A Project report on

DESIGN PLANNING AND COST ESTIMATION OF SHOPPING COMPLEX IN CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT PARALAKHEMUNDI, GAJAPATI, ODISHA

To fulfilment of the requirement for award of the degree of

Bachelor of Technology
In
Civil Engineering

By

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Under the Esteemed Guidance of

Prof. BIKRAM NARAYAN

Department of Civil Engineering, CUTM, Paralakhemundi

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CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT

JAN-2025

CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT
Paralakhemundi, Odisha 761211

Department of Civil Engineering

CERTIFICATE

This is to certify that the project work entitled ***"Design Planning and Cost Estimation of Shopping Complex in Centurion University of Technology and Management, Gajapati District, Odisha"*** *is a Bonafide work of* ***Rahul Kumar (210101110009) Kaushal Kumar (210101110002) Arun Kumar (210101110003)****, submitted towards partial fulfilment of the requirements for the award of Bachelor of Technology in "CIVIL ENGINEERING" during the academic year2024- 2025.*

Certified that the above-mentioned project has been carried out as per the norms of the college and statutes of the university

Prof. Bikram Narayan(Asst. Prof.)
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CUTM, Paralakhemundi
(Supervisor)

Head of the Department
Dept. of Civil Engineering
CUTM, Paralakhemundi

External Examiner

ACKNOWLEDGEMENT

With great solemnity and sincerity, we offer our profuse thanks to **Centurion University of Technology and Management** for providing all the resources to complete my project successfully.

We wish to express my deep sense of gratitude to **Prof. Bikram Narayan,** Department of Civil Engineering, CUTM PKD for his wholehearted co-operation, unfailing inspiration and valuable guidance. Throughout the project work, his useful suggestions, constant encouragement has given a right direction and shape to my learning. Really, we are indebted to his for his excellent and enlightened guidance.

We consider OUR privilege to express deepest gratitude to **Prof. Bikram Narayan** Department of Civil Engineering, CUTM PKD for his valuable suggestions and constant motivation that greatly helped the project work to get successfully completed.

It is our pleasure to acknowledge the help and support of all the teaching and Non-teaching faculty of Civil Department. We thank all those who contributed directly or indirectly in successfully carrying out this work.

Rahul Kumar

Arun Kumar

Kaushal Kumar

DECLARATION

We hereby declare that this thesis entitled ***"Design Planning and Cost Estimation of Shopping Complex in Centurion University of Technology and Management Paralakhemundi, Gajapati, Odisha"*** is entirely original and has been carried out in the Department of Civil Engineering, Centurion University of Technology & Management. This is being submitted in partial fulfillment for the award of Degree of Bachelor of Technology in Structural Detailing and Drawing from Centurion University of Technology & Management, Paralakhemundi, Odisha.

We hereby state that this report is not submitted to any other College/University or published at any time before.

Rahul Kumar

Arun Kumar

Kaushal Kumar

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CHAPTER-1
INTRODUCTION

A Master Plan has been prepared by the 8th Semester Group – 2 students of Civil Engineering, Department of Civil Engineering, Centurion University (CUTM), Paralakhemundi, Gajapati, Odisha "**Design Planning and Cost Estimation of Shopping Complex** in Centurion university of Technology and management, Paralakhemundi.

Master plan for the total site area of 1 acres accommodates

Shopping complex Building with a total **Built-Up Area (BUA)** of 2437.8 Sq. meter. with associated infrastructure including parking apace at the ground floor of Shopping Complex.

The proposed Shopping Complex Building will be Variety of stores under one roof, Good selection of merchandise, Sales and discounts, Entertainment and dining options, in the Paralakhemundi Campus. Various Design Considerations for the proposed building are furnished hereinafter in this Design Basis Report.

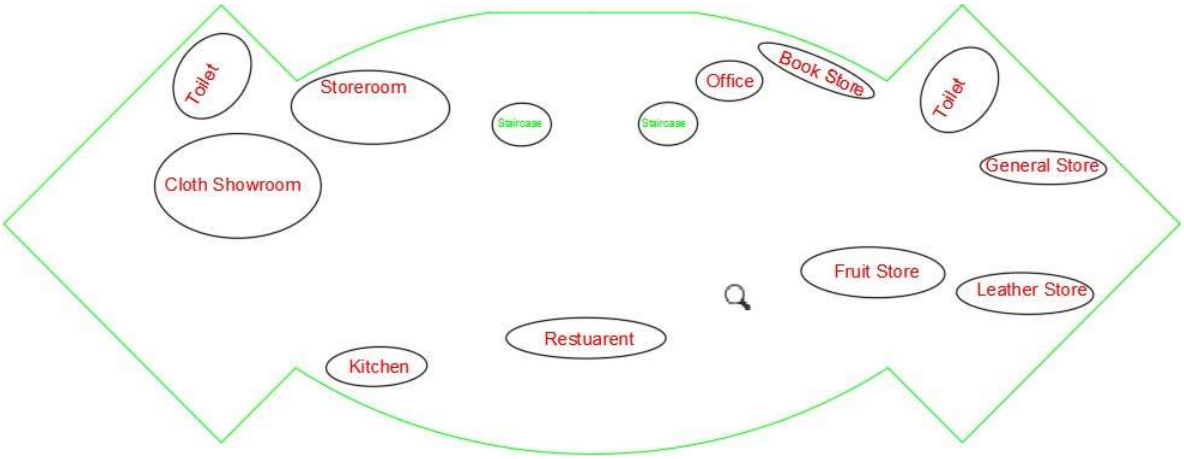
1.1 Scope and Objective of Shopping Complex

- To Design Plan and Cost Estimation of a Shopping Complex in Centurion University of Technology and Management, Paralakhemundi Campus.
- Shopping Complex consisting of Cloth Showroom, Restaurant, General Store, Fruit Store etc. Having attached Balcony, Toilet and Bath on each floor.
- Buildings are mainly made up of RCC foundation, RCC frame structure.
- Shopping Complex GF- Interior finishes considered for Car Park Areas & Driveways, Lift Lobby and Stairs.
- The role of the Shopping Centre as a business place is to provide a better place for retailers in terms of attractiveness of the location, its catchments of population, accessibility, parking facilities and the quality of the shopping environment.

CHAPTER – 2
BUILDING DESIGN APPROACH

2.1 Shopping Complex:

- Efficient functions of Shopping Complex are served by two type of main accesspoints located at the center of the Building.
- The East Wing and West Wing are separated by a central core area consisting of one staircase and on lift for vertical communication.
- Common spaces (Waiting Hall) are available at the two side of central core area for both the staff as well as for the guests.
- The building is divided mainly into six parts having Cloth showroom, Staircase, Restaurant, General store etc. ineach part.
- As per NBC manual the building has open spaces, balconies for natural ventilation and lighting purpose.
- This building is located in North – East direction having balconies and ventilators for natural lighting and air circulation purpose.
- a large retail complex containing stores and restaurants in adjacent buildings or in a single large building.



PLAN FOR SHOPPING COMPLEX

Figure – 1: Shows the desired linkage between the functional spaces of SC

2.2 Salient Features:

2.2.1 Shopping Complex

Utility of building: Residential Building
No of stories: G + 2
Shape of the building: Rectangular
Built Up Area: 2437.8 Sq. M
No of staircases: 02
No of lifts: 01
Type of construction: R.C.C framed structure
Types of walls: brick wall (0.3 m thick)
Ground floor: 3m (Parking)
Floor to floor height: 3m.
Height of plinth: 0.6m
Depth of foundation: 1500mm

Materials:

Concrete grade: M40
All steel grades: Fe415 grade
Bearing capacity of soil: 300KN/M2

CHAPTER – 3
BUILDING DRAWINGS BY USING AUTOCAD AND SKETCH UP

3.1 Shopping Complex

3.1.1 Plan:

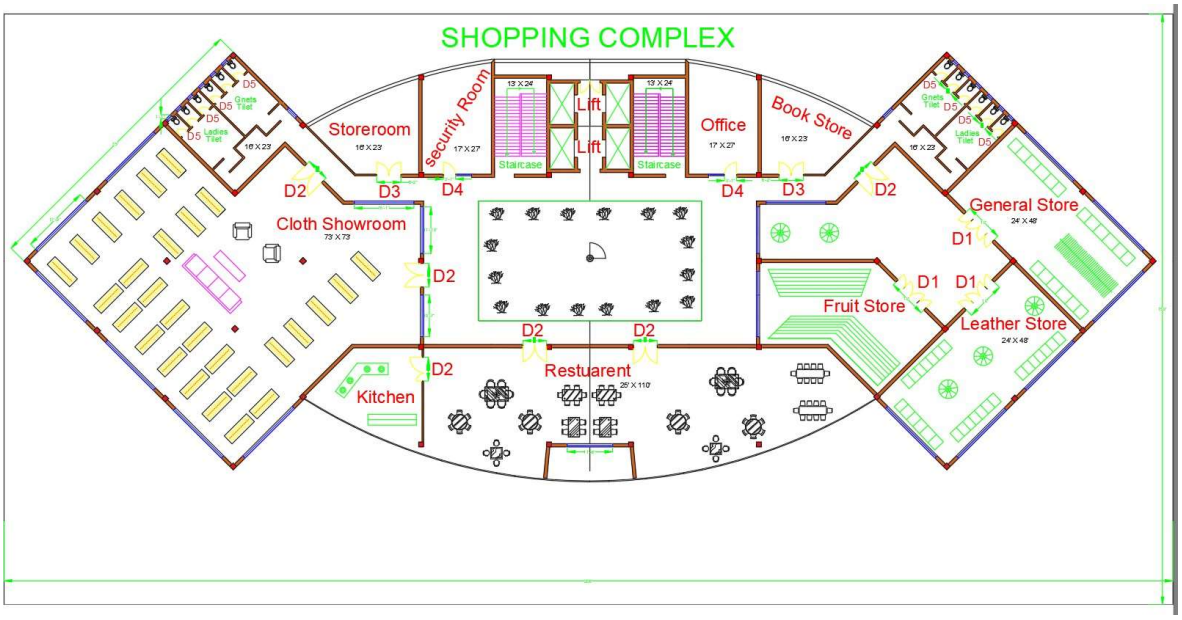


FIG.2:- S.C PLAN

ALL DIMENSIONS IN FEET

Sl.No.	Name	Notation	Dimension	Description
1	Door	D1	7’ X 10’	Glazed Glass
2	Door	D2	7’ X 6’	Glazed Glass
3	Door	D3	7’ X 6’2”	Glazed Glass
4	Door	D4	7’ X 3’1”	Glazed Glass

Sl.No.	Name	Notation	Dimension	Description
1	Window	W1	7’ X 17’9”	Glazed Glass
2	Window	W2	7’ X 17’ 2”	Glazed Glass
3	Window	W3	7’ X 15’1”	Glazed Glass
4	Window	W4	4’ X 11’10”	Glazed Glass
5	Window	W5	1’ X 1’1”	Ventilation

Centurion University	Project: Domain Project				
Drawing Title	All floor Plan		Fig. No.	01&02	
Date		Scale		Drawn By	Gr-2
Drawing No.	01	Approved By	Prof. Bikram Narayan		

