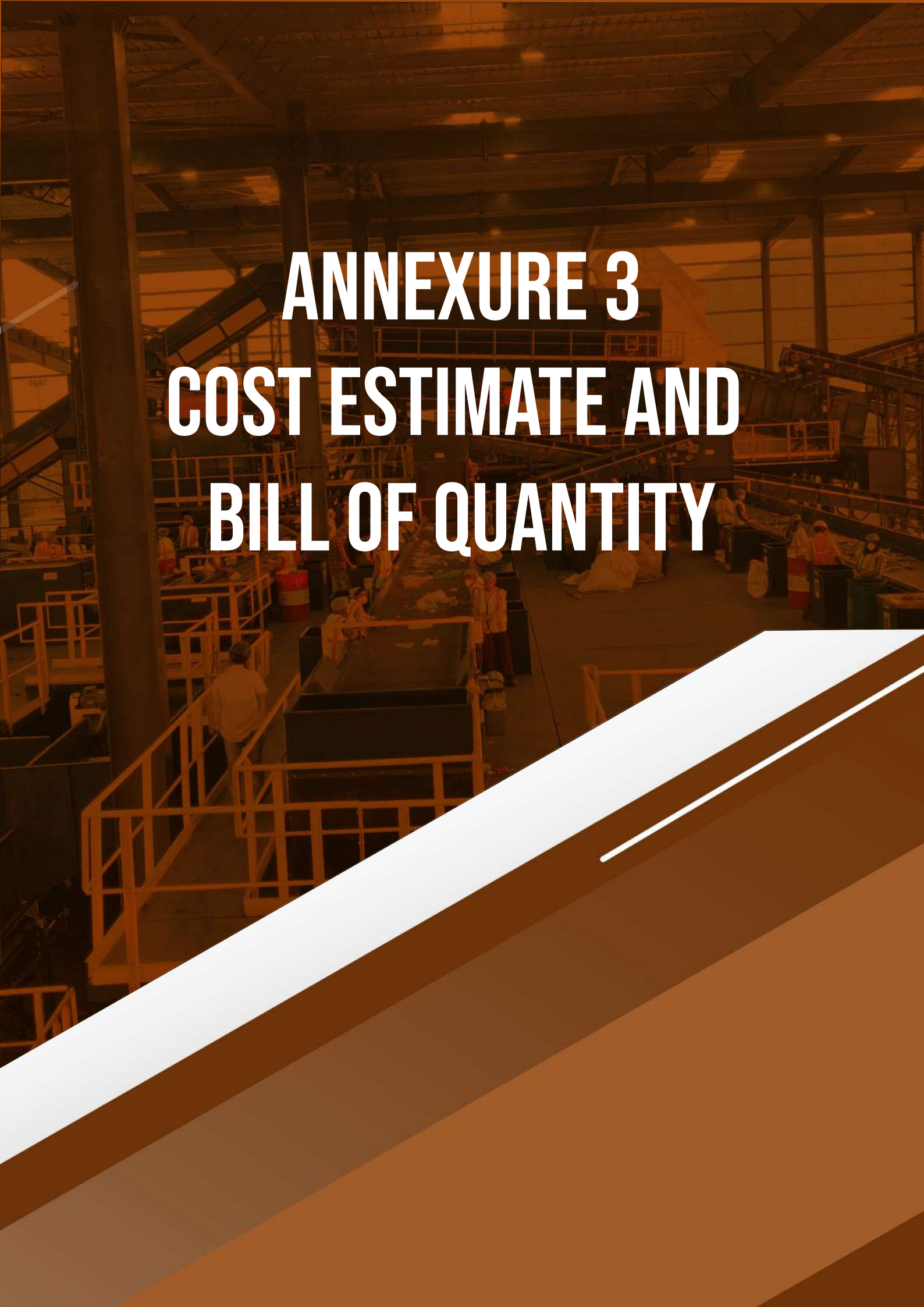
\*\* format for daily electrical safety checking and keeping signed copy in office records.



**12. Information Display**

<b>Local Body Name:</b>	<b>Date:</b>	<b>MRF Incharge Name &amp; number:</b>
<b>Location of MRF Plant:</b>	<b>Operating Time: AM to PM</b>	<b>Operating Firm &amp; contact person name &amp; number:</b>
<b>Material Accepted</b>		
<b>Total Plastic Bottles (PET)</b>		
<b>Total Cardboard (Paper)</b>		
<b>Total Glass bottles (Glass) etc</b>		





