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भारत सरकार
आवासन और शहरी कार्य मंत्रालय
निर्माण भवन
GOVERNMENT OF INDIA
MINISTRY OF HOUSING AND URBAN AFFAIRS
NIRMAN BHAWAN

नई दिल्ली–110011, तारीख 20
New Delhi-110011, dated the 20

D.O. No. Z-14011/2/2024-PHE/SBM Dated: 21.08.2024

Respected Sir/Madam,

Subject: Suggestions on Model Design of MRF for Hilly Areas regarding.

The Ministry has recently released Model Design for Material Recovery Facilities (MRF) with capacities of 5 TPD for Hilly areas, which are now accessible on the Ministry's official website (www.sbmurban.org).

We encourage you to download these designs and provide any feedback or suggestions you may have. Your input regarding aspects such as capacity, specifications, feasibility, and cost-effectiveness would be greatly appreciated. Please ensure your feedback reaches us no later than September 8th, 2024. Kindly direct your suggestions to the designated officers: Shri Ankit Jain (ankit.j@nic.in,) and Dr. Anand Sonawane (anand.sonawane@rites.com, 7768802999).

With Kind Regards,

Yours Sincerely,

Binay Kumar Jha

(Binay Kumar Jha)

ACS/Principal Secretary /Secretary,
Urban Development Departments,
All States/UTs.

Copy To:

National Mission Director, Swachha Bharat Mission- Urban 2.0

State Mission Director, Swachha Bharat Mission (Urban)

आवासन और शहरी कार्य मंत्रालय
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स्वच्छ भारत
एक कदम स्वच्छता की ओर

DRAFT
MODEL DESIGN

For

5 TPD Material Recovery Facility for Hilly Areas

Swachh Bharat Mission - Urban 2.0

Central Public Health and Environmental Engineering Organisation (CPHEEO)

August
2024

MINISTRY OF HOUSING AND URBAN AFFAIRS
GOVERNMENT OF INDIA

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Abbreviations

AMC	:	Annual Maintenance Contract
ANSI	:	American National Standards Institute
BSI	:	Bureau of Indian Standards
BOQ	:	Bill of Quantities
CAPEX	:	Capital Expenses
CMC	:	Comprehensive Services Contract
CTE	:	Consent to Establish
CTO	:	Consent to Operate
DHW	:	Domestic Hazardous Waste
E&OE	:	Errors and Omissions Excepted
ELCB	:	Earth Leakage Circuit Breaker
EN	:	European Nation
EPA	:	Environment Protection Act
EU	:	European Union
GeM	:	Government e Marketplace
GSM	:	Gramme per Square Metre
HDPE	:	High Density Poly Ethylene
HFL	:	High Flood Level
IEC	:	International Electro technical Commission
ID	:	Inner Diameter
ISO	:	International Standards Organization
MSW	:	Municipal Solid Waste
MSWM	:	Municipal Solid Waste Management
NITI	:	National Institution for Transforming India
OD	:	Outer Diameter
OPEX	:	Operational Expenses
PCC	:	Pollution Control Committee
PPE	:	Personal Protection Equipment
PVC	:	Poly Vinyl Chloride
RCCB	:	Residual Current Circuit Breaker
RDF	:	Refuse Derived Fuel
SOP	:	Standard Operating Procedure
SPCB	:	State Pollution Control Board
ULB	:	Urban Local Body

Executive Summary

Urban India generates about 58 million tonnes of municipal solid waste annually. Municipal Solid Waste (MSW) management is a day to day challenge of the Urban Local Bodies (ULBs).It is even more difficult in the hilly regions due to their topographic features and climatic conditions. The mountains and hilly areas occupy about 29.3% of the total land area of the country. Though the quantity of solid waste generation is small in comparison with the plain and plateau cities, the terrain conditions and unique ecosystem emphasize the need for a separate design for Material Recovery Facilities (MRFs) for these areas. The Central Government is supporting these ULBs in implementing waste management action plans in mission mode for proper collection, sorting, transportation, processing, and safe disposal of municipal solid waste under its flagship programme of SBM-U 2.0.

The Solid Waste Management (SWM) Rules, 2016, mandate the setting up of a Material Recovery Facility (MRF) for the secondary sorting of recyclable materials from the dry fraction of MSW. The Rules also specify certain clauses for SWM in hilly areas and recommend the step garden approach for establishing decentralized waste processing facilities. Thus MRF helps to enhances the Waste to Wealth intervention in dry MSW management by proper sorting of recyclable materials for recycling industry and eliminating the dumping of dry waste at landfills.

To assist the ULBs in planning, designing, and implementing material recovery from solid waste, this typical design for a 5-Tonne per Day (TPD) Material Recovery Facility has been prepared. It provides details of essential machinery and their standard specifications. This facility is envisaged for dry waste handling only. As per SWM Rule 2016, dry and wet waste are to be collected separately and transport only dry waste to the MRF, entailing the handling of wet waste separately.

This design has been developed in consultation with MRF operators, manufacturers, suppliers, vendors, user agencies, and learning from visits to a few operating MRFs. This model document has been prepared with a view to providing general guidance and guidelines for the ULB. The document also provides an estimate of CAPEX, OPEX, SOPs, and safety procedures for the proper operations of the MRF. It is essential to recall that India is a vast and diverse country. Therefore, while planning and designing an MRF for a particular town, local and regional factors such as climate and topography along with characteristics of MSW need to be factored in before implementation.

It is expected that ULBs can develop their tenders and BOQs using this document as a reference.

Table A. Abstract of Normative CAPEX and OPEX Cost Estimate

Sr No	Description	As per detailed Estimates (Rs in Lakh)
A)	**CAPEX**	
	Civil Cost	110.22
	Mechanical & firefighting equipment cost	60.48
	Electrical equipment cost	25.80
	TOTAL	196.50
B)	**OPEX (One year)**	55.77
	Recovery Potential ♻ Recyclables per day — 2.0 TPD ♻ Annual Operating days — 365 ♻ Annual Recyclables — 730 MT ♻ Approx. Sale Price for recyclables(Rs) — 6000 per MT ♻ Annual Revenue from Sale (Rs) — 43.80 lakh ♻ Annual O&M Expenditure (Rs) — 55.77 lakh	

1. Introduction

India is a vast country with a varying physiographic region along its North- South and East – West directions. Physiography of the country is complex and heterogeneous with its mountainous regions in north, gangetic plains, plateau and coastal plains. Diverse terrain and demographic conditions of the hilly areas reinforces the need for a separate design of Material Recovery Facility (MRF) for hilly regions.

The States/UTs of Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttrakhand, Sikkim, Manipur, Meghalaya, Nagaland, Tripura, and Arunachal Pradesh are the hilly States located in North and North East regions of India. Designing MRF for hilly Urban Local Bodies (ULBs) possess unique challenge due to the difficult terrain conditions and space limitations. Though these ULBs have lesser population, the undulating terrain and steep slopes are constraints before the ULB's for constructing MRF. Hence a compact MRF suitable for hilly terrain is the need of the hour.

2. Need for MRF

MRF serves as an intermediate step between the collection of recyclable materials and handing over recyclable, non-recyclables and Refuse Derived Fuel (RDF) to the user agencies for further processing or reuse, as appropriate, as a step towards circular economy. After maximizing recyclable waste recovery in MRFs, minimum residual inert materials and rejects alone would go to landfill. Thus setting up of MRF is a important for resource recovery facilitating 'Circular Economy'.

SWM Rules mandate that only inert rejects (residue waste) from processing facilities, inert street sweepings, etc. can be land filled. Therefore all options for minimizing waste residue should be practiced. To meet the aim to reduce the amount of waste being finally disposed and maximizing resource recovery and efficiency, MRFs are required to be established.

3. Advantages of MRF

- Recovers materials for reuse, recycling and conservations
- Enhances the availability of scarce resources as well as reducing environmental impacts
- The quantity and volume of waste dumped gets reduced resulting in cost savings in the disposal infrastructure
- Generates livelihood opportunities for informal waste pickers, local vendors and recyclers
- Reducing the burden of waste management costs on ULBs
- Increases the life span of landfills/reduced requirement of land, and
- Helps in facilitating circular economy.

4. MRF Process Description

Non-biodegradable fraction of municipal solid waste gathered from door to door collection is transported to MRF unit in suitable vehicles of the ULB. Upon reaching the MRF facility,

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. From the unloading/tipping area, the dry waste will be fed onto the in-feed conveyor belt for sorting through ballistic separator. The Ballistic separators have long paddles that undulate at alternate intervals to separate materials like plastic films, paper etc. from materials like bottle and cans. Two dimensional materials walks up the paddles and falls over the screen. Three dimensional materials bounce back and off the screen onto a conveyor. Then the separated items will be further sorted manually at the tail end conveyor lines. After sorting, rejects/inert will be sent for land filling and domestic hazardous waste will be handed over to respective common facility.

Magnetic separator is fixed at the end of conveyor belt before ballistic separator to segregate waste materials having magnetic constituents at in-feed conveyor belt. The depth of moving waste layer on conveyor belt leading to disc screens should be maintained less than 10 cm. Materials separated using magnetic separator shall be stored and send to the recyclers.

Baling will be required for sorted fractions of paper, cardboard, metals, and plastics. The bales of different materials shall be kept in the storage area and will be handed over for further recycling. The glass fractions shall be stored separately for recycling. The general process flow diagram for a 05 TPD MRF facility is shown in Figure 1.

To get the maximum price, recyclable materials recovered at MRF must meet the needs of market. The recovered materials should be clean, adhering to quality parameter, in bulk package, uniformly compacted/baled etc. to facilitate and meet the market demand.

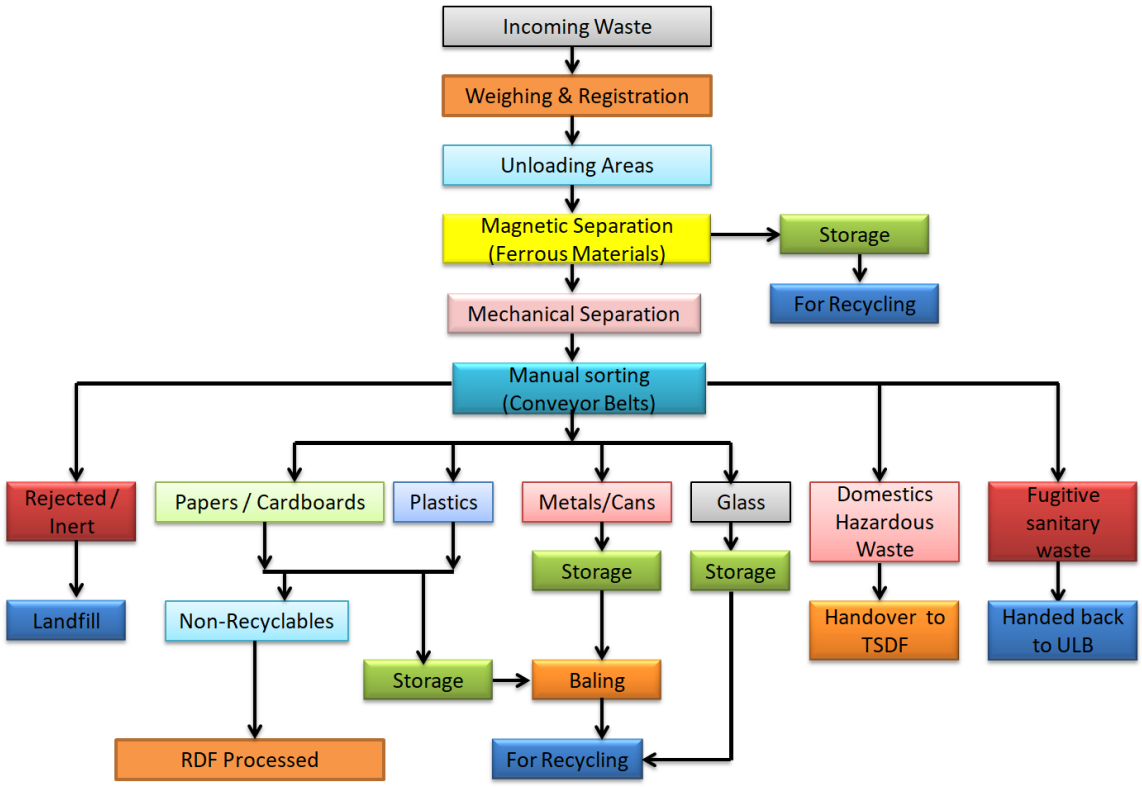


Figure 1: General MRF Process Flow Chart for Dry Waste

5. Minimum Requirement of Land, Manpower, Water Demand, Machinery

5.1 Land Requirement

The availability of suitable level plot of land is an essential requirement for establishing MRF at hilly areas. The terrain are normally sloppy in nature, necessitate a multilevel Material Recovery Facility. MRF under consideration is with a capacity of 5 TPD. The minimum land area required is 160 sq.m. which includes space for tipping, sorting, dispatching, storage, office space, changing rooms and toilets. The area requirement for a typical MRF process plant is given in Table 1.

Table 1: Land Requirement

Sl. No.	Items	Numbers /Quantity	Floor Area (m^2)
	Ground Floor		
1	Receiving area	1	28
2	Processing & Dispatch Area	1	77.85
3	Bale Storage area	1	24.5
4	Office area with toilet	1	9.6
5	Security cabin cum weigh bridge cabin	1	9

Sl. No.	Items	Numbers /Quantity	Floor Area (m^2)
6	Weigh Bridge	1	9.2
7	Bale Lifting area (opening)	1	1.95
		Area of ground floor	**160**
	Basement Floor		
8	Processing Area- Basement floor	1	125.45
9	Storage of recyclables	10	13
10	Male and Female changing rooms with toilets	1	19.6
11	Bale Lifting area (opening)	1	1.95
		Area of basement floor	**160**

5.2 Manpower Requirement

Functioning of MRF depends upon the deployment of sufficient labour at the sorting unit in respective sections. The manpower requirement for a 5 TPD plant is envisaged as 13 persons per day for an 8 hour operational plant, in which 6 are for sorting, 3 security staff, 1 electrician cum baler operator, weighbridge operator and others. The manpower requirement with respective qualifications and responsibilities are given in Table 2.

Table 2: Manpower, Qualifications and Responsibility

Sl. No.	Manpower	Qualification	Number	Responsibility
1	In-charge / Supervisor	Any Graduate with 2 years of experience in Plant Operations	1	♻ Overseeing all the operational activities at MRF. ♻ Maintain communications with local authorities like health departments, police, fire brigade etc. ♻ Maintain interactions with the ULB officials ♻ Ensure that machineries maintained properly ♻ Ensure appropriate safety equipment and PPEs used at all times. ♻ Periodic checking at the MRF for red spots(Spiting spots), yellow spots and cleanliness of the plant ♻ Maintain all administrative and inventory records. ♻ Reviewing accidents, incidents, and near misses, environmental

Sl. No.	Manpower	Qualification	Number	Responsibility
				hazards, health & safety breaches. Site Incident Controller during emergency at the MRF. ♻ To perform other tasks including weekly/monthly reporting to ULB officials and/or supervisory duties.
2	Electrician cum baling operator	ITI Electrician with 2 years of experience in similar projects	1	♻ Operate and maintain the baler machine to compress and bind the sorted waste. ♻ Notify maintenance requirements with the Manager. ♻ Troubleshooting electrical issues in the plant like reversal of polarity, checking the continuity of the earthing etc. ♻ Ensure all the electrical equipments/machinery switched off before leaving the plant ♻ Keep equipment in a clean and orderly condition and maintain the work area. ♻ Run the day to day activities of the plant in the absence of Plant In charge
3	Weigh Bridge operator	12th Pass	1	♻ Weighing of in and out vehicles carrying segregated waste. ♻ Preparing daily/ weekly/monthly reports and record keeping. ♻ Submitting reports to plant incharge ♻ Checking of incoming waste, reporting contamination or non-conforming wastes delivered to site.
4	Security	10th Pass	3	♻ Protect the MRF from intruders.

Sl. No.	Manpower	Qualification	Number	Responsibility
				♻ 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). ♻ Periodically conduct security checks (surveillance) of specified areas. ♻ Maintain a security log register. ♻ Patrolling the MRF(Inside and outside), thrice in a shift
5	Sorting workers[#]	Not Applicable	6	♻ 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. ♻ Inspect materials for contaminants, such as non-recyclable items or domestic hazardous substances, and store them separately to maintain the quality of waste. ♻ Maintain cleanliness and orderliness in the recycling facility by regularly cleaning work areas. ♻ In any case, assist with the maintenance and repair of equipment to ensure proper functioning and minimize downtime.
6	Multi Task Staff (MTS)	Not Applicable	1	♻ Tearing of dumpster bags and feeding the segregated waste into hopper. ♻ Identify and remove the domestic hazardous waste, discarded blankets, furniture and empty cans from dry waste. ♻ Keep tipping area clean.

Sl. No.	Manpower	Qualification	Number	Responsibility
				♻ Cleaning wash room/toilets and keeping all emergency exits and walkways clear from obstructions. ♻ Reporting at MRF two hours before commencement of operations and keeping working area neat and tidy ♻ Switch on the fans half an hour before the commencement of MRF operations ♻ Should engage in the sorting activity on clearing the receiving area
		Total	**13**	

*Wages shall be paid as per the norms of concerned State Government Order

Integration of informal sector need to be ensured by ULBs

The yield of a sorting worker is assumed as 0.5 Tonne per eight hour of operations

5.3 Water Demand

Minimum water requirement is calculated as per guidelines of NBC 2016 for factory building with bathroom facility. For calculating the water demand, 45 litres per day/head is considered for staff and 15 litre per day/head is used for visitors visiting the plant. The details are given in Table 3.

Table 3: Tentative Water Demand

Sl. No.	Labour Details	Number of workers (Nos.)	Per capita demand (L)	Total Requirement (L)
1	Manpower	13	45	585
2	Visitors to the facility	3	15	45
3	Water for cleaning			300
	Total water requirement per day in Litres			**930 say 1000**

The water demand is calculated as 1.0 KLD and monthly demand would be 30.5 KL. The volumetric charge for industrial use for monthly consumption between 25 – 50 KL is Rs. 73.21/ KL as per Delhi Jal Board (DJB). Rate may vary from State to State. The annual water charges are presented as **Annexure 3**.

5.4 Wastewater generation (Used Water)

As per CPHEEO manual, 80 % of water consumed would be generated as waste water. Hence the wastewater quantity expected is 800 litre per day and disposal may be done

through a upflow anaerobic filter arrangement. If public sewer connection is available within a distance of 100 metre, wastewater should be disposed off in public sewer. Monthly and annual sewer charges are presented as **Annexure 3**.

5.5 Indicative Machinery Requirement

The minimum and essential machinery for 05 TPD MRF is given in Table 4.

Table 4: List of Indicative Machineries

Sl. No.	Name of Machinery/Equipment	Description	Quantity (Nos.)
1	Weigh Bridge	10 Tonne capacity	01
2	Ballistic Separators	05 TPD	01
3	Flat sorting conveyor Belts	End to end conveyors with 800 mm width and 4 m length 1000 mm width and 4 m length 1000 mm width and 7.8 m length	03
4	Magnetic Separator	Separate ferrous materials using electromagnetic field	01
5	Hydraulic baling Machine	Weight of Bale : 40 – 50 kg Cycle time of bale : 12- 15 minutes	01
6	Wheelbarrow (Two-wheel types as per IS:4184)	Volume: 140 litre	03
7	HDPE Container bins	Volume : 1100 litre	09
8	Pallet truck	Load capacity : 2 Tonne	01

Disclaimer: These are Indicative machineries. ULBs may choose alternate or similar machinery depending upon availability and suitability as per their own site conditions and standard specification.

6. Technical Specifications of Machinery

Technical specifications for the machineries required in the MRF are briefly given in the following tables along with their pictures/sketches.