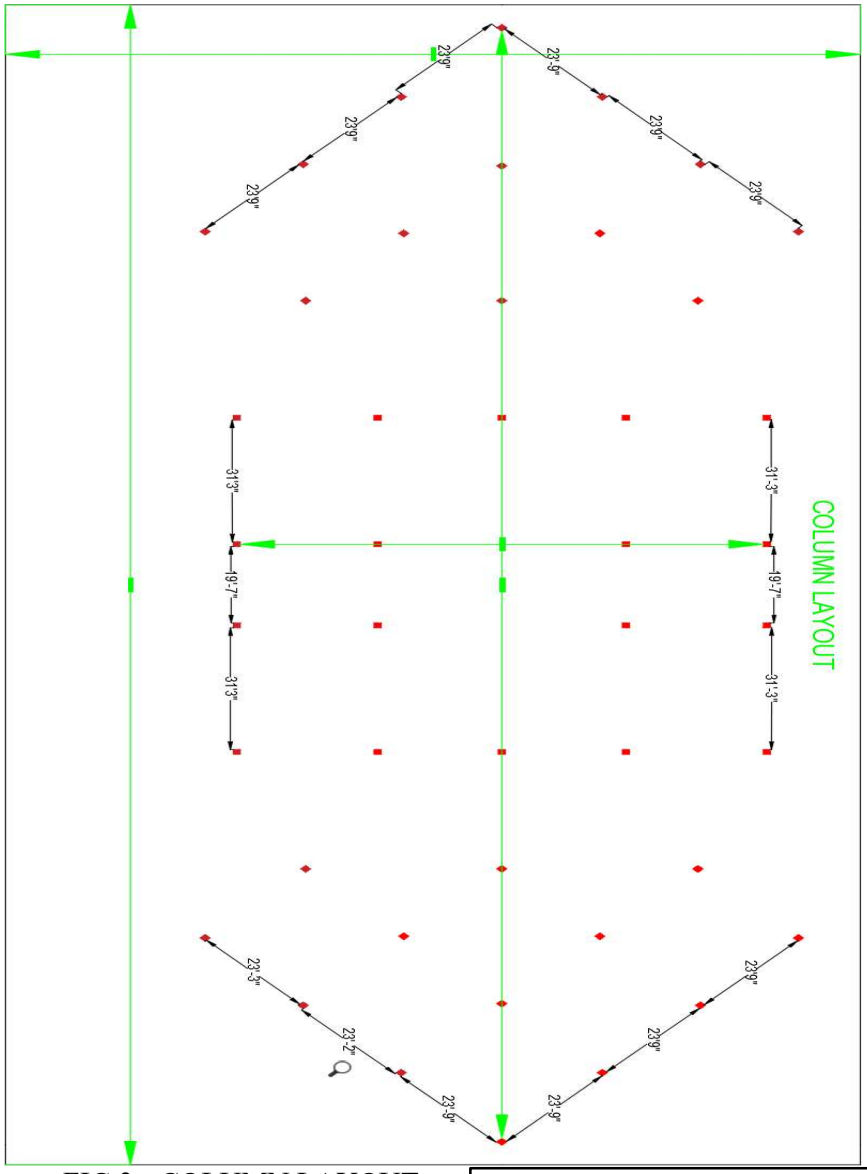


FIG.3:- COLUMN LAYOUT

NOTE:

ALL DIMENSIONS ARE IN FEET

Centurion University	Project: Domain Project				
Drawing Title	Column Plan		Fig. No.	03	
Date		Scale		Drawn By	Gr-2
Drawing No.	01	Approved By	Prof. Bikram Narayan		

3.1.2 Section

FIG. 4:- SECTION VIEW

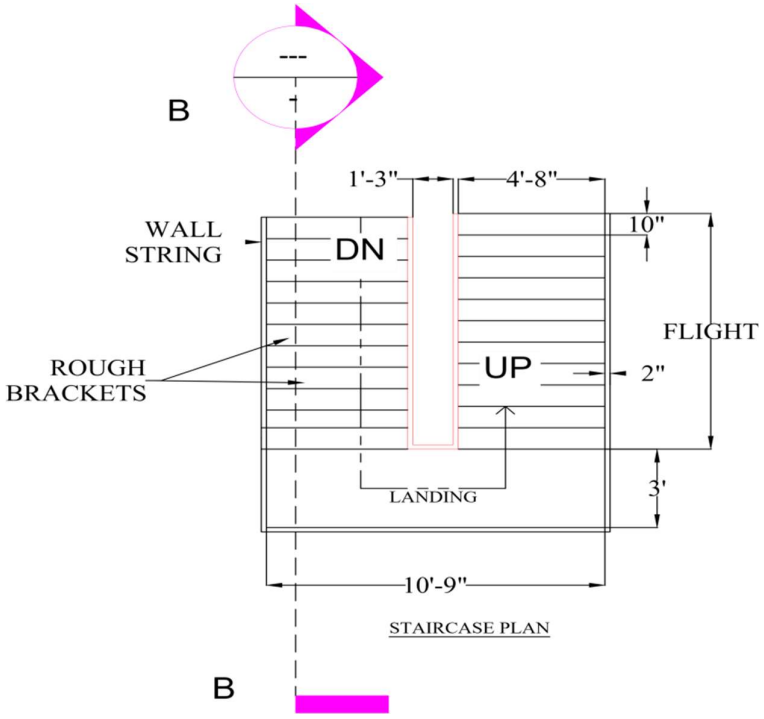
SECTION M - N

NOTE:
GL – Ground Level
PL - Plinth Level
FFFL - First Floor Finish Level
PCC - Plain Cement Concrete
SS – Stainless Steel
RCC - Reinforce Cement Concrete

NOTE:
ALL DIMENSIONS ARE IN FEET

Centurion University	Project: Domain Project			
Drawing Title	SECTION M-N	Fig. No.	4	
Date		Scale	Drawn By	Gr-2
Drawing No.	02	Approved By	Prof. Bikram Narayan	

3.1.1 Staircase Plan & Section



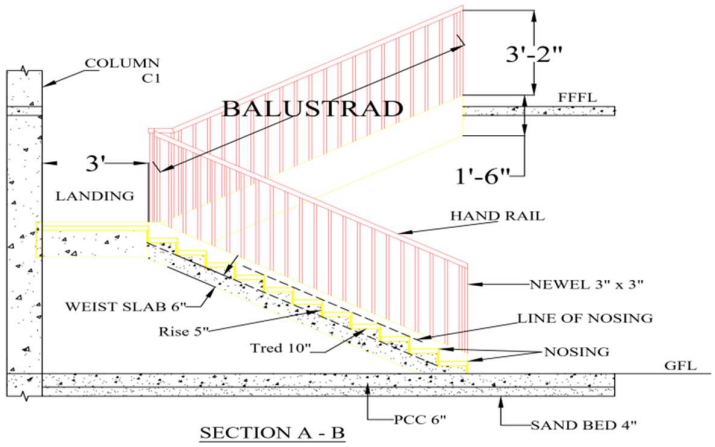


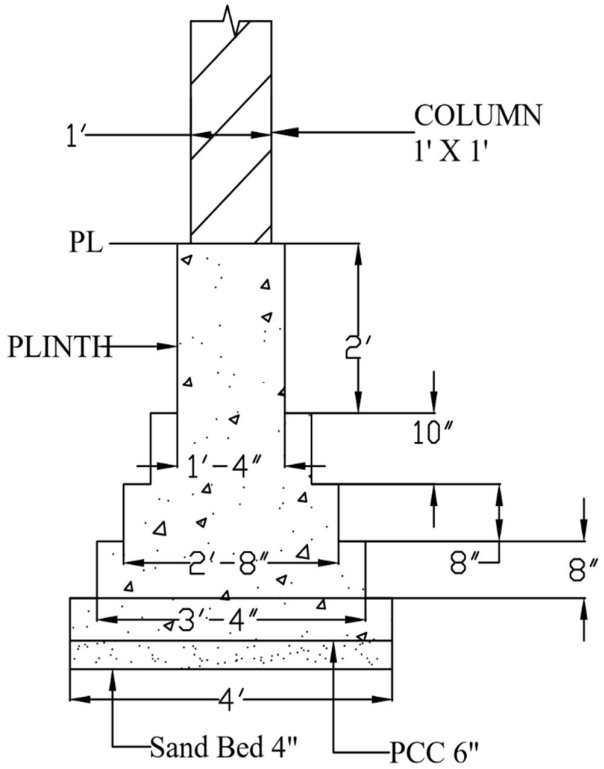
FIG.5:- STAIRCASE ELEVATION

NOTE:

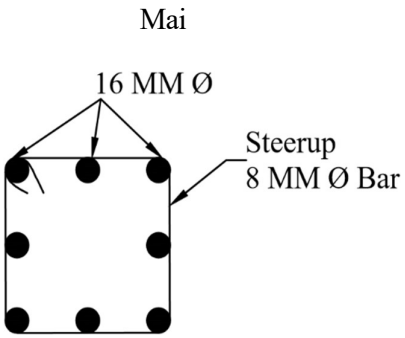
ALL DIMENSIONS ARE IN FEET

Centurion University	Project: Domain Project				
Drawing Title	Staircase			Fig. No.	5
Date		Scale		Drawn By	Gr-2
Drawing No.	02	Approved By	Prof. Bikram Narayan		

3.1.2 Footing Plan & Section



21- SECTION



22- COLUMN REINFORCEMENT

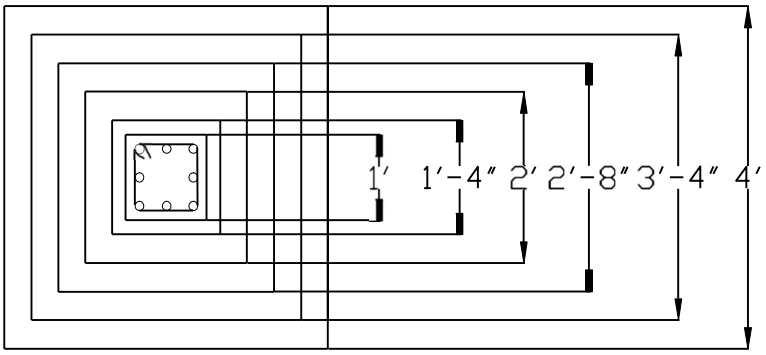


FIG.6:- COLUMN SECTION

Centurion University	Project: Domain Project				
Drawing Title	FOOTING		Fig. No.	6	
Date		Scale		Drawn By	Gr-2
Drawing No.	02	Approved By	Prof. Bikram Narayan		

NOTE:
ALL DIMENSIONS ARE IN FEET

3.1.3 Elevations:

FIG.7: – **FRONT ELEVATION**

FIG.8:- **BACK ELEVATION**

FIG.9:- **SIDE ELEVATION**

Centurion University

Project: Domain Project

Drawing Title	ELEVATIONS	Fig. No.	7, 8 & 9
Date		Scale	
Drawn By	Gr-2		
Drawing No.	02	Approved By	Prof. Bikram Narayan

CHAPTER-4
DESIGN OF THE ASSIGNED BUILDING BY STAAD PRO.

4.1 Assumptions and Notations used:

The notations adopted throughout the work is same IS-456-2000.

4.2 Assumptions in Design:

- Using partial safety factor for loads in accordance with clause 36.4 of IS-456-2000 as ϒt=1.5
- Partial safety factor for material in accordance with clause 36.4.2 is IS-456-2000 is taken as 1.5 for concrete and 1.15 for steel.
- Using partial safety factors in accordance with clause 36.4 of IS-456-2000 combination of load.

D.L+L.L. 1.5

D.L+L.L+W.L 1.2

4.3 Density of materials used:

- Plain concrete 24.0KN/m3
- Reinforced 25.0KN/m3
- Flooring material(c.m) 20.0KN/m3
- Brick masonry 19.0KN/m3
- Fly ash 5.0KN/m3

4.4 Live Loads: In accordance with IS. 875-86

- Live load on slabs = 20.0KN/m2
- Live load on passage = 4.0KN/m2
- iii)Live load on stairs = 4.0KN/m2

4.5 Design Constants:

Using M40 and Fe 415 grade of concrete and steel for beams, slabs, footings, columns.

Therefore:-

fck = Characteristic strength for M40-40N/mm2

fy = Characteristic strength of steel-415N/mm2

4.6 Assumptions Regarding Design:

- Slab is assumed to be continuous over interior support and partially fixed on edges, due to monolithic construction and due to construction of walls over it.
- Beams are assumed to be continuous over interior support and they frame in to the column at ends.

4.7 Assumptions on Design:

- M40 grade is used in designing unless specified.
- Tor steel Fe 415 is used for the main reinforcement.
- Tor steel Fe 415 and steel is used for the distribution reinforcement.
- Mild steel Fe 250 is used for shear reinforcement.

4.8 Design of multi storied residential building:

4.8.1 General:

A structure can be defined as a body which can resist the applied loads without appreciable deformations.

Civil engineering structures are created to serve some specific functions like human habitation, transportation, bridges, storage etc. in a safe and economical way. A structure is an assemblage of individual elements like pinned elements (truss elements), beam element, column, shear wall slab cable or arch. Structural engineering is concerned with the planning, designing and thee construction of structures.

Structure analysis involves the determination of the forces and displacements of the structures or components of a structure. Design process involves the selection and detailing of the components that make up the structural system.

The main object of reinforced concrete design is to achieve a structure that will result in a safe economical solution.

4.8.2 The Objective of the Design is

- Foundation design
- Column design
- Beam design
- Slab design

These all are designed under limit state method

4.9 Limit state method:

The object of design based on the limit state concept is to achieve an acceptability that a structure will not become unserviceable in its life time for the use for which it is intended. i.e. it will not reach a limit state. In this limit state method all relevant states must be considered in design to ensure a degree of safety and serviceability.

Limit state:

The acceptable limit for the safety and serviceability requirements before failure occurs is called a limit state.

Limit state of collapse:

This is corresponds to the maximum load carrying capacity.

