

A STUDY ON COST AND TIME OPTIMIZATION IN CONSTRUCTION PROJECTS WITHN STAY-IN PLACE FORM WORK SYSTEM

A Thesis

Submitted in partial fulfilment of the requirements for the award of
Master of Architecture degree in Building Management

by

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Report is the bonafide work of **AMRISH RUBAN (40840002)** who carried out the Thesis entitled "**A STUDY ON COST AND TIME OPTIMIZATION IN CONSTRUCTION PROJECTS WITH STAY-IN-PLACE FORMWORK SYSTEM**" under our supervision from January 2022 to May 2022.

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PLACE: Chennai

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ABSTRACT

In construction industry form work plays important role in execution. Different materials such as wood, Steel sheets/plates, ply boards etc... Are commonly used form work materials? But formwork costs Around 40-50% of the total construction cost in reinforced concrete construction. The storing of Formwork materials and limitations in reusing the materials increases the capital investment in Construction industry. In construction activity placing the formwork and its alignment consumes More time compared to the concreting work. Much advancement has been occurred in form work Materials, methods and in implementation techniques. Aluminum form work, steel form work, Vinyl based form work, rubber and glass form works are also available. In SIP the formwork material Become an integral part of the structural elements and offer additional advantages such as thermal Comfort, external protection to resist the durability issues, additional confining pressure and reduces. The construction time and offers viable economical solution.

TABLE OF CONTENTS

CHAPTER No.	TITLE	PAGE No.
	ABSTRACT	v
	LIST OF TABLES	viii
	LIST OF FIGURES	ix
1	INTRODUCTION	1
1.1	AIM	1
1.2	OBJECTIVE AND SCOPE FOR THE STUDY	1
1.3	METHODOLOGY	2
2	LITERATURE REVIEW	3
2.1	INTRODUCTION	3
2.2	INSULATED CONCRETE FORMS	4
	2.2.1 Advantages	4
2.3	STRUCTURAL SIP SYSTEM	6
2.4	FRP BASED SIP FORMWORK SYSTEM	7
2.5	PVC STAY-IN-PLACE FORMWORK SYSTEM	8
	2.5.1 Benefits Of Selecting Pvc Stay In Formwork System	9
	2.5.2 Components of the System	10
	2.5.3 Limitation of PVC Panel	11
	2.5.4 Panel Components	11

2.5.5	Typical Reinforcement Details At Corner	14
2.5.6	Typical Reinforcement Details At Interconnections	14
2.5.7	Construction Process	15
2.6	RESEARCH PAPERS	20
2.6.1	Fire Resistance Performance Of Concrete-Pvc Panels With Polyvinyl Chloride(Pvc)Stay In Place(Sip)Formwork	20
2.6.2	Experimental Investigation On Pvc Encased Columns	22
2.6.3	Effect Of Stay-In-Place Pvc Formwork Panel Geometry On Flexural Behaviour Of Reinforced Concrete Walls	24
2.6.4	The Gfrp Profiles As Stay-In-Place Formwork	26
2.6.5	The Seismic Performance Of High Strength Concrete Columns Cast In Stay In Place Frp Formwork	28
3	CASE STUDIES	32
3.1.1	LIGHT HOUSE PROJECT LUCKNOW	32
4	ANALYSIS AND RESULTS	61
4.1	COST ANALYSIS - PVC PANEL vs CONVENTIONAL BUILDING	63
4.2	TIME ANALYSIS - PVC PANEL Vs CONVENTIONAL BUILDING	67
4.3	LIFE CYCLE COST FOR PVC VS CONVENTIONAL BUILDING	88
5	SUMMARY AND CONCLUSION	90

LIST OF TABLES

TABLE No.	TITLE	PAGE No.
2.5.1	Benefits Of Selecting Pvc Stay In Formwork System	9
2.6.5	Journal & Reference	30
3.1.6	Schedule of Joinery	38
3.1.15	Earthing detail	60
4.1	Cost Analysis - Pvc Panel Vs Conventional Building	63
4.1.A	Cost Analysis - Table & Graph Pvc Panel Vs Conventional Building	66
4.2	Time Analysis - Pvc Panel Vs Conventional Building	67
4.3	Life Cycle Cost For Pvc Vs Conventional Building	88

LIST OF FIGURES

FIGURE No.	TITLE	PAGE No.
1.2	Structural stay- in – place Formwork system	2
1.3	Research Methodology	2
2.1.a	Stay- in – place Formwork system	3
2.1.b	Material Properties of stay- in-place Formwork system	4
2.2.1.a	Sections of Insulated Concrete Forms	5
2.2.1.b	Sections of Insulated Concrete Forms	5
2.3	Structural SIP System	6
2.4	Frp Based Sip Formwork System	7
2.5	Pvc Stay-In-Place Formwork System	8
2.5.1.a	Benefits Of Selecting Pvc Stay In Formwork System	9
2.5.2.a&b	Components Of The System	10
2.5.4.1	Panel Components	11
2.5.4.2	Panel Components	12
2.5.4.3	PVC Panel	13
2.5.5	Typical Reinforcement Details At Corner	14
2.5.6	Typical Reinforcement Details At Interconnections	14

2.5.7.a	Survey And Setting Out	15
2.5.7.b	Bottom track fixing	16
2.5.7.c	Wall Panel Installation	17
2.5.7.c.2	Door & Window Installation	18
2.6.1	Fire Resistance Performance Of Concrete-Pvc Panels With Polyvinyl Chloride(Pvc)Stay In Place(Sip)Formwork	20
2.6.1.a	Test Result	21
2.6.1.b	Details of the final aspect of the concrete's surfaces.	22
2.6.2.a	Experimental Investigation On Pvc Encased Columns	23
2.6.3.a	Effect Of Stay-In-Place Pvc Formwork Panel Geometry On Flexural Behaviour Of Reinforced Concrete Walls	24
2.6.3.b	Effect Of Stay-In-Place Pvc Formwork Panel Geometry On Flexural Behaviour Of Reinforced Concrete Walls	25
2.6.4.a	The Gfrp Profiles As Stay-In-Place Formwork	27
2.6.4.b	The Gfrp Profiles As Stay-In-Place Formwork	27
2.6.5.a	The Seismic Performance Of High Strength Concrete Columns Cast In Stay In Place Frp Formwork	28
2.6.5.b	The Seismic Performance Of High Strength Concrete Columns Cast In Stay In Place Frp Formwork	29
2.6.5.c	Journal & Reference	30

2.6.7	Case Study-1	31
3.1.1	Live Case Studies	32
3.1.1.1	Live Case Specification	33/34
3.1.2.1	Site Analysis	34
3.1.3	Soil Test Report	35
3.1.4	Site Plan	36
3.1.5	Block Proximity	36
3.1.6&a	Floor Plan	37/38
3.1.6.b	Terrace & mumty Floor Plan	40
3.1.7.1	Elevation - A	41
3.1.7.2	Elevation – B & D	42
3.1.7.3	Elevation - C	43
3.1.8	View	43
3.1.9	Sections	44
3.1.10	Unit Plan	45
3.1.11	Mockup Unit	45
3.1.12	Site Photos	46/47
3.1.13.1	Structural	48
3.1.13.2	Raft Bottom Extra Reinforcement	48
3.1.13.2	Raft Top Extra Reinforcement	49

3.1.13.4. Pedestal layout	50
3.1.13.5 Anchor Bolt & Base Plate Layout	50
3.1.13.6 Steel Column Layout	51
3.1.13.7 Staircase Detail	51
3.1.13.8. Plinth level plan & typical level plan	52
3.1.13.9. Connection detail & Schedule	53
3.1.13.10. Connection detail & Schedule	53
3.1.14.2. Electrical layout & detail	54
3.1.14.1. Electrical layout & detail	54/55
3.1.14.3. Typical unit Electrical layout & detail	55
3.1.15.1. Stilt & Typical unit FAS layout & Detail	56
3.1.15.3. FAS Terrace layout	57
3.1.15.4. Plumbing detail	58
3.1.15.5 Sewage layout & water supply & fire layout	58
3.1.15.6 Substation layout detail	59
3.1.15.7 Substation layout detail	59
4.1 Site Plan	61
4.1.1 Block plan	62
4.2 Time Analysis - Pvc Panel Vs Conventional Building	77
4.2.1 Result - PVC PANEL vs CONVENTIONAL BUILDING	87

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Structural stay-in-place formwork is already widely used for some types of concrete elements like floor slabs. But for other types like concrete beams, few commercial systems are available. Generally, the existing systems are made out of timber, steel or fibre reinforced polymers. All of them combine on the one hand the advantages of prefabrication like speed, accuracy, controlled surface quality, and finish and on the other hand the advantages of in situ casting like economy and continuity. Another big advantage is the reduction of manual labour and thus of salary cost, since there is no tying of the steel stirrups and no assembly and dismantling of the formwork. This formwork can also be seen as a protection of the concrete from the environment, which may lead to considerations concerning the necessary concrete cover when steel reinforcement is used.

1.2 AIM

The study aim to evaluate the effective use of Structural Stay-in-Place Formwork System and to achieve high speed of construction with optimum cost, time and quality when compared to conventional system.

1.3 OBJECTIVE AND SCOPE FOR THE STUDY

- 1)To Study the construction methodology with due focus on the difference from the conventional construction.
- 2)To Identify and understand, pros and cons of in Structural Stay-in-Place Formwork System.
- 3)To analyse the cost of structure due to savings in materials compared against conventional constructions.
- 4)To analyse the Scheduling compared against the conventional method.
- 5)To study its advantages and disadvantages of the Structural Stay-in-Place Formwork System.
- 6)To understand the cost-effective alternate building materials and techniques for the saving of energy, reap economic and environmental benefits.

7) This study would mainly focus on building materials done with conventional method and a comparative analysis will be carried out.



Fig 1.2 Structural stay- in – place Formwork system

1.4 METHODOLOGY

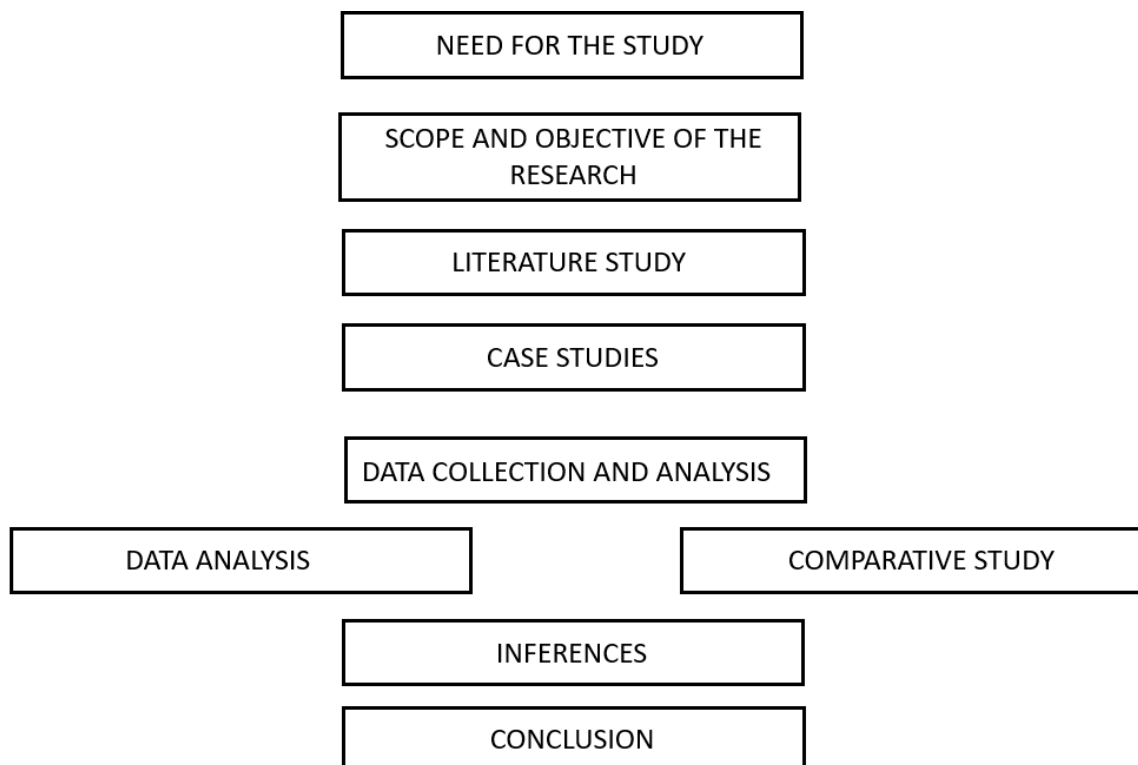


Fig 1.3 Research Methodology

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In Stay In Place the formwork material become an integral part of the structural elements. The advantages such as thermal comfort, external protection to resist the durability issues, additional confining pressure and reduces the construction time and offers viable economical solution

The different types of Stay in Place Formwork system are

- a. **INSULATED CONCRETE FORMS**
- b. **STRUCTURAL SIP SYSTEM**
- c. **FIBERS REINFORCED POLYMERS(FRP)**
- d. **POLYVINYL(PVC)**



Fig 2.1.a Stay- in – place Formwork system

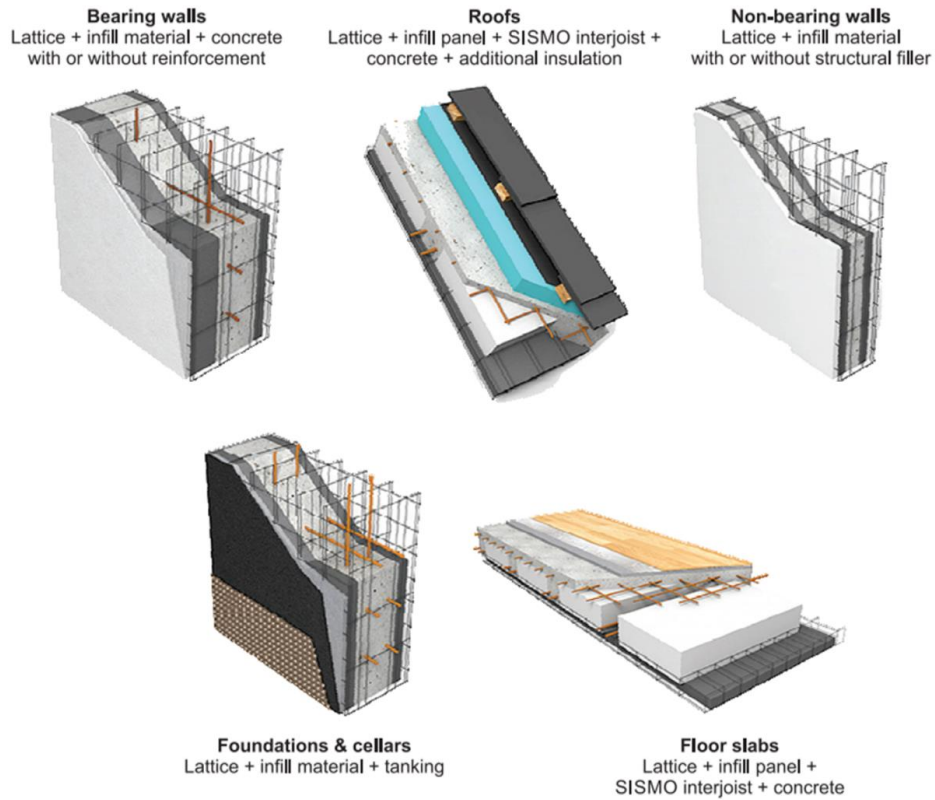


Fig 2.1.b Material Properties of stay- in – place Formwork system

2.2 INSULATED CONCRETE FORMS

ICF system, expanded polystyrene are used with proper interlocking mechanism which accommodates the EPS blocks together. There are two external EPS layers and hollow interior part offers space for fresh concrete option. In this type EPS blocks are fixed in order over a defined height followed by reinforcement placement and concreting. The connectors between the EPS layers interlink the EPS blocks/panels and hold the reinforcement in vertical and horizontal directions. Based on the lateral pressure due to the concreting the EPS panels and interlinking mechanisms are designed and also it.

2.2.1 Advantages

Resistance to gravity and lateral loading due to its monolithic construction technique. Energy efficiency and thermal comfort, Noise reduction, Resistant to corrosion. Easy to install and time saving construction technique. Cost effective solution.

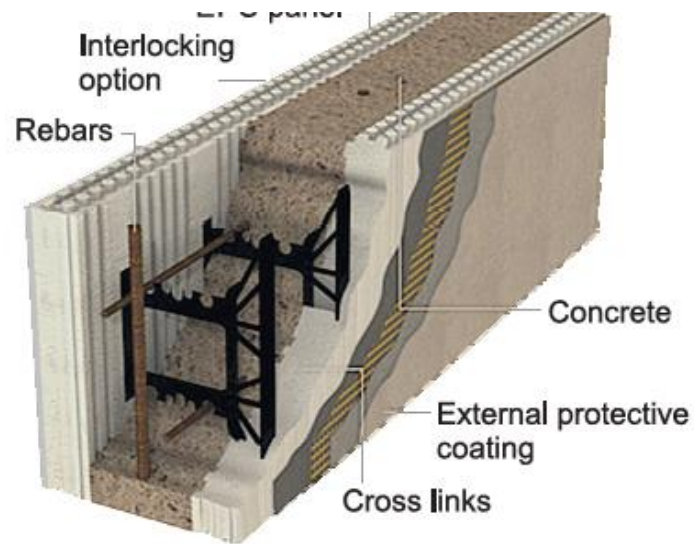


Fig 2.2.1.a Sections of Insulated Concrete Forms



Fig 2.2.1.b Sections of Insulated Concrete Forms

2.3 STRUCTURAL SIP SYSTEM

In this SIP system two steel grid mesh as sacrificial form work with “C” channel section inter connectors used to connect two layers of grid mesh. Fresh concrete will be used inside the cavity similar to the other ICF systems. Instead of EPS any other insulating materials can be affixed with the external grid mesh to improve the thermal and acoustic comfort. In this method the steel channels are acting as reinforcements instead of conventional rebar and if requires additional reinforcements can also be used. Connection methods and procedures are varying with respect to the elemental sections The external grid mesh is provided with very fine gaps which will not allow the concrete to flow out and also offers better confining pressure. IS 456:2000; IS 1893:2016 and IS 13920:2016 are used in designing the structure to resist the gravity and seismic loading. These walls are generally considered as shear walls and designed. This panel act as light reinforced RCC walls.



Fig 2.3 STRUCTURAL SIP SYSTEM

2.4 FRP BASED SIP FORMWORK SYSTEM

Fibre Reinforced Polymer(FRP)composites are very effective in retrofitting and strengthening work. FRP based materials such as rebar's, flats, pultruded sections are also available with enhanced strength and durable property. This FRP is used as SIP form work materials as also acts as reinforcement in slabs.FRP panels light weight concrete/foam-based concrete used as core material over a thin layer of normal concrete will be used.



Fig. 4.14: FRP concrete deck preparation

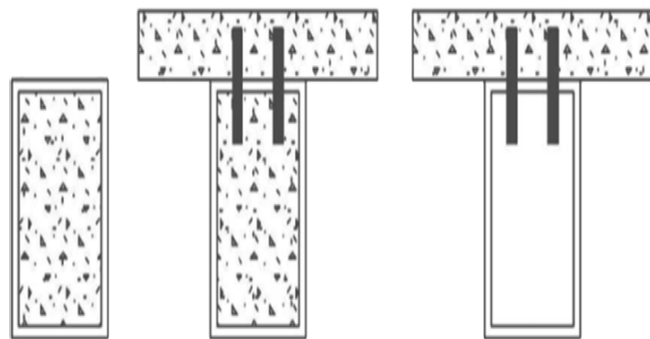


Fig. 4.23: Concrete-filled FRP tubes with a concrete slab on top [11]

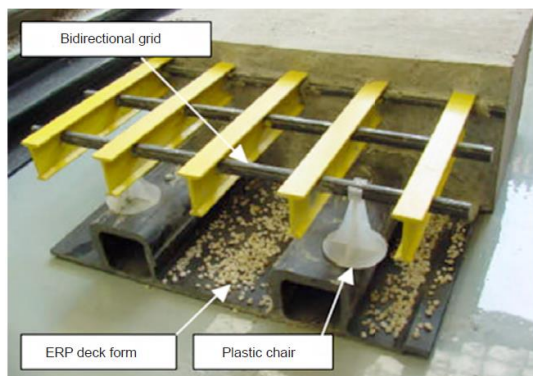


Fig. 4.13: FRP section with shear connector [17]

Fig 2.4 FRP BASED SIP FORMWORK SYSTEM

2.5 PVC STAY-IN-PLACE FORMWORK SYSTEM

Permanent structural walling system consisting of rigid poly-vinyl chloride (PVC) based polymer Components that serve as a permanent durable finished form-work for concrete walls. The poly-vinyl chloride (PVC) based form work system consists of hollow members with different interlocking internal patterns to make the connection more sustainable. Light weight, Stay-In-Place formwork—snap lock easy assembly 110mm,155mm,200mm,250m thick walls.Plug and play for affordable housing project. Single trade, significant savings on labour. Suitable for all seismic zones, high rises>30 floor.

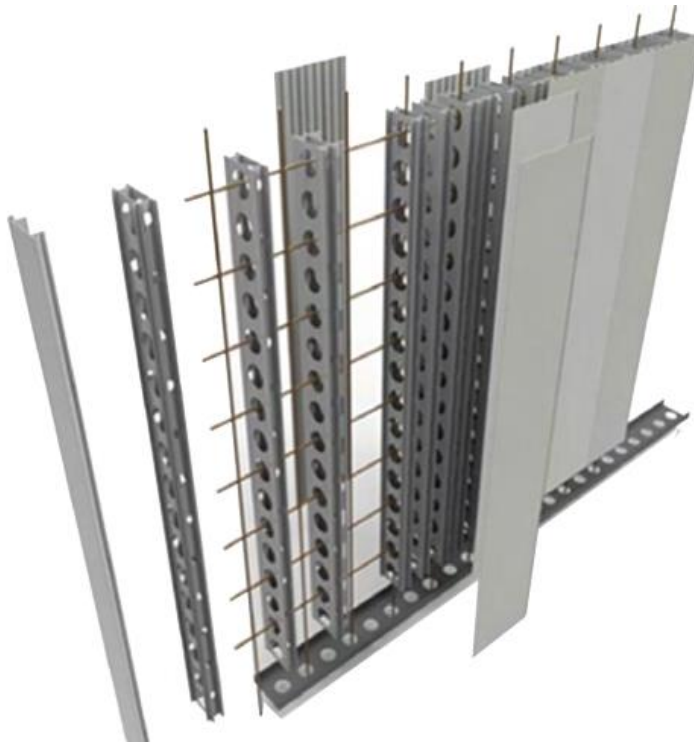


Fig 2.5 PVC STAY-IN-PLACE FORMWORK SYSTEM

2.5.1 BENEFITS OF SELECTING PVC STAY IN FORMWORK SYSTEM

TRADES REDUCED/REMOVED	OTHER CONSTRUCTION BENEFITS
• No brickwork • No external plastering • No gypsum (internal plastering) • No de-shuttering • Guided rebar placement • Waterproofing requirements reduced • Service conduiting along with formworks prior to casting • Reduced need for labour in general and skilled labour	• No curing of concrete required due to encapsulation • No honeycombs, voids, steel corrosion • No constraint on minimum required repetition of designs • Reduced labour overheads such as compliances, labour camp, etc. • Multiple units can be built simultaneously (unlike repetitive formwork) • Flexibility of design is possible as formwork is not built for any particular design • Reduced construction time- up to 70% less time compared to conventional construction • No upfront locking of capital like repetitive formworks

2.5.1 BENEFITS OF SELECTING PVC STAY IN FORMWORK SYSTEM

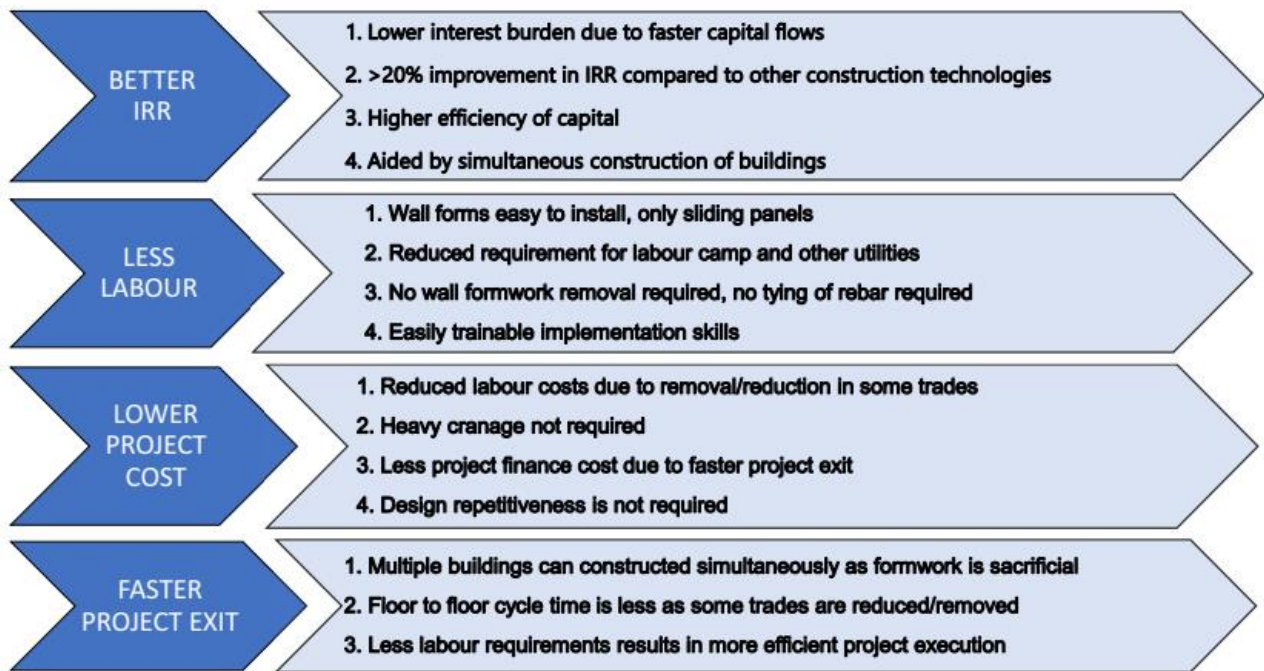


Fig 2.5.1.a BENEFITS OF SELECTING PVC STAY IN FORMWORK SYSTEM

2.5.2 COMPONENTS OF THE SYSTEM

Components of the System

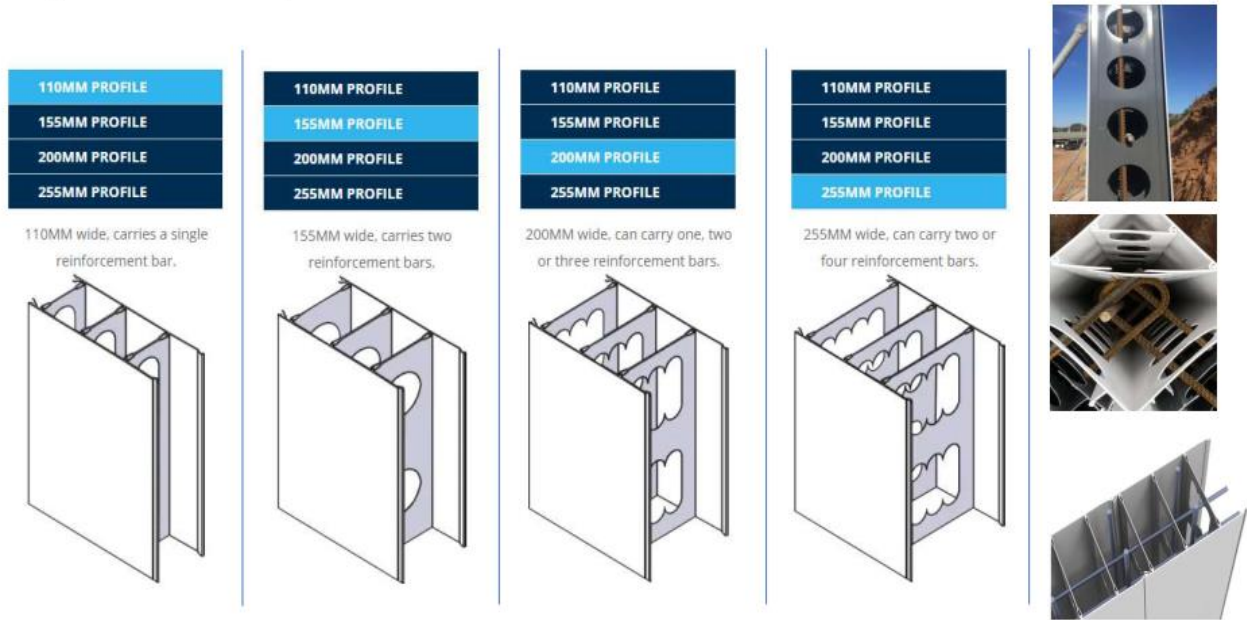


Fig 2.5.2.a COMPONENTS OF THE SYSTEM

PRODUCT SPECIFICATIONS	
PROFILES	110MM, 150MM, 200MM AND 250MM
PVC THICKNESS	2.6 MM
LIFE EXPECTANCY	MINIMUM 50 YEARS
HEIGHT	ALL PANELS CAN BE ORDERED TO CUSTOM HEIGHTS MINIMUM 1.0M – MAXIMUM 8.0M STOCK HEIGHTS: 2.8M, 3M, 3.3M, 3.6M, 3.8M, 4.0M, 4.6M, 5M, 6M.

PANEL WIDTH	300 MM
PVC DENSITY	1,300 KG/ M ³
FINISH	GLOSS WHITE, WATER RESISTANT
UV STABILITY	NOT AFFECTED BY EXPOSURE TO SUNLIGHT EITHER IN STORAGE OR AS FINISHED PRODUCT

	CONCRETE VOLUME (M ³ / M ²)	PRODUCT WEIGHT (KG/ M ²)	FIRE RATING (MINUTES MINIMUM)
110MM PROFILE	0.101	14.7	90
155MM PROFILE	0.146	15.8	180
200MM PROFILE	0.188	16.8	≥ 240
250MM PROFILE	0.2404	17.8	≥ 240

Fig 2.5.2.b COMPONENTS OF THE SYSTEM

2.5.3 LIMITATIONS OF PVC STAY IN FORMWORK SYSTEM

Stay in Place PVC Forms Walls shall need pre planned & installed MEP/Services for concealed network. Door and Window position shall not be changed after pouring of concrete. Erection of panels shall be under supervision of trained staff.

2.5.4 PANEL COMPONENTS

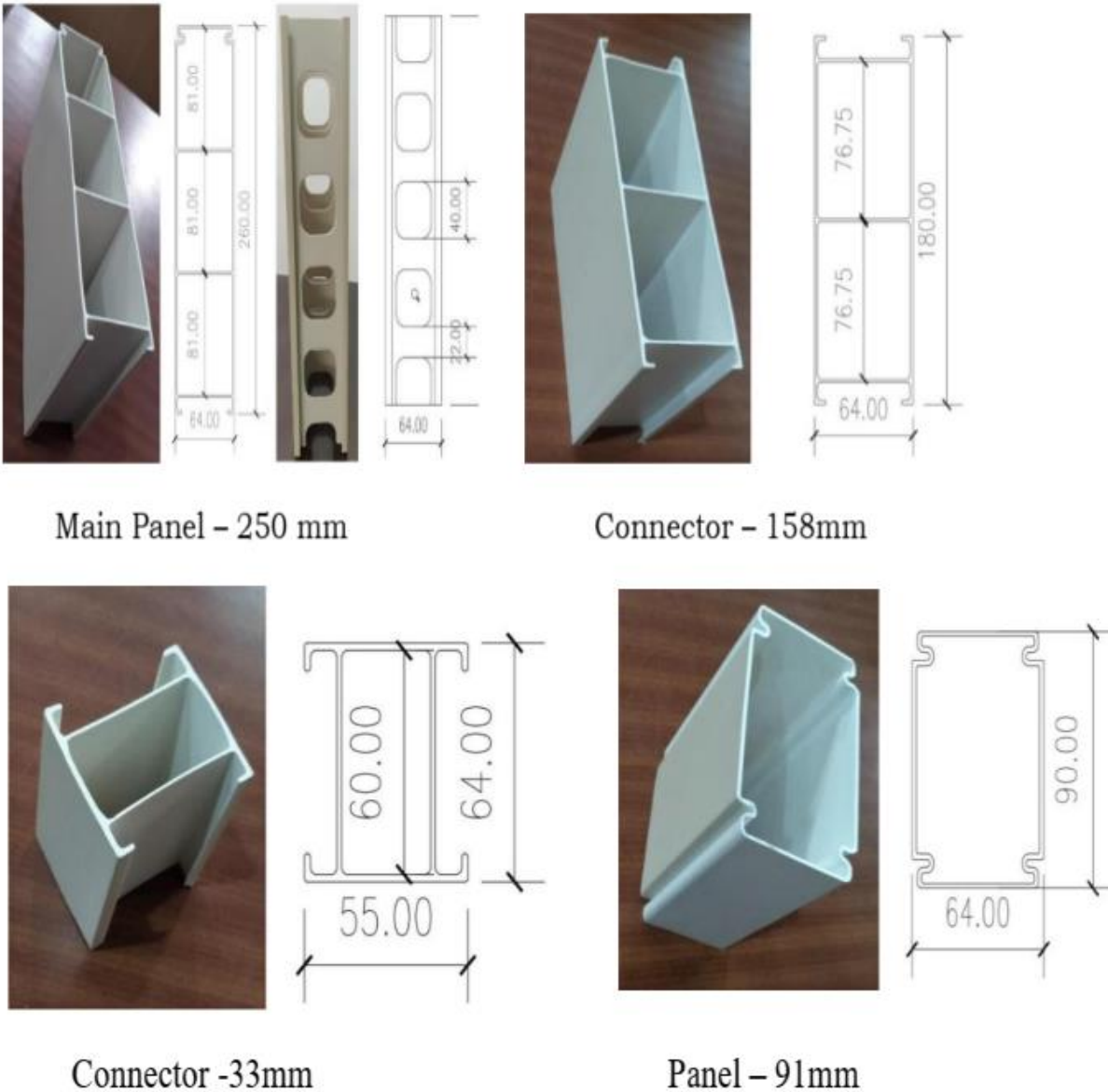
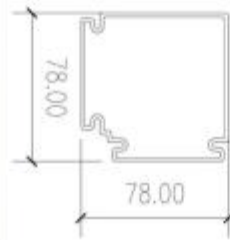
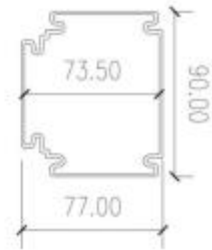


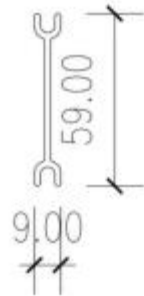
Fig 2.5.4.1 PANEL COMPONENT



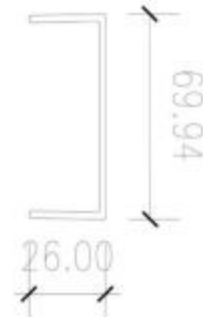
Corner Panel



3-WAY (T-CONNECTOR)



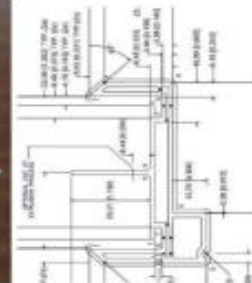
Jointer Connector



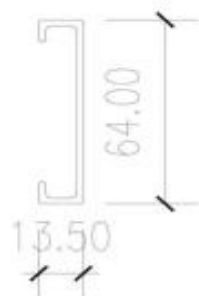
Basic Frame



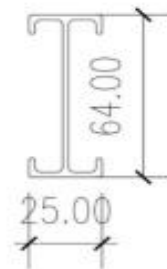
Window Frame



Azteca Frame



Starter



Jointer Panel

Fig 2.5.4.2 PANEL COMPONENT

These form works are reinforced with internal webs, ribs which acts as stiffener against the bending and provides rigidity to the form works. PVC formworks are made in different segments with respect to the structural elements can be integrated through the shear connectors. Inside the panels hollow spaces are available in vertical and horizontal directions for the placement of reinforcement. Additional reinforcements in both the directions to be provided at corner of the walls and in interconnections for integrity. The provided PVC panels restricts the evaporation of moisture present in concrete, makes the structure durable and resistant to corrosion and seismic.

