

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

Final Report

October 2018

This is a technical document produced by SGArchitects, New Delhi. The author(s) of the document has taken all reasonable care to ensure that the contents of the document do not violate any existing copyright or other intellectual property rights of any person in any manner whatsoever. In the event the authors have been unable to track any source and if any copyright has been inadvertently infringed, please notify us in writing for corrective action. You may also contact us for any further technical clarification and discrepancies at address below.

SGArchitects
6151/8, Sector D, Pocket 6
Vasant Kunj
New Delhi – 110070
www.sgarchitect.in

Key Contributors:

Sandeep Gandhi
Principal Architect

Satyajit Ganguly
Senior Transport Planner

Kanica Gola
Infrastructure Planner

Pushkar Dhawale
Urban and Regional Planner

Garima Aggarwal
Urban Designer

Kartikay Kochhar
Architect

Acknowledgements

The authors would like to express our gratitude to Shakti Sustainable Energy Foundation. Shakti Sustainable Energy Foundation works to strengthen the energy security of India by aiding the design and implementation of policies that support renewable energy, energy efficiency and sustainable transport solutions.

We would like to thank Government of National Capital Territory of Delhi (GNCTD), for their participation as case study examples, for their immense support and cooperation in making the document possible. We deeply acknowledge Shri. Kailash Gahlot, Hon'ble Minister of Transport, GNCTD, Mr. Jasmin Shah, Advisor to the Minister Transport, GNCTD, Mr. Manoj Kumar, I.A.S., Managing Director, DTC and Mr. S K Goyal, DTC for their guidance and valuable inputs.

Disclaimer:

The views/analysis expressed in this report/document do not necessarily reflect the views of Shakti Sustainable Energy Foundation. The Foundation also does not guarantee the accuracy of any data included in this publication nor does it accept any responsibility for the consequences of its use.

Contents

1	Introduction	5
2	Depot Design Evaluation	7
2.1	Planning Principles Used	7
2.2	Functions and Area Comparison	13
3	Conclusion	23
4	Annexures	24
4.1	Bawana Bus Depot (Existing proposal):	24
4.2	Burari Bus Depot Plan (Existing proposal):	25
4.3	East Vinod Nagar Bus Depot Plans (Existing proposal):	26
4.4	Bawana Bus Depot Plans (Proposed Option 1):	31
4.5	Bawana Bus Depot Plans (Proposed Option 2):	34
4.6	Burari Bus Depot Plans (Proposed):	37
4.7	East Vinod Nagar Bus Depot Plans (Proposed):	40
4.8	Response to Comments on Bus Depot Design Evaluation Report.....	43

List of Tables:

Table 1: Bus depot details.....	7
Table 2: Evaluation of current design based on ASRTU Guidelines.....	7
Table 3: Comparison of the overall site for Bawana Bus Depot	14
Table 4: Comparison of the overall site for Burari Bus Depot.....	14
Table 5: Comparison of the overall site for East Vinod Nagar Bus Depot	15
Table 6: Detailed area comparison for administrative/ restroom/ toilet blocks and workshop area for Bawana Depot	16
Table 7: Detailed area comparison for administrative/ restroom/ toilet blocks and workshop area for Burari Depot	18
Table 8: Detailed area comparison for administrative/ restroom/ toilet blocks and workshop area for East Vinod Nagar Depot	20
Table 9: Broad classification of responses on key design comments.....	43
Table 10: Detailed response to comments on the design evaluation report – Bawana Depot	43
Table 11: Detailed response to comments on the design evaluation report – East Vinod Nagar Depot	44
Table 12: Detailed response to comments on the design evaluation report – Burari Depot	46

List of Figures:

Figure 1: Proposed Workshop area (Bawana Bus Depot)	9
Figure 2: Proposed Workshop area (Burari Bus Depot)	10
Figure 3: Proposed Workshop area (East Vinod Nagar Bus Depot).....	10
Figure 4: Crew and admin staff circulation in Admin block (Bawana Bus Depot).....	11
Figure 5: Crew and admin staff circulation in Admin block (Burari Bus Depot).....	11
Figure 6: Crew and admin staff circulation in Admin block (East vinod nagar Bus Depot)	12
Figure 7: Two-way Bus circulation in existing proposal (Burari Bus Depot).....	12
Figure 8: One-way Bus circulation in proposed option (Burari Bus Depot)	12

1 Introduction

Transport Department, Government of Delhi desires to expand the bus fleet in Delhi to approximately 9,500 buses immediately, and to about 11,000 buses in the near future- from the current 6450 buses (including both, buses operated by Delhi Transport Corporation and Cluster buses operated by DIMTS). Of these 11,000 buses, roughly half i.e. 5,500, shall be operated by Delhi Transport Corporation (DTC), while the remaining 5,500 shall be under the cluster bus operations.

Of the current fleet of 6,450 buses being operated in Delhi, roughly 4,800 are being operated by DTC, while 1650 buses are being operated by DIMTS. Additionally, DIMTS is undertaking a bus route rationalization study for the Transport Department, and the findings from the same are expected to be available for use some time during the end of this year. The findings of this study are likely to affect a redistribution of routes between terminals and a subsequent re-allocation of bus fleet between depots.

Currently DTC is in the process of acquiring the about 700 buses to meet its target of 5,500 and is expected to accommodate the same in its existing depots through specific capacity enhancement measures. DIMTS on the other hand is in the process of procuring another 1,000 buses. The depot land to accommodate the same has already been handed over to them and the same is under development. Additional 1,350 buses need to be added to the fleet of cluster buses in the near future in order to achieve the short-term target of a fleet of 9,500 buses in Delhi. The Transport Department GNCTD, is awaiting the transfer of promised depot land from Delhi Development Authority (DDA), before going ahead with the procurement.

In order to meet the medium-term target of a fleet of 11,000 buses in Delhi, Over the short term target of 9500 buses, Transport Department GNCTD needs to facilitate an additional induction of 1,500 buses under the cluster bus operations. This is subject to availability of land for depots to accommodate these buses. Transport Department understands that this land may be hard to come by and thus intends to focus on augmenting optimization of current available land, through better planning, combined uses and development of multi-level parking structure for buses. These recommendations have also been listed in the 'Centre for Science and Environment' (CSE) publication – Waiting for the Bus (2017).

Of the 4550 buses that need to be added in Delhi, in the short to medium term, GNCTD intends to include nearly 600 electric buses. To this end, off the depot land parcels made available, to Transport Department by DDA, six sites are currently being planned to be developed as dedicated electric bus depots.

Out of above mentioned six sites, electric bus depot proposals have been developed for three sites (i.e. Bawana, Burari and East Vinod Nagar) by GNCTD. SGArchitects also developed design options for same three depots with the help of ASRTU Planning and Design

Guidelines. This report compared the existing proposals developed by GNCTD and proposal developed with ASRTU Guideline.

2 Depot Design Evaluation

This study evaluates the designs developed for three bus depots. The details of these depots and the organization under whom the designs are being developed are presented in Table 1.

Table 1: Bus depot details

S. No.	Depot Name and location	Organization developing it	Site area (in Sqm)
1	Bawana Depot	Transport Department, GNCTD	23085
2	Burari Depot	Transport Department, GNCTD	27315
3	East Vinod Nagar	Transport Department, GNCTD	18821

For evaluating these depot designs, the designs are compared with planning principles and area estimates recommended by Association of State Road Transport Undertaking (ASRTU) (S G Architects, 2017), and also with the designs of depots developed for same site using ASRTU recommendations.

This report provides this comparison at two levels:

- Planning principles used
- Detailed designs and area occupied

2.1 Planning Principles Used

ASRTU recommends using a compact design approach in order to improve space use efficiency of the existing depot site. It is said that currently depots are designed consuming an area of between 160 to up to 200 sqm per bus (depending on the capacity of the depot site), whereas this space requirement can be brought down to between 140 and 160 sq.m. per bus. A compact design approach recommends going vertical (for functions which allow vertical development), thereby releasing the site to accommodate more buses. Additionally, it is recommended that in order to ensure safety and security of material and staff at the depot, there should be designed access control at the site. The three depot site designs being evaluated have no designed access control – there is no physical segregation between crew/visitor parking and bus parking. Existing proposal plans for Bawana, Burari and East Vinod Nagar bus depot has been presented in Annexure 4.4, 4.5, 4.6 and 4.7 respectively. Table 2 provides a detailed description of deviation of the designs being evaluated from ASRTU planning and design principles.

Table 2: Evaluation of current design based on ASRTU Guidelines

Planning and Design Principle	Current design	Recommended approach
Compact design	Current designs include 4 building blocks scattered at the site. These are: Admin block, crew restrooms, toilet block and workshop. Each of these blocks are 1 to 2 story high, thereby occupying higher overall	ASRTU recommends two blocks, workshop and Admin. The admin block should accommodate admin and crew facilities (including toilet block) at different floors and separate accesses, so that these

	<p>site footprint. However, utility of toilet block is not clear as toilets have been provided in workshop, restroom and admin block.</p>	<p>two functions do not interfere with each other. Such admin blocks can be up to 3 story tall. Workshop block should have its separate toilet facilities for service staff (Refer Figure 1, Figure 2 and Figure 3)</p>
Comfort	<p>In the current design, rest room block is located adjacent to workshop block. This location of rest room block may cause uncomfortable environment for resting crew during night due to disturbance from workshop which operates throughout the night.</p>	<p>Provision of comfortable restroom for crew is essential for higher crew productivity as well overall safety. It is therefore recommended that restrooms should be as much isolated as possible from any major sources of noise and disturbance in the depot.</p>
Access control	<p>The site area is one continuous uncontrolled space, and common bus, staff, visitor and staff vehicle entrance is provided through one common gate. Entrance through this gate allows by design, unhindered access to all facilities/areas in the depot.</p>	<p>Access to depot area should be strictly restricted to only authorized and necessary personnel. This is possible by using the admin block as access control to the depot area. All personnel, visitors and staff need to pass through the admin block in order to gain access to the depot operational area. Thus, admin block should be the barrier/buffer between the private vehicle parking and bus parking with access-controlled gates on both sides (Refer Figure 4, Figure 5 and Figure 6)</p>
Barrier free design	<p>The depot design does not follow the principles of universal accessibility. Lifts for staff, and others have not been provided for access to upper floors by physically challenged.</p>	<p>Depot design should incorporate lifts in all buildings with more than one floor.</p>
Circulation design	<p>Bus bay arrangement and circulation design leads to creation of negative/unused spaces between buses in the central aisle (refer Figure 7).</p>	<p>Aisle of central bus bays (between the driveways) can be designed with one-way circulation in order to eliminate negative spaces created between parked buses (refer Figure 8).</p>
Charging infrastructure	<p>The proposed depot sites are being developed as depots for electric buses, however the</p>	<p>It is estimated that for a depot with a capacity of 150 buses, a substation with a total area of close</p>

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

designs include CNG infrastructure along with electrical sub stations. However, the area provided for electrical sub stations is much lower than that prescribed by dis-coms (120 to 200 sq.m.). Additional no space has been allocated for transformers and covered electric charging stations have not been shown in the designs.

to 600sq.m. is required, in addition a space for 6 transformers totaling 120 sqm (4m X 5m each) is required to be provided. Each electrical charging station needs a protected platform with a recommended minimum size of 2.5m X 2.5m, and it is suggested the number of bus bays served by charging stations should be at least 60% of the total number of buses in the depot¹. Thus, charging stations provided between the buses in the central aisle have a potential to serve more buses per station, thereby minimizing the costs involved.

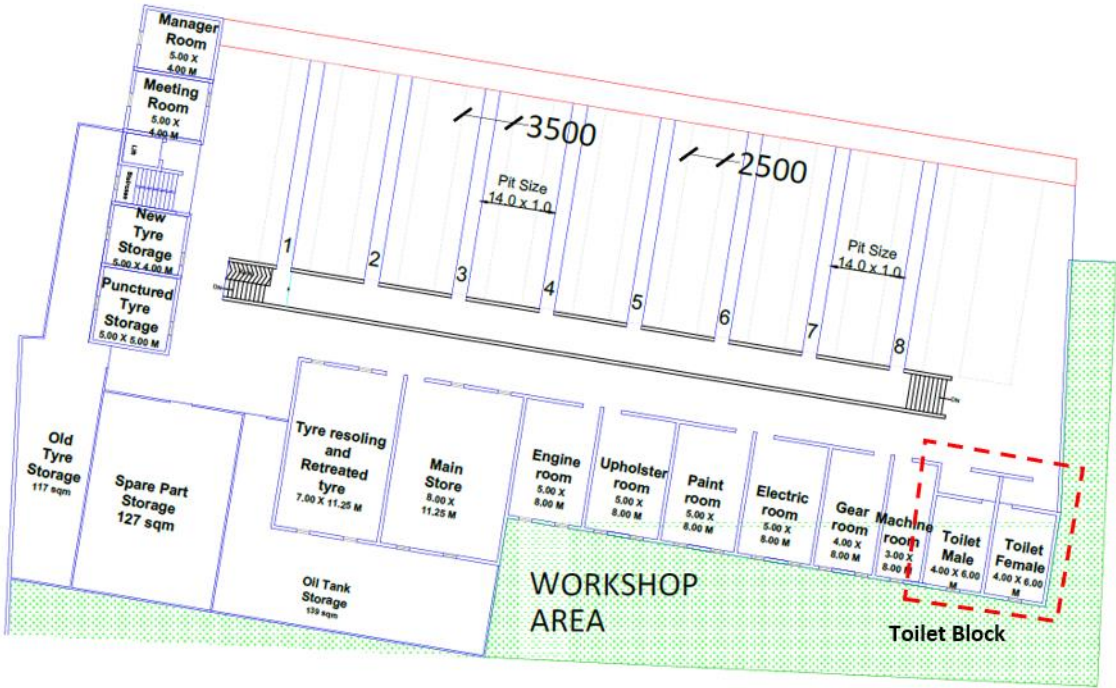


Figure 1: Proposed Workshop area (Bawana Bus Depot)

¹ 1 charging station can charge more than 1 bus – depending on the design of the charging stations.

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

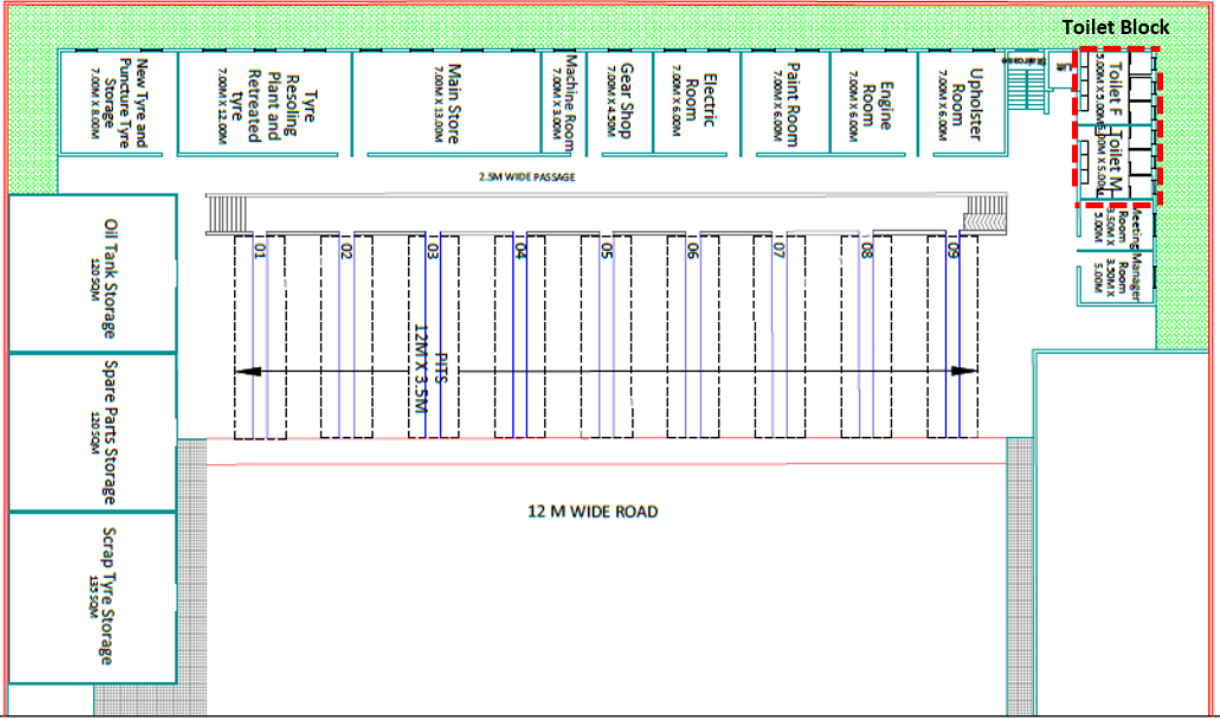


Figure 2: Proposed Workshop area (Burari Bus Depot)

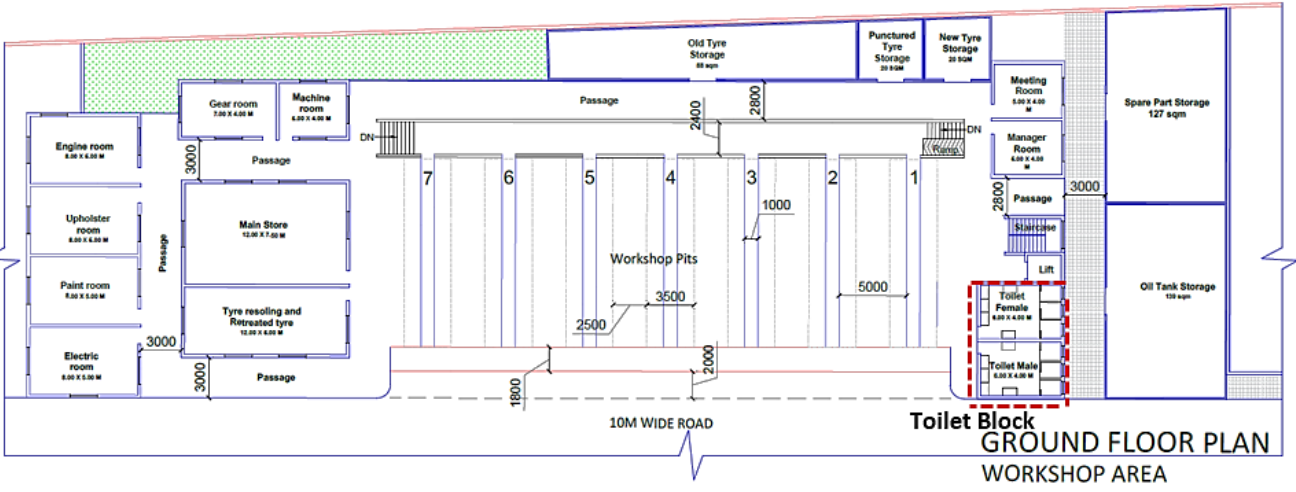


Figure 3: Proposed Workshop area (East Vinod Nagar Bus Depot)

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

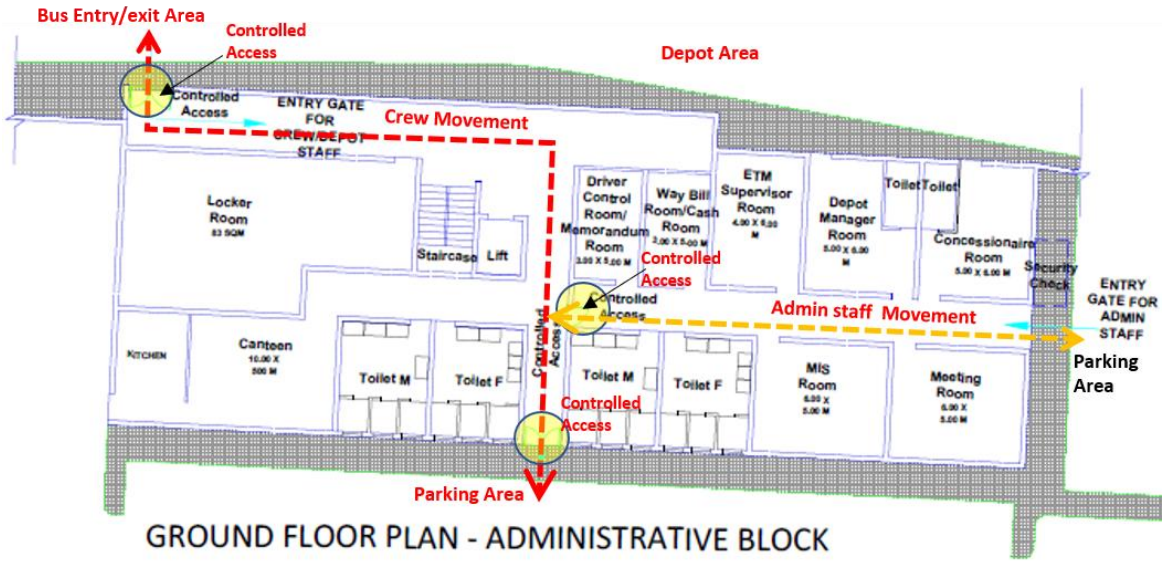


Figure 4: Crew and admin staff circulation in Admin block (Bawana Bus Depot)