6.1. Weigh Bridge

Table 5: Technical Specification of Weigh Bridge

Parameter	Specifications
Weigh Bridge Type	Electronic Pitless Type
Platform material & Size	High Tensile Structural Steel as per IS:2062:2006 Should be anti-skid type. Thickness of platform plate not less than 10 mm Size 4.8 metre and 2.8 metre (length X width)
Weighing Capacity	10 Tonne
Load cell	4 Load cell with Nickel plated alloy steel body
UPS	30 minute backup
Printer	Laser
Display modes	Indicate weight

Parameter	Specifications
	Indicate calibration-Auto zero tracking Calibration to be checked automatically every 5 minutes
Indicator Units	Kg
Least count	2 Kg
Type/capacity of load cell	Digital double ended shear beam load cells, pre-calibrated load cells – 5000/kg (04 No.) with mounting kits
Accessories of Junction Box (01 Set)	Cables: Home run cable 20 metre & inter connections cable between load cell and junction box & weighing electronics 2 m.
Electric supply	3 Phase (440 V 50Hz)
Surface finish on metal parts	Powder coating/ paint
Electric supply	3 Phase (440 V, 50 Hz)
Machine metal part	Powder/paint
Weighment & printouts	Attached at **Annexure 2(1)**

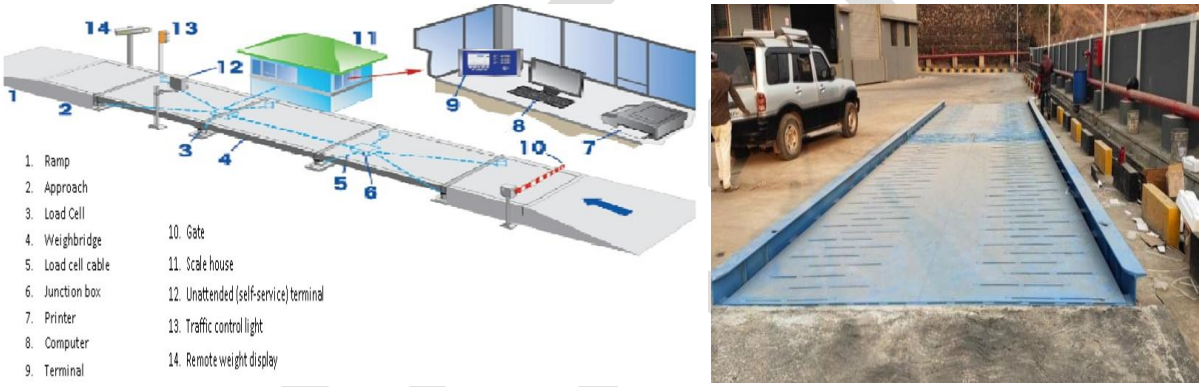


Figure 2: Representative picture for general assembly of Weigh Bridge

6.2. Ballistic separator

Ballistic separator is designed to perform as effective separation of mixed wastes according to different physical characteristics. This separation method is known as gravimetric and is used for the separation of materials like plastic film, paper etc. from bottles and cans before sending for manual sorting. In ballistic separators, the bottle and cans bounce back while moving through the inclined separator whereas plastic films, papers moves forward. Fine fractions in the waste are sieved through the screening holes.

The adjustable inclination angle and long sorting paddles help to achieve high efficiency in sorting. Due to elliptical movement of the paddles, there is no wrapping of long and stringy flexible items. The durable crankshaft and replaceable paddle parts ensure the low operation cost and easy maintenance. With a compact footprint it uses space efficiently and is easy to integrate and retrofit within existing system. The technical specification is given in Table 6.

Table 6: Technical Specification for Ballistic Separator

Parameter	Specifications
Capacity	5 TPD
Duty of Operation	Heavy duty
No. of Paddles	4 nos
No of crank shafts	8 nos
Material	Mild Steel
Casing thickness	10 mm
Range for degree of adjustment	6 degree
Overall size of machine	L- 2500 mm X W-1000 mm X H-1250 mm
Effective Width	2900 mm
Angular Adjustment	Screw jack type
Screen Type	Mesh/ MS flat (8 mm thick)
Paddle Perforation	50 mm x 50 mm
Cam Shaft dia	150 mm (at bearing)
No of paddle drive	1 no
Paddle drive power	11 kW
Paddle width	253 mm
Paddle length	2300 mm
No of screening paddle	4 nos.
Paddle drive type	Helical SF2 (Parallel Shaft)
Paddle Shaft MOC	EN-33
Paddle MOC	Wear resistant steel hard ox 400
Sieve screen MOC	Wear resistant steel hard ox 400
Central lubrication system	Automatic with timer
No of air blower (High Separation efficiency)	2 nos
Motor rating for air blowers	1 kW (VFD Controlled)

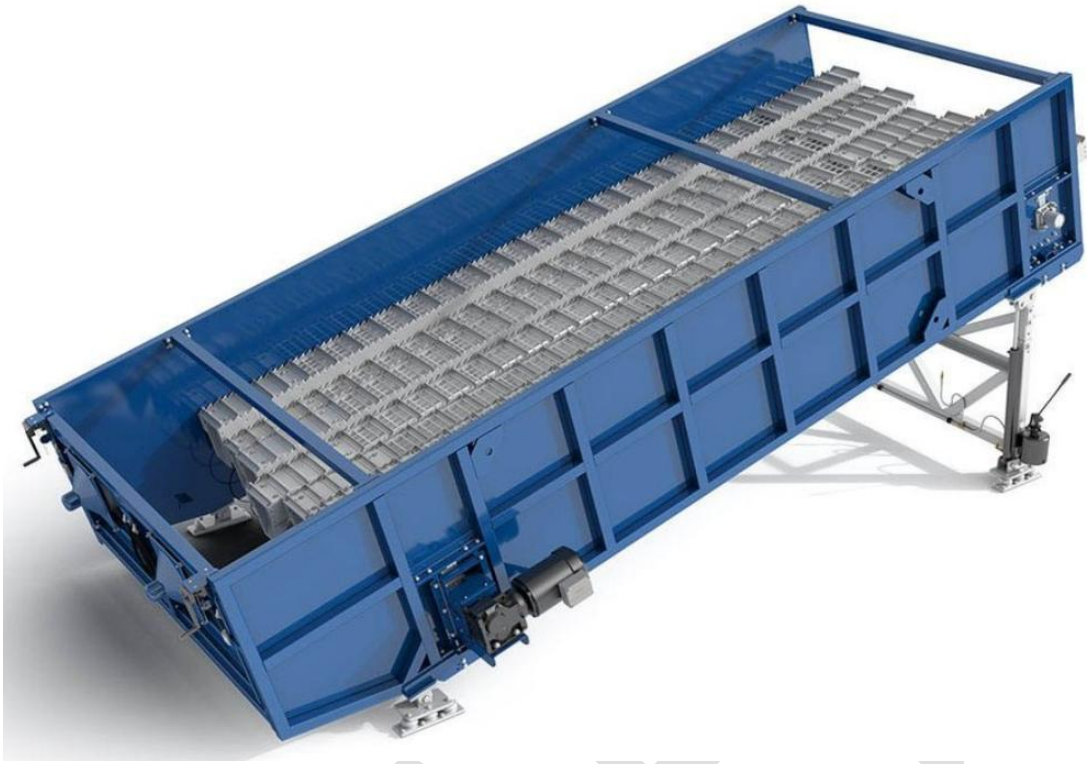


Figure 3: Representative picture of Ballistic Separator

6.3. Flat Conveyor Belt for Sorting

Conveyor belts are used at MRF for feeding waste to ballistic separator and also for taking away different fractions for sorting. Efficiency of a MRF is greatly enhanced by using conveyor system to move waste from the receiving area to sorting. Different pieces of waste such as PET bottles, glass bottles, plastics, metals, polythene, paper etc. apart from inert material are separated manually on the belt conveyors. Belt conveyor shall confirm to IS: 11592: 2000 and material of belt i.e., rubber conveyor shall confirm to IS: 1891-4. The specification of a conveyor belt system is given in Table 7.

Table 7 Technical Specifications for Flat Sorting Conveyor Belt

Parameter	Specifications
Conveyor Belts 1 (Feeding Conveyor Belt 1)	
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	20° Inclined flat
Length of Conveyor	Approx. 4 m from End to End of conveyor
Size of belt	800 mm wide (working width 600 mm)
Belt Specification	Chevron 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

Parameter	Specifications
Conveyor Belts 2 (3D Material Conveyor Belt)	
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 m from End to End of conveyor
Size of belt	1000 mm wide (working width 800 mm)
Belt Specification	Plain rubber belt, 4 ply, 3 mm top, 1.5 mm bottom rubber covering, total belt thickness 10 mm, nylon cord conforming to M 24 grade
Conveyor Belts 3 (Sorting Conveyor Belt)	
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. 7.8 m from End to End of conveyor
Size of belt	1000 mm wide (working width 800 mm)
Belt Specification	Plain rubber belt, 4 ply, 3 mm top, 1.5 mm bottom rubber covering, total belt thickness 10 mm, nylon cord conforming to M 24 grade
Other details (Common for above conveyor belts from 1 to 3)	
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	Ø290 mm OD with crowning surface with 70 mm shaft with rubber coating and hearing bone design
Rear pulley for conveyor	Ø290 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	Ø50 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
Belt joint	Endless type belt

Parameter	Specifications
Scrappers	Driver side: Flat Scrapper Rear Pulley: V plough type
Take up	Screw type take up design at front side of conveyor
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 4: Representative picture of Plain/Chevron type conveyor belts

6.4. Magnetic Separators

Magnetic separators are used to separate materials having magnetic constituent from a moving stream of particles when passed through an electromagnetic field. It is important that the materials should be put through it as a thin spread in order that all the particles are subjected to a field of same intensity and so that the free movement of individual particles is not impeded. The technical specification for a magnetic separator is given below:

Table 8: 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 Intensity	1500 Gauss
Magnetic properties	Magnet Grade:Y35 Maximum operating temperature : 180° C
Magnet housing	High permeability low carbon steel

Parameters	Specifications
Type of cleaning	Self
Bottom plate	Stainless Steel – SS304
Suspension	Four point suspension
Bearing Drums	With shaft mounted on removable hubs
Belt driven	Direct coupled with gear box
Gear ratio	20:1
Working height (mm)	240 - 320
Belt width – Across (mm)	800
Motor	2.2 kW, AC-3 phase induction motor, 415 V, 1440 RPM, 50 Hz
Belt type	Belt with 35 mm high studs
Length of magnet (mm)	1000
Width of magnet (mm)	700
Depth of magnet (mm)	300

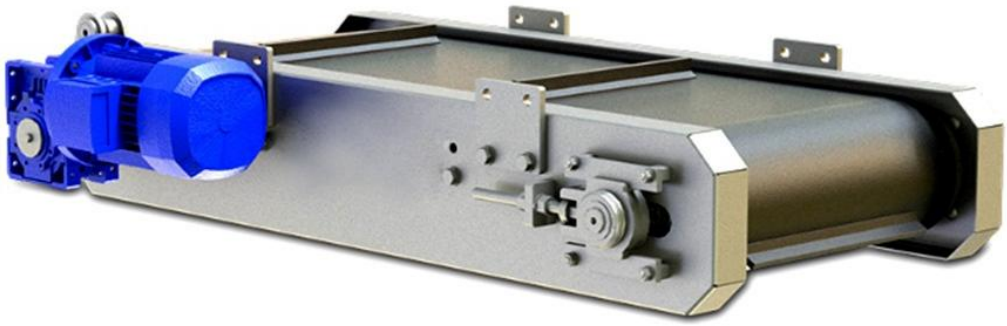


Figure 5: Representative picture of Magnetic Separator

6.5. Vertical Hydraulic Baling Machine (Single Cylinder- Double Chamber)

The Hydraulic Baling machine is used for compressing material such as plastic bottles, aluminum cans, disposal plastic and cardboards etc. into a compact bale for storage and transportation. It shall be vertical single cylinder with double chamber. Detailed specifications are given in the Table 9.

Table 9: Vertical Hydraulic Baling Machine

Parameter	Specifications
Length x Width x Height (mm x mm x mm)	540 X 680 X 2600
Machine material	Mild Steel (Confirming to IS:10748 and IS: 2062, as applicable)
Type	Vertical Single Cylinder Double Chamber
Capacity of Machine	25 Tonne (Jack force)
Chamber size	540mm x 450mm x 1200mm
Day light gap	1050 mm
Weight of Bale (kg)	40kg -50kg
Cycle time per bale	12min – 15min
Number of Cylinder	1
Stroke length	1100 mm

Parameter	Specifications
Platform size	540 x 450 mm
Bale size	540mm x 450mm x 450mm
Machine powder coated	Yes
Cylinder size	65 mm
Operation	Hand Lever Operation System
Motor	5.22 kW (7 HP) copper winding, AC inducting motor, 3-phase, (440 V 50Hz)
Thickness of body plate	8mm
Number of doors	4 nos
Thickness of Clamping plate	30 mm
Accessories & parts	Confirming to BIS Standards
Bale Ejection	By side door
Hydraulic oil tank capacity	120 litre
Drainage system for residue fluid/liquid	Yes
Number of Rope ties	2 nos
Approx weight of machine	850 kg
Manual	Yes, shall be provided

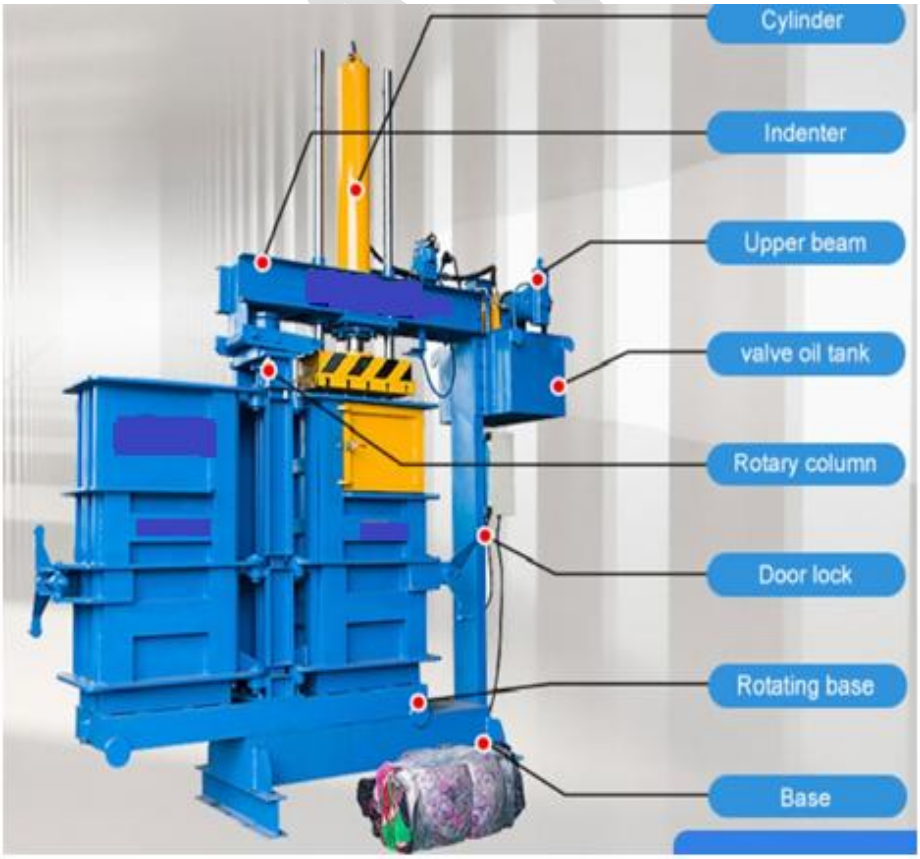


Figure 6: Representative picture of Vertical Hydraulic Baling Machine

6.6. Wheel Barrow

A wheel barrow is a small hand-driven vehicle with two wheels designed to be pushed and guided by a single person using two handles given at the rear. The main usage of wheel barrow at MRF is to move baled materials or any other materials between the designated places. The detailed specifications of wheel barrow are given in Table 10.

Table 10: Technical Specification for Double Wheel Barrow

Parameter	Specifications
Capacity of Wheel barrow	140 litre
Load carrying capacity	450 kg
Sheet Material	Steel sheets confirming to IS:1079
Sheet thickness	1.8 mm
Wheel material	Mild Steel with Solid or Cushioned rubber tyre
Type of bearing / bush	Cast iron bearing
Steel tube	not be drilled, light tubes confirming to IS:1239
Grey Iron Castings	Conform to IS:210
Finish of Metal parts	Two coats of black bituminous paint
Diameter of the Wheel	500 mm
Nominal width of tyre	50 mm
Hand Grips	Yes
Leg support	Yes
GeM portal ID	5116877-24324484266

Figure 7: Representative picture of Wheel Barrow

6.7. HDPE wheeled Container Bin

These container bins are required to temporarily store the sorted materials at MRF. Dedicated bins will be placed for sorted of materials. The detailed specifications for HDPE wheeled storage bin are given in Table 11.

Table 11: Technical Specification for HDPE Wheeled Container Bin

Parameter	Specifications
Capacity	1100 litre
Size of Container (A x B x C)	1354 x 1373 x 1073 mm ('A' Height x 'B' Width x 'C' Depth)
Upper edge comb (D)	1206 mm

Parameter	Specifications
Wheel base width (E)	750 mm
Wheel base depth (F)	880 mm
Wheel base Diameter (G)	200 mm
Material	High Density Polyethylene (HDPE)
Type	Material Injection molded
High resistance to	Heat, chemicals and radiation
Dead weight	50 kg
Pay load	440 kg
Confirming Standards	EN 840-1: 2020
Legs support	4 nos
Hand Grips	Yes

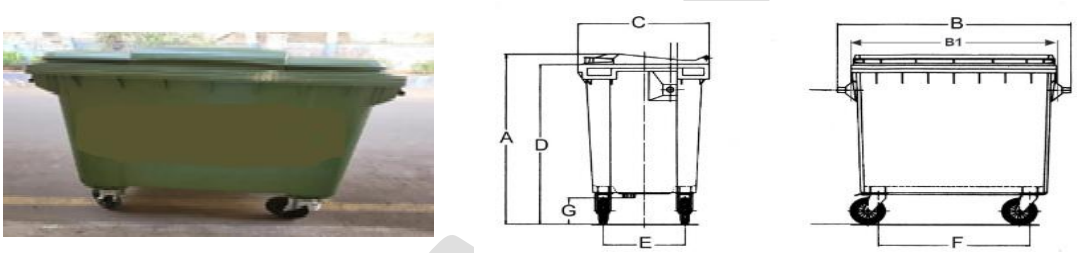


Figure 8: Representative of HDPE Wheeled Container Bin

6.8. Pallet Truck

Pallet truck are used for material handling and transportation of goods through narrow aisles and tight spaces with ease. They are manually operated which requires minimal effort to maneuver. They are more affordable and have lower maintenance cost. The detailed specification for a pallet truck is given in Table 12.

Table 12: Technical Specification for Pallet Truck

Parameter	Specifications
Pallet type	Manual
Fork Material	Mild Steel
Specific fork arm length	1150 mm
Specific Fork arm width	550 mm
Width of each fork arm	160 mm
Load capacity	2000 kg
Brakes Mechanism	Manual
Lifting height	200 mm
Turning radius	1450 mm
Total weight	69 kg
Lowered fork height	85 mm
Overall pallet truck width	825 mm
Overall pallet truck length	2000 mm
Total height	1200 mm
Lift pump assembly	Integrated serviceable hydraulic pump
Fork wheel type	Nylon wheel
Steering wheel type	Nylon wheel

Parameter	Specifications
Number of loading wheels in each fork arm	2
Handle type	Manual with 3 position control lever to raise, lower and neutral
GeM portal ID	5116877-18309960979

Figure 9: Representative picture of Pallet Truck

7. Power Consumption

Monthly power consumption cost, by considering Rs 10 per unit (including fixed cost, cess, etc), is estimated as Rs 50,700.00 (6.10 Lakh annual). The details of appliances with their power rating are given in Table 13.

Table 13: Estimated Power Consumption

Sl. No.	Appliance details	Power Rating (W)	Duration of Operation (Hr)	Quantity (Nos.)	Per day Power consumption with usage factor (W)
1	Weighing Bridge	500	5	1	2500
2	Conveyor Belt motors	8250	5	1	41250
3	Ballistic Separator	13000	5	1	65000
4	Magnetic Separator	2200	5	1	11000
5	Baler Machine	5250	4	1	21000
6	Desktop PC	200	8	2	3200
7	LED Street Light	250	12	2	6000
8	LED Light	100	4	14	5600
9	LED Tub Lights	22	8	11	1936
10	Wall mounted Fan	180	8	4	5760

Sl. No.	Appliance details	Power Rating (W)	Duration of Operation (Hr)	Quantity (Nos.)	Per day Power consumption with usage factor (W)
11	Ceiling Fan	75	5	5	1875
12	Exhaust Fan	60	8	2	960
		Expected power consumption in W/day			166081
		Expected power consumption in kWh (units)			166.08
		Expected power consumption per month (units)			5065.47
	Expected annual power consumption in kWh(units)				60785.65

8. Earth Leakage Circuit Breaker (ELCB)

Earth Leakage Circuit Breakers detect and interrupt ground faults. They would protect people, equipment and property from dangerous line-to-ground and shock hazard currents. Applications include ground fault protection of equipment (GFPE), especially when high distributed capacitance or other leakages cause excessive nuisance trips at lower fault currents. The detailed specification of ELCB is given in Table 14.

Table 14: Specification of Earth Leakage Circuit Breaker

Particulars	Motor	
	3 HP	5 HP
Compliance to ISO certification	ISO 9001	ISO 9001
Conformity to Standard	IEC 61008 – 1	NA
Certification	CE	NA
Electricity	3 phase	
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	IP20	IP20
Current Rating, Ampere	25	63
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 imp (kV)	4 KV	4 KV

3 HP

5 HP

Figure 10: Pictorial view of ELCB

9. Personal Protective Equipment (PPE)

The PPE are mandatory requirement for the safety and hygiene purpose for workers at the MRF. Table 15 provides the detailed specifications, GeM portal IDs along with applicable codes of practice.