# **ANNEXURE 3 COST ESTIMATE AND BILL OF QUANTITY**

## A. CAPEX

### I. Process Equipments

Sl. No.	Equipments	No. of Units	Unit rate Rs. (lakh)	Total cost of equipment (lakh)
1	Weigh Bridge	1	6.50	6.50
2	Conveyor belts system	1	27.13	27.13
3	Trommel	1	20.00	20.00
4	Magnetic Separator	1	2.50	2.50
5	Air blower	1	0.76	0.76
6	Baler Machine	2	4.50	9.00
7	Shredder	1	30.00	30.00
8	Tractor with loader	1	8.75	8.75
9	Electric Fork lift	1	8.00	8.00
10	Storage bins	18	0.30	5.40
11	Wheel barrows	4	0.037	0.15
	Total			118.19
	Transportation and Installation charges extra (10%)			11.81
	<b>Total Cost</b>			<b>130.00</b>

**Disclaimers:** Cost of machinery is indicative while transportation, installation and GST charges will be extra "as applicable"

Rates from GeM portal are average price, which may change depending upon product and vendor availability

Wherever applicable approved make for civil construction materials, mechanical equipment and electrical equipment notified by concerned departments/authorities of the Government of State/UT must be followed to maintain assured quality

### II. Electrical Equipments

Sl. No	Equipment/Instrument	No of units	Unit rate (Rs.)	Cost of equipments (Rs.)
1	Solar Panels	160 <sup>0</sup>	7796	1247360 <sup>x</sup>
2	Lighting and Ventilation equipments	1	283433 <sup>*</sup>	283433
3	Desktop PC	2	33436	66872
4	Water cooler	1	36400	36400
	Total			1634065.00
	Transportation and installation charges (10%)			163406.00
	<b>Total cost in Lakh</b>			<b>17.97</b>

**Disclaimers:** Cost of machinery is indicative while transportation, installation and GST charges will be extra "as applicable"



Rates from GeM portal are average price, which may change depending upon product and vendor availability

Wherever applicable approved make for civil construction materials, mechanical equipment and electrical equipment notified by concerned departments/authorities of the Government of State/UT must be followed to maintain assured quality

\* Considered the cumulative price of all the lighting and ventilation equipments

∅ Drawings for the installation of solar panels need to be checked and approved by concerned experts before individual project to get the actual number of panels as per the availability of sunlight in that area

\* ULB's must utilize the available schemes by Government of India for the purposes to promote such renewable energy source.

### III. Fire Fighting Equipments

Sl. No.	Equipment/Instrument	No. of Units	Unit Rate ( Rs.)	Cost of equipments (Rs.)
1	Fire fighting pump	1	500000*	500000
2	Jockey Pump	1		
3	Diesel fire fighting pump	1		
4	Fire Extinguisher	17	15104*	15104
5	Fire Bucket	24	272	6528
6	Fire hydrant system & pipes	1	210000	210000
7	Fire Hose-30 m	5	7830	39150
8	Fire alarm system	8	16500	132000
	Total cost of fire fighting equipments			902782
	Transportation and installation charges extra (10%)			90278
	<b>Total cost in Lakh</b>			<b>9.93</b>

**Disclaimers:** Cost of machinery is indicative while transportation, installation and GST charges will be extra "as applicable"

Rates from GeM portal are average price, which may change depending upon product and vendor availability

Wherever applicable approved make for civil construction materials, mechanical equipment and electrical equipment notified by concerned departments/authorities of the Government of State/UT must be followed to maintain assured quality

\* Considered the cumulative price of all the fire fighting pumps and fire extinguishers





## B. OPEX

### 1. PPE Cost

Sl. No.	Item	Annual requirement (no)	Unit rate (Rs.)	Amount (Rs.)
1	Nose Mask (Surgical)	20075	10	200750
2	Safety goggles	110	250	27500
3	Chemical resistant gloves, multi-use	165	125	20625
4	Safety (High visibility/warning) Jacket	55	50	2750
5	Bouffant Caps	20075	1	20075
6	Safety shoes	55	400	22000
7	Ear Plugs / Canal caps	220	50	11000
8	Apron	55	200	11000
<b>Annual Cost ( Total) (+GST as applicable)</b>				<b>3,15,700</b>

**Note:** Cost of PPEs is tentative as ascertained in Oct. 2023, it may change, depending upon product and vendor availability

Rates from GeM portal are average price, which may change depending upon product and vendor availability