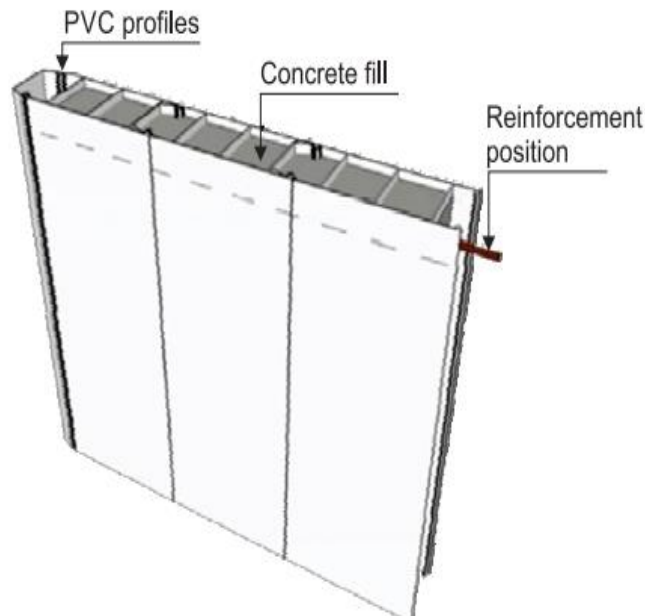


Fig 2.5.4.3 PVC panels

2.5.5 TYPICAL REINFORCEMENT DETAILS AT CORNER

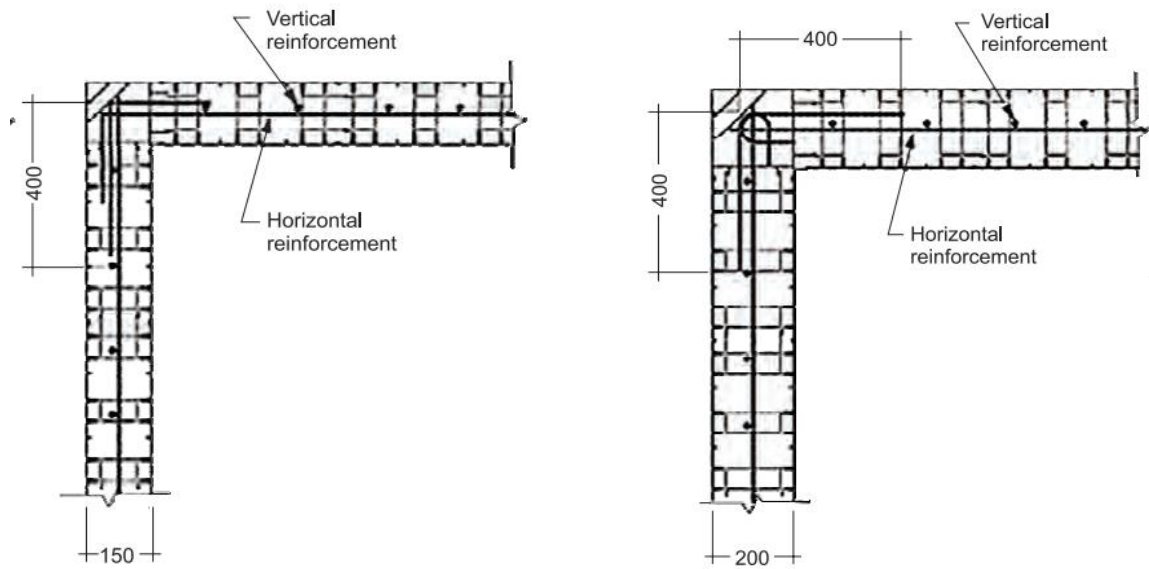


Fig 2.5.5 TYPICAL REINFORCEMENT DETAILS AT CORNER

2.5.6 TYPICAL REINFORCEMENT DETAILS AT INTERCONNECTIONS

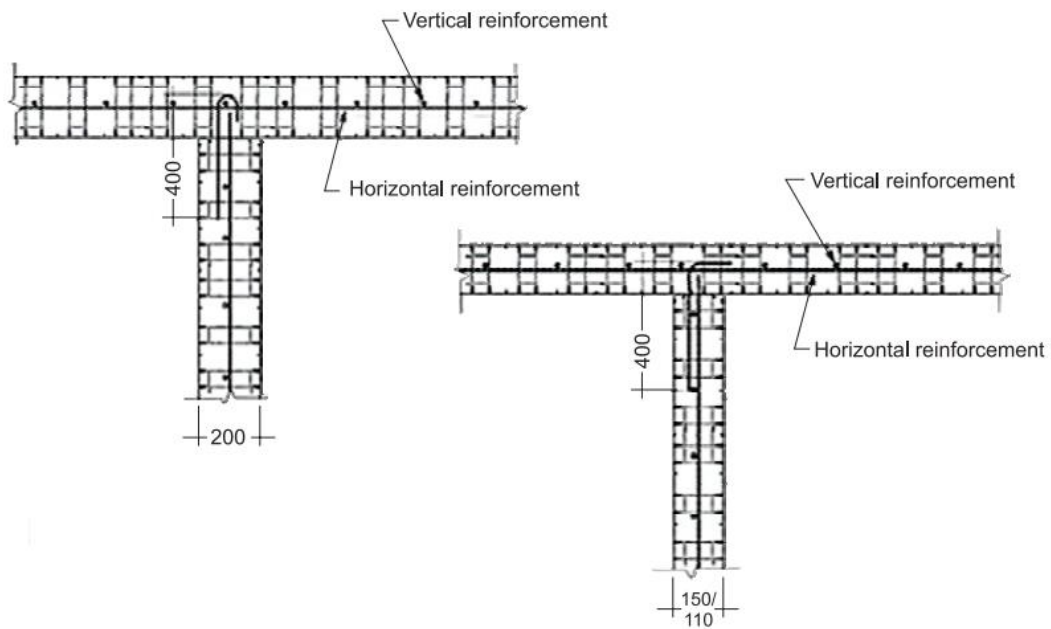


Fig 2.5.6 TYPICAL REINFORCEMENT DETAILS AT INTERCONNECTIONS

2.5.7 CONSTRUCTION PROCESS

A. SURVEY AND SETTING OUT

Consider the wall layout. Establish the best starting point. Sequence to proceed with installation of panels. Ensure most working space possible.

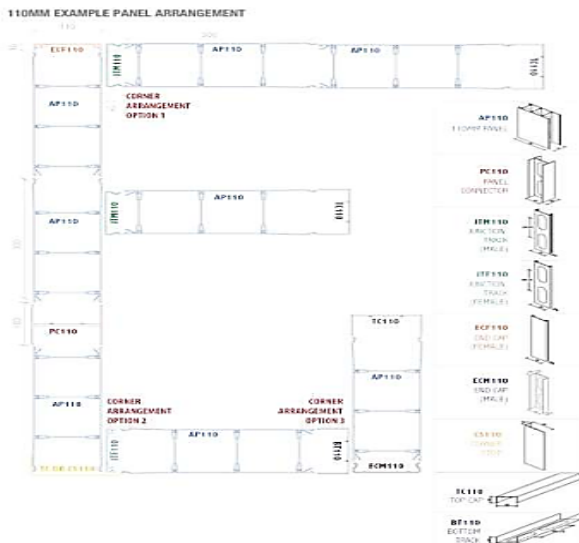


Fig 2.5.7.A SURVEY AND SETTING OUT

B. BOTTOM TRACK FIXING

Ensure that concrete footing/slab is clear, flat and free of debris. Bottom tracks are first laid atop the starter bars and fixed into the plinth to create proper channels for fixing the wall panels.

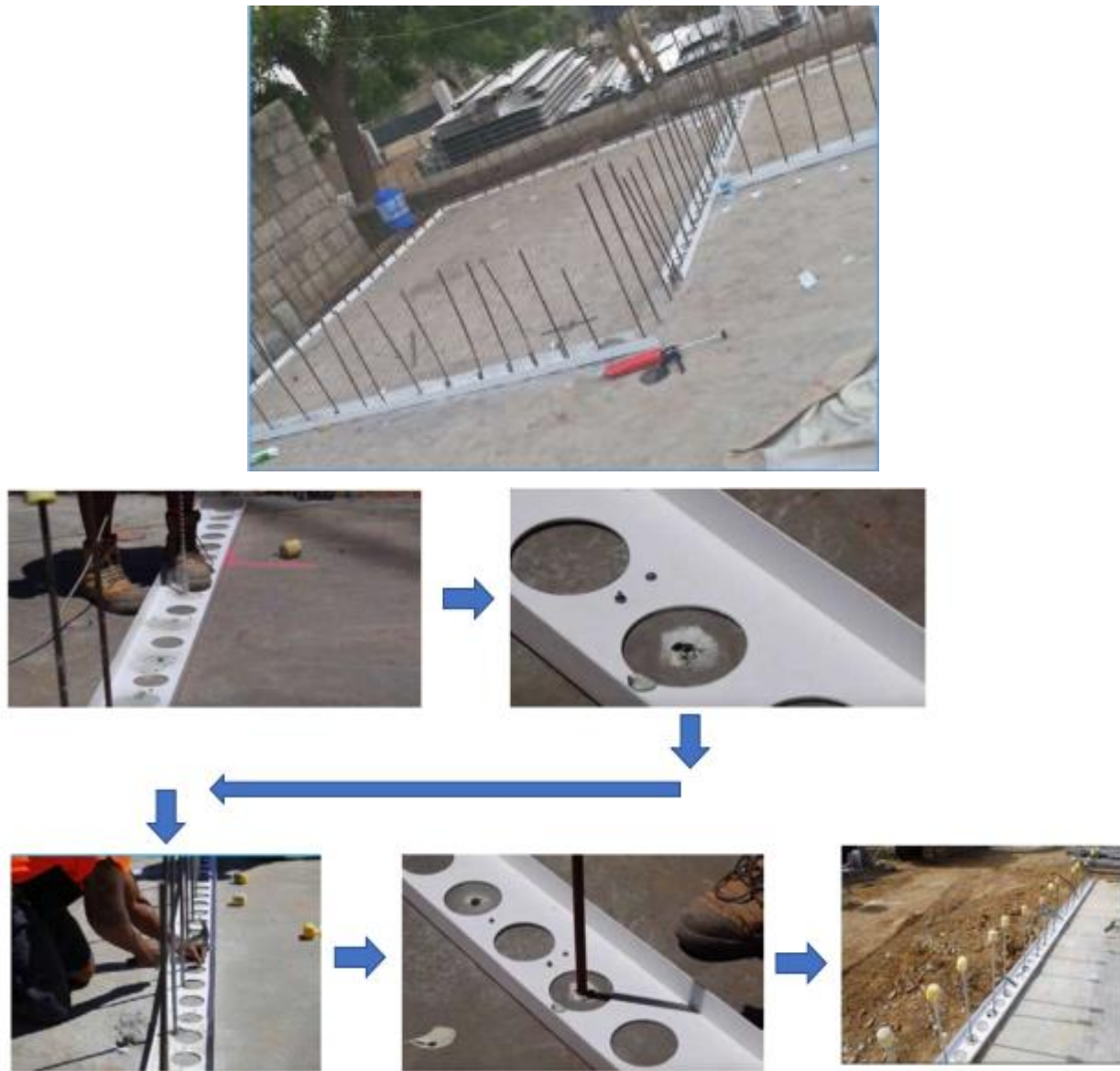


Fig 2.5.7.B BOTTOM TRACK FIXING

C. WALL PANEL INSTALLATION

Start with a corner panel and plumb this from adjacent faces. Beginning with the corner panel, the assembled wall panels are slid into each other side by side atop the bottom tracks and starter bars. Should any of the starter bars foul on the ribs within the panel, the bars can normally be pushed/pulled clear of the rib and the panel successfully lowered as normal. Occasionally it may be necessary to lift the panel completely clear and bend the starter bar that is fouling to re-align them sufficiently for the panel to be easily lowered into position. Brace the first panel using one screw per brace. The base of the brace is then fixed to the slab using an anchor style bolt. The first panel is then plumbed with a spirit level or similar before the brace is fixed.

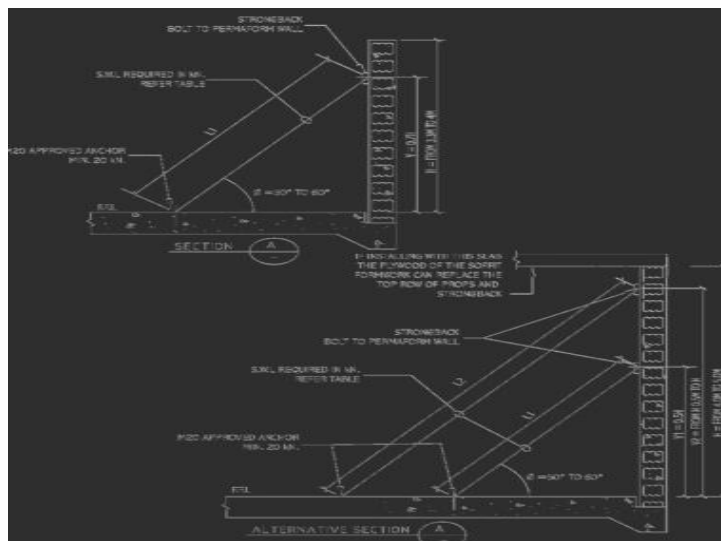


Fig 2.5.7.C.1 WALL PANEL INSTALLATION

Vertical rebars are first slid from a top, tied to starter bar at the bottom by lifting panels. They are long enough to act as starter bar for next floor Horizontal rebars are then slid through the holes in the ribs. They are U-bent at the corner as seen here and the vertical rebar slid through the horizontal U bents ensure they stay in position. Vertical and horizontal bars are tied at the top,

ensuring they do not move during concrete pour

ELECTRIC AND PLUMBING DUCTS.

The electric and plumbing ducts etc. Shall be placed inside the ducts. For connectors, small openings shall be made in the expanded metal

DOORS, WINDOWS AND CONCRETING

Capping panels are fixed on edges of doors windows before fixing wooden frames to gain strength for concrete pour. The frames are removed once concrete is set. No gaps to be left in between panels. Water proofing/hydrophilic sealant installed to cover all gaps and prevent concrete leak. All corners, doors, windows, stop ends are adequately braced Metal strip on external wall corners and aluminium angles on top third of walls Screws on window panels and bottom connectors Self-Compacting Concrete shall be poured by boom pump with a 50mm dia. end hose. Pour shall not be done more than 1 mt.at any point to ensure panels can withstand concrete pressure.



. Fig 2.5.7.C.2 DOORS, WINDOWS AND CONCRETING

E. CONCRETE

When pouring, do not aim the pump directly at corners or wall ends. Always point the pump nozzle towards a rib/diaphragm. Pump nozzle should remain at least 500mm away from wall/column ends. When moving around the walls filling them, remember that the shorter or thinner a section of wall is, the faster it will fill. Do not leave finished concrete surface uneven at the top of forms. Following compaction at the top of the walls, screed the concrete to achieve a smooth and even surface.

When slab and walls are poured at the same time, finish the concreting for the walls first. This should provide enough time for wall concrete to settle before the slab concreting takes place over the particular wall. While pouring, be sure to visually inspect walls regularly to ensure vertical alignment and plumb of the panels is maintained. Stop the pour or proceed at reduced speed if any areas start to move. Keep props, timbers or plywood readily available to provide

temporary bracing if required.

F. VIBRATING

Proper compacting of concrete is essential to prevent voids in the finished walls. Pay particular attention to the sides of all openings, bulkheads and any areas that have a high concentration of steel. Use a 25mm pocket vibrator. Vibrating helps ensure the concrete mix slurry fills all voids, particularly at joints. When vibrating, take care not to damage ribs or the external face of the panels. Place the vibrator in the upper 300mm of the wall panel. System is made from PVC and is non-porous. This means it does not absorb water like masonry, fibre cement or plywood. This increases the flow ability of concrete and reduces honeycombing.

G. POST POUR INSPECTION.

Any household detergent can be used for general cleaning purposes. Any concrete slurry that has spilt onto the panels can be easily removed if it is washed with high pressure water within 30 minutes before the slurry hardens. If concrete slurry has hardened, removing it may damage the wall surface. Apply high water pressure to remove the solution and slurry within 10 minutes.

2.6 RESEARCH PAPERS

I. RESEARCH PAPERS-1

FIRE RESISTANCE PERFORMANCE OF CONCRETE-PVC PANELS WITH POLYVINYL CHLORIDE(PVC)STAY IN PLACE(SIP)FORMWORK.

Michel Murillo A.a,b,*,Bernardo F.Tutikianc,Vinicius Ortolanc,Marcos L.S.Oliveirad,Carlos H.Sampaioe,Leandro Gómez Pa,Luis F.Silva Oa

The paper talks about the following factors:

The aim of this paper was to study the fire resistance performances of structural and non-structural concrete panels with polyvinyl chloride (PVC)SIP formwork.

METHODOLOGY:

Three 124.01 in×110.24 in×3.15 in panels of PVC SIP formwork were tested and compared to one another.All panels were aged for 28days, then exposed to the standard fire curve based on the ISO 834:2014 standard, and the temperatures in each panel surface recorded.The results indicate that concrete strength significantly influenced the structural stability and the fire resistance time of the panels(under load),even in this type of panels when exposed to high temperatures.

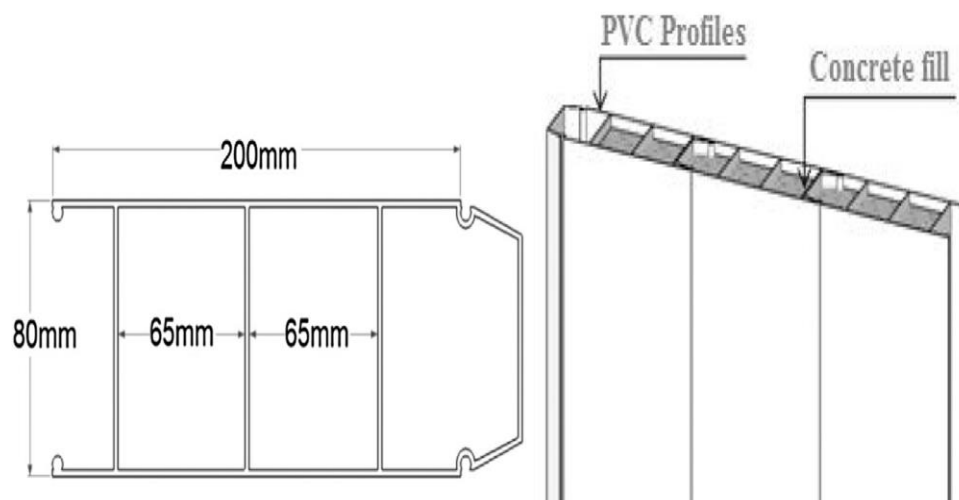


Fig 2.6.1 FIRE RESISTANCE PERFORMANCE OF CONCRETE-PVC PANELS WITH POLYVINYL CHLORIDE(PVC)STAY IN PLACE(SIP)FORMWORK.

TEST RESULTS

The PVC1 panel test lasted 26 min, reaching a maximum lateral displacement of 32 mm and developing an explosive crevice in the concrete what led to the loss of integrity of the system, so that no integrity test could be performed. The PVC2 panel achieved a total fire resistance time of 64 min, reaching a maximum lateral displacement of 55 mm, losing stability during the test. Despite this, six integrity tests were carried out confirming positive results. The PVC3 panel achieved a total fire resistance time of 60 min and reaching a maximum lateral displacement of 31.8 mm. The sample maintained his integrity characteristics for the first 30 min of the test, but later smoke appeared on the external surface of the wall due to the development of fissures, sufficient to allow the passage of gases.

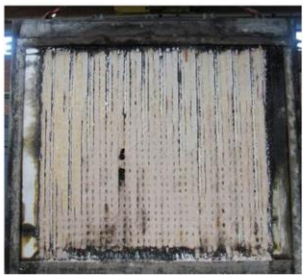
Sample	Before exposure to fire	After exposure to fire
PVC1		
PVC2		
PVC3		

Fig 2.6.1a TEST RESULTS



Fig 2.6.1b Details of the final aspect of the concrete's surfaces.

INFERENCE

Based on the results of this experimental investigation, it can be inferred that the Thermal insulation performance of the PVC coated concrete panels was slightly better than that of the reinforced concrete panels with a traditional removable formwork. Concrete strength significantly affects the structural stability of the panels (under load), even in this type of panels when subjected to high temperatures. This combination of qualities results in the inclusion of PVC within the group of organic materials of better technical classification, being a resistant material, antibacterial, mould able, hygienic and recyclable, ideal for fire prevention, but mainly to turn houses into healthy and sustainable housing.

II. RESEARCH PAPERS-2

EXPERIMENTAL INVESTIGATION ON PVC ENCASED COLUMNS

H.Eramma¹, Madhukar.N.J²

The paper talks about the following factors:

To study the PVC Tubes subjected to axial loading by considering Length. To study the influence of concrete strength by using two different sizes of coarse aggregate 6.3mm and 10 mm using design mix method as per IS:10262-1982. To study the strength and confinement of concrete filled PVC pipes.

METHODOLOGY

Poly vinyl chloride (PVC) tubes filled with concrete are axially loaded until failure of the specimen to investigate their load carrying capacity.

Total eighteen specimens of PVC tubes of diameter 150 mm with effective lengths of 500 mm, 600 mm and 700 mm were cast. M20 grade of concrete of two different mixes having two

different sizes of aggregate 6.3mm and 10mm was filled inside the tubes for casting of PVC concrete filled tube(CFT)column specimens. The column specimens were tested for axial loading in the UTM machine of capacity 100 tons. Their load-displacement curves and stress-strain curves were recorded. Theoretical and experimental results were compared and tabulated and it was found to be 1.36%&35.55%for 6.3 mm size and 11.28%&27.46%for 10 mm size of aggregates as conservative side as increased with compressive strength of PVC Concrete Filled Tube Columns experimentally and catalogue results when compared with theoretical results.

INFERENCE

Confinement of concrete columns with PVC tubes improves their compressive strength.The improvement in strength is dependent on the concrete strength and geometrical properties of the tubes.As the Length increases, the ultimate axial strength of the column increases.

The experimental result is about 35.55%and 27.46%greater than theoretical result for the concrete columns which is prepared by using 6.3mm and 10 mm coarse aggregates.The failure pattern can be seen by local buckling.i.e.,Decrease in length and increase in diameter. About 5mm decrease in length and 3mm increase in diameter.The PVC CFTC was not completely failed till 10 mm of compression in displacement. From it was concluded that PVC CFTC absorbs considerable energy also

Table (d). Comparison between the Strength Parameters of 6.3mm and 10mm Aggregate on CFTC PVC Tubes

S.L.N O	SPECIMEN	AVERAGE MAXIMUM LOAD (KN)	AVERAGE MAXIMUM DISPLACEMENT (MM)
1	6.3CFTC500	592.73	11.24
2	6.3CFTC600	652.31	9.37
3	6.3CFTC700	677.98	7.9
4	10CFTC500	517.19	11.51
5	10CFTC600	577.33	10.36
6	10CFTC700	617.3	10.07

In the Fig(a) the load v/s displacement is plotted for M30 grade of concrete with 6.3mm and 10mm size of coarse aggregates for length varied from 500 to 700mm and the following points are observed

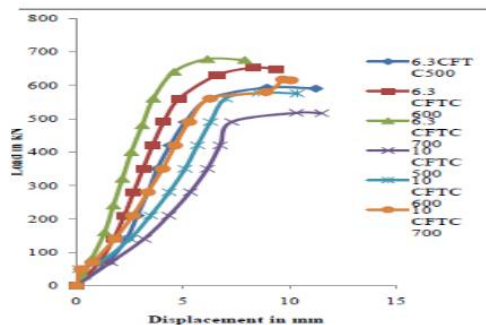


Plate (3): Experimental Setup

Fig 2.6.2a EXPERIMENTAL INVESTIGATION ON PVC ENCASED COLUMNS

III. RESEARCH PAPERS–3

EFFECT OF STAY-IN-PLACE PVC FORMWORK PANEL GEOMETRY ON FLEXURAL BEHAVIOUR OF REINFORCED CONCRETE WALLS

Benjamin Scott a,1,NoranWahabb,2,*,Adil Al-Mayah b,Khaled A.Soudki b,3

The paper talks about the following factors

The research herein outlines tests on reinforced concrete walls with a compressive strength of 25 MPa,utilizing two types of PVC panels:flat or hollow,in order to further understand the polymer's contribution to flexural resistance.

METHODOLOGY

Variables studied included concrete core thickness (152mm,178mm,and 203mm),reinforcing ratio(3–10Mbars or 3–15Mbars),and panel type(hollow or flat).The walls were tested in four point bending. Walls failed due to steel yielding followed by concrete crushing, PVC buckling,and/or PVC rupture depending on the reinforcement ratio and panel type.

The hollow panel encased specimens also experienced slip of the panels on the tensile face.The PVC encasement enhanced the yield load,ultimate load,ductility, and toughness of the concrete walls. Concrete cores were taken from the tested PVC encased specimens and compressive strength was found to be the same as the control walls.

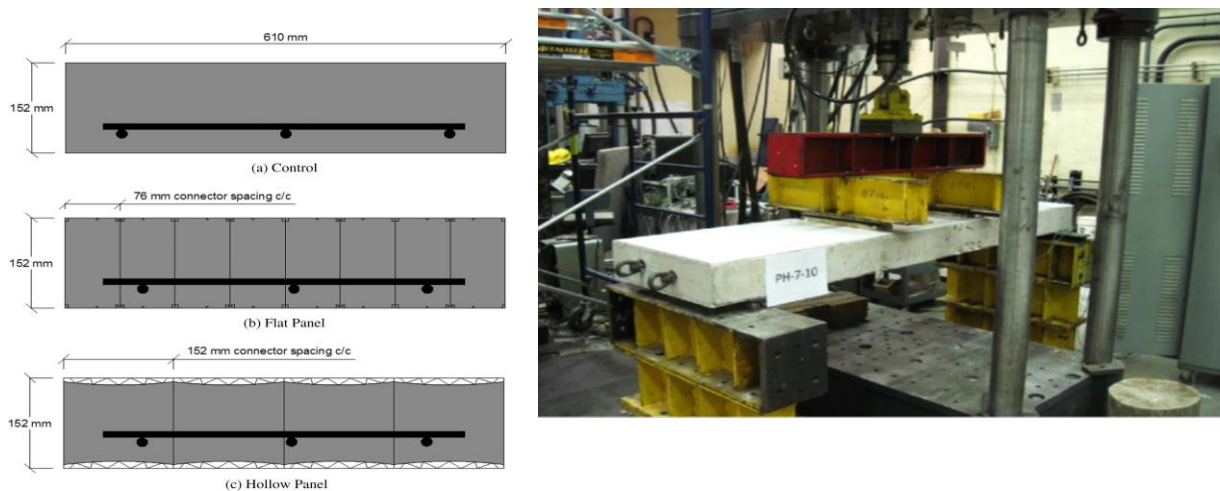


Fig 2.6.3a EFFECT OF STAY-IN-PLACE PVC FORMWORK PANEL GEOMETRY ON FLEXURAL BEHAVIOUR OF REINFORCED CONCRETE WALLS

INFERENCE

All PVC encased specimens failed by steel yielding on the tension side and concrete crushing and PVC buckling on the compression side. PVC encasement improved the load capacity of the reinforced concrete walls. For flat panel encased walls, the average improvement at yield and ultimate loads was 21% and 27% respectively. Hollow panel encased walls recorded average yield and ultimate load improvements of 8% and 27% respectively.

A comparison was made between walls with the SIP PVC system and walls that were conventionally constructed and 25mm (1") thicker. The yield and peak loads were very similar in this comparison, suggesting the potential for using the SIP system as a means to reduce the wall thickness and achieve the same structural performance. There was no statistically significant difference observed in the concrete strength of PVC encased walls and traditionally formed concrete.

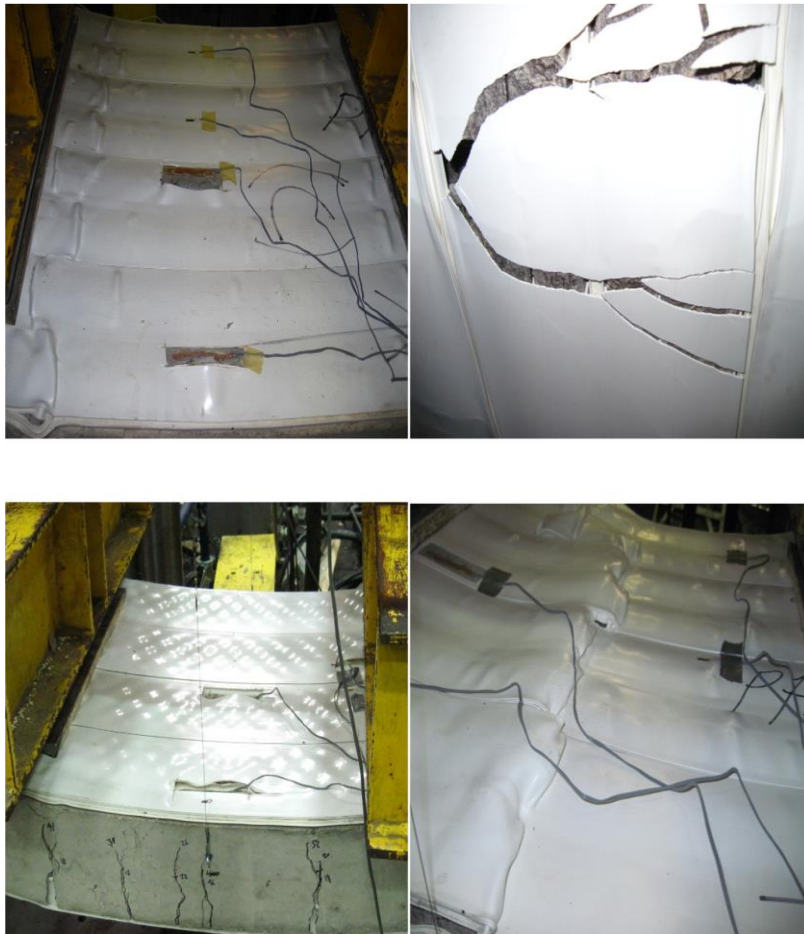


Fig 2.6.3b EFFECT OF STAY-IN-PLACE PVC FORMWORK PANEL GEOMETRY ON FLEXURAL BEHAVIOUR OF REINFORCED CONCRETE WALLS

IV. RESEARCH PAPERS-4

THE GFRP PROFILES AS STAY-IN-PLACE FORMWORK-

Kinga Brózda^{1,*}, Jacek Selejdak¹, and Peter Koteš²

The paper talks about the following factors:

This paper describes research on the GFRP (Glass Fibre Reinforced Polymers) materials are characterized by good mechanical properties and very high corrosion resistance. Currently the GFRP profiles in the form of modular structural elements are used as so-called decking systems. However, the last researches concern the possibility of using the modular FRP profiles as a stay-in-place (SIP) formwork.

In this article the conception of the shape and cross-sectional dimensions selection of the FRP profile was attempted. The conception applies to the prototype of the GFRP profile, which is able to use as a self-supporting formwork in composite slab in building structures on floors or as the deck in composite bridge structures. On the basis of theoretical and practical studies available in the literature, the theoretical evaluation of the composite element were done.

METHODOLOGY:

The conception of the SIP FRP formwork system: The primary objective of the analysis is to determine the shape of structural profile which will be the main part of the stay-in-place formwork system. During analysis the load carrying capacity and the related maximum load force were taken into consideration.

The FRP SIP formwork shown in the Fig.1 is an example of a SIP formwork system which is based on hollow box sections. This system consists of the modular structural GFRP profiles, which can be connected with each other by special grooves and thus act as a self-supporting formwork for RC (reinforced concrete) slab. In this solution the load-carrying capacity highly depends on quality of the bonding between GFRP formwork and concrete.

The creation of the new trapezoidal-shaped section of FRP formwork:

This shape modifications can increase the bonding between FRP formwork and concrete and consequently provides more effective composite action. In addition, the appropriate surface treatment (e.g. sand-blast of FRP surface) can be carried out to increase the bonding between FRP and concrete. Using analytical calculations the theoretical analysis of the composite

element was done.

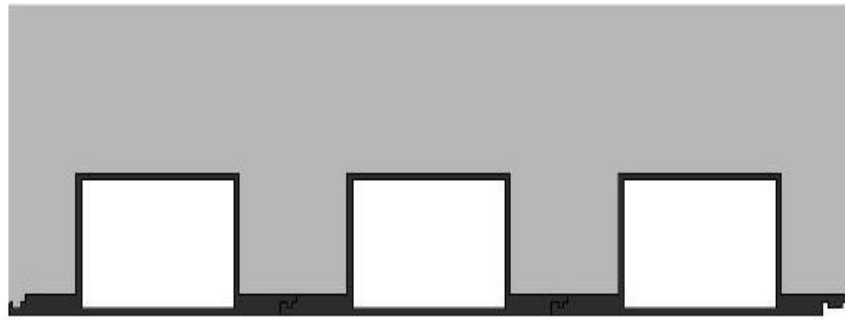


Fig. 1. The cross-section of the modular GFRP SIP formwork [9].

Fig 2.6.4a THE GFRP PROFILES AS STAY-IN-PLACE FORMWORK

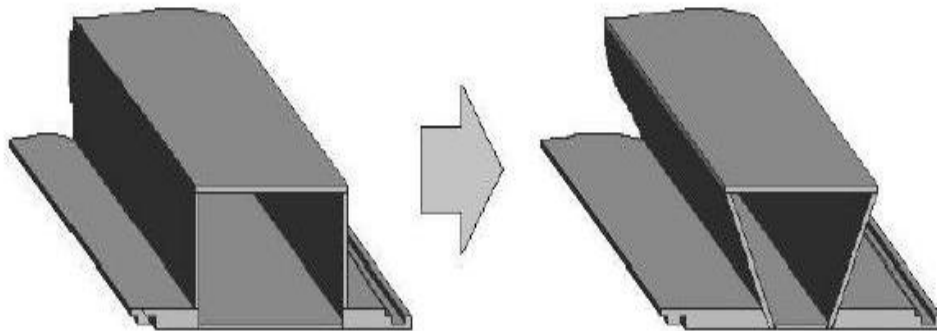


Fig. 2. The schema of the modified modular GFRP SIP formwork.

Fig 2.6.4b THE GFRP PROFILES AS STAY-IN-PLACE FORMWORK

INFERENCES:

The paper presented a the authors have proposed the lightweight and easy to install GFRP SIP formwork for slabs. The formwork system is based on hollow trapezoidal-shaped section. The analytical calculations of the composite element(GFRP formwork+RC slab)were done. The load-carrying capacity depending on the height of concrete slab and the associated maximum load force were investigated. The results were compared with the prototype box-shaped section.

The use of FRPs in SIP formwork systems reduces the self-weight of the formed structure and increase economic efficiency. Moreover, the modular GFRP profile provides an additional corrosive protection of steel reinforcement. Due to the anti-corrosive properties, the use of this GFRP SIP formwork system is mainly intended for structures exposed to an aggressive environment, providing a long failure-free service life with little maintenance.

V. RESEARCH PAPERS-5

THE SEISMIC PERFORMANCE OF HIGH STRENGTH CONCRETE COLUMNS CAST IN STAY IN PLACE FRP FORMWORK

Togay OZBAKKALOGLU¹ and Murat SAATCIOGLU²

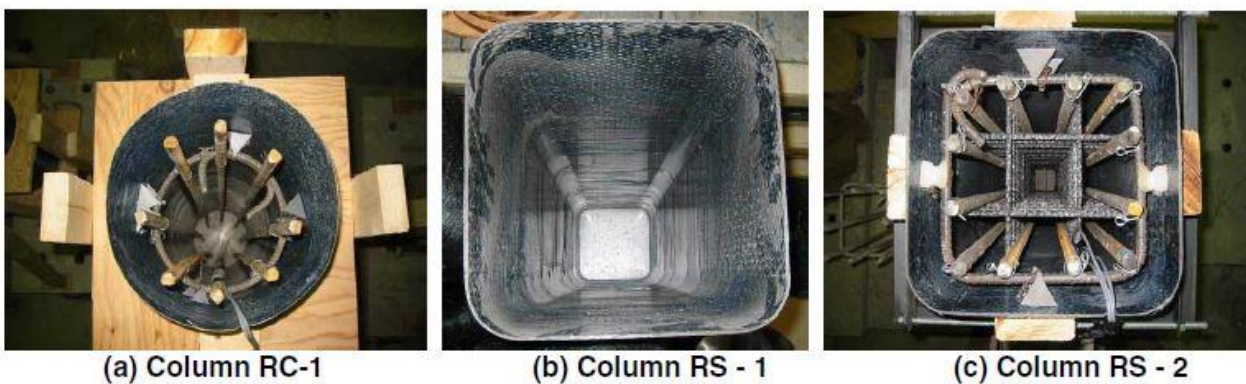
The paper talks about the following factors

This paper describes research the use of high-strength concrete (HSC) in seismically active regions poses a major concern because of the brittle nature of material. The confinement requirements for HSC columns may be prohibitively stringent since they require proportionately higher confinement than columns of normal-strength concrete.

An alternative to conventional confinement reinforcement is the use of fibre reinforced polymer (FRP) casings, in the form of a stay-in-place formwork, which can fulfill multiple functions of Formwork, Confinement Reinforcement Protective Shell Against Corrosion, Weathering And Chemical Attacks. This paper investigates the use of stay-in-place FRP formwork as concrete confinement reinforcement for HSC columns with square and circular cross-sections.

METHODOLOGY:

Most of the existing research focuses on repair, rehabilitation and retrofit of existing normal-strength concrete columns, overlooking potentials for application to new construction, especially to new HSC columns. On the other hand, multiple functions and effectiveness of FRP stay-in-place formwork offer advantages for use as confinement reinforcement, especially for a brittle material like HSC.