Table 15: Specifications for PPE

Name of PPE	Specification	Photos
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	
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	
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)	
Safety (High visibility/ warning) Jacket	100% mesh polyester, high gloss reflective tape, confirming to IS: 15809 -2017	
Bouffant Caps	Lightweight, water repellent and confirming to IS: 2925-1984, CE-EN-397, ANSI Z891-2003	
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	

Name of PPE	Specification	Photos
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	
Apron	Width of 80cm (+/-10cm), thickness of 150-300 microns confirming to as per standards: IS: 4501- 1981	

Note: Apron having reflective stripe both (apron &safety jacket) may be preferred instead of having separately

10. Standard Operating Procedures (SOP)

Collected dry waste from the sources will be receiving through the auto tipper/other vehicles, which will then be weighed on a weigh bridge. Vehicles will be unloaded at the tipping area. The dumpster bags, gathari etc will be unbundled and oversized materials will be taken out physically for further handling and disposal. The remaining waste will be scooped and placed on infeed hooper, waste will be feed to ballestic separator through feeding conveyor belt. The ballistic separators have long paddles that undulate at alternate intervals to separate 2-dimensional material from 3-dimensional material. 2D material walks up the paddles and falls over the screen. 3D items bounce back and off the screen onto a conveyor. Then the separated items will be further sorted manually at the tail end conveyor lines. After sorting, rejects/inert will be sent for landfilling and other Domestic Hazardous Waste (DHW), such as empty paint cans, empty vials of injections, discarded/expired medicines, etc. are segregated. DHW would be handedover to respective common facilities for hazardous wastes and bio-medical wastes, as relevant. Checklist and formats are attached at **Annexure 2**.

10.1 Morning Protocol

While starting operations in the morning, MRF 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 (2).**

- *Swachhata Mitra* should wear uniform and put on the required PPE.
- Premises of the facility shall be cleaned.
- Waste receiving and transfer points shall be kept clear.
- Switch on the fans for proper ventilation half an hour before the operation

10.2 Receiving of Waste

Each consignment of segregated dry waste would be weighed. Segregated dry waste shall be brought to “Tipping area”. Sample format for the receipt of material/waste is provided at **Annexure 2 (3).**

10.3 Sorting of Waste

Waste sorting commence from receving area by removing Domestic Hazardous Waste (DHW) followed by the balastic seperator. The valuable recyclable materials such as, paper, empty cans, metal scrap, plastics (polyethylene terephthalate and polypropylene) and glass will be sorted.

- Dry solid waste shall be fed into ballistic separator to separate out between 2-dimensional and 3-dimensional materials.
- Six workers (preferably trained rag pickers) should be employed for sorting the materials at conveyor belts. Chute shaft / One 1100 litre HDPE bin should be placed between two workers.
- Sorting workers should sort materials as per the category of waste and should deposit in respective bins.
- All material except glass, glass bottles and E-waste shall be separately baled in the baling machine.

10.4 Storage

- It should be ensured that sorted items are stored in designated compartments.
- Fragile material shall be heaped in low height heap.
- Individual recyclable materials shall be evacuated on reaching its 90% storage capacity.
- Compartments should be cleaned thoroughly once in a month, at a set date of calendar month.
- Rodent control measures shall be adopted at least once in a month. Intense control measures shall be adopted if rat infestation noticed (visibility of rats and rat litter)

Sorted & stored plastic bottles

Bales of plastic bottles

Sorted & stored cardboard papers

Bales cardboard papers

Sorted & stored Aluminum cans

Bales Aluminum cans

Figure 11: Examples of good practices for the storage of sorted waste

10.5 Dispatch and Sales

Materials must be dispatched at regular frequency to the authorized and contracted recycles. Dispatch procedures shall be initiated for a particular material when it occupies 90% of its allotted space. During dispatch, outgoing materials shall be weighed and recorded by the authorized person at plant. Sale proceeds received in cash/on-line shall be registered. Formats for material dispatch and sale is provided at **Annexure 2 (4) & Annexure 2 (5).**

10.6 Documentation and Reporting

- Receipt & dispatch details including photographs shall be documented for monthly reporting by the MRF In-charge at **Annexure 2(6).**
- Monthly wages shall be processed based on attendance register.
- A suggestion and feedback register shall be maintained at the facility.

10.7 Evening Protocol

- All workers should 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 and if required they can take a bath.

- Ensure all the machinery/ equipments (fan/lights) are switched off before leaving the plant.
- Ensure all water taps are properly closed.

11. Maintenance

A maintenance schedule is required for the smooth, uninterrupted operations of the MRF. Preventive and breakdown maintenance are the two major parts. For breakdown maintenance follow LOTO checklist **Annexure 2(8)**. Preventive maintenance is required at MRF may be on daily, weekly, and monthly basis. Maintenance schedule may be drawn in consultation with the equipment supplier(s) and should be adhered to. Some of the major points are given below.

- A preventive maintenance checklist /record book / card shall be maintained.
- All bearing, roller and rotating machine parts shall be cleaned and greased every week (Say Friday).
- The functioning of all utilities like drinking water, toilet facilities, electrical fittings, rainwater harvesting system (if any), and solar panel & inverter (if any) shall be checked for complaints & problems by the incharge every week (Say Thursday).
- All firefighting equipment and accessories are regularly checked and ensured in place (every Wednesday).

On Site maintenance should be recorded in format given at **Annexure 2 (8)**.

12. Annual Maintenance Contract (AMC)

Various machines such as ballistic separator, conveyor belts, weigh bridge, hydraulic baling machine, desktop computer, fans, etc should be installed at MRF. Each machine has a warranty associated with fresh procurement. On expiry of warranty period, maintenance contract would be necessary.

An Annual Maintenance Contract (AMC) to cover basic service on products or a Comprehensive Services Contract (CMC) covering additional spare parts, labour, travel cost of technician, etc may be entered into. It may be appropriate that AMC/CMC is done with the contractor, who has supplied and commissioned MRF, for a period of three years after the initial warranty period.

13. Display of Information Under The Factories Act, 1948

- Working hours shall be displayed outside the facility.
- The facility shall also display “OPEN” and “CLOSED” signboards during and after working hours respectively.
- Bilingual signboard mentioning “Child labour Prohibited” shall be permanently displayed at main gate of facility.
- Campaign posters on the following topics like segregation, recyclability, and hazards of burning mixed waste/incineration shall be displayed.
- The contact number of the MRF-in-charge, helpline numbers, nearest physician, hospital, area fire station and police station shall be prominently displayed.

14. Safety and Hygiene Practices

On commissioning of MRF and during handing over to ULB or, operated on behalf of ULB, following table shall be referred and safety practices should be adopted as per checklists for electric safety, mechanical safety and fire prevention & protection. Check list for machine safety and format for electrical safety is attached at **Annexure 2 (9 & 10).**

Table 16: Hazardous Activities and 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	Medical help be sought immediately in case of injury
2	Contact with dirt and domestic hazardous waste	Along with wearing gloves, sanitizers always be carried and used	---
3	Contact with used sanitary napkin, and soiled diapers	Gloves should be worn and direct contact with any such waste be avoided. Handle with tools and store & forward to BMW facilities.	---
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 for severe cases to be sought immediately

14.1. Hygiene Practices

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

- Always keep the MRF dry & clean.
- Keep sorting & storage area dry and free from pests & flies.
- Regularly spray disinfection agent as a prevention practice.
- All working personnel at the MRF must wear uniform and PPEs while at MRF plant.
- Hands should be washed with soap before leaving/eating at the MRF.
- 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.

15. Safety Trainings

15.1. Refresher Training

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

15.2. Toolbox Talk

At least one toolbox talk should be organized once a month. 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 local language. A safety pledge will be developed and it should be a part of toolbox talks.

16. Fire Prevention and Protection

The following are some of the fire prevention measures that shall be adopted.

- Store flammable liquids in approved containers, cabinets, and designated areas and follow the standard procedures.
- Never pour flammable liquids into sewer or drains.
- Ensure fire extinguishers are placed at strategic locations and should be always in working condition.

17. Emergency Response Plan

An emergency response plan is for the effective management of accidents to minimize 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 MRF 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:

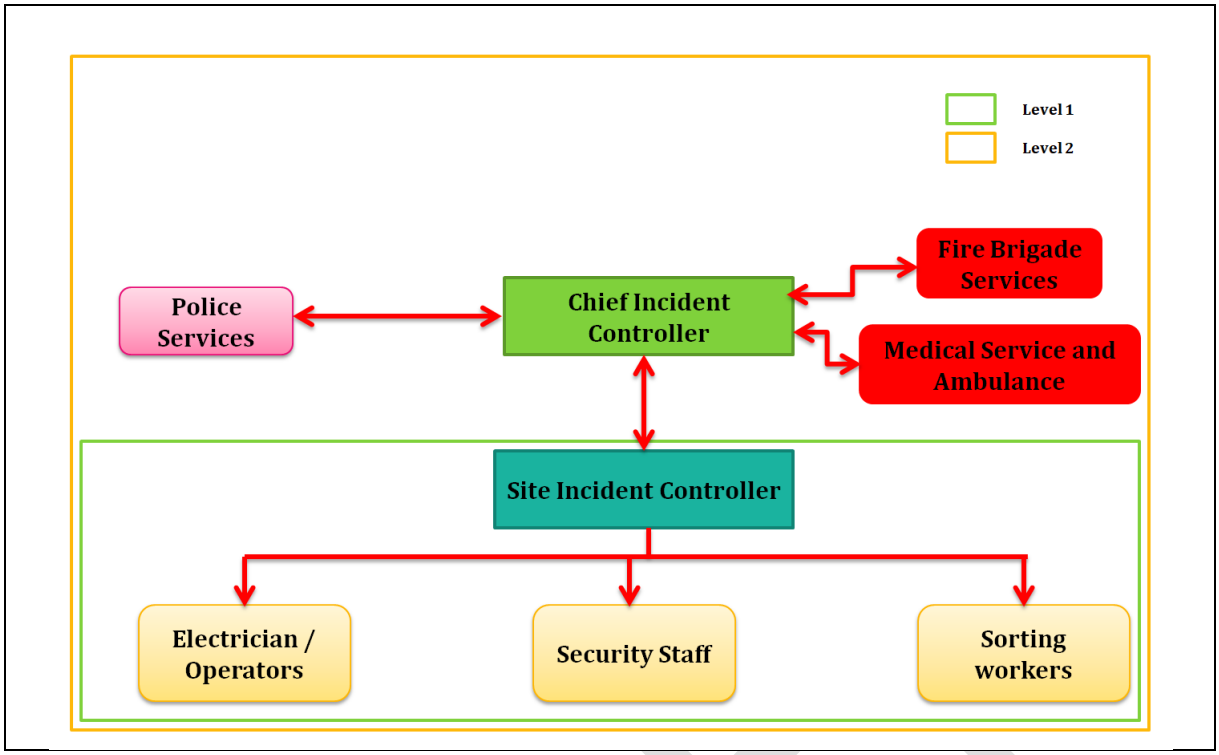


Figure 12: Emergency Response Plan

17.1. Roles and Responsibilities of Emergency Response Team

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

Table 17: Roles and Responsibility of Emergency Response Team

Sl. No.	Position Held	Staff Deployed	Responsibility
1.	Chief Incident Controller	Health Supervisor/Sanitation Officer of ULB	♻ Act as the coordinating point for transfer of information between District administration and SIC ♻ Extend all the supports to SIC through external assistance regarding technical resources/equipment/medical supports as deemed necessary
2.	Site Incident Controller	In Charge - Supervisor	♻ Ensure essential HSE equipment are availed with ERT ♻ Lead response team and start response activities without any delay ♻ Take quick decisions on priority of operation – life saving requirements/ response requirements ♻ Updating CIC about the incident and supporting him for taking decisions

Sl. No.	Position Held	Staff Deployed	Responsibility
3.	Electrician/Operators	Electrician cum baling operator	♻ Responsible for monitoring and assessing hazardous, unsafe act and conditions ♻ Ensure power supply in the plant ♻ Take orders from SIC regarding the evacuation of wheeled skid loader ♻ Switch off the machines as per directions from SIC
4.	Security staff	Security staff	♻ Controls and directs traffic in the plant ♻ Shall supervise evacuation of personnel from the scene
5.	Sorting labours	Sorting labours	♻ Will take orders from the site incident controllers ♻ Will respond to the incident with available resources

The emergency contact numbers are given in Table 18.

Table 18: Emergency Contact Numbers

Sl No	Particulars	Contact Number
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 De-poisoning Centre	-

18. First Aid Box

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

Figure 13: First Aid Box

19. Other Guidelines

- The entrance and exit of MRF plant should always be kept clear.
- A minimum safe distance/clearance between two machines as advised by the manufacturer and in case of doing maintenance or, futuristic replacement.
- Facility should be certified by a structural engineer/local ULB engineer and the fire department as per rules.
- Emergency numbers can be displayed at prominent locations.
- Regular checking of PPEs and maintain PPE replacement records.
- Fitness certification of machines/equipment, frequency of certification need to be recorded in a file.
- Regular inspection, medical fitness record of personals and workmen, tied up with the nearby hospitals.
- 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.
- Different type of mock-drills to check the effectiveness of the system.

20. Important points in Civil Works

Sequence of civil works for MRF construction

- Clearing out the site (Drawings as per design should be ready)
- Setting out the MRF building
- Excavations for isolated footing and flooring
- Construction of isolated footing and column upto the plinth beam level- All works
- Construction of plinth beam and superstructure including columns, brick walls etc. to the full height of the building
- Laying of flooring (Industrial type) 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.

21. Statutory Requirement

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 plant. A generic requirement of clearances is described in Table 19.

Table 19: Statutory Clearances

Sl. No.	Clearance Requirement	Regulatory Authority	Remarks
1	Consent to Establish (CTE)	State Pollution Control Board/PCC for UTs	To be obtained by the ULB/Contractor under Water Act 1974 and Air Act 1981 through online application at the respective SPCB/PCC with necessary supporting documents like layout plan, key plan, project report and consent fee at least 30 days prior to the commencement of works at site
2	Consent to Operate (CTO)	State Pollution Control Board/PCC for UT	To be obtained by the ULB/Contractor/Occupier under Water Act 1974 & 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 at least 30 days prior to the commencement of operation of plant
3	Building permit/building number	Concerned Urban Local Body	Buildings permit/building number to be issued to the MRF.
4	LT power connections	Electricity Supply Company	The ULB/operator/occupier need to submit an application with necessary fees at the concerned electricity 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 facility should be submitted prior to the commencement of operation of the plant.

Sl. No.	Clearance Requirement	Regulatory Authority	Remarks
5	Water Connection	Water Supply and Sewerage Department/ULBs	The applicant should submit an application of water connection with necessary fees and supporting documents to the concerned water supply and sewage department prior to the commencement of operation of the unit.
6	Sewer Connection	Water Supply and Sewerage Department	The applicant should submit a new application for connecting the sewage outlet with the sewerage network system with necessary fees 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	Fire Department	The respective ULB shall obtain NoC/Clearance from respective fire department prior to the operation of the plant after the issue of building number.

22. Suggestions for Siting of MRF

Accessibility and land use may be important for MRF siting. MRF facility shall be located close to the source of the MSW generation for minimization of travel distances and cost optimization. Decentralized MRF can be adopted as per site suitability. Some of the suggestions for siting of MRF are given below:

- Located close to existing roads after considering the resultant additional traffic from the movement of waste collection trucks and the trucks used for transporting recovered materials.
- SWM Rules, 2016 insist for a step garden approach for optimizing the utilization of hilly space.
- Safe from land slide.
- Slope stability and sequence of rock structures to be checked for the plot
- Flood-prone areas should be avoided. If there is no alternative site, its plinth level may be 1.0 metre above the high flood level (HFL) mark.
- Apart from above, every State Pollution Control Board/ Pollution Control Committee has their own siting guidelines which shall be adhered to siting MRF.

23. Lightning Protection System

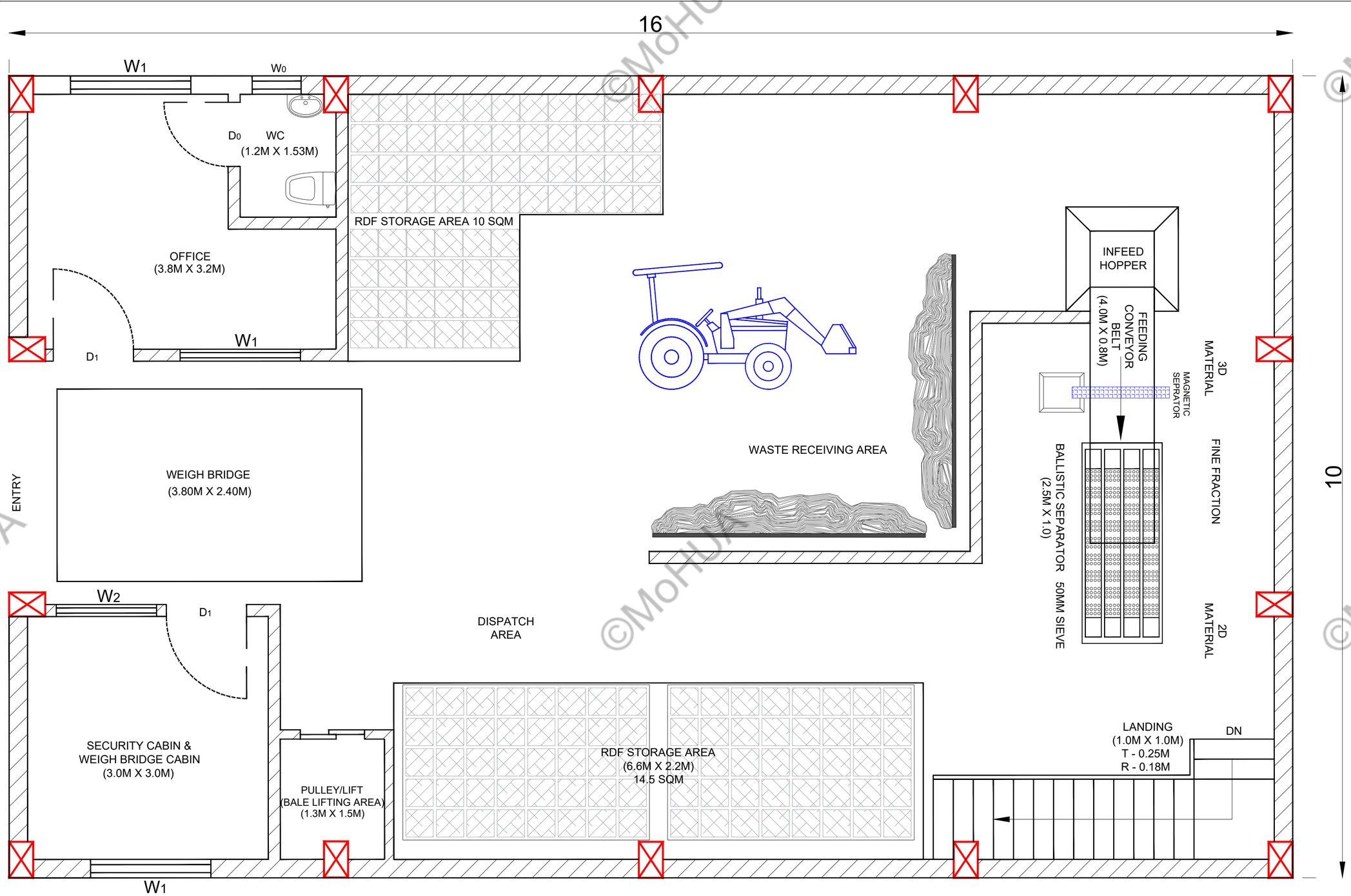
A lightning arrestor confirming to IS -2309:1989 may be provided to protect the shed and machinery/equipment.

References

- 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 2 & 3, 2016 by Central Public Health and Environmental Engineering Organization(CPHEEO)
- The Solid Waste Management Rules, 2016
- The Plastic Waste Management Rules, 2016
- Guidelines for Disposal of Plastic Waste, Central Pollution Control Board, 2017
- National Building Code of India 2016 Volume 1 & 2
- Delhi Schedule of Rates Volume 1 & 2, 2021
- EPA Handbook of MRF for Municipal Solid waste Management, Sept., 1991.