### 2. Manpower Cost

Sl. No.	Manpower	Number	Wages* (Rs.)/day	Total Cost (Rs.)
1.	Manager In-charge (Skilled)	1	1150	1150
2.	Safety Supervisor	1	973	973
3.	Weigh bridge operator	1	897	897
4.	Electrician cum baler operator (Skilled)	1	973	973
5.	Electrician cum Shredder operator (skilled)	1	973	973
6.	Multi-Tasking Staff (MTS ) (skilled)	1	897	897
7.	Electric Fork lift operator (Skilled)	1	897	897
8.	Skip loader operator (Skilled)	1	897	897
9.	Security# (unskilled)	3	897	2691
10.	Safai mitra Cleaner# (unskilled)	2	736	1472
11.	Person at tipping area (unskilled )	4	736	2944
12.	Sorting workers# (women's) (unskilled)	25	736	18400
Total wages per day				33,164/-
Monthly wages				10,11,502/-
<b>Annual wages</b>				<b>1,21,38,024/-</b>



**Disclaimers:** Wages of staff are indicative. Wages shall be paid as per the norms of concern State Government.

# Possibility of integration of informal sector may also be explored by ULBs at MRF Plant.

### 3. Indicative Operation and Maintenance Cost

Sl. No.	Components of O & M	Rate	Quantity	Expected Expenditures (Rs)	
				Monthly	Annually
1	Water Consumption	@ Rs. 146.4/ KLD for consumption exceeding 100 KL (180KL/Month) and service charges @ Rs. 1317.69/monthly	6KLD i.e. 180 KL/month	27,670	3,32,040
2	Sewerage charges	60% of water consumption charges	--	15,850	1,90,200
3	Civil Maintenance	@ Rs. 10/ Sq. m. including toilets	Area 3000 Sq. m.	30,000	3,60,000
4	Electrical + Mechanical Maintenance Equipment	10% of cost of equipment per annum	Rs.14,79,696	1,23,312	14,79,747
5	Firefighting Equipment	5% of cost of equipment per annum	Rs. 49,653	4,137	49,653
6	Electricity Consumption	@Rs. 7.75/kWH + @Rs. 2.30/- other charges = @Rs. 10- per kWh Approx	714.51 kWh for 08 hr per day	2,17,925	26,15,100
<b>Total Cost (Rs.)</b>				<b>4,18,894</b>	<b>50,26,740</b>

**Note:** Cost of Operation and Maintenance is indicative, as ascertain in Oct 2023, it may change



The image shows a large-scale industrial or construction site. In the center, the text "BILL OF QUANTITY" is written in a bold, white, sans-serif font. The background is a photograph of a vast, open-plan facility with a high ceiling supported by a network of steel beams. Numerous workers in safety gear are visible, engaged in various tasks. There are conveyor belts, large storage bins, and structural elements under construction. A prominent white diagonal graphic cuts across the lower right portion of the image, adding a modern, graphic design element. The overall color palette is dominated by warm, brownish-orange tones, likely due to the lighting or a color filter applied to the photograph.

# BILL OF QUANTITY

## BOQ for 50 TPD MRF Shed

### (Delhi Schedule Rates (2023), Quotation & Market Rate)

**Disclaimer:** Modifications based on the suitability as per soil, site and local conditions, shall be carried out by ULBs with proper departmental approval.

**Note:** It must be vetted for individual project by the competent engineer / authorities of the ULBs / Department concerned.

DSR Item No.	Description	Unit	Qty.	Rate	Amount
<b>(1)</b>	<b>SITE CLEANING</b>				
2.31	<b>Clearing jungle</b> including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth up to 30 cm measured at a height of 1 m above ground level and removal of rubbish up to a distance of 50 m outside the periphery of the area cleared.	sqm	6366.10	17.60	112043.36
<b>(2)</b>	<b>EXCAVATION</b>				
2.6	<b>Earth work in excavation</b> by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge.				
2.6.1	Ordinary Soil	cum	2487.93	177.50	441608.00
2.7	<b>Earth work in excavation</b> by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sgm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge.				
2.7.1	Ordinary Rock	cum	564.18	498.90	281468.40
<b>(3)</b>	<b>CEMENT CONCRETE</b>				
4.1.4	<b>1:2:4</b> (1 Cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 40 mm nominal size derived from natural sources)	cum	415.94	7780.30	3236159.92
4.10	Providing and laying <b>damp-proof course</b> 40 mm thick with cement concrete 1:2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 12.5 mm nominal size derived from natural sources)	sqm	68.25	410.85	28040.59
<b>(4)</b>	<b>BACK FILLING</b>				
2.25	<b>Filling available excavated earth</b> (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	cum	1406.41	196.00	275656.43