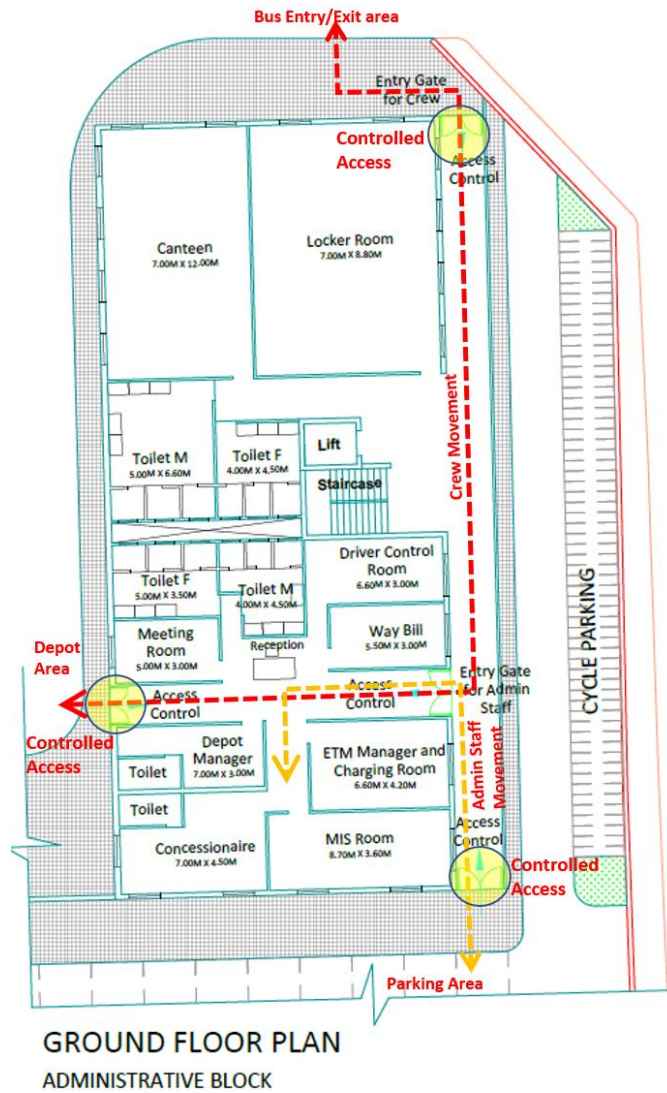


Figure 5: Crew and admin staff circulation in Admin block (Burari Bus Depot)

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

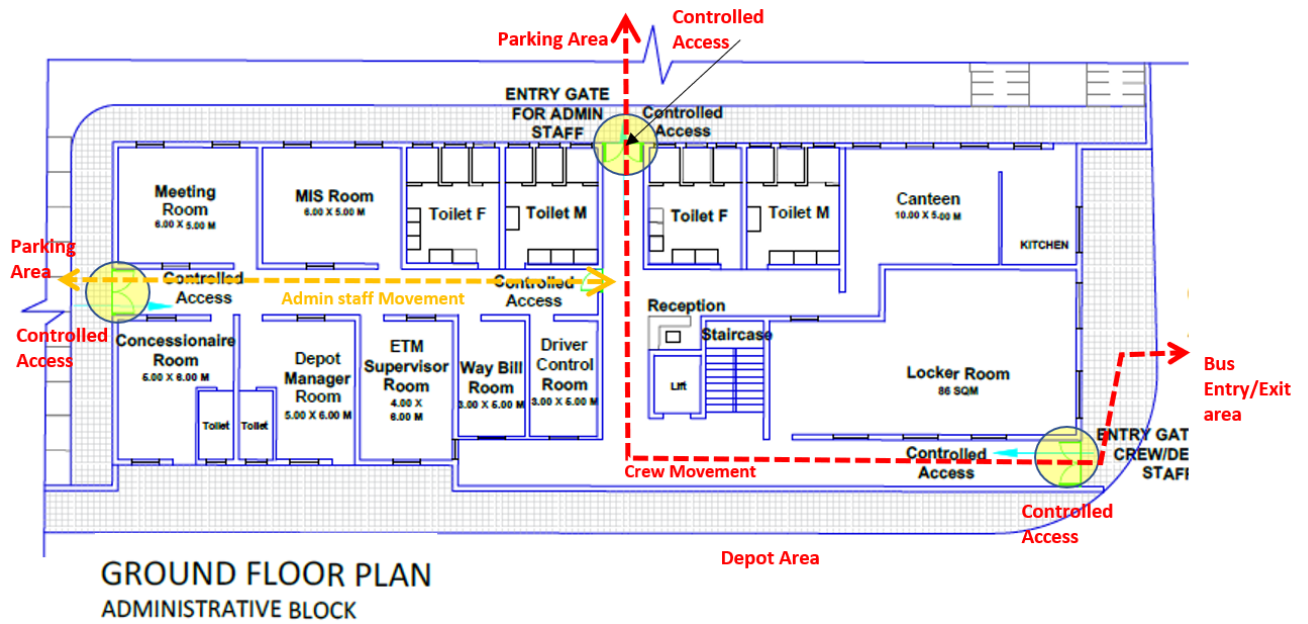


Figure 6: Crew and admin staff circulation in Admin block (East vinod nagar Bus Depot)

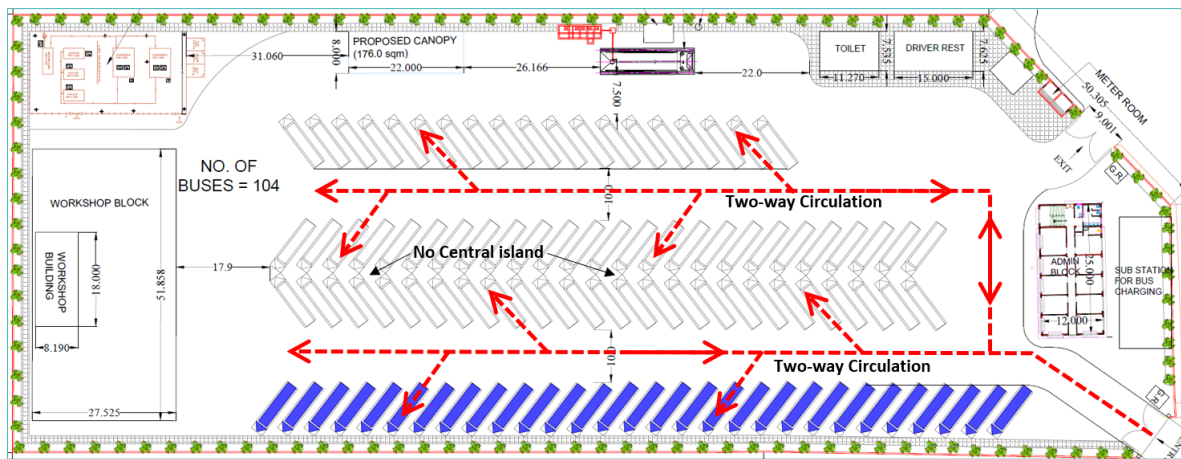


Figure 7: Two-way Bus circulation in existing proposal (Burari Bus Depot)

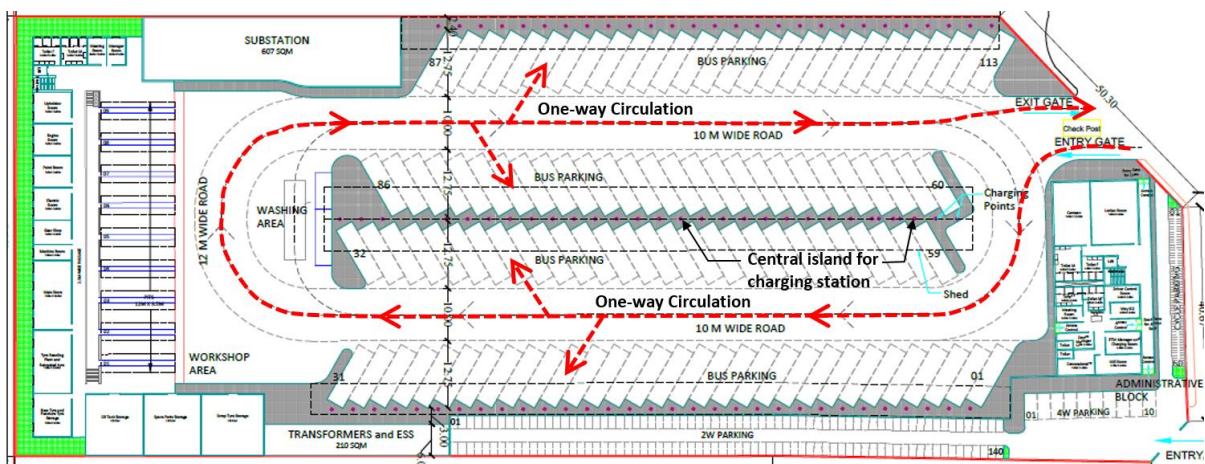


Figure 8: One-way Bus circulation in proposed option (Burari Bus Depot)

2.2 Functions and Area Comparison

It is observed that because of the way the circulation of buses inside the depot is designed, the way the staff and visitor parking has been accommodated and the way block with different functions are laid out at different locations in the site, the space use efficiency of the plan suffers. This leads to loss of capacity by as much as 19 Buses (in Bawana depot). In addition it is observed that most functions and area allocation of functions is less than what is recommended by ASRTU (S G Architects, 2017). For example, ASRTU recommends lodging facilities (restrooms) and cafeteria, on site for 25% of the crew and lockers/change rooms for 100% of the crew. The area provided in the current designs ensures restroom provisions for only 5% of the crew and it excludes any provisions for crew change rooms and locker rooms. In addition, spaces and provision for many other functions in all or most of the three depot designs is missing. These include Sub-station area, defined staff parking and space for charging stations near bus parking.

Table 3 to Table 5 present the area comparison of the overall site for each of the three depots. The comparison shows that even though the areas recommended by ASRTU and the same provided in the ASRTU guideline (SGArchitects, 2015) based designs is much more than those presented in the current proposals (under review), the ASRTU recommendations based designs manage to accommodate more buses and reduce per bus area requirement to as low as 144 sqm per bus (for Bawana and Burari Depot). This has been achieved by the compact design approach mentioned above, as well by integrating circulation design which minimizes dead/unused spaces. Proposed plans for Bawana (option 1), Bawana (option 2), Burari and East Vinod Nagar bus depot has been presented in Annexure 4.4, 4.5, 4.6 and 4.7 respectively.

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

Table 3: Comparison of the overall site for Bawana Bus Depot

BAWANA BUS DEPOT					
Nos.	Site Area	Existing Proposal	ASRTU Guideline	Option 1	Option 2
	Total Site area (Sq.m)	23085	24370	23085	23085
1	Workshop Building footprint (including stores) (Sq.m.)	1138	2280	2398	2092
2	Area for washing (Sq.m.)	158	420	175	175
3	Sub Station Area (Sq.m.)	-	-	600	637
4	Area under Transformers & ESS (Sq.m.)	128	-	151	315
5	Charging station area (Sq.m)	-	-	1171	1287
6	CNG Pump area (Sq.m.)	725	648	-	-
7	Bus Parking Area (Sq.m.)	13902	15760	14365	11059
8	Admin block footprint (Sq.m.)	300	370	626	463
9	Restroom footprint (Sq.m.)	140	-	-	-
10	Toilet block footprint (Sq.m.)	92	-	-	-
11	Staff Parking Area (Sq.m.)	659	1020	1161	1098
12	Commercial Area	-	-	-	2500
13	Area under circulation and negative spaces	5843	3872	2438	3459
14	Bus Parking Capacity (Buses)	141	160	160	150
15	Staff parking Capacity (ECS)	29	44	50	48
16	No. of Electrical Charging station (Nos.)	-	-	107	116
17	No. of CNG Dispensers (Nos.)	2	4	-	-
18	Number of washing bays (Nos.)	1	2	2	2
19	Number of workshop pits (Nos.)	4	8	8	8
20	Number of workshop service bays (Nos.)	3	-	1	-
21	Area per bus (Sq.m)	164	152	144	154

Table 4: Comparison of the overall site for Burari Bus Depot

BURARI BUS DEPOT				
Nos.	Site Area	Existing Proposal	Guideline	Option 1
	Total Site area (Sq.m.)	27315	28390	27315
1	Workshop Building footprint (including stores) (Sq.m.)	2071	2630	2465
2	Area for washing (Sq.m.)	275	420	219
3	Sub Station Area (Sq.m.)	250	-	625
4	Area under Transformers & ESS (Sq.m.)	-	-	210
5	Charging station area (Sq.m)	-	-	1473
6	CNG Pump area (Sq.m.)	675	785	-
7	Bus Parking Area (Sq.m.)	15908	18690	16838
8	Admin block footprint (Sq.m.)	300	390	696

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

9	Restroom footprint (Sq.m.)	114	-	-
10	Toilet block footprint (Sq.m.)	146	-	-
11	Staff Parking Area (Sq.m.)	-	1160	1377
12	commercial Area	-	-	-
13	Area under circulation and negative spaces	7576	4315	3412
14	Bus Parking Capacity (Buses)	181	190	190
15	Staff parking Capacity (ECS)	-	50	60
16	No. of Electrical Charging station (Nos.)	-	-	152
17	No. of CNG Dispensers (Nos.)	2	5	-
18	Number of washing bays (Nos.)	1	2	2
19	Number of workshop pits (Nos.)	6	10	10
20	Number of workshop service bays (Nos.)	4	-	-
21	Area per bus (Sq.m)	151	149	144

Table 5: Comparison of the overall site for East Vinod Nagar Bus Depot

EAST VINOD NAGAR BUS DEPOT				
Nos.	Site Area	Existing Proposal	Guideline	Option 1
	Total Site area (Sq.m.)	18821	19650	18821
1	Workshop Building footprint (including stores) (Sq.m.)	1091	2130	1855
2	Area for washing (Sq.m.)	161	210	130
3	Sub Station Area (Sq.m.)	-	-	600
4	Area under Transformers & ESS (Sq.m.)	128	-	170
5	Charging station area (Sq.m)	-	-	992
6	CNG Pump area (Sq.m.)	0	511	-
7	Bus Parking Area (Sq.m.)	9480	12340	10849
8	Admin block footprint (Sq.m.)	300	340	612
9	Restroom footprint (Sq.m.)	140	-	-
10	Toilet block footprint (Sq.m.)	92	-	-
11	Staff Parking Area (Sq.m.)	-	850	1159
12	commercial Area	-	-	-
13	Area under circulation and negative spaces	7429	3269	2454
14	Bus Parking Capacity (Buses)	124	125	125
15	Staff parking Capacity (ECS)	-	37	50
16	No. of Electrical Charging station (Nos.)	-	-	93
17	No. of CNG Dispensers (Nos.)	0	3	-
18	Number of washing bays (Nos.)	1	1	1
19	Number of workshop pits (Nos.)	4	7	7
20	Number of workshop service bays (Nos.)	3	-	-
21	Area per bus (Sq.m)	152	157	151

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

Table 6 To Table 8 Present the detailed area comparison for administrative cum restroom cum toilet blocks/functions and workshop block/functions for each of the three depot sites under review. The comparison shows that areas allocated most functions in the proposed designs (under review) are less than those recommended by ASRTU (S G Architects, 2017) or included in the ASRTU recommendation based designs. In all three existing proposals, it is observed that Workshop total built up area is significantly low than that advised by ASRTU Guideline. Additionally, no dedicated spaces have been provided for functions such as Concessionaire Room, Meeting room, Workshop worker rest room & locker room, Storage areas (including scrap tyre, spare parts and oil tank storage areas) and workshop manager & meeting room.

Table 6: Detailed area comparison for administrative/ restroom/ toilet blocks and workshop area for Bawana Depot

BAWANA DEPOT: ADMINISTRATIVE REST ROOM & TOILET BLOCK					
A	GROUND FLOOR	Existing Proposal	ASRTU Guideline	Option 1	Option 2
1	Locker room	-	50	83	40
2	Canteen and kitchen	-	50	50	68
3	Toilet for Crew	-	56	41	26
4	Toilet for Staff	22	15	41	21
5	Driver control room	-	15	15	15
6	Way bill room	22	15	15	20
7	ETM room	22	25	24	25
8	Depot Manager room	-	15	30	18
9	Concessionaire Room	-	30	30	31
10	MIS room	33	30	30	32
11	Meeting room	-	20	30	30
12	Ticket room	26	-	-	-
13	Computer room	33	-	-	-
14	Room 1	22	-	-	-
15	Room 2	22	-	-	-
16	Passage/Circulation/Staircase & Lift/Walls	99	49	237	137
	<i>Total Ground floor area</i>	<i>300</i>	<i>370</i>	<i>626</i>	<i>463</i>
	Rest room Block				
17	Rest room	40	-	-	-
18	Canteen and kitchen	36	-	-	-
19	Toilet	28	-	-	-
20	Passage/Circulation/Staircase & Lift/Walls	36	-	-	-
	<i>Total Ground floor area</i>	<i>140</i>	<i>-</i>	<i>-</i>	<i>-</i>
	Toilet Block				
21	<i>Total Ground floor area</i>	<i>92</i>	<i>-</i>	<i>-</i>	<i>-</i>

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

<i>B</i>	FIRST FLOOR	Existing Proposal	ASRTU Guideline	Option 1	Option 2
22	Depot Manager room	26	-	-	-
23	7 Rooms - function not defined	154	-	-	-
24	Crew rest room	-	285	310	450
25	Toilet	15	50	82	47
26	Passage/Circulation/Staircase & Lift/Walls	105	35	234	163
	<i>Total First floor area</i>	<i>300</i>	<i>370</i>	<i>626</i>	<i>660</i>
	Rest room Block				
27	Rest room	40	-	-	-
28	Terrace	36	-	-	-
29	Toilet	28	-	-	-
30	Passage/Circulation/Staircase & Lift/Walls	36	-	-	-
	<i>Total First floor area</i>	<i>140</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>C</i>	SECOND FLOOR	Existing Proposal	ASRTU Guideline	Option 1	Option 2
31	Crew rest room	-	285	310	450
32	Toilet	-	50	82	47
33	Passage/Circulation/Staircase & Lift/Walls	-	35	234	163
	<i>Total Second floor area</i>	<i>-</i>	<i>370</i>	<i>626</i>	<i>660</i>
BAWANA DEPOT: WORKSHOP AREA					
<i>A</i>	GROUND FLOOR	Existing Proposal	ASRTU Guideline	Option 1	Option 2
1	Workshop Pits	125	392	392	392
2	Service Bays	94	-	49	-
3	Manager room	-	20	20	20
4	Meeting room	-	20	20	19
5	Tyre Resoling plant and Retreated tyre		68	79	70
6	Main store		90	90	94
7	Engine room		40	40	42
8	Upholster room		40	40	42
9	Paint room		40	40	42
10	Electric room		40	40	-
11	Gear room		30	32	32
12	Machine room		18	24	28
13	Toilet	12	45	48	43
14	New tyre storage	-	20	20	25
15	Punctured tyre storage	-	22	25	28
16	Old tyre storage	-	113	117	101
17	Spare parts storage	-	120	127	124
18	Oil tank storage	-	120	139	106

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

19	8 Rooms - function not defined	91	-	-	-
20	Passage/Circulation/Staircase & Lift/Walls	816	1042	1056	885
	<i>Total Ground floor area</i>	<i>1138</i>	<i>2280</i>	<i>2398</i>	<i>2092</i>
B	FIRST FLOOR	Existing Proposal	ASRTU Guideline	Option 1	Option 2
21	Rest room	-	40	46	37
22	Toilet	12	20	19	25
23	Locker room	-	28	27	25
24	Pantry	-	16	16	16
25	8 Rooms - function not defined	91	-	-	-
26	Passage/Circulation/Staircase & Lift/Walls	75	100	92	81
	<i>Total First floor area</i>	<i>178</i>	<i>204</i>	<i>200</i>	<i>184</i>