ANNEXURE

ANNEXURE 1
ENGINEERING DRAWING



MAIN LAYOUT
GROUND FLOOR PLAN

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.	EQUIPMENTS	QUANTITY(NO.)	DIMENSIONS(M)
01	WEIGH BRIDGE	1	2.4 X 3.8
02	BALLISTIC SEPARATOR	1	1.0 X 2.5
03	CONVEYOR BELTS	1	4M
04	BALER	1	2.9 X 0.9
05	MAGNETIC SEPRATOR	1	

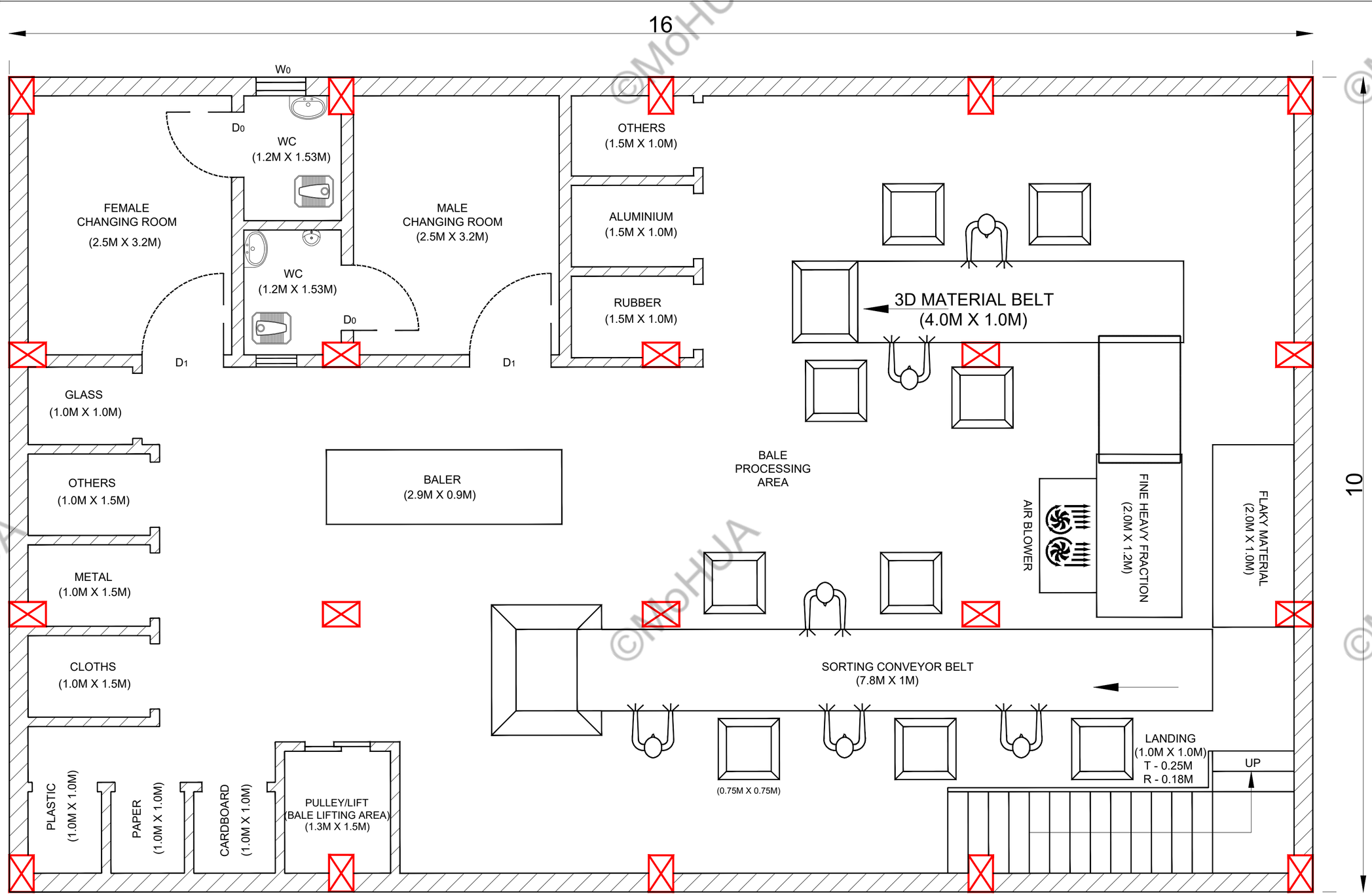
Client: Ministry of Housing and Urban Affairs, Government of India
MINISTRY OF HOUSING AND URBAN AFFAIRS

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

Project:
MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:
TYPICAL LAYOUT FOR 5 TPD HILLY REGION MRF PLANT (GROUND FLOOR PLAN)

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	DATE : AUGUST 2024



MAIN LAYOUT
BASEMENT FLOOR PLAN

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.	EQUIPMENTS	QUANTITY(NO.)	DIMENSIONS(M)
01	BALER	1	2.9 X 0.9
02	CONVEYOR BELTS	2	7.8 + 4.0 = 11.8M
03			
04			
05			

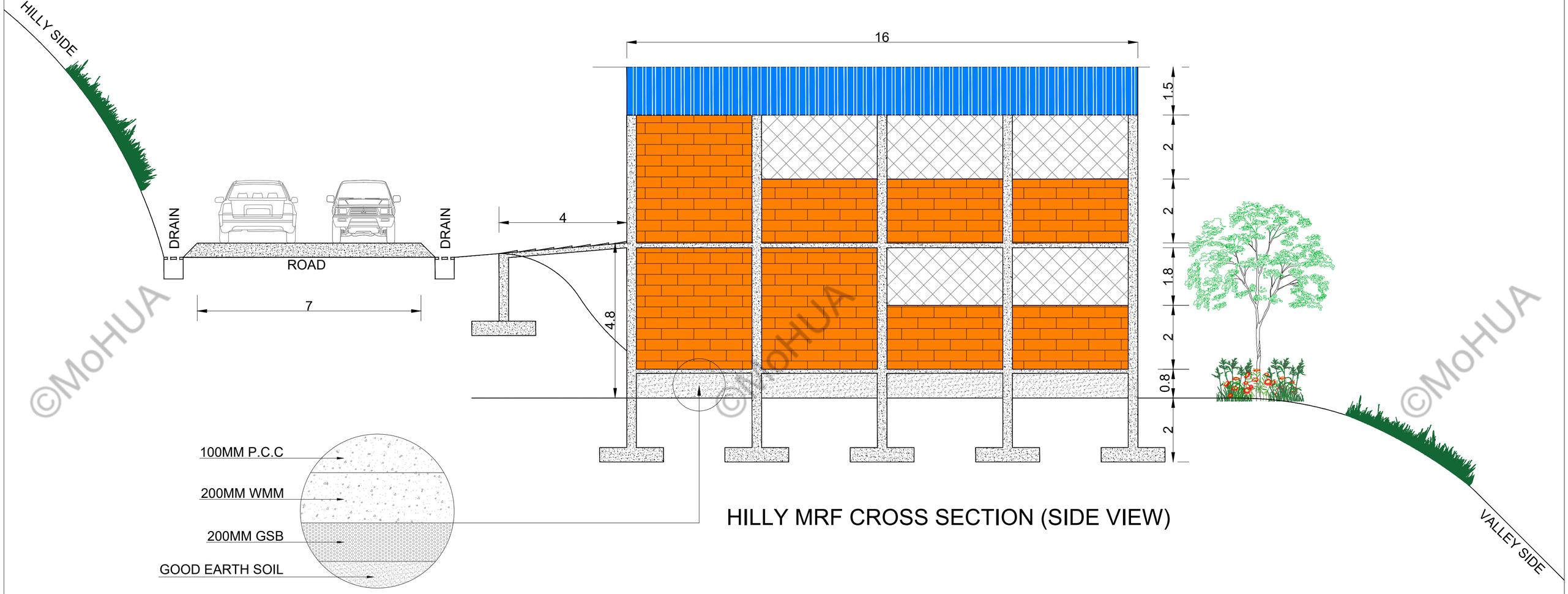
Client: Ministry of Housing and Urban Affairs, Government of India
MINISTRY OF HOUSING AND URBAN AFFAIRS

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

Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE: TYPICAL LAYOUT FOR 5 TPD HILLY REGION MRF PLANT (BASEMENT FLOOR PLAN)

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	DATE : AUGUST 2024



HILLY MRF CROSS SECTION (SIDE VIEW)

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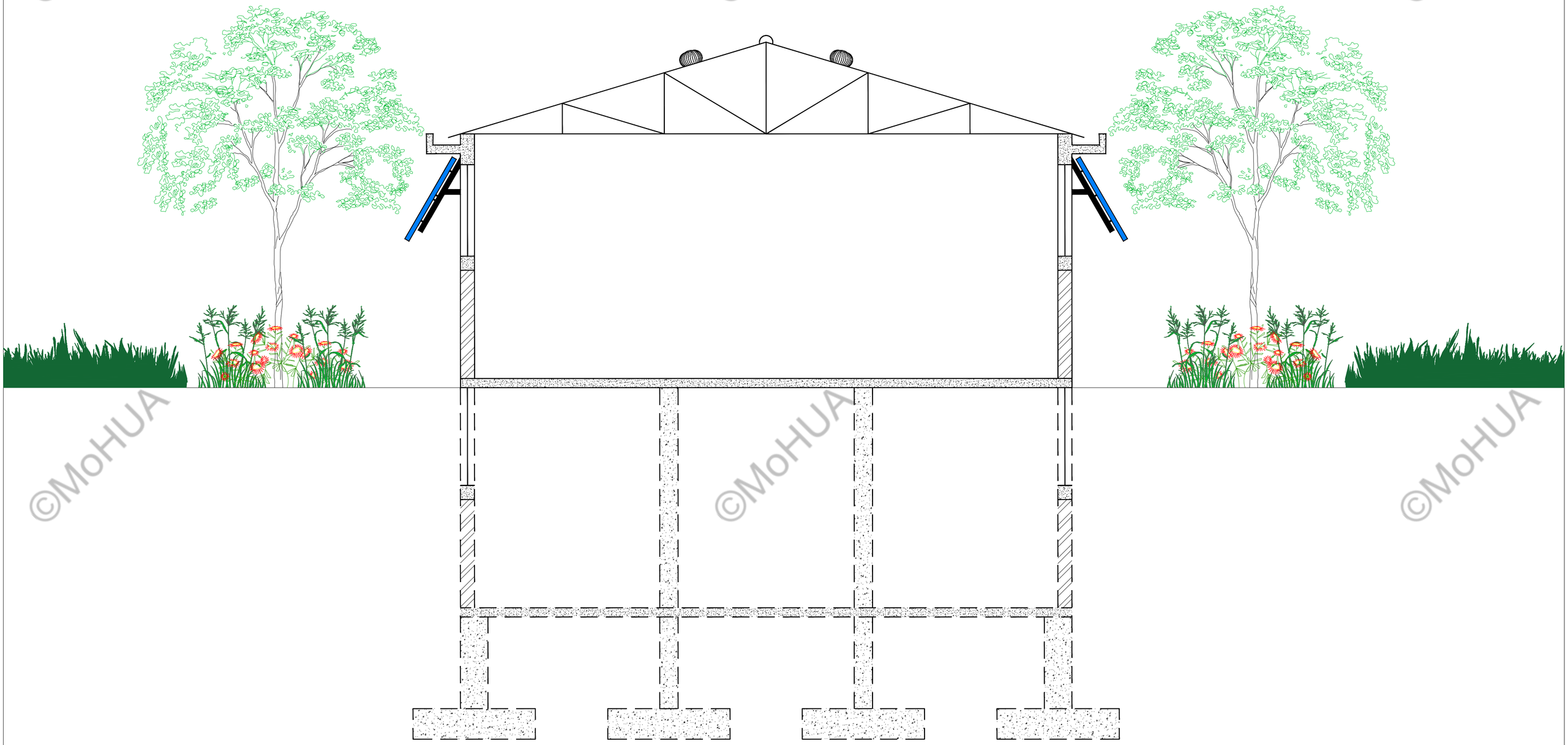
NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client: Ministry of Housing and Urban Affairs, Government of India — MINISTRY OF HOUSING AND URBAN AFFAIRS	Consultant: RITES — THE INFRASTRUCTURE PEOPLE — RITES Ltd. (A Government of India Enterprise)	Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
			DRAWN BY :	RAHUL ARYA
		TITLE: TYPICAL CROSS SECTION (SIDE VIEW) FOR 5 TPD HILLY REGION MRF PLANT	CHECKED BY :	SANJAY RAUT
			REVIEWED BY :	CPHEEO,MoHUA
			DATE :	AUGUST 2024



HILLY MRF CROSS SECTION (FRONT VIEW)

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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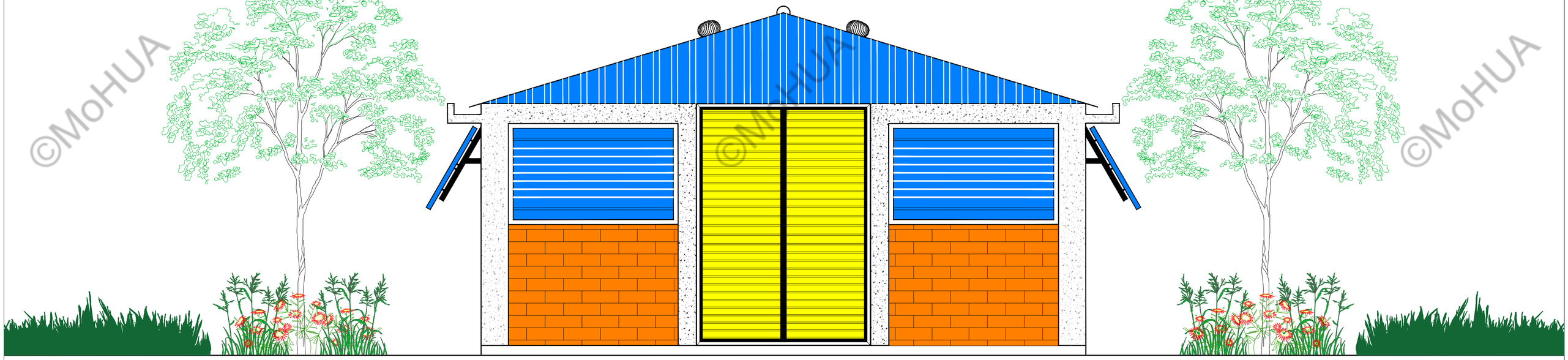
NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client: Ministry of Housing and Urban Affairs, Government of India — MINISTRY OF HOUSING AND URBAN AFFAIRS	Consultant: RITES Ltd. (A Government of India Enterprise)	Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
			DRAWN BY :	RAHUL ARYA	
		TITLE: TYPICAL CROSS SECTION (FRONT VIEW) FOR 5 TPD HILLY REGION MRF PLANT	CHECKED BY :	SANJAY RAUT	
			REVIEWED BY :	CPHEEO,MoHUA	DATE : AUGUST 2024



HILLY MRF FRONT ELEVATION

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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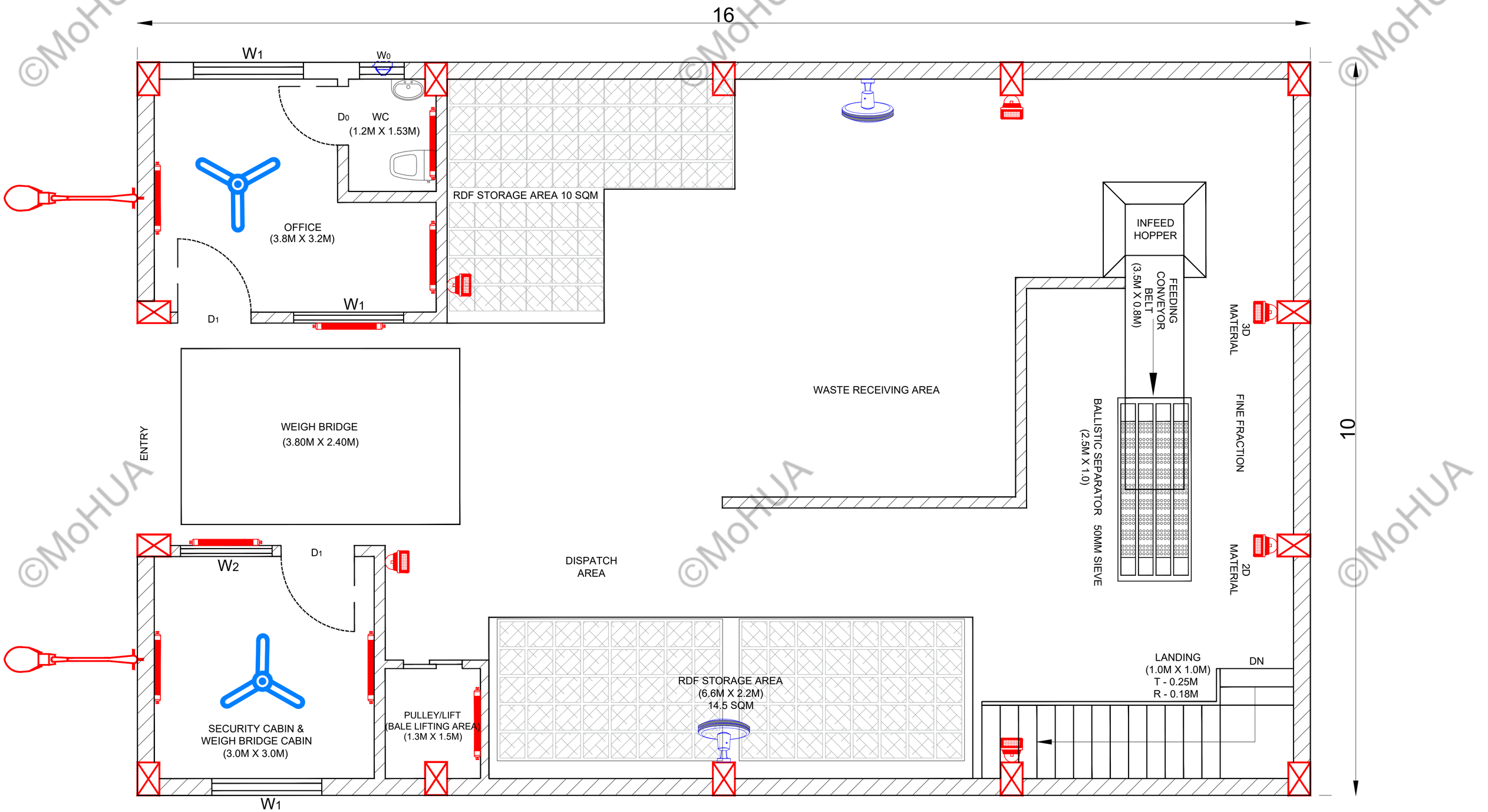
NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client: Ministry of Housing and Urban Affairs, Government of India — MINISTRY OF HOUSING AND URBAN AFFAIRS	Consultant: RITES Ltd. (A Government of India Enterprise)	Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
			DRAWN BY :	RAHUL ARYA	
		TITLE: TYPICAL FRONT ELEVATION FOR 5 TPD HILLY REGION MRF PLANT	CHECKED BY :	SANJAY RAUT	
			REVIEWED BY :	CPHEEO,MoHUA	Date : AUGUST 2024



ELECTRICAL LAYOUT
GROUND FLOOR PLAN

SR. NO.	ITEMS	QUANTITY(NO.)	SYMBOL
01	STREET LIGHT (250W)	02	
02	LED LIGHT (100W)	06	
03	LED TUBE (24W)	08	
04	WALL MOUNTED FAN (180W)	02	
05	CELLING FAN (75W)	02	
06	TOILET EXHAUST FAN (60W)	01	

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MINISTRY OF HOUSING AND URBAN AFFAIRS