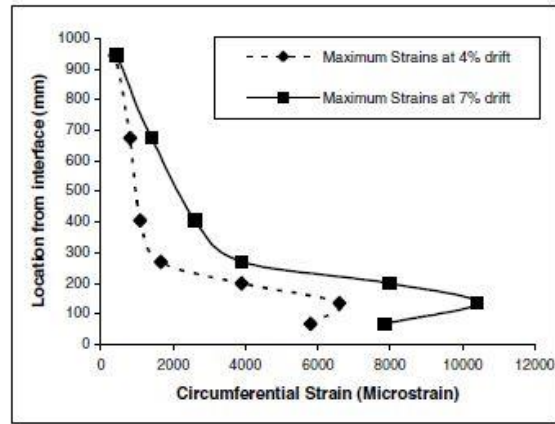


Fig 2.6.5a THE SEISMIC PERFORMANCE OF HIGH STRENGTH CONCRETE COLUMNS CAST IN STAY IN PLACE FRP FORMWORK

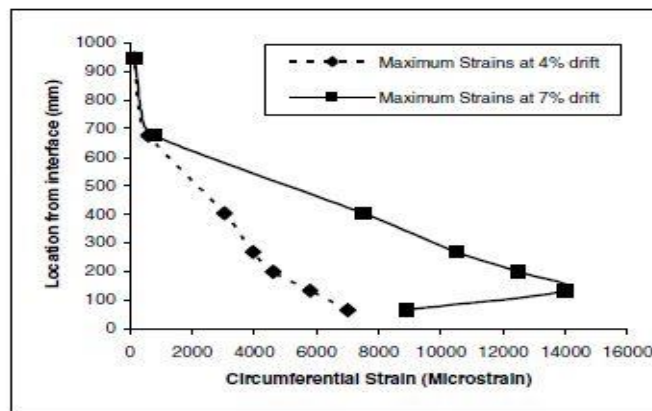
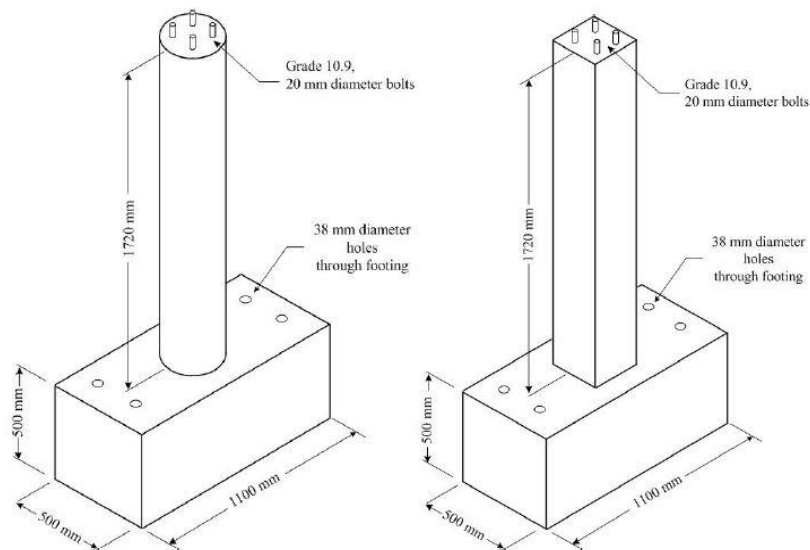


Fig 2.6.5b THE SEISMIC PERFORMANCE OF HIGH STRENGTH CONCRETE COLUMNS CAST IN STAY IN PLACE FRP FORMWORK

INFERENCE

The paper presented High-strength concrete columns confined with carbon FRP stay-in-place formwork can develop extremely ductile behavior under simulated seismic loading. Column tests reported in this paper indicate that inelastic deformability of 90 MPa concrete columns can be increased up to 12% lateral drift ratio with FRP stay-in-place formwork. The increased confinement requirements for HSC columns can be met by using FRP stay-in-place formwork. Unlike the conventional steel reinforcement that only confines the core concrete, FRP stay-in-place formwork effectively confines the entire column section.

The strain data recorded during column tests reported in this paper illustrates that the design transverse strain of 0.4% recommended by current FRP design guidelines is conservative for the columns tested. Transverse strains of 1% and above were recorded in FRP formwork, when subjected to simulated seismic loading.

Additional confinement provided by a footing appears to strengthen the column critical section at column-footing interface, which consequently shifts the failure away from the interface. This shift was observed to be approximately equal to half the column cross-sectional dimension in the columns tested and the axial load applied.

S.N	JOURNAL	INFERENCE
1	Fire resistance performance of concrete-PVC panels with polyvinyl chloride (PVC) stay in place (SIP) formwork	Thermal insulation performance of the PVC coated concrete panels was slightly better than that of the reinforced concrete panels with a traditional removable formwork . Concrete strength significantly affects the structural stability of the panels (under load), even in this type of panels when subjected to high temperatures.
2	EXPERIMENTAL INVESTIGATION ON PVC ENCASED COLUMNS H. Eramma1, Madhukar.N.J2	Confinement of concrete columns with PVC tubes improves their compressive strength. Length increases, the ultimate axial strength of the column increases. 35.55% and 27.46% greater than theoretical result for the concrete columns which is prepared by using 6.3mm and 10 mm coarse aggregates .
3	Effect of stay-in-place PVC formwork panel geometry on flexural behaviour of reinforced concrete walls	A comparison was made between walls with the SIP PVC system and walls that were conventionally constructed and 25mm (1") thicker. The yield and peak loads were very similar in this comparison, suggesting the potential for using the SIP system as a means to reduce the wall thickness and achieve the same structural performance. There was no statistically significant difference observed in the concrete's Strength of PVC encased walls and traditionally formed concrete
4	The GFRP profiles as stay-in-place formwork	The use of FRPs in SIP formwork systems reduces the self-weight of the formed structure and increase economic efficiency . Moreover, the modular GFRP profile provides an additional corrosive protection of steel reinforcement
5	The Seismic performance of high strength concrete columns Cast in stay in place FRP formwork	The strain data recorded during column tests reported in this paper illustrates that the design transverse strain of 0.4% recommended by current FRP design guidelines is conservative for the columns tested. Transverse strains of 1% and above were recorded in FRP formwork, when subjected to simulated seismic loading

Fig 2.6.5c Journal & Reference

CASE STUDY



22

. Fig 2.6.7 CASE STUDY - 1

CHAPTER 3

LIVE CASE STUDY

LIGHT HOUSE PROJECT - LUCKNOW

3.1.1 INTRODUCTION

TECHNOLOGY–STAY IN PLACE FORMWORK PVC

Technology provider-NOVEL Assemblers pvt.ltd

Contracting Agency–JAM Sustainable Housing

The area of the flats is 1040 in which the flats will be constructed.

The carpet area of the flats under Light House Project is 34.50 Sq.meters.

State government and central government provide the subsidy of Rs.7.84 Lakh at the total cost



. Fig 3.1.1 LIVE CASE STUDY



Fig 3.1.1.1 LIVE CASE STUDY SPECIFICATIONS

		04-07-2019	
Total plot area (sq mt)		20000	
1.	Pem isible FAR. (2.5)	50000.00	sq.mt.
2	Proposed Green Area (15.00%)	3000.00	sq.mt.
		Awaz Yoyna	
S.NO.	DESCRIPTION OF ITEM	1 BHK	TOTAL
2	No. of Flats	1040	1040
3	Carpet Area	34.50	
4	Built up Area	38.38	
5	Super Area	46.50	
6	No of flats at Typical floor	80	
7	Total Area on typical floor	3720.00	3720.00
	Total Area on Stit floor (for parking)	3720.00	3720.00
8	Achived Ground Coverage (22.35%)		4470.00
9	Total Built up area of all floors	48360.00	48360.00
10	Built up area of commercial (ground floor)		500.00
11	Built up area of community space (ground & 1st. floor)		500.00
12	Grand Total of Built up area (sq mt)		49360.00

Broad Specifications	
Foundation	RCC raft foundation
Structural Frame	Pre-engineered steel structural frame
Walling	Stay In Place PVC Formwork System
Floor Slabs/Roofing	Cast in-situ deck slab
Joinery & Finishing	Door Frame/ Shutter: - Pressed steel door frame with flush shutters - PVC door frame with PVC Shutters in toilets. Window Frame/ Shutter: - uPVC frame with glazed panel and wire mesh shutters. Flooring: - Vitrified tile flooring in Rooms & Kitchen - Anti-skid ceramic tiles in bath & WC - Kota stone Flooring in Common area. - Kota stone on Staircase steps.
Infrastructure	Internal Water Supply, Laying of Sewerage Pipe Line, RCC storm water drain, Provisions for Fire Fighting, Internal Electrification, Internal Road & Pathway (CC Road and Bituminous Road), Providing Lifts in building blocks, Landscaping of site, Street light with LED lights, Solar Street Light System, Sewerage Treatment Plant, External Electrification, Water Supply System including underground water reservoir, Compound wall with Boundary Gates, Horticulture facilities, Rain Water Harvesting, Solid Waste Management.

Fig 3.1.1.1 LIVE CASE STUDY SPECIFICATIONS

3.1.2 Site Analysis

1. Location: The site is located in Shanthi Nagar,Lucknow.
2. Climate: Warm humid subtropical climate
3. Airport: Chaudhary Charan Singh International Airport-15.1 km
4. Bus Stop: Shanthi Nager Bus Stop–1km
5. Railway-Lucknow–Kanpur Suburban Railway and Barabanki-Lucknow Suburban Railway
6. Landuse: Residential

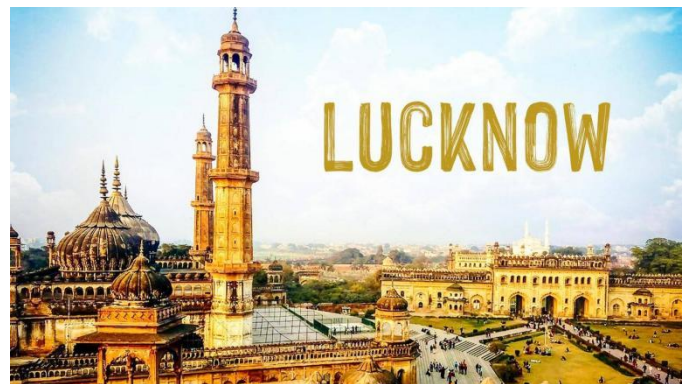
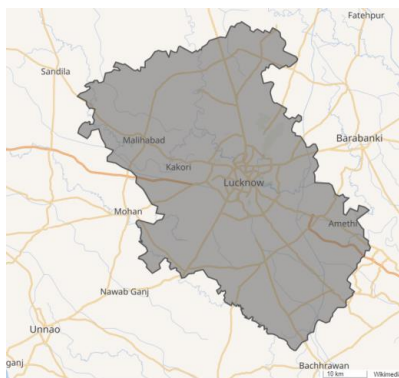


Fig 3.1.2 SITE ANALYSIS

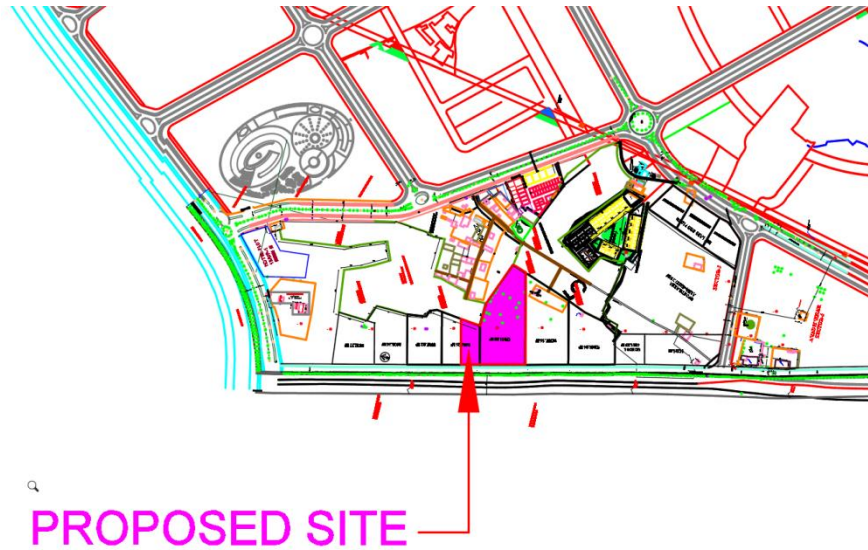


Fig 3.1.2.1 SITE ANALYSIS

3.1.3 Soil Test Report

At the present site, water table was encountered at a depth of **14.0m** in all the investigated bore holes.

Based on soil test results and N-values, the net safe bearing capacity / allowable bearing pressure for a raft foundation placed at a depth of **1.5m , 3.0m and 4.5m** below existing ground level comes out to be **11.0 t/m² , 13.0 t/m² and 15.0 t/m²** respectively with respect to settlement. The allowable settlement was considered as 50mm.

5.0 BEARING CAPACITY AND RECOMMENDATIONS

The sub soil investigation work was carried out to find the soil parameters in order to design the foundation for Multi-storied buildings (EWS & LIG) of U.P. Avasi Vikas Parishad, Construction Division-14, Lucknow at Awadh Vihar Yojana, Sector-05, in Lucknow District. Four boreholes (Nos. 1, 3, 5 & 6) were investigated at site up to a depth of 20.0m & the other two bore hole (Nos. 2 & 4) up to a depth of 30.0m from the existing ground level.

At the present site, in bore hole No. 1, non-plastic silty soil (ML) was found with varying thicknesses at different depths except from 6.0m to 7.2m depth where clay with medium compressibility (CI) was observed.

In bore hole Nos. 2 and 4, non-plastic silty soil (ML) was found with varying thicknesses at various depths throughout the investigation depth.

Geotechnical Engineering Division

North India Engineers' Lab & Consultants

Shed No. 62, Industrial Estate, M.N.N.I.T, Allahabad

BORE LOG CHART

Site: U.P.A.V.P., Lucknow

Structure: EWS, Multi Storied Building

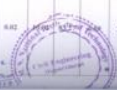
Bore Hole No.: 1

Depth metre	SPT Value	Soil Description	Classification	Particle Size Distribution				Liquid Limit w _L %	Plastic Limit w _P %	Shrinkage Ratio	Atterberg's Limits w _L %	Shrinkage Ratio	Compression Index	
				Gravel	Sand	Silt	Clay							
0.0														
1.5	9	Non-Plastic Silty Soil	ML	1.56	6.78	88.78	1.93	15.6	1.94	1.75	2.64	Non-Plastic	0.01	18
3.0	18													
4.5	13													
6.0	18													
7.2	17	Clay with Medium Compressibility	CI	0.00	0.20	71.57	28.23	21.4	2.35	1.77	2.70	30	19	20
9.0	20													
10.5	17	Non-Plastic Silty Soil	ML	0.78	28.02	70.06	1.14	20.3	1.36	1.80	2.64	Non-Plastic	0.02	19
12.0	28													
13.5	16													
15.0	11													
16.5	24	Non-Plastic Silty Soil	ML	0.02				21.4	2.30	1.80	2.64	Non-Plastic	0.05	19
18.0	27													
19.5	41													
21.0														

Examine & Verify

[Signature]

22/07/2022



Uttarakhand



22/07/2022

Geotechnical Engineering Division

North India Engineers' Lab & Consultants

Shed No. 62, Industrial Estate, M.N.N.I.T, Allahabad

BORE LOG CHART

Site: U.P.A.V.P., Lucknow

Structure: LIG, Multi Storied Building

Bore Hole No.: 6

Depth	SPT Value	Soil Description	Classification	Particle Size Distribution				Liquid Limit	Plastic Limit	Shrinkage Ratio	Atterberg's Limits in %	Shrinkage Parameters	Compression Index	
				Gravel	Sand	Silt	Clay							
0.0														
1.5	8													
3.0	12	Non-Plastic Silty Soil	ML	0.22	6.22	90.97	2.89	12.1	1.89	1.69	2.64	Non-Plastic	0.03	21
4.5	13													
6.0	15													
7.5	18													
9.0	20													
10.5	22	Non-Plastic Silty Soil	ML	0.96	2.68	93.87	13.48	16.6	1.94	1.66	2.64	Non-Plastic	0.17	13
12.0	19													
13.5	31													
15.0	39	Non-Plastic Silty Sand	SM	49.50	9.09	37.44	3.47	25.4	1.99	1.89	2.62	Non-Plastic	0.03	28
16.5	20													
18.0	29													
19.5	40	Non-Plastic Silty Soil	ML	3.22	4.94	91.11	10.73	28.7	2.14	1.70	2.64	Non-Plastic	0.19	19
21.0														

Handwritten signature: Prakash Chandra K.S.

Handwritten signature: Utkarsh

Scale: 1 cm = 1 m

Fig 3.1.3. SOIL TEST REPORT

3.1.4 Site Plan

The LHPs are model housing projects with houses built with shortlisted alternate technology suitable to the geo-climatic and hazard conditions of the region. This will demonstrate and deliver

ready to live houses with speed, economy and with better quality of construction in a sustainable manner.

TECHNOLOGY SELECTED: -PVC Stay In Place Formwork System

No.of Towers:4 No.of Houses:1040 No.of Floors:14

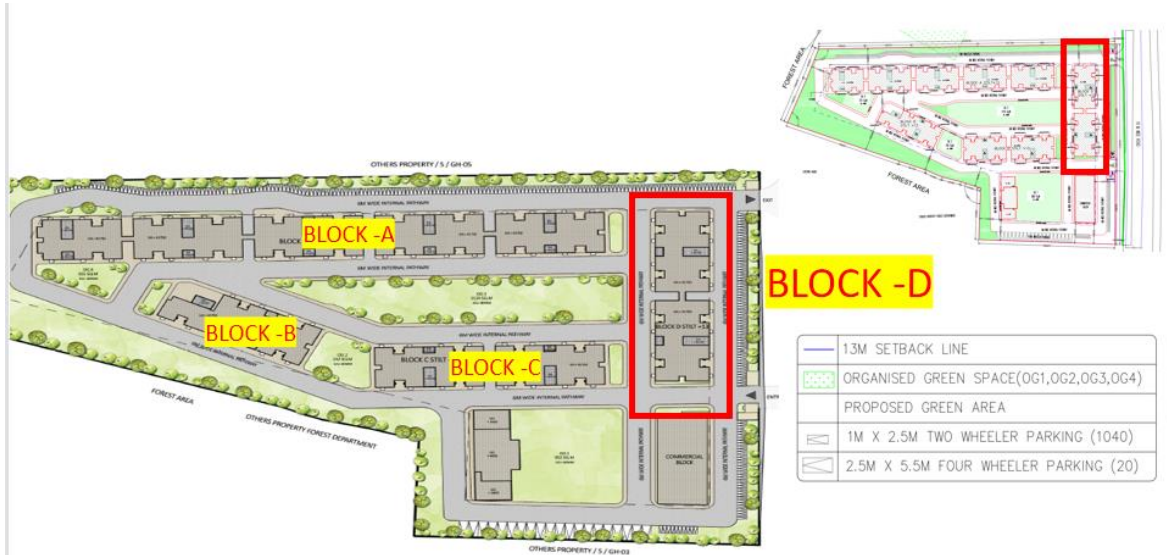


Fig 3.1.4. SITE PLAN

3.1.5 Block Proximity

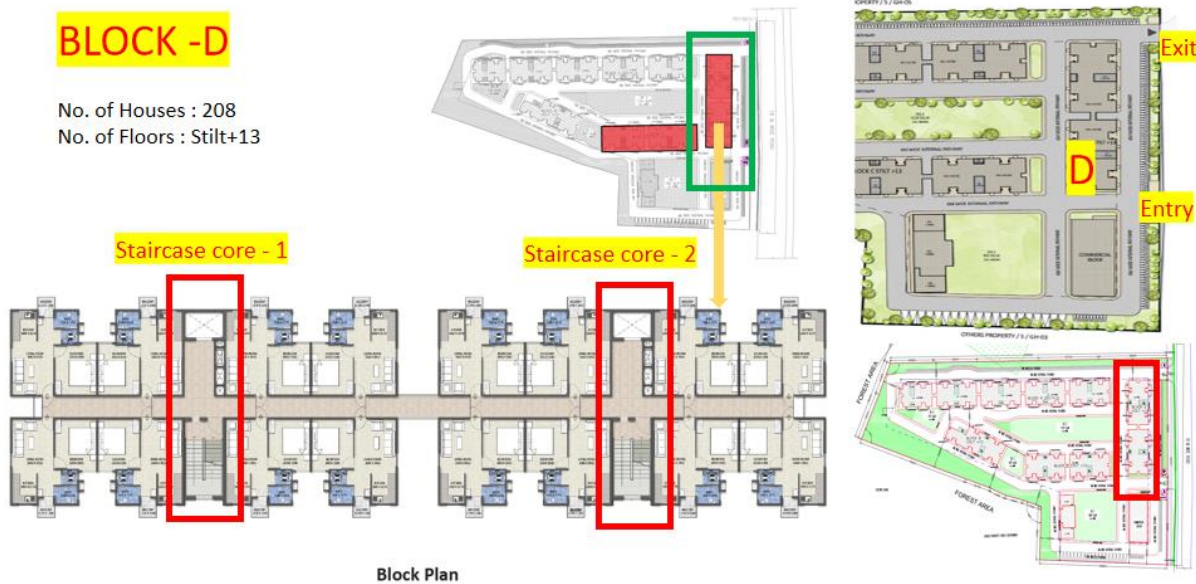
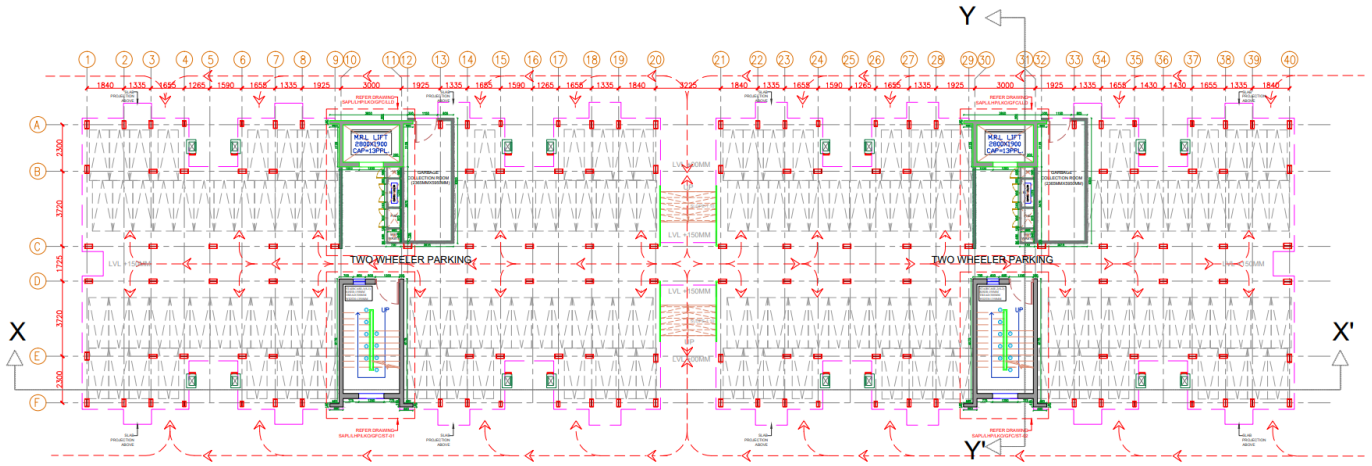


Fig 3.1.5. Block Proximity

3.1.6 Floor Plans

Stilt Floor Layout



Typical Floor Layout-1 to 13th floor



Fig 3.1.6. Floor Plan

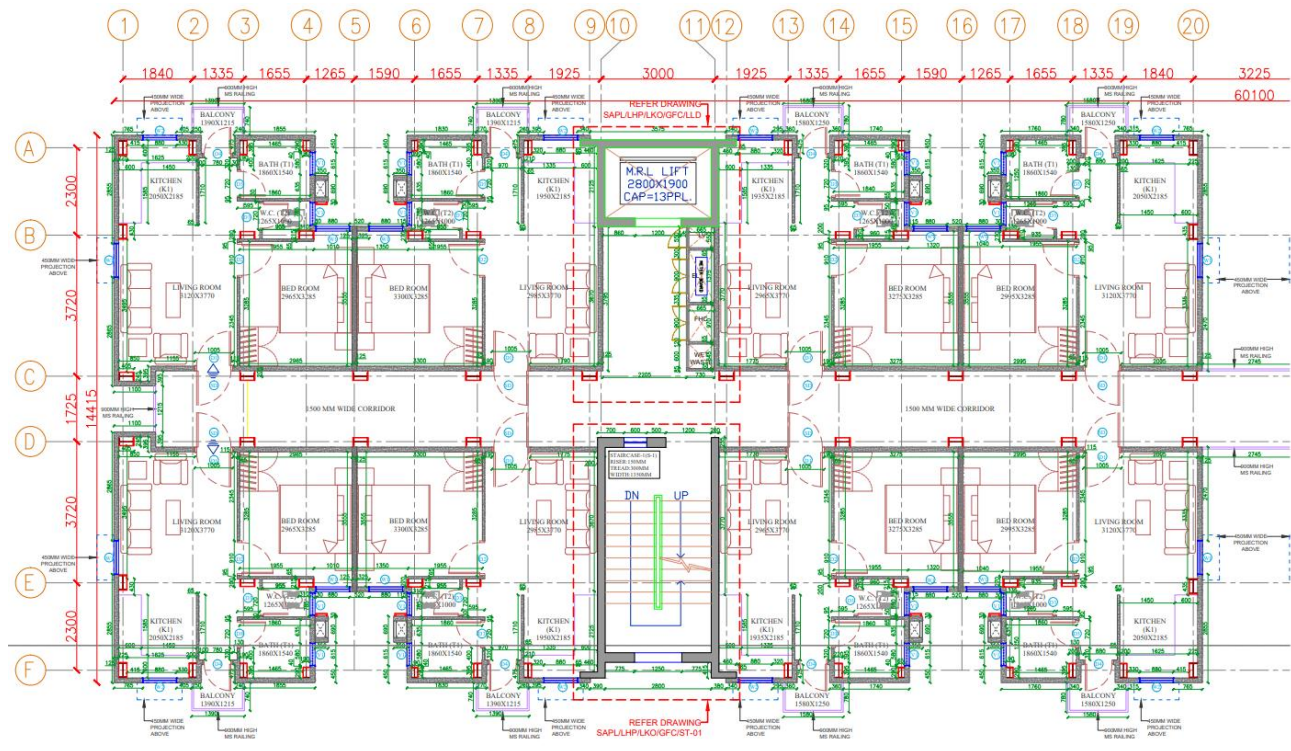
SCHEDULE OF DOOR & WINDOW								
S.NO.	TYPE	SIZE	WIDTH	HEIGHT	SILL	LINTEL	NOS.	REMARK
01	D1	1005X2400	1005	+2400	---	+2400	1	WOODEN DOOR
02	SD	1005X2100	1005	+2100	---	+2100	1	MS. DOOR
03	D2	910X2100	910	+2100	---	+2100	1	WOODEN DOOR
05	D3	720X2100	720	+2100	---	+2100	1	PVC DOOR
06	D4	780X2400	780	+2400	---	+2400	1	GLASS DOOR
07	W1	880X1200	880	+1200	+900	+2100	1	WINDOW
08	W2	880X1500	880	+1500	+900	+2400	1	WINDOW
09	V1	580X600	580	+600	+1500	+2100	1	VENTILATOR
10	FD	1200X2100	1200	+2100	---	+2100	---	FIRE DOOR

3.1.6 Schedule of Joinery

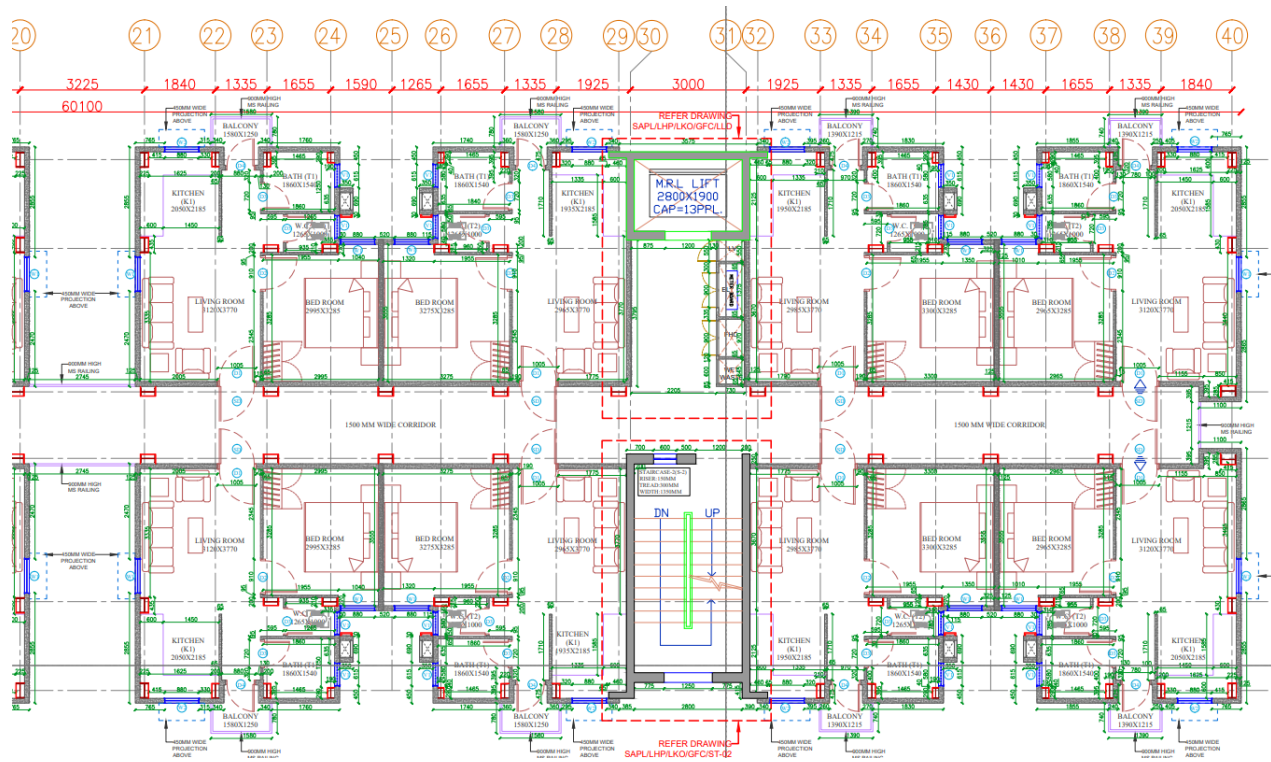


Fig 3.1.6.a Typical Floor Plan

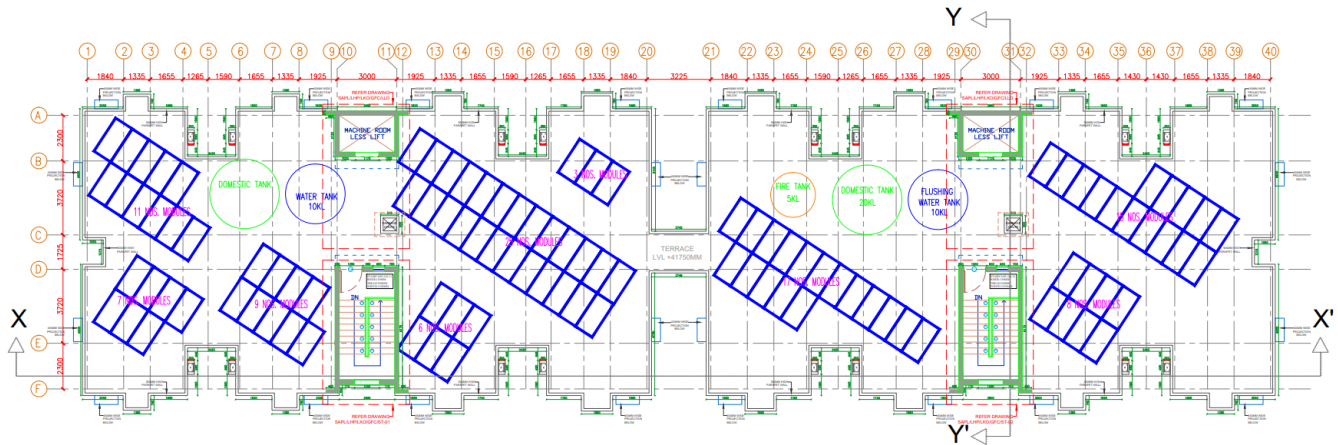
Typical Floor Part Plan-Right Wing



Typical Floor Part Plan-Left Wing



Terrace Floor Layout



Mumty level Layout

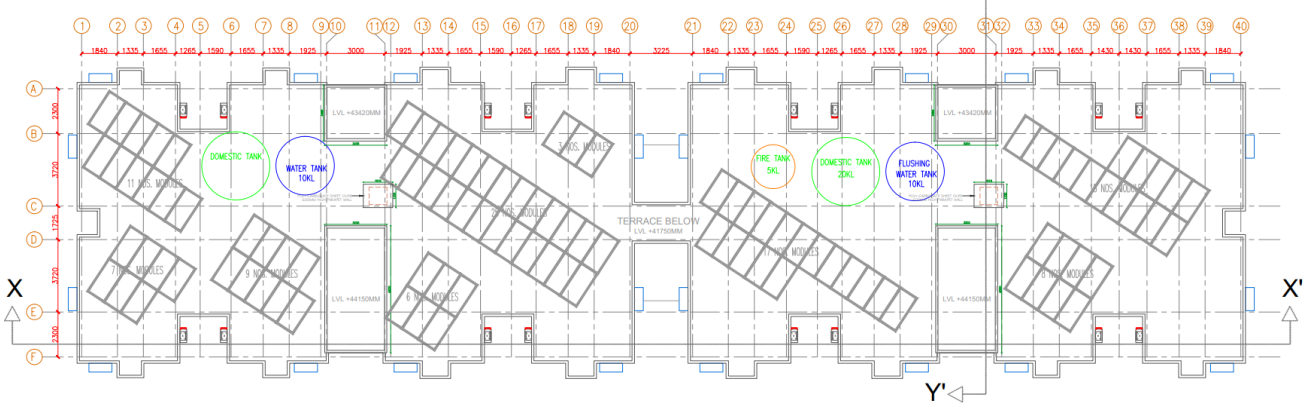
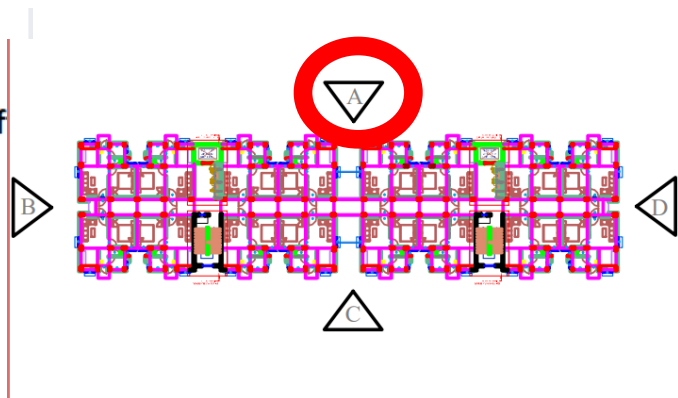


Fig 3.1.6.b Terrace & mumty Floor Plan

3.1.7 Elevations

Stilt floor of height – 2600mm(8.5ft)
 Typical floor of height – 3000mm(9.8ft)
 Total Height of the building-44550mm(146ft)
 Sill height – 900mm (2.9ft)
 Lintel height – 2100mm(6.8ft)
 MS Rail of height – 900mm(2.9ft)
 Parapet height – 900mm(2.9ft)