DSR Item No.	Description	Unit	Qty.	Rate	Amount
2.25(a)	Excavating, <b>supplying</b> and filling of <b>local earth</b> (including royalty) by mechanical transport upto a lead of 5km also including ramming and watering of the earth in layers not exceeding 20 cm in trenches, plinth, sides of foundation etc. complete.	cum	1253.85	700.50	878321.93
2.26	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.				
2.26.2	Ordinary or hard rock	cum	564.18	227.40	128294.08
<b>(5)</b>	<b>REINFORCED CEMENT CONCRETE</b>				
5.33A	Providing and laying in position ready mixed or site batched design mix cement concrete for reinforced cement concrete work; using coarse aggregate and fine aggregate derived from natural sources and using recycled concrete aggregate (RCA) as coarse aggregate and fine aggregate within permissible utilization of 20% each, Portland Pozzolana [Ordinary Portland/Portland Slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying, curing, carriage for all leads; but excluding the cost of centering, shuttering, finishing and reinforcement as per direction of the engineer-in-charge; for the following grades of concrete. Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 110% of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost of extra cement.				
5.33A.1	All works upto plinth level				
5.33A.1.1	Concrete of M25 grade with minimum cement content of 330 kg /cum	cum	1389.75	9333.95	12971831.34
5.33A.2	All works above plinth level up to floor V level				
5.33A.2.1	Concrete of M25 grade with minimum cement content of 330 kg /cum	cum	638.39	9689.60	6185720.66
5.35	Add for using extra cement in the items of design mix over and above the specified cement content therein.	cum	277.95	733.50	203875.92
5.35	Add for using extra cement in the items of design mix over and above the specified cement content therein.	cum	127.68	733.50	93651.46
<b>(6)</b>	<b>CENTERING AND SHUTTERING</b>				
5.9	<b>Centering and shuttering</b> including strutting, propping etc. and removal of form for				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
5.9.1	<b>Foundations</b> , footings, bases of columns, etc. for mass concrete	sqm	590.10	392.15	231407.72
5.9.2	<b>Walls</b> (any thickness) including attached pilasters, buttersesses, plinth and string courses etc.	sqm	672.62	842.50	566685.72
5.9.3	Suspended floors, <b>roofs</b> , landings, balconies and access platform	sqm	113.10	927.25	104871.98
5.9.5	Lintels, <b>beams</b> , plinth beams, girders, bressumers and cantilevers	sqm	696.34	736.40	512781.83
5.9.6	<b>Columns</b> , Pillars, Piers, Abutments, Posts and Struts	sqm	1418.28	961.30	1363392.56
<b>(7)</b>	<b>STEEL REINFORCEMENT</b>				
5.22	<b>Steel reinforcement</b> for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.				
5.22.6	Thermo-Mechanically Treated bars of grade Fe-500D or more.	kg	111179.78	107.85	11990739.27
5.22A.6	Thermo-Mechanically Treated bars of grade Fe-500D or more.	kg	51071.01	107.85	5508008.37
<b>(8)</b>	<b>BRICK WORK</b>				
6.1	<b>Brick work</b> with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 , In foundation and plinth in.				
6.1.1	Cement mortar 1:4 (1 cement : 4 coarse sand)	cum	2.66	7370.65	19622.17
6.4	<b>Brick work</b> with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level in all shapes and sizes in				
6.4.1	Cement mortar 1:6 (1 cement : 6 coarse sand)	cum	268.40	9105.95	2444000.19
<b>(9)</b>	<b>CLADDING, WOOD AND STEEL WORK</b>				
8.27	Providing and fixing specified <b>wood frame</b> work consisting of battens 50x25 mm fixed with rawl plug and drilling necessary holes for rawl plug etc. including priming coat complete.				
8.27.1	Kiln seasoned and chemically treated hollock wood	cum	0.85	187227.65	158540.63
9.21	Providing and fixing ISI marked <b>flush door</b> shutters conforming to IS : 2202 (Part I) non-decorative type, core of block board construction with frame of 1st class hard wood and well matched commercial 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters:				
9.21.1	<b>35 mm thick</b> including ISI marked Stainless Steel butt hinges with necessary screws	sqm	70.29	2392.65	168179.37
<b>(10)</b>	<b>CEMENT PLASTER</b>				
13.1	<b>12 mm</b> cement plaster of mix				
13.1.1	1:4 (1 cement: 4 fine sand)	sqm	2628.36	347.05	912173.73
13.2	<b>15 mm</b> cement plaster on the rough side of single or half brick wall of mix:				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
13.2.1	1:4 (1 cement: 4 fine sand)	sqm	7197.83	399.45	2875174.39
13.16	6 mm cement plaster of mix				
13.16.1	1:3 (1 cement : 3 fine sand)	sqm	570.43	300.45	171384.49
<b>(11)</b>	<b>SELF-SUPPORTED MECHANICALLY SEAMED ROOFING</b>				
Quotation	<p>Providing and fixing of self supported mechanically seamed roofing system such as proflex, green curve, Kialash roofing or equivalent made of high strength quality steel, having 340 MPA yield strength, pre coated galvalume sheet as per ASTM A792 M of base metal thickness 1.4 mm (Tolerance +/- 0.02 mm). high grade steel sheet should have 55% aluminium and 45% Zinc coating by hot dip process of minimum 25 micron on top side and 12 micron on back side with epoxy primer and polyester wash -coat as per AZM 150. Roofing should be designed as per ASCE 7-20 international building code 2002. The analysis should carried out for span and centre arch -rise considering the required live load, wind load, dead load and seismic factor. The analysis should also determine the thickness of steel and the end reaction at the beam level. Shop drawing of roofing system shall be submitted by contractor through consultant and same shall be checked and approved by the department. The roof panel formation shall be done as per the required length and curvature using hydraulic profile machine to give it the trapezoidal shape in required curvature. In this process the width of sheet the width of sheet reduces from 0.914 meter to 0.61 meter (tolerance +/- 0.02 mm). The roof panel shall be lifted using a suitable crane and using a spreader bar and a sling evenly placed to ensure no distortion of panel till the alignment is done and completed using plumb and a water tube and bolted into beam. These curved panels have interlocking formation and are crimped together using mechanical seaming machine which imposed a load of approximately five tonnes to ensure the seaming of required rigidity. After seaming a clear epoxy lacquer is applied on the inner side of panel and concrete beam. Theses panel are installed over water proof concrete gutter - beams having bevelled edge to receive (support) curved panels. Beam shall designed for arch reaction and vertical loads. Plaster shall not be applied on the beam. Schmitt hammer test of concrete should be carried before erection to ensure that the anchor bolt can be securely fixed on the support. In case of steel structure a steel runner plate of 6 mm thickness and GI sheet gutter of suitable size shall be provided for installation of panels, G.I. anchor bolt of required sizes and type with G.I. washer and neoprene washer shall be as design. After installation of panels, trapezoidal voids are created between gutter-beam and panels which should be covered by a flashing fabricated or brick masonry which</p>	sqm	4785.72	2773.00	13270808.22