Table 7: Detailed area comparison for administrative/ restroom/ toilet blocks and workshop area for Burari Depot

BURARI DEPOT: ADMINISTRATIVE REST ROOM & TOILET BLOCK				
A	GROUND FLOOR	Existing Proposal	ASRTU Guideline	Option 1
1	Locker room	-	105	107
2	Canteen and kitchen	-	75	84
3	Toilet for Crew	-	29	50
4	Toilet for Staff	-	14	34
5	Driver control room	-	15	20
6	Way bill room	-	15	17
7	ETM room	-	25	28
8	Depot Manager room	-	15	21
9	Concessionaire Room	-	30	32
10	MIS room	-	30	31
11	Meeting room	-	20	15
12	Ticket room	-	-	-
13	Computer room	-	-	-
14	Room 1	-	-	-
15	Room 2	-	-	-
16	Passage/Circulation/Staircase & Lift/Walls	-	17	258
	<i>Total Ground floor area</i>	<i>300</i>	<i>390</i>	<i>696</i>
	Rest room Block			
17	Rest room	<i>Details not available</i>	-	-
18	Canteen and kitchen		-	-
19	Toilet		-	-
20	Passage/Circulation/Staircase & Lift/Walls		-	-
	<i>Total Ground floor area</i>	<i>114</i>	-	-
	Toilet Block			

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

21	<i>Total Ground floor area</i>	146	-	-
B	FIRST FLOOR	Existing Proposal	ASRTU Guideline	Option 1
22	Crew rest room	-	360	370
23	Toilet	-	29	50
24	Passage/Circulation/Staircase & Lift/Walls	-	111	276
	<i>Total First floor area</i>	-	500	696
	Rest room Block			
25	Rest room	<i>Details not available</i>	-	-
26	Canteen and kitchen		-	-
27	Toilet		-	-
28	Passage/Circulation/Staircase & Lift/Walls		-	-
	<i>Total Ground floor area</i>	114	-	-
C	SECOND FLOOR	Existing Proposal	ASRTU Guideline	Option 1
29	Crew rest room	-	360	370
30	Toilet	-	29	50
31	Passage/Circulation/Staircase & Lift/Walls	-	111	276
	<i>Total Second floor area</i>	-	500	696
BURARI DEPOT: WORKSHOP AREA				
A	GROUND FLOOR	Existing Proposal	ASRTU Guideline	Option 1
1	Workshop Pits	<i>Details not available</i>	490	490
2	Service Bays		-	-
3	Manager room		20	18
4	Meeting room		20	18
5	Tyre Resoling plant and Retreated tyre		76	84
6	Main store		90	91
7	Engine room		40	42
8	Upholster room		40	42
9	Paint room		40	42
10	Electric room		40	42
11	Gear room		30	32
12	Machine room		18	21
13	Toilet		16	50
14	New tyre storage		30	30
15	Punctured tyre storage		24	26
16	Old tyre storage		130	135
17	Spare parts storage		120	120
18	Oil tank storage		120	120
19	Passage/Circulation/Staircase & Lift/Walls			1286
	<i>Total Ground floor area</i>	2071	2630	2465

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

B	FIRST FLOOR	Existing Proposal	ASRTU Guideline	Option 1
19	Rest room	<i>Details not available</i>	46	59
20	Toilet		12	50
21	Locker room		32	35
22	Pantry		17	17
23	Passage/Circulation/Staircase & Lift/Walls		93	71
	<i>Total First floor area</i>			200

Table 8: Detailed area comparison for administrative/ restroom/ toilet blocks and workshop area for East Vinod Nagar Depot

EAST VINOD NAGAR DEPOT: ADMINISTRATIVE REST ROOM & TOILET BLOCK				
A	GROUND FLOOR	Existing Proposal	ASRTU Guideline	Option 1
1	Locker room	-	69	86
2	Canteen and kitchen	-	50	50
3	Toilet for Crew	-	19	41
4	Toilet for Staff	15	14	41
5	Driver control room	-	15	15
6	Way bill room	26	15	15
7	ETM room	22	25	24
8	Depot Manager room	-	15	30
9	Concessionaire Room	-	30	30
10	MIS room	33	30	30
11	Meeting room	-	20	30
12	Ticket room	22	-	-
13	Computer room	33	-	-
14	Room 1	22	-	-
15	Room 2	22	-	-
16	Passage/Circulation/Staircase & Lift/Walls	105	38	220
	<i>Total Ground floor area</i>	<i>300</i>	<i>340</i>	<i>612</i>
	Rest room Block			
17	Rest room	40	-	-
18	Canteen and kitchen	36	-	-
19	Toilet	28	-	-
20	Passage/Circulation/Staircase & Lift/Walls	36	-	-
	<i>Total Ground floor area</i>	<i>140</i>	<i>-</i>	<i>-</i>
	Toilet Block			
21	<i>Total Ground floor area</i>	<i>92</i>	<i>-</i>	<i>-</i>
B	FIRST FLOOR	Existing Proposal	ASRTU Guideline	Option 1
22	Depot Manager room	26	-	-

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

23	7 Rooms - function not defined	154	-	-
24	Crew rest room	-	300	300
25	Toilet	15	19	41
26	Passage/Circulation/Staircase & Lift/Walls	105	21	271
	<i>Total Ground floor area</i>	300	340	612
	Rest room Block			
27	Rest room	40	-	-
28	Terrace	36	-	-
29	Toilet	28	-	-
30	Passage/Circulation/Staircase & Lift/Walls	36	-	-
	<i>Total First floor area</i>	140	-	-
C	SECOND FLOOR	Existing Proposal	ASRTU Guideline	Option 1
31	Crew rest room	-	150	160
32	Toilet	-	19	41
33	Passage/Circulation/Staircase & Lift/Walls	-	31	146
	<i>Total Second floor area</i>	-	200	347
EAST VINOD NAGAR DEPOT: WORKSHOP AREA				
A	GROUND FLOOR	Existing Proposal	ASRTU Guideline	Option 1
1	Workshop Pits	196	343	343
2	Service Bays	147	-	-
3	Manager room	-	20	20
4	Meeting room	-	20	20
5	Tyre Resoling plant and Retreated tyre	-	59	60
6	Main store	-	90	90
7	Engine room	-	40	40
8	Upholster room	-	40	40
9	Paint room	-	40	40
10	Electric room	-	40	40
11	Gear room	-	30	28
12	Machine room	-	18	20
13	Toilet	12	12	49
14	New tyre storage	-	20	20
15	Punctured tyre storage	-	16	20
16	Old tyre storage	-	86	88
17	Spare parts storage	-	120	127
18	Oil tank storage	-	120	139
19	8 Rooms - function not defined	91	-	-
20	Passage/Circulation/Staircase & Lift/Walls	645	1016	671
	<i>Total Ground floor area</i>	1091	2130	1855

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

<i>B</i>	FIRST FLOOR	Existing Proposal	ASRTU Guideline	Option 1
21	Rest room	-	33	40
22	Toilet	12	12	49
23	Locker room	-	21	14
24	Pantry	-	16	-
25	8 Rooms - function not defined	91	-	-
26	Passage/Circulation/Staircase & Lift/Walls	75	118	128
	<i>Total First floor area</i>	<i>178</i>	<i>200</i>	<i>231</i>

A detailed discussion on the comparison between existing design and demonstrative designs was undertaken with all stakeholders on May 16, 2018. As part of this discussion, the reasons, along with pros and cons, for each element suggested in the demonstrative designs (as an alternative to existing design) were presented to all three consultants. As an outcome of this meeting, most of the recommendations included above were accepted by all three consultants. A detailed explanation to comments on the demonstrative designs and comparative analysis has been presented in Annexure 4.8.

3 Conclusion

The comparison of depot designs currently being developed for Transport Department by different consultants, with the requirements and principles, listed in the Depot design guidelines as well their comparison with sample designs (for the given sites) based on depot design guidelines, indicates at the need to revise these designs and the planning approach undertaken.

The comparison suggests that between marginal to significant augmentation of depot capacity can be achieved by adopting a more compact design approach. This approach not only reduces the number of blocks in the depot, but by combining functions in a single physical space, allows better access control and streamlined circulation. Additionally, bus circulation and bus bay arrangement (in relation to bus circulation) may not allow optimum use of parking space in the depot.

The comparison suggests that the current depot designs may not have been developed for electric buses. This is because the area allocated to sub stations is only a fraction of what is required, area for transformers has not been earmarked and sheltered electric charging units have not been shown in the designs. Instead all designs include CNG fueling units.

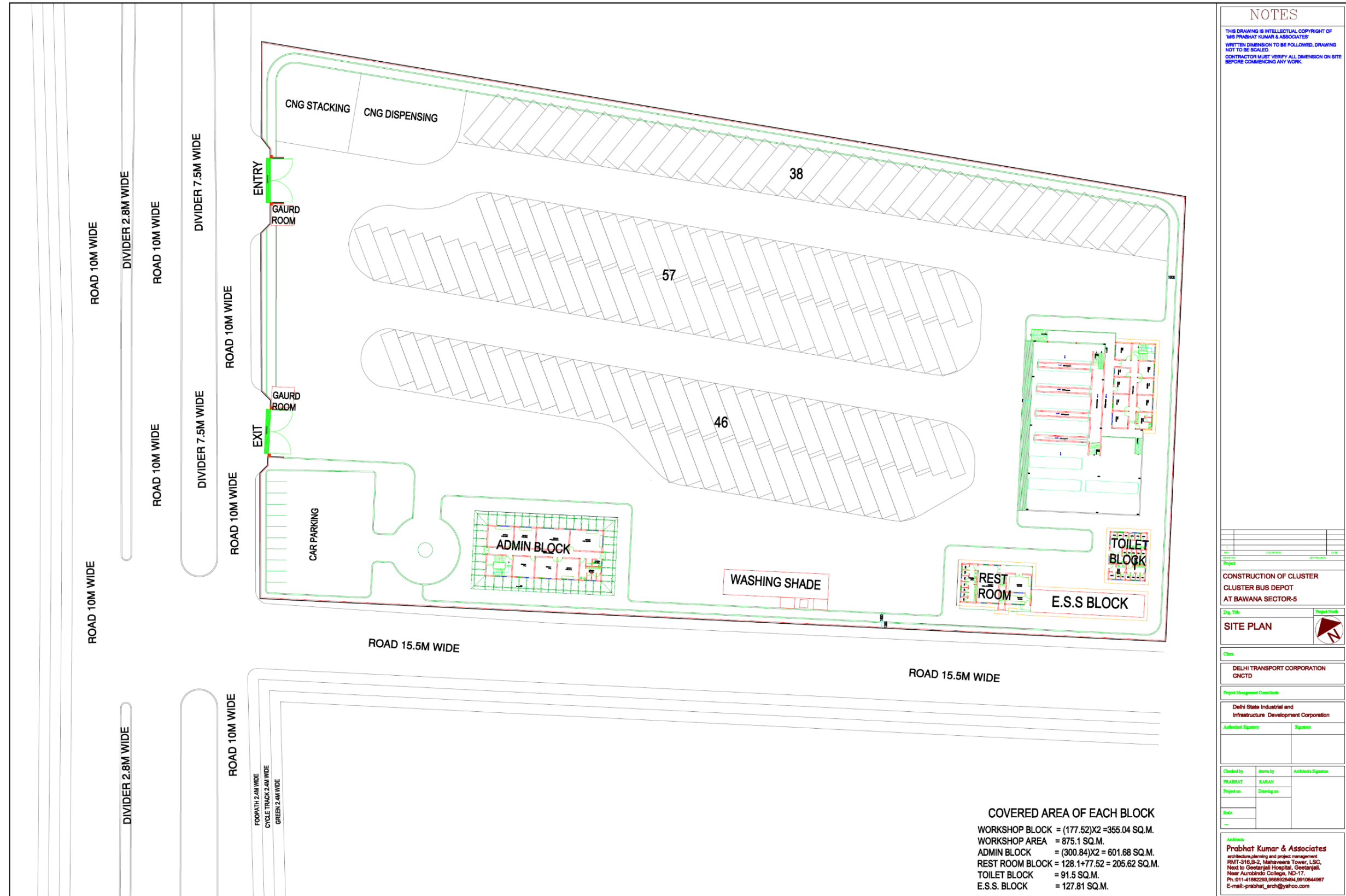
Comparison also suggests that depot infrastructure is planned for a functional capacity lower than the demand. For example, area allocated for crew restroom is only 1/5th of that suggested in the guidelines, and the area allocated for workshop functions is significantly lower than that suggested by ASRTU (S G Architects, 2017). Many other functions are missing, such as crew change rooms and locker rooms, workshop stores, etc. This suggests that these depots may be under designed for efficient operations.

It can be inferred from the depot designs being evaluated, that the depots may not be designed for universal designs and features such as lifts may need to be incorporated. However perhaps the biggest shortcoming of these designs may be the failure (by design) to allow access control for different functions and areas in the depot. The current designs in no way allow segregation of bus parking and private vehicle/staff parking and permits staff, crew and visitors to access any area of the site unchecked and unsupervised.

The ASRTU Depot Design Guidelines, provides recommendations to achieve higher utilization and efficiency from depot infrastructure through a specified design approach. It may be advisable to refer to these guidelines in order to improve the depot designs for the three sites of Bawana, East Vinod Nagar and Burari.

4 Annexures

4.1 Bawana Bus Depot (Existing proposal):



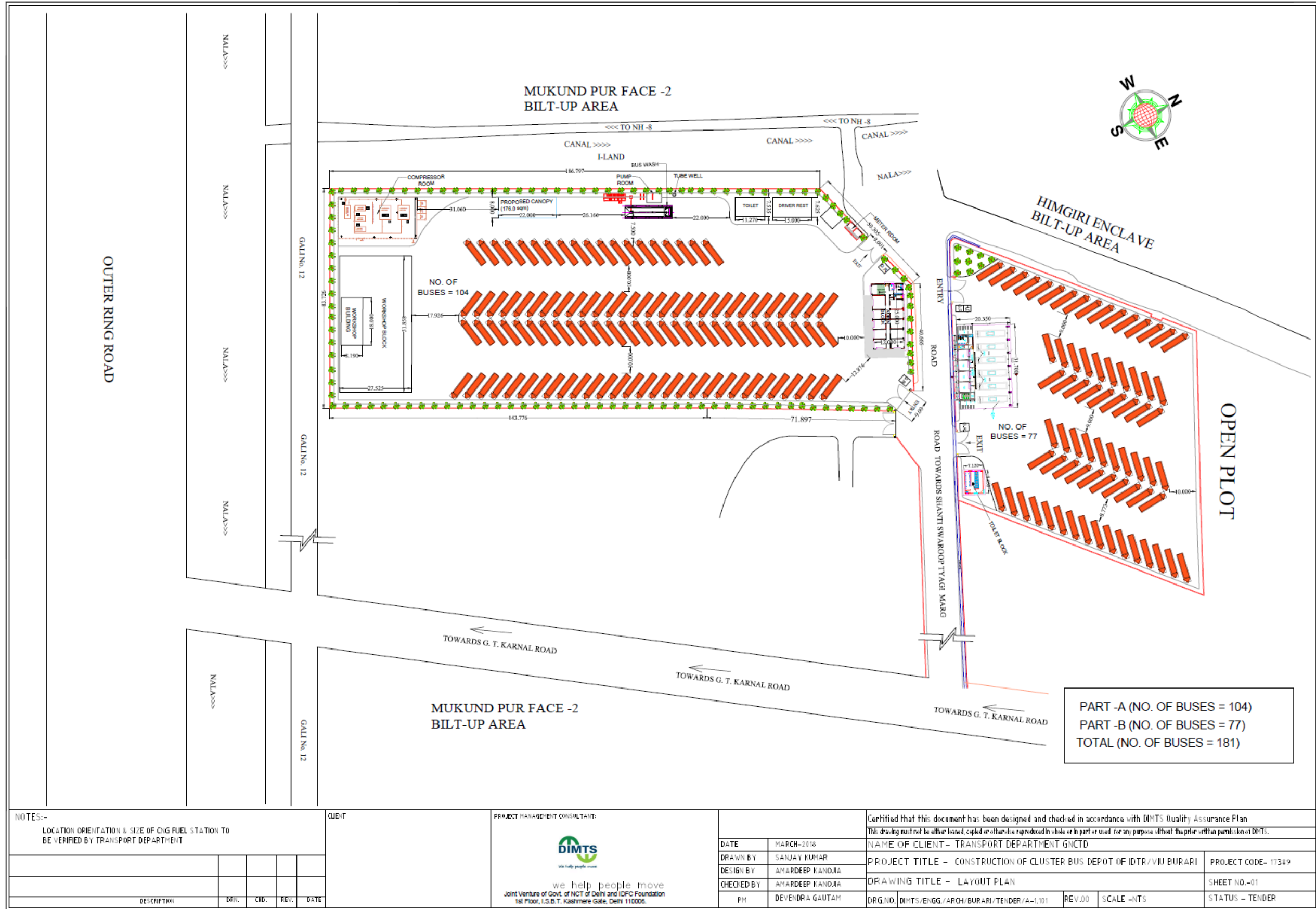
NOTES

THIS DRAWING IS INTELLECTUAL COPYRIGHT OF M/S PRABHAT KUMAR & ASSOCIATES
 WRITTEN DIMENSION TO BE FOLLOWED, DRAWING NOT TO BE SCALED.
 CONTRACTOR MUST VERIFY ALL DIMENSION ON SITE BEFORE COMMENCING ANY WORK.

Project	CONSTRUCTION OF CLUSTER BUS DEPOT AT BAWANA SECTOR-5
Dwg. Title	SITE PLAN
Client	DELHI TRANSPORT CORPORATION GNCTD
Project Management Consultant	Delhi State Industrial and Infrastructure Development Corporation
Authorised Signatory	Signature
Checked by	PRABHAT
Drawn by	KARAN
Project no.	
Drawing no.	
Scale	---

Architect
 Prabhat Kumar & Associates
 architecture planning and project management
 RMT-318, B-2, Mahaveera Tower, LSC,
 Next to Goletaraji Hospital, Goletaraji,
 Near Aurobindo College, ND-17.
 Ph. 011-41882283, 9869228494, 9910844967
 E-mail: prabhat_arch@yahoo.com

4.2 Burari Bus Depot Plan (Existing proposal):



NOTES:-
 LOCATION ORIENTATION & SIZE OF CNG FUEL STATION TO BE VERIFIED BY TRANSPORT DEPARTMENT

DESCRIPTION	DRG.	CRD.	REV.	DATE

CLIENT	
--------	--

PROJECT MANAGEMENT CONSULTANT:

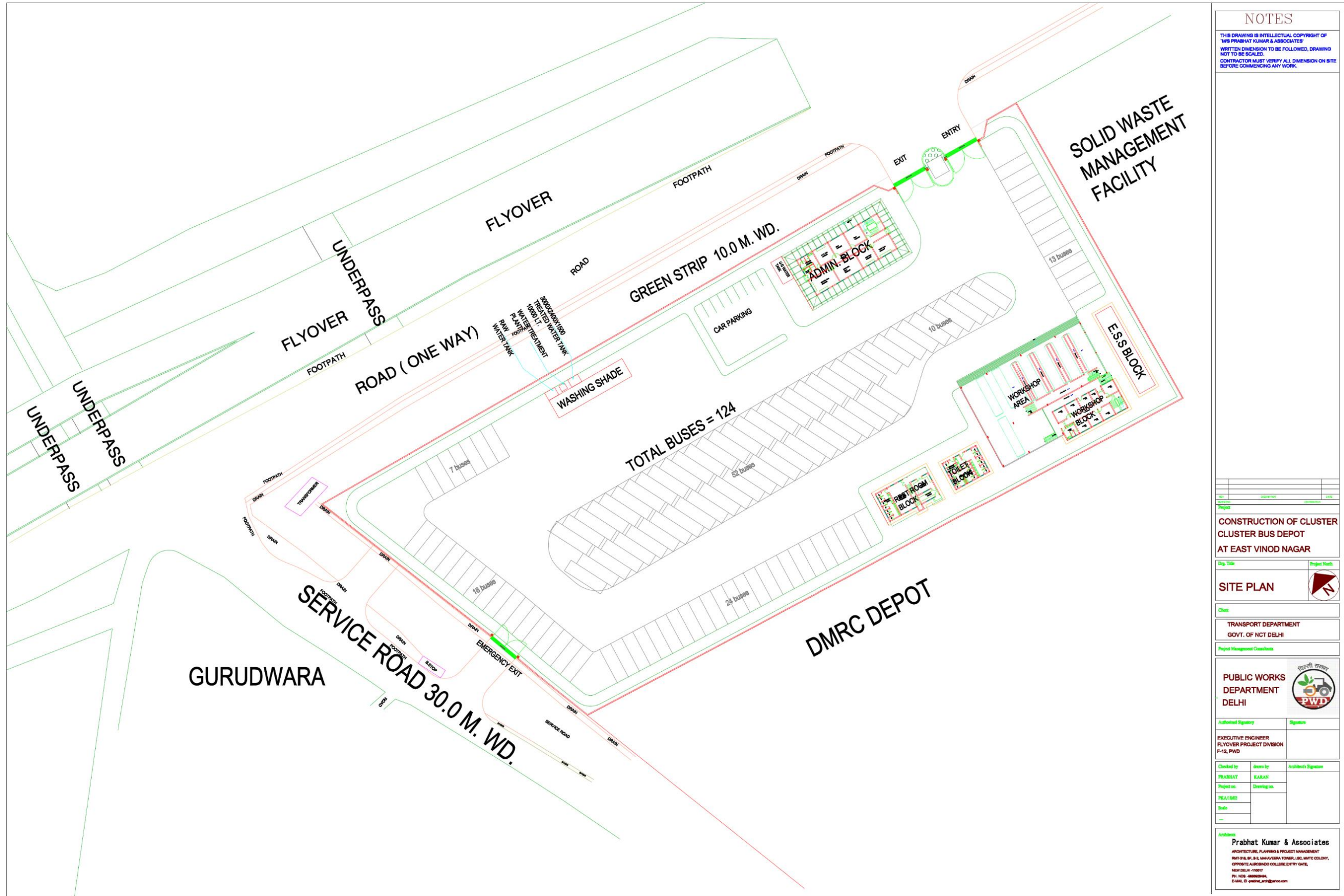


we help people move
 Joint Venture of Govt. of NCT of Delhi and IDFC Foundation
 1st Floor, I.S.B.T. Kashmir Gate, Delhi 110005.