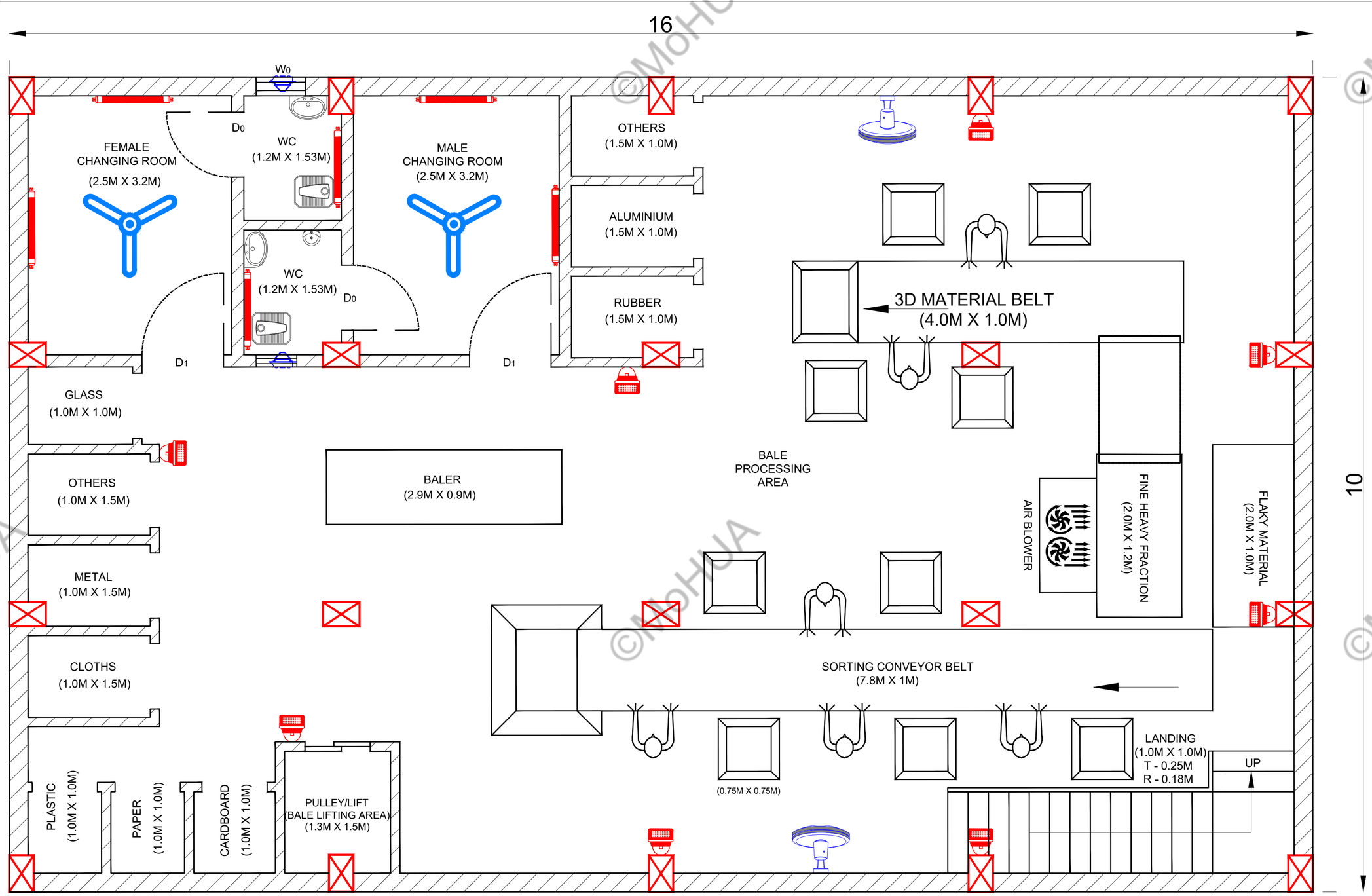
Consultant: RITES — THE INFRASTRUCTURE PEOPLE
RITES Ltd. (A Government of India Enterprise)

Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE: TYPICAL ELECTRICAL LAYOUT FOR 5 TPD HILLY REGION MRF PLANT (GROUND FLOOR PLAN)

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

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION



ELECTRICAL LAYOUT
BASEMENT FLOOR PLAN

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

SR. NO.	ITEMS	QUANTITY(NO.)	SYMBOL
01	STREET LIGHT (250W)	-----	
02	LED LIGHT (100W)	08	
03	LED TUBE (24W)	06	
04	WALL MOUNTED FAN (180W)	02	
05	CELLING FAN (75W)	02	
06	TOILET EXHAUST FAN (60W)	02	

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Project:
MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:
TYPICAL ELECTRICAL LAYOUT FOR 5 TPD HILLY REGION MRF PLANT (BASEMENT FLOOR PLAN)

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
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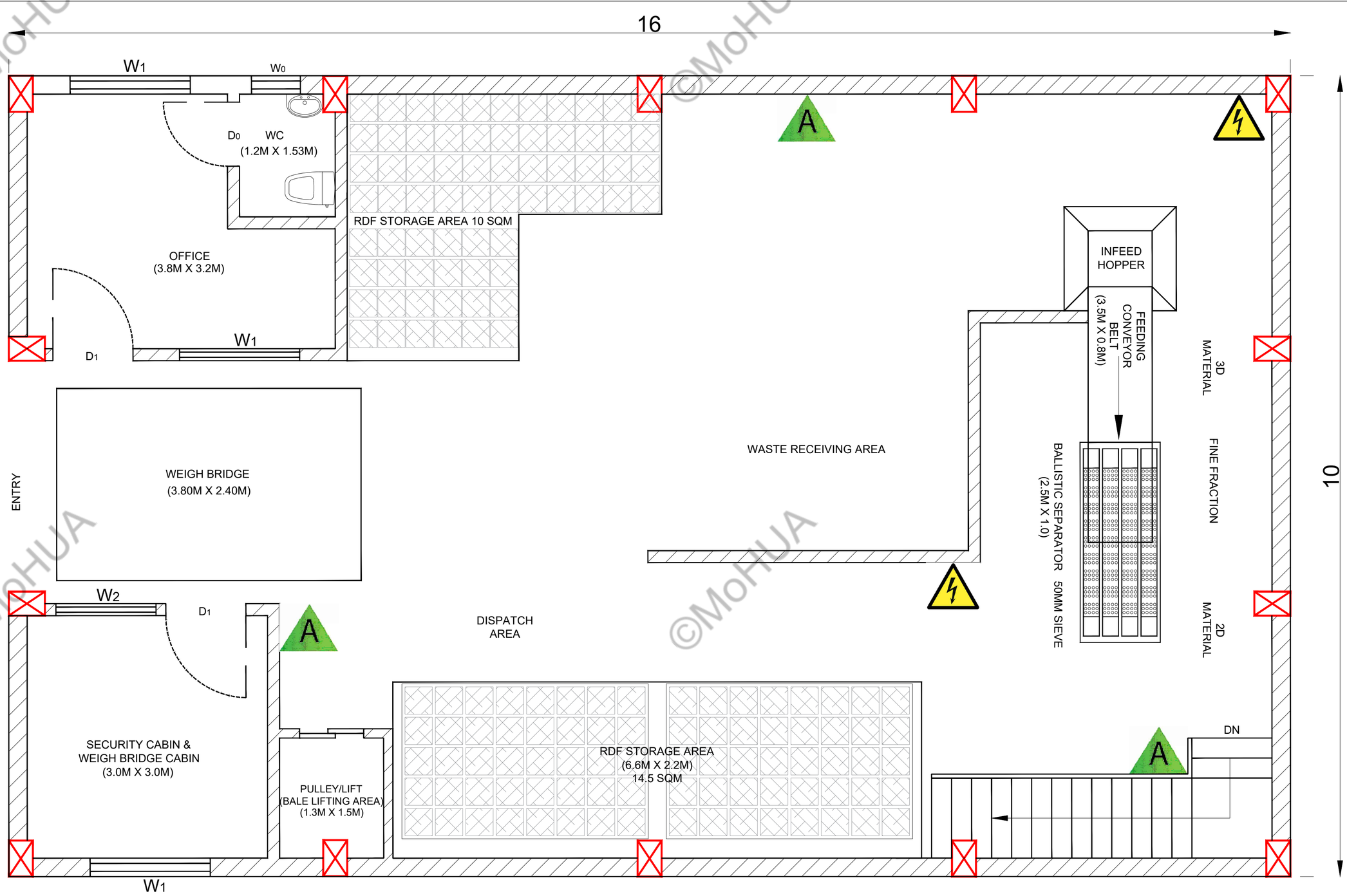

CO2, TYPES

ABC FIRE EXTINGUISHER

FIRE FIGHTING LAYOUT
GROUND FLOOR PLAN

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

SR. NO.	ITEMS	QUANTITY(NO.)	SYMBOL
01	ABC FIRE EXTINGUISHER	03	A
02	CO-2 TYPES	02	

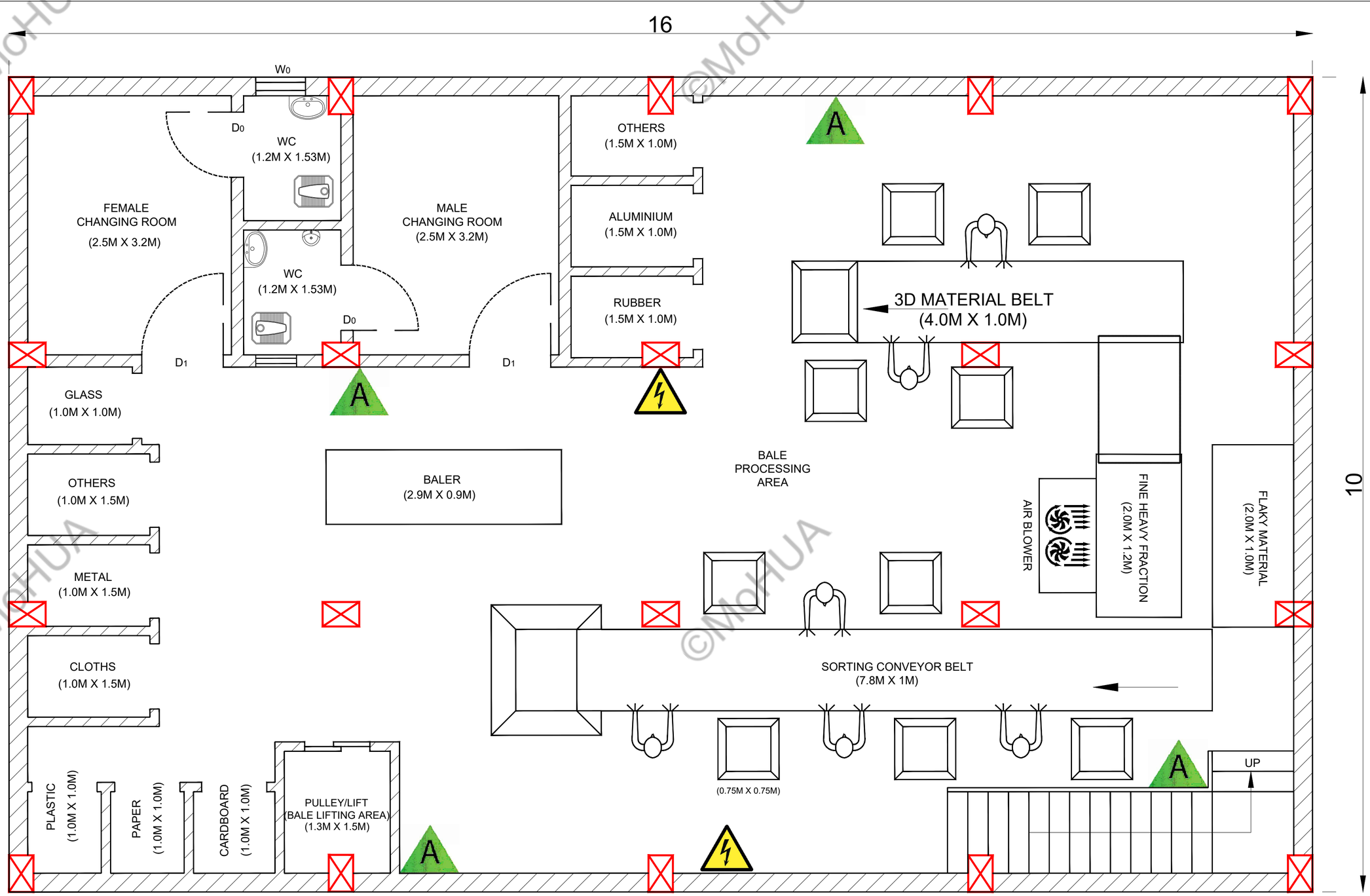
Client: Ministry of Housing and Urban Affairs, Government of India
MINISTRY OF HOUSING AND URBAN AFFAIRS

Consultant: RITES — THE INFRASTRUCTURE PEOPLE
RITES Ltd. (A Government of India Enterprise)

Project:
MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:
TYPICAL FIRE FIGHTING LAYOUT FOR 5 TPD HILLT REGION MRF PLANT (GROUND FLOOR PLAN)

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	DATE : AUGUST 2024



CO2, TYPES

ABC FIRE EXTINGUISHER

FIRE FIGHTING LAYOUT
BASEMENT FLOOR PLAN

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NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

SR. NO.	ITEMS	QUANTITY(NO.)	SYMBOL
01	ABC FIRE EXTINGUISHER	04	A
02	CO-2 TYPES	02	

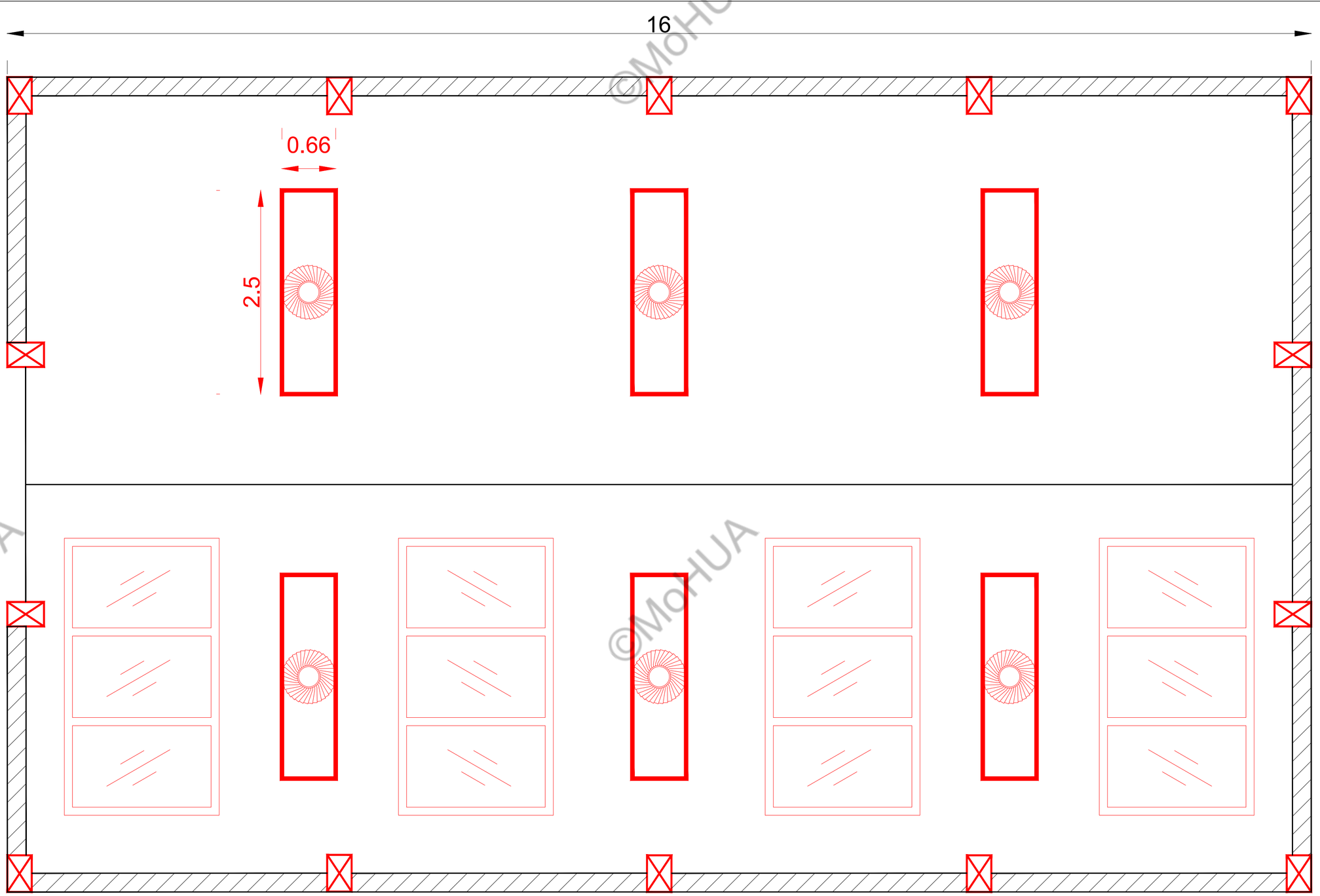
Client: Ministry of Housing and Urban Affairs, Government of India
MINISTRY OF HOUSING AND URBAN AFFAIRS

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

Project:
MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:
TYPICAL FIRE FIGHTING LAYOUT FOR 5 TPD HILLT REGION MRF PLANT (BASEMENT FLOOR PLAN)

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	DATE : AUGUST 2024



LAYOUT PLAN FOR
SKYLIGHT & EXHAUST FAN & SOLAR PANEL

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NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

SR. NO.	ITEMS	SYMBOLS
01	SOLAR PANEL (8 x 3 = 24 Nos.)	
02	SKYLIGHT SHEET WITH ROOF EXHAUST FAN (2.5 X 0.66M)	
03	BRICK WORK	

Client: Ministry of Housing and Urban Affairs, Government of India

MINISTRY OF HOUSING AND URBAN AFFAIRS

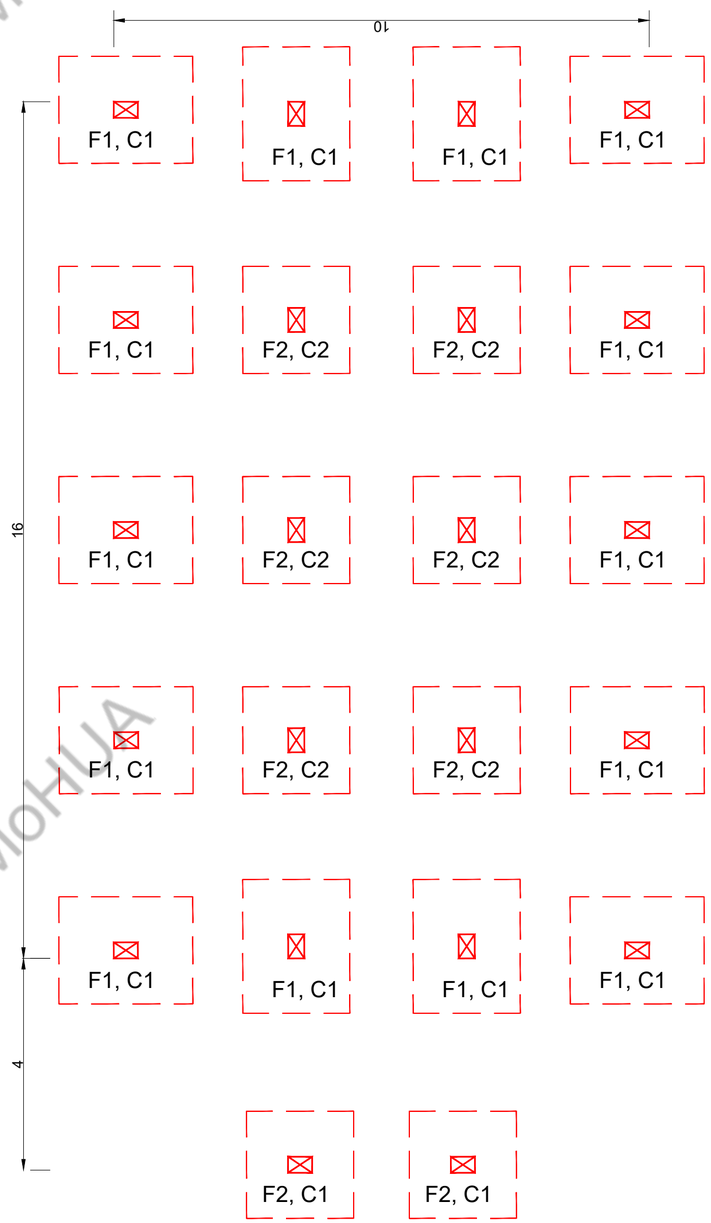
Consultant: RITES THE INFRASTRUCTURE PEOPLE

RITES Ltd. (A Government of India Enterprise)

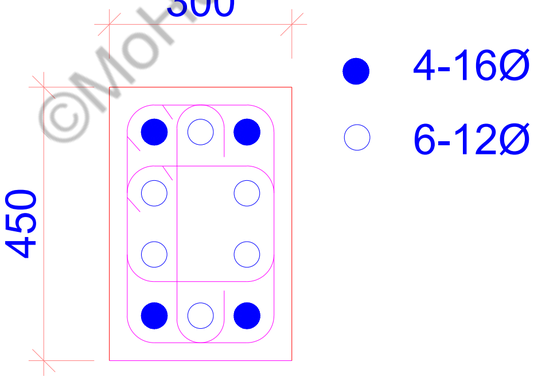
Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE: TYPICAL LAYOUT PLAN FOR SKYLIGHT & EXHAUST FAN & SOLAR PANEL FOR 5 TPD HILLY REGION MRF PLANT

DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	DATE : AUGUST 2024

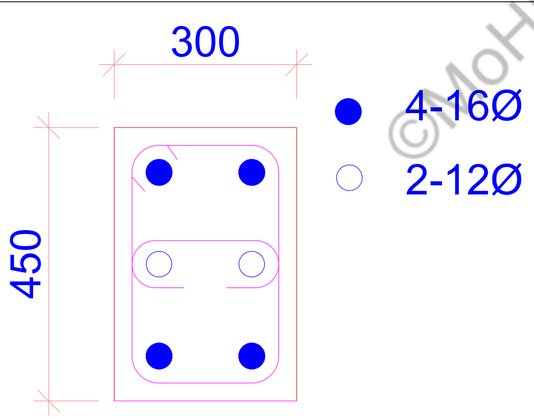


LAYOUT PLAN FOR
COLUMN & FOOTING PLAN



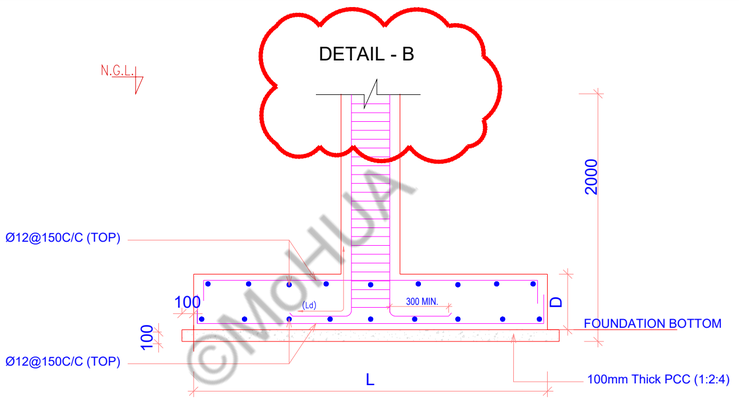
ALL STIRRUPS Ø8@150C/C
C1 COLUMN REINFORCEMENT
UP TO GROUND FLOOR SLAB

DETAIL - B

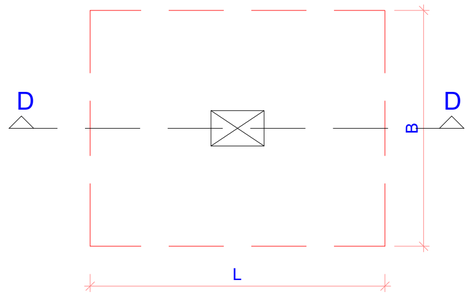


ALL STIRRUPS Ø8@150C/C
C1 COLUMN REINFORCEMENT
GROUND FLOOR SLAB TO GROUND FLOOR TIE BEAM

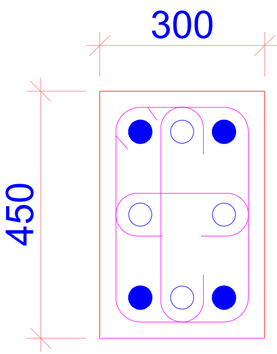
DETAIL - B



SECTION D-D



DETAIL - A



ALL STIRRUPS Ø8@150C/C
C2 COLUMN REINFORCEMENT
UP TO GROUND FLOOR SLAB

DETAIL - B

STRUCTURAL MEMBER	DIMENSIONS (m)		NO.
	L	B	
COLUMN -1 (C1)	0.45	0.3	16
COLUMN -2 (C2)	0.45	0.3	6

STRUCTURAL MEMBER	DIMENSIONS (m)			NO.
	L	B	D	
FOUNDATION -1 (F1)	2.5	2	0.6	14
FOUNDATION -2 (F2)	2	2	0.5	8

NOTES:-

1. All dimensions are in millimeters, unless otherwise specified.
2. Dimensions are not to be scaled, only written dimensions shall be followed.
3. SBC assumed for design of foundation is 15 ton/m2 at 2m below the natural ground level.
4. Building is assumed to be situated in Seismic Zone IV as per IS:1893-2016.
5. Grade of concrete as M30.
6. 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.
7. Wind load at top of the RCC frame and wind pressure applicable on the RCC frame is taken as per truss loading provided for basic wind speed 47m/sec as per IS:875 (Part-3) - 2015.
8. The walls are assumed to be made up of block work (200mm thick) having a density of 11kN/m3.
9. All RCC works to be done as per IS 456-2000.
10. All reinforcement work to conform to IS-456-2000 & IS-13920-2003.
11. All intersections of bars shall be securely bound with n0.18 gauge pliable wire.
12. 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.
13. The Design shall be reconsidered for snow fall areas.

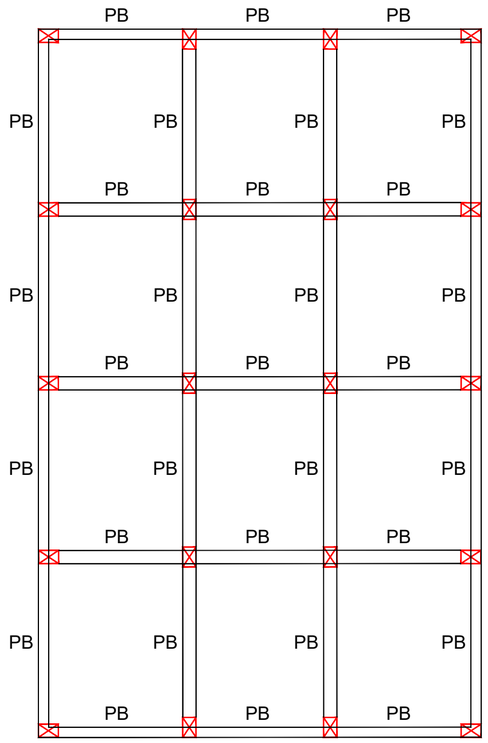
Client:
Ministry of Housing and Urban Affairs
Government of India
MINISTRY OF HOUSING AND URBAN AFFAIRS

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

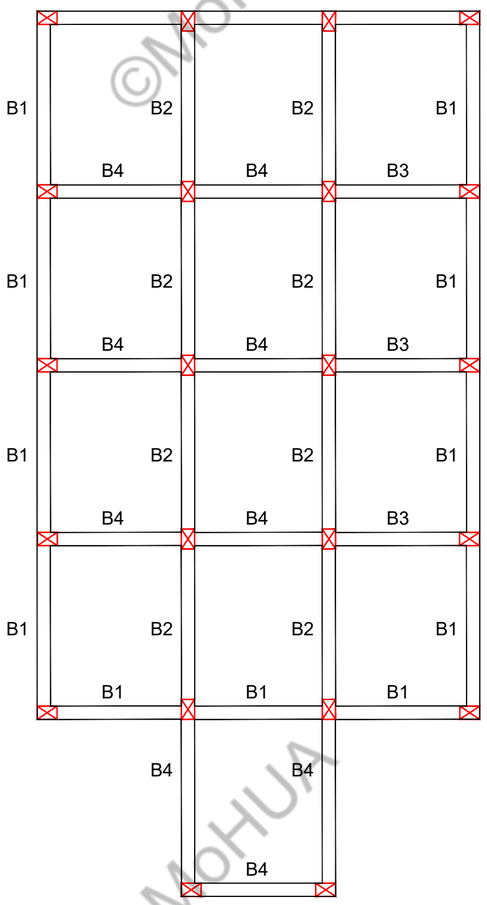
Project:
MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:
TYPICAL LAYOUT PLAN FOR COLUMN &FOOTING FOR 5 TPD HILLY REGION MRF PLANT

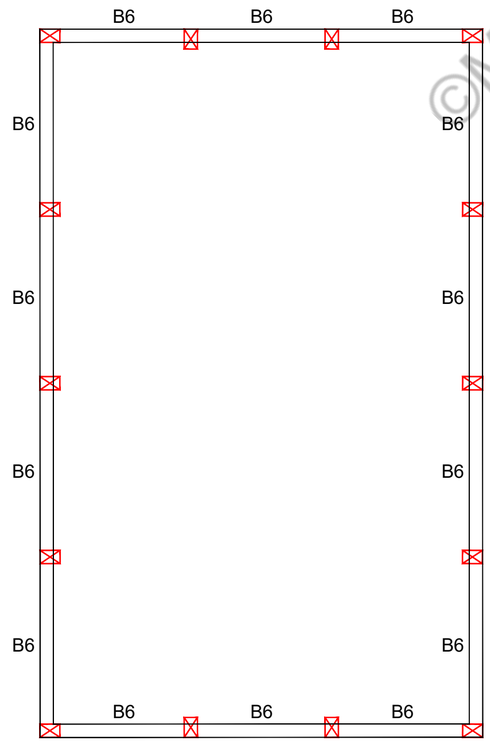
DESIGNED BY :	VIPIN VERMA	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	CHETAN A. PATIL	
APPROVED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	Date : AUGUST 2024



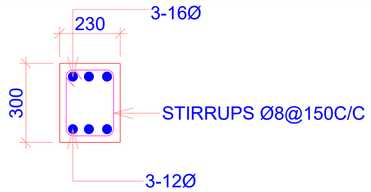
LAYOUT PLAN FOR
PLINTH BEAM



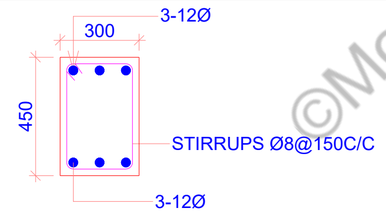
LAYOUT PLAN FOR
BEAM AT GROUND FLOOR LEVEL



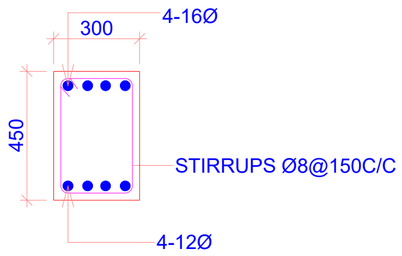
LAYOUT PLAN FOR
GROUND FLOOR TIE BEAM



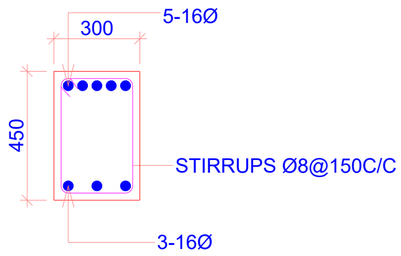
PLINTH BEAM REINFORCEMENT



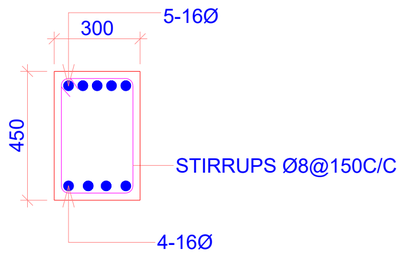
B6 BEAM REINFORCEMENT



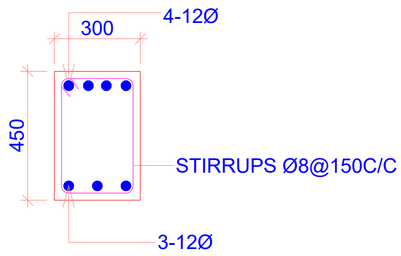
B1 BEAM REINFORCEMENT



B2 BEAM REINFORCEMENT



B3 BEAM REINFORCEMENT



B4 BEAM REINFORCEMENT

NOTES:-

1. All dimensions are in millimeters, unless otherwise specified.
2. Dimensions are not to be scaled, only written dimensions shall be followed.
3. SBC assumed for design of foundation is 15 ton/m2 at 2m below the natural ground level.
4. Building is assumed to be situated in Seismic Zone IV as per IS:1893-2016.
5. Grade of concrete as M30.
6. 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.
7. Wind load at top of the RCC frame and wind pressure applicable on the RCC frame is taken as per truss loading provided for basic wind speed 47m/sec as per IS:875 (Part-3) - 2015.
8. The walls are assumed to be made up of block work (200mm thick) having a density of 11kN/m3.
9. All RCC works to be done as per IS 456-2000.
10. All reinforcement work to conform to IS-456-2000 & IS-13920-2003.
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13. The Design shall be reconsidered for snow fall areas.

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MINISTRY OF HOUSING AND URBAN AFFAIRS

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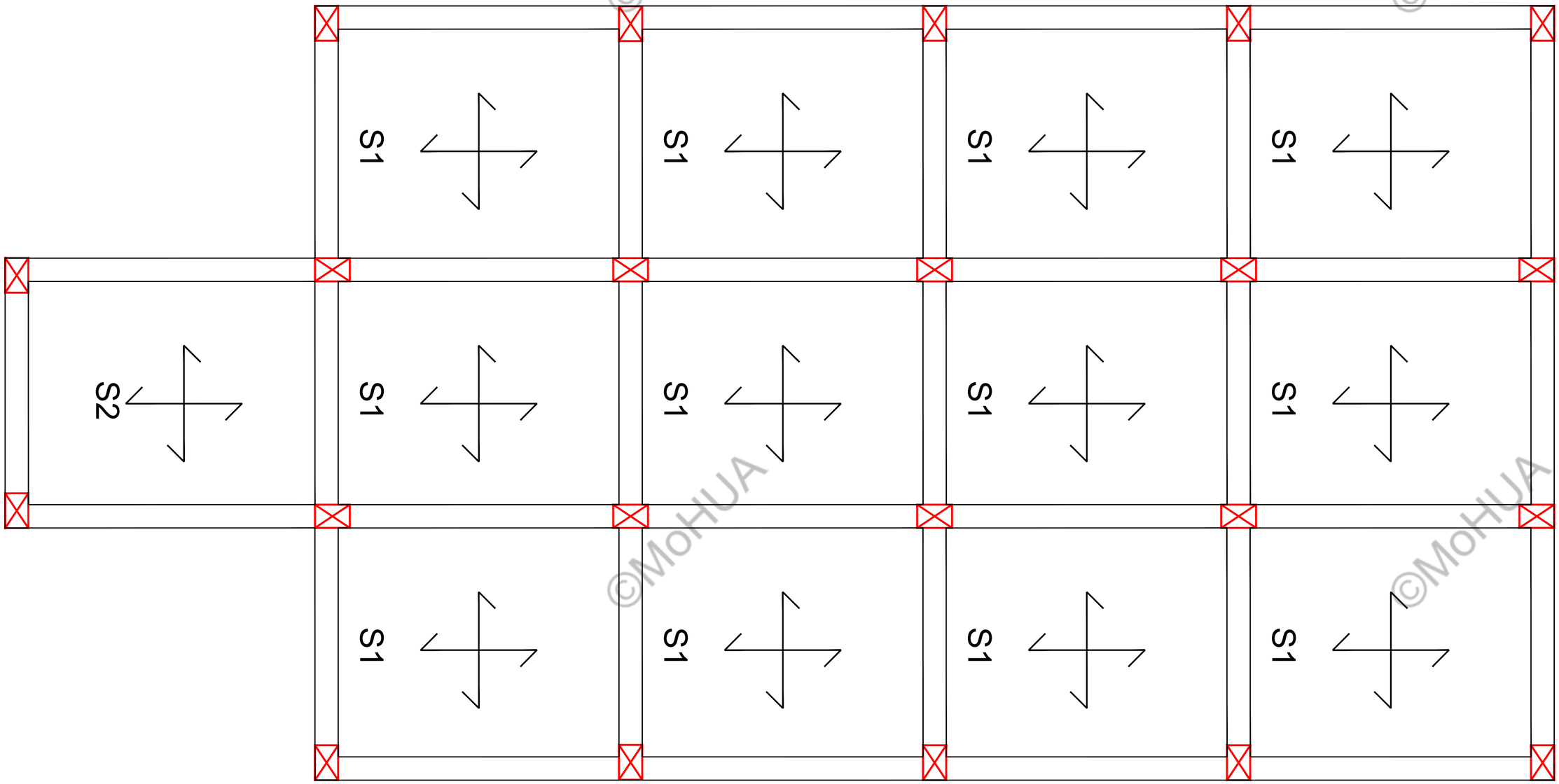
THE INFRASTRUCTURE PEOPLE
RITES Ltd. (A Government of India Enterprise)

Project:
MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE:
TYPICAL LAYOUT PLAN FOR BEAM FOR 5 TPD HILLY REGION MRF PLANT

DESIGNED BY :	VIPIN VERMA	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	CHETAN A. PATIL	
APPROVED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	Date : AUGUST 2024



LAYOUT PLAN FOR SLAB AT GROUND FLOOR LEVEL

STRUCTURAL MEMBER	DIMENSIONS (m)			REINFORCEMENT
	L	B	D	
SLAB (S1)	2.81	3.63	0.2	10Ø@150mm C/C
SLAB (S2)	2.81	2.7	0.2	10Ø@150mm C/C

NOTES:-

1. All dimensions are in millimeters, unless otherwise specified.
2. Dimensions are not to be scaled, only written dimensions shall be followed.
3. SBC assumed for design of foundation is 15 ton/m2 at 2m below the natural ground level.
4. Building is assumed to be situated in Seismic Zone IV as per IS:1893-2016.
5. Grade of concrete as M30.
6. 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.
7. Wind load at top of the RCC frame and wind pressure applicable on the RCC frame is taken as per truss loading provided for basic wind speed 47m/sec as per IS:875 (Part-3) - 2015.
8. The walls are assumed to be made up of block work (200mm thick) having a density of 11kN/m3.
9. All RCC works to be done as per IS 456-2000.
10. All reinforcement work to conform to IS-456-2000 & IS-13920-2003.
11. All intersections of bars shall be securely bound with n0.18 gauge pliable wire.
12. 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.
13. The Design shall be reconsidered for snow fall areas.

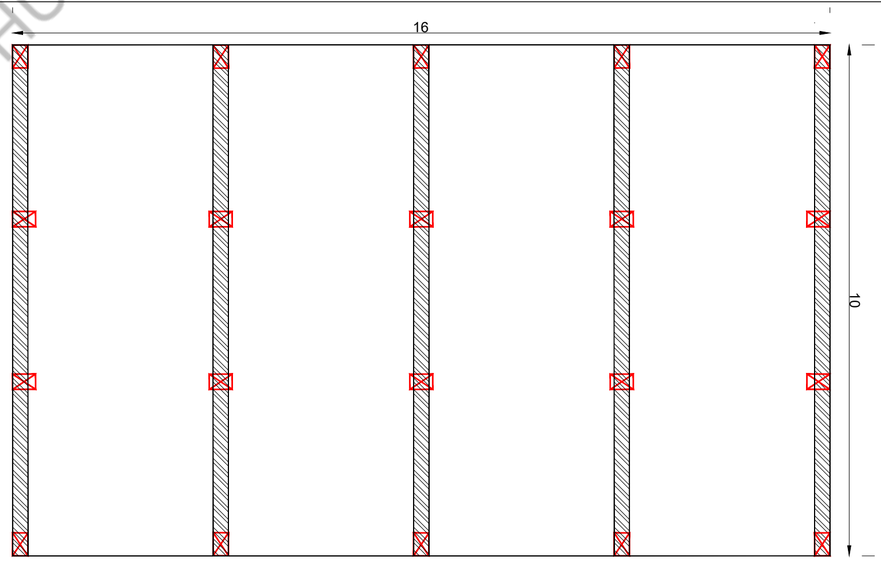
Client: Ministry of Housing and Urban Affairs, Government of India
MINISTRY OF HOUSING AND URBAN AFFAIRS

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

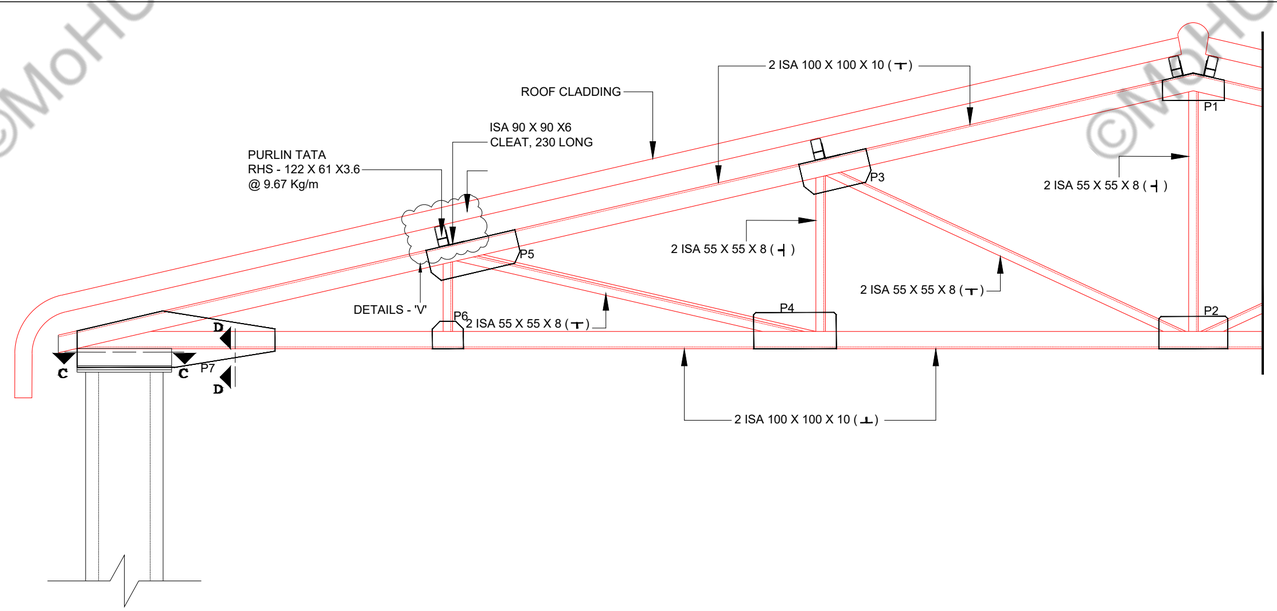
Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

TITLE: TYPICAL LAYOUT PLAN FOR SLAB FOR 5 TPD HILLY REGION MRF PLANT

DESIGNED BY :	VIPIN VERMA	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	CHETAN A. PATIL	
APPROVED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	Date : AUGUST 2024