Elevation-A

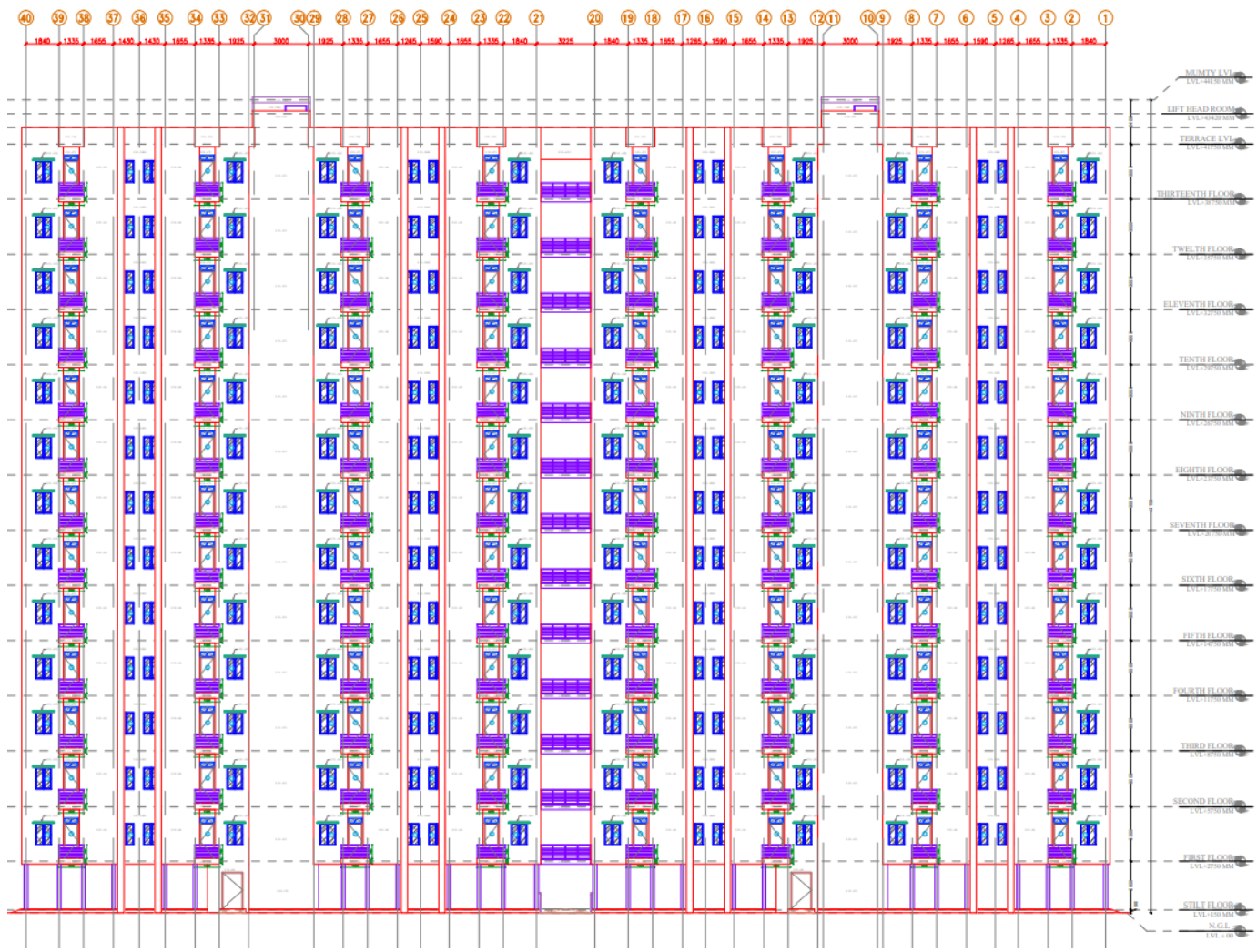


Fig 3.1.7.1 Elevations

Elevation-B&D

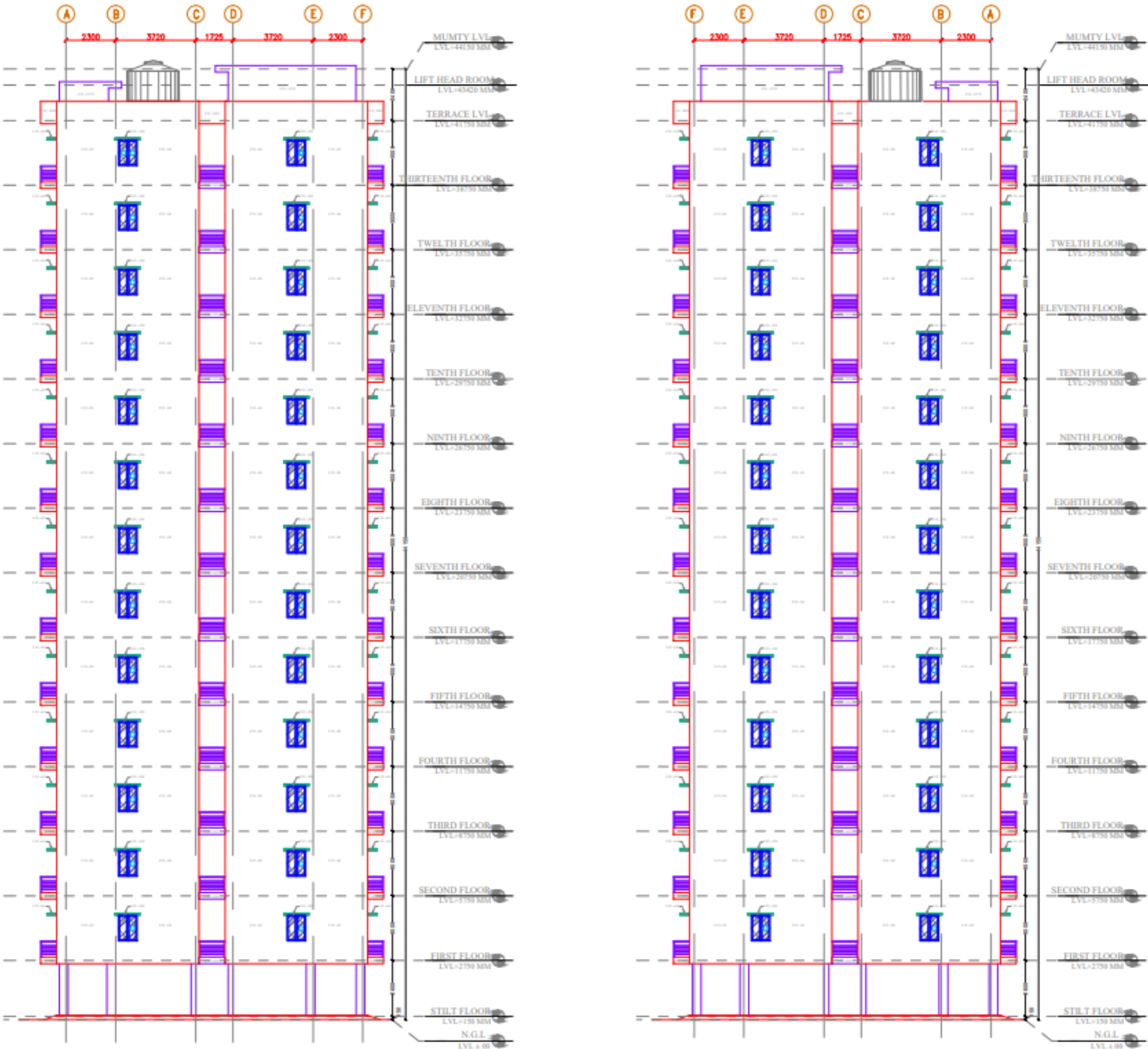
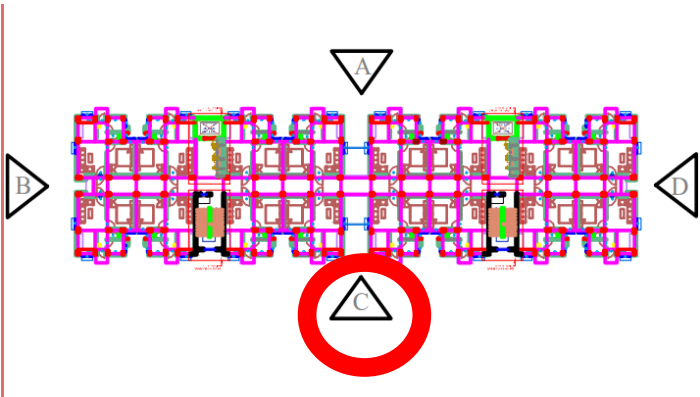


Fig 3.1.7.2 Elevations

Elevation-C



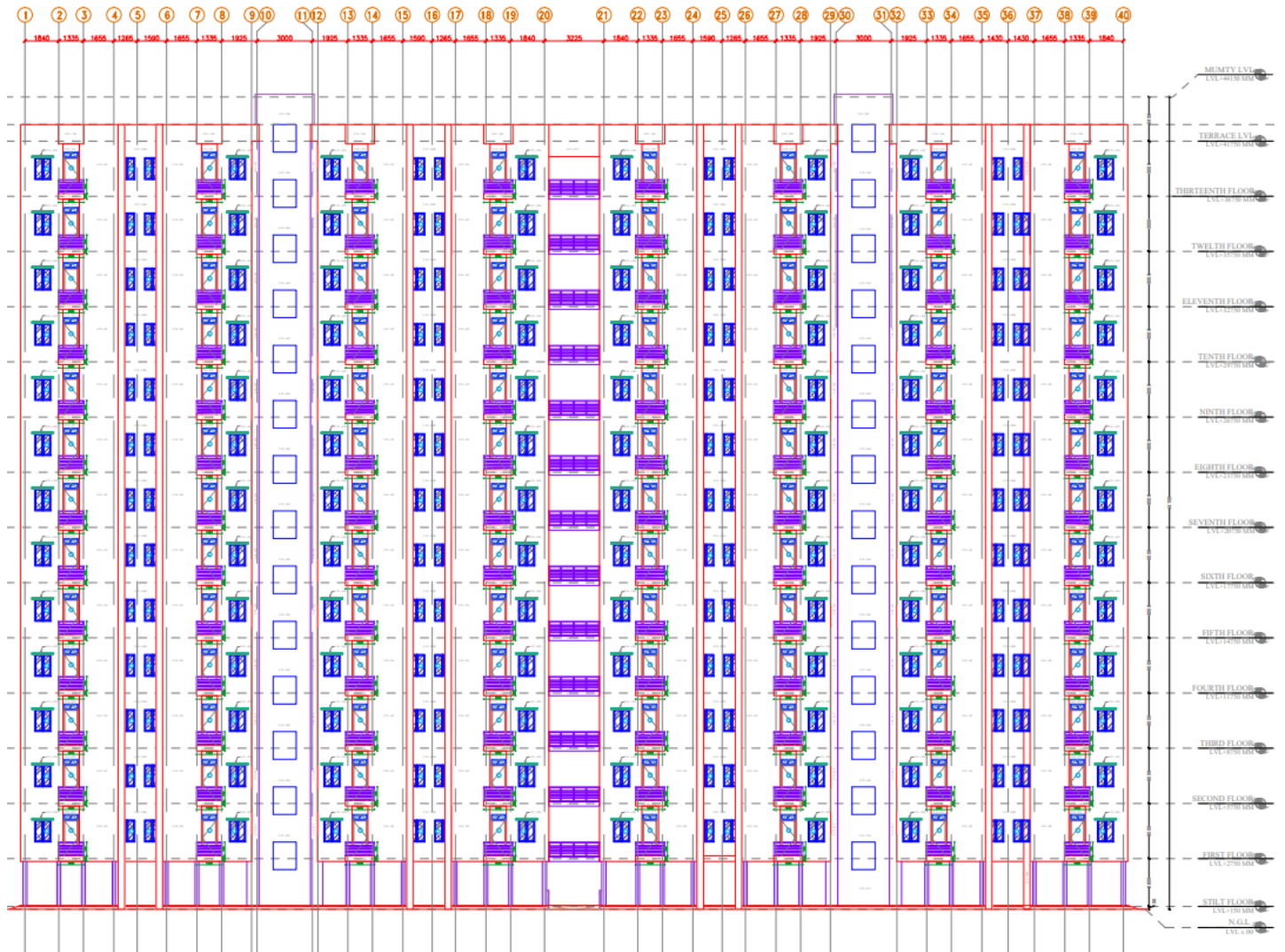


Fig 3.1.7.3 Elevations

3.1.8 Views



Fig 3.1.8 Views

3.1.9 Sections

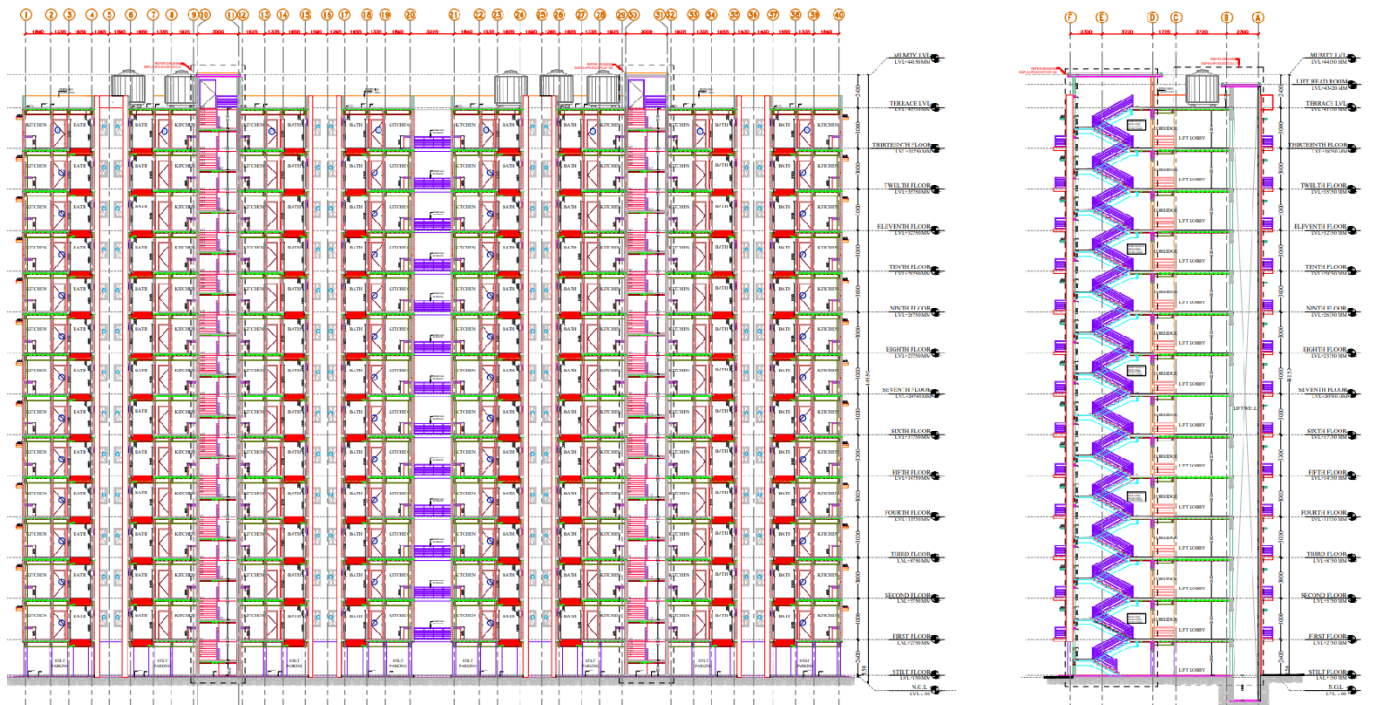
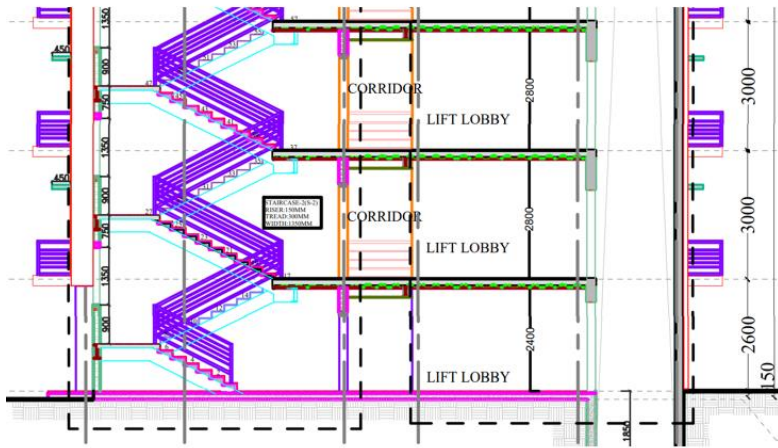


Fig 3.1.9 Section



Staircase section

Clear Height achieved is 2800mm in the typical floors.
 Clear Height achieved is 2400mm in the Stilt floor.
 Staircase riser – 150mm
 Staircase tread – 300mm



3.1.10 Unit Plan

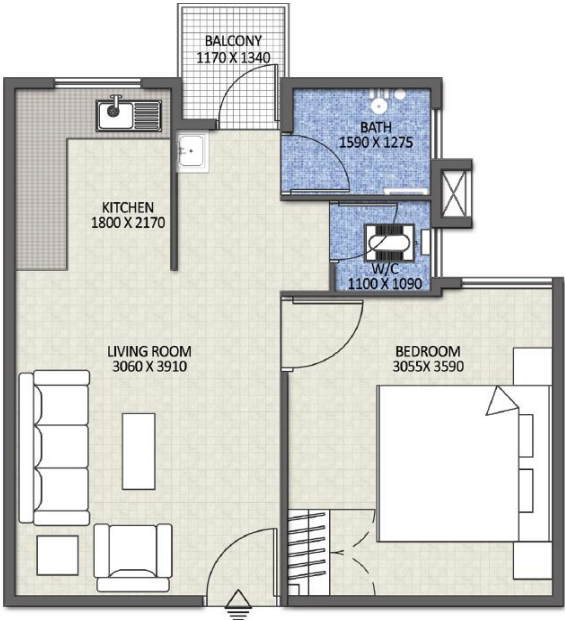


Fig 3.1.10. Unit plan

3.1.11 Mockup unit



Fig 3.1.11. Mockup Unit

3.1.12 Site Photos



Staircase Core on progress



Stilt floor Concreting



BLOCK D SIP WALL INSTALLATION IN PROGRESS OF FIRST FLOOR AND PEB ERECTION OF THIRD PHASE IN PROGRESS

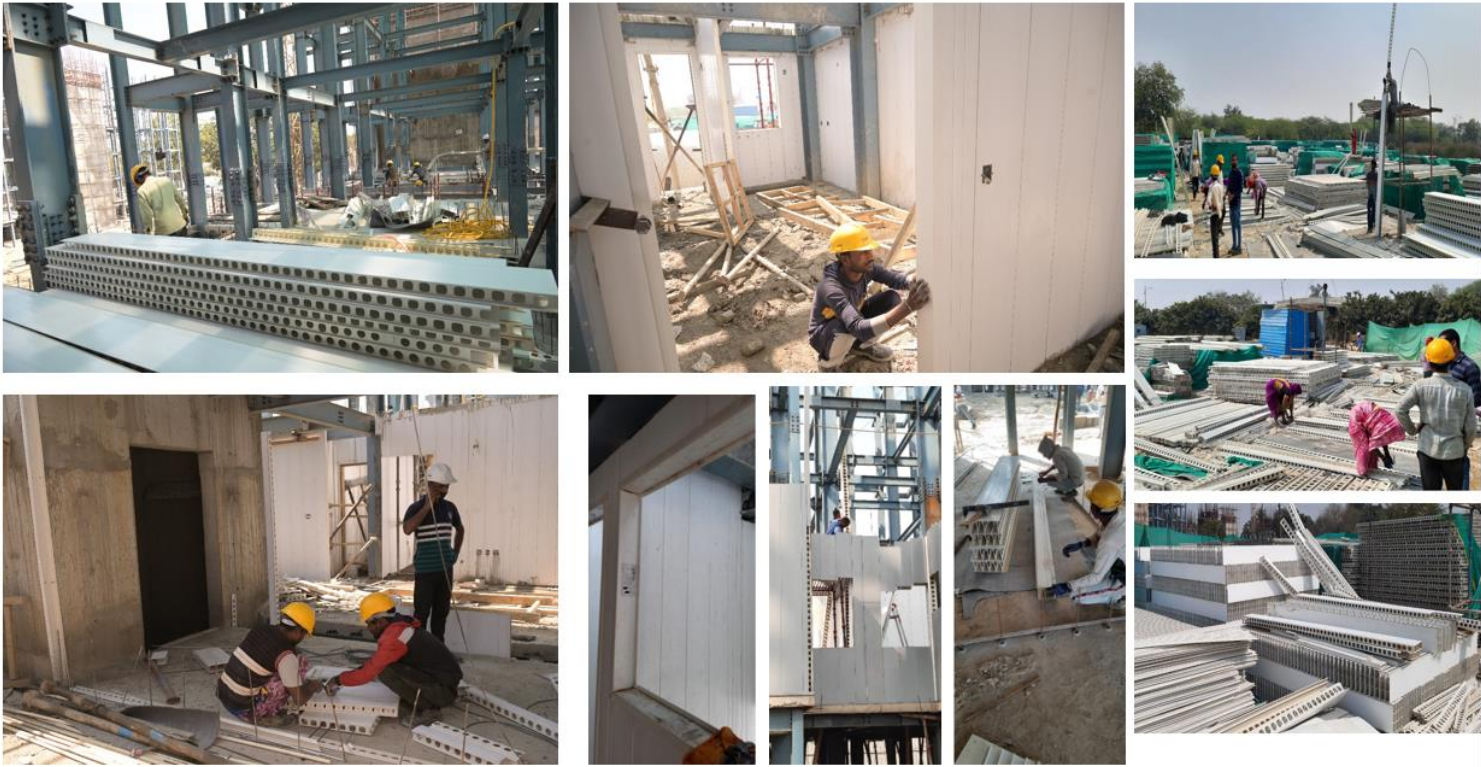


BLOCK C SIP WALL INSTALLATION IN PROGRESS OF FIRST FLOOR



1ST FLOOR & 2ND Floor PANEL WORK ON PROGRESS

Fig 3.1.12. Site Photos



COMMUNITY CENTER PLINTH BEAM CASTING DONE AND SOIL FILLING IN PROGRESS



**COMMUNITY CENTER PLINTH BEA, CASTING
DONE AND SOIL FILLING IN PROGRESS**



**BOUNDARY WALL BRICK WOKR IN
PROGRESS**

Fig 3.1.12. Site Photos

3.1.13 Structural

Foundation Plan

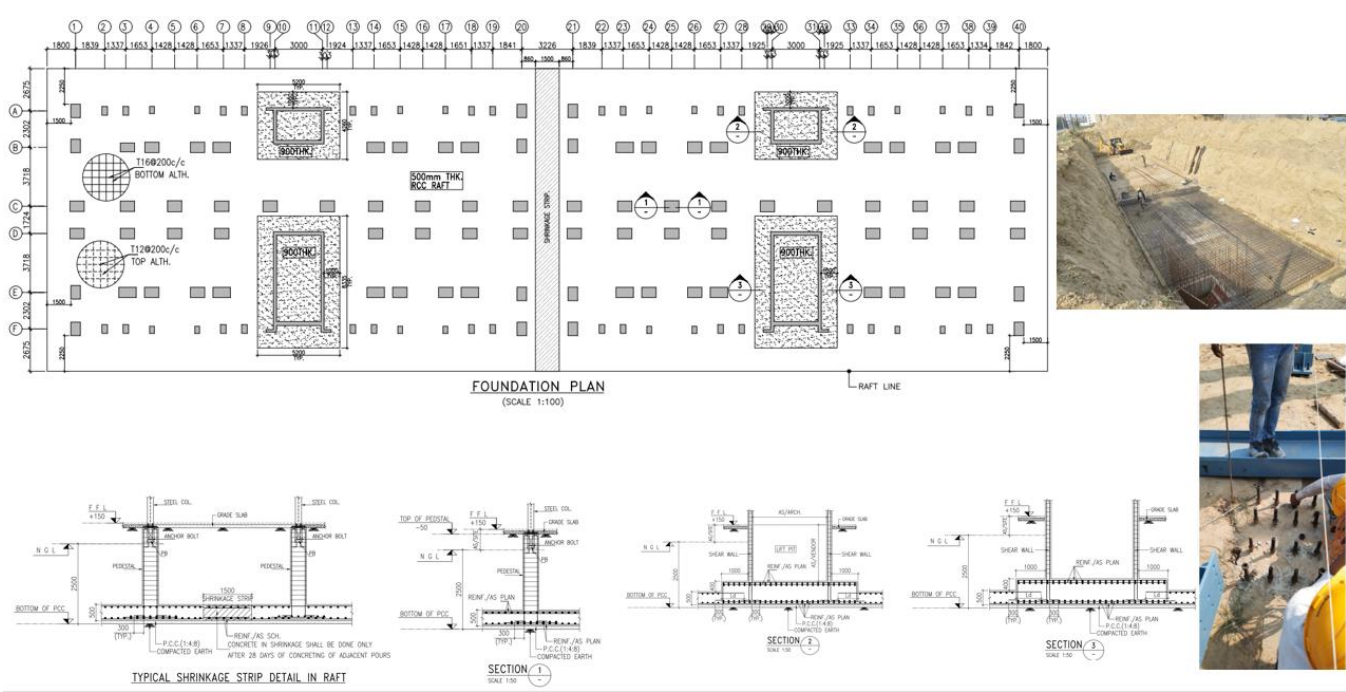


Fig 3.1.13.1 Structural

Raft Bottom Extra Reinforcement

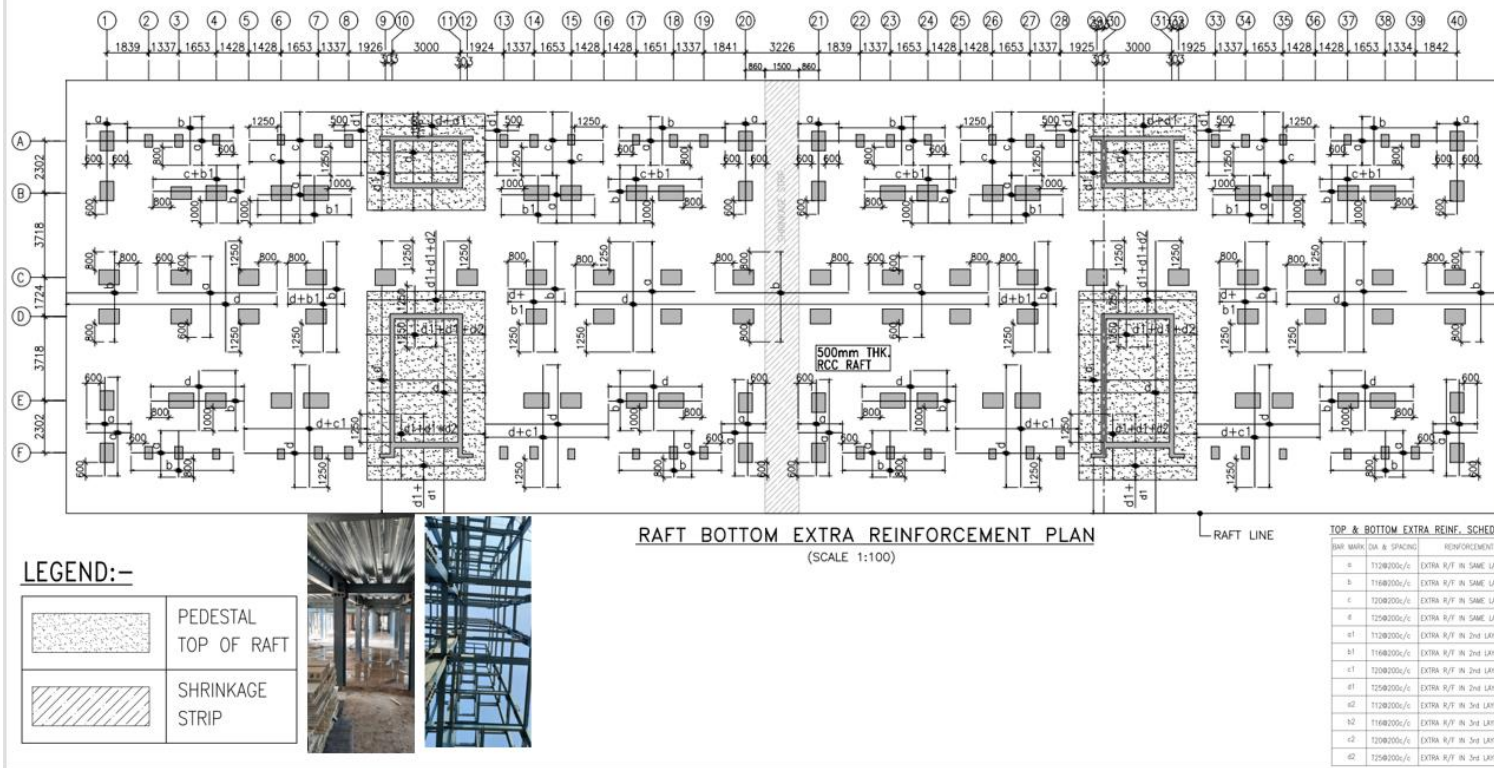


Fig 3.1.13.2 Raft Bottom Extra Reinforcement

Raft Top Extra Reinforcement

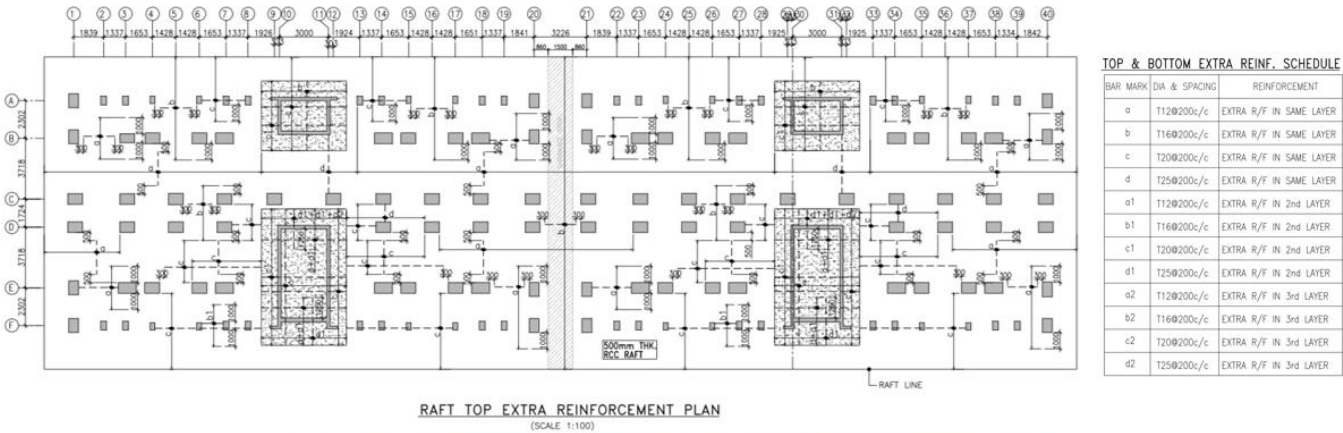
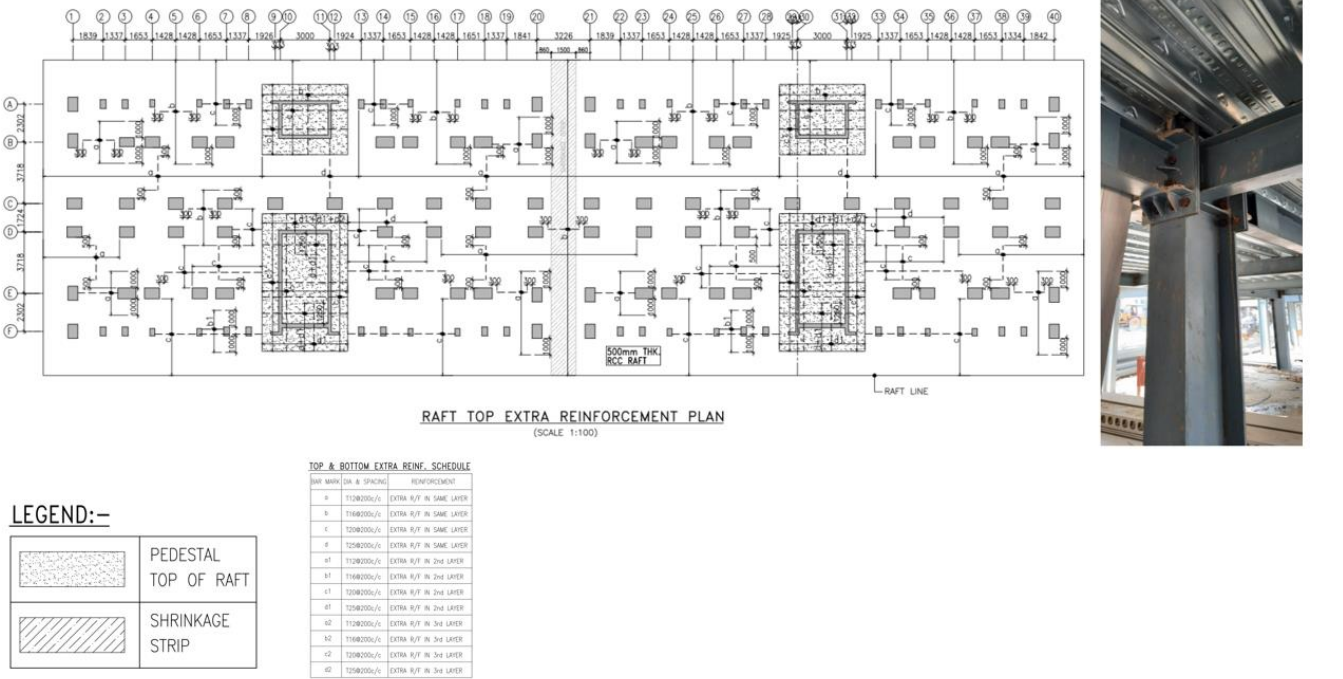