Violation of collapse limit state implies failures in the source that a clearly defined limit state of structural usefulness has been exceeded. However it does not mean complete collapse.

This limit state corresponds to:

- Flexural
- Compression
- Shear
- Torsion

Limit state of survivability:

This state corresponds to development of excessive deformation and is used for checking member in which magnitude of deformations may limit the rise of the structure of its components.

- Deflection
- Cracking
- Vibration

4.10 STAAD

Staad is powerful design software licensed by Bentley. Staad stands for structural analysis and design

Any object which is stable under a given loading can be considered as structure. So first find the outline of the structure, whereas analysis is the estimation of what are the type of loads that acts on the beam and calculation of shear force and bending moment comes under analysis stage. Design phase is designing the type of materials and its dimensions to resist the load. This we do after the analysis.

To calculate s.f.d and b.m.d of a complex loading beam it takes about an hour. So when it comes into the building with several members it will take a week. Staad pro is a very powerful tool which does this job in just an hour's staad is a best alternative for high rise buildings.

Now a day's most of the high rise buildings are designed by staad which makes a compulsion for a civil engineer to know about this software.

These software can be used to carry rcc, steel, bridge, truss etc according to various country codes.

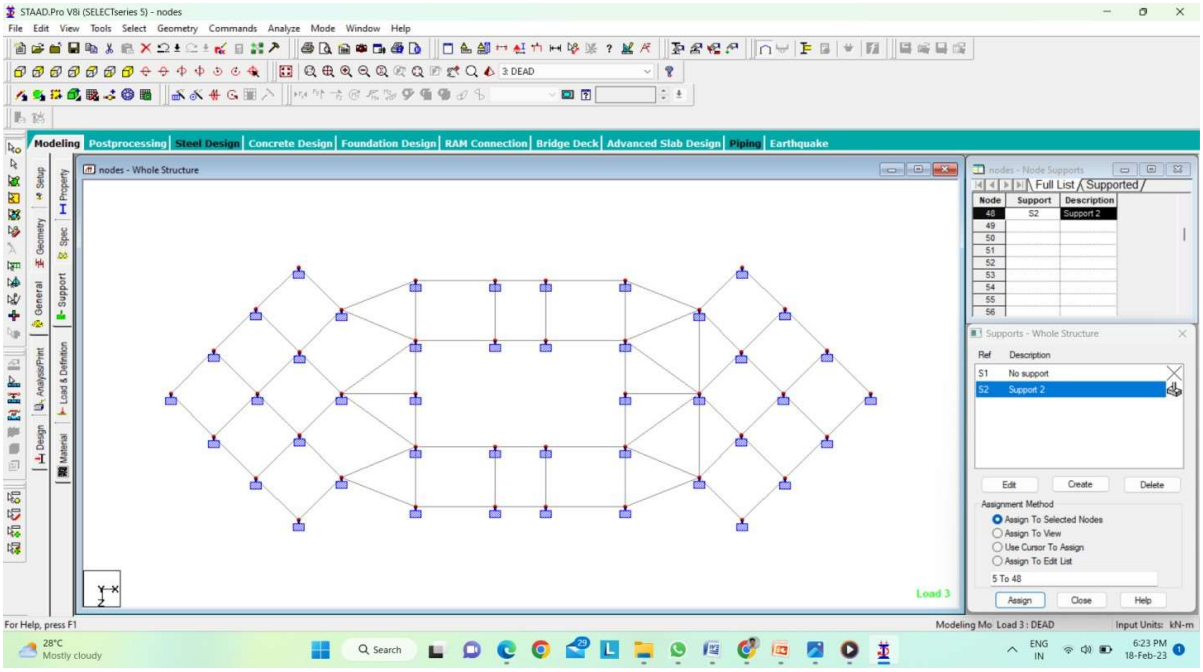


FIG -10:- Centerline Diagram of Shopping Complex

The above figure represents the center line diagram of our building in staad pro. Each support represents the location of different columns in the structure. This structure is used in generating the entire structure using a tool called transitional repeat and link steps. After using the tool the structure that is created can be analyzed in staad pro under various loading cases.

Below figure represents the skeletal structure of the building which is used to carry out the analysis of our building.

All the loadings are acted on this skeletal structure to carry out the analysis of our building.

This is not the actual structure but just represents the outline of the building in staad pro.

A mesh is automatically created for the analysis of these building.

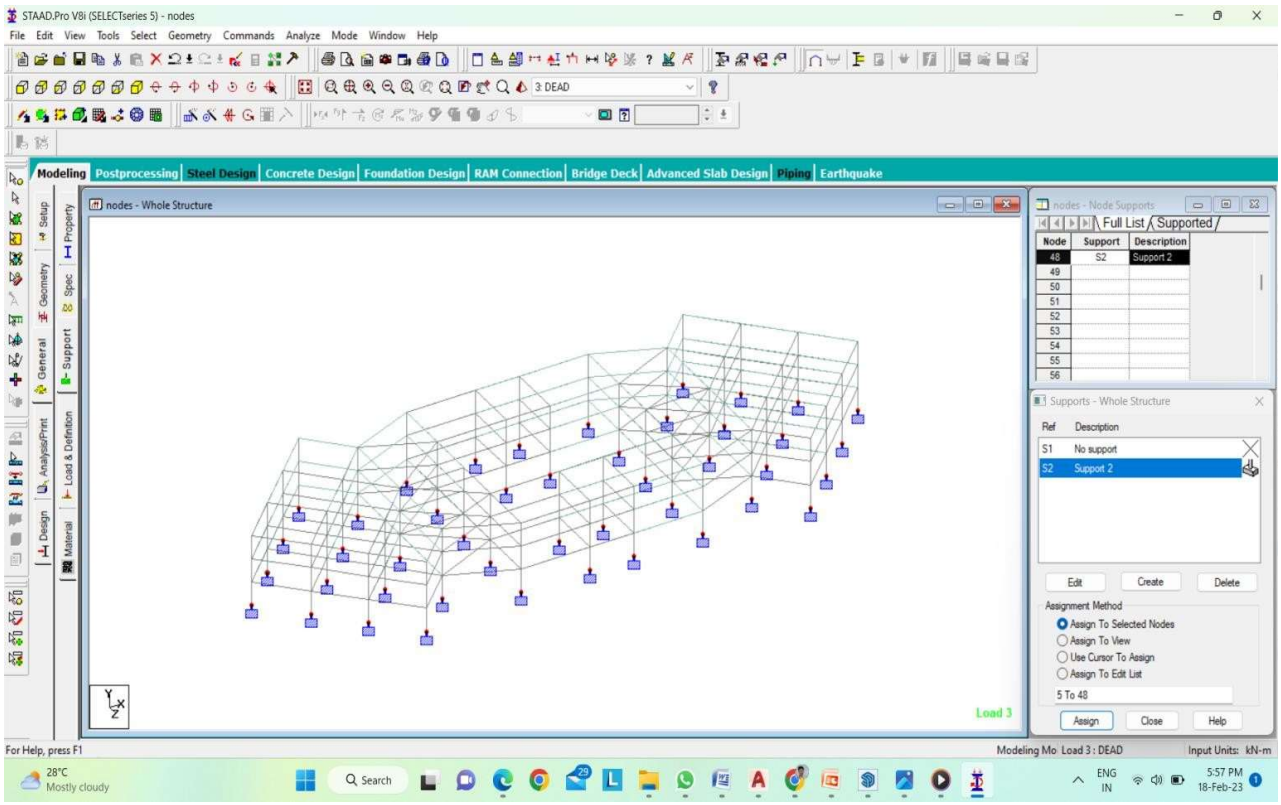


Fig.11:- Skeletal Structure of Shopping Complex

4.11 Design loads for residential buildings:

General

Loads are a primary consideration in any building design because they define the nature and magnitude of hazards are external forces that a building must resist to provide a reasonable performance(i.e., safety and serviceability)throughout the structure's useful life. The anticipated loads are influenced by a building's intended use (occupancy and function), configuration (size and shape) and location (climate and site conditions).Ultimately, the type and magnitude of design loads affect critical decisions such as material collection, construction details and architectural configuration.

Thus, to optimize the value (i.e., performance versus economy) of the finished product, it is essential to apply design loads realistically.

4.11.1 Seismic Loads:

The building can be seriously affected by the tectonic movement of the earth which is called as earth quake. This load is a kind of vibration load and its factor is variable according to the zone divided. In this software seismic load is applied

to the building as per the self-weight and zone of the area where the building is located.

Wind loads are calculated as per **IS 1893 - 2002**

4.11.2 Dead Loads:

Dead loads consist of the permanent construction material loads compressing the roof, floor, wall, and foundation systems, including claddings, finishes and fixed equipment. Dead load is the total load of all of the components of the components of the building that generally do not change over time, such as the steel columns, concrete floors, bricks, roofing material etc.

In staad pro assignment of dead load is automatically done by giving the property of the member.

In load case we have option called self-weight which automatically calculates weights using the properties of material i.e., density and after assignment of dead load the skeletal structure looks red in color as shown in the figure.

Dead load is calculated as per **IS 875 part 1**

4.11.3 Live Loads:

Live loads are produced by the use and occupancy of a building. Loads include those from human occupants, furnishings, no fixed equipment, storage, and construction and maintenance activities. As required to adequately define the loading condition, loads are presented in terms of uniform area loads, concentrated loads, and uniform line loads.

Live loads are calculated as per **IS 875 part 2**

4.11.4 Floor load:

Floor load is calculated based on the load on the slabs. Assignment of floor load is done by creating a load case for floor load.

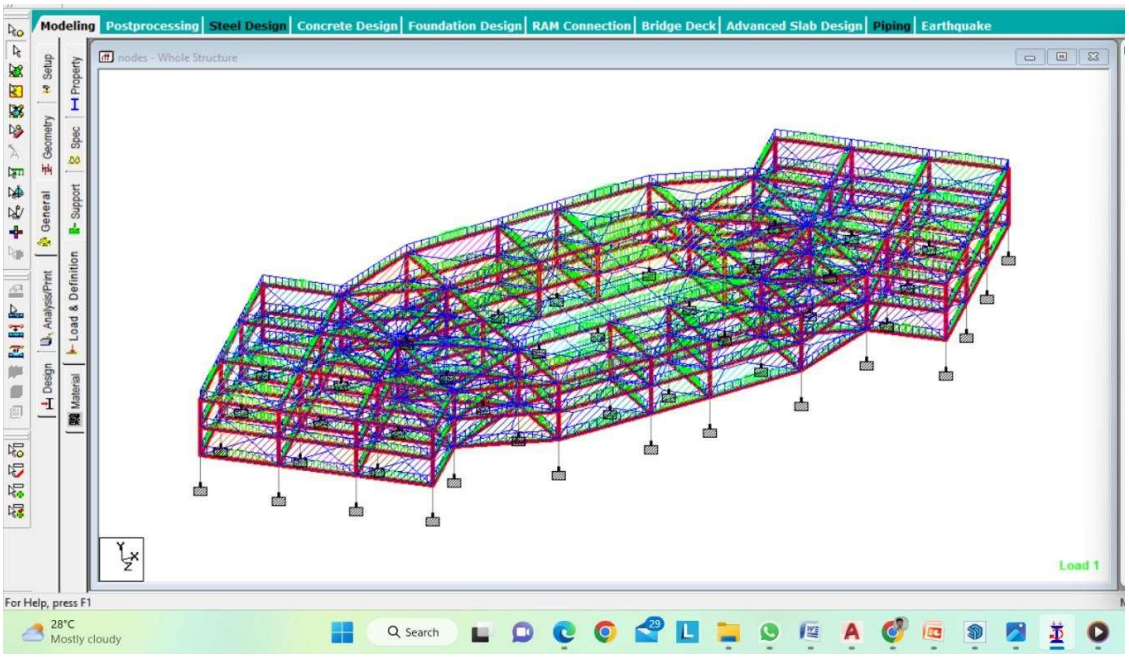


Fig.12:- Example of loads applied on the building

4.11.5 Wind loads:

In the list of loads we can see wind load is present both in vertical and horizontal loads.

This is because wind load causes uplift of the roof by creating a negative (suction) pressure on the top of the roof.