LAYOUT PLAN FOR
GROUND FLOOR ROOF TRUSS



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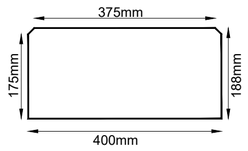

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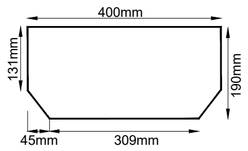

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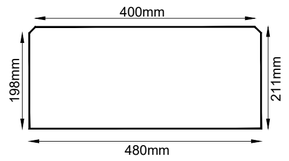

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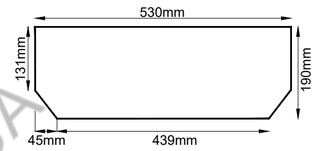

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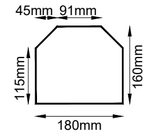

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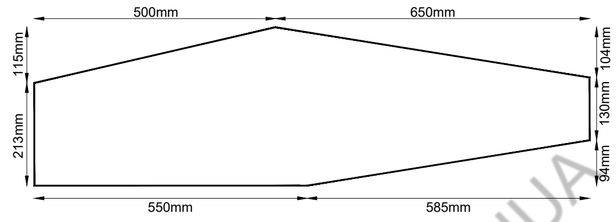

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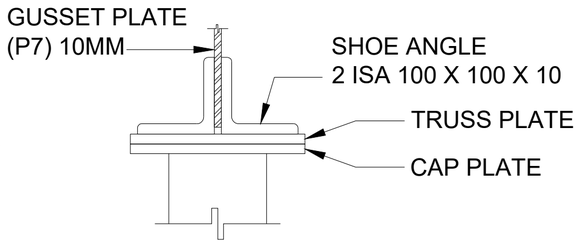
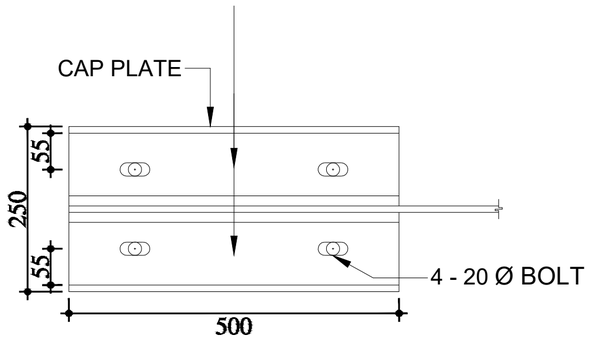
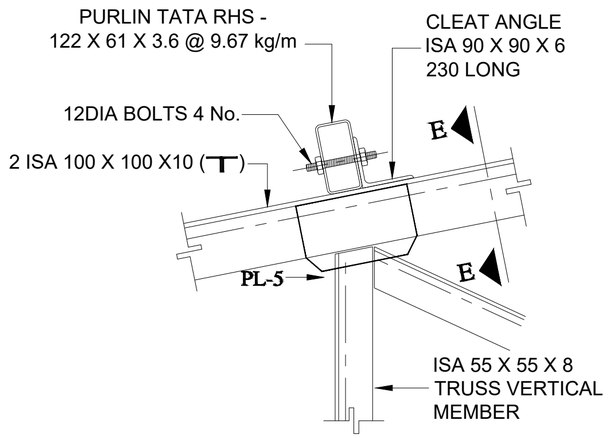


SECTION "D - D"

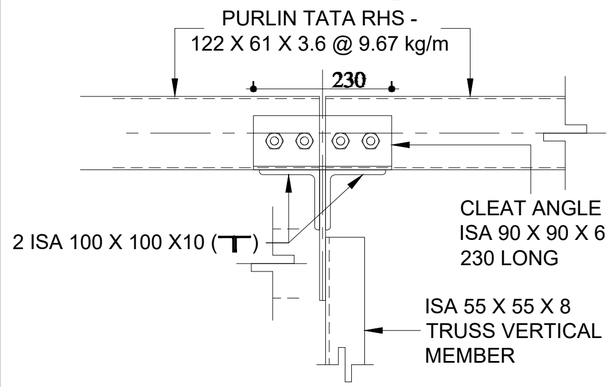
100 X 100 X 10 SHOE ANGLES
WITH OVAL SHAPED HOLES AT
ONE END OF TRUSS AND CIRCULAR
HOLES AT OTHER END.



SECTION "C - C"



DETAIL " V "



SECTION "E - E"

NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

NOTES:-

1. All dimensions are in millimeters, unless otherwise specified.
2. Dimensions are not to be scaled, only written dimensions shall be followed.
3. SBC assumed for design of foundation is 15 ton/m2 at 2m below the natural ground level.
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Government of India
MINISTRY OF HOUSING AND URBAN AFFAIRS

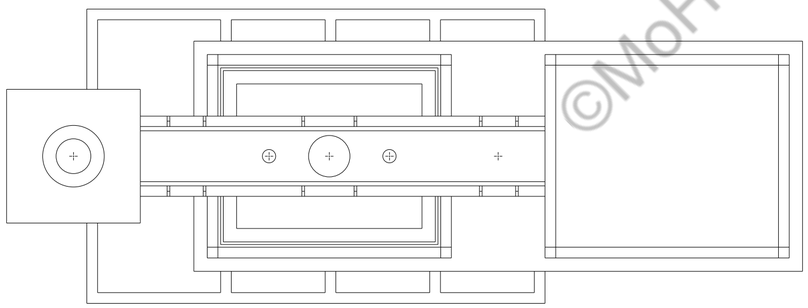
Consultant:
RITES
THE INFRASTRUCTURE PEOPLE
RITES Ltd. (A Government of India Enterprise)

Project:
MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0

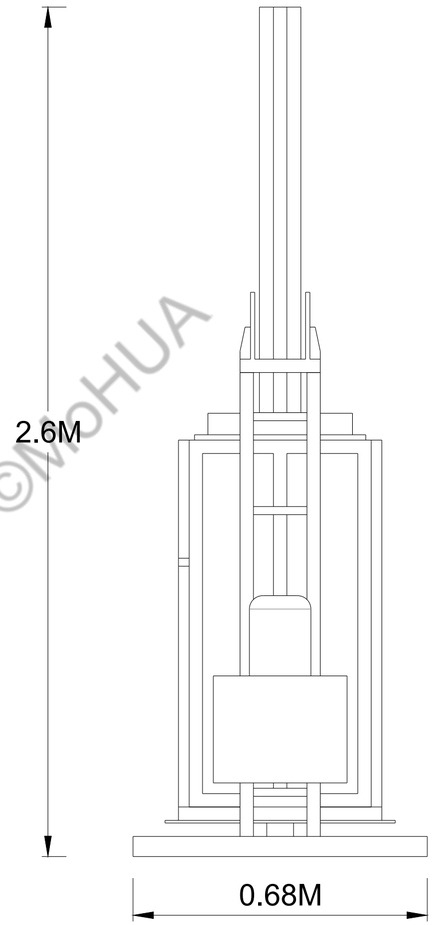
TITLE:
TYPICAL LAYOUT PLAN & DETAILS FOR ROOF TRUSS FOR 5 TPD HILLY REGION MRF PLANT

DESIGNED BY :	VIPIN VERMA	
DRAWN BY :	RAHUL ARYA	
CHECKED BY :	CHETAN A. PATIL	
APPROVED BY :	SANJAY RAUT	
REVIEWED BY :	CPHEEO,MoHUA	Date : AUGUST 2024

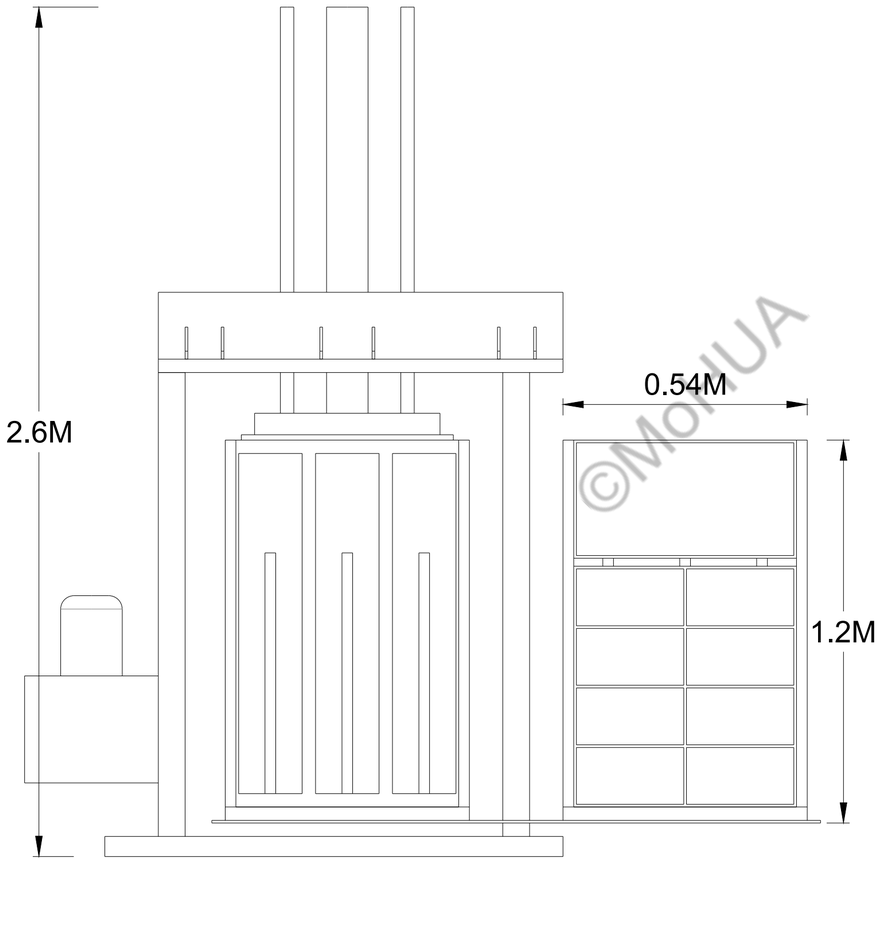
DOUBLE BUCKET SINGLE CYLINDER BALER MACHINE



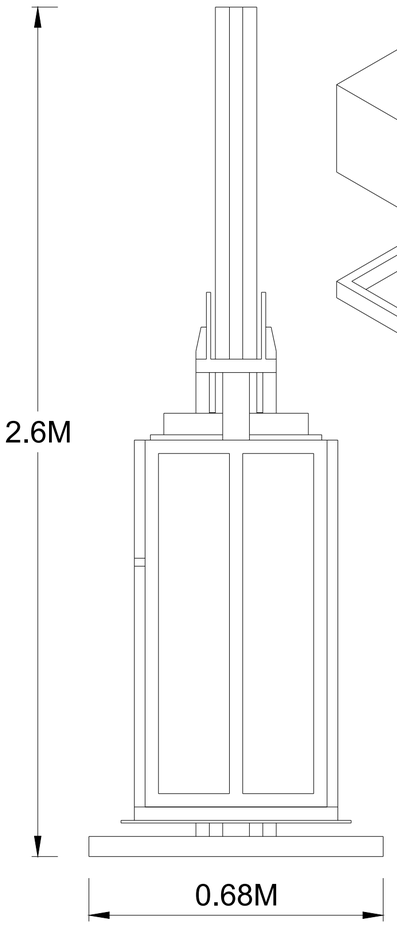
TOP VIEW



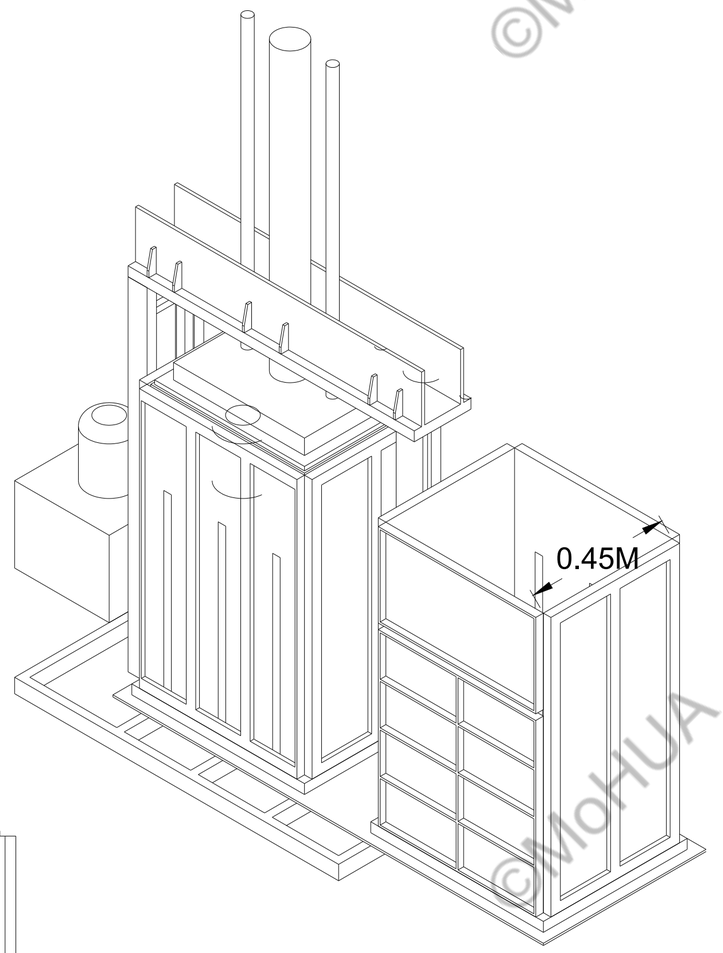
SIDE VIEW



FRONT VIEW

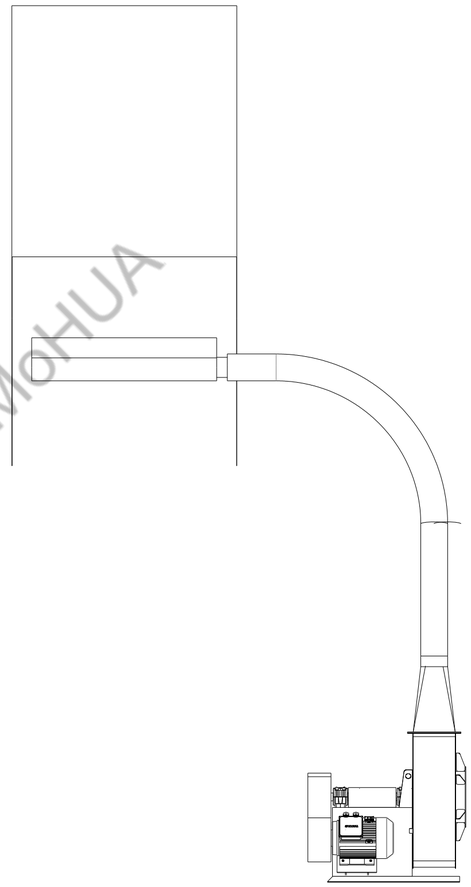


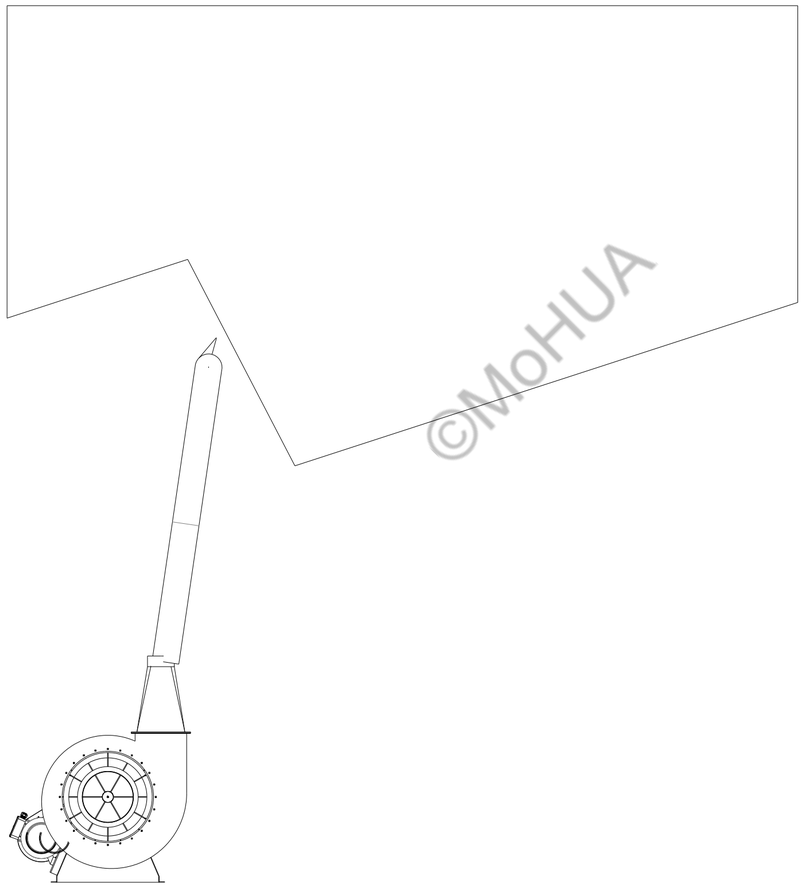
SIDE VIEW

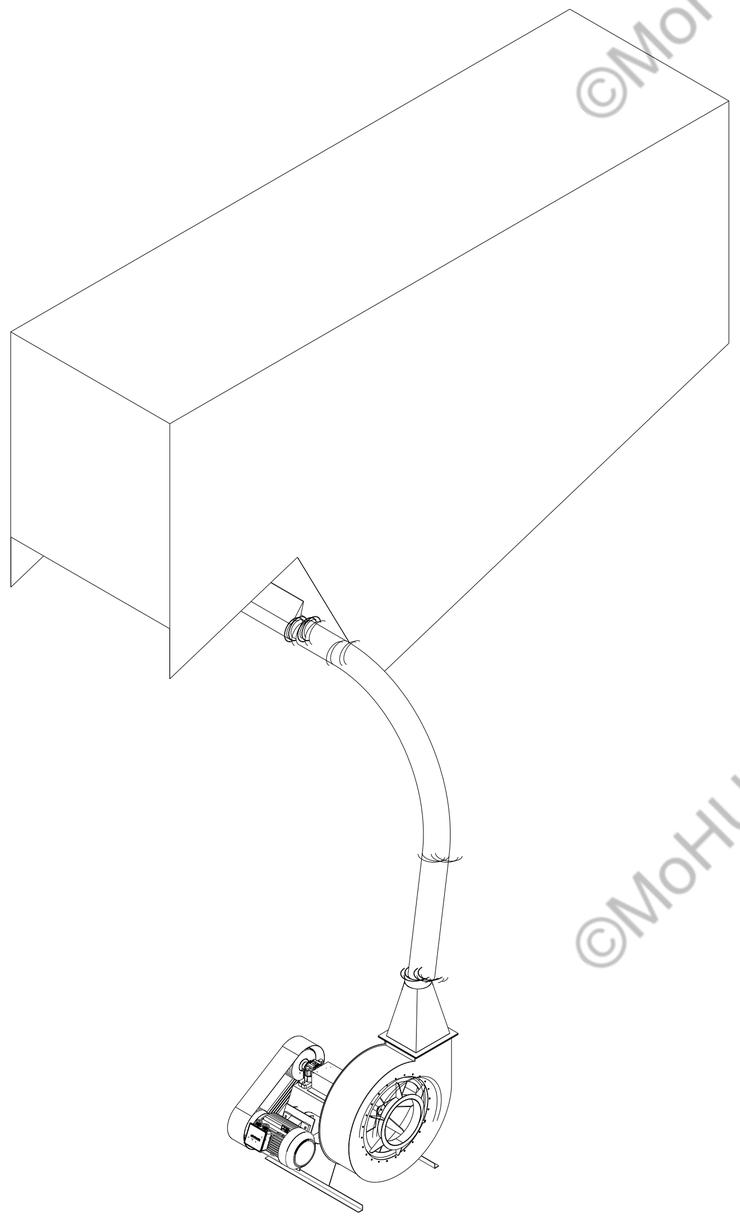


NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client: Ministry of Housing and Urban Affairs, Government of India — MINISTRY OF HOUSING AND URBAN AFFAIRS	Consultant: RITES Ltd. (A Government of India Enterprise)	Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0	DESIGNED BY : CHETAN A. PATIL & DR. ANAND SONAWANE
			DRAWN BY : RAHUL ARYA
		TITLE: TYPICAL BALER DETAILS	CHECKED BY : SANJAY RAUT
			REVIEWED BY : CPHEEO,MoHUA — DATE : AUGUST 2024