Fig 3.1.13.3 Raft Top Extra Reinforcement

Raft Top Extra Reinforcement



Pedestal Layout

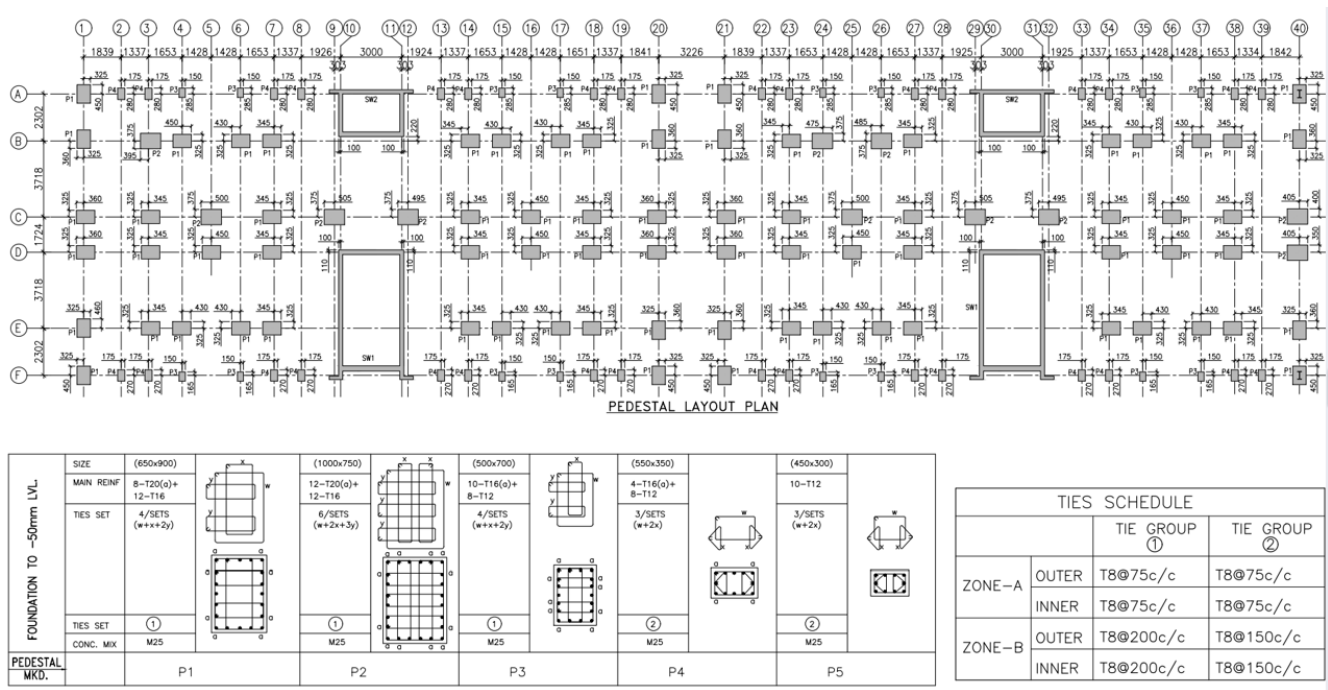


Fig 3.1.13.4. Pedestal layout

Anchor Bolt&Base Plate Layout

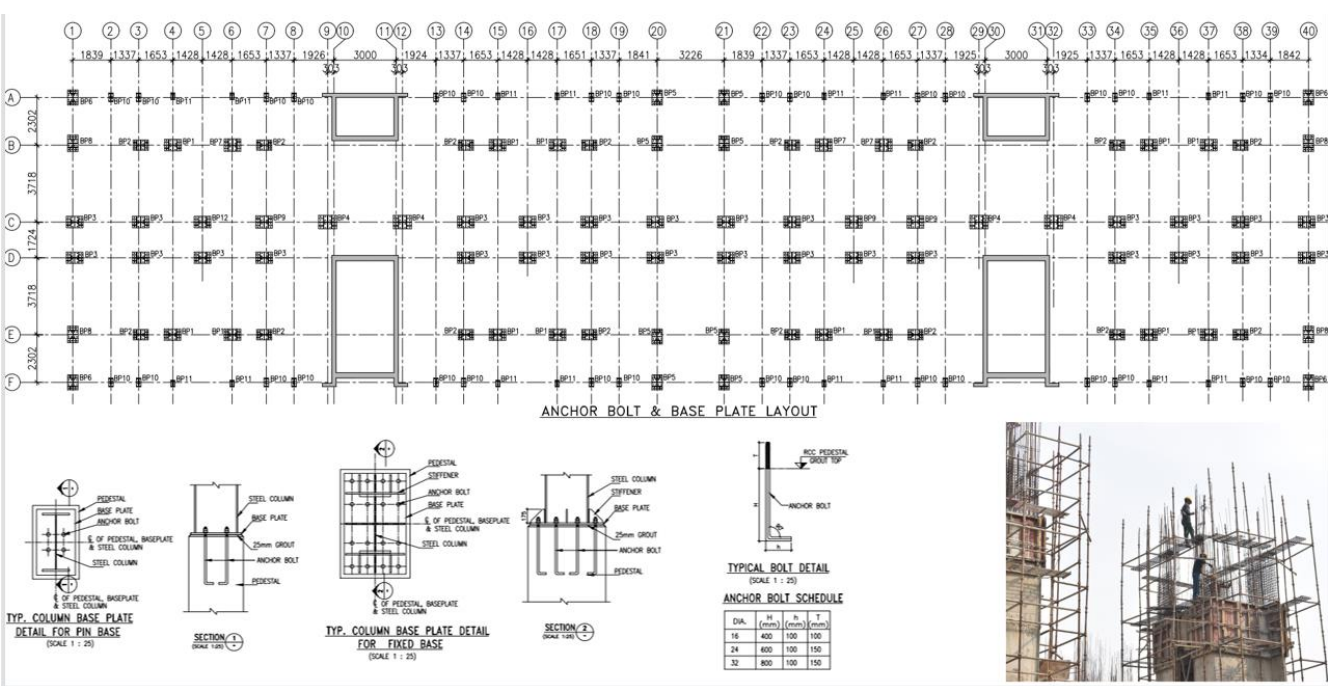


Fig 3.1.13.5 Anchor Bolt & Base Plate Layout

Steel Column Layout

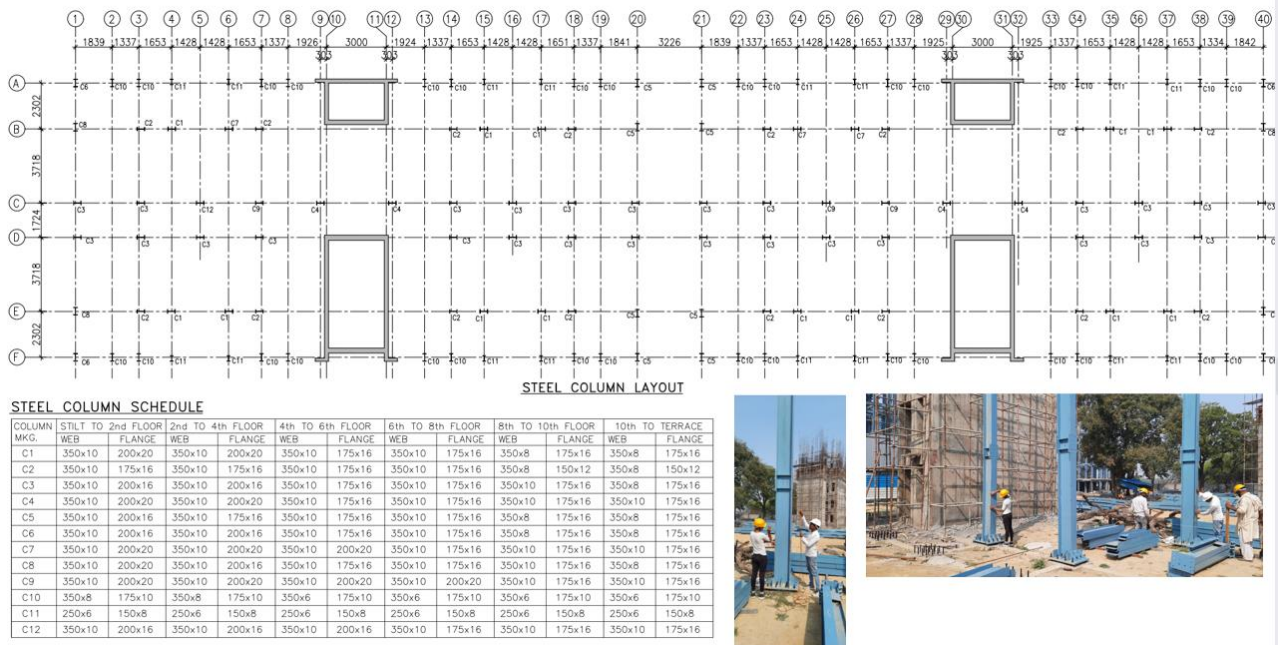


Fig 3.1.13.6 Steel Column Layout

Staircase Detail

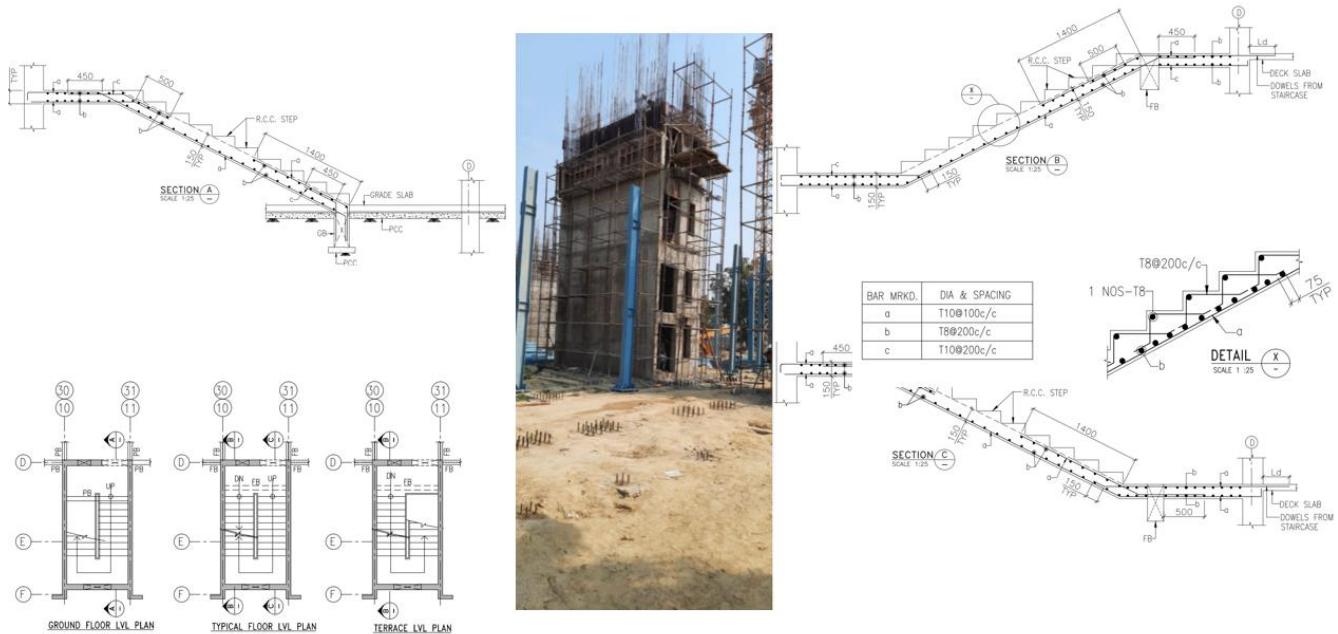
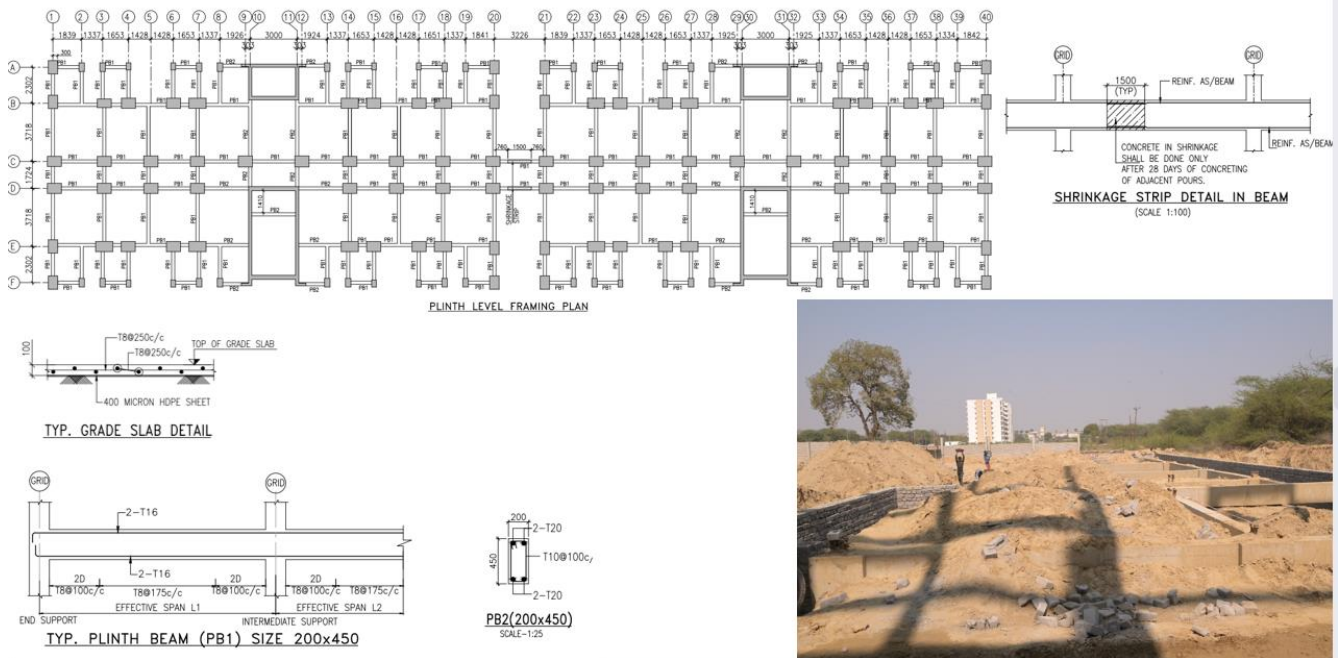


Fig 3.1.13.7. Staircase Detail

Plinth Level Framing plan



Typical Floor-Framing

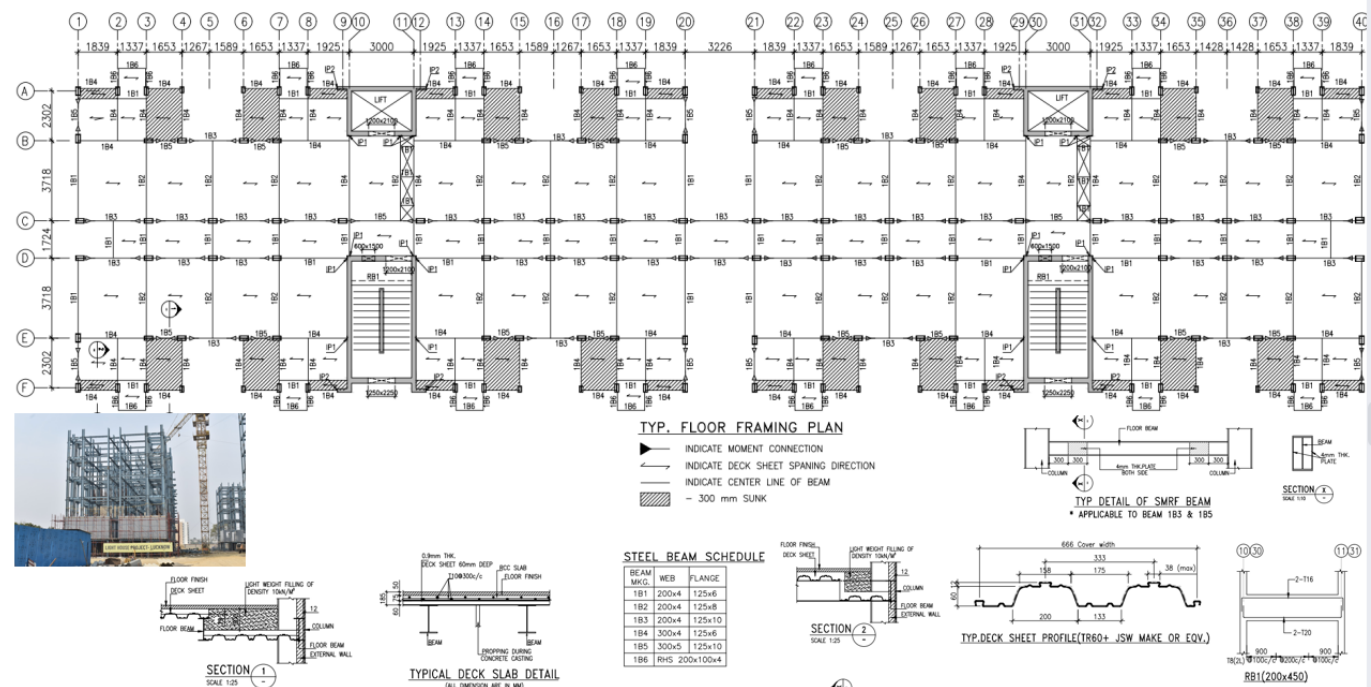


Fig 3.1.13.8. Plinth level plan & typical level plan

Connection detail & Schedule

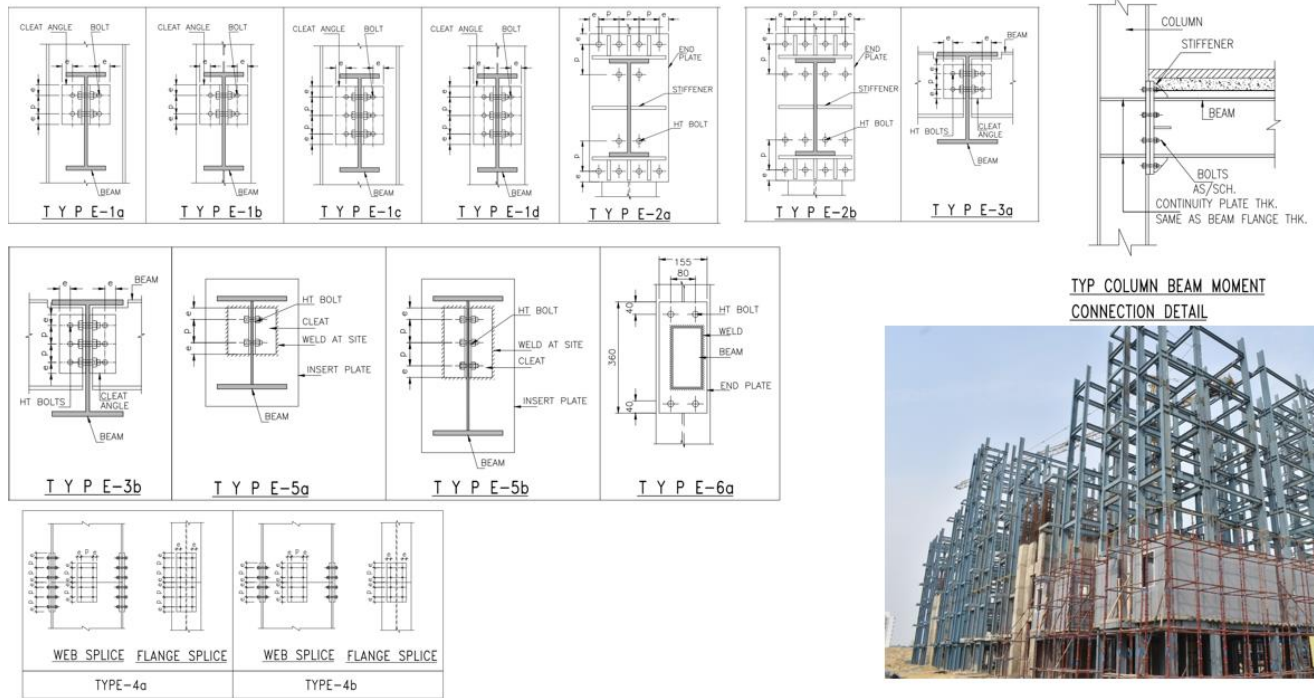


Fig 3.1.13.9. Connection detail & Schedule

Connection detail&Schedule

SCHEDULE OF COLUMN SPlice									
COLUMN MKD	FLANGE SPlice	PLATE THICKNESS	IN FLANGE SPlice	PLATE THICKNESS	WEB SPlice	PLATE THICKNESS	BOLTS	TYPE	
C1	12 nos 279	10mm	8 nos 159	4s					
C2	12 nos 249	10mm	8 nos 159	4s					
C3	12 nos 249	10mm	8 nos 159	4s					
C4	12 nos 279	10mm	8 nos 159	4s					
C5	12 nos 249	10mm	8 nos 159	4s					
C6	12 nos 249	10mm	8 nos 159	4s					
C7	12 nos 279	10mm	8 nos 159	4s					
C8	12 nos 249	10mm	8 nos 159	4s					
C9	12 nos 279	10mm	8 nos 159	4s					
C10	12 nos 249	10mm	8 nos 159	4s					
C11	12 nos 249	10mm	8 nos 159	4s					
C12	12 nos 249	10mm	8 nos 159	4s					
C13	12 nos 249	10mm	8 nos 159	4s					
C14	12 nos 249	10mm	8 nos 159	4s					
C15	12 nos 249	10mm	8 nos 159	4s					
C16	12 nos 249	10mm	8 nos 159	4s					
C17	12 nos 249	10mm	8 nos 159	4s					
C18	12 nos 249	10mm	8 nos 159	4s					
C19	12 nos 249	10mm	8 nos 159	4s					
C20	12 nos 249	10mm	8 nos 159	4s					
C21	12 nos 249	10mm	8 nos 159	4s					
C22	12 nos 249	10mm	8 nos 159	4s					
C23	12 nos 249	10mm	8 nos 159	4s					
C24	12 nos 249	10mm	8 nos 159	4s					
C25	12 nos 249	10mm	8 nos 159	4s					
C26	12 nos 249	10mm	8 nos 159	4s					
C27	12 nos 249	10mm	8 nos 159	4s					
C28	12 nos 249	10mm	8 nos 159	4s					
C29	12 nos 249	10mm	8 nos 159	4s					
C30	12 nos 249	10mm	8 nos 159	4s					
C31	12 nos 249	10mm	8 nos 159	4s					
C32	12 nos 249	10mm	8 nos 159	4s					
C33	12 nos 249	10mm	8 nos 159	4s					
C34	12 nos 249	10mm	8 nos 159	4s					
C35	12 nos 249	10mm	8 nos 159	4s					
C36	12 nos 249	10mm	8 nos 159	4s					
C37	12 nos 249	10mm	8 nos 159	4s					
C38	12 nos 249	10mm	8 nos 159	4s					
C39	12 nos 249	10mm	8 nos 159	4s					
C40	12 nos 249	10mm	8 nos 159	4s					
C41	12 nos 249	10mm	8 nos 159	4s					
C42	12 nos 249	10mm	8 nos 159	4s					
C43	12 nos 249	10mm	8 nos 159	4s					
C44	12 nos 249	10mm	8 nos 159	4s					
C45	12 nos 249	10mm	8 nos 159	4s					
C46	12 nos 249	10mm	8 nos 159	4s					
C47	12 nos 249	10mm	8 nos 159	4s					
C48	12 nos 249	10mm	8 nos 159	4s					
C49	12 nos 249	10mm	8 nos 159	4s					
C50	12 nos 249	10mm	8 nos 159	4s					
C51	12 nos 249	10mm	8 nos 159	4s					
C52	12 nos 249	10mm	8 nos 159	4s					
C53	12 nos 249	10mm	8 nos 159	4s					
C54	12 nos 249	10mm	8 nos 159	4s					
C55	12 nos 249	10mm	8 nos 159	4s					
C56	12 nos 249	10mm	8 nos 159	4s					
C57	12 nos 249	10mm	8 nos 159	4s					
C58	12 nos 249	10mm	8 nos 159	4s					
C59	12 nos 249	10mm	8 nos 159	4s					
C60	12 nos 249	10mm	8 nos 159	4s					
C61	12 nos 249	10mm	8 nos 159	4s					
C62	12 nos 249	10mm	8 nos 159	4s					
C63	12 nos 249	10mm	8 nos 159	4s					
C64	12 nos 249	10mm	8 nos 159	4s					
C65	12 nos 249	10mm	8 nos 159	4s					
C66	12 nos 249	10mm	8 nos 159	4s					
C67	12 nos 249	10mm	8 nos 159	4s					
C68	12 nos 249	10mm	8 nos 159	4s					
C69	12 nos 249	10mm	8 nos 159	4s					
C70	12 nos 249	10mm	8 nos 159	4s					
C71	12 nos 249	10mm	8 nos 159	4s					
C72	12 nos 249	10mm	8 nos 159	4s					
C73	12 nos 249	10mm	8 nos 159	4s					
C74	12 nos 249	10mm	8 nos 159	4s					
C75	12 nos 249	10mm	8 nos 159	4s					
C76	12 nos 249	10mm	8 nos 159	4s					
C77	12 nos 249	10mm	8 nos 159	4s					
C78	12 nos 249	10mm	8 nos 159	4s					
C79	12 nos 249	10mm	8 nos 159	4s					
C80	12 nos 249	10mm	8 nos 159	4s					
C81	12 nos 249	10mm	8 nos 159	4s					
C82	12 nos 249	10mm	8 nos 159	4s					
C83	12 nos 249	10mm	8 nos 159	4s					
C84	12 nos 249	10mm	8 nos 159	4s					
C85	12 nos 249	10mm	8 nos 159	4s					
C86	12 nos 249	10mm	8 nos 159	4s					
C87	12 nos 249	10mm	8 nos 159	4s					
C88	12 nos 249	10mm	8 nos 159	4s					
C89	12 nos 249	10mm	8 nos 159	4s					
C90	12 nos 249	10mm	8 nos 159	4s					
C91	12 nos 249	10mm	8 nos 159	4s					
C92	12 nos 249	10mm	8 nos 159	4s					
C93	12 nos 249	10mm	8 nos 159	4s					
C94	12 nos 249	10mm	8 nos 159	4s					
C95	12 nos 249	10mm	8 nos 159	4s					
C96	12 nos 249	10mm	8 nos 159	4s					
C97	12 nos 249	10mm	8 nos 159	4s					
C98	12 nos 249	10mm	8 nos 159	4s					
C99	12 nos 249	10mm	8 nos 159	4s					
C100	12 nos 249	10mm	8 nos 159	4s					



Fig 3.1.13.10. Connection detail & Schedule

3.1.14 Electrical

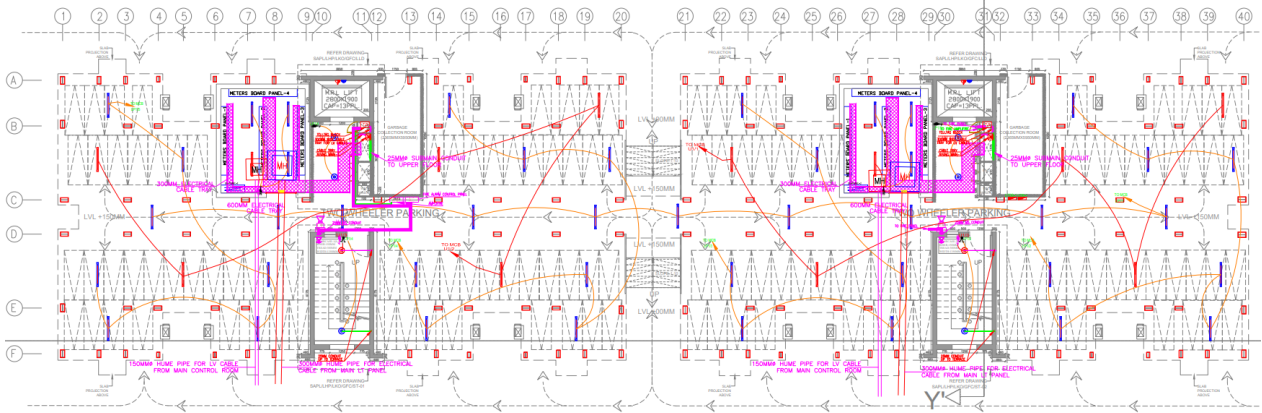
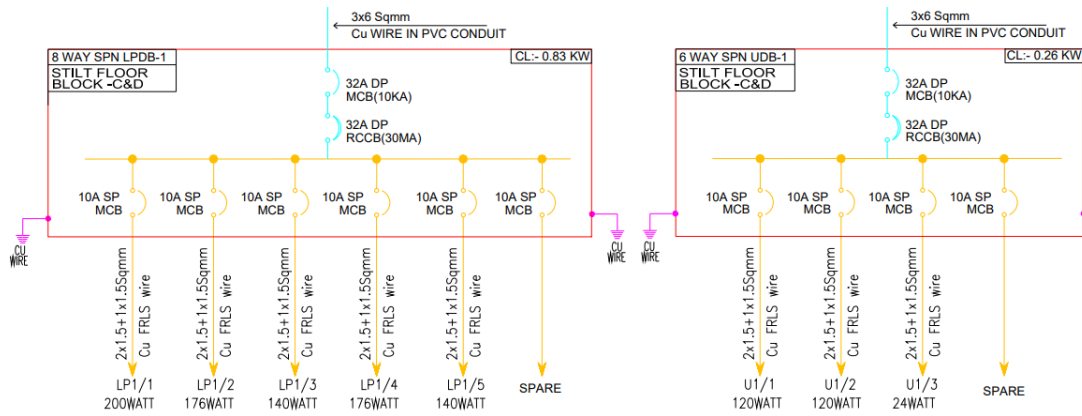


Fig 3.1.14.1. Electrical layout & detail



Typical floor-Electrical

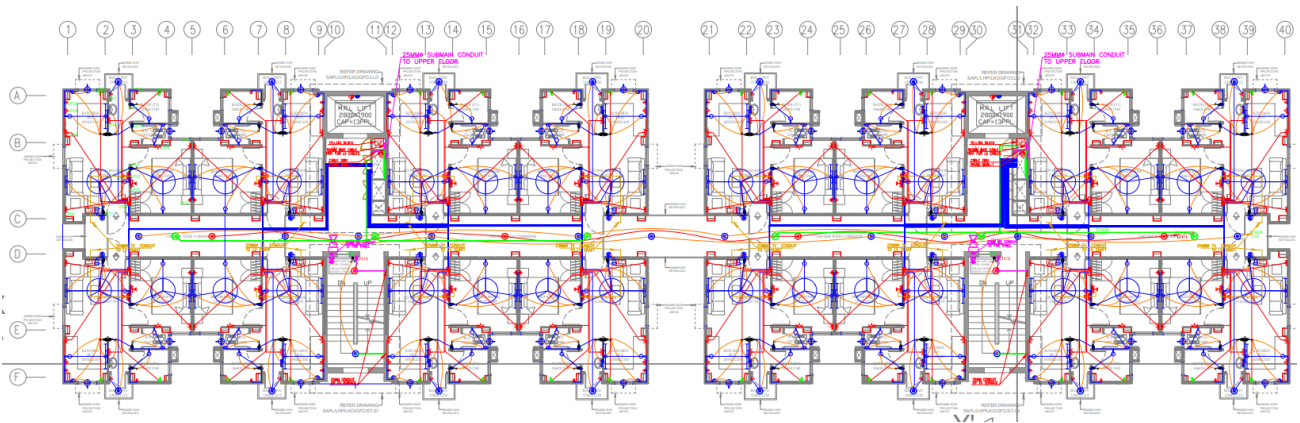
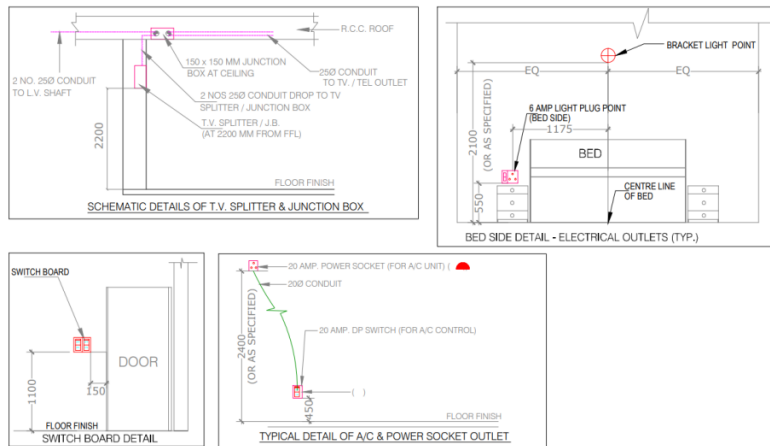


Fig 3.1.14.2. Electrical layout & detail



SYMBOL	DESCRIPTION	MOUNTING HEIGHT FROM F.F.L.(MM)
	SWITCH BOARD	1100 MM
	TWO WAY SWITCH BOARD	1100 MM
	E.M. SWITCH BOARD	1100 MM
	18W LED WALL BRACKET LIGHT	2100 MM
	20W WALL MOUNTED TUB LIGHT	2100 MM
	CALL BELL BUZZER	2100 MM
	CALL BELL PUSH	1100 MM
	11W MIRROR LIGHT	2100 MM
	1200MM DIA CEILING FAN	CEILING
	EXHAUST FAN (300MM DIA)	AS PER SITE
	EXHAUST FAN SOCKET..	2100 MM
	12W LED DOWN LIGHT	CEILING
	BULK HEAD LIGHT	AS PER SITE
	16A SWITCH SOCKET	AS PER SITE
	6A SWITCH SOCKETS	450 MM
	6A SWITCH SOCKETS FOR WASHING MACHINE	1100 MM
	16 A SWITCH SOCKET	450 MM
	16 A SWITCH SOCKET	1100 MM
	16A POWER POINT FOR GEYSER	AS PER SITE
	6/16A SWITCH SOCKET	1100 MM
	6A SWITCH SOCKET	550 MM
	TV OUTLET	450 MM
	20A SOCKET FOR AC	AS PER SITE
	DISTRIBUTION BOARD	1500 MM

Typical Unit -Electrical

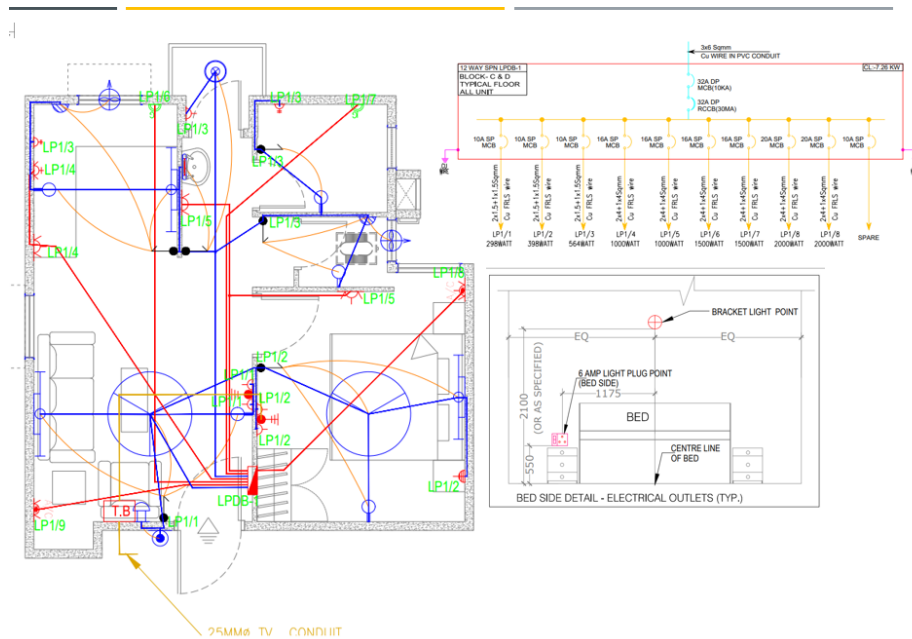
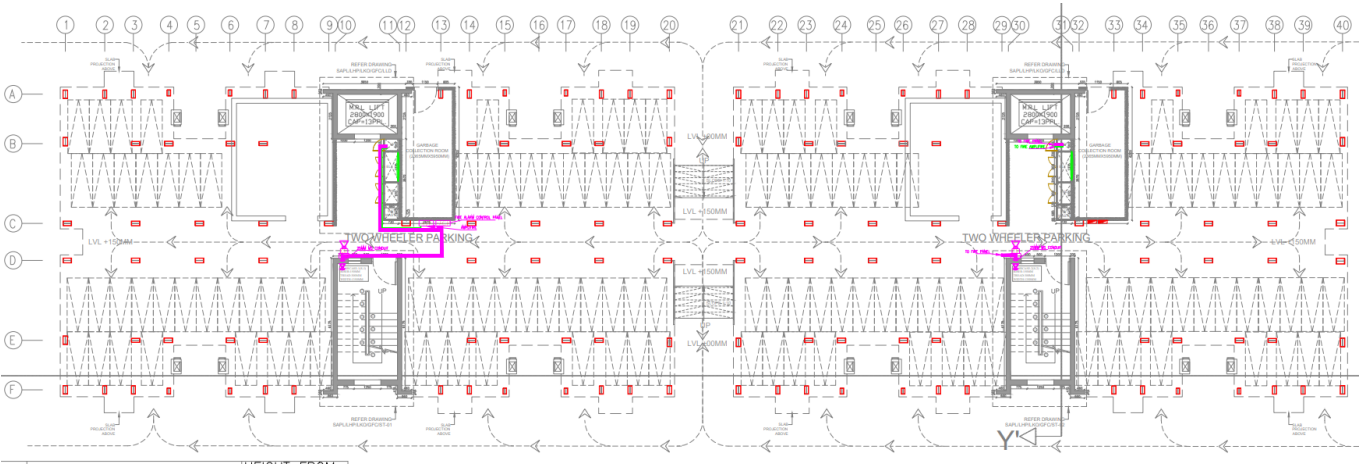


Fig 3.1.14.3. Typical unit Electrical layout & detail

3.1.15 Fire Alarm Layout / Plumbing

Stilt floor



Typical floor-Fire Alarm Layout

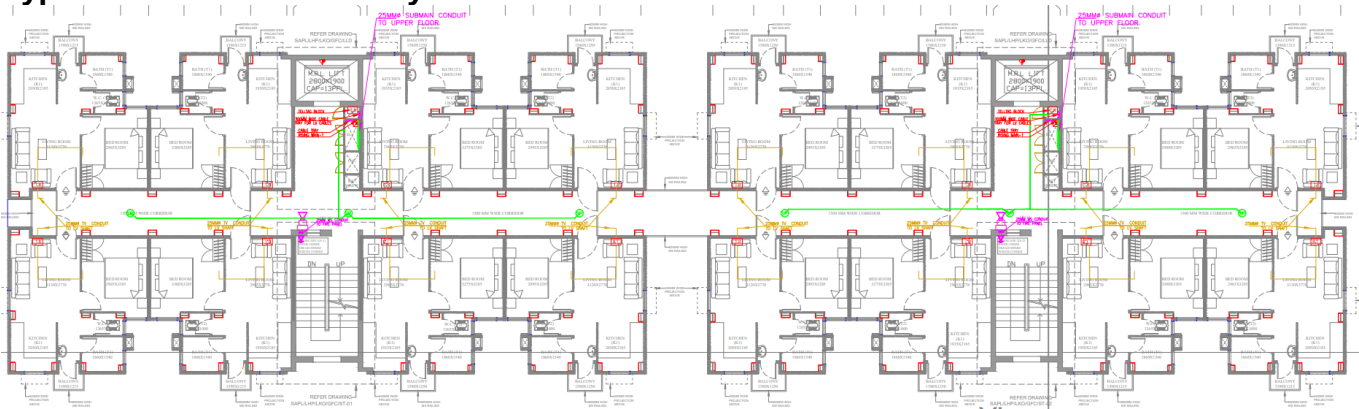


Fig 3.1.15.1. Stilt & Typical unit FAS layout

FIRE ALARM LEGEND:-		HEIGHT FROM F.F.L
	HOOTER CUM STROBE	2100
	MANUAL CALL POINT	1050
	TELEPHONE JACK	1050
	CONTROL MODULE	1050
	T.V TAG BLOCK	AS PER SITE
	EXIT SINAGE	CEILING HANG
	SPEAKER	CEILING
	FIRE ALARM CONTROL PANEL	
	AMPLIFIRE	
	SPEAKER CONDUIT	CEILING
	SMOCK DETECTOR CONDUIT	CEILING

LEGEND:-	DESCRIPTION
	25X3 MM GI STRIP
	EARTHING
	Cross connector (Stainless Steel)
	DOWN CONDUCTOR
	LIGHTING ARRESTOR
	SOLAR PANEL