Wind loads are calculated as per **IS 875 part 3**

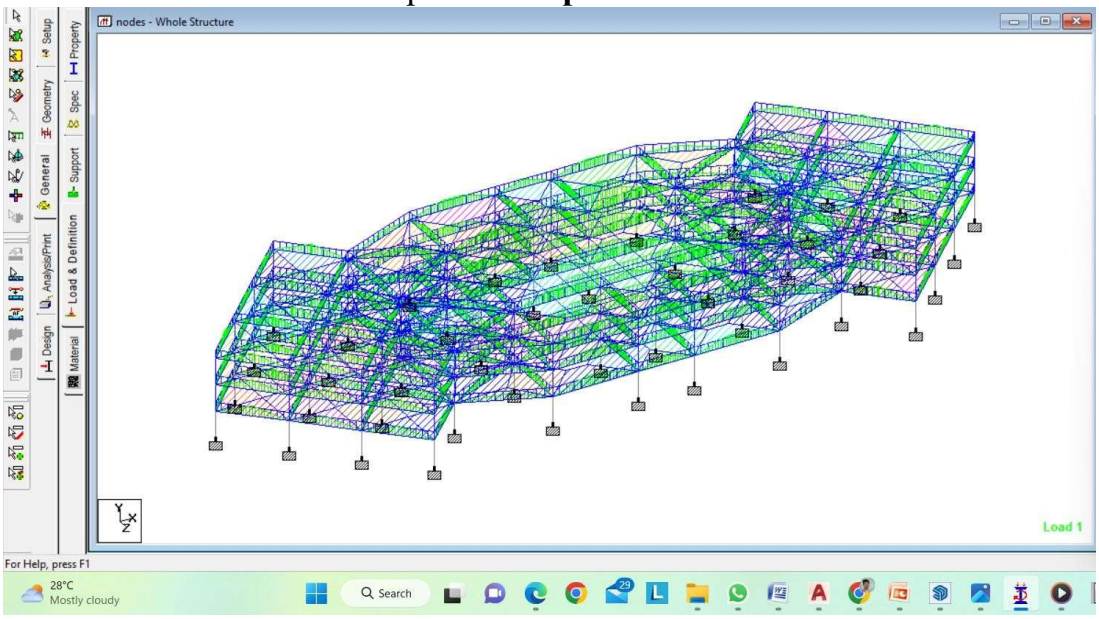


Fig.13:- Example of wind load applied on the building

4.11.6 Load combinations:

All the load cases are tested by taking load factors and analyzing the building in different load combination as per **IS456** and analyzed the building for all the load combinations and results are taken and maximum load combination is selected for the design

Load factors as per **IS456-2000**

Live Load	Dead Load	Wind Load
1.5	1.5	0
1.2	1.2	1.2
0.9	0.9	0.9

When the building is designed for both wind and seismic loads maximum of both is taken. Because wind and seismic do not come at same time as per code.

Structure is analyzed by taking all the above combinations.

4.12 Beams:

Beams transfer load from slabs to columns. Beams are designed for bending.

In general we have two types of beam: single and double. Similar to columns geometry and perimeters of the beams are assigned. Design beam command is assigned and analysis is carried out, now reinforcement details are taken.

Different beam designs are obtained as per safe to failure region.

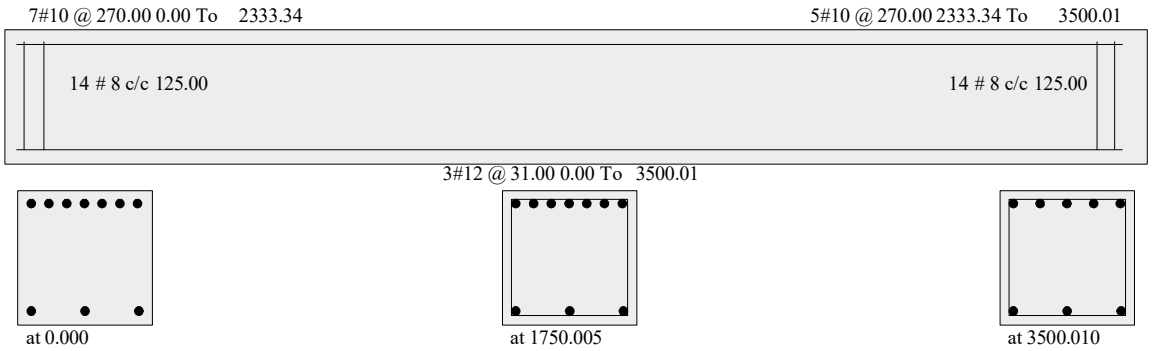
Some beams of Staff quarter are given below.

Software licensed to Hewlett-Packard	Job No **01**	Sheet No **1**	Rev
	Part		
Job Title: Shopping Complex	Ref		
	By Er. Chitranjan Date 24-Dec-22 Chd Dr. Rajiv Kumar Majhi		
Client CUTM	File Shopping Complex	Date/Time 26-Dec-2022 12:30	

STAAD.Pro Query Concrete Design

Beam no. 130

Design Code: IS-456



Design Load

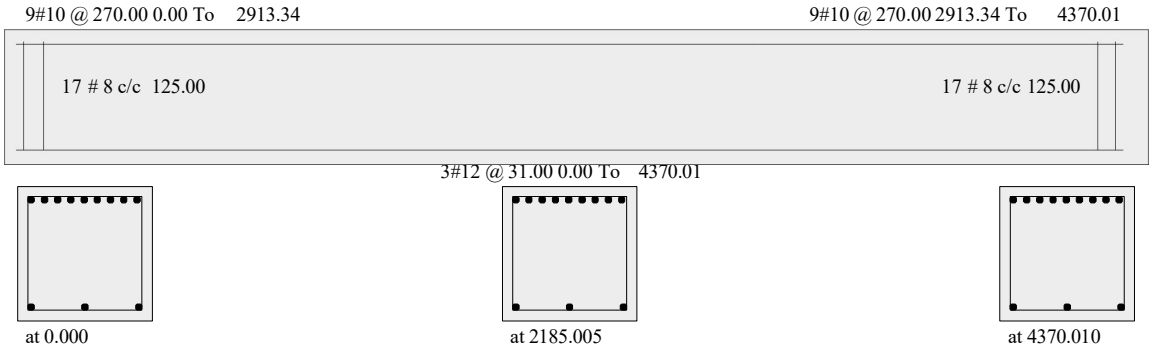
Mz(Kn Met)	Dist. et	Load
17.190001	1.800000	30
-48.310001	0.000000	32
-33.270000	3.500000	30

Design Parameter

Fy(Mpa)	415.000000
Fc(Mpa)	40.000000
Depth(m)	0.299999
Width(m)	0.299999
Length(m)	3.500003

Beam no. 90

Design Code: IS-456



Design Load

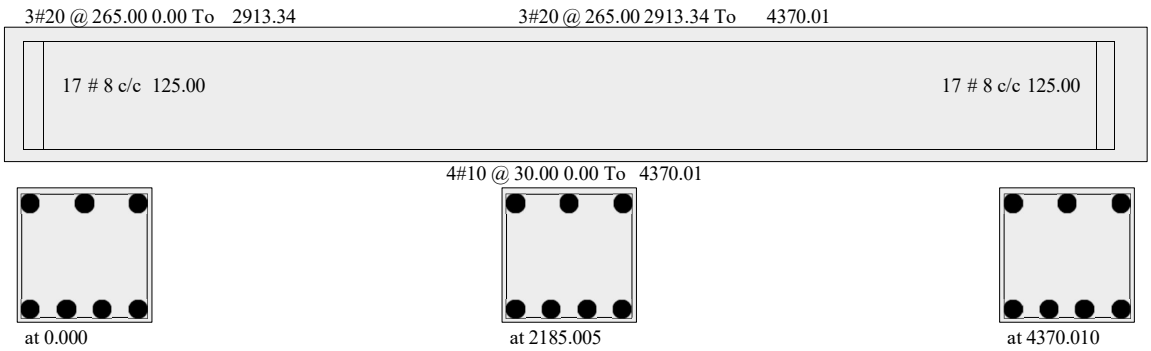
Design Parameter

Mz(Kn Met)	Dist. et	Load
29.290001	2.200000	29
-57.380001	0.000000	32
-59.279999	4.400000	30

Fy(Mpa)	415.000000
Fc(Mpa)	40.000000
Depth(m)	0.299999
Width(m)	0.299999
Length(m)	4.370001

Beam no. 43

Design Code: IS-456



Design Load

Mz(Kn Met)	Dist. et	Load
27.799999	2.200000	32
-55.349998	0.000000	32
-54.860001	4.400000	30

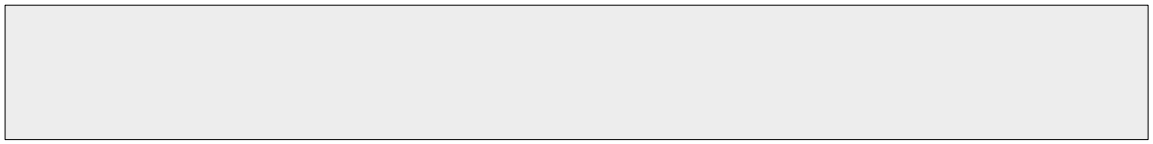
Design Parameter

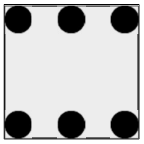
Fy(Mpa)	415.000000
Fc(Mpa)	40.000000
Depth(m)	0.299999
Width(m)	0.299999
Length(m)	4.370001

Beam no. 132

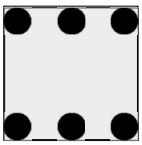
Design Code: IS-456

3#16 @ 267.00 0.00 To 2540.00 3#16 @ 267.00 2540.00 To 3810.00

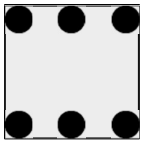




at 0.000



3#12 @ 31.00 0.00 To 3810.00
at 1905.000



at 3810.000

Mz(Kn Met)	Dist. et	Load
21.059999	1.900000	32
-37.240002	0.000000	32
-52.119999	3.800000	30

Design Load

Design Parameter

Fy(Mpa)	415.000000
Fc(Mpa)	40.000000
Depth(m)	0.299999
Width(m)	0.299999
Length(m)	3.809994

4.13 Columns:

A column or strut is a compression member, which is used primary to support axial compressive loads and with a height of at least three it is least lateral dimension.

A reinforced concrete column is said to be subjected to axially loaded when line of the resultant thrust of loads supported by column is coincident with the line of C.G 0f the column I the longitudinal direction.

Depending upon the architectural requirements and loads to be supported, R.C columns may be cast in various shapes i.e square, rectangle, and hexagonal, octagonal, circular. Columns of L shaped or T shaped are also sometimes used in multistoried buildings.

The longitudinal bars in columns help to bear the load in the combination with the concrete. The longitudinal bars are held in position by transverse reinforcement, or lateral binders.

The binders prevent displacement of longitudinal bars during concreting operation and also check the tendency of their buckling towards under loads.

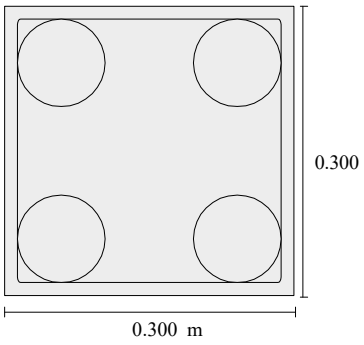
4.13.1 Positioning of columns:

Some of the guiding principles which help the positioning of the columns are as follows:-

- Columns should be preferably located at or near the corners of the building and at the intersection of the wall, but for the columns on the property line as the following requirements some area beyond the column, the column can be shifted inside along a cross wall to provide the required area for the footing with in the property line. Alternatively a combined or a strap footing may be provided.
- The spacing between the columns is governed by the lamination on spans of supported beams, as the spanning of the column decides the span of the beam. As the span of the of the beam increases, the depth of the beam, and hence the self-weight of the beam and the total.

4.13.2 Different types of column design are mentioned below:

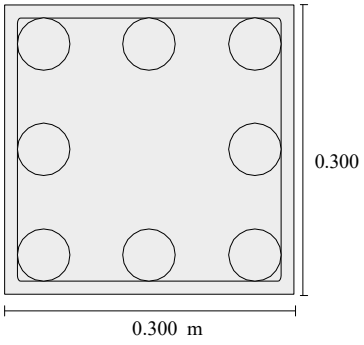
Design Code: IS-456



Load	1
Location	End 1
Pu(Kns)	-49.750000
Mz(Kns-Mt)	13.780000
My(Kns-Mt)	0.910000

Fy(Mpa)	415
Fc(Mpa)	40
As Reqd(mm²)	720.000000
As (%)	0.894000
Bar Size	16
Bar No	4

Design Code: IS-456



Fy(Mpa)	415
Fc(Mpa)	40
As Reqd(mm²)	864.000000
As (%)	1.005000
Bar Size	12
Bar No	8

Load	2
Location	End 2
Pu(Kns)	-80.150002
Mz(Kns-Mt)	0.130000
My(Kns-Mt)	26.129999

4.14 Output:

Due to very huge and detailed explanation of staad output for each and every column and beam we have attached the detailed report separately and mentioned the concrete and steel quantity below.