DATE	MARCH-2016
DRAWN BY	SANJAY KUMAR
DESIGN BY	AMARDEEP KANDIJA
CHECKED BY	AMARDEEP KANDIJA
PM	DEVENDRA GAUTAM

Certified that this document has been designed and checked in accordance with DIMTS Quality Assurance Plan This drawing must not be either loaned, copied or otherwise reproduced in whole or in part or used for any purpose without the prior written permission of DIMTS.			
NAME OF CLIENT - TRANSPORT DEPARTMENT GNCTD			
PROJECT TITLE - CONSTRUCTION OF CLUSTER BUS DEPOT OF IDTR/VII BURARI		PROJECT CODE- 173&9	
DRAWING TITLE - LAYOUT PLAN		SHEET NO.-01	
DRG.NO.	DIMTS/ENGG./ARCH./BURARI/TENDER/A-1,101	REV.00	SCALE -NTS
STATUS - TENDER			

4.3 East Vinod Nagar Bus Depot Plans (Existing proposal):




NOTES

THIS DRAWING IS INTELLECTUAL COPYRIGHT OF 'M/S PRABHAT KUMAR & ASSOCIATES'. WRITTEN DIMENSION TO BE FOLLOWED. DRAWING NOT TO BE SCALED. CONTRACTOR MUST VERIFY ALL DIMENSION ON SITE BEFORE COMMENCING ANY WORK.

NO.	REVISION	DATE


CONSTRUCTION OF CLUSTER CLUSTER BUS DEPOT AT EAST VINOD NAGAR

Project Name: _____ Project Month: _____

SITE PLAN 

Client: TRANSPORT DEPARTMENT GOVT. OF NCT DELHI

Project Management Classification: _____

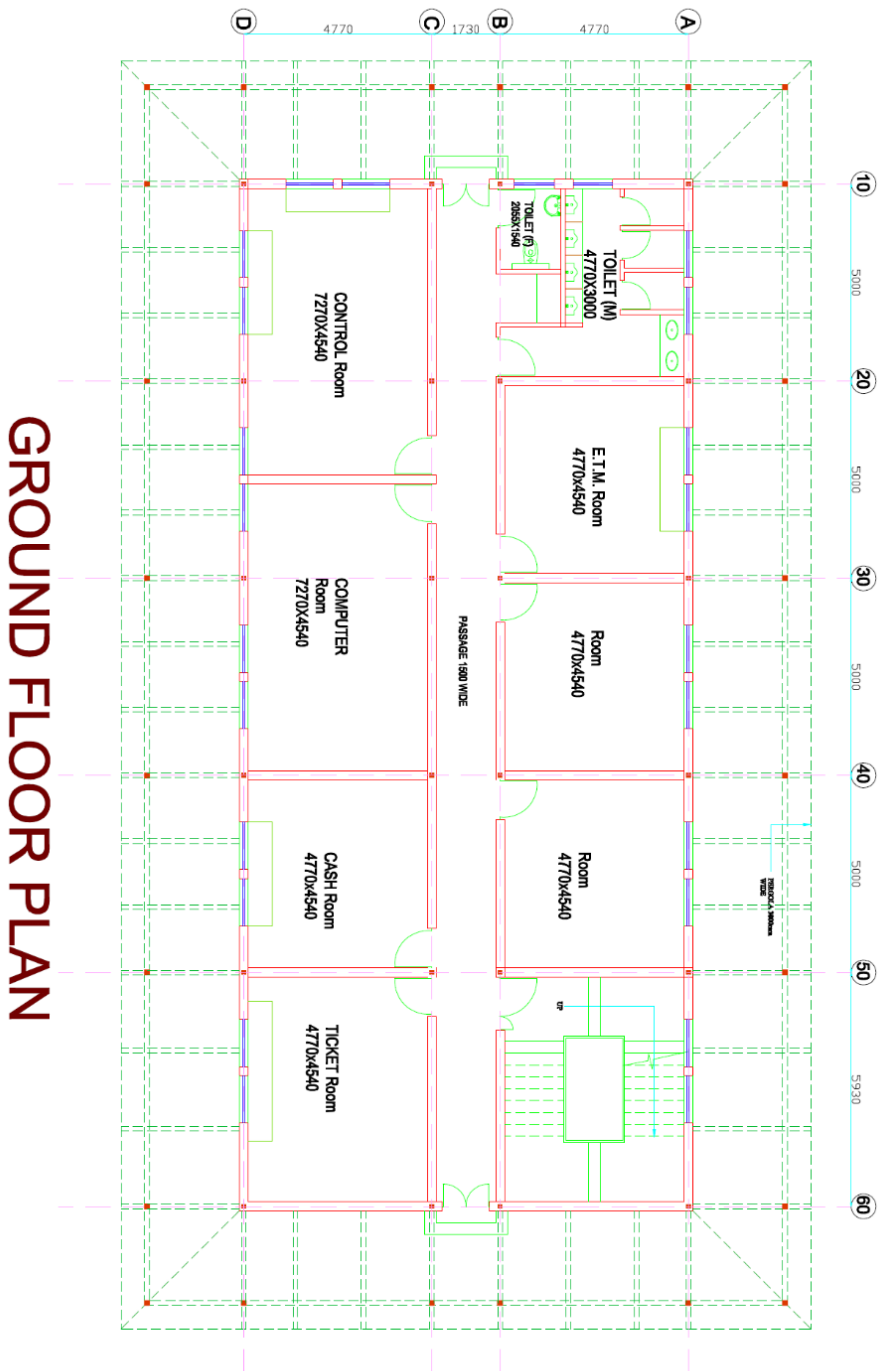
PUBLIC WORKS DEPARTMENT DELHI 

Authorised Signatory: _____ Signature: _____

EXECUTIVE ENGINEER FLYOVER PROJECT DIVISION F-12, PWD

Checked by: PRABHAT KARAN
 Drawn by: _____
 Project no.: TRA/1885
 Scale: _____

Architect: **Prabhat Kumar & Associates**
 ARCHITECTURE, PLANNING & PROJECT MANAGEMENT
 PLOT 214, B.P. D.S. MANAVISRA TOWNSHIP, SEC. 13/17C COLONY,
 OPPOSITE ALUMINUM COLLEGE ENTRY GATE,
 NEW DELHI - 110017
 PH. NO. 26000948,
 E-MAIL: © prabhat.associates@gmail.com



GROUND FLOOR PLAN



FIRST FLOOR PLAN

NOTES
THIS DRAWING IS INTELLECTUAL COPYRIGHT OF THIS PRACTICE. PRACTICE & ASSOCIATES. WRITTEN PERMISSION IS REQUIRED FOR REPRODUCTION. DRAWING CONTRACTOR MUST VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORK.

CONSTRUCTION OF CLUSTER CLUSTER BUS DEPOT AT EAST VINOD NAGAR

Project Title	Project Block
Client	TRANSPORT DEPARTMENT GOVT. OF NCT DELHI
Project Manager	

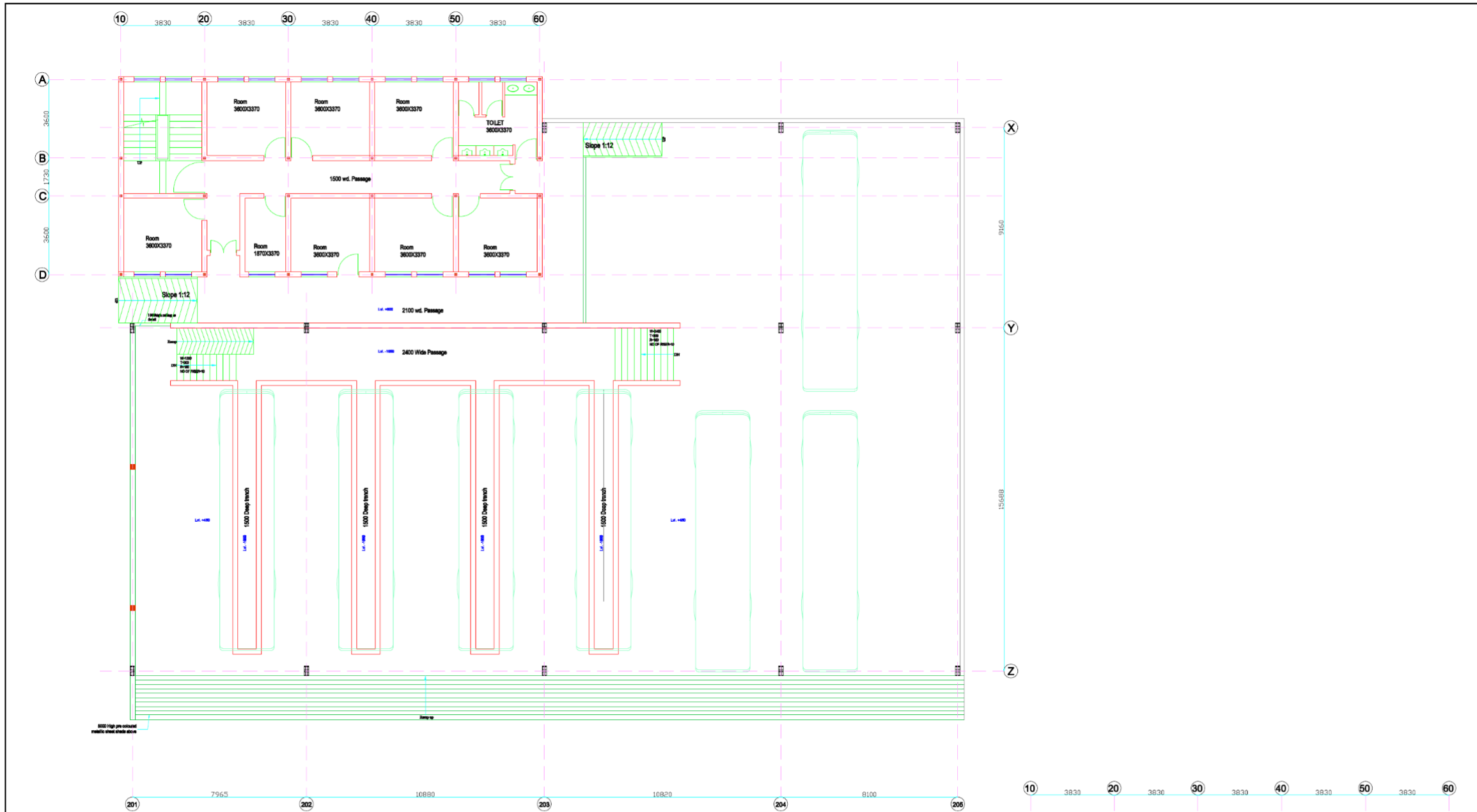
PUBLIC WORKS DEPARTMENT DELHI

Project Manager
Siddhant Singhal

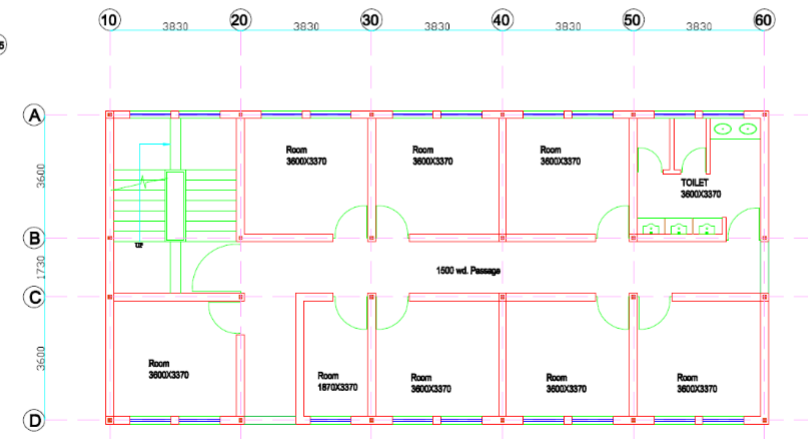
Checked by	Drawn by	Scale
RAJANIVAT	Charviya sh	
Project No.	Project Name	

Prabhat Kumar & Associates
ARCHITECTS, ENGINEERS & PROJECT MANAGERS
PLOT NO. 10, SECTOR 10, GATEWAY INDIA, NEW DELHI - 110021
PHONE: 011-26101111
WWW.PKASOCIATES.COM

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar



GROUND FLOOR PLAN



FIRST FLOOR PLAN

NOTES

THIS DRAWING IS INTELLECTUAL COPYRIGHT OF
 M/S PRABHAT KUMAR & ASSOCIATES
 WRITTEN DIMENSION TO BE FOLLOWED, DRAWING
 NOT TO BE SCALED.
 CONTRACTOR MUST VERIFY ALL DIMENSION ON SITE
 BEFORE COMMENCING ANY WORK.

CONSTRUCTION OF CLUSTER
 CLUSTER BUS DEPOT
 AT EAST VINOD NAGAR

WORKSHOP BLOCK

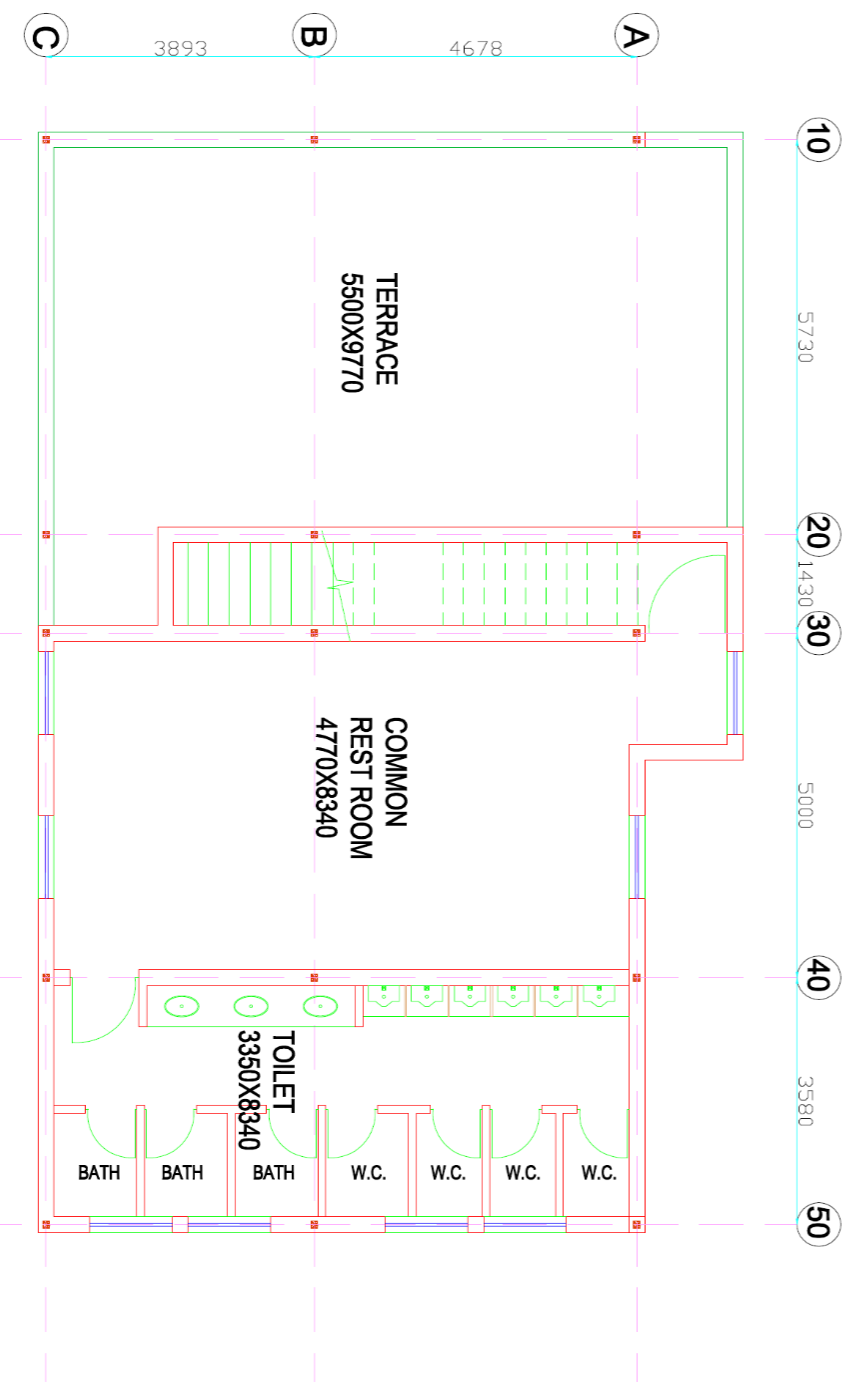
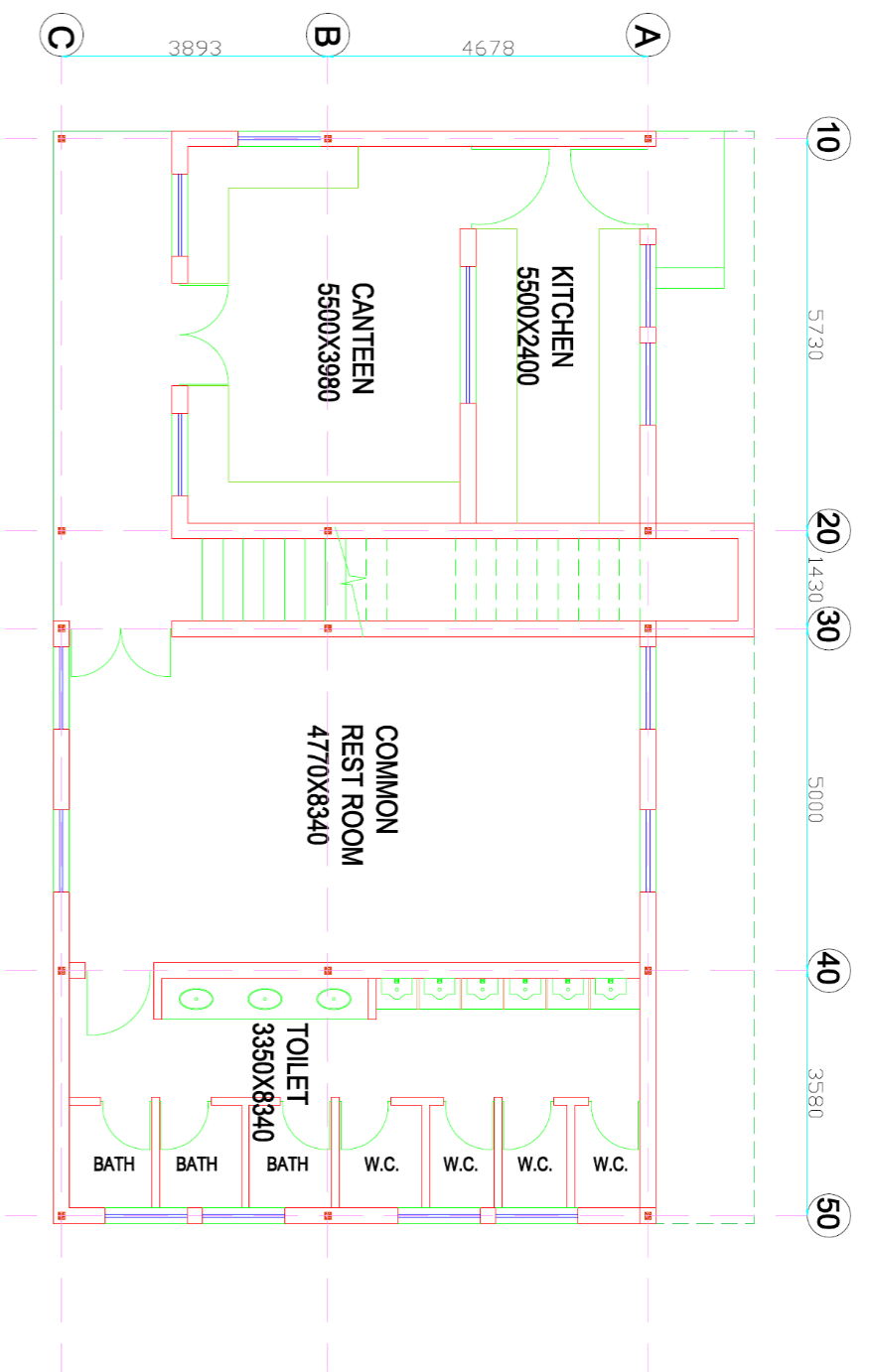
Client
 TRANSPORT DEPARTMENT
 GOVT. OF NCT DELHI