Fig 3.1.15.2. FAS details

Terrace floor–Light protection Layout

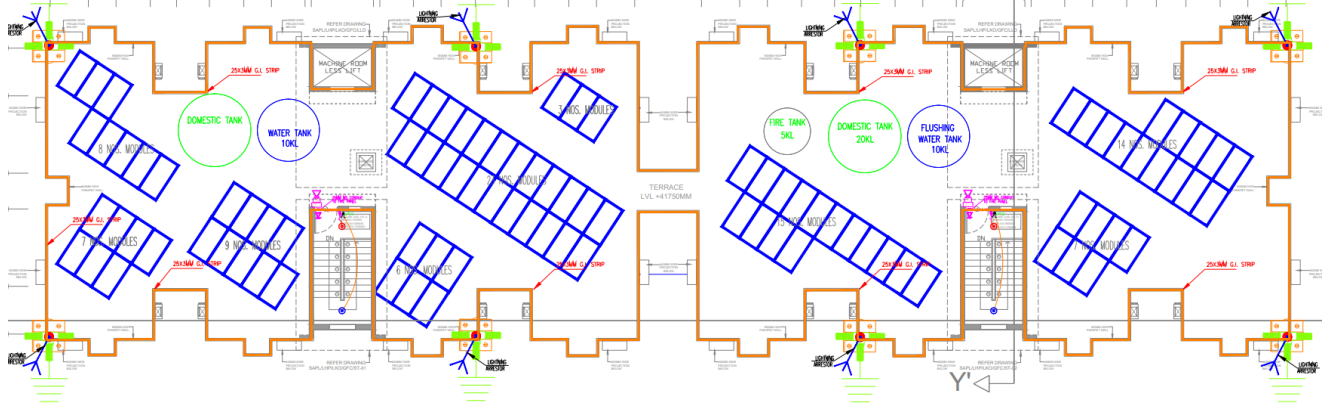


Fig 3.1.15.3. FAS Terrace layout

Plumbing&Fire Layout

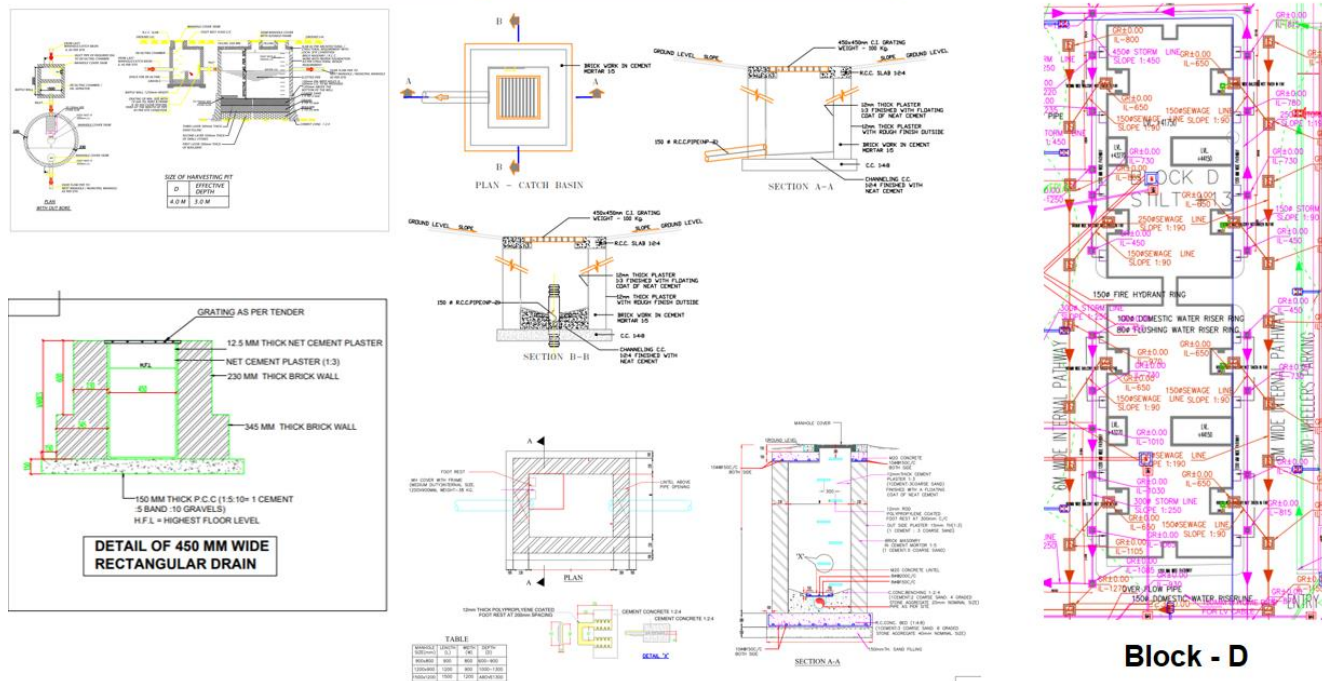


Fig 3.1.15.4. plumbing detail

Sewage Layout Storm Layout & Water supply and fire Layout

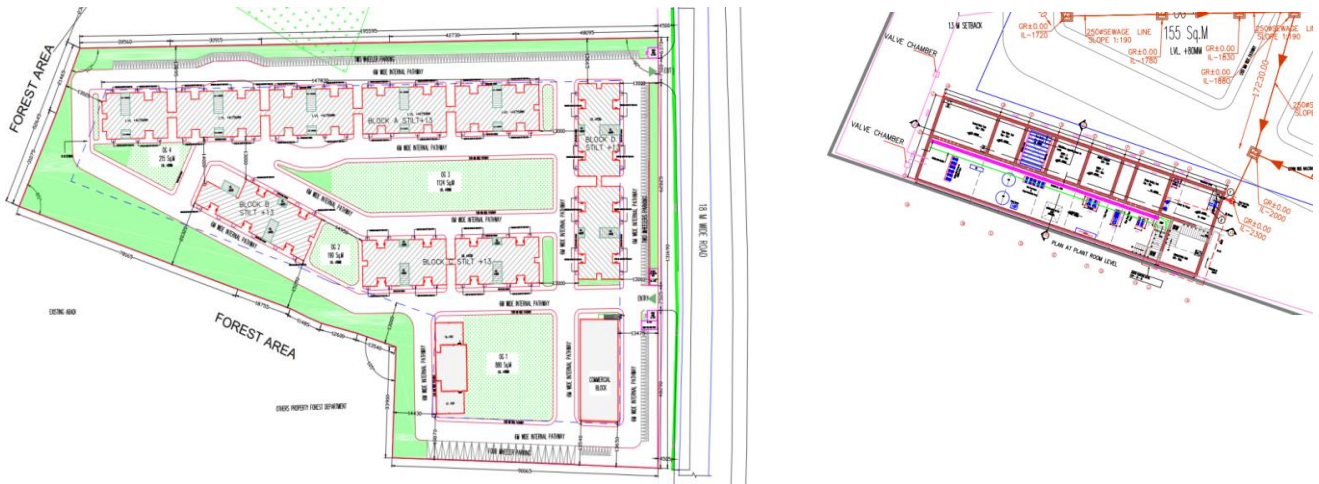


Fig 3.1.15.5 Sewage layout & water supply & fire layout

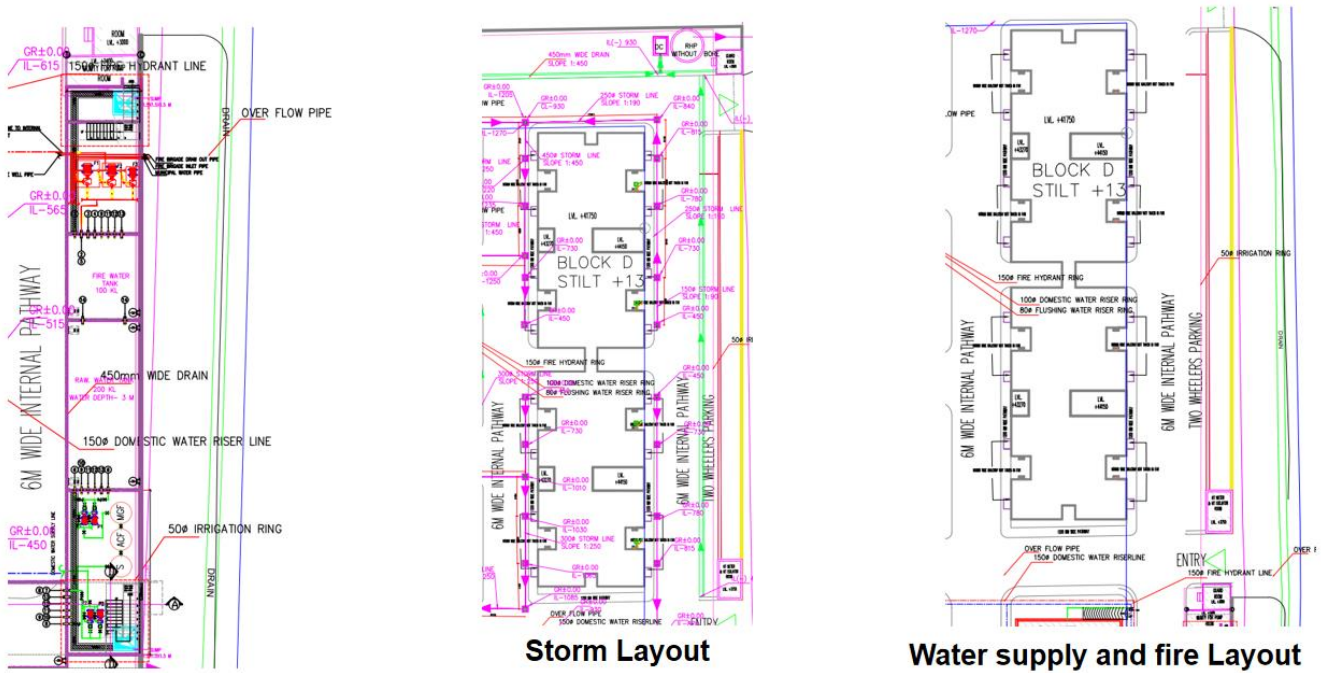


Fig 3.1.15.5 Sewage layout & water supply & fire layout

Substation Layout

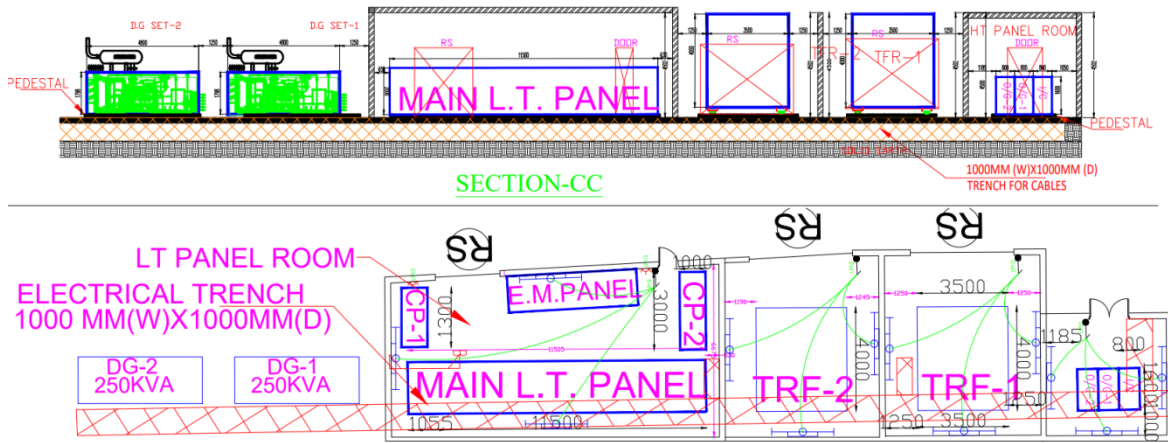


Fig 3.1.15.6 Substation layout

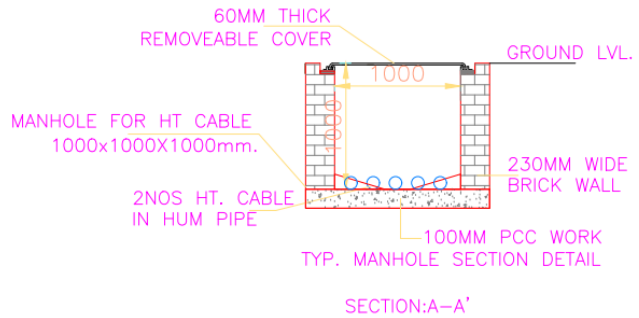
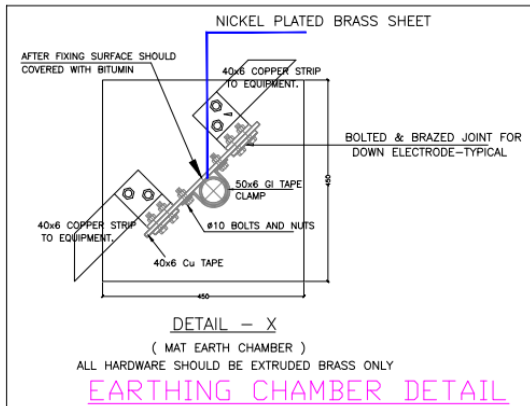
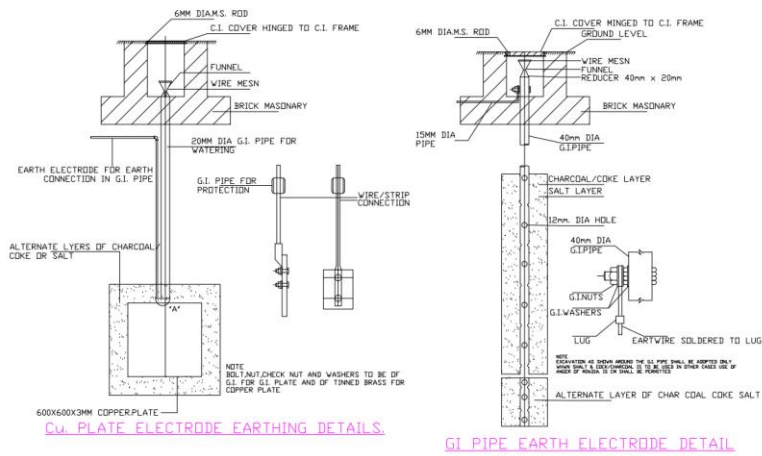


Fig 3.1.15.6 Substation layout detail



EARTHING DETAIL		
DESCRIPTION	CU EARTHING (600X600X6MM)	GI EARTHING (600X600X3MM)
	NOS.	NOS.
2 POLE STRUCTURE		02
HT METER		02
HT PANEL		02
TRANSFORMER-1	02	02
TRANSFORMER-2	02	02
DG SET-1	02	02
DG SET-2	02	02
LT PANEL		02
BLOCK-D LIFT-1		02
BLOCK-D LIFT-2		02
BLOCK-D PANEL-1		02
BLOCK-D PANEL-2		02

3.1.15 Earthing detail

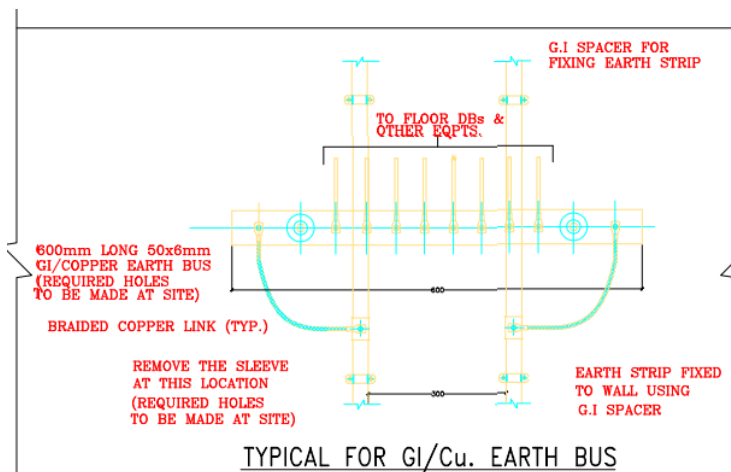


Fig 3.1.15.7 Substation layout detail

CHAPTER 4

ANALYSIS AND RESULTS

Site Detail-Floor Plan

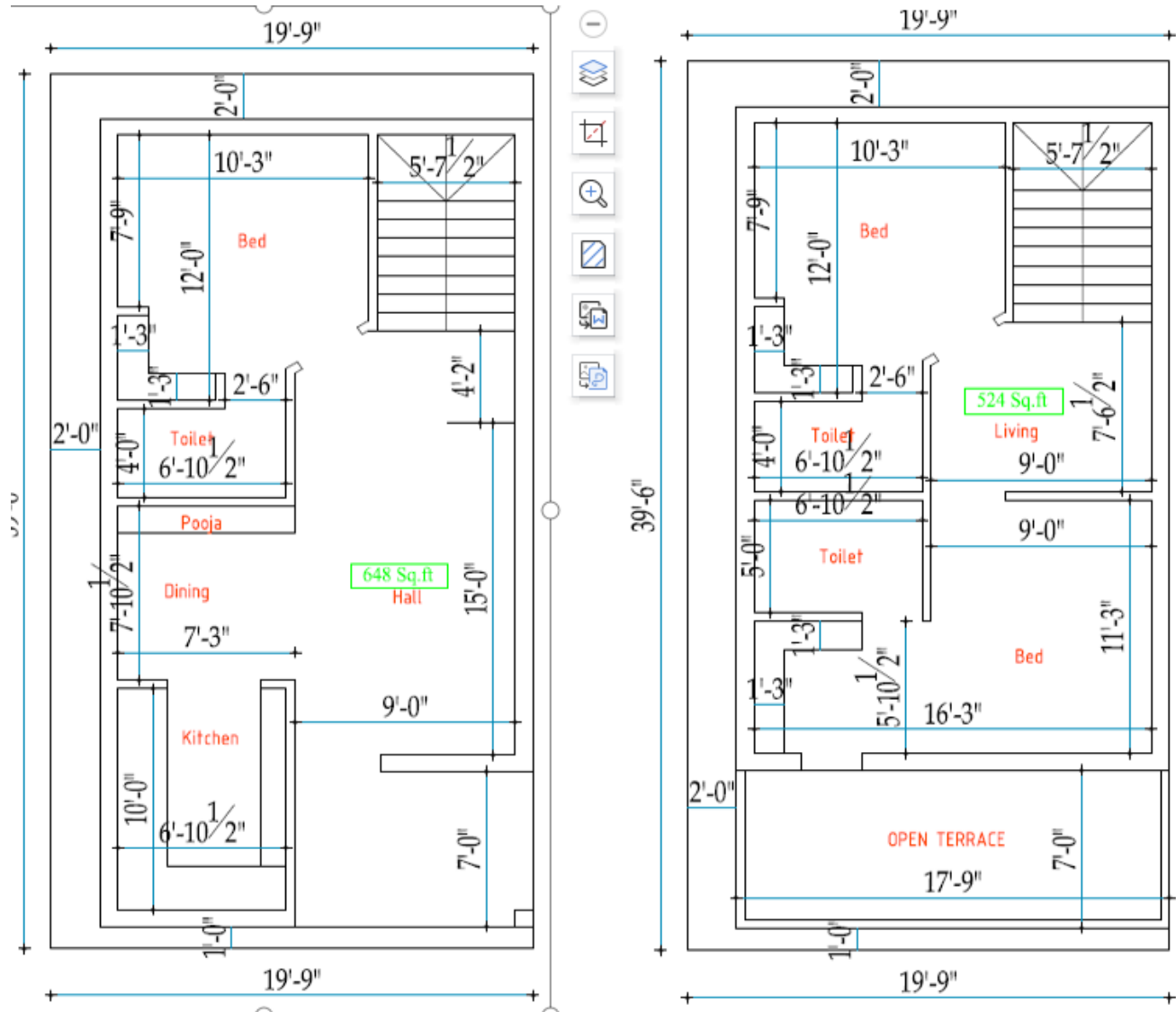


Fig 4.1 site detail

Site Detail



COST ANALYSIS-PVC PANEL vs CONVENTIONAL BUILDING



Block Plan
Fig 4.1.1 block plan

A G+13 storied building as shown in the (Plan and section of building) & Fig. (Elevation of building) is situated at Lucknow which I had done case study and I had taken it to do analysis.

Area=9848 SQ.M

Area of each unit(including balcony)=34.54 SQ.M

Area of each unit(excluding balcony)=32.84SQ.M

Area excluding walls carpet area=27.2 SQ.M

Wall thickness 165 mm external and 64mm internal

4.1.COST ANALYSIS - PVC PANEL Vs CONVENTIONAL BUILDING

SNO	DESCRIPTION	QTY	RATE	AMOUNT	SNO	DESCRIPTION	QTY	RATE	AMOUNT
1	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	1742	30	52260	1	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	1742	30	52260
2	Earth work in excavation by mechanical means (Hydraulic excavator/manual means over areas excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil	10661	80	852880	2	Earth work in excavation by mechanical means (Hydraulic excavator/manual means over areas excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil	10661	80	852880
3	Providing and laying in position cement concrete of specified grade for raft foundation - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)	1956	6430	12577080	3	Providing and laying in position cement concrete of specified grade for raft foundation - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)	1956	6430	12577080
4	Filling available excavated earth (excluding rock) in trenches, plinths, sides of foundation etc.	455	170	77350	4	Filling available excavated earth (excluding rock) in trenches, plinths, sides of foundation etc.	455	170	77350
5	Designing, providing, installing and fixing factory finished custom designed cold form Light Gauge Steel Framed super structure comprising of steel wallpanel, trusses, purlins etc manufactured out of minimum 0.75 mm thick steel sheet as per design requirements.	86000	220	18920000	5	Designing, providing, installing and fixing factory finished custom designed cold form Light Gauge Steel Framed super structure comprising of steel wallpanel, trusses, purlins etc manufactured out of minimum 0.75 mm thick steel sheet as per design requirements.	86000	220	18920000
6	Providing and fixing of external wall system on Light gauge steel frame work with Outer face having 164mm thick PVC panel interlocked with steel rod vertical and horizontally	7560	1150	8694000	6	Providing and fixing of external wall system on Light gauge steel frame work with Outer face having 164mm thick PVC panel interlocked with steel rod vertical and horizontally	7560	1150	8694000
7	Providing and fixing internal wall panels on Light gauge steel frame work PVC panel of 64mm thickness with steel rod vertically and horizontally	12948	950	12300600	7	Providing and fixing internal wall panels on Light gauge steel frame work PVC panel of 64mm thickness with steel rod vertically and horizontally	12948	950	12300600
8	Providing and fixing roofing consist of 0.8 mm thick galvanized steel deck sheet conforming to IS 277:1992 used as permanent shuttering over which M5 wire mesh 3mm laid at 100x100 mm grid including edge trim covered with concrete. This metal deck will be supported on structural steel beam with shear studs	9867	1500	14800500	8	Providing and fixing roofing consist of 0.8 mm thick galvanized steel deck sheet conforming to IS 277:1992 used as permanent shuttering over which M5 wire mesh 3mm laid at 100x100 mm grid including edge trim covered with concrete. This metal deck will be supported on structural steel beam with shear studs	9867	1500	14800500
9	Providing and fixing M.S. fan clamp type I or II of 16 mm dia M.S. bar, bent to shape with hooked ends in R.C.C. slabs or beams during laying, including painting the exposed portion of loop, all as per standard design complete.	460	148	68080	9	Providing and fixing M.S. fan clamp type I or II of 16 mm dia M.S. bar, bent to shape with hooked ends in R.C.C. slabs or beams during laying, including painting the exposed portion of loop, all as per standard design complete.	460	148	68080
10	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer - in-charge	3230	5500	17765000	10	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer - in-charge	3230	5500	17765000
11	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer - in-charge	1876	5500	10318000	11	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer - in-charge	1876	5500	10318000
12	Water proof plastering with Cement Mortar 1:4 (1 cement : 4 fine sand) 12mm thick plaster finished with a floating coat of neat cement mixed with water proofing compound of approved make @ 2kg/m2 of mix floated hard and trowelled smooth including all labour, material, conveyance charges etc complete	91.465	933.29	85363.36985	12	Water proof plastering with Cement Mortar 1:4 (1 cement : 4 fine sand) 12mm thick plaster finished with a floating coat of neat cement mixed with water proofing compound of approved make @ 2kg/m2 of mix floated hard and trowelled smooth including all labour, material, conveyance charges etc complete	91.465	933.29	85363.36985
13	Providing and fixing ISI marked flush door shutters conforming to IS : 2202 (Part I) decorative type, core of block board construction with frame of 1 st class hard wood and well matched teak 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters. 35 mm thick including ISI marked Stainless Steel butt hinges with necessary screws	347	2800	971600	13	Providing and fixing ISI marked flush door shutters conforming to IS : 2202 (Part I) decorative type, core of block board construction with frame of 1 st class hard wood and well matched teak 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters. 35 mm thick including ISI marked Stainless Steel butt hinges with necessary screws	347	2800	971600
14	Providing and fixing Fiber Glass Reinforced plastic (FRP) Door Frames of cross-section 90 mm x 45 mm having single rebate of 32 mm x 15 mm to receive shutter of 30 mm thickness. The laminated shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat. Door frame laminate shall be 2 mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame.	1543	488	752984	14	Providing and fixing Fiber Glass Reinforced plastic (FRP) Door Frames of cross-section 90 mm x 45 mm having single rebate of 32 mm x 15 mm to receive shutter of 30 mm thickness. The laminated shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat. Door frame laminate shall be 2 mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame.	1543	488	752984
15	Providing and fixing to existing door frames 30 mm thick Glass Fibre Reinforced Plastic (FRP) panelled door shutter of required colour and approved brand and manufacture, made with fire-retardant grade unsaturated polyester resin, moulded to 3 mm thick FRP laminate for forming hollow rails and styles, with wooden frame and suitable blocks of seasoned wood inside at required places for fixing of fittings, cast monolithically with 5 mm thick FRP laminate for panels according to IS : 1868. Minimum anodic coating of grade AC 15	301.4	2888.18	870497.452	15	Providing and fixing to existing door frames 30 mm thick Glass Fibre Reinforced Plastic (FRP) panelled door shutter of required colour and approved brand and manufacture, made with fire-retardant grade unsaturated polyester resin, moulded to 3 mm thick FRP laminate for forming hollow rails and styles, with wooden frame and suitable blocks of seasoned wood inside at required places for fixing of fittings, cast monolithically with 5 mm thick FRP laminate for panels according to IS : 1868. Minimum anodic coating of grade AC 15	301.4	2888.18	870497.452
16	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 : 7733 and IS 1285. Facing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with approved EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including clear angle, Aluminium snap bead for glazing /panelling, C.P. brass/ stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.(Glazing, panelling and dash fasteners to be paid for separately)For fixed portionAnodised aluminium (anodised transparent or dyed to required shade according to IS : 1868. Minimum anodic coating of grade AC 15)	560	116.33	65144.8	16	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 : 7733 and IS 1285. Facing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with approved EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including clear angle, Aluminium snap bead for glazing /panelling, C.P. brass/ stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.(Glazing, panelling and dash fasteners to be paid for separately)For fixed portionAnodised aluminium (anodised transparent or dyed to required shade according to IS : 1868. Minimum anodic coating of grade AC 15)	560	116.33	65144.8
17	Providing and fixing bright finished brass 100 mm mortice latch and lock with 6 levers and a pair of lever handles of approved quality with necessary screws etc. complete.	416	650	270400	17	Providing and fixing bright finished brass 100 mm mortice latch and lock with 6 levers and a pair of lever handles of approved quality with necessary screws etc. complete.	416	650	270400
18	Providing and fixing bright finished door latch with necessary screws etc. complete:250x16x5 mm	420	280	117600	18	Providing and fixing bright finished door latch with necessary screws etc. complete:250x16x5 mm	420	280	117600
19	Providing and fixing approved quality readymade hollow section pvc door shutter with frame including all fixtures, complete.	416	2903.75	1207960	19	Providing and fixing approved quality readymade hollow section pvc door shutter with frame including all fixtures, complete.	416	2903.75	1207960
20	Providing and fixing M.S. Grills of required pattern in frames of windows etc. with M.S. flats, square or round bars etc. including priming coat with approved steel primer all complete.Fixed to openings/ wooden frames with rawl plugs screws etc.	4865	148.78	723814.7	20	Providing and fixing M.S. Grills of required pattern in frames of windows etc. with M.S. flats, square or round bars etc. including priming coat with approved steel primer all complete.Fixed to openings/ wooden frames with rawl plugs screws etc.	4865	148.78	723814.7
21	For shutters of doors, windows & ventilators including providing and fixing hinges / pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber/ neoprene gasket required (Fittings shall be paid for separately)Anodised aluminium (anodised transparent or dyed to required shade according to IS : 1868. Minimum anodic coating of grade AC 15)	1200	548.03	657363	21	For shutters of doors, windows & ventilators including providing and fixing hinges / pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber/ neoprene gasket required (Fittings shall be paid for separately)Anodised aluminium (anodised transparent or dyed to required shade according to IS : 1868. Minimum anodic coating of grade AC 15)	1200	548.03	657363
22	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 : 7733 and IS 1285. Facing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with approved EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including clear angle, Aluminium snap bead for glazing /panelling, C.P. brass/ stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.(Glazing, panelling and dash fasteners to be paid for separately)For fixed portionAnodised aluminium (anodised transparent or dyed to required shade according to IS : 1868. Minimum anodic coating of grade AC 15)	782.404	469.07	367002.2443	22	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 : 7733 and IS 1285. Facing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with approved EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including clear angle, Aluminium snap bead for glazing /panelling, C.P. brass/ stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.(Glazing, panelling and dash fasteners to be paid for separately)For fixed portionAnodised aluminium (anodised transparent or dyed to required shade according to IS : 1868. Minimum anodic coating of grade AC 15)	782.404	469.07	367002.2443
23	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 bead shall be paid in basic item)With float glass panes of 4.0 mm thickness	628	979.08	614862.24	23	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 bead shall be paid in basic item)With float glass panes of 4.0 mm thickness	628	979.08	614862.24
24	Providing and fixing aluminium casement windows fasterener of required length for aluminium windows with necessary necessary screws etc. complete.Powder coated minimum thickness 50 micron aluminium	1224	73.28	89694.72	24	Providing and fixing aluminium casement windows fasterener of required length for aluminium windows with necessary necessary screws etc. complete.Powder coated minimum thickness 50 micron aluminium	1224	73.28	89694.72
25	Providing and fixing 1 st 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 @ 3.3 kg per sqm, including pointing in white cement mixed with pigment of matching shade complete.	180	960	172800	25	Providing and fixing 1 st 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 @ 3.3 kg per sqm, including pointing in white cement mixed with pigment of matching shade complete.	180	960	172800
26	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in all colours, shades, except White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick bed of cement mortar 1:4 (1 cement : 4 coarse sand), including pointing the joints with white cement and matching pigments etc., complete.	9800	1200	11760000	26	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in all colours, shades, except White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick bed of cement mortar 1:4 (1 cement : 4 coarse sand), including pointing the joints with white cement and matching pigments etc., complete.	9800	1200	11760000
27	Providing and laying water proofing treatment in sunken portion of WCs, bathroom etc., by applying cement slurry mixed with water proofing cement compound consisting of applying : a) First layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/sqm. This layer will be allowed to air cure for 4 hours. b) Second layer of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing for 48 hours. The rate includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer mixed slurry	420	660	277200	27	Providing and laying water proofing treatment in sunken portion of WCs, bathroom etc., by applying cement slurry mixed with water proofing cement compound consisting of applying : a) First layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/sqm. This layer will be allowed to air cure for 4 hours. b) Second layer of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing for 48 hours. The rate includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer mixed slurry	420	660	277200
28	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), including grouting the joints with white cement and matching pigments etc., complete.Size of Tile 600 x 600 mm.	760	1100	836000	28	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), including grouting the joints with white cement and matching pigments etc., complete.Size of Tile 600 x 600 mm.	760	1100	836000
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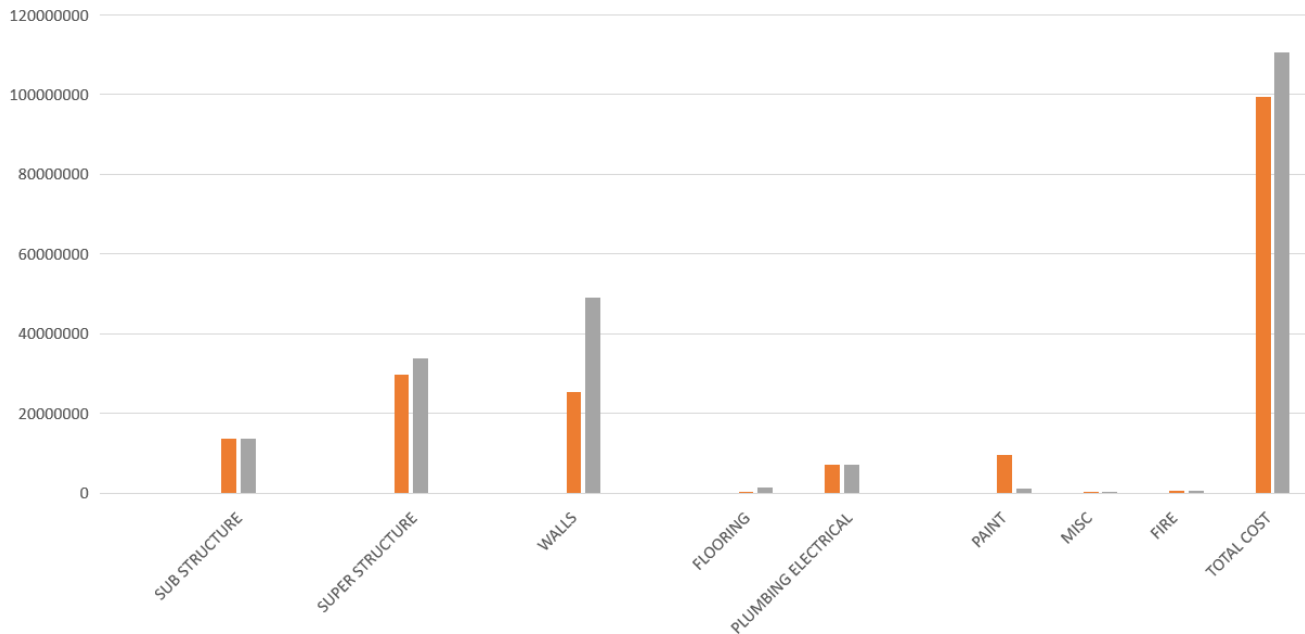
PLUMBING AND SANITARY							
SNO	DESCRIPTION	QTY	RATE	AMOUNT			
	Providing and fixing white vitreous china pedestal type water closet (Indian type) with seat and lid, 10 litre low level white P.V.C., flushing clothes, including flush pipe, with manually controlled device (hand lever), conforming to IS : 7233, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required. P.V.C. pan with IS marked black solid plastic seat and lid	208	2800	582400			
	Providing and fixing flush basin C.P. with 15 mm C.P. brass pillar stays, 32 mm C.P. brass base of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever required. White Vitreous China Flat back wash basin size 550x400mm with single 15 mm C.P. brass pillar stays	208	2399.63	499123.04			
	Providing and fixing PVC Health faucet having quality including cost of materials and labour charges etc. complete as per the direction of site engineer-in-charge.	208	347.62	72304.96			
	Supplying and fixing PTMT SSO Dish Holder good length of 138 mm, breadth 102 mm, height of 75 mm with concealed fittings arrangements, weighing not less than 106 kgs.	208	148.28	30842.24			
	Providing and fixing PTMT stop cock of approved quality and colour. 20 mm nominal bore, 89 mm long, weighing not less than 88 kgs	208	177.79	36980.32			
	Providing and fixing PTMT level rail complete with brackets fitted to wooden cleats with CP brass screws with concealed fitting arrangement of approved quality and colour. 600 mm long level rail with total length of 645 mm, width 78 mm and effective length 88 mm, weighing not less than 130 kgs.	208	558.13	116091.04			
	Providing and fixing 100 mm sand cast iron grating for gully trap.	208	38.62	8032.96			
	Providing and fixing Stainless Steel AISI 304 (316) kitchen sink as per IS 13093 with C.I. brackets and stainless steel gully 40 mm, including painting of fittings and brackets, cutting and making good the walls wherever required. Kitchen sink without drain board 350 mm head depth 400 mm	208	3270.1	680180.80			
	Providing and fixing PTMT pillar cock of approved quality and colour. 15 mm nominal bore, 107 mm long, weighing not less than 130 kgs	208	223.02	46388.16			
	Providing and fixing PVC pipes, fittings including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge. Concealed wall, including cutting chases and making good the wall etc. 20 mm pipe 10 Kg/cf/cm2	1800	276.45	497610			
	Providing and fixing PVC pipes, fittings including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge 32 mm dia 6 Kg/cf/cm2 - External work - Exposed on wall	1550	226.05	350377.5			
	Providing and fixing PVC pipes, fittings including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge 50 mm dia 6 Kg/cf/cm2 - Internal work - Exposed on wall	1600	270.16	432256			
	Providing and fixing PVC pipes, fittings including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge concealed work including cutting chases and making good the wall etc. 63 mm dia 6 Kg/cf/cm2	200	463.3	92660			
	Providing and fixing PVC pipes, fittings including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge 50 mm dia 6 Kg/cf/cm2 - External work - Exposed on wall	350	278.35	97422.5			
	Providing and fixing PVC pipes including fixing the pipe with clamps/clips at 1.00 m spacing. This includes jointing of pipes with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge 63 mm dia 4 Kg/cf/cm2 - External work - Exposed on wall	185.16					
	Providing and fixing PVC pipes including fixing the pipe with clamps/clips at 1.00 m spacing. This included jointing of pipes with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge 75 mm dia 4 Kg/cf/cm2 - External work - Exposed on wall	350		27774			
	Providing and fixing PVC pipes including fixing the pipe with clamps/clips at 1.00 m spacing. This includes jointing of pipes with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge 110 mm dia 4 Kg/cf/cm2 - External work - Exposed on wall	120	199.76	23971.2			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 63 mm dia Elbow	180	291.26	52426.8			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 63 dia 45 degree Elbow	45	66.93	3011.85			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 63 dia 45 degree Elbow	45	58.23	2620.35			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 63 mm dia Door Tee	45	74.78	3365.1			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia Elbow	12	100.9	1210.8			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia 45 degree Elbow	12	98.6	1183.2			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia Door Tee	12	125.3	1503.6			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia vent	12	117.15	1405.8			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110x75 mm dia Reducer	12	100.9	1210.8			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia Bend	50	154.35	7717.5			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes including jointing with PVC solvent cement - 100x110 dia Tee	30	167.67	5030.1			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110x110x110 mm dia Door Tee	50	180.54	9027			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110x110x75 mm dia Door Tee	50	173.59	8679.5			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia offset	50	157.85	7892.5			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia end cap	50	68.4	3420			
	Providing and fixing PVC moulded fittings/accessories for Rigid PVC pipes, including jointing with PVC solvent cement - 110 mm dia Socket/coupling	50	104.4	5220			
	Providing and laying water proofing treatment in sunken portion of WCs, bathroom etc., by applying cement slurry mixed with water proofing cement compound consisting of applying : a) First layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/sqm. This layer will be allowed to air cure for 4 hours. b) Second layer of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing for 48 hours. The rate includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer mixed slurry.	36			420	660	277200