Concrete and steel calculation of Shopping Complex.

TOTAL VOLUME OF CONCRETE = 396.8 CU.METER

BAR DIA (in mm)	WEIGHT (in New)
8	109649
10	45684
12	95312
16	99107
20	5545
*** TOTAL=	355297

CHAPTER-5
DESIGN OF SLAB

5.1 Slab design:

Slab is plate elements forming floor and roofs of buildings carrying distributed loads primarily by flexure.

5.2 One way slab:

One way slab are those in which the length is more than twice the breadth it can be simply supported beam or continuous beam.

5.3 Two way slab:

When slabs are supported to four sides two ways spanning action occurs. Such as slab are simply supported on any or continuous or all sides the deflections and bending moments are considerably reduces as compared to those in one way slab.

5.4 Checks:

There is no need to check serviceability conditions, because design satisfying the span for depth ratio.

- Simply supported slab
- Continuous beam

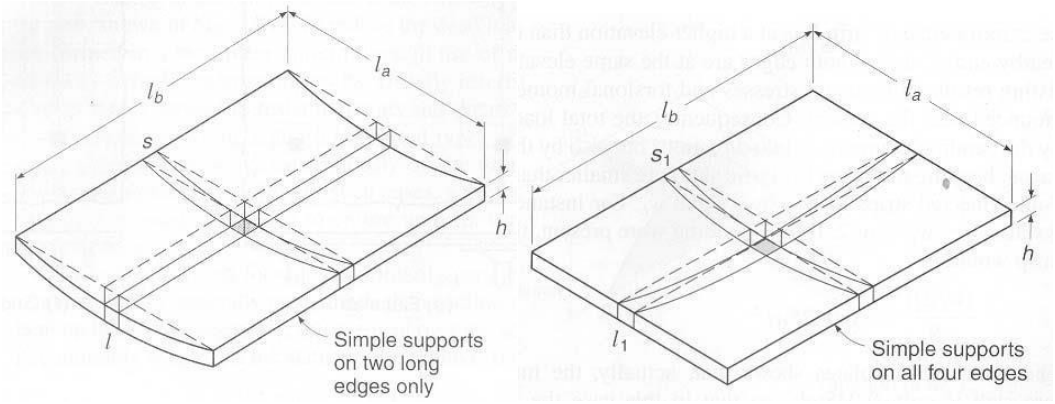


Fig.14:- Diagrams of slab deflection in one way and two way slabs

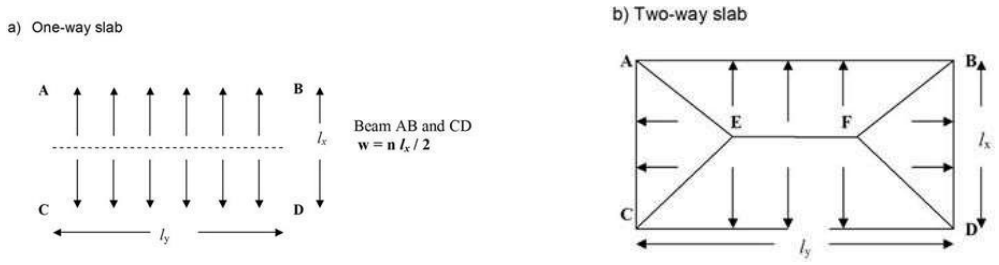


Fig. – 10 Diagram of load distribution of one way and two way slabs

Slabs are designed for deflection. Slabs are designed based on yield theory

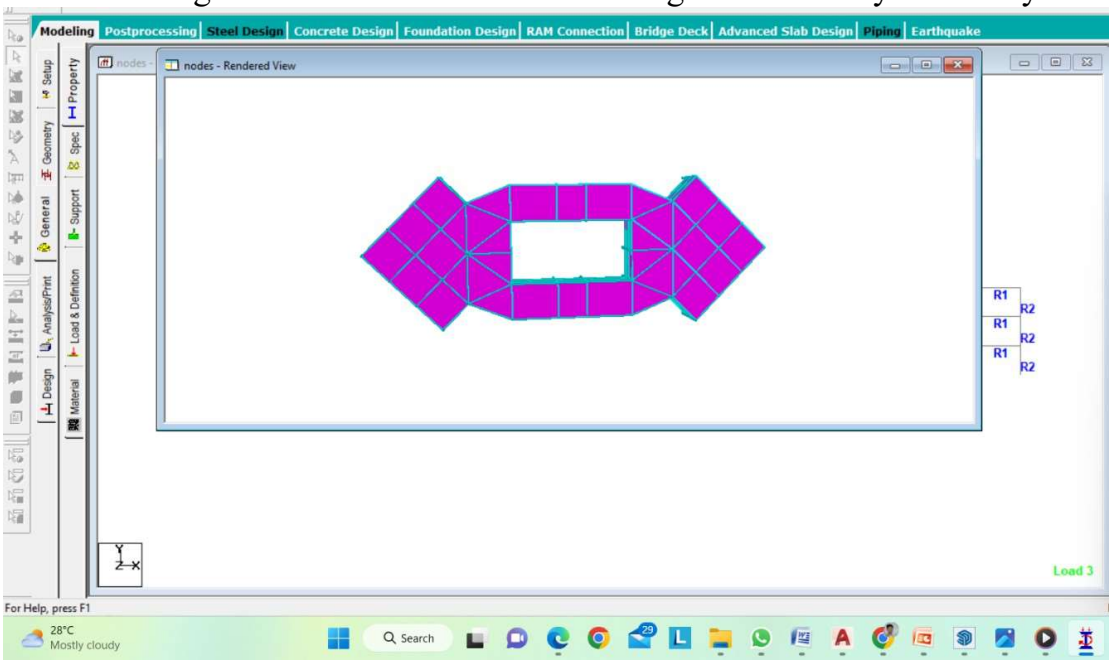


Fig.15:- Diagram shows the distribution of loads in slab.

5.5 Design of slabs:

Size: 3.88m x 3.53m

End conditions for slab:

Adjacent long and short sides are continuous and other edges discontinuous.

Assuming the thickness of slab as 120 mm.

Calculation of loads:

Live load:

For residential building live load is usually taken as 2 kN/sq.m. (in accordance with 875 part II)

Dead load:

Self-weight of slab = 1x1x0.12x25 = 3.0 KN/m2

Weight of flooring (75mm thick) = 1x1x0.005x20 = 1.0 KN/m2

Accidental loads = 1.0 KN/m2 = 1.0 KN/m2

5.0 KN/m2

Live load:

Live load is taken = 2.0 KN/m2

Total load = 2 + 5.0 KN/m2

Factored load = 1.5x7.0 KN/m2

Design load = 10.5 KN/m2

Calculation of moments:

(As per Table 12 of IS 456-2000)

Bending moment coefficients for slab:

Dead load and super imposed load

Near the middle

End of span +1/12

At support next to

End support -1/10

Positive bending moment at mid span = wl2/12

Mu = 10.5x (3.88)2/12

= 13.17KNm

Negative bending moment at support = -10.5x (3.88)2/10

= 15.8KNm

Design bending moment = 15.8KNm

Calculation of effective depth:

Adopting M30 concrete and Fe 415 steel

As per IS 456-2000(Annexure G)

Mu,limit =0.36xXumax/d(1-0.42Xumax/d)bd2fck

=0.36x0.46 (1-0.42x0.48) bd2x30
Xumax/d =0.48
Mulimit =4.13bd2
Assuming b =1000mm
Mu =Mulimit
d =√15.8x106/ (4.13x1000)
=61.852mm
Adopting 8-mm dia bars as reinforcement
Effective cover = 15+10/2 =20mm
Over all depth = D =61.852+20=81.852
Therefore providing overall depth D = 120mm
Effective depth d = 120-20=100mm
Calculation of steel: (MAIN REINFORCEMENT)
Form IS 456-2000(Annexure G)
Mu =0.87xfyxAstxd (1-fyxAst/bdfck)
15.8 =0.87x415x100xAst (1-415xAst/ (1000x100x30)
Ast =437.6mm2
Providing minimum steel of =0.12%xbxD=144mm2
Spacing of 10mm dia bars = (astx1000)/Ast
= (Πx102x1000)/ (4x437.6)
=179.47mm c/c
As per IS 456 2000, clause 26.3.3b, the spacing of Reinforcement should be not more than least of following
1. 3xeffective depth =3x100 =300mm
2. 300mm
Provide 10 mm Φ bars @ 175 mm.
Distribution reinforcement:
As per IS 456-2000(clause: 26.5.2.1)
Providing 0.12% of gross area as distribution reinforcement
Area of steel = (0.12x120x1000)/100 =144mm2
Adopting 6mm Φ bars as distribution reinforcement
Spacing = (astx1000)/Ast
= (Π/4x62x1000)/144
=196.35mm c/c
Provide 6mm Φ bars @ 180mm c/c
Check for development length:
As per IS 456-2000(clause 26.2.1)

The development length Ld is given by

Ld = Φσst/4 ᵗbd

= (10x0.87x415)/ (4x1.2x1.6)

= 470.11 mm (req.)

Ld(available) = MI/V+L0

M1 = 0.87xfyxAstxd (1-fyxAst/bdfck)

= 0.87x415x437x100 (1-437x415/ (1000x100x30)

= 14.82x106N-mm

Shear force at the section due to design loads

V = W1/2 = 10.5x3.88/2

= 20.37

M1/V+L0 = 14.82/20.37 +L0

= 0.727m + L0

=727mm +L0

Ld(available)>Ld(req'd) safe

CHAPTER-6
PROJECT SCHEDULING

6.1 General Introduction

The construction industry today has been built on the need of the world's inhabitants to provide shelter, harness energy, and create public access. The basic human need have not changed over time even though the process and environment in which designer or constructor operate have becoming increasingly more complicated. Rapidly escalating technology has made possible structure and processes unimaginable even from generation to generation.

By looking for the expenditure of the constructions industry, the project management profession is being very valuable for the construction companies in order to make sure the project that currently running can be completed successfully. The project management knowledge becomes the critical part in the project because it contains the knowledge in controlling the cost, scheduling, and resources. In this project management field, project manager plays very important role in the construction project. Project manager is responsible personnel to ensure the project complete successfully thus it are important for the project manager to have experience and knowledge in project management technique.

6.2 Objective and Approach

This project provides an introduction to the Principles of Construction Management with the focus primarily on the Scheduling and Cost Estimation aspects that govern the effective and timely delivery of projects. In order to further this understanding of the above mentioned, by a building studied. The project starts by giving a background to construction management and then moves on to define and broadly describe the following topics:

- WBS
- MS project
- Gantt Chart
- Network diagram

6.3 Work Breakdown Structure

A work breakdown structure (WBS) is a key project deliverable that organizes the team's work into manageable sections. The Project Management Body of Knowledge (PMBOK) defines the work breakdown structure as a "deliverable oriented hierarchical decomposition of the work to be executed by the project team." WBS helps to execute works in a logistic order that is surveying to completion of building construction as well as fix all building components. Work breakdown structure shows the constructional work from Sub Structure to Finishing of the building including land Scaping.

6.4 Ms Project

Microsoft Project is a project management software product, developed and sold by Microsoft. It is designed to assist a project manager in developing a plan, assigning resources to tasks, tracking progress, managing the budget, and analysing workloads.

Microsoft Project was the company's third Microsoft Windows-based application, and within a couple of years of its introduction it became the dominant PC-based project management software

Project creates budgets based on assignment work and resource rates. As resources are assigned to tasks and assignment work estimated, the program calculates the cost, equal to the work times the rate, which rolls up to the task level and then to any summary tasks and finally to the project level. Resource definitions (people, equipment and materials) can be shared between projects using a shared resource pool. Each resource can have its own calendar, which defines what days and shifts a resource is available. Resource rates are used to calculate resource assignment costs which are rolled up and summarized at the resource level. Each resource can be assigned to multiple tasks in multiple plans and each task can be assigned multiple resources, and the application schedules task work based on the resource availability as defined in the resource calendars. All resources can be defined in label without limit. Therefore, it cannot determine how many finished products can be produced with a given amount of raw materials. This makes Microsoft Project unsuitable for solving problems of available materials constrained production. Additional software is necessary to manage a complex facility that produces physical goods.