Project Management Organisation
 PUBLIC WORKS
 DEPARTMENT
 DELHI

Authorized Signatory
 EXECUTIVE ENGINEER
 FLYOVER PROJECT DIVISION
 P-12, PWD

Checked by: PRABHAT
 Drawn by: EAMAN
 Project no.: PKA/18/02
 Scale: ---

Architect
 Prabhat Kumar & Associates
 ARCHITECTURE, PLANNING & PROJECT MANAGEMENT
 B-17/18, 2/F, 34-2, ANAND VIHAR, TOWER, L-12, WARD 10 COLONY,
 DIPLOMAT ANAND VIHAR COLLEGE ENTRY GATE,
 NEW DELHI - 110017
 Ph: +91-11-26108888
 Email: C.prasad_ank@prabhat.com



NOTES

THIS DRAWING IS AN INTELLECTUAL PROPERTY OF THE CONSULTANT. ANY REUSE OR MODIFICATION WITHOUT THE WRITTEN PERMISSION OF THE CONSULTANT IS STRICTLY PROHIBITED. ALL DIMENSIONS ON SITE SHOULD BE VERIFIED BEFORE COMMENCING ANY WORK.

**CONSTRUCTION OF CLUSTER
CLUSTER BUS DEPOT
AT EAST VINOD NAGAR**

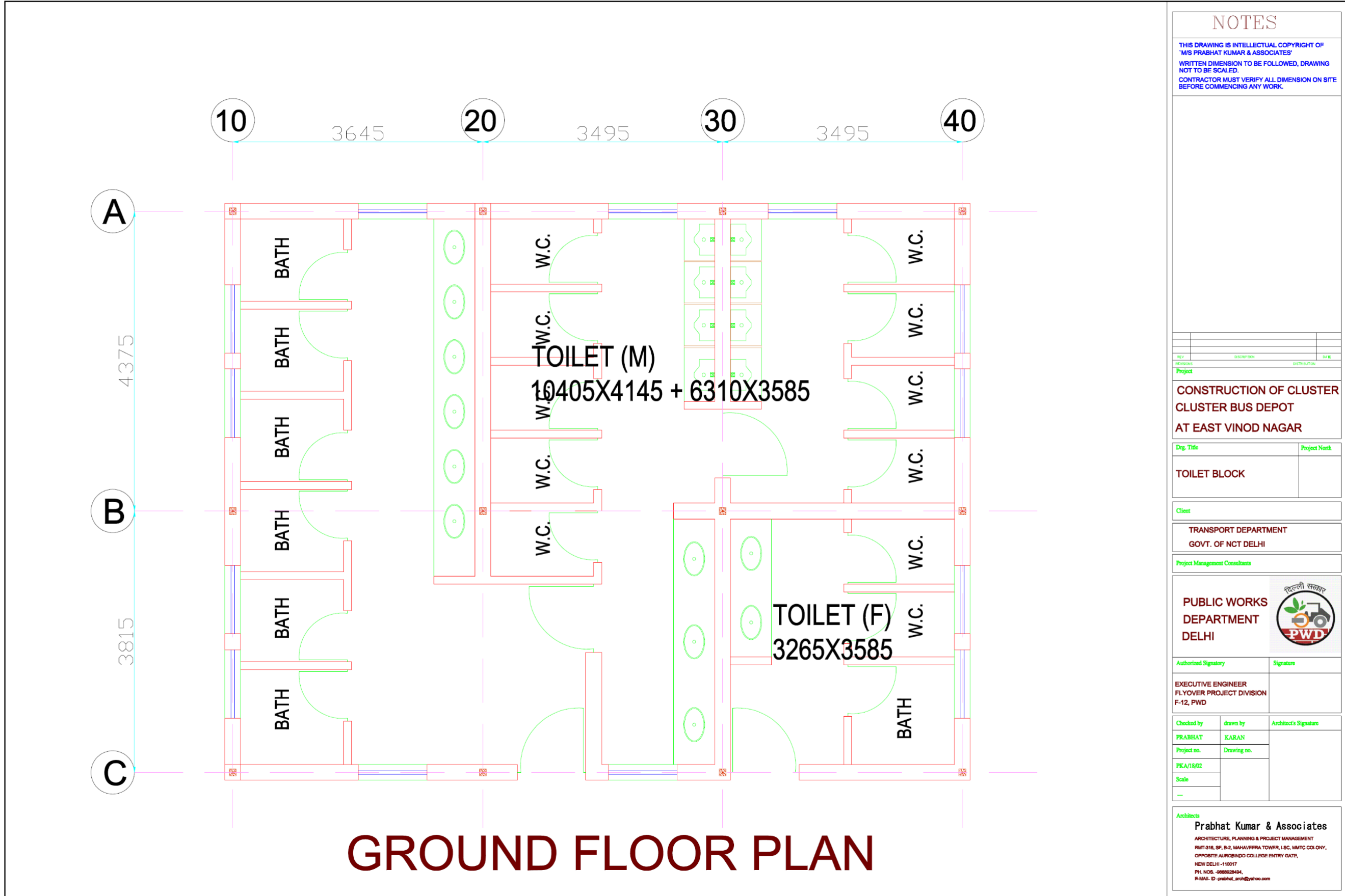
Project Name: Rest Room Block

Client: TRANSPORT DEPARTMENT
GOVT. OF NCT DELHI

Project Manager:

Author:	Prabhakar Kumar & Associates
Checked By:	Prabhakar Kumar
Approved By:	Prabhakar Kumar
Scale:	As per drawing

Prabhakar Kumar & Associates
 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.



GROUND FLOOR PLAN

NOTES

THIS DRAWING IS INTELLECTUAL COPYRIGHT OF 'M/S PRABHAT KUMAR & ASSOCIATES'
 WRITTEN DIMENSION TO BE FOLLOWED, DRAWING NOT TO BE SCALED.
 CONTRACTOR MUST VERIFY ALL DIMENSION ON SITE BEFORE COMMENCING ANY WORK.

REV	DESCRIPTION	DATE

**CONSTRUCTION OF CLUSTER
 CLUSTER BUS DEPOT
 AT EAST VINOD NAGAR**

Dep. Title: Project North

TOILET BLOCK

Client:
 TRANSPORT DEPARTMENT
 GOVT. OF NCT DELHI

Project Management Consultants:

**PUBLIC WORKS
 DEPARTMENT
 DELHI**



Authorized Signatory: Signature

EXECUTIVE ENGINEER
 FLYOVER PROJECT DIVISION
 F-12, PWD

Checked by: PRABHAT, drawn by: KARAN, Architect's Signature

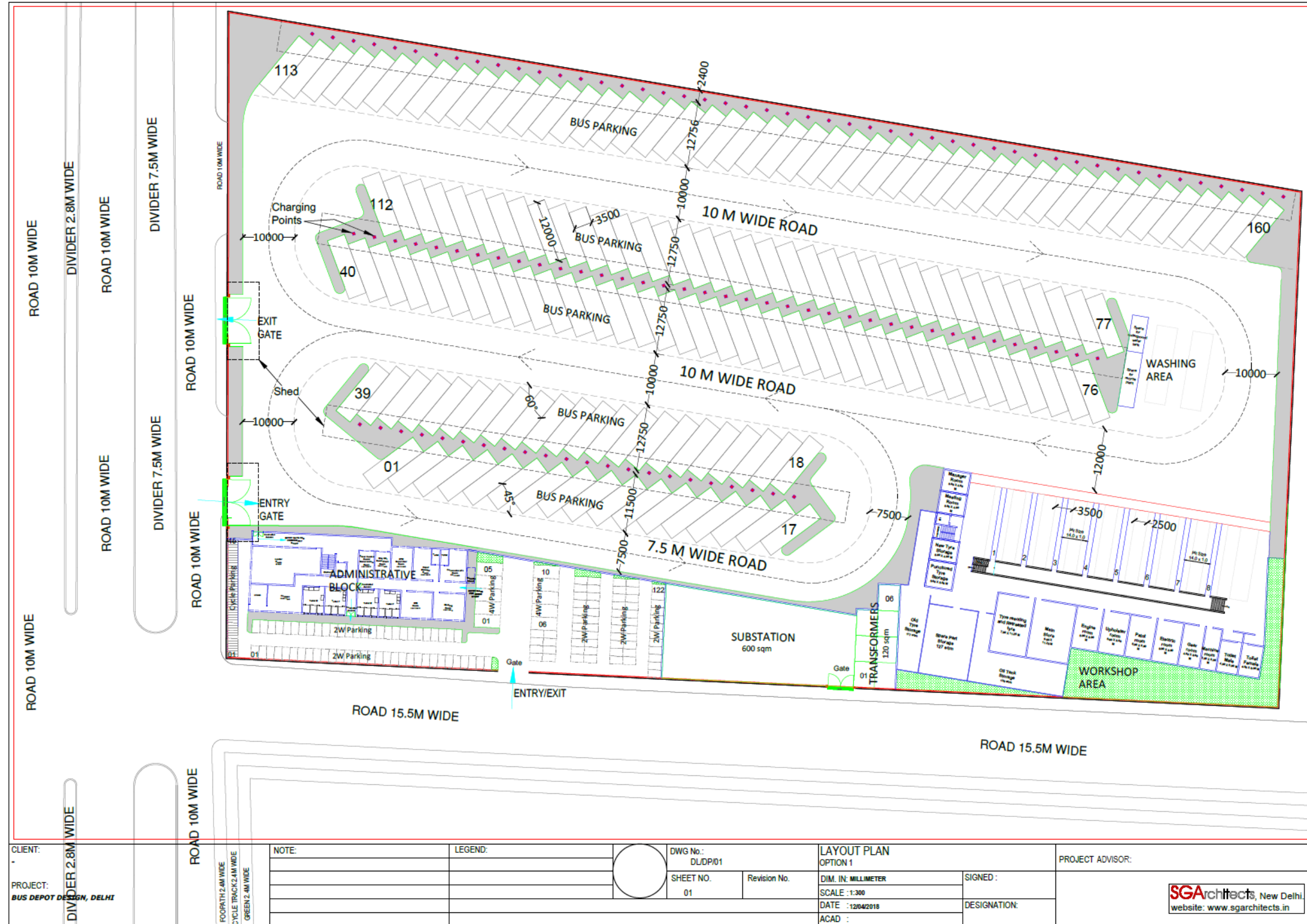
Project no.: PKA/18/02, Drawing no.:


Scale: --

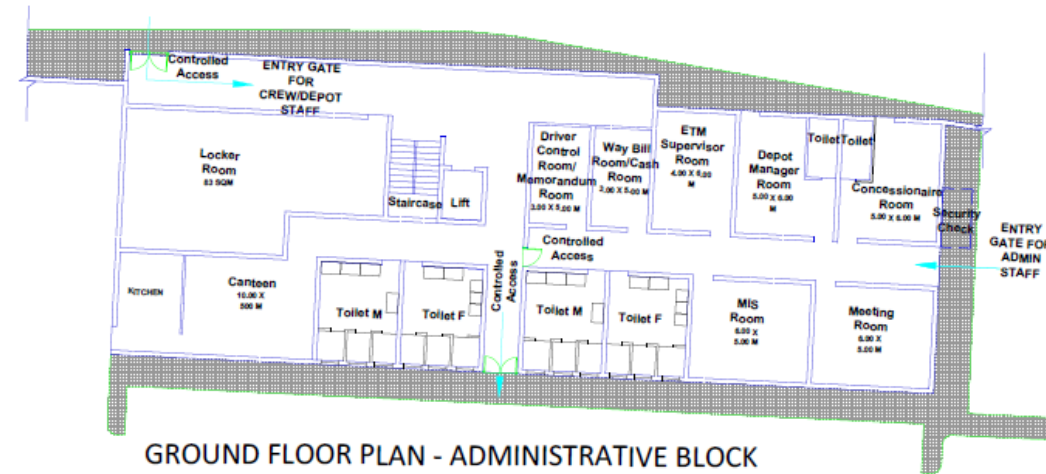
Architects:
Prabhat Kumar & Associates
 ARCHITECTURE, PLANNING & PROJECT MANAGEMENT
 RMT-316, SF, B-2, MAHAVEERA TOWER, I.S.C., MITC COLONY,
 OPPOSITE ALROBINDO COLLEGE ENTRY GATE,
 NEW DELHI - 110017
 PH. NOS. - 886828484,
 E-MAIL: ID - prabhat_arch@yahoo.com

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

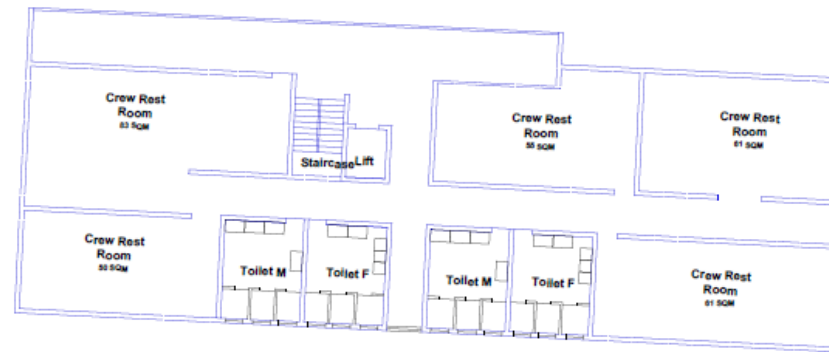
4.4 Bawana Bus Depot Plans (Proposed Option 1):



CLIENT: -	PROJECT: BUS DEPOT DESIGN, DELHI	NOTE:	LEGEND:	DWG No.: DU/DP/01	LAYOUT PLAN OPTION 1		PROJECT ADVISOR:
					SHEET NO. 01	Revision No.	
ROAD 10M WIDE		ROAD 10M WIDE		ROAD 15.5M WIDE		DATE : 12/04/2018	
DIVIDER 2.8M WIDE		ROAD 10M WIDE		ROAD 15.5M WIDE		ACAD :	
ROAD 10M WIDE		ROAD 10M WIDE		ROAD 15.5M WIDE		DESIGNATION:	
ROAD 10M WIDE		ROAD 10M WIDE		ROAD 15.5M WIDE		 SGArchitects, New Delhi. website: www.sgarchitects.in	
ROAD 10M WIDE		ROAD 10M WIDE		ROAD 15.5M WIDE			



GROUND FLOOR PLAN - ADMINISTRATIVE BLOCK

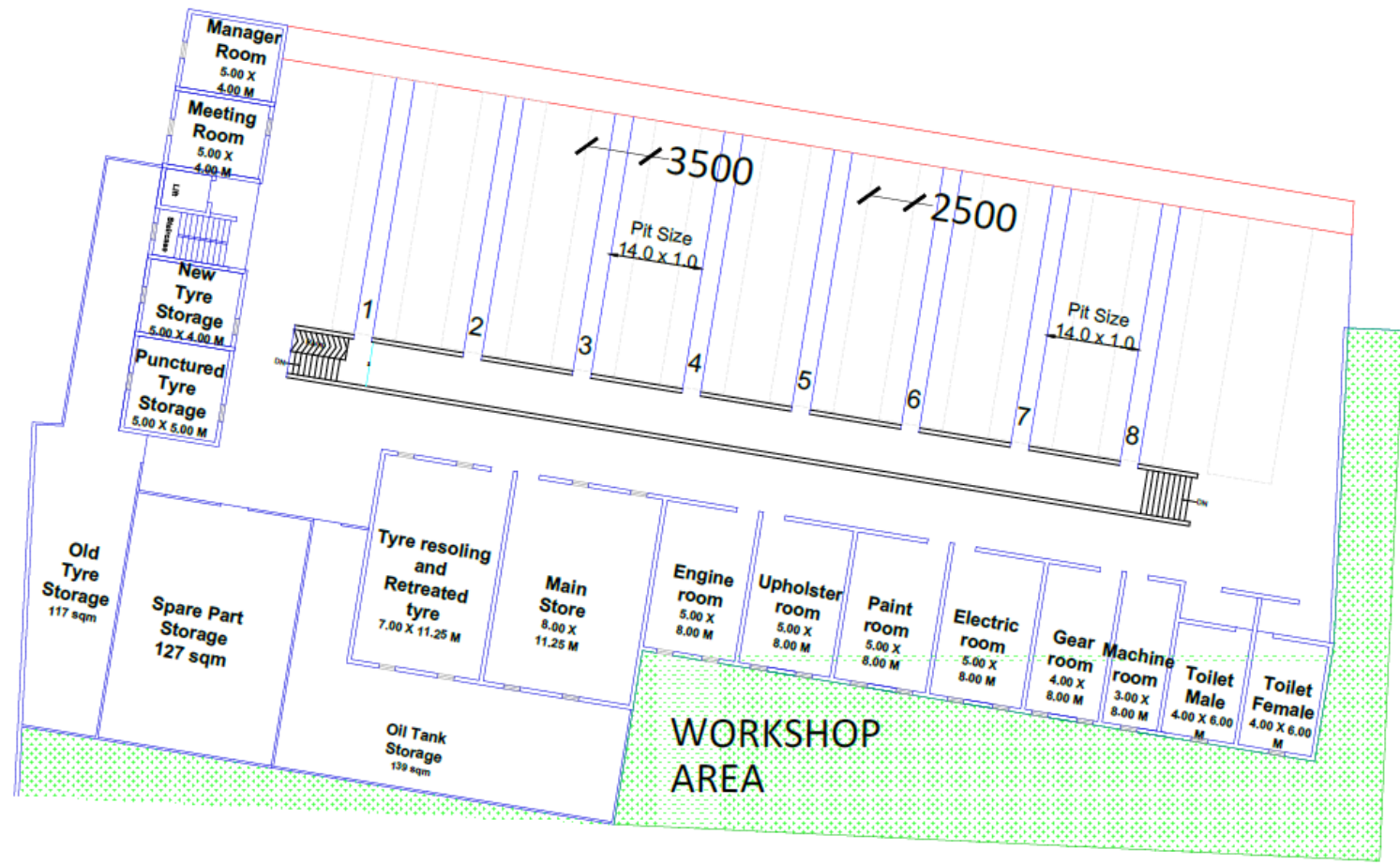


FIRST FLOOR PLAN - ADMINISTRATIVE BLOCK
REST ROOM TOTAL AREA : 310 SQM

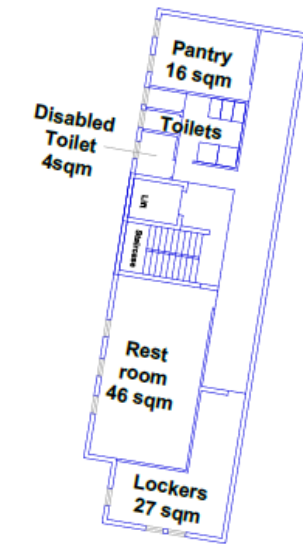


SECOND FLOOR PLAN - ADMINISTRATIVE BLOCK
REST ROOM TOTAL AREA : 310 SQM

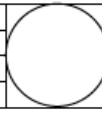

CLIENT: - PROJECT: BUS DEPOT DESIGN, DELHI	NOTE:	LEGEND:		DWG No.: DLDDP/01	ADMINISTRATIVE BLOCK PLANS OPTION 1		PROJECT ADVISOR:	
				SHEET NO. 01	Revision No.	DIM. IN: MILLIMETER	SIGNED :	
						SCALE : 1:300	DESIGNATION:	
						DATE : 12/04/2018		
					ACAD :			