				FIRE AND SAFETY ARRANGEMENT			
				SNO	DESCRIPTION	QTY	RATE AMOUNT
	Supply, conveyance and fixing the following types & current rating control gears & switchgears conforming to IS 13947 suitable for 440 V, 50 Hz, AC supply in the existing panel assembly as required. 16 A-100A, 16 kA (Ics=100%icu), 4 pole, current limiting type MCCB having thermal setting range of 80 - 100% with thermal magnetic release having adjustable OL	1	4616.15	4616.15	1	Supply, installation, testing and commissioning of ceiling type HOSE REEL DRUM made of 16 gauge MS sheet to keep 30mm dia 30 Mtrs long PVC lined heavy duty rubber belted hose pipe with chrome plated nozzle on one end and all other necessary fitting materials.	4 6900 27600
25	Providing and fixing M.V. danger notice plate of 200 mm X 150 mm, made of mild steel, at least 2mm thick, and vitreous enameled white on both sides, and with inscription in single red colour on front side as required.	6	196.74	1180.44	2	Supply, fabrication, installation, testing and commissioning of CO2 fixed, PANEL, (16 gauge) with 1/8" sockets for terrace fire pump.	1 16000 16000
26	Supplying and fixing following rating, double pole, (single phase and neutral), 240 volts, residual current circuit breaker (RCCB), having a sensitivity current upto 300 milliamperes in the existing MCB DB complete with connections, testing and commissioning etc. as required 25 amps	45	2178.66	98039.7	3	Supply, installation, testing and commissioning of Electrical driven Terrace Pump for automatic pressurization of down corner, that will be capable of minor leakage consisting of 1/2 inch section type fire pump bronze impeller, running at 2950RPM capable of delivering 1000LPH against a head of 40 Mtrs. b) Squire cage 1/2" C.I. section motor suitable for 415V, 3 phase, 50Hz AC supply of 5HP conforming to IP55 protection & class F insulation for the above pump running at 2900RPM. c) Common bed plate of requisite strength manufactured out of MS channel 50x5.	1 28500 28500
27	Earthing with G.I. earth pipe 4.5 metre long, 40 mm dia including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoal/ coke and salt as required	6	4848.51	29091.06	4	Supply, installation, testing and commissioning of GI BUTTERFLY VALVES (IP44) with seal standard lever operated type conforming to IS:1325 with 1/2" shaft & dia. flanges, nuts, bolts etc. complete	3 3500 10500
28	Laying and fixing of one piece PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size on cable tray as required. Upto 35 sq. mm (clamped with 1mm thick saddle)	650	27.73	18024.5	5	Supply, installation, testing and commissioning of 1/2" section type fire pump bronze impeller, running at 2950RPM capable of delivering 1000LPH against a head of 40 Mtrs. b) Squire cage 1/2" C.I. section motor suitable for 415V, 3 phase, 50Hz AC supply of 5HP conforming to IP55 protection & class F insulation for the above pump running at 2900RPM. c) Common bed plate of requisite strength manufactured out of MS channel 50x5.	1 3500 3500
29	Supply of the following 12 W, square/round recess type LED light fittings of good quality and approved make working on 240V/50Hz AC supply including all the accessories like clamps, screws and standard length connection leads etc.	26	1289	33514	6	Supply, installation, testing and commissioning of FIRE BRIGADE HELY connection with 2 nos of 63mm dia built in Gun metal Non return valves instantaneous coupling type arranged on 100mm dia etc. pipe manifold shall be connected to down corner, main.	1 4500 4500
30	Supply of decorative, white glass finish fixture suitable for 9W LED lamp for existing holder base. (equivalent reputed make)	224	246	55104	7	Supply, installation, testing and commissioning of Bronze body lever operated 1 Ball Valve (IP425) of approved make with necessary BVA metal threaded fittings.	4 850 3400
31	Supply of the following 18 W, LED Tube light fittings with luminaries including all the accessories like clamps, screws and standard length connection leads etc. required for fixing and working on 240V, 50 Hz AC supply	180	412	74160	8	Supply and installation of stored pressure ABC Type fire extinguisher of 4 kg.Capacity complete with initial charges and installation brackets with ISI mark/ISI certificate with serial number will be issued	8 2034 16272
32	Supply of 150mm Light Duty Exhaust fan with louvers working on 240V single phase AC of good quality & approved make to the existing opening/ false ceiling	44	1540	67760	9	Supply, installation, testing and commissioning of Pressure Gauge suitable range for pumpsets with siphon fittings like unions/ colors/ reducers etc.	1 1750 1750
33	Supply & providing 1200mm sweep Ceiling fan with all accessories of good quality & approved make, including wiring the down rods of standard length (upto 30 cm) with 3C x1.5 sq. mm FR PVC insulated, copper conductor, flexible cable etc. as required	132	1718	226776	10	Supply, installation, testing and commissioning of Pressure Gauge suitable range for pumpsets with siphon fittings like unions/ colors/ reducers etc.	1 1800 1800
34	Supply & laying the following sizes of Earth Strip for earthing interconnection, termination and leads, for continues earthing along with cables tinned at terminals etc. complete. 0.25 x 3 mm copper strip	250	774.2	193550	11	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
35	Supplying and fixing 32A-240V Single phase energy meter in the existing meter box	44	2090.22	91969.68	12	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
36	Supply, fixing, testing and commissioning of 63A Three phase energy meter in the existing meter panel board. with fuse.	1	5000	5000	13	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
37	R, Y, B indicator working on single phase 240 v, 50 Hz I) 1 set	1	488	488	14	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
38	Supply of 300 mm heavy Duty PVC Exhaust fan with louvers working on 240V single phase AC of good quality & approved make to the existing opening/ false ceiling etc. complete as required at site	2	2133	4266	15	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
39	Supply of 20A Fuse base with 2A HRC Fuse link	6	170.52	1023.12	16	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
40	Supply, installation and commissioning of Multifunction meter of series 4405, flush mounting 96 x 96 mm, class 1.0, input voltage measurement range 50 V- 520 V.	1	5701.99	5701.99	17	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
41	Selectable of V, A, PF, KW, KVA, Kwh etc.	2	2700	5400	18	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
42	Supply and providing 5 Kg. Dry Chemical Powder type Fire Extinguisher with hose and clamps including fixing it to wall as required.	10	2102	21020	19	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
43	Supply and providing 2mm thick Elastomeric Fire retardent insulating mat as per IS 15652/2006 to withstand 3.3 KV dielectric strength.	10	5866	58660	20	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
44	Supply, fabrication and installation of cable trench covers using 6 mm thick MS chequered plates for covering cable trenches in switchboards room.	1	646922	646922.11	21	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500
45	Supply & Installation, testing and commissioning of 10 KVA DG set complete with fuel tank, residential silencer, anti vibration pad, fuel piping and acoustic enclosure as per CPCB regulation, standard control panel, all meters and neutral CT and std by E/I/F relay. Including all civil works as required.	1	3437502.36	3437502.36	22	Supply, installation, testing and commissioning of brass body Air Release Valve 20mm dia type of approved make.	1 1500 1500

4.1.A COST ANALYSIS - Table & Graph PVC PANEL vs CONVENTIONAL BUILDING

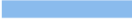
S.NO`	DISCRIPITION	CONVENTIONAL	PVC	SAVINGS	
				CON	PVC
1	Sub Structure	13,559,570	13,559,570		SAME
2	Super Structure	Column,Beam, Roof	ISMB, Decking sheet		
		29,663,100	33,720,500	13.5%	-
	WALLs	Solid Block with plaster	PVC Panel no plaster		
		25,365,600	49,077,600	51.3%	
3	Finishing				
	Flooring, Wall	1,304,600	307,400	-	41.3
	Plumbing ,Electrical	7,177,748	7,177,748	-	-
	Painting	Exterior, Interior,HandRail	Handrail		
		9,577,392	1,016,512	-	10.6%
4	Miscellaneous	124,600	124,600	-	-
5	Fire & safety	218680	218680	-	-
	TOTAL COST	99,326,893	110,557,909	10.5%	-

COST ANALYSIS- PVC PANEL vs CONVENTIONAL BUILDING



4.2 TIME ANALYSIS - PVC PANEL vs CONVENTIONAL BUILDING

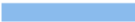
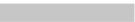
ID	Task Mode	Task Name	Duration	Start
0		PVC FORM WORK	246 days	14-10-21 9:00 AM
1		Mobilization	48 days	14-10-21 9:00 AM
2		Labor sources	43 days	14-10-21 9:00 AM
3		Material sources	6 days	25-11-21 9:00 AM
4		Execution(Structures):	204 days	25-11-21 9:00 AM
5		Mile stones-01	44 days	25-11-21 9:00 AM
6		Site Jungle Clearence work	11 days	25-11-21 9:00 AM
7		Site Survey (Contour LVL)	2 days	05-12-21 9:00 AM
8		Earth Excavation	2 days	06-12-21 9:00 AM
9		Site Settingout for foundation layout	1 day	07-12-21 9:00 AM
10		Foundation Excavation	5 days	08-12-21 9:00 AM
11		Dressing,levelling & compaction of earth below PCC	5 days	12-12-21 9:00 AM
12		PCC for below footings	4 days	16-12-21 9:00 AM
13		Reinforcement for footings/Raft	4 days	20-12-21 9:00 AM
14		Shuttering for footings/raft	4 days	23-12-21 9:00 AM
15		Concrete for footings/raft	3 days	26-12-21 9:00 AM
16		Column/pedestals layout below PB	5 days	28-12-21 9:00 AM
17		anchor bolt work below PB	3 days	01-01-22 9:00 AM
18		anchor bolt work above PB	2 days	03-01-22 9:00 AM
19		ISMB steel column upto stilt level	3 days	04-01-22 9:00 AM
20		RCC work for car parking area	2 days	06-01-22 9:00 AM
21		Mile stones-02	161 days	07-01-22 9:00 AM

Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task		Deadline	
	Split		Duration-only		Baseline	
	Milestone		Manual Summary Rollup		Baseline Milestone	
	Summary		Manual Summary		Baseline Summary	
	Project Summary		Start-only		Progress	
	Inactive Task		Finish-only		Manual Progress	
	Inactive Milestone		External Tasks			
	Inactive Summary		External Milestone			

Page 1

ID		Task Mode	Task Name	Duration	Start
22			Starter layout for ,Shear walls & lift core walls	5 days	07-01-22 9:00 AM
23			Reinforcement lapping for shear walls,staircase & lift core walls	2 days	11-01-22 9:00 AM
24			Shuttering for shear walls,staircase lift core wall	3 days	12-01-22 9:00 AM
25			Concrete for shear walls,staircase & lift core walls above PB	2 days	14-01-22 9:00 AM
26			ISMB steel column upto 8th level	27 days	15-01-22 9:00 AM
27			decking sheet RCC roof and electrical conduit for stilt	9 days	17-01-22 9:00 AM
28			Shuttering for shear walls,staircase lift core wall above stilt	1 day	22-01-22 9:00 AM
29			Concrete for shear walls,staircase & lift core walls	1 day	23-01-22 9:00 AM
30			pvc panel , plumbing electrical work for 16 dweling units in FF	7 days	25-01-22 9:00 AM
31			Concrete pour for the 16 units	7 days	25-01-22 9:00 AM
32			decking sheet RCC roof and electrical conduit for FF	6 days	31-01-22 9:00 AM
33			Shuttering for shear walls,staircase & lift core walls above FF	1 day	02-02-22 9:00 AM
34			Concrete for shear walls,staircase & lift core walls above FF	1 day	03-02-22 9:00 AM
35			pvc panel , plumbing electrical work for 16 dweling units in SF	7 days	05-02-22 9:00 AM
36			Concrete pour for the 16 units	7 days	05-02-22 9:00 AM
37			decking sheet RCC roof and electrical conduit for SF	9 days	05-02-22 9:00 AM
38			Shuttering for shear walls,staircase & lift core walls above SF	1 day	11-02-22 9:00 AM
39			Concrete for shear walls,staircase & lift core walls above SF	1 day	12-02-22 9:00 AM
40			pvc panel , plumbing electrical work for 16 dweling units in	5 days	13-02-22 9:00 AM
41			Concrete pour for the 16 units	5 days	13-02-22 9:00 AM
42			decking sheet RCC roof and electrical conduit for 3rdF	7 days	13-02-22 9:00 AM
43			Shuttering for shear walls,staircase & lift core walls above	1 day	21-02-22 9:00 AM

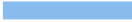
Project: PVC FORM WORK
Date: 30-03-22 1:01 PM

Task		Manual Task		Deadline	
Split		Duration-only		Baseline	
Milestone		Manual Summary Rollup		Baseline Milestone	
Summary		Manual Summary		Baseline Summary	
Project Summary		Start-only		Progress	
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Inactive Milestone		External Tasks			
Inactive Summary		External Milestone			

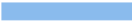
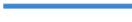
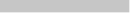
ID	Task Mode	Task Name	Duration	Start
44		Concrete for shear walls,staircase & lift core walls above 3RDF	1 day	22-02-22 9:00 AM
45		pvc panel , plumbing electrical work for 16 dweling units in	7 days	19-02-22 9:00 AM
46		Concrete pour for the 16 units	7 days	19-02-22 9:00 AM
47		decking sheet RCC roof and electrical conduit for 4thF	9 days	19-02-22 9:00 AM
48		Shuttering for shear walls,staircase & lift core walls above 4THF	1 day	01-03-22 9:00 AM
49		Concrete for shear walls,staircase & lift core walls above 4THF	1 day	02-03-22 9:00 AM
50		pvc panel , plumbing electrical work for 16 dweling units in	7 days	27-02-22 9:00 AM
51		Concrete pour for the 16 units	7 days	27-02-22 9:00 AM
52		decking sheet RCC roof and electrical conduit for 5thF	9 days	27-02-22 9:00 AM
53		Shuttering for shear walls,staircase & lift core walls above 5THF	1 day	11-03-22 9:00 AM
54		Concrete for shear walls,staircase & lift core walls above 5THF	1 day	12-03-22 9:00 AM
55		ISMB steel column from 9th Floor till 13th Floor	27 days	13-03-22 9:00 AM
56		pvc panel , plumbing electrical work for 16 dweling units in	7 days	07-03-22 9:00 AM
57		Concrete pour for the 16 units	7 days	07-03-22 9:00 AM
58		decking sheet RCC roof and electrical conduit for 6thF	9 days	07-03-22 9:00 AM
59		Shuttering for shear walls,staircase & lift core walls above 6THF	1 day	21-03-22 9:00 AM
60		Concrete for shear walls,staircase & lift core walls above 6THF	1 day	22-03-22 9:00 AM
61		pvc panel , plumbing electrical work for 16 dweling units in	7 days	15-03-22 9:00 AM
62		Concrete pour for the 16 units	7 days	15-03-22 9:00 AM
63		decking sheet RCC roof and electrical conduit for 7thF	9 days	15-03-22 9:00 AM
64		Shuttering for shear walls,staircase & lift core walls above 7THF	1 day	30-03-22 9:00 AM
65		Concrete for shear walls,staircase & lift core walls above 7THF	1 day	31-03-22 9:00 AM

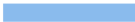
Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task		Deadline	
	Split		Duration-only		Baseline	
	Milestone		Manual Summary Rollup		Baseline Milestone	
	Summary		Manual Summary		Baseline Summary	
	Project Summary		Start-only		Progress	
	Inactive Task		Finish-only		Manual Progress	
	Inactive Milestone		External Tasks			
	Inactive Summary		External Milestone			

ID	Task Mode	Task Name	Duration	Start
66		pvc panel , plumbing electrical work for 16 dweling units in	7 days	23-03-22 9:00 AM
67		Concrete pour for the 16 units	7 days	23-03-22 9:00 AM
68		decking sheet RCC roof and electrical conduit for 8thF	9 days	23-03-22 9:00 AM
69		Shuttering for shear walls,staircase & lift core walls above 8THF	1 day	01-04-22 9:00 AM
70		Concrete for shear walls,staircase & lift core walls above 8THF	1 day	02-04-22 9:00 AM
71		pvc panel , plumbing electrical work for 16 dweling units in	7 days	31-03-22 9:00 AM
72		Concrete pour for the 16 units	7 days	31-03-22 9:00 AM
73		decking sheet RCC roof and electrical conduit for 9thF	7 days	31-03-22 9:00 AM
74		Shuttering for shear walls,staircase & lift core walls above 9THF	1 day	11-04-22 9:00 AM
75		Concrete for shear walls,staircase & lift core walls above 9THF	1 day	12-04-22 9:00 AM
76		pvc panel , plumbing electrical work for 16 dweling units in	7 days	06-04-22 9:00 AM
77		Concrete pour for the 16 units	7 days	06-04-22 9:00 AM
78		decking sheet RCC roof and electrical conduit for 10thF	9 days	06-04-22 9:00 AM
79		Shuttering for shear walls,staircase & lift core walls above	1 day	21-04-22 9:00 AM
80		Concrete for shear walls,staircase & lift core walls above 10THF	1 day	22-04-22 9:00 AM
81		pvc panel , plumbing electrical work for 16 dweling units in	7 days	14-04-22 9:00 AM
82		Concrete pour for the 16 units	7 days	14-04-22 9:00 AM
83		decking sheet RCC roof and electrical conduit for 11thF	9 days	14-04-22 9:00 AM
84		Shuttering for shear walls,staircase & lift core walls above	1 day	29-04-22 9:00 AM
85		Concrete for shear walls,staircase & lift core walls above 1THF	1 day	30-04-22 9:00 AM
86		pvc panel , plumbing electrical work for 16 dweling units in	7 days	22-04-22 9:00 AM
87		Concrete pour for the 16 units	7 days	22-04-22 9:00 AM

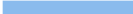
Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task		Deadline	
	Split		Duration-only		Baseline	
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	Summary		Manual Summary		Baseline Summary	
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	Inactive Task		Finish-only		Manual Progress	
	Inactive Milestone		External Tasks			
	Inactive Summary		External Milestone			
Page 4						

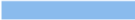
ID		Task Mode	Task Name	Duration	Start
					
88			decking sheet RCC roof and electrical conduit for 12thF	9 days	22-04-22 9:00 AM
89			Shuttering for shear walls,staircase & lift core walls above	1 day	08-04-22 9:00 AM
90			Concrete for shear walls,staircase & lift core walls above 12THF	1 day	09-04-22 9:00 AM
91			pvc panel , plumbing electrical work for 16 dweling units in	7 days	30-04-22 9:00 AM
92			Concrete pour for the 16 units	7 days	30-04-22 9:00 AM
93			decking sheet RCC roof and electrical conduit for 13THF	9 days	30-04-22 9:00 AM
94			Beams/Slab shuttering for Mumty,OHT & M/C rooms	3 days	20-04-22 9:00 AM
95			Beams/Slab Reinforcement fixing,laying of conduits & DB	2 days	22-04-22 9:00 AM
96			Fixing of Door frames & windows @ FF to 5th floor	50 days	10-03-22 9:00 AM
97			Fixing of Door frames & windows @ 6th floor to 13th floor	54 days	24-04-22 9:00 AM
98			Brick work for parapet wall	15 days	10-05-22 9:00 AM
99			Terrace/Mumty/OHT waterproofing work	3 days	05-05-22 9:00 AM

Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task		Deadline	
	Split		Duration-only		Baseline	
	Milestone		Manual Summary Rollup		Baseline Milestone	
	Summary		Manual Summary		Baseline Summary	
	Project Summary		Start-only		Progress	
	Inactive Task		Finish-only		Manual Progress	
	Inactive Milestone		External Tasks			
	Inactive Summary		External Milestone			

Finish	Task Name (Conventional Building)	Baseline Duration	Baseline Start	Baseline Finish	Oct			
					26-09	0		
16-06-22 6:00 PM	Conventional Building	713 days	14-10-21 9:00 AM	26-09-23 6:00 PM				
30-11-21 6:00 PM	Mobilization	48 days	14-10-21 9:00 AM	30-11-21 6:00 PM				
25-11-21 6:00 PM	Labor sources	43 days	14-10-21 9:00 AM	25-11-21 6:00 PM				
30-11-21 6:00 PM	Material sources	6 days	25-11-21 9:00 AM	30-11-21 6:00 PM				
16-06-22 6:00 PM	Execution(Structures):	671 days	25-11-21 9:00 AM	26-09-23 6:00 PM				
07-01-22 6:00 PM	Mile Stone-01	58 days	25-11-21 9:00 AM	21-01-22 6:00 PM				
05-12-21 6:00 PM	Site Jungle Clearence work	11 days	25-11-21 9:00 AM	05-12-21 6:00 PM				
06-12-21 6:00 PM	Site Survey (Contour LVL)	2 days	05-12-21 9:00 AM	06-12-21 6:00 PM				
07-12-21 6:00 PM	Earth Excavation	2 days	06-12-21 9:00 AM	07-12-21 6:00 PM				
07-12-21 6:00 PM	Site Settingout for foundation layout	1 day	07-12-21 9:00 AM	07-12-21 6:00 PM				
12-12-21 6:00 PM	Foundation Excavation	5 days	08-12-21 9:00 AM	12-12-21 6:00 PM				
16-12-21 6:00 PM	Dressing,levelling & compaction of earth	5 days	12-12-21 9:00 AM	16-12-21 6:00 PM				
19-12-21 6:00 PM	PCC for below footings	4 days	16-12-21 9:00 AM	19-12-21 6:00 PM				
23-12-21 6:00 PM	Reinforcement for footings/Raft	4 days	20-12-21 9:00 AM	23-12-21 6:00 PM				
26-12-21 6:00 PM	Shuttering for footings/raft	4 days	23-12-21 9:00 AM	26-12-21 6:00 PM				
28-12-21 6:00 PM	Concrete for footings/raft	3 days	26-12-21 9:00 AM	28-12-21 6:00 PM				
01-01-22 6:00 PM	Column/pedestals layout below PB	5 days	28-12-21 9:00 AM	01-01-22 6:00 PM				
03-01-22 6:00 PM	Reinforcement for columns up to PB , Sh	3 days	01-01-22 9:00 AM	03-01-22 6:00 PM				
04-01-22 6:00 PM	Reinforcement for columns up to PB , Sh	2 days	03-01-22 9:00 AM	04-01-22 6:00 PM				
06-01-22 6:00 PM	Reinforcement for columns up to PB , Sh	15 days	05-01-22 9:00 AM	19-01-22 6:00 PM				
07-01-22 6:00 PM	RCC work for car parking area	2 days	20-01-22 9:00 AM	21-01-22 6:00 PM				
16-06-22 6:00 PM	Mile stones-02	613 days	22-01-22 9:00 AM	26-09-23 6:00 PM				
Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task				Deadline	
	Split		Duration-only				Baseline	
	Milestone		Manual Summary Rollup		Baseline Milestone			
	Summary		Manual Summary		Baseline Summary			
	Project Summary		Start-only		Progress			
	Inactive Task		Finish-only		Manual Progress			
	Inactive Milestone		External Tasks					
	Inactive Summary		External Milestone					
Page 6								

Finish	Task Name (Conventional Building)	Baseline Duration	Baseline Start	Baseline Finish		
					Octo	0
11-01-22 6:00 PM	Starter layout for ,Shear walls & lift core	18 days	22-01-22 9:00 AM	08-02-22 6:00 PM		
12-01-22 6:00 PM	Reinforcement lapping for shear	2 days	09-02-22 9:00 AM	10-02-22 6:00 PM		
14-01-22 6:00 PM	Shuttering for shear walls,staircase lift c	3 days	11-02-22 9:00 AM	13-02-22 6:00 PM		
15-01-22 6:00 PM	Concrete for shear walls,staircase & lift	2 days	14-02-22 9:00 AM	15-02-22 6:00 PM		
10-02-22 6:00 PM	RCC Column upto 8th Floor Roof	35 days	16-02-22 9:00 AM	22-03-22 6:00 PM		
25-01-22 6:00 PM	RCC roof and electrical conduit for stilt s	12 days	23-03-22 9:00 AM	03-04-22 6:00 PM		
22-01-22 6:00 PM	Shuttering for shear walls,staircase lift	1 day	04-04-22 9:00 AM	04-04-22 6:00 PM		
23-01-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	05-04-22 9:00 AM	05-04-22 6:00 PM		
31-01-22 6:00 PM	Brick work @ FF	18 days	06-04-22 9:00 AM	23-04-22 6:00 PM		
31-01-22 6:00 PM	Beams/Slab shuttering for FF	7 days	24-04-22 9:00 AM	30-04-22 6:00 PM		
05-02-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	01-05-22 9:00 AM	06-05-22 6:00 PM		
02-02-22 6:00 PM	Shuttering for shear walls,staircase &	1 day	07-05-22 9:00 AM	07-05-22 6:00 PM		
03-02-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	08-05-22 9:00 AM	08-05-22 6:00 PM		
11-02-22 6:00 PM	Brick work @ SF	18 days	09-05-22 9:00 AM	26-05-22 6:00 PM		
11-02-22 6:00 PM	Beams/Slab shuttering for SF	7 days	27-05-22 9:00 AM	02-06-22 6:00 PM		
13-02-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	03-06-22 9:00 AM	08-06-22 6:00 PM		
11-02-22 6:00 PM	Shuttering for shear walls,staircase lift	1 day	09-06-22 9:00 AM	09-06-22 6:00 PM		
12-02-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	10-06-22 9:00 AM	10-06-22 6:00 PM		
17-02-22 6:00 PM	Brick work @ 3rdF	18 days	11-06-22 9:00 AM	28-06-22 6:00 PM		
17-02-22 6:00 PM	Beams/Slab shuttering for 3rdF	7 days	29-06-22 9:00 AM	05-07-22 6:00 PM		
19-02-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	06-07-22 9:00 AM	11-07-22 6:00 PM		
21-02-22 6:00 PM	Shuttering for shear walls,staircase &	1 day	12-07-22 9:00 AM	12-07-22 6:00 PM		
Project: PVC FORM WORK Date: 30-03-22 1:01 PM Task Split Milestone Summary Project Summary Inactive Task Inactive Milestone Inactive Summary Manual Task Duration-only Manual Summary Rollup Manual Summary Start-only Finish-only External Tasks External Milestone Deadline Baseline Baseline Milestone Baseline Summary Progress Manual Progress ↓ ◇ ◇						
Page 7						

Finish	Task Name (Conventional Building)	Baseline Duration	Baseline Start	Baseline Finish	Oct			
					26-09	0		
22-02-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	13-07-22 9:00 AM	13-07-22 6:00 PM				
25-02-22 6:00 PM	Brick work @ 4thF	18 days	14-07-22 9:00 AM	31-07-22 6:00 PM				
25-02-22 6:00 PM	Beams/Slab shuttering for 4thF	7 days	01-08-22 9:00 AM	07-08-22 6:00 PM				
27-02-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	08-08-22 9:00 AM	13-08-22 6:00 PM				
01-03-22 6:00 PM	Shuttering for shear walls,staircase &	1 day	14-08-22 9:00 AM	14-08-22 6:00 PM				
02-03-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	15-08-22 9:00 AM	15-08-22 6:00 PM				
05-03-22 6:00 PM	Brick work @ 5thF	18 days	16-08-22 9:00 AM	02-09-22 6:00 PM				
05-03-22 6:00 PM	Beams/Slab shuttering for 5thF	7 days	03-09-22 9:00 AM	09-09-22 6:00 PM				
07-03-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	10-09-22 9:00 AM	15-09-22 6:00 PM				
11-03-22 6:00 PM	Shuttering for shear walls,staircase &	1 day	16-09-22 9:00 AM	16-09-22 6:00 PM				
12-03-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	17-09-22 9:00 AM	17-09-22 6:00 PM				
08-04-22 6:00 PM	RCC Column 9th Floor till 13th Floor	35 days	18-09-22 9:00 AM	22-10-22 6:00 PM				
13-03-22 6:00 PM	Brick work @ 6thF	18 days	23-10-22 9:00 AM	09-11-22 6:00 PM				
13-03-22 6:00 PM	Beams/Slab shuttering for 6thF	7 days	10-11-22 9:00 AM	16-11-22 6:00 PM				
15-03-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	17-11-22 9:00 AM	22-11-22 6:00 PM				
21-03-22 6:00 PM	Shuttering for shear walls,staircase & lift	1 day	23-11-22 9:00 AM	23-11-22 6:00 PM				
22-03-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	24-11-22 9:00 AM	24-11-22 6:00 PM				
21-03-22 6:00 PM	Brick work @ 7thF	18 days	25-11-22 9:00 AM	12-12-22 6:00 PM				
21-03-22 6:00 PM	Beams/Slab shuttering for 7thF	7 days	13-12-22 9:00 AM	19-12-22 6:00 PM				
23-03-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	20-12-22 9:00 AM	25-12-22 6:00 PM				
30-03-22 6:00 PM	Shuttering for shear walls,staircase & lift	1 day	26-12-22 9:00 AM	26-12-22 6:00 PM				
31-03-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	27-12-22 9:00 AM	27-12-22 6:00 PM				
Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task				Deadline	
	Split		Duration-only				Baseline	
	Milestone		Manual Summary Rollup				Baseline Milestone	
	Summary		Manual Summary				Baseline Summary	
	Project Summary		Start-only				Progress	
	Inactive Task		Finish-only				Manual Progress	
	Inactive Milestone		External Tasks					
	Inactive Summary		External Milestone					
Page 8								

Finish	Task Name (Conventional Building)	Baseline Duration	Baseline Start	Baseline Finish	Oct			
					26-09	0		
29-03-22 6:00 PM	Brick work @ 8thF	18 days	28-12-22 9:00 AM	14-01-23 6:00 PM				
29-03-22 6:00 PM	Beams/Slab shuttering for 7thF	7 days	15-01-23 9:00 AM	21-01-23 6:00 PM				
31-03-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	22-01-23 9:00 AM	27-01-23 6:00 PM				
01-04-22 6:00 PM	Shuttering for shear walls,staircase & lift	1 day	28-01-23 9:00 AM	28-01-23 6:00 PM				
02-04-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	29-01-23 9:00 AM	29-01-23 6:00 PM				
06-04-22 6:00 PM	Brick work @ 9thF	18 days	30-01-23 9:00 AM	16-02-23 6:00 PM				
06-04-22 6:00 PM	Beams/Slab shuttering for 9thF	7 days	17-02-23 9:00 AM	23-02-23 6:00 PM				
06-04-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	24-02-23 9:00 AM	01-03-23 6:00 PM				
11-04-22 6:00 PM	Shuttering for shear walls,staircase & lift	1 day	02-03-23 9:00 AM	02-03-23 6:00 PM				
12-04-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	03-03-23 9:00 AM	03-03-23 6:00 PM				
12-04-22 6:00 PM	Brick work @ 10thF	18 days	04-03-23 9:00 AM	21-03-23 6:00 PM				
12-04-22 6:00 PM	Beams/Slab shuttering for 10thF	7 days	22-03-23 9:00 AM	28-03-23 6:00 PM				
14-04-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	29-03-23 9:00 AM	03-04-23 6:00 PM				
21-04-22 6:00 PM	Shuttering for shear walls,staircase & lift	1 day	04-04-23 9:00 AM	04-04-23 6:00 PM				
22-04-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	05-04-23 9:00 AM	05-04-23 6:00 PM				
20-04-22 6:00 PM	Brick work @ 11thF	18 days	06-04-23 9:00 AM	23-04-23 6:00 PM				
20-04-22 6:00 PM	Beams/Slab shuttering for 10thF	7 days	24-04-23 9:00 AM	30-04-23 6:00 PM				
22-04-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	01-05-23 9:00 AM	06-05-23 6:00 PM				
29-04-22 6:00 PM	Shuttering for shear walls,staircase & lift	1 day	07-05-23 9:00 AM	07-05-23 6:00 PM				
30-04-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	08-05-23 9:00 AM	08-05-23 6:00 PM				
28-04-22 6:00 PM	Brick work @ 12thF	18 days	09-05-23 9:00 AM	26-05-23 6:00 PM				
28-04-22 6:00 PM	Beams/Slab shuttering for 12thF	7 days	27-05-23 9:00 AM	02-06-23 6:00 PM				
Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task				Deadline	
	Split		Duration-only				Baseline	
	Milestone		Manual Summary Rollup		Baseline Milestone			
	Summary		Manual Summary		Baseline Summary			
	Project Summary		Start-only		Progress			
	Inactive Task		Finish-only		Manual Progress			
	Inactive Milestone		External Tasks					
	Inactive Summary		External Milestone					
Page 9								

Finish	Task Name (Conventional Building)	Baseline Duration	Baseline Start	Baseline Finish	Octo	
					26-09	0
30-04-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	03-06-23 9:00 AM	08-06-23 6:00 PM		
08-04-22 6:00 PM	Shuttering for shear walls,staircase & lift	1 day	09-06-23 9:00 AM	09-06-23 6:00 PM		
09-04-22 6:00 PM	Concrete for shear walls,staircase & lift	1 day	10-06-23 9:00 AM	10-06-23 6:00 PM		
06-05-22 6:00 PM	Brick work @ 13thF	18 days	11-06-23 9:00 AM	28-06-23 6:00 PM		
06-05-22 6:00 PM	Beams/Slab shuttering for 13thF	7 days	29-06-23 9:00 AM	05-07-23 6:00 PM		
08-05-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	6 days	06-07-23 9:00 AM	11-07-23 6:00 PM		
22-04-22 6:00 PM	Beams/Slab shuttering for Mumty,OHT & 3	3 days	12-07-23 9:00 AM	14-07-23 6:00 PM		
23-04-22 6:00 PM	Beams/Slab Reinforcement fixing,laying	2 days	15-07-23 9:00 AM	16-07-23 6:00 PM		
28-04-22 6:00 PM	Fixing of Door frames & windows @ FF t	50 days	17-07-23 9:00 AM	04-09-23 6:00 PM		
16-06-22 6:00 PM	Fixing of Door frames & windows @ 6th	54 days	17-07-23 9:00 AM	08-09-23 6:00 PM		
24-05-22 6:00 PM	Brick work for parapet wall	15 days	09-09-23 9:00 AM	23-09-23 6:00 PM		
07-05-22 6:00 PM	Terrace/Mumty/OHT waterproofing wor	3 days	24-09-23 9:00 AM	26-09-23 6:00 PM		
Project: PVC FORM WORK Date: 30-03-22 1:01 PM	Task		Manual Task		Deadline	
	Split		Duration-only		Baseline	
	Milestone		Manual Summary Rollup		Baseline Milestone	
	Summary		Manual Summary		Baseline Summary	
	Project Summary		Start-only		Progress	
	Inactive Task		Finish-only		Manual Progress	
	Inactive Milestone		External Tasks			
	Inactive Summary		External Milestone			
Page 10						