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	is to be paid separately. Area of this roof shall be measured along the periphery on hem-top between end to end panels. Ridge and valley shall not taken in to consideration for measuring length transverse to periphery. The rate includes supplying, fixing, loading unloading, hire charges of all plants machineries, anchors, fasteners, washers, bolt, epoxy, paint and all wastage etc. complete. Accessories and fixtures like hangers /clamp for installation of lighting/ fixtures /utility/duct as per requirement and ventilators, skylight can also be provided at crown/ridge by making cuts into the panels which is to be paid separately. This item shall be executed only by the agency which has all required manufacturing machineries and necessary expertise.				
Quotation	Triple Turbo Ventilators with Skylights with complete Fitting Accessories. Side Sky Light sheets (2 feet x 28 feet )	each	18.00	41300.00	743400.00
<b>(12)</b>	<b>FLOORING BASE CONCRETE</b>				
26.83	<p>Applying stamping finish to the top surface of freshly laid plain/reinforced cement concrete of specified grade in porticos, sidewalks, driveways, pool decks and open yards as per direction of the Engineer-in-Charge.</p> <p>The process shall include the following:-</p> <ul style="list-style-type: none"> <li>The concrete shall be placed and screened to the finished grade, and floated to a uniform surface by using standard finishing techniques. The approved color hardener @ 2.7 kg/sqm shall be applied evenly to the surface of the fresh concrete by the dry shake method by sprinkling in two or more shakes, floated after each shake and trowelled only after the final floating. The approved release agent @ 0.113 kg/sqm shall be applied evenly to the trowelled surface before stamping or the said release agent can be applied to the flexible polyurethane stamp moulds of approved design and in required sizes to achieve final stamped pattern. These stampings shall be placed on the surface of concrete in three to four pieces at a time and tapped gently with rammers of sufficient size &amp; weight to leave proper stamp marks and the process repeated for the remaining concrete surface till the whole surface to be stamped is completed within the time while concrete is in plastic stage of setting.</li> <li>After stamping, the curing shall be done as per manufactures specifications. After initial curing the imprinted joints shall be grouted using cement slurry mixed with color hardener as per the requirement. The surface shall be sealed by applying acrylic based sealer not less than 0.167 litre/sqm.on finished surface.</li> <li>The construction joints shall be provided by groove cutting of size 4 mm x 20 mm in panel size</li> </ul>	sqm	3000.00	762.75	2288250.00