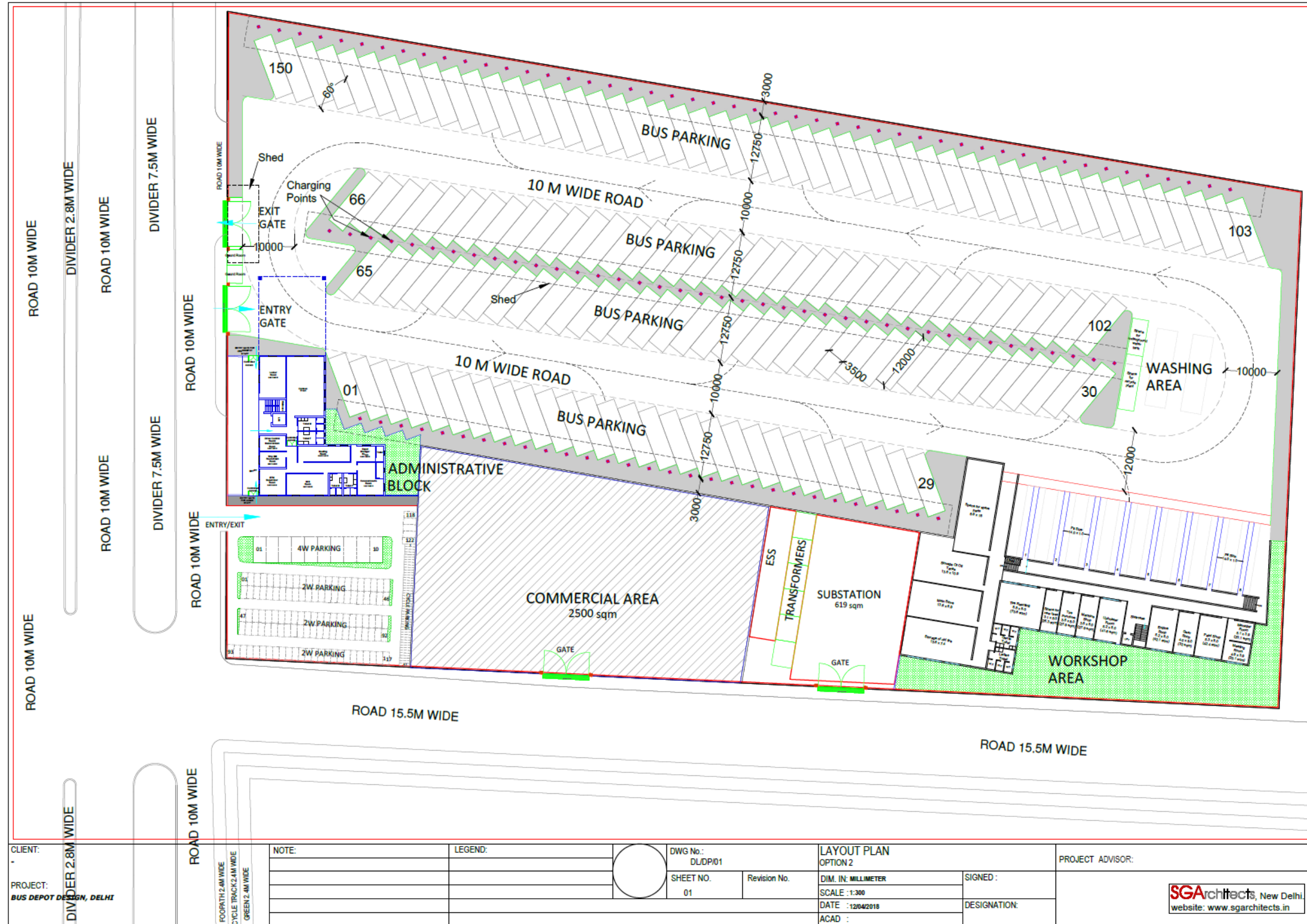
GROUND FLOOR PLAN - WORKSHOP BLOCK

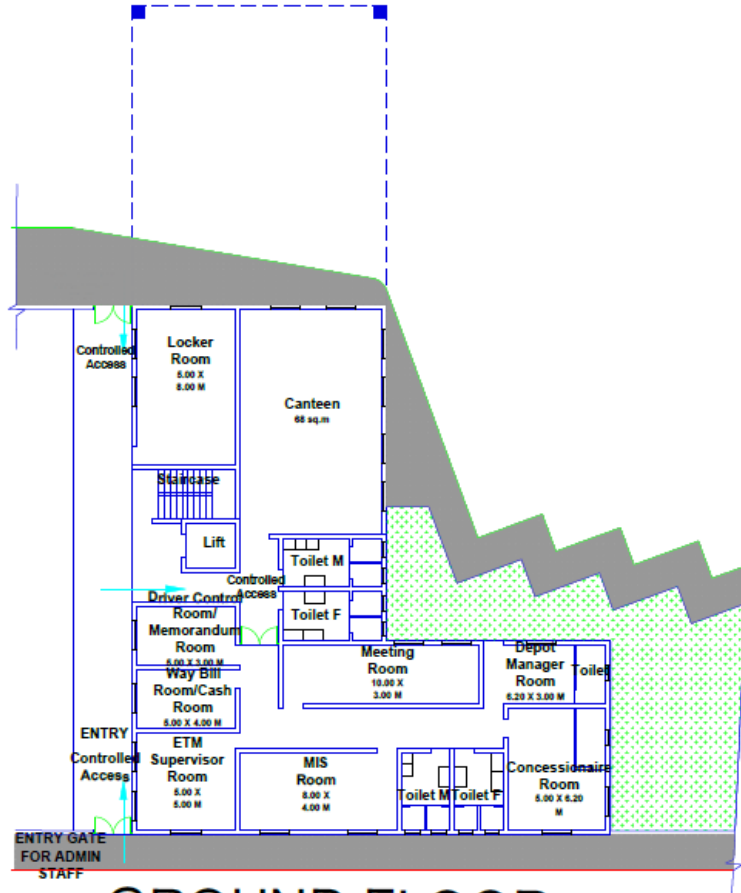


FIRST FLOOR PLAN - WORKSHOP BLOCK

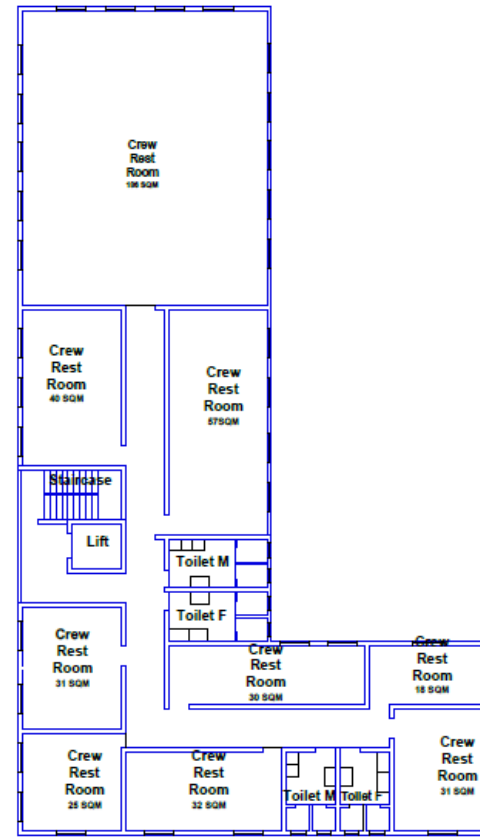
CLIENT: -	NOTE:	LEGEND:		DWG No.: DLDP/01	WORKSHOP BLOCK PLANS OPTION 1		PROJECT ADVISOR:
	PROJECT: BUS DEPOT DESIGN, DELHI				SHEET NO.: 01	Revision No.:	DIM. IN: MILLIMETER SCALE : 1:300 DATE : 12/04/2018 ACAD :
							 SGA Architects, New Delhi. website: www.sgarchitects.in

4.5 Bawana Bus Depot Plans (Proposed Option 2):

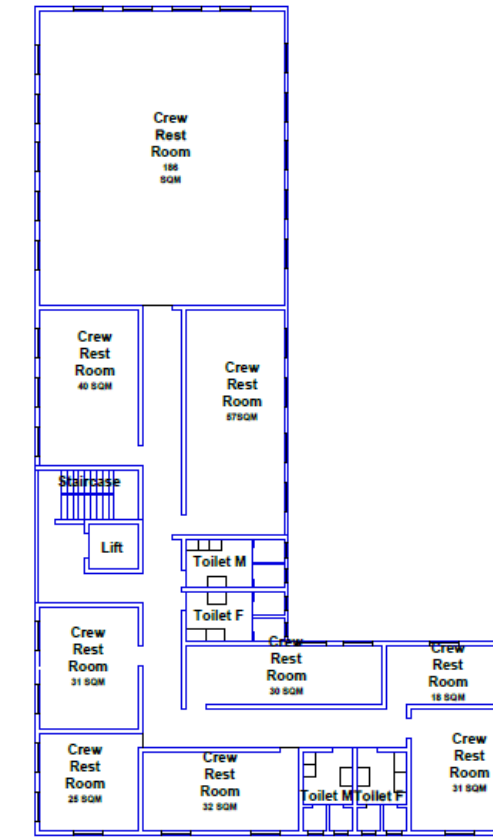




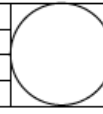

GROUND FLOOR
ADMINISTRATIVE BLOCK

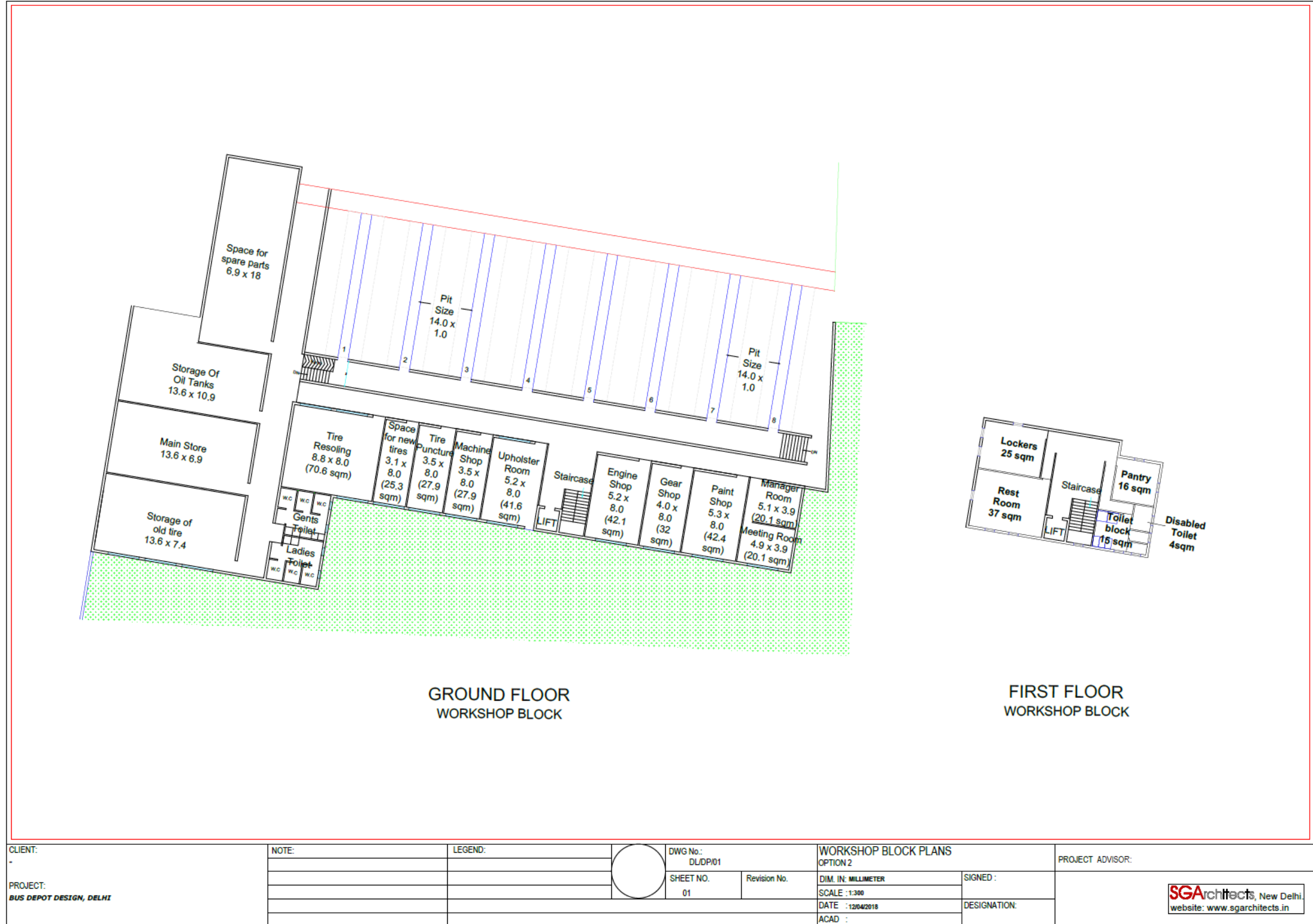


FIRST FLOOR
Rest room total Area = 450 sqm



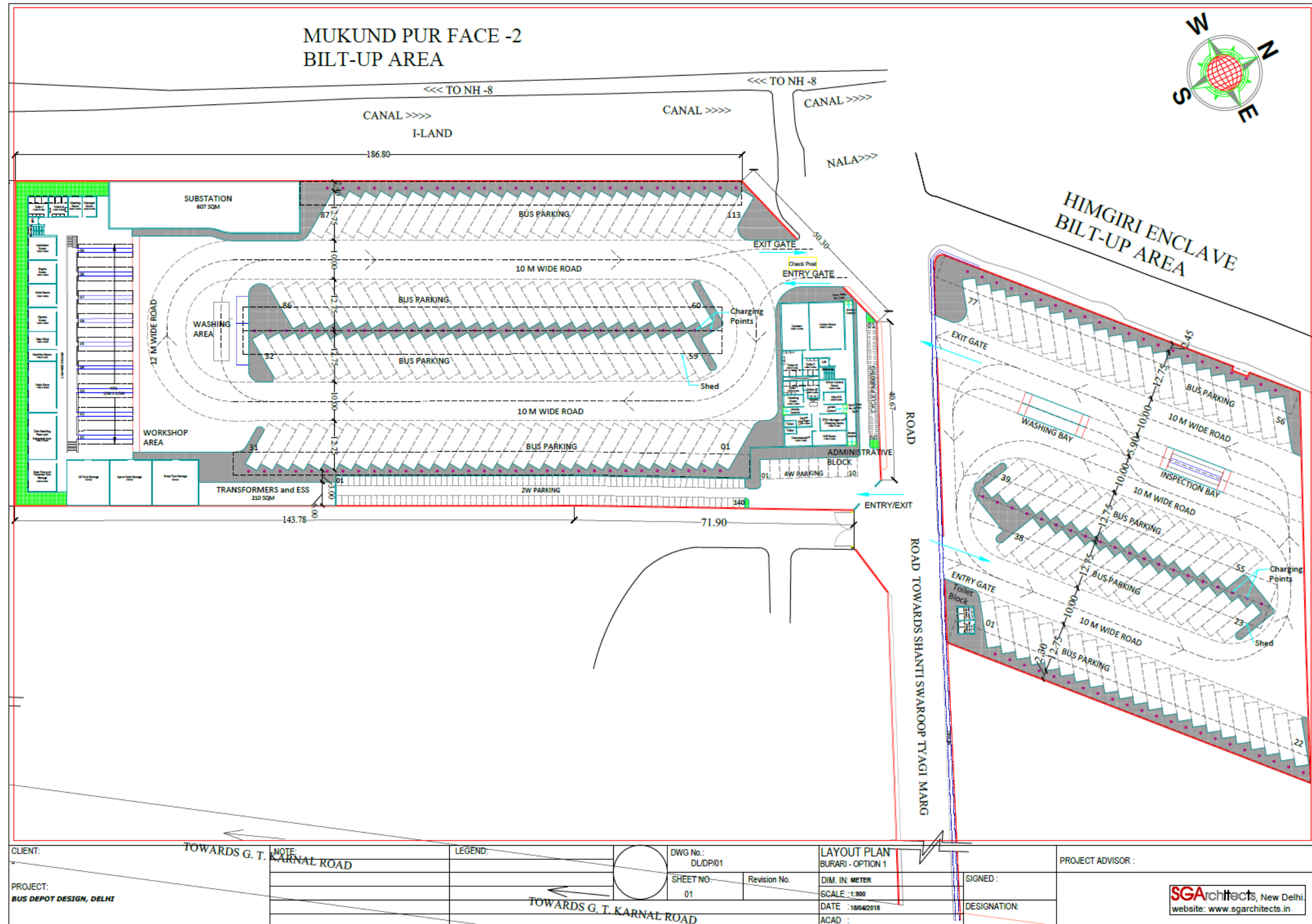
SECOND FLOOR
Rest room total Area = 450 sqm

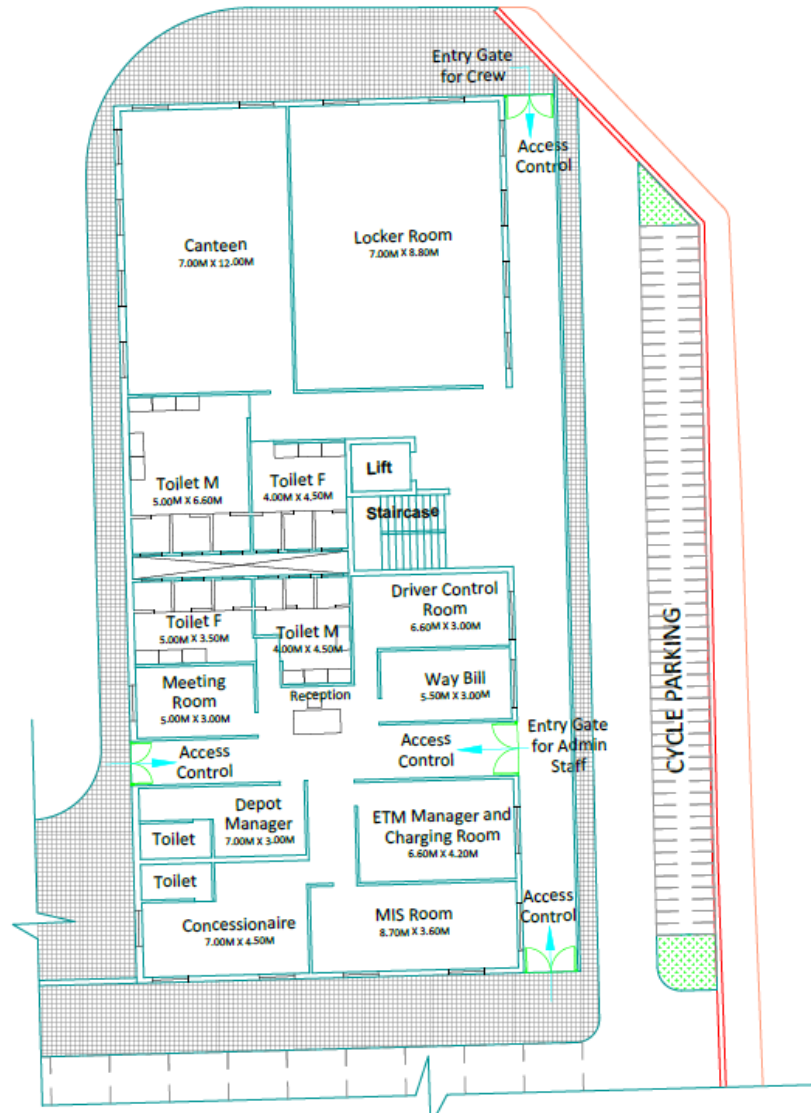
CLIENT: -	NOTE:	LEGEND:		DWG No.: DLDP/01	ADMINISTRATIVE BLOCK PLANS OPTION 2		PROJECT ADVISOR:	
PROJECT: BUS DEPOT DESIGN, DELHI				SHEET NO. 01	Revision No.	DIM. IN: MILLIMETER	SIGNED :	 SGA Architects, New Delhi. website: www.sgarchitects.in
						SCALE : 1:300	DESIGNATION:	
						DATE : 12/04/2018		
					ACAD :			