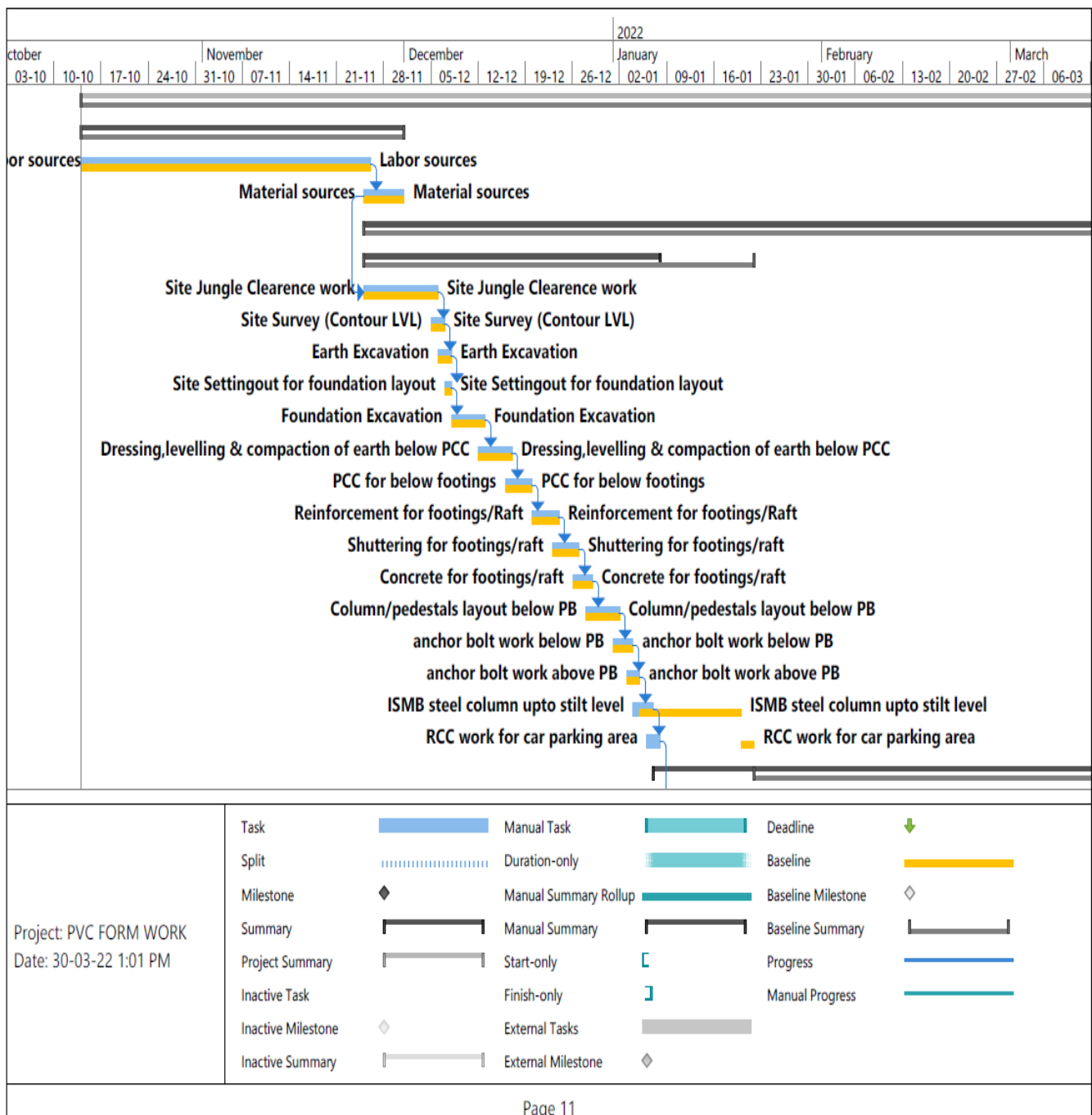
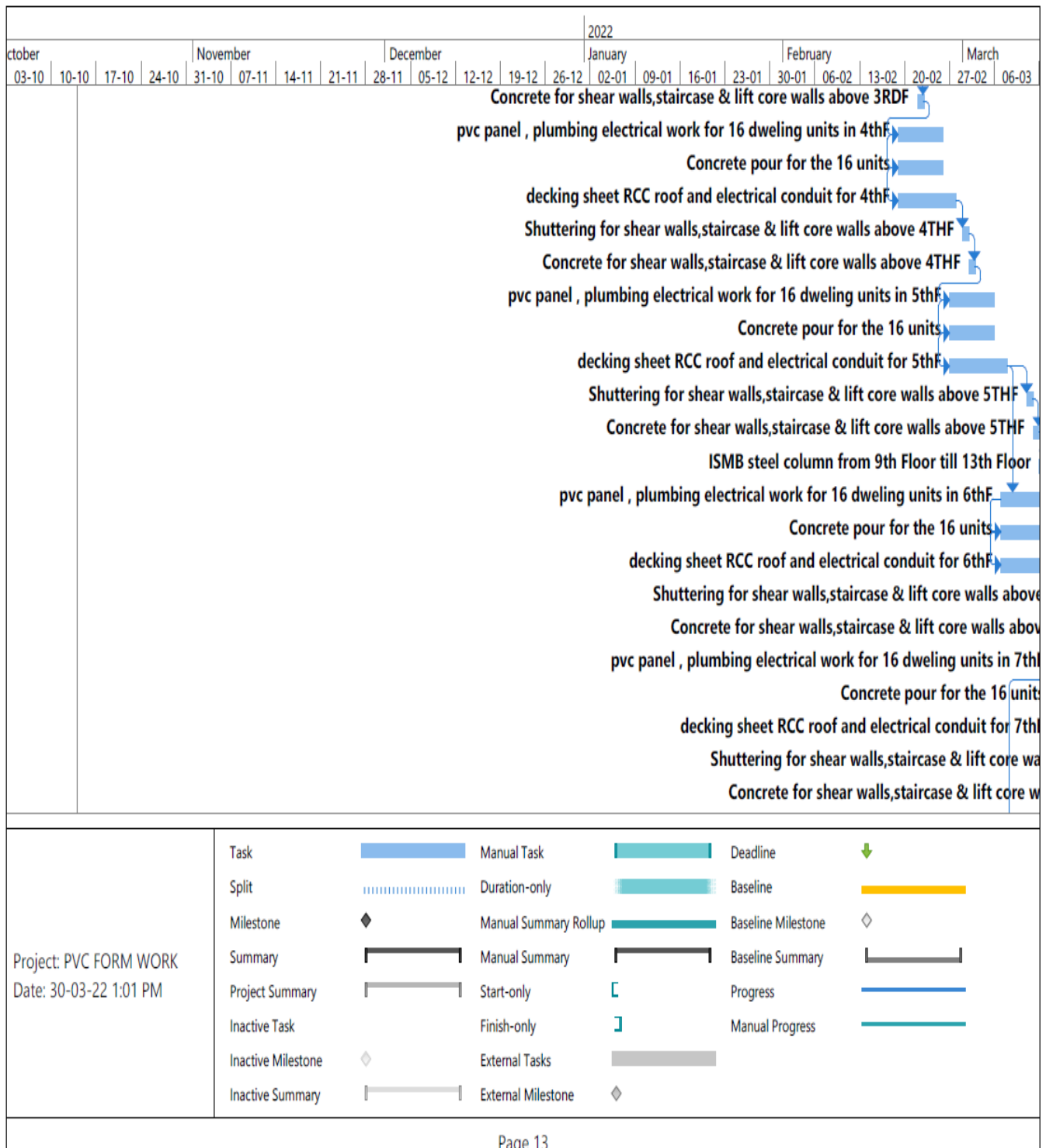
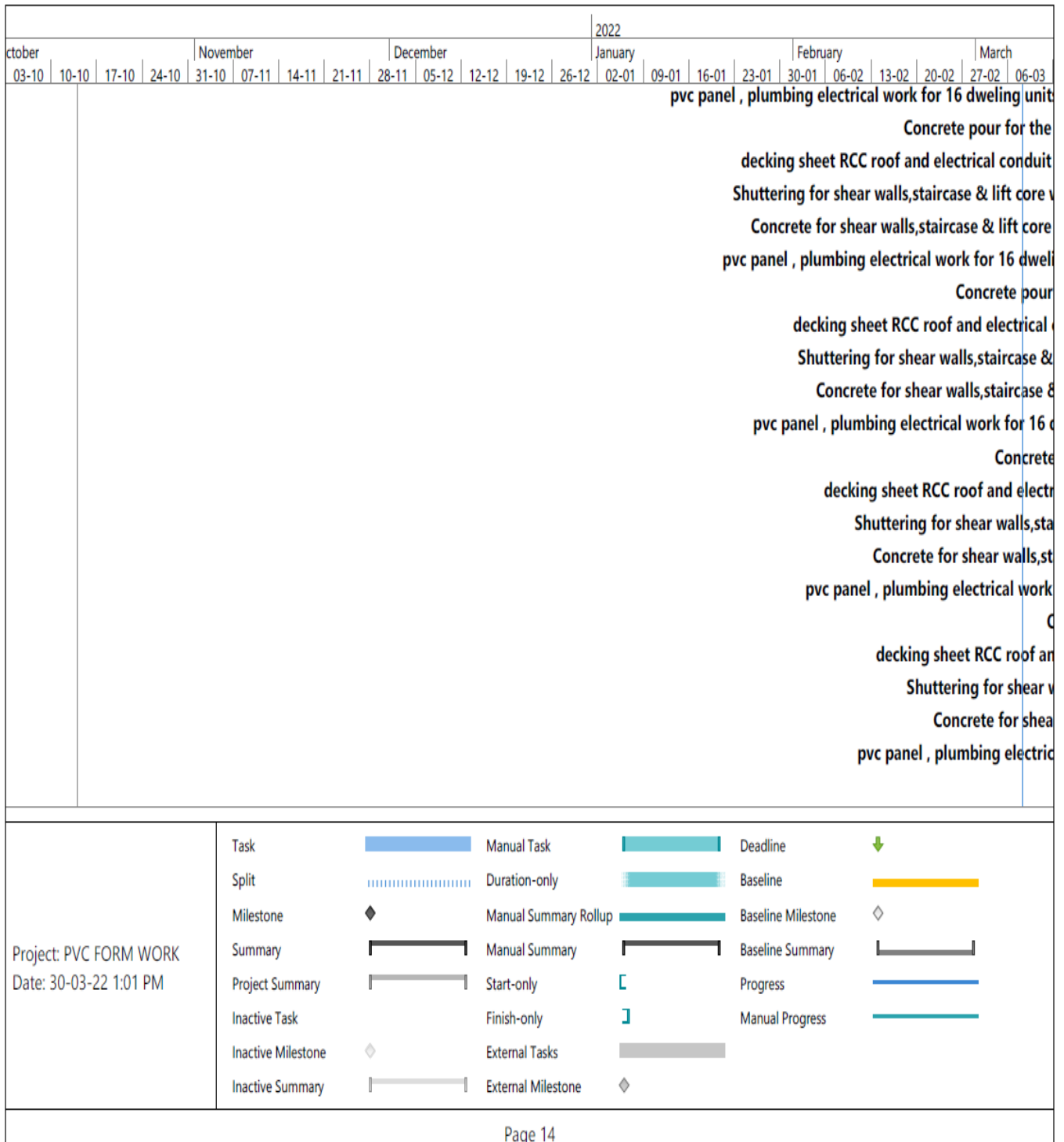
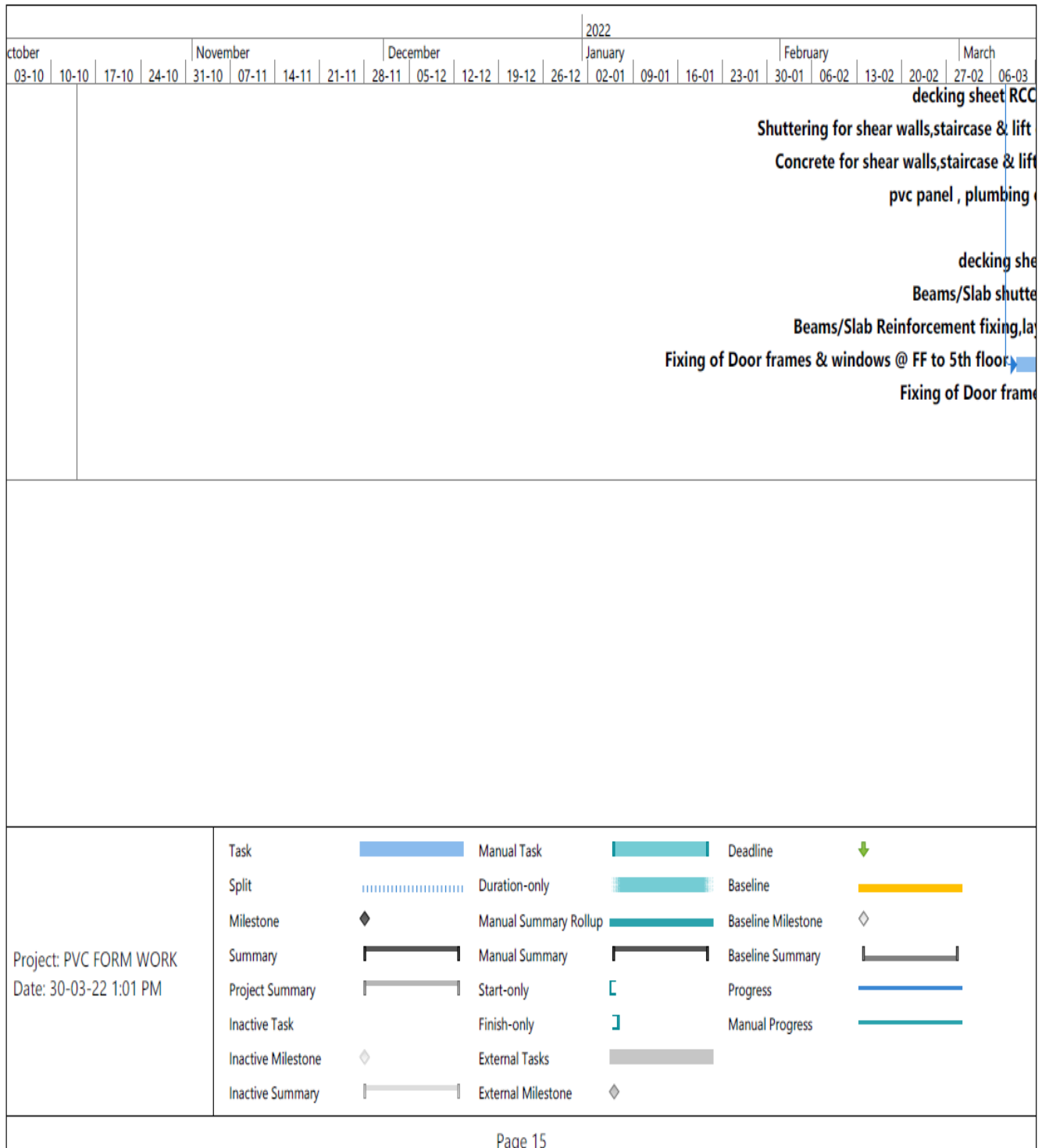


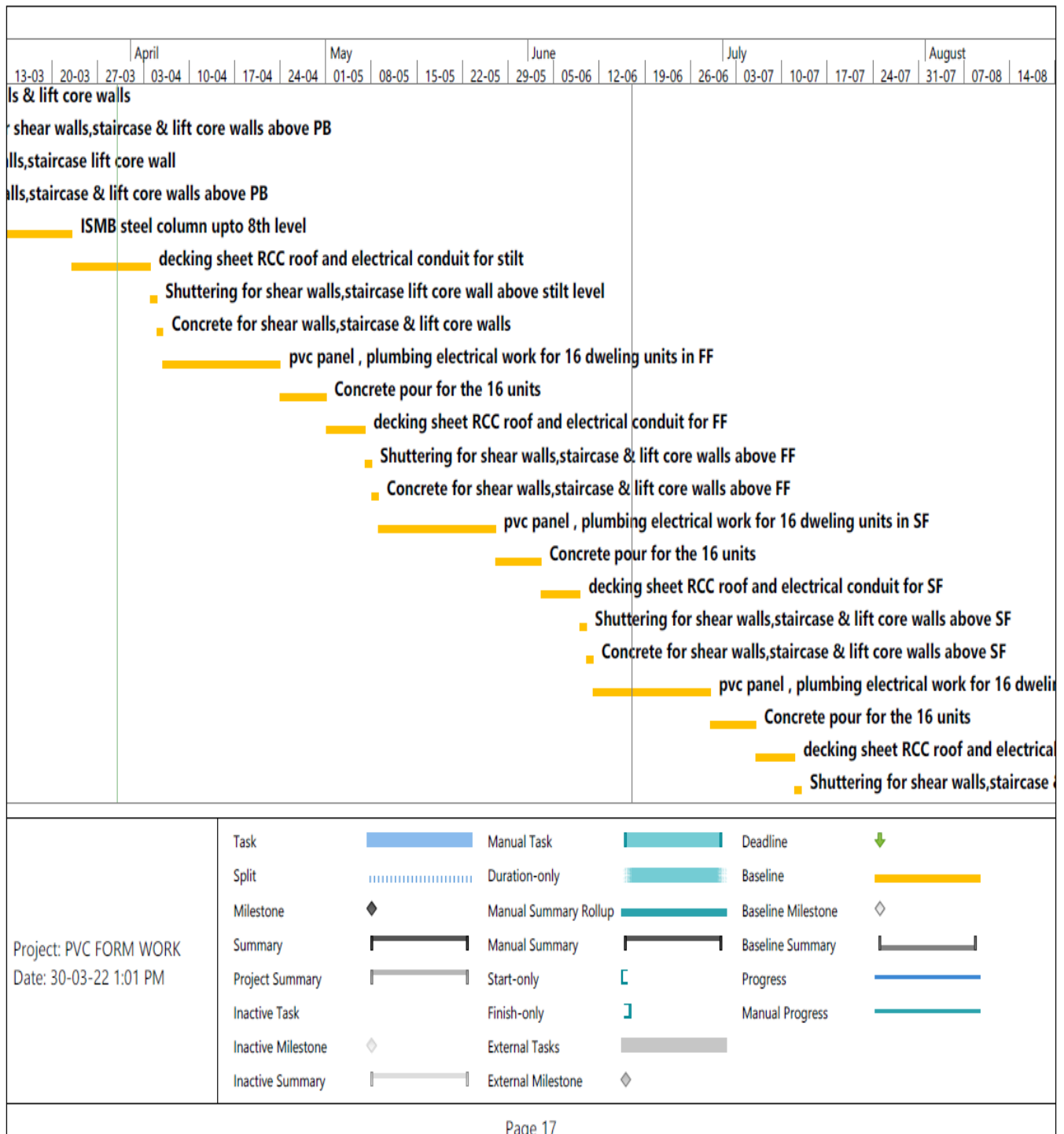
Fig 4.2 TIME ANALYSIS - PVC PANEL vs CONVENTIONAL BUILDING

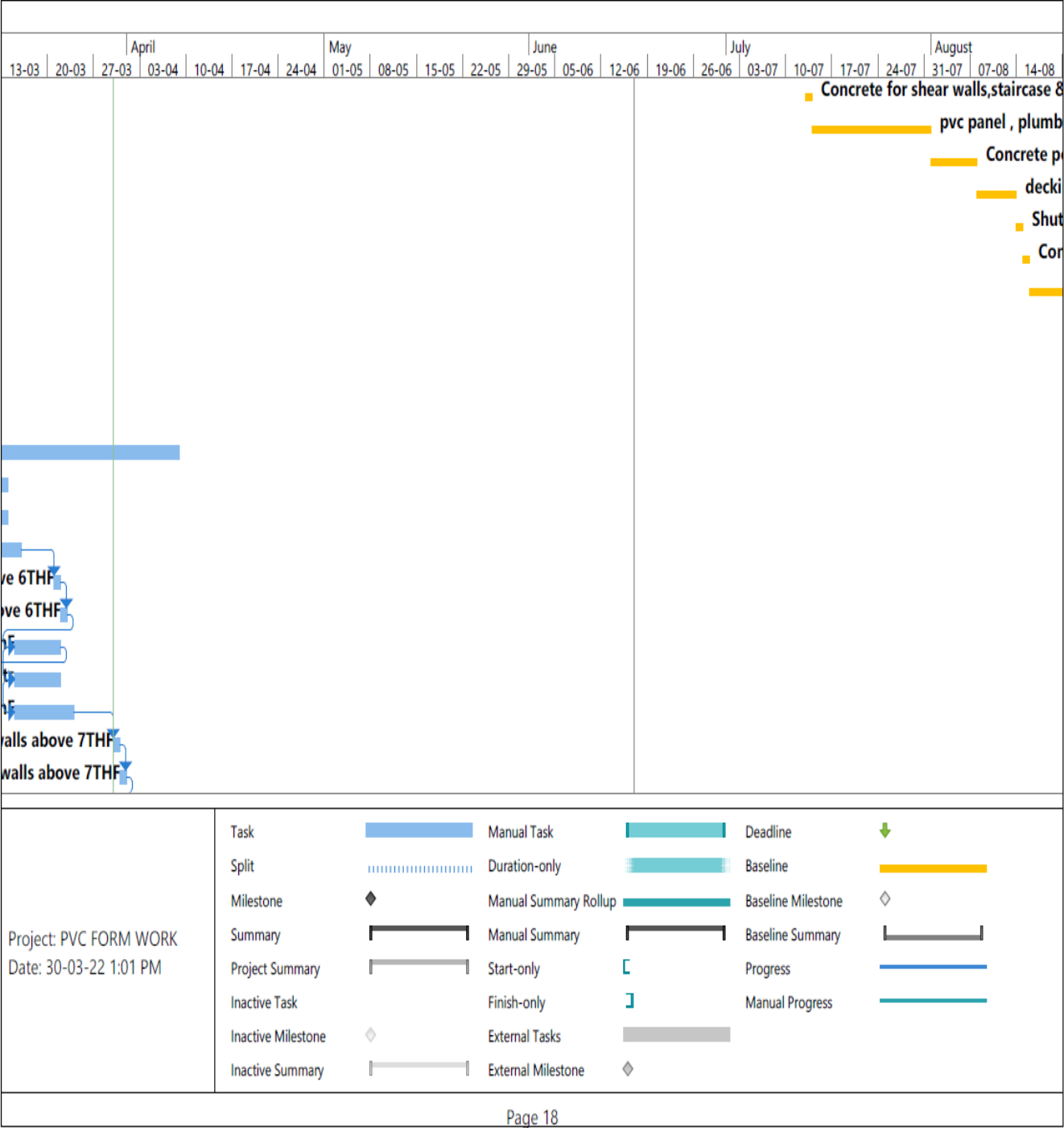




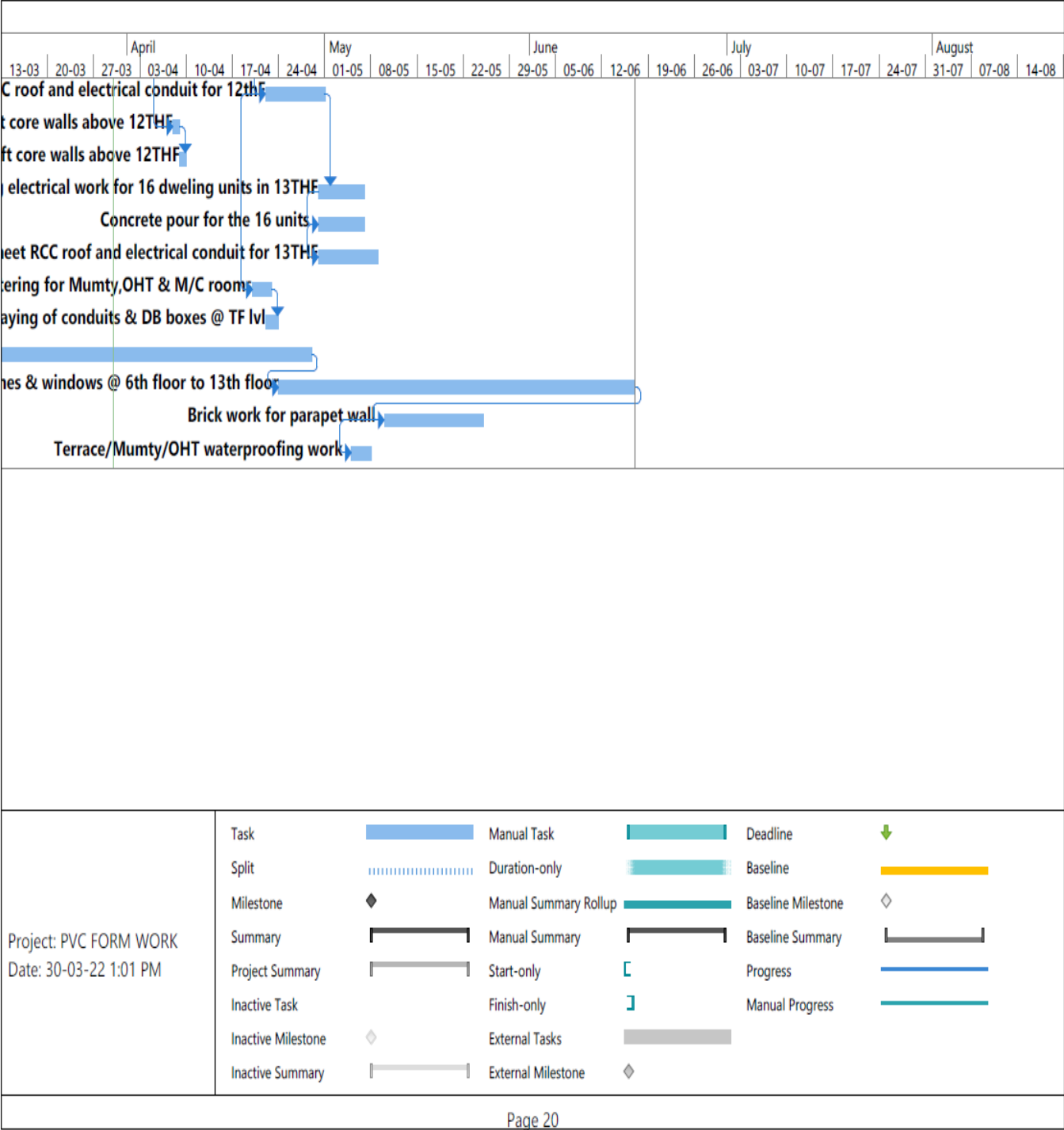


April							May							June							July							August						
13-03	20-03	27-03	03-04	10-04	17-04	24-04	01-05	08-05	15-05	22-05	29-05	05-06	12-06	19-06	26-06	03-07	10-07	17-07	24-07	31-07	07-08	14-08												









RESULT



70% TIME IS SAVED IN PVC FORMWORK SYSTEM COMPARED TO CONVENTION SOLID BLOCK SYSTEM, MOST TIME IS SAVED DURING THE PVC PANELING CONCRETE FORMWORK PROCESS

Fig 4.2.1 Result - PVC PANEL vs CONVENTIONAL BUILDING

4.3 LIFE CYCLE COST FOR PVC VS CONVENTIONAL BUILDING

SI.NO	DISCRIPTION	EXISTING/PVC WALL PANEL	SOLID BLOCK
1	PRICE	RS. 27,614,000	RS. 25,365,600
2	BREAKAGE/WASTAGE	10%	5%
3	U-VALUE	0.14 W/SQM.K	2 W/ SQM.K

NOTE: WITH THE THERMAL CONDUCTANCE OF THE MATERIALS FROM THE TABLE THE ENERGY CONSUMPTIONS FOR THE DIFFERENT COMINATIONS OF THE MATERIALS IS CALCULATED

HEAT GAIN IN PVC STRUCTURE						HEAT GAIN IN SOLID STRUCTURE					
1.CONDUCTION OF HEAT IN WALLS AND WINDOWS						1.CONDUCTION OF HEAT THROUGH WALLS AND WINDOWS					
1.Conduction: $Q_c = A \cdot U \cdot T.DIFF$ (WHERE; A=AREA IN Sq. Meter U=U-FACTOR(THERMAL TRANSMITTANCE) T.DIFF=TEMPERATURE DIFFERENCE BETWEEN OUTDOOR AND INDOOR						1.Conduction: $Q_c = A \cdot U \cdot T.DIFF$ (WHERE; A=AREA IN Sq. Meter U=U-FACTOR(THERMAL TRANSMITTANCE) T.DIFF=TEMPERATURE DIFFERENCE BETWEEN OUTDOOR AND INDOOR					
SI.NO	STRUCTURE	AREA(SQ.M)	U-VALUE W/Sqm.K	T.DIFF(CELCIOUS)	W	SI.NO	STRUCTURE	AREA(SQ.M)	U-VALUE W/Sqm.K	T.DIFF(CELCIOUS)	W
1	NORTH WALL	75.3	0.14	6	63.252	1	NORTH WALL	75.3	2	6	903.6
2	SOUTH WALL	75.3	0.14	6	63.252	2	SOUTH WALL	75.3	2	6	903.6
3	EAST WALL	39.2	0.14	6	32.928	3	EAST WALL	39.2	2	6	470.4
4	WEST WALL	39.2	0.14	6	32.928	4	WEST WALL	39.2	2	6	470.4
5	NORTH WINDOW	9.6	2.5	6	144	5	NORTH WINDOW	9.6	2.5	6	144
6	SOUTH WINDOW	9.6	2.5	6	144	6	SOUTH WINDOW	9.6	2.5	6	144
7	EAST WINDOW	1.6	2.5	6	24	7	EAST WINDOW	1.6	2.5	6	24
8	WEST WINDOW	2.2	2.5	6	33	8	WEST WINDOW	2.2	2.5	6	33
9	TOTAL PER FLOOR				537.36	9	TOTAL PER FLOOR				3093
10	NO.OF FLOORS				13	10	NO.OF FLOORS				13
11	ALL FLOOR TOTAL				6985.68	11	ALL FLOOR TOTAL				40209
12	ROOF	757.56	0.14	6	636.3504	12	ROOF	757.56	2	6	9090.72
13	FLOOR	757.56	0.14	6	636.3504	13	FLOOR	757.56	2	6	9090.72
14	GRAND TOTAL				8258.3808	14	GRAND TOTAL				58390.44

2.SOLAR RADIATION THROUGH WINDOW						2.SOLAR RADIATION THROUGH WINDOW					
$Q_s = A \cdot I \cdot \theta$ (WHERE; A=AREA IN Sq. Meter I= Radiation heat flow density, in W/m2 θ = Solar gain factor of window glass						$Q_s = A \cdot I \cdot \theta$ (WHERE; A=AREA IN Sq. Meter I= Radiation heat flow density, in W/m2 θ = Solar gain factor of window glass					
SI.NO	STRUCTURE	AREA	I	θ	W	SI.NO	STRUCTURE	AREA	I	θ	W
1	NORTH WINDOW	9.6	0.5	1360	6528	1	NORTH WINDOW	9.6	0.5	1360	6528
2	SOUTH WINDOW	9.6	0.5	1360	6528	2	SOUTH WINDOW	9.6	0.5	1360	6528
3	EAST WINDOW	1.6	0.5	1360	1088	3	EAST WINDOW	1.6	0.5	1360	1088
4	WEST WINDOW	2.2	0.5	1360	1496	4	WEST WINDOW	2.2	0.5	1360	1496
5	PER FLOOR TOTAL				15640	5	PER FLOOR TOTAL				15640
6	NO.OF FLOORS				13	6	NO.OF FLOORS				13
7	GRAND TOTAL				203320	7	GRAND TOTAL				203320
3.INTERNAL HEAT GAIN DUE TO OCCUPANCY ,LIGHTING AND ETC						3.INTERNAL HEAT GAIN DUE TO OCCUPANCY ,LIGHTING AND ETC					
SI.NO	DESCRIPTION	NO.OF UNITS	WATTS	TOTAL W		SI.NO	DESCRIPTION	NO.OF UNITS	WATTS	TOTAL W	
1	LED TUBE LIGHT	48	12	576		1	LED TUBE LIGHT	48	12	576	
2	LED BULBS	32	10	320		2	LED BULBS	32	10	320	
3	PLUG POINTS	64	100	6400		3	PLUG POINTS	64	100	6400	
4	FAN	32	75	2400		4	FAN	32			
5	CHIMNEY	16	120	1920		5	CHIMNEY	16	120	1920	
6	T.V	16	5	80		6	T.V	16	5	80	
7	FRIDGE	16	100	1600		7	FRIDGE	16	100	1600	
8	OCCUPANCY	70	130	9100		8	OCCUPANCY	70	130	9100	
9	HEAT GAINED PER UNIT			19996		9	HEAT GAINED PER UNIT			19996	
10	TOTAL NO.OF UNITS			208		10	TOTAL NO.OF UNITS			208	
11	GRAND TOTAL			4159168		11	GRAND TOTAL			4159168	

OPERATION COST TO REMOVE HEAT GAIN IN BUILDING							MAINTENANCE COSTING FOR PVC				MAINTANANCE COST FOR SOLID STRUCTURE			
NO.OF YEAR	YEAR	ENERGY CONSUMPTION (ANNUAL) COST	AIR CONDITIONER MAINTANENCE (ANNUAL) COST	REPAIRS AND REPLACEMENTS (NON-ANNUAL) COST	INTEREST RATE(7%)	TOTAL	NO.OF YEAR	YEAR	REPAIRS AND REPLACEMENTS(N ON-ANNUAL) COST	INTEREST RATE(7%)	NO.OF YEAR	YEAR	REPAIRS AND REPLACEMENTS(N ON-ANNUAL) COST	INTEREST RATE(7%)
1	2022	17,23,357	78000		0.07	1801357	1	2022		0.07	1	2022		0.07
2	2023	1843991.99	83460			1927451.99	2	2023			2	2023		
3	2024	1973071.429	89302.2			2062373.629	3	2024			3	2024		
4	2025	2111186.429	95553.354			2206739.783	4	2025			4	2025		
5	2026	2258969.479	102242.0888	700000		3061211.568	5	2026	55000		5	2026	700000	
6	2027	2417097.343	109399.035			2526496.378	6	2027			6	2027		
7	2028	2586294.157	117056.9674			2703351.124	7	2028			7	2028		
8	2029	2767934.748	125250.9552			2892585.703	8	2029			8	2029		
9	2030	2961048.18	134018.522			3095066.702	9	2030			9	2030		
10	2031	3168321.553	143399.8186	1286921.449		4598642.82	10	2031	101115.2567		10	2031	1286921.449	
11	2032	3390104.062	153437.8059			3543541.868	11	2032			11	2032		
12	2033	3627411.346	164178.4523			3791589.798	12	2033			12	2033		
13	2034	3881330.14	175670.9439			4057001.084	13	2034			13	2034		
14	2035	4153023.25	187967.91			4340991.16	14	2035			14	2035		
15	2036	4443734.877	201125.6637	1804973.905		6449834.446	15	2036	141819.3783		15	2036	1804973.905	
16	2037	4754796.319	215204.4602			4970000.779	16	2037			16	2037		
17	2038	5087632.061	230268.7724			5087632.061	17	2038			17	2038		
18	2039	5443766.306	246387.5865			5690153.892	18	2039			18	2039		
19	2040	5824829.947	263634.7175			6088464.664	19	2040			19	2040		
20	2041	6232568.043	282089.1477	2531569.275		9046226.465	20	2041	198909.0144		20	2041	2531569.275	
21	2042	6668847.806	301835.3881			6970683.194	21	2042			21	2042		
22	2043	7135667.153	322963.8652			7458631.018	22	2043			22	2043		
23	2044	7635163.853	345571.3358			7980735.189	23	2044			23	2044		
24	2045	8169625.323	369761.3293			8539386.652	24	2045			24	2045		
25	2046	8741499.096	395644.6224	3550656.867		12687800.59	25	2046	278980.1824		25	2046	3550656.867	
TOTAL		109000671.9	4913424.942	9874121.496		123808218.3	TOTAL		775823.8318		TOTAL		9874121.496	

RESULT

Assuming the ac to be a 3 star rated, its Energy Efficiency Ratio (EER)=2.7 cooling capacity of 1 ton is equal to 3.517 kW of power. From the above calculation we come to know that it takes 120 TR of air conditioning to remove the heat collected in the building per hour. For an 1 TR AC, the monthly cost would go up to Rs.1,382 considering that the AC runs for 8 hours a day, so the annual operation cost of running,57 TR of AC will be Rs. 1,990,080. Maintenance is 90% higher for the solid block system while compared with PVC panel system.

CHAPTER 5

CONCLUSION

RECOMMENDATIONS OF PVC WALL PANELING SYSTEM IN CONSTRUCTION SECTOR

Mass housing PVC panelling system are more cost efficient and economical. In this Construction we can reduce man power, cost and time of construction. The use of natural resources which are now day not easily available like river sand, water and agricultural land is used. It reduces adverse effects on environment. The building constructed using raw materials comes under green building categories as after constructing it energy requirement for heat insulation, sound insulation, humidity and temperature inside is less than conventional building. It is very effective technology to beat the current rising cost of construction. And the most important this new technology is having potential to provide shelter to the "HOMELESS INDIANS". Thereby reduce burning down of the environment and help to reduce global warming. The PVC panelling system is used also to protect the lives and properties of the people as these building will be resistant to natural disasters like earthquakes, cyclone, fire etc. This will also contribute to achieve the goal of much needed social inclusive development due to its various benefits and advantages with affordability for low income segments also.

ADVANTAGES OVER CONVENTIONAL BUILDING

Less embodied energy and carbon footprint: significant reduction in use of river sand water and cement, recycling of industrial waste PVC. Lower cost of structure, due to that we can save materials. Lower Building weight contributing to savings in foundation and reduction in design for earthquake forces, particularly in multi-storied construction. Buildings up to 8 – 15 storeys can be designed using this load – bearing system, without the need for beams and columns. The structure is light weight and accurate. The whole construction is economical, cost effective, PVC panel is the perfect choice for many insulation and construction lightweight, fast and economic construction.

CONCLUSION

From the analysis of the case studies conducted it was found that construction cost of 10.5% is saved while using conventional solid block system but when used in mass housing the cost saving will be more in PVC is efficient in mass housing. 70% time is saved compared to conventional building when PVC panels are used. Most time is saved during panelling work and concrete work in PVC panelling work. To conclude that, PVC panelling, this method of construction is an alternative and efficient solution for building construction techniques. Therefore this is the good solution for fast delivery of mass dwelling / housing is very critical for reducing huge urban housing shortage in india.