DSR Item No.	Description	Unit	Qty.	Rate	Amount
	3m x 3 m or lesser as per the site conditions and filling the same with 10 mm baker rod and providing and laying (PU) Polyurethane based joint sealer of approved make as per manufacturer's specifications and finished by applying Polyurethane resin based top protective clear coat of minimum 80 micron applied with rollers on properly cured and dry clean surface.				
<b>(13)</b>	<b>WATER PROOFING FOR WC etc</b>				
22.3	<p>Providing and laying <b>water proofing treatment</b> to vertical and horizontal surfaces of depressed portions of W.C., kitchen and the like consisting of:</p> <p>(i) Ist course of applying cement slurry @ 4.4 kg/sqm mixed with water proofing compound conforming to IS : 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.</p> <p>(ii) IInd course of 20 mm cement plaster 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.</p> <p>(iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sqm of area.</p> <p>(iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sqm).</p>	sqm	497.28	769.60	382706.69
22.7	<p>Providing and laying integral cement based <b>water proofing treatment</b> including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations:</p> <p>a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment.</p> <p>b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.</p>				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	<p>c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge.</p> <p>d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep.</p> <p>e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. "All above operations to be done in order and as directed and specified by the Engineer-in-Charge":</p>				
22.7.1	With average thickness of 120 mm and minimum thickness at khurra as 65 mm.	sqm	113.10	1684.60	190528.26
<b>(14)</b>	<b>PAINT</b>				
13.41	Distempering with 1st quality <b>acrylic distemper</b> (ready mixed) having VOC content less than 50 gram/litre, of approved manufacturer and of required shade and colour all complete to achieve even shade and colour				
13.41.1	New work (two or more coats) over and including water thinnable priming coat with cement primer having VOC content less than 50 gram/litre	sqm	2628.36	185.65	487955.78
13.46	Finishing walls with Acrylic Smooth <b>exterior paint</b> of required shade				
13.46.1	New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including <b>priming coat of exterior</b> primer applied @ 0.90 litre/10 sqm)	sqm	7197.83	160.60	1155971.98
13.50.3	Applying priming coat: With ready mixed <b>red oxide</b> zinc chromate primer of approved brand and manufacture on steel galvanised iron/ steel works.	sqm	499.51	67.40	33666.70
13.62.1	Painting with synthetic enamel paint of approved brand and manufacture of required colour to give an even shade : Two or more coats on new work over an under coat of suitable shade with ordinary paint of approved brand and manufacture.	sqm	499.51	226.25	113013.23
13.80	Providing and applying white cement based <b>putty</b> of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	sqm	2628.36	156.05	410156.20
Market Rate	Applying priming coat: With ready mixed <b>red oxide</b> zinc chromate primer of approved brand and	meter	3412.80	27.00	92145.60

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	manufacture on steel galvanised iron/ steel works.				
Market Rate	<b>Painting</b> with synthetic enamel paint of approved brand and manufacture of required colour to give an even shade : Two or more coats on new work over an under coat of suitable shade with ordinary paint of approved brand and manufacture.	meter	3412.80	91.00	310564.80
<b>(15)</b>	<b>Top Layer of Flowering (Tiles)</b>				
8.31	Providing and fixing 1st quality ceramic glazed <b>wall tiles</b> conforming to IS: 15622 (thickness to be specified by the manufacturer), of approved make, in all colours, shades except burgundy, bottle green, black of any size as approved by Engineer-in-Charge, in skirting, risers of steps and dados, over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm, including pointing in white cement mixed with pigment of matching shade complete.	sqm	248.51	1267.95	315094.45
11.41	Providing and laying <b>vitrified floor tiles</b> in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete.				
11.41.2	Size of Tile 600x600 mm	sqm	332.54	1553.45	516585.51
11.41A	Providing and laying <b>Vitrified tiles in floor</b> in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS:15622, of approved brand & manufacturer, in all colours and shade, laid on 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry @3.3 kg/sqm including grouting the joints with white cement and matching pigments etc. The tiles must be cut with the zero chipping diamond cutter only . Laying of tiles will be done with the notch trowel, plier, wedge, clips of required thickness, leveling system and rubber mallet for placing the tiles gently and easily.				
11.41A.3.1	Glazed Vitrified tiles Matt/ <b>Antiskid finish</b> of size	sqm	271.38	1464.85	397530.99
<b>(16)</b>	<b>STEEL WORK</b>				
10.6	Supplying and fixing <b>rolling shutters</b> of approved make, made of required size M.S. laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	strength conforming to IS: 4454 - part 1 and M.S. top cover of required thickness for rolling shutters.				
10.6.1	80x1.25 mm M.S. laths with 1.25 mm thick top cover	sqm	73.65	3653.20	269058.18
10.7	Providing and fixing ball bearing for rolling shutters.	each	9.00	492.35	4431.15
10.8	Extra for providing mechanical device chain and crank operation for operating rolling shutters.				
10.8.2	Exceeding 16.80 sqm in area	sqm	73.65	1181.80	87039.57
10.9	Extra for providing grilled rolling shutters manufactured out of 8 mm dia M.S. bar instead of laths as per design approved by Engineer-in-charge,	sqm	7.37	768.25	5658.16
10.15	Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.				
10.15.2	Fixing with carbon steel galvanised dash fastener of required dia and size (to be paid for separately)	kg	4301.15	181.25	779582.64
10.25	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required.				
10.25.2	In gratings, <b>frames, guard bar, ladder, railings</b> , brackets, gates and similar works	kg	6211.30	172.60	1072069.69
10.29	Providing & fixing <b>fly proof wire gauze to windows</b> , clerestory windows & doors with M.S. Flat 15x3 mm and nuts & bolts complete.				
10.29.2	Stainless steel (grade 304) wire gauze of 0.5 mm dia wire and 1.4 mm aperture on both sides	sqm	468.58	1133.55	531154.32
<b>(17)</b>	<b>ALUMINIUM WORK</b>				
21.1	Providing and fixing aluminium work for <b>doors</b> , windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / panelling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) :				
21.1.1.1	Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868,	kg	253.44	295.50	74891.52

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	Minimum anodic coating of grade AC 15)				
21.1.2	For shutters of doors, <b>windows</b> & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber / neoprene gasket required (Fittings shall be paid for separately)				
21.1.2.1	Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum anodic coating of grade AC 15) (Window Shutter)	kg	158.40	598.60	94818.24
21.3	Providing and fixing <b>glazing</b> in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge. (Cost of aluminium snap beading shall be paid in basic item):				
21.3.2	With float glass panes of 5 mm thickness (weight not less than 12.50 kg/sqm)	sqm	31.68	1505.25	47686.32
<b>(18)</b>	<b>SANITARY INSTALLATIONS</b>				
14.80	Providing & fixing White vitreous china <b>water closet</b> squatting pan ( <b>Indian type</b> ) along with "S" or "P" trap including dismantling of old WC seat and "S" or "P" trap at site complete with all operations including all necessary materials, labour and disposal of dismantled material including malba, all complete as per the direction of Engineer-in charge.				
14.80.2	Orissa pattern W.C Pan of size 580x440 mm	each	5.00	4478.75	22393.75
17.2	Providing and fixing white vitreous china pedestal type <b>water closet (European type W.C. pan)</b> with seat and lid, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever), conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required :				
17.2.1	W.C. pan with ISI marked white solid plastic seat and lid	each	1.00	6515.55	6515.55
17.7	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require:				
17.7.2	White Vitreous China <b>Wash basin</b> size 630x450 mm with a single 15 mm C.P. brass pillar tap	each	3.00	2226.35	6679.05
17.23	Providing and fixing white vitreous china flat back or wall corner type lipped front <b>urinal basin</b> of 430x260x350 mm or 340x410x265 mm sizes respectively.	each	4.00	1648.95	6595.80
18.48	Providing and placing on terrace (at all floor levels) polyethylene <b>water storage tank</b> , IS : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.	per lit	6000.00	11.00	66000.00

DSR Item No.	Description	Unit	Qty.	Rate	Amount
Market Rate	<b>RCC SEPTIC TANK</b> 1200 MM, 3000 liters capacity for 25 users, with two outlets.	each	2.00	30385.00	60770.00
<b>(19)</b>	<b>ROAD WORK</b>				
16.75	Providing and laying <b>C.C. pavement</b> of mix M-25 with ready mixed concrete from batching plant. The ready mixed concrete shall be laid and finished with screed board vibrator , vacuum dewatering process and finally finished by floating, brooming with wire brush etc. complete as per specifications and directions of Engineer-in-charge.	cum	320.40	9823.80	3147545.52
	(Note:- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable/ recoverable separately).	cum	64.08	9823.80	629509.10
16.78	Construction of <b>granular sub-base</b> by providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in- Charge.				
16.78.1	With material conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value-30	cum	1140.53	2784.00	3175221.60
16.79	Providing, laying, spreading and compacting graded stone aggregate (size range 53 mm to 0.075 mm ) to <b>wet mix macadam (WMM)</b> specification including premixing the material with water at OMC in for all leads & lifts, laying in uniform layers with mechanical paver finisher in sub- base / base course on well prepared surface and compacting with vibratory roller of 8 to 10 tonne capacity to achieve the desired density, complete as per specifications and directions of Engineer-in-Charge.	cum	460.04	2914.30	1340680.00
16.80	Construction of <b>dry lean cement concrete</b> sub base over a prepared subgrade with coarse and fine aggregate conforming to IS:383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per specifications, cement content not to be less than 150 Kg/cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge.	cum	213.60	4148.65	886151.64

DSR Item No.	Description	Unit	Qty.	Rate	Amount
16.91	Providing and laying factory made chamfered edge Cement Concrete <b>paver blocks in footpath</b> , parks, lawns, drive ways or light traffic parking etc, of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50 mm thick compacted bed of sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand. complete all as per direction of Engineer-in-Charge.				
16.91.1	60 mm thick cement concrete paver block of M-35 grade with approved colour, design & pattern.	sqm	652.73	1045.65	682529.22
Market Rate	Providing and Placing in position suitable 125 micron PVC water stops conforming for construction/ expansion joints	kg	133.50	122.36	16335.06
<b>(20)</b>	<b>GREEN BELT</b>				
DSR- 2022-23: Gov. Maharashtra PWD Park, Garden , Pune Region	Preparation of Shrub garden with suppling fersh soil 30 cm deep with decomposed farmyard manure for excavation area 30 cm deep. Providing varity of shrubs 30 cm c/c, (free from weeds and disease etc.) size 7" x 8" . Excavation for planting shrubs bed in earth, soil of all types, soft murum, including removing the excavated material up to a distance of 50 mtrs. for a depth of 30 cms. Filling fresh garden soil / silt & manure in excavated area of depth 30cms. Mixing garden soil/silt & manure thoroughly well, watering previous night. Planting required plant species, lawn grass as directed etc. complete for required depth 30 cms. for planting lawn/ shrub/ flower bed/ hedges/ edges/ canna bed/ ground cover. Maintenance of Newly Developed Shrubs Area. For First 30 days Only.	sqm	1039.45	789.00	820126.05
DSR- 2022-23: Gov. Maharashtra PWD Park, Garden , Pune Region	Plantation of Trees ; Supplying on site fersh for excavated pit size area of 0.60 x 0.60 x 0.60m, Supplying on site well decomposed Farm Yard Manure FYM for excavated pit size area of 0.60 x 0.60 x 0.60m. Providing on site required variety of Tree (free from weeds /disease etc.) 30 cms. apart c/c.Name:- Bahava;Bag Size 13 x13", ht 6-8'. Excavation pit size 0.60 x 0.60 x 0.60 m for planting small & medium ornamental plants/ large flowering/ shady trees (plant height 1 to 2 mtr.) in earth, soil of all types, soft murum, including removing the excavated & unwanted material up to a required distance of 50 mtrs. Filling fresh garden soil / silt & manure in excavated pit size area of 0.60 x 0.60 x 0.60m. Mixing garden soil/silt & manure thoroughly well, watering previous night. Planting required plant species as directed etc. complete for required pit size 0.60 x 0.60 x 0.60m. Maintenance of Newly Planted tree varieties having height 1mtr. - 2mtr. For First 30 days Only	each	107.00	719.00	76933.00
<b>(21)</b>	<b>EXTRA CIVIL ITEMS</b>				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
Market Rate	Rubble Soling	cum	80.47	2400.00	193119.60
<b>(22)</b>	<b>ELECTRIC FIXTURES</b>				
Market Rate	Internal Illumination & Fan				
	Street Light (250 W)	each	17.00	4613.00	78421.00
	Led Light (100 W)	each	16.00	2779.00	44464.00
	Led Tube (25 W)	each	33.00	260.00	8580.00
	Wall Mounted Fan (180 W)	each	10.00	11206.00	112060.00
	Celling Fan (75W)	each	15.00	2360.00	35400.00
	Toilet Exhaust Fan (60 W)	each	4.00	1127.00	4508.00
<b>(23)</b>	<b>OTHERS</b>				
Lump Sum	Main Gate	each	1.00	200000.00	200000.00
Lump Sum	Gritting Platform with Railing and ladder with Railing (Foot Bridge)	each	1.00	40000.00	40000.00
Lump Sum	Gritting Platform with Railing and ladder with Railing (Steps)	each	5.00	15000.00	75000.00
Lump Sum	Cowcatcher		1.00	200000.00	200000.00
Lump Sum	Illuminated Signage				30000.00
Lump Sum	Internal Plumbing and Electric Work (Termite treatment etc.)				360000.00
				<b>Sub Total Rs</b>	91103940.67
				<b>Contingency</b>	<b>3%</b> 2733118.22
				<b>Total</b>	<b>93837058.89</b>
				<b>Total Rs in Lakh</b>	<b>938.37</b>

Disclaimer

Where ever applicable approved make for civil construction materials, mechanical equipment and electrical equipment notified by the concerned department/authority of the state government should be followed to maintain assured quality





Ministry of Housing and Urban Affairs  
Government of India





Prepared by





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