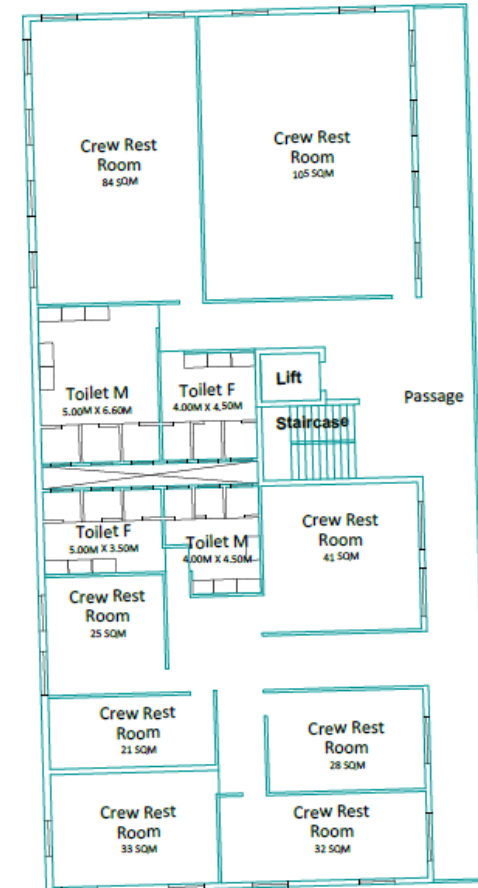
CLIENT: - PROJECT: BUS DEPOT DESIGN, DELHI	NOTE:	LEGEND:	DWG No.: DLDP/01 SHEET NO.: 01	WORKSHOP BLOCK PLANS OPTION 2		PROJECT ADVISOR:
				DIM. IN: MILLIMETER SCALE : 1:300	SIGNED :	
				DATE : 12/04/2018 ACAD :	DESIGNATION:	

4.6 Burari Bus Depot Plans (Proposed):

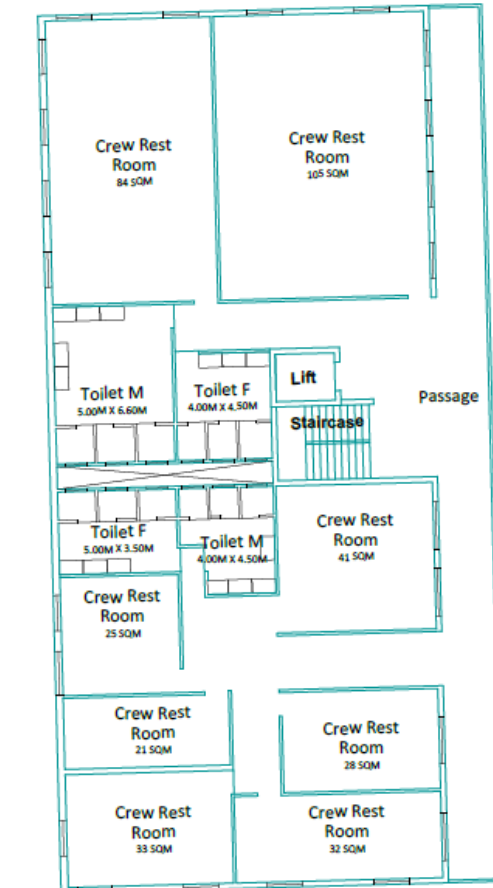




GROUND FLOOR PLAN
ADMINISTRATIVE BLOCK



FIRST FLOOR PLAN
ADMINISTRATIVE BLOCK
CREW REST ROOM AREA - 370 SQM

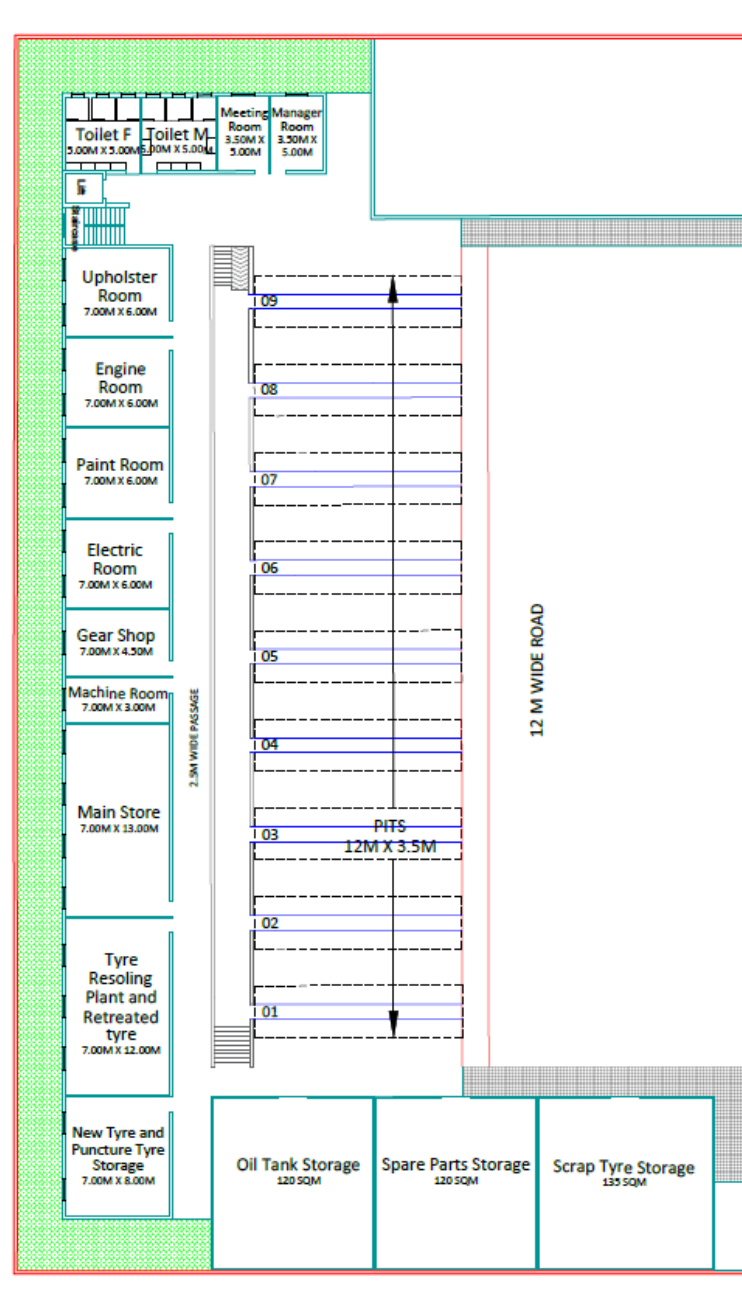


SECOND FLOOR PLAN
ADMINISTRATIVE BLOCK
CREW REST ROOM AREA - 370 SQM

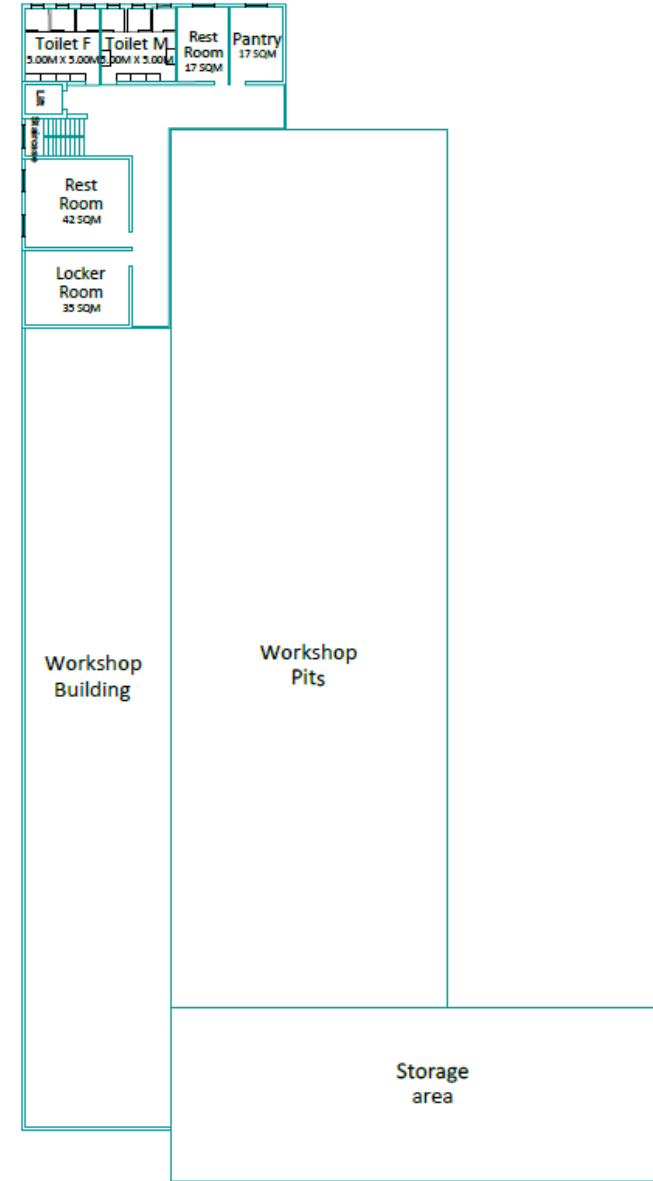
CLIENT: -	NOTE:	LEGEND:	DWG No.: DLDDP/01	ADMINISTRATIVE BLOCK PLANS		PROJECT ADVISOR:
				BURARI - OPTION 1		
PROJECT: BUS DEPOT DESIGN, DELHI			SHEET NO. 02	Revision No.	DIM. IN: METER	SIGNED:
					SCALE : 1:250	DESIGNATION:
					DATE : 18/04/2018	
				ACAD :		

SGArchitects, New Delhi.
website: www.sgarchitects.in

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar



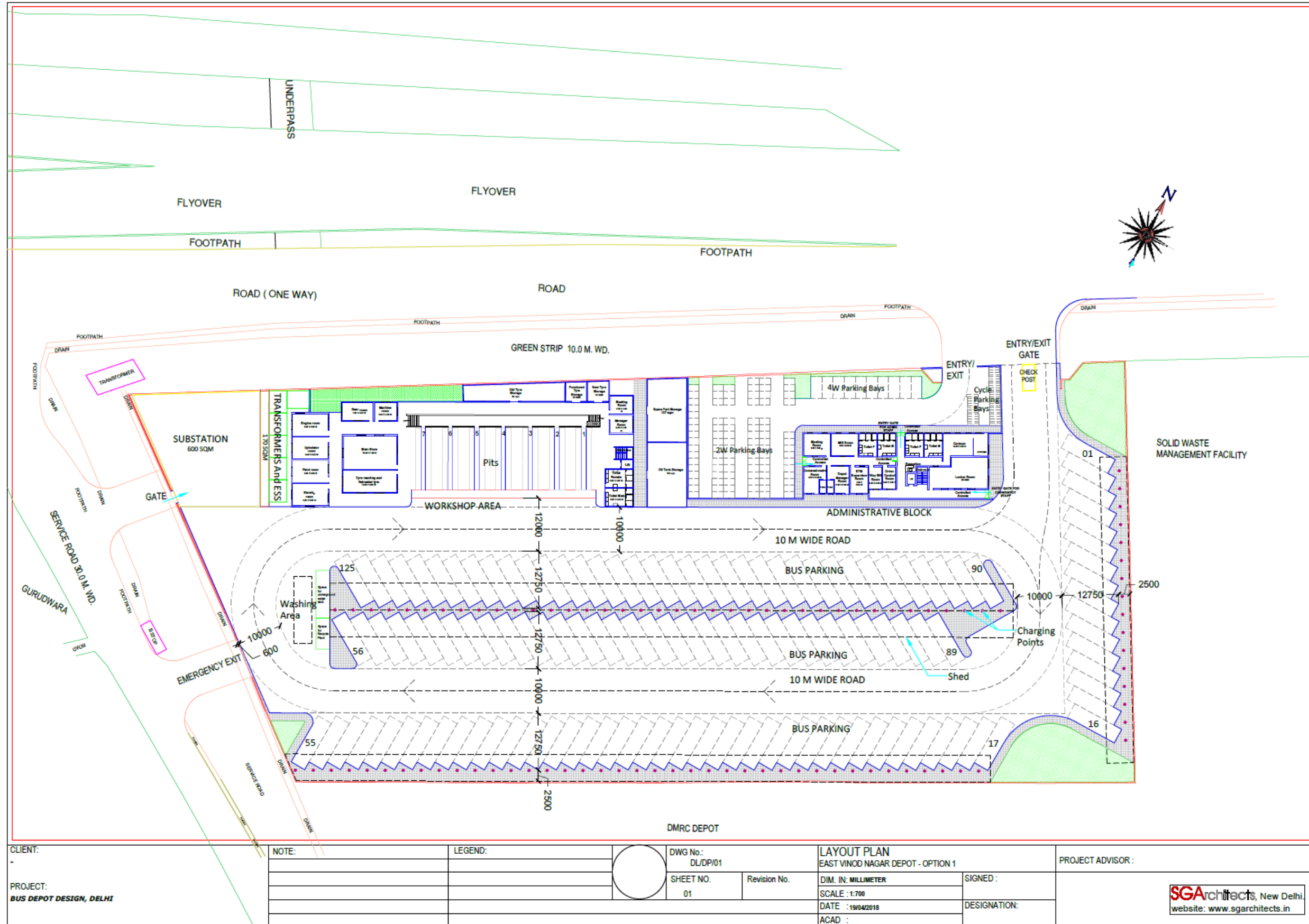
GROUND FLOOR PLAN
WORKSHOP AREA

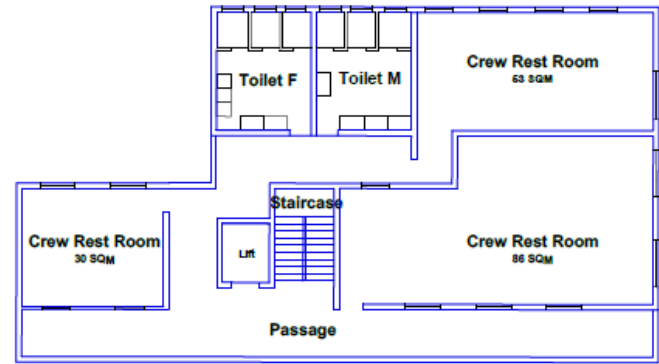


FIRST FLOOR PLAN
WORKSHOP AREA

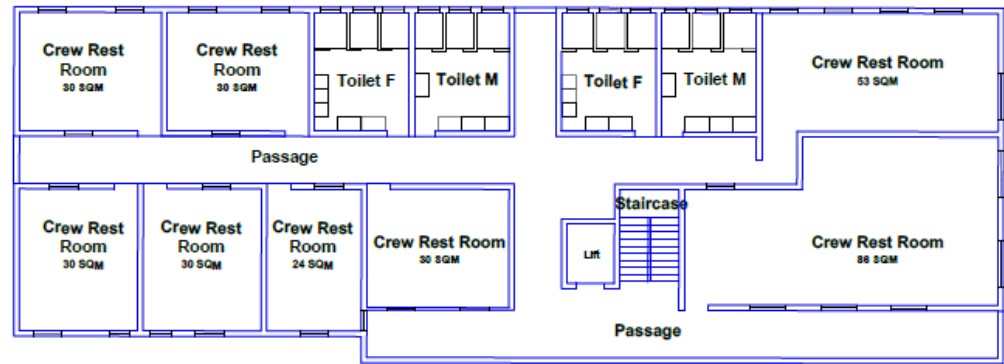
CLIENT: -	NOTE:	LEGEND:	DWG No.: DLDP/01	WORKSHOP PLANS BURARI - OPTION 1		PROJECT ADVISOR :
				SHEET NO. 03	Revision No.	
PROJECT: BUS DEPOT DESIGN, DELHI				DIM. IN: METER	DESIGNATION:	SGArchitects, New Delhi. website: www.sgarchitects.in
				SCALE : 1:400		
				DATE : 18/04/2018		
				ACAD :		