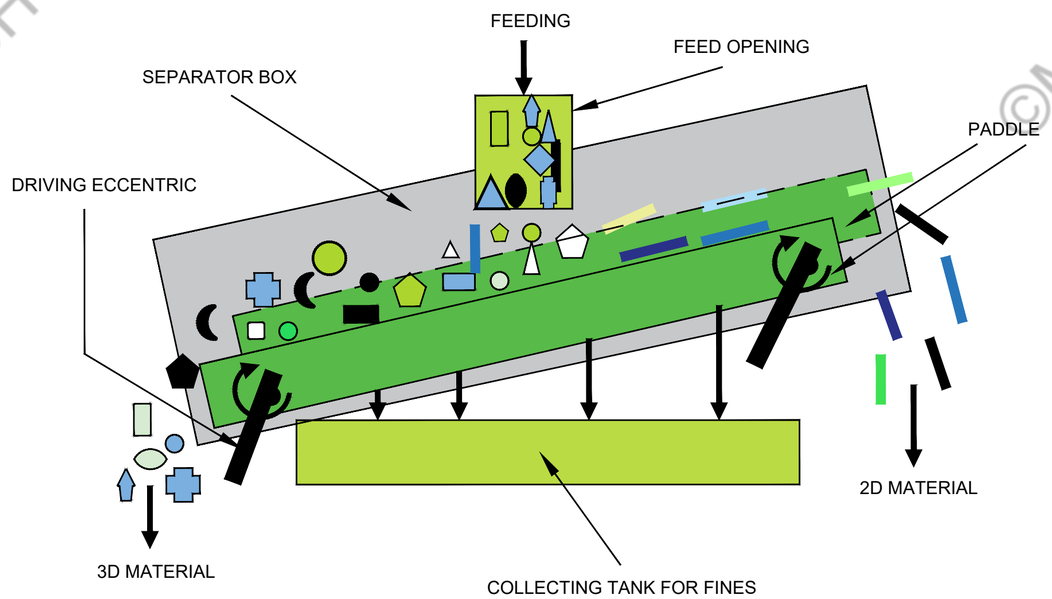




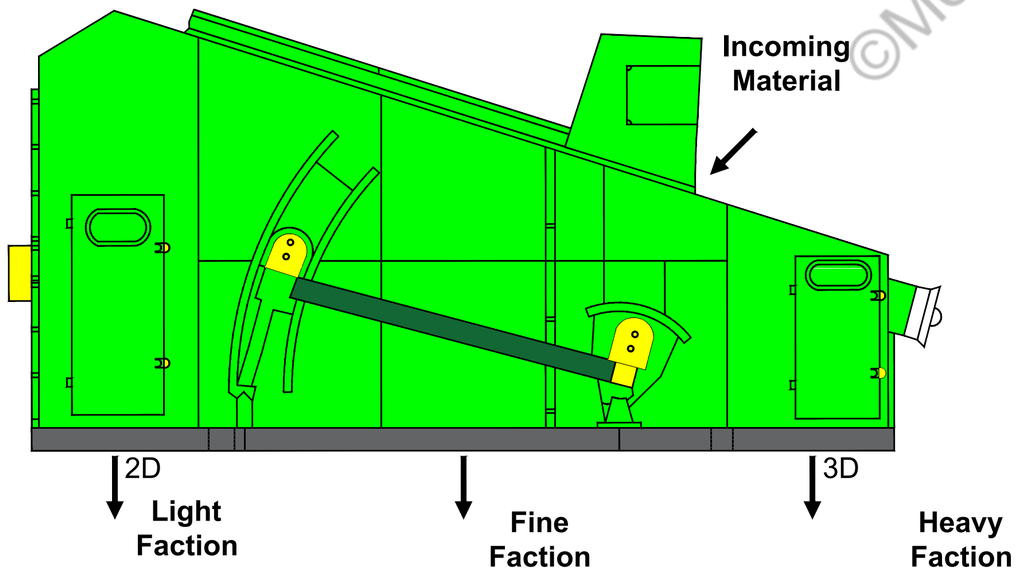


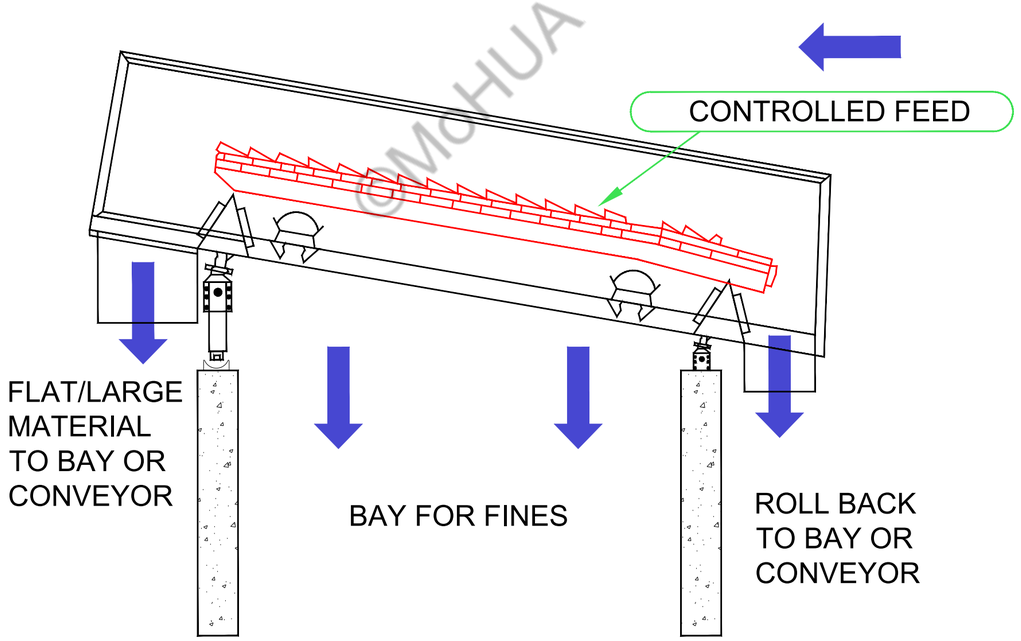
NOTE : ALL DIMENSIONS IN METER OTHERWISE MENTION

Client: Ministry of Housing and Urban Affairs, Government of India — MINISTRY OF HOUSING AND URBAN AFFAIRS	Consultant: RITES Ltd. (A Government of India Enterprise)	Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE	
			DRAWN BY :	RAHUL ARYA	
		TITLE: TYPICAL AIR DENSITY SEPARATOR (ADS)	CHECKED BY :	SANJAY RAUT	
			REVIEWED BY :	CPHEEO,MoHUA	DATE : AUGUST 2024



BALLISTIC SEPARATOR DIAGRAM





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 Ltd. (A Government of India Enterprise)	Project: MODEL DESIGN FOR 5 TPD HILLY REGION MATERIAL RECOVERY FACILITY UNDER SBM-U 2.0	DESIGNED BY :	CHETAN A. PATIL & DR. ANAND SONAWANE
			DRAWN BY :	RAHUL ARYA
		TITLE: BALLISTIC SEPARATOR DIAGRAM	CHECKED BY :	SANJAY RAUT
			REVIEWED BY :	CPHEEO,MoHUA
			DATE :	AUGUST 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. 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			

3. Material Receipt

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

4. Material Dispatch

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

5. Material Sale

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

6. Monthly Report

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

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. 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 ofLOTO?			

9. Check list for Machine Safety

Sl. No	Equipment Safeguarding (in proper working condition)`	Yes/No	Remarks
A	**General**		
1.	Whether machine guards are in place and functional to prevent contact with moving parts?		
B	**Tools**		
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?		
Remarks if any:			
Name, Signature and Date of Checking Officials			

10. 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.		
Remarks if any: **Name, Signature and Date of Checking Officials**			

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

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	4.00	4.00
2	Ballistic Separator	1	29.26	29.26
3	Conveyor belts system	1	7.55	7.55
4	Magnetic Separator	1	6.95	6.95
5	Vertical hydraulic baling machine	1	4.50	4.50
6	Wheel barrows	3	0.0375	0.11
7	HDPE wheeled container bin	9	0.26	2.34
8	Pallet truck	1	0.15	0.15
	Total			54.86
	Transportation and Installation charges extra (10%)			5.49
	Total Cost			**60.35**

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	Building cost		10112347.02	
2	Electrical External Service Connections		3.75%	379213.01
3	Civil External Service Connection		1.25%	126404.34
4	Local Body Approvals Including Tree cutting etc.		1.25%	126404.34
5	Internal Electric Installations		12.50%	1264043.38
6	Extra for power wiring and plugs		4.00%	404493.88
7	Extra for lightening conductors		0.25%	25280.87
8	Extra for third party quality assurance		1.00%	101123.47

Sl. No	Equipment/Instrument	No of units	Unit rate (Rs.)	Cost of equipments (Rs.)
9	Desktop PC	2	33436	66872
10	Water cooler	1	36400	36400
11	CCTV system + LED	3	Lumsum	50000
	Total			25,80,235.32
	Total cost in Lakh			**25.80**

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

III. Fire Fighting Equipments

Sl. No.	Equipment/Instrument	No. of Units	Unit Rate (Rs.)	Cost of equipments (Rs.)
1	Fire Extinguisher (ABC)	7	767	5369
2	Fire Extinguisher (CO_2)	4	1180	4720
3	Fire Bucket	8	272	2176
	Total cost of fire fighting equipments			12265
	Transportation and installation charges extra (10%)			1226
	Total cost			**13491**

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

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B. OPEX

1. PPE Cost

Sl. No.	Item	Annual requirement (no)	Unit rate (Rs.)	Amount (Rs.)
1	Nose Mask (Surgical type for 15 persons daily)	5475	10	54750
2	Safety goggles (twice in year, considering for 10 person)	20	250	5000
3	Chemical resistant gloves, multi-use	40	125	5000
4	Safety (High visibility/ warning) Jacket(twice in year, considering for 10 person)	20	50	1000
5	Bouffant Caps (daily)	3650	1	3650
6	Safety shoes (Twice in year considering for 10 person)	20	400	8000
7	Ear Plugs / Canal caps (twice in a year, considering for 10 person)	20	50	1000
8	Apron (twice in a year, considering for 10 person)	20	200	4000
9	Sanitizer (in litre)	24	181	4344
	Annual Cost (Total) (+GST as applicable)			**86,744**

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 (DSR 2023)	Total Cost (Rs.)
1.	Safety Supervisor	1	973	973
2.	Weigh bridge operator	1	897	897
3.	Electrician cum baler operator (Skilled)	1	973	973
4.	Security[#] (unskilled)	3	897	2691
5.	Sorting workers[#] (women's) (unskilled)	6	736	4416
6.	Multi-Tasking Staff (MTS) (skilled)	1	736	736

Sl. No.	Manpower	Number	Wages* (Rs.)/day (DSR 2023)	Total Cost (Rs.)
			Total wages per day	10,686/-
			Monthly wages	3,25,923/-
			Annual wages	**39,11,076/-**

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. 73.21/ KLD for consumption between 25 -50 KL/month and service charges @ Rs. 1024.87/monthly	1.0KLD i.e. 30.5 KL/month	3,258	39,096
2	Sewerage charges	60% of water consumption charges	--	1,340	16,080
3	Civil Maintenance	@ Rs. 10/ Sq. m. including toilets	Area 320 Sq. m.	3,200	38,400
4	Mechanical equipment maintenance cost	10% of cost of equipment per annum	Rs. 6,03,540	50,295	6,03,540
5	Electrical equipment maintenance cost	10% of cost of equipment per annum	Rs. 2,58,024	21,502	2,58,024
6	Firefighting Equipment	As per actual for fire extinguishers replacement/	Rs. 15,468	1289	15,468
7	Electricity Consumption	@Rs. 7.75/kWH + @Rs. 2.30/- other charges = @Rs. 10- per kWh Approx	166.08 kWh for 08 hr per day	50,700	6,08,400
			Total Cost (Rs.)	**1,31,584**	**15,79,008**

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

BILL OF QUANTITY

BOQ for 5 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 vetted for individual project by the competent engineer / authorities of the ULB's / Department concerned.*

DSR Item No.	Description	Unit	Qty.	Rate	Amount
A	**Site Cleaning**				
2.31	**Clearing jungle** 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	640.00	17.60	11264.00
B	**Excavation**				
2.6	**Earth work in excavation** 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	246.33	177.50	43723.58
2.7	**Earth work in excavation** 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	82.11	498.90	40964.68
C	**Cement Concrete**				
4.1.4	**1:2:4** (1 Cement : 2 coarse sand (zone-lll) derived from natural sources : 4 graded stone aggregate 40 mm nominal size derived from natural sources)	cum	35.90	7780.30	279274.18
D	**Plinth and Back filling**				
5.33A.1	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,				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	shuttering, finishing and reinforcement as per direction of the engineer-in-charge; for the following grades of concrete.				
2.25	Filling **available excavated earth** (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 for all lift	cum	239.04	196.00	46851.64
2.25(a)	Excavating, **supplying and filling of local earth** (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	31.46	700.50	22037.73
16.78	Construction of **granular sub-base** 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	32.00	2784.00	89088.00
16.79	Providing, laying, spreading and compacting graded stone aggregate (size range 53 mm to 0.075 mm) to **wet mix macadam (WMM)** 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	31.46	2914.30	91683.88
E	**Reinforced Cement Concrete**				
	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.				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	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	167.89	9333.95	1567105.71
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	22.01	9689.60	213242.90
5.35	Add for using extra cement in the items of design mix over and above the specified cement content therein.	cum	67.16	733.50	49259.83
5.35	Add for using extra cement in the items of design mix over and above the specified cement content therein.	cum	8.80	733.50	6456.97
F	**Centering and Shuttering**				
5.9	**Centering and shuttering** including strutting, propping etc. and removal of form for				
5.9.1	**Foundations**, **footings**, bases of columns, etc. for mass concrete	sqm	280.00	392.15	109802.00
5.9.2	**Walls** (any thickness) including attached pilasters, buttresses, plinth and string courses etc.	sqm	50.80	842.50	42795.63
5.9.3	Suspended floors, **roofs**, landings, balconies and access platform	sqm	193.47	927.25	179396.17
5.9.5	Lintels, **beams, plinth beams**, girders, bressumers and cantilevers	sqm	293.47	736.40	216112.78
5.9.6	**Columns, Pillars**, Piers, Abutments, Posts and Struts	sqm	119.02	961.30	114410.08
5.9.16	**Edges of slabs** and breaks in floors and walls				
5.9.16.1	**Under 20 cm** wide	meter	52.00	208.55	10844.60
G	**Steel Reinforcement**				
5.22	Steel reinforcement 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	21752.21	107.85	2345976.10
5.22A.6	Thermo-Mechanically Treated bars of grade Fe-500D or more.	Kg	4552.47	107.85	490983.61
H	**Brick Work**				
6.1	**Brick work** with common burnt clay F.P.S. (non-modular) bricks of class designation 7.5 , In foundation and **plinth in**				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
6.1.1	Cement mortar 1:4 (1 cement : 4 coarse sand)	cum	36.95	7370.65	272332.99
6.4	Brick work 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	36.15	9105.95	329136.11
I	**Cladding, Wood And Steel Work**				
8.27	Providing and fixing specified **wood frame 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	0.76	187227.65	142388.87
9.21	Providing and fixing ISI marked **flush door 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	**35 mm thick** including ISI marked Stainless Steel butt hinges with necessary screws	sqm	12.66	2392.65	30278.99
J	**Cement Plaster**				
13.1	**12 mm cement plaster** of mix:				
13.1.1	1:4 (1 cement: 4 fine sand)	sqm	475.05	347.05	164867.49
13.2	**15 mm cement plaster** on the rough side of single or half brick wall of mix:				
13.2.1	1:4 (1 cement: 4 fine sand)	sqm	271.79	399.45	108567.71
13.16	**6 mm** cement plaster of mix:				
13.16.1	1:3 (1 cement : 3 fine sand)	sqm	34.01	300.45	10217.70
K	**Roofing with truss and skylight sheet**				
12.1	Providing corrugated G.S. sheet roofing including vertical / curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead, including a coat of approved steel				
12.1.1	1.00 mm thick with Zinc Coating not less than 275 gm/m2	sqm	437.80	1457.15	637940.27
12.4	Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete.				
12.4.1	0.63 mm thick with zinc coating not less than 275 gm/m2	meter	16.60	1083.30	17982.78
Quotation	**Skylight sheet** (2.5 m x 0.66 m) with **single turbo ventilator** with complete fitting accessories	each	6.00	15000.00	90000.00

DSR Item No.	Description	Unit	Qty.	Rate	Amount
10.1	**Structural steel work** riveted, bolted or welded in built up sections, **trusses and framed work**, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	kg	8055.00	133.70	1076953.50
L	**Flooring Base Concrete**				
26.83	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. The process shall include the following:- • 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 & 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. • 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. • The construction joints shall be provided by **groove cutting of size 4 mm x 20 mm** in panel size 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.	sqm	160.00	762.75	122040.00
M	**Water Proofing**				
22.3	Providing and laying **water proofing treatment to vertical and horizontal surfaces** of depressed	sqm	5.51	769.60	4238.96

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	portions of W.C., kitchen and the like consisting of: • 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. • 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. • IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sqm of area. • 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).				
22.7	Providing and laying integral cement based water proofing treatment including preparation of surface as required for **treatment of roofs, balconies, terraces etc** consisting of following operations: 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. 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. 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. 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				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	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. 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":				
22.7.1	With average thickness of 120 mm and minimum thickness at khurra as 65 mm.	sqm	5.51	1684.60	9278.78
4.10	Providing and laying **damp-proof course 40 mm thick** with cement concrete 1:2:4 (1 cement : 2 coarse sand (zone-lll) derived from natural sources : 4 graded stone aggregate 12.5 mm nominal size derived from natural sources)	sqm	69.10	410.85	28389.74
N	**Paint**				
13.41	Distempering with 1st quality acrylic distemper (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	475.05	185.65	88193.78
13.46	Finishing walls with Acrylic Smooth exterior paint of required shade				
13.46.1	New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 0.90 litre/10 sqm)	sqm	271.79	160.60	43649.96
13.57	Painting with oil type wood preservative of approved brand and manufacture				
13.57.1	New work (Two or more coats)	sqm	149.52	54.40	8133.64
O	**Top Layer of Flowering (Tiles)**				
8.31	Providing and fixing Ist quality ceramic glazed **wall tiles** 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	60.87	1267.95	77174.41

DSR Item No.	Description	Unit	Qty.	Rate	Amount
11.41	Providing and laying **vitrified floor tiles** 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	29.16	1553.45	45298.60
11.41A	Providing and laying **Vitrified tiles in floor** 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/**Antiskid finish** of size	sqm	5.51	1464.85	8068.39
P	**Steel Work**				
10.6.1	Supplying and fixing **rolling shutters** 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 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	13.93	3653.20	50896.38
10.7	Providing and fixing **ball bearing** for rolling shutters.	each	3.00	492.35	1477.05
10.8	Extra for providing mechanical device chain and crank operation for operating rolling shutters.				
10.8.1	Exceeding 10.00 sqm and **upto 16.80 sqm** in the area	sqm	13.93	1281.35	17851.77
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	1.74	768.25	1337.91
9.48	providing and fixing M.S. grill of required pattern in frames of windows etc. with M.S. flats, square				

DSR Item No.	Description	Unit	Qty.	Rate	Amount
	or round bars etc. including priming coat with approved steel primer all complete.				
9.48.2	Fixed to openings/ wooden frames with rawl plugs screws	kg	1517.58	238.25	361563.99
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, frames, guard bar, ladder, railings**, brackets, gates and similar works	Kg	197.93	172.60	34162.10
10.29	Providing & fixing **fly proof wire gauze** to windows, 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	149.52	1133.55	169483.30
Q	**Aluminium Work**				
21.1	Providing and fixing **aluminium work for doors, 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, Minimum anodic coating of grade AC 15)	kg	101.24	495.05	50118.86
21.3	Providing and fixing glazing 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	12.66	1505.25	19048.94
R	**Others**				
Quotation	Grating Platform with Railing and ladder with Railing	each	1	70000.00	70000.00
Lump Sum	Illuminated Signage				50000.00
	Sub Total Rs				10112347.02

DSR Item No.	Description	Unit	Qty.	Rate	Amount
CPWD Plinth Area Rate 2021	**Internal Water Supply & Sanitary Installations**			4.00%	**404493.88**
CPWD SOP 2022	**Contingency**			5.00%	**505617.35**
	Total Rs				11022458.25
	Total Rs In Lakh				110.22

Electrical Cost

(Plinth Area Rates [PAR] 2021)

PAR Item no.	Description	Rate	Amount
	Building Cost		11022458.25
2	Services		
2.2	External Service Connections and Local Body Approval Charges		
2.2.1	Electrical External Service Connections	3.75%	379213.01
2.2.2	Civil External Service Connection	1.25%	126404.34
2.2.3	Local Body Approvals Including Tree cutting etc.	1.25%	126404.34
2.3	Internal Electric Installations	12.50%	1264043.38
2.4	Extra For		
2.4.1	Power Wiring and Plugs	4.00%	404493.88
2.4.2	Lightening Conductors	0.25%	25280.87
2.4.4	Third Party Quality Assurance	1.00%	101123.47
	Total Electrical Cost (In Rs)		**2426963.29**
	Total Electrical Cost (Rs in Lakh)		**24.27**

Ministry of Housing and Urban Affairs
Government of India

Prepared by

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