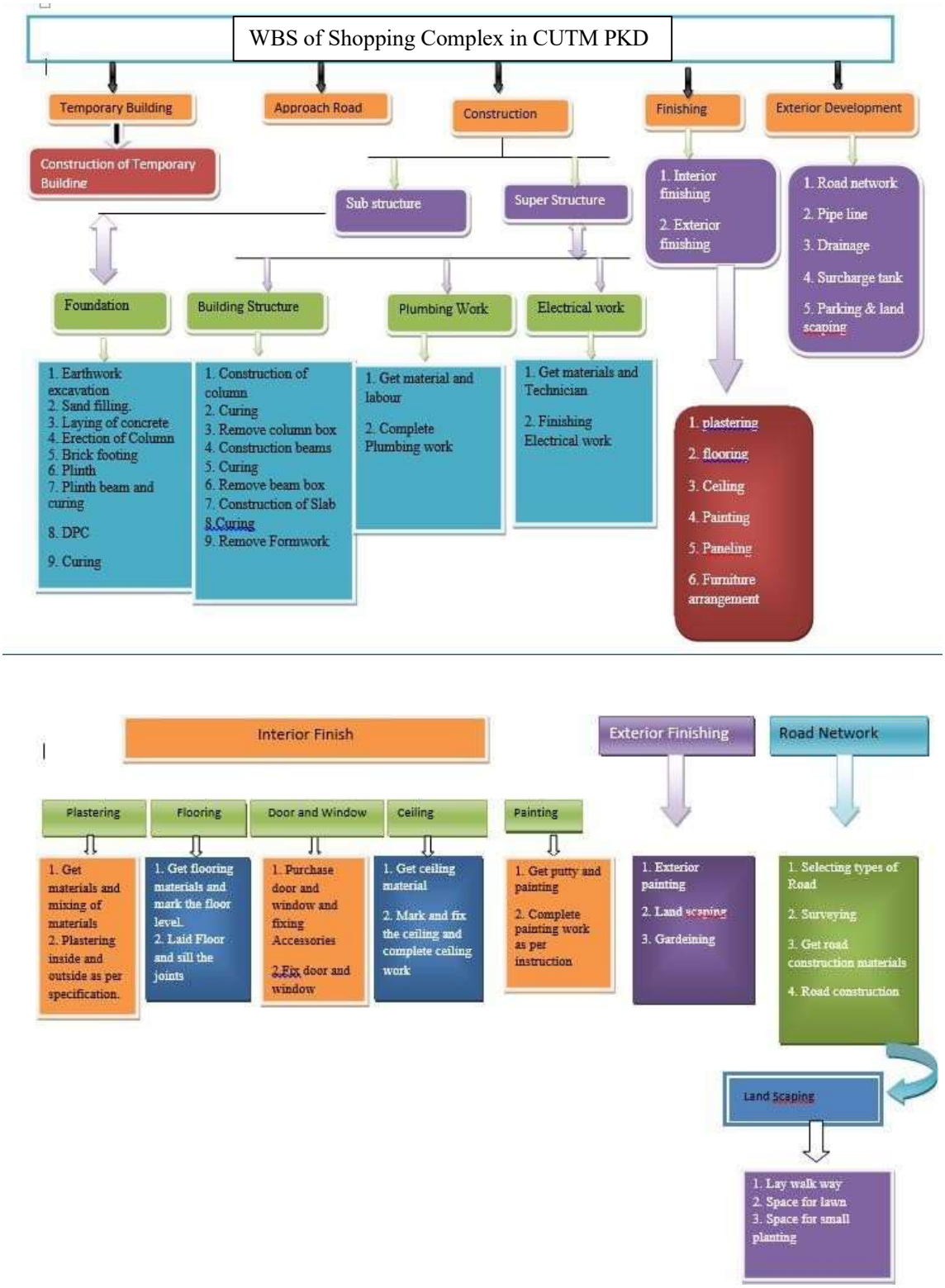


FIG.16:- WBS OF SHOPPING COMPLEX IN PKD CAMPUS

6.5 Gantt chart

A Gantt chart is a type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates of the terminal elements and summary elements of a project. Terminal elements and summary elements comprise the work breakdown structure of the project. Modern Gantt charts also show the dependency (i.e., precedence network) relationships between activities. Gantt charts can be used to show current schedule status using percent-complete shadings of works.

6.6 Historical Development

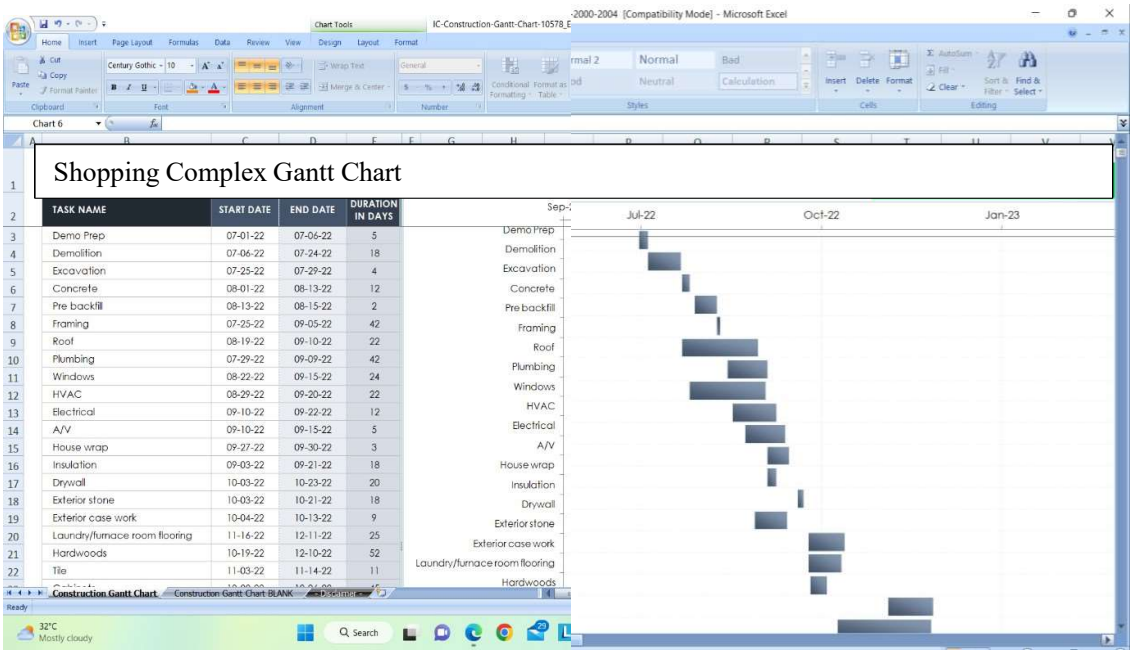
The first known tool of this type was developed in 1896 by Karol Adamiecki, who called it a harmonogram. Adamiecki did not publish his chart until 1931, however, and only in Polish, which limited both its adoption and recognition of his authorship. The chart is named after Henry Gantt (1861–1919), who designed his chart around the years 1910–1915.

One of the first major applications of Gantt charts was by the United States during world war at instigation of General William Crosier.

In the 1980s, personal computers allowed widespread creation of complex and elaborate Gantt charts. The first desktop applications were intended mainly for project managers and project schedulers. With the advent of the Internet and increased collaboration over networks at the end of the 1990s, Gantt charts became a common feature of web-based applications, including collaborative groupware.

6.7 Further application of Gantt chart

Gantt charts can be used for scheduling generic resources as well as project management. They can also be used for scheduling production processes and employee roistering. In the latter context, they may also be known as time bar schedules. Gantt charts can be used to track shifts or tasks and also vacations or other types of out-of-office time. Specialized employee scheduling software may output schedules as a Gantt chart, or they may be created through popular desktop publishing software.



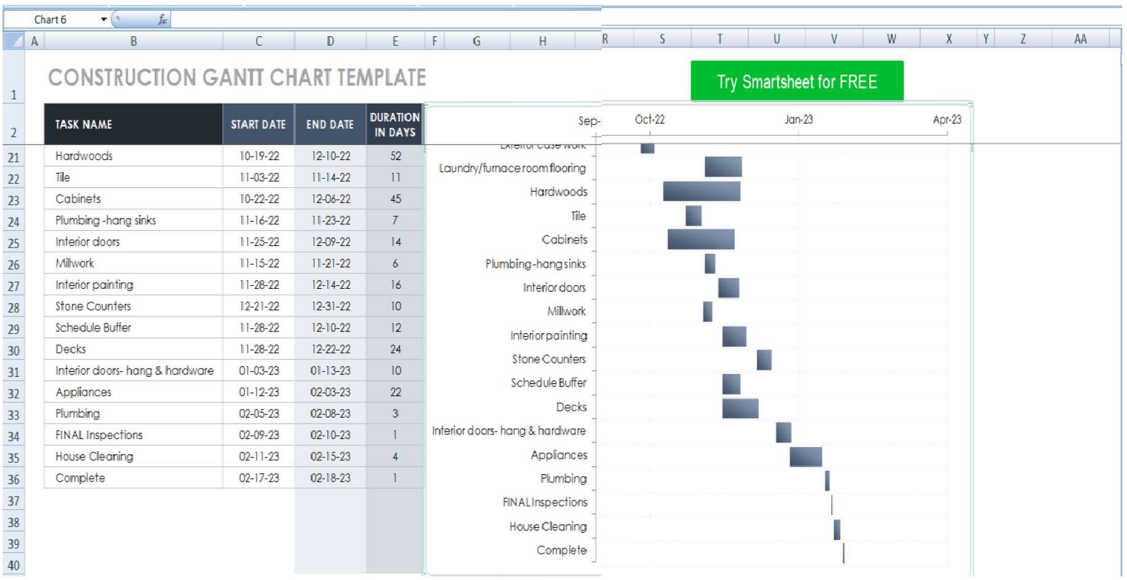


FIG.17:- GANTT CHART

6.8 Network Diagram

Network diagrams serve as visual representations of a project. Network diagrams are complemented by PERT and Gantt charts. In terms of planning and tracking a project from beginning to end, network diagrams are invaluable in today's world. Both the project's critical path and scope are defined. An effective project schedule network diagram will serve as a clear and concise representation of the project.

The Arrow diagram and the Precedence diagram are the two types of network diagrams that exist. In an **Arrow diagram,** nodes are used to depict events and arrows are used for activities, whereas activities are depicted in the order they occur in a **Precedence diagram.**

In Arrow diagrams, each event node refers to the instant in which an activity is started or completed. An event node only occurs when all of the activities entering the node have been completed and the arrow represents the activity that is taking place during the event. If we were to take an example of a task in a project being 'research location possibilities then the event nodes would identify the beginning and end of this particular activity while the arrow would identify the activity itself.

6.9 Use of network Diagram

Since they portray how components interact, network diagram project management plans serve a multitude of purposes**, some of which include:**

- Planning the structure of a project
- Coordinating updates or changes automatically
- Identifying potential risks or bottlenecks of a project
- Documentation for external communication
- Keeping track of project progress
- Selling a project proposal to financial stakeholders
- When proposing changes to stakeholders
- Helping to justify the time estimate for your project
- Aid in planning, organizing and controlling your project
- Identify activity interdependencies
- Define the project workflow
- Identify opportunities
- Show project progress

6.10 Active network diagram

An activity network project diagram is a diagram visual representation of all the sequential and dependent activities within a project. The relationships between all the activities are represented by arrow and nodes. It is a toll used widely in project management due to its effectiveness in helping a project team in reaching its goal efficiently, working out project duration times and defining a project's critical path.

Team and PM create an activity network diagram that aids them in planning and organizing all the activities in a project. The nodes represent the activities and the arrows that connect them represent the flow and what activity follows the next. Some of the project process steps run in series, while others run in parallel. Series represents activities that are sequential, but face dependencies. This means that one after the next cannot be started until the one preceding has been completed. The activities running in parallel face potentially having different completion times because they are dependent on the series of activities preceding.

Critical Path

When creating a critical path of a project, that is, finding out which activities are most critical to the project's process, you must take into consideration which nodes will take the most and least amount of time. The critical path goes through all the nodes with the longest expected completion times., **the critical path is made clearly visible to users as it is highlighted at the top of the network diagram**. Any activities that are running in parallel with the critical path must consider how long their completion will take and be on par with the critical path.

Most Likely Time

Most Likely time defines the expected completion time of the project. Usually, it is defined and based on the critical path.

Optimistic Time

If a project team wished to know the fastest time in which they could potentially complete the project, they must decide on the shortest possible time for each of the nodes. In this way, if they complete each node in its established shortest time, the project will be completed faster. This would be seen as the most optimistic outcome of the project.

Pessimistic Time

A project team may also wish to see what the worst-case scenario would be in terms of project duration. This is a useful feature of a network project diagram as

it prepares both the project team and stakeholders for the worst. The team would have to decide on the longest possible amount of time that each node could take. After adding these values, the longest duration a project could take is produced and is seen as the most pessimistic outcome.

Expected Time

Overall, expected time portrays what a project's most likely duration would be, but also warns of potential longer durations or the possibility of a faster completion date.

6.11 Benefit of Network diagram

Network diagrams are useful in project management in many ways. Some of the benefits of using network diagrams include:

Network Diagrams help validate the time estimation for your project:

Network diagrams paint a clear picture of how varying tasks fit in to a project and their specific interdependencies. This allows for useful duration estimation. Through the development of a critical path and the activities that lie on it, rather accurate project duration is produced and can be used to communicate to stakeholders.

Network Diagrams aid in planning, organizing and controlling:

Due to the sequential visualization of all project tasks and activities all their dependencies, planning the project is an easier feat whilst being able to take into consideration the criticality of each task in a project.

Task interdependencies are clearly defined:

With the help of visual representation of project tasks, their dependencies, criticality and duration are all clearly defined. This allows for a more effective project workflow as team members receive a more in-depth understanding of the individual tasks and how to perform each one in order to reach the project's objective and goal.

Activity workflow is defined: A project's workflow is important to have planned and understood. What activities are dependent on each other and what their sequence is all represented by network diagrams? Network diagrams such as those created on Sinnaps show which activities in the workflow have been completed and when, which are in process and which are left to be done. A PM in this way, can judge the effectiveness and status of a project's workflow.

Network diagrams identify opportunities to compress the schedule:

Some activities or the project in general may need to be shortened in duration. This may need to be done for a number of reasons. Since a network diagrams lays out everything clearly, it is easier to see which activities, depending on their criticality, can be shortened or even omitted.

Project progress is constantly identified:

Since a network diagram visual represents everything to do with a project, progress it visible clearly and PMs can judge how could or bad they and their team are performing.

Overall, network diagrams help a great deal with time management of projects. Whether it knows specific task durations, seeing and understanding ask interdependencies and how they affect the project as a whole or having the project's workflow defined, network diagrams are invaluable. A project team is more likely to identify potential opportunities within the project since a network diagrams serves as a visual representation of the project which helps to paint a clearer picture and give a more in-depth understanding of the project.

CHAPTER 7
RESOURCE SCHEDULING AND RESOURCE ALOCATION

7.1 Introduction

Project scheduling is a mechanism to communicate what tasks need to get done and which organizational resources will be allocated to complete those tasks in what timeframe. The project schedule is a document collecting all the work needed to deliver the project on time.

A project is made up of many tasks, and each task is given a start and end (or due date), so it can be completed on time. Likewise, people have different schedules, and their availability and vacation or leave dates need to be documented in order to successfully plan those tasks. Whereas people in the past might have printed calendars on a shared wall in the water-cooler room, or shared spreadsheets via email, today most teams use Typically, project scheduling is just one feature within a larger project management software solution, and there are many different places in the software where scheduling takes place.

For example, most tools have task lists, which enable the manager to schedule multiple tasks, their due dates, sometimes the planned effort against that task, and then assign that task to a person. The software might also have resource scheduling, basically the ability to schedule the team's availability, but also the availability of non-human resources like machines or buildings or meeting rooms.

Project scheduling occurs during the planning phase of the project so we have to decide ourselves and planned for execution of project, so we have to arise three question in our mind i.e. what needs to be done? When will it be done? Who will do it?

7.2 Define Activities

What are the activities that i have to do in the project? By using a Work Breakdown Structure (WBS), i can begin to take these activities and organize them by mapping out the tasks necessary to complete them in an order than makes sense. Then we have to estimate the project by breaking activity to different tasks, then we have to determine the time and effort it will take to complete them. This is an essential piece of the equation in order to calculate the correct schedule.

Next step is assign resource for project, finalizing our planned schedule is to decide on what resources we are going to need to get those tasks done on time. We are going to have to assemble a team, and their time will need to be scheduled just like the tasks.

7.3 Resource Scheduling

Resource scheduling is a collection of techniques used to calculate the resources required delivering the work and when they will be required.

There are two broad categories of resource – consumable and re-usable. Scheduling these resources ensures:

- Efficient and effective utilisation.
- Confidence that the schedule is realistic.
- Early identification of resource capacity bottlenecks and conflicts.

The resource scheduling process has three steps:

- Allocation
- Aggregation
- Scheduling

7.4 Allocation, Aggregation and Scheduling

Allocation involves identifying what resources are needed to complete the work. In the case of consumable resources it is simply the quantity required. In the case of re-usable resources it is the total effort required and the number of individual resources.

Once time scheduling and resource allocation are complete, the resources can be aggregated on a daily, weekly or monthly basis as appropriate. The aggregated data is usually presented in a histogram that illustrates the fluctuating use of resources against time. In the case of consumable resources a cumulative curve is used to show the total amount consumed at any point in time.

Few re-usable resources are limitless, so the time schedule has to be adjusted to take into account the limited availability of resources over time. There are two approaches to reconciling resource limits and time constraints; resource smoothing (or time limited resource scheduling) and resource levelling (or resource limited scheduling).

Resource smoothing is used when the time constraint takes priority. The objective is to complete the work by the required date while avoiding peaks and troughs of resource demand. A smoothed resource profile will be achieved by delaying some work. This will remove some flexibility from the schedule and its ability to deal with unavoidable delays, but the advantage is usually a more efficient and cost-effective use of resources.

Resource levelling is used when limits on the availability of resources are paramount. It simply answers the question 'With the resources available, when the work will be finished?'

In many situations a mixture of levelling and smoothing may be required. This is particularly true in the programme and portfolio dimensions.

Other factors that can be considered include cost-efficiency measures, such as 'just-in-time' material deliveries; risks affecting resource availability; and the effect of learning curves on performance.

The fully-resourced schedule has to be achievable and have the support of the management team. Unless the team has input into the schedule, this support is likely to be limited at best and withheld at worst.

Resource scheduling may well reveal that the original target, calculated through time scheduling, and cannot be achieved. This must be explained to senior management so that expectations can be managed. A fully resourced schedule, taking into account all constraints, will support the case for an extension of time or budget. Without it any case will be less substantial and unlikely to be accepted.

7.5 Project

The network analysis models used in time scheduling can be used to perform equally detailed calculations for resource leveling and resource smoothing. Software packages perform very sophisticated calculations that can result in schedules being significantly changed. The danger with these calculations is that they make cause and effect difficult to determine. For example, if a resource leveling calculation is done that takes limits on five different resources into account and delays the project by a significant amount, it will be virtually impossible to see which resource had the greatest impact. It should also be borne in mind that concepts such as the critical path and float have little meaning after a resource scheduling calculation has been applied.

An alternative to creating networks based on activity dependencies is to use a technique called critical chain. This method considers the availability of resources and the interdependencies between resources. Once a suitable resource is developed, 'buffers' of spare time are allowed at the end of each path. Monitoring the rate of usage of the buffer time is key in controlling projects based on critical path.

7.6 Program

The projects and change management activity within a program will have varied requirements for resource scheduling. The program management team must decide how resources will be scheduled in each context. On some projects (or parts of projects) the program manager may impose time constraints that require the resource schedule to be smoothed. On others, resource constraints may be imposed that require the schedule to be levelled.

The program and its use of resources are a highly dynamic and complex environment. Successful resource scheduling will depend upon a close working relationship between the program manager, project managers and business change managers, who all put the needs of the program ahead of individual projects and change management activity.

7.7 Portfolio

In general management usage, capacity planning is defined as 'the maximum amount of work that an organization is capable of completing in a given period '. Capacity planning, in this sense, also applies to portfolios.

In the portfolio domain, resource scheduling is done at a very high level. It is not so much about the timing of resource usage as ensuring that the overall capacity is compatible with the amount of work to be done.

The portfolio practice of categorization helps break the problem down. Prioritization shows where resources need to be focused and resource demand is one of the factors taken into account when balancing the portfolio.

7.8 Important Resource

There are 7 Resources plays important role in execution of a project efficiently.

- Manpower
- Material
- Machine
- Money
- Tools and Equipment
- Plant
- Space

Manpower scheduling is a process of constructing a shift schedule and allocating manpower to the shift schedule, such that customer demands are satisfied. Efficient scheduling decision is crucial as allocating manpower excessively results in excess labour cost, while allocating less manpower than required results in lost sales, dissatisfied customers, or overstretched manpower.

CHAPTER 8

TIME MANAGEMENT

8.1 Introduction

Time management is important in any construction project. Without proper time management, many problems will occur such as extension of time. Some of the researchers describe time overrun as delay and some of them describe that the time overrun is an effect from the construction delay time overrun become the most general problem in construction industry worldwide. Time overrun occur when the actual progress of a construction project is slower than the planned schedule Delay or time overrun will affect all parties involved in the project. It will affect the profits which would be obtained if the project can be completed on the schedule. But due to the time overrun, contractors had to spend more money on labour, plant and may lose the opportunity to get the next project. Hence, effective time management is very important and crucial to achieve successful completion of construction projects.

8.2 Time management Methods

In the pursuit of efficient project performance, time control is one of the most important functions. It is more crucial in large scale and megaprojects; where various risk variables Cause schedule delays. Hence, there are numerous time management techniques and software packages used for project planning and scheduling worldwide. Each of the techniques has different functions and process in providing a list of dates on which certain items are to be completed. Following sections explain all the related techniques/methods.

- Gantt bar Chart
- Critical Path Networks/Method
- Milestone Date Programming Techniques
- Program Evaluation and Review Technique (PERT)
- Line of Balance Method
- Precedence Network Diagram

8.3 Gantt bar Chart:-

Gantt charts are simple and easy to construct and hence are the most commonly used method of scheduling and controlling in construction industry. Gantt charts help in managing the dependencies between tasks and determining the resources required for each activity. These are used in monitoring progress of the project.

The main advantages of Gantt charts are as follows:

a) Gantt charts are useful tools for planning and scheduling projects.
b) Gantt charts allow assessment on how long a project should take.

8.4 Critical path method:-

Critical path method has been widely used for network analysis and project planning industry and as a project management tool to improve scheduling and project administration tasks, supporting project managers to ensure project is completed on time and budget. Critical path methods are used to determine project duration, early and latest dates float time, critical path, logical constraints and a number of other activity characteristics. The major objective is to build up the feasible duration plan required to perform a specific project.

8.5 Program Evaluation and Review Technique (PERT)

The program evaluation and review technique (PERT) is network model that allows for randomness in activity completion times.

The main advantages of PERT are:

a) The primary use of PERT is for the projects which have not been done before.
b) PERT provides a basis from which time and cost performance can be estimated.
c) PERT provides an assessment of the probability of reaching certain milestones by specified dates or of achieving overall project completion within a specified time period

8.6 Time management Software

Keeping a project on track throughout its life cycle can help in saving money by eliminating the chance for a missed deadline. There are many scheduling and

management software packages to help effective scheduling and time management in construction industry.

8.7 Microsoft Project

Microsoft project was designed to assist the project manager in developing a plan, assigning resources to tasks tracking progress, managing the budget and analyzing workloads. This program has many different versions where it allows the user to understand and control project schedules and finances, to communicate and present project information, and to organize work and people to make sure that projects are completed on schedule. It also provides functionality for the user to create reports that communicate the status and progress of the project.

CHAPTER 9
MATERIAL MANAGEMENT

9.1 Material Management

Materials management is deal with campus planning and building design for the movement of materials, or with logistics that deal with the tangible components of a supply chain. Specifically, this covers the acquisition of building construction materials, quality control of purchasing and ordering such parts, and the standards involved in ordering, shipping, and warehousing the said parts. Materials management is the function responsible for the coordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner in order to complete building project at a minimum cost.

Materials required for constructing a building listed below,

- Cement
- Sand
- Aggregates
- Reinforcement or Bar
- Flooring materials
- Windows component
- Doors component etc.

9.2 Inventory Management

Inventory management is crucial function in construction industry for better productivity. As well as execution of project. Material Management is defined as the process to provide right material at right place at right time in right quantity so as to minimize the cost of the project.

This study mainly focuses on Inventory Control techniques which includes ABC analysis, EOQ analysis ABC Analysis. The ABC inventory control technique is based on the principle that a small portion of the items may typically represent

the bulk of money value of the total inventory in construction process, while a relatively large number of items may from a small part of the money value of stores. The money value is ascertained by multiplying the quantity of material of each item by its unit price. The items “A” Category – 5% to 10% of the items represent 70% to 75% of the money value. “B” Category – 15% to 20% of the items represent 15% to 20% of the money. “C” Category – The remaining number of the items represent 5% to 10% of the money value. The relative position of these items show that items of category A should be under the maximum control, items of category B may not be given that much attention and item C may be under a loose control.

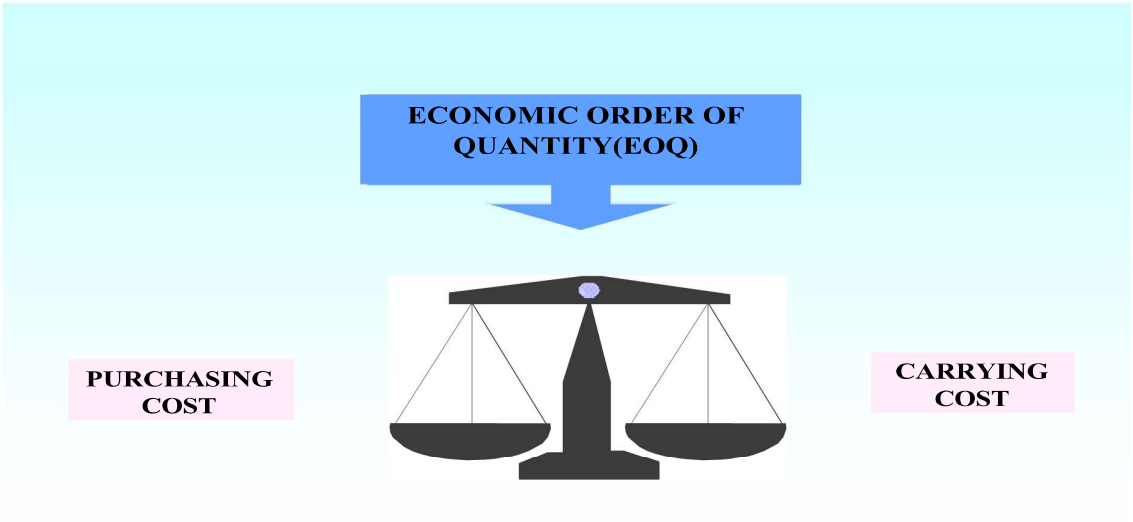


FIG.19:- EOQ

9.3 EOQ Analysis

The EOQ refers to the order size that will result in the lowest total of ordering and carrying costs for an item of inventory. If a firm place unnecessary orders it will incur √unneeded order costs. If a firm places too few order, it must maintain large stocks of goods and will have excessive carrying cost.

In this study EOQ analysis is performed on Cement, Reinforcement Steel, Bricks, Sand & Aggregate. While performing EOQ analysis Ordering Cost & Inventory Carrying Cost is assumed for each material with practical execution procedure of construction. Inventory carrying cost incurred for maintaining the inventory, this includes Cost of Storage, Insurance taxes, Deterioration & obsolescence this calculates in %. Inventory Carrying Cost = 26% Economic Order Quantity is calculated by following formula,

$Q = \sqrt{2} * Co * S / \sqrt{Cu} * I$

Where, Co = Ordering Cost, S = Total Consumption Cu = Cost of Item I = Inventory carrying Cost.

CHAPTER 10

QUALITY ASSURANCE AND QUALITY CONTROL

10.0 Quality Assurance and Quality Control

The construction project quality is managed by a program which has two different elements. One is the quality control (QC) program and the other is the quality assurance (QA) process. These two elements have somewhat different functions. Whether you are the project owner, the designer, or the contractor, each has a stake in the effectiveness of the QA/QC management process. If the quality of the product comes into question, and rework is required, it can become a costly proposition and may become an issue for the contractor. Some unacceptable quality issues can lead to costly litigation and damage reputations and relationships. Therefore, managing quality is an important aspect of a successful project delivery process.

The quality control element defines how the contractor expects to manage the quality requirements of the project as defined by the specifications. And the quality assurance element defines the steps the contactors will take to ensure it. The first thing contractors need to reassure themselves of is that there is a clear understanding of any vague specified quality standard and that workmanship is linked to specific and measurable standards. If there is no way to clarify them or there is complexity involved in the work, then a mock-up or sample of the work should be made and approved so that it may be used as a standard to which subsequent work may be compared.

Quality assurance is the planned and systematic activities implemented within quality system and demonstrated, as needed, to provide adequate confidence that an entity will fulfil requirements for quality.

Quality assurance is evaluating the overall project performance on a regular basis to provide a confidence that the project will satisfy the relevant quality standards. The primary function of quality assurance is to obtain completed construction that meets all contract requirements. Assurance is defined as a degree of certainty. Quality assurance personnel continually assure or make certain that the contractor's work complies with contract requirements.

Quality Control is the monitoring of specific project results to determine if they comply with the relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

Both ANSI (American National Standards Institute) and ISO define quality control as the operational technique and activity; for example, providing a means to control and measure the characteristics of a material, structure, component, or system that are used to fulfil requirements for quality.

10.1 Contractor Quality Management Program

The contractor's quality management program is a written document defining the contractor's processes, practices, and procedures, which are to ensure the project's quality requirement, are met or exceeded. The program has two elements which are the quality control plan and the quality assurance procedures.

- **QC Plan:** Quality control (QC) is the contractor's definition of how the project quality will be managed during construction of the project. Any unique project quality requirement must be defined in a project specific document. It defines who is responsible for achieving the quality standards and how this is to be accomplished. It establishes a framework with defined procedures and practices to ensure that the completed product meets or exceeds the project specified quality requirements.
- **QA Process:** Quality assurance (QA) is defined as the process or procedure the contractor will engage in to ensure that the required quality of the project is achieved. This process defines the inspection requirements, the timing of the inspections, written report, and who is to receive and review them, and in the event that any need for correction who and how it will be done, with the appropriate defined follow up.

10.2 Managing Quality

Quality Assurance Personnel: The role of the quality assurance personnel is to ensure that the quality control program is functioning properly and its intent is carried out diligently.

QA Procedures: Review adequacy of the quality assurance plan:

- ✓ Determine if the work practices are such that the expected quality standard will be met.
- ✓ Examine the quality of the ongoing and completed work to determine that it meets or exceeds the project requirements.

- ✓ Ensure that the material used meets project quality standards.
- ✓ The finished work is sufficiently protected from harm or damage.
- ✓ Issue a report of acceptable work as well as any substandard work.
- ✓ Track the corrective work and issue status report until satisfactory completion.
- ✓ Examine the quality control methods being used to determine if the supervisor is properly controlling construction activities.
- ✓ Review processes, practices and procedures. and identify possible areas for change so as to improve the quality of the resulting work
- ✓ Recommend any changes to project staff and/or management.

10.3 Contractor Quality Management Process

All contractors make an effort to control quality, but generally most of them do not have a robust quality management process in place. In many cases, they do not have a written program either. Traditionally, the project superintendent is responsible for the quality of the work. And the superintendent depends of the different craft workers to follow normal and customary industry practice when it comes to the quality of the work. Such a process depends a lot on to the ability, knowledge, discretion, and diligence of workers, and the supervisor's persistent and careful oversight.

Under such a "loose" management system, as mentioned above, there are many factors that come into play which must be managed well to ensure that the resulting quality of the work

Will meet expectations. The workforce must be qualified, so keeping qualified workers on the payroll and managing the worker workloads, as well as the hiring practices, come into play. Ensuring that the supervisor has the time to oversee work quality and manage it effectively becomes important. Having management oversight of the quality process will ensure that standards are met. To some extent, this is how many of the construction firms try to ensure the achievement of contact quality requirements.

A more structured approach is to draft a quality management program, devise a quality management process, train supervision on the process, implement a control system, hold people specifically accountable, and review performance and results. Continuously improve the process where possible. Following is a

framework for a sample quality management process that may become the basis for managing quality of the project delivery process at a construction company.

Failure to meet project quality requirement can have a number of negative connotations on the project delivery process. It creates extra work for the parties involved, but has the greatest impact on the contractor, though it may negatively influence the designer and the owner to some extent. It can damage business relationships and possibly lead to time-consuming and costly litigation for contractors. In a. research study conducted a few years ago, the findings revealed that costs associates with rework (having to redo a step or portion of construction due to poor craftsmanship or change in plan) were as high as 12 percent of the total project cost and required as much as 11 percent of the total project working hours.

10.4 Quality Management Process Outline:

Introductory Statement

1. Program Elements

    - Policy and Procedures
    - Goals and Objectives
    - General Quality Management
    - Roles and Responsibilities
    - Approvals and Reviews
    - Document Control
    - Process Improvement
    - Project-Specific Quality Management Plan

2. Preconstruction (some activities may not apply)
    - Review of Plans and Specifications
    - Quality standards
        - ✓ Review Requirements
        - ✓ Clarify
        - ✓ Samples
    - Constructability Reviews

- Documenting Existing Conditions
- Material Management
  - ✓ Transportation Factors
  - ✓ Receiving at the Jobsite
  - ✓ Storage and Protection
- Subcontractor factors
  - ✓ QA/QC Program
  - ✓ Field Procedures
  - ✓ Fabrication Shop Inspections
- Testing
  - ✓ Requirements
  - ✓ Procedures
  - ✓ Documentation

3. Construction Operations
   - Zero Defect Program
   - Quality Assurance Administration
   - Roles and Responsibilities
   - Inspection and Testing Plan
   - Inspection Checklists
   - Quality Assurance(QA) Process
     - ✓ Specified Quality Requirements
     - ✓ QA Process
       - ❖ Pre-Installation Meeting and Inspection
       - ❖ First Work-in-Place Meeting and Inspection
       - ❖ Follow-Up or Daily Inspections
   - Inspections

- ✓ Inspection schedule
- ✓ Pre-Cover-Up and Pre-Closure Inspections
- ✓ Documentation
  - ❖ Written Report
  - ❖ Digital Pictures

- Non-conformance Procedures
  - ✓ Report
  - ✓ Tracking
  - ✓ Correction
- Material Verification
- Water Intrusion Prevention
  - ✓ Preconstruction
  - ✓ Inspections During Construction
- Protection of the Work

4. Closeout
   - Closeout Procedures
     - ✓ As Built
     - ✓ Punch List Work Management
   - Systems Turnover Practices
     - ✓ Start-up
     - ✓ Testing of Systems
     - ✓ Training of Personnel
     - ✓ Documentation
     - ✓ Manuals
   - Final Acceptance

5. Post construction
   - Warranties
   - Warranty Management During the Warranty Period
   - Warranty Call-backs after the Warranty Period
   - Resulting Damage
   - Post construction Documentation
6. Abbreviations
7. Glossary of Terms
8. References
9. Attachments
   - Meeting Documentation
     - ✓ Preconstruction Meeting Agenda
     - ✓ Pre-installation Meeting Minutes

- ✓ First Work-in-Place Meeting Minutes

- Reports
  - ✓ Daily Quality Control Inspection Report
  - ✓ Subcontractor's Daily Quality Control Inspection Report
  - ✓ Non-conformance Report
- Checklists
  - ✓ Construction Site Inspection Checklist
  - ✓ Preclusive Inspection Form
- Logs
  - ✓ Inspection and Testing Log
  - ✓ Non-conformance Report Log
  - ✓ Digital Photo Log
  - ✓ Warranty Work Log
- Sample Plans
  - ✓ Subcontractor's Site Specific Quality Control Plan
  - ✓ Inspection and Testing Plan
  - ✓ Water Intrusion Management Plan

- Warranties
- Warranty Management During the Warranty Period
- Warranty Call-backs after the Warranty Period
- Resulting Damage
- Post construction Documentation

10. Abbreviations
11. Glossary of Terms
12. References
13. Attachments

- Meeting Documentation

  - ✓ Preconstruction Meeting Agenda
  - ✓ Pre-installation Meeting Minutes
  - ✓ First Work-in-Place Meeting Minutes

- Reports

  - ✓ Daily Quality Control Inspection Report
  - ✓ Subcontractor's Daily Quality Control Inspection Report
  - ✓ Non-conformance Report

- Checklists

  - ✓ Construction Site Inspection Checklist
  - ✓ Preclusive Inspection Form

- Logs

  - ✓ Inspection and Testing Log
  - ✓ Non-conformance Report Log
  - ✓ Digital Photo Log
  - ✓ Warranty Work Log

- Sample Plans

  - ✓ Subcontractor's Site Specific Quality Control