4.7 East Vinod Nagar Bus Depot Plans (Proposed):

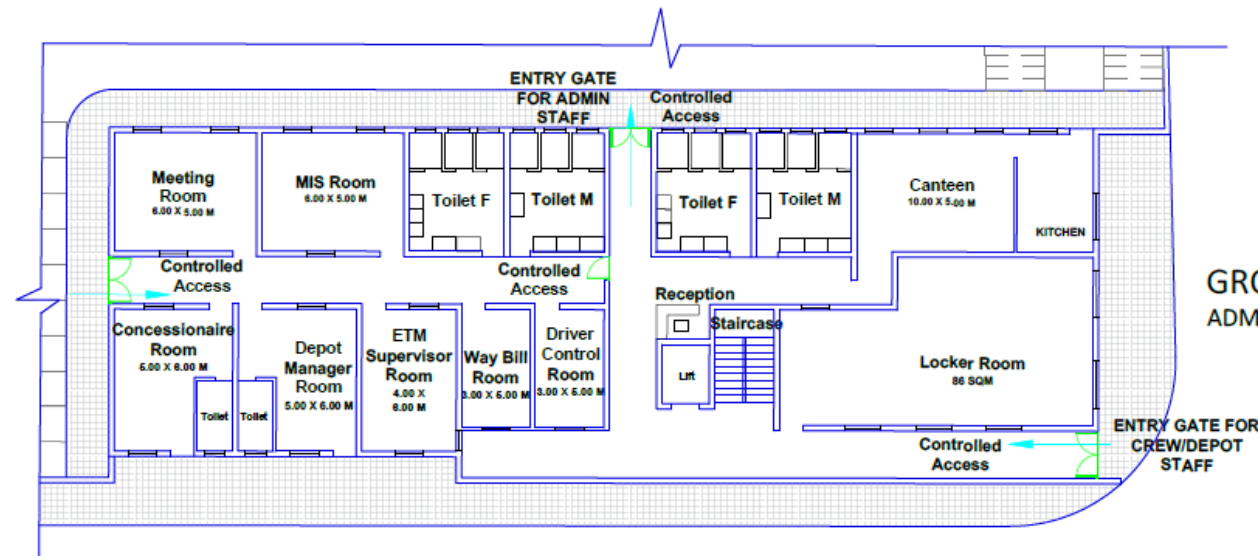




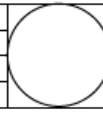

FIRST FLOOR PLAN
ADMINISTRATIVE BLOCK
CREW REST ROOM AREA: 160 SQM

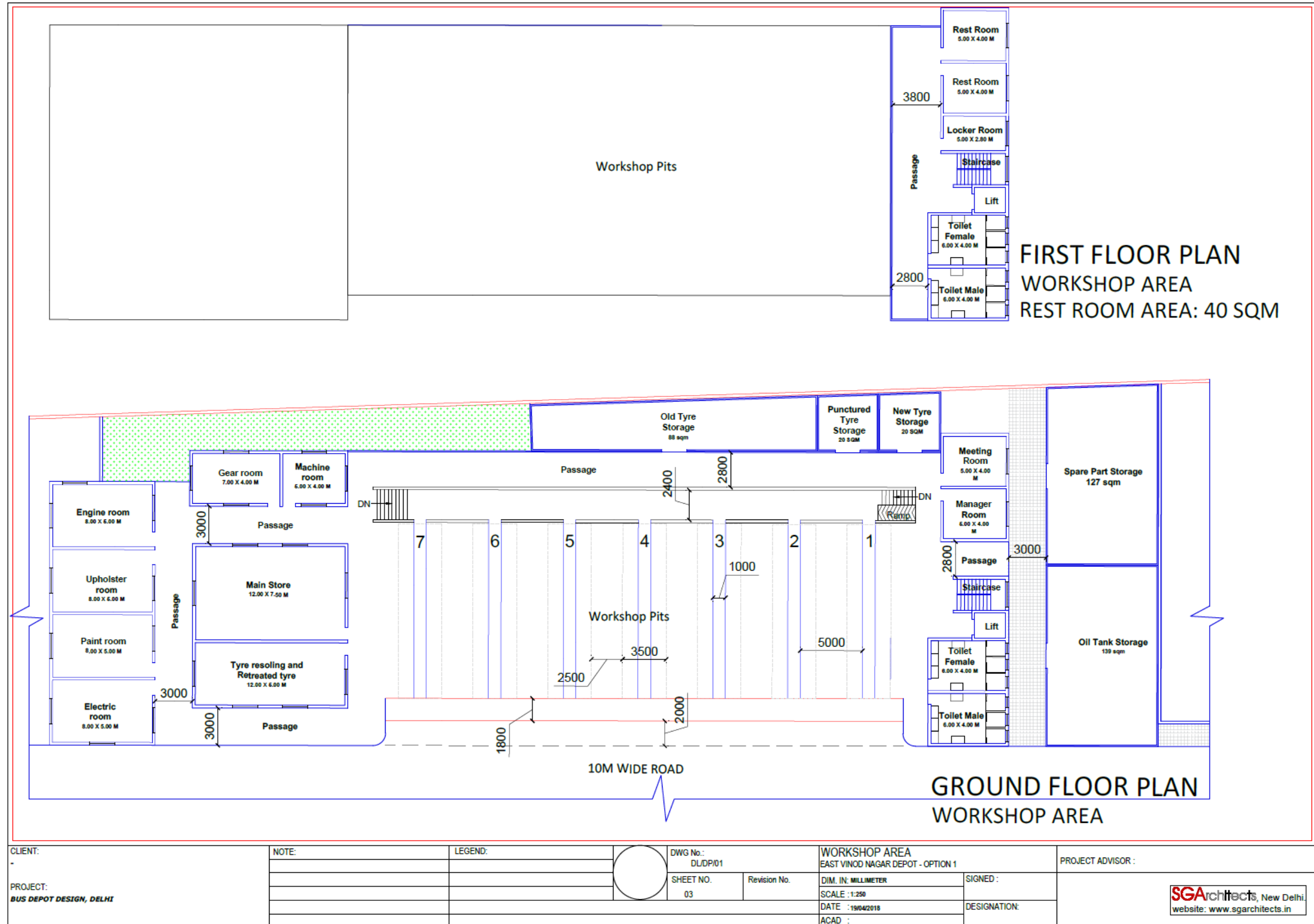


FIRST FLOOR PLAN
ADMINISTRATIVE BLOCK
CREW REST ROOM AREA: 300 SQM



GROUND FLOOR PLAN
ADMINISTRATIVE BLOCK

CLIENT: -	NOTE:	LEGEND:		DWG No.: DUDP/01	ADMINISTRATIVE BLOCK EAST VINOD NAGAR DEPOT - OPTION 1		PROJECT ADVISOR :
	PROJECT: BUS DEPOT DESIGN, DELHI				SHEET NO. 02	Revision No.	DIM. IN: MILLIMETER SCALE : 1:250 DATE : 19/04/2018 ACAD :
 SGA Architects, New Delhi. website: www.sgarchitects.in							



4.8 Response to Comments on Bus Depot Design Evaluation Report

The bus depot design evaluation report included clarifications on five main planning and design deficiencies through a demonstrative exercise where evaluated designs were compared against a sample design developed (for each site) based on the ASRTU guidelines. The five main design deficiencies and the commonalities in response to these by all three agencies has been presented in Table 9.

Overall it needs to be re-iterated that the designs developed for the report based on ASRTU guidelines were to allow comparison between existing designs and ASRTU guidelines-based designs and are not prescriptive but demonstrative. These are layout plans and not implementation drawings. However, designs have been developed taking in to account implementation concerns.

Most of the comments received from PWD and DSIDC do not respond to design issues raised by the reports. They are limited to implementation concerns. It has been pointed out in the response below that stakeholder requirements of higher capacity, efficiency and productivity are to be met by improved designs. Implementation, operations and maintenance strategies will need to be developed/modified as per the revised designs, and concerns based on current practices may not be valid.

Table 9: Broad classification of responses on key design comments

S. No.	Key comments on design	Responses
1	Bus depot is not planned for electric buses. No charging stations and no space for substation and transformers	PWD and DSIDC have not responded to this comment, while DIMTS has raised additional queries on the same
2	Specific function area and equipment/bays provided is short of that required to meet functional requirements as per ASRTU guidelines	PWD and DSIDC has raised concerns on area requirement mismatch, however no details with regards to detailed area table have been included. DIMTS considers areas/functions as per ASRTU guideline to be more or less correct
3	Compact design approach and better circulation design can improve space utilization – 1 to 19 additional buses can be added, per bus area requirement can be reduced by up to 20 sqm per bus	DIMTS has pointed out that VIU requirements need to be met, while PWD and DSIDC has not provided any design related response. DIMTS has doubts if G+2 SPS structures are permitted, while DSIDC and PWD have implementation doubts on G+2 SPS structure.
4	Better control and isolation of depot functions, for safety security and improved operations and management	All three agencies do not question the need for better control, but cite operational, management and safety concerns, based on current practices.
5	Staff comfort, convenience, policy requirements, built form efficiency.	No design concerns have been raised. All three agencies raise (possibly management) concerns in providing lifts as per disability act requirements. PWD and DIMTS appear to be concerned by perceived form and poor aesthetics related issues.

Detailed response to comments on the three depot design recommendations/feedback has been presented in Table 10, Table 11 and Table 12.

Table 10: Detailed response to comments on the design evaluation report – Bawana Depot

Bawana Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		comments received	Response	Comments received	Response
1	Bus depot is not planned for electric buses. No charging stations and no space for substation and transformers				
2	Specific function area and equipment/bays provided is short of that required to meet functional requirements as per ASRTU guidelines	Administration Office area does not have sufficient accommodation as per the transport department norms for bus depots.	The report does not present prescriptive options. These are demonstrative options to be compared against operator/transport department design brief. Designers are free to accommodate these area requirements as per given context. However missing requirements or area requirements less than the minimum specified in ASRTU guidelines should be questioned.		
		The workshop building area is very large compared to transport department guidelines.			
		The administration office building has a very narrow frontage for conductors group in the morning and late evenings. The solution of open verandas in existing building is comparatively better.			
3	Compact design approach and better circulation design can improve space utilization – 19 additional buses can be added, per bus area can reduce from 164 sq.m. to 144 sq.m.			The proposed buildings are SPS type of building. The bus movement create vibration in the structure. Cracks have been reported earlier in 2 storey buildings. Hence 3 storey buildings in SPS should be avoided.	Structural solutions need to be sought as per design – using steel structure with filler block walls (and other options), using dampers, isolators etc.

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

Bawana Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		comments received	Response	Comments received	Response
4	Better control and isolation of depot functions, for safety security and improved operations and management			The administration office area and crew rest areas are given in the same building. This will create avoidable disturbances to office work. Complications in usage of common conveniences are bound to arise. Solutions like passages and doors shall not solve this problem.	Crew and administrative office access and conveniences are separate. They are functionally and physically separated. It appears that crew is considered a severe security risk which cannot be overcome by security apparatus or physical and temporal segregation – this has graver operational and organizational implications – it is not a design issue. Operations, maintenance and security strategies need to be planned as per design
				Common building for administrative office and crew rest area is security hazard for office. Design has not paid any attention to this.	
				Separate staff parking entry is a security hazard. It is an additional burden for security setup.	Operations, maintenance and security strategies need to be planned as per design
5	Staff comfort, convenience, policy requirements, built form efficiency.			Lift should be avoided.	Why? Operations, maintenance and security strategies need to be planned as per design
				The buildings are placed right on the plot line. This is a security hazard. The aesthetic appearance shall be bad for surrounding areas.	Buildings have a setback of 3 to 6m from plot line (open stores are between building and plot line). Building aesthetics/facade can be designed to suit the context. Operations, maintenance and security strategies need to be planned as per design
				Workshop and office buildings are adjacent to each other. Another security hazard.	Workshop and office buildings are set apart by 70m. Operations, maintenance and security strategies need to be planned as per design
6	OTHERS			DSIIDC has already processed the tenders based on the drawings approved by transport department adhering to their guidelines for bus depots. It is not possible to change the drawings at this stage.	Transport department needs to take a call.

Table 11: Detailed response to comments on the design evaluation report – East Vinod Nagar Depot

East Vinod Nagar Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		comments received	Response	Comments received	Response
1	Bus depot is not planned for electric buses. No charging stations and no space for substation and transformers				
2	Specific function area and equipment/bays provided is short of that required to meet functional requirements as per ASRTU guidelines	Administration Office area does not have sufficient accommodation as per the transport department norms for bus depots.	The report does not present prescriptive options. These are demonstrative options to be compared against operator/transport department design brief. Designers are free to accommodate these area requirements as per given context. However missing requirements or area requirements less than the minimum		
		The workshop building area is very large compared to transport department guidelines.			
		The administration office building has a very narrow frontage for conductors group in the morning and late evenings. The solution of			

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

East Vinod Nagar Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		comments received	Response	Comments received	Response
		open verandas in existing building is comparatively better.	specified in ASRTU guidelines should be questioned.		
3	Compact design approach and better circulation design can improve space utilization – 1 additional bus can be accommodated			The proposed buildings are SPS type of building. The bus movement create vibration in the structure. Cracks have been reported earlier in 2 storey buildings. Hence 3 storey buildings in SPS should be avoided.	Structural solutions need to be sought as per design – using steel structure with filler block walls (and other options), using dampers, isolators etc.
				The external road at point at which the entry is shown is at a height of around 4 m from the site. So entry is not possible at this point. Entry should be somewhere in the middle of this side or on extreme left.	All entries are planned as per the original design prepared by PWD. If this is an issue, it may be a problem in the original design as well. Circulation and entry/exit design can be adjusted as per site requirements.
4	Better control and isolation of depot functions, for safety security and improved operations and management			The administration office area and crew rest areas are given in the same building. This will create avoidable disturbances to office work. Complications in usage of common conveniences are bound to arise. Solutions like passages and doors shall not solve this problem.	Crew and administrative office access and conveniences are separate. They are functionally and physically separated. It appears that crew is considered a severe security risk which cannot be overcome by security apparatus or physical and temporal segregation – this has graver operational and organizational implications – it is not a design issue. Operations, maintenance and security strategies need to be planned as per design
				Common building for administrative office and crew rest area is security hazard for office. Design has not paid any attention to this.	
				Separate staff parking entry is a security hazard. It is an additional burden for security setup.	Operations, maintenance and security strategies need to be planned as per design
5	Staff comfort, convenience, policy requirements, built form efficiency.			Lift should be avoided.	Why? Operations, maintenance and security strategies need to be planned as per design
				The buildings are placed right on the plot line. This is a security hazard. The aesthetic appearance shall be bad for surrounding areas.	Buildings have a setback of 3 to 6m from plot line (open stores are between building and plot line). Building aesthetics/facade can be designed to suit the context. Operations, maintenance and security strategies need to be planned as per design
				Workshop and office buildings are adjacent to each other. Another security hazard.	Workshop and office buildings are set apart by 25m. Operations, maintenance and security strategies need to be planned as per design
6	OTHERS			DSIIDC has already processed the tenders based on the drawings approved by transport department adhering to their guidelines for bus depots. It is not possible to change the drawings at this stage.	Transport department needs to take a call.

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

East Vinod Nagar Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		Comments received	Response	Comments received	Response
				Building aesthetics/facade can be designed to suit the context.	Façade can be designed as per context.
				Roofing of workshop and administration buildings are different. High roof of workshop will not look good with administration building roof.	

Table 12: Detailed response to comments on the design evaluation report – Burari Depot

Burari Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		Comments received	Response	Comments received	Response
1	Bus depot is not planned for electric buses. No charging stations and no space for substation and transformers	Charging arrangement to be checked - if batteries to be charged, or buses to be charged, location of charging point in buses if bus to be charged,	Charging technology assumed is bus charging and not battery swapping. Transport department to take a call on charging technology.	Buses and charging points in front of the Transformers & ESS area are not advisable,	This is an implementation issue and adequate fire safety barriers may be incorporated after discussion with the Discoms in the interest of better space utilization.
		Buses and charging points in front of the Transformers & ESS area are not advisable,	As per Discoms, the three electrical requirements, i.e. substation, transformers and charging equipment can be separate connected by necessary electrical wires. Sub stations and transformers need to be accessed by Discom staff. Designs are not prescriptive, these may be modified to meet specific Discom requirements.	<ul style="list-style-type: none"> Cable trenches/ routes have not been shown. Street Lights poles/ High Masts have not been shown for area lighting, Sufficient space is required to be provided along the boundary wall for laying of Fire Pipes [Ring Main] and Fire Hose Cabinets/ cables, 	These are design detailing and implementation issues. Current gap between buses or bus and boundary wall is 2.5m. Size of charging equipment is 0.5m X 0.5m, it is expected that these considerations can be accommodated in the current designs also. Additionally, designs are not prescriptive. Operators may plan the designs in order to meet all key requirements.
		M/s SGA may please explain the basis of providing 607sqm area for the Substation [for Bus Charging infrastructure]	Approximate area requirement of a substation of electric bus depot with a capacity in the range of 150 buses is 600 sq.m. as per NDPL sources. This has been discussed by Discoms with transport department in a separate meeting according to this source. This may be cross checked officially with Discoms by transport department.		
		One Bus charging points has been shown for each bus parking bay along the boundary whereas only 50 Bus charging points have been shown for 88 buses in the middle area parking bays [including VIU area]. Needs to be re-checked,	Location of charging stations have been shown in proximity to every bus. This is a planning requirement and not an equipment requirement. Equipment may be placed as per equipment specifications at every bus bay or at alternate bays, etc. However, plan should build in requirements for all types of equipment.		
2	Specific function area and equipment/bays provided is short of that required to meet functional requirements as per ASRTU guidelines	VIU Area - This area pertains to the inspection unit for TSR and shall be used only for parking of buses. In day time it will exclusively use as vehicle inspection unit for which workshop way, workshop office and other allied facilities would be required,	In the demonstrative design, this area does not accommodate specific requirements for VIU. These will need to be accommodated as required by the planner. A washing unit was added here so that operationally buses could be segregated at night, based on service	Workshop - The slope of ramp to the pit may be checked.	Slopes are 1:12. These may be detailed during the design detailing stage. The demonstrative designs are for planning comparison purposes only.

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

Burari Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		comments received	Response	Comments received	Response
		VIU Area - General facilities for operational staff and other general public seems unavailable,	requirement. Buses which do not require servicing, can park on the VIU site, and they may be washed here, without the need to rotate them between two sites. This is also because the number of buses located at VIU site, meet the requirement of one washing bay. However, this may be omitted if it clashes with functional requirement for VIU.		
		VIU Area - Washing bay may not be required for auto rickshaws and provisioning it at centre is not advisable in any case.			
		VIU Area - Some guard room or check post at entry/exit gates should be planned,			
		The functioning of Admin has a few extrovert operations wherein counters are made on the periphery of building. Conductor/ driver /Other operational staff may be required to stand in queue outside. These counters planned near bus entry/ exit, may raise the safety concern. This may kindly be re-planned,	Included designs are only demonstrative, as per minimum or expected requirements based on ASRTU guidelines. Such specific requirements (in addition to the minimum) may be incorporated by adjusting as per specific operator and site requirements.		
		Toilet facilities may have to be assessed again, as not many female staff is expected; hence minimum facilities for females could be planned after consulting client.			
		If female crew is expected then all the facilities pertaining to resting/washrooms etc., on the upper floors should be completely segregated like Hostel facility,			
		Rest Rooms should be planned as dormitories rather than independent rooms.		Restrooms shown in the demonstrative designs are dormitories and not individual rooms. Instead of one common dormitory, multiple dormitories are shown in order to allow any classification/segregation as per facilities, age, gender, seniority, crew type, etc.	
		It appears to be okay in terms of planning, except the space for POL and storage for tyre etc.	Refer table 7 of the report -these are included. Designers should feel free to accommodate any additional contextual requirements apart from the minimum included in the ASRTU guideline.		
		Number of pits in proportion of buses may be re-assessed, open repair bays for painting etc., seems un-available,	Number of bays in the workshop have been provided as per ASRTU guidelines. All bays have been shown with pits to allow multifunctionality. Some of the bays may not have pits, and multifunctionality is supported by portable lifts or other means. Keeping multifunctionality requirement in mind, designers should be free to provide bays in line with ASRTU guidelines.		
3	Compact design approach and better circulation design can improve space utilization - 9 additional buses can be added, per bus area can reduce from 164 sq.m. to 144 sq.m.	Circulation of buses seems okay in Layout plan		Washing area was preferred along the boundary wall, for ease of drainage etc. at present it is in the centre. Pump Room and Tank provision etc. needs to be addressed. Also it may not be advisable to have washing station next to charging station.	Designs are not prescriptive – best arrangement for increasing space use efficiency and operations may be adopted. Drainage and other concerns can also be addressed through design detailing
		Bus parking bay size needs to be mentioned and thereafter checked; if adequate space is available between buses for charging	Bus parking bays are 3.5m X 12m as per ASVV an ASRTU guidelines	The bus depots are generally required on urgent basis, hence need to be constructed on priority. Therefore SPS	As per sources in transport department, G+2 structures can qualify as SPS. This is based on the experience from education department.

Evaluation of Electric Bus Depot Design for Bawana, Burari and East Vinod Nagar

Burari Depot					
S. No	Key Design Concerns raised	Planning related reaction		Implementation related reaction	
		comments received	Response	Comments received	Response
		process. Charging arrangement to be checked		construction is adopted to save preconstruction time by not obtaining the approval of statutory authorities. Double story SPS building is generally adopted based on the previous practices being adopted by Delhi Transport Corporation in construction of various bus depots. Raising of story from two to three may cause objection by the statutory authorities,	Additionally – implementations issues need to resolved as per design requirements and can be taken up at an institutional level by the Transport Department.
		For Private entry/exit, diagonal chamfering of site may not be required. In existing site conditions, gate at corner could be comfortable,	Site chamfering has not been modified it is as per existing plans. Designs are not prescriptive; design and detailing may be undertaken to meet the requirements and objective of the exercise.		
4	Better control and isolation of depot functions, for safety security and improved operations and management			Too many access seems in admin block and may not be appropriate for access control, need to be checked from operational point of view	Operations, maintenance and security strategies need to be planned as per design
				For peaceful functioning of Admin Block, Driver's Rest Room/Canteen facilities should be planned away from the administrative functions,	
5	Staff comfort, convenience, policy requirements, built form efficiency.	Separate toilet block other than already available in all the building blocks would also be required for the operational staff who are not staying within the depot and doing their duties from their home or outside the depot premises,	Since administrative block acts as the interface between depot area and staff/entry exit/parking, all staff pass through the corridor which serves ETM and cash counters. Common toilet facilities are provided alongside this corridor for all crew (and other support staff) (even those not staying at the depot).	Physically Challenged person may not be able to discharge the duties of Driver/Conductor, mechanic or other support/operational staff in workshop. Any physically challenged support staff deployed in Admin block can be placed at ground floor. Therefore, requirement of lifts in double story buildings need to be re-checked. Regular maintenance of assets in bus depots are also a big challenge.	Lifts are required in public buildings as per disability act of 1999. They are not necessarily for complete physical disability. They also include permanent disability. Lot of support staff are also required in depots, such as cleaners, repair and maintenance staff etc. They may suffer from some permanent or temporary disability, including joint problems, injury, pregnant ladies, etc.
6	OTHERS			Location of Fire Tanks and Fire Pump Room are not shown in the layout	This is not a prescriptive design and does not include implementation level detailing. These may be developed over the final design developed by DIMTS.
				There may be financial implication due to increase of size in building mass,	Implementation and financing issues need to be resolved as per design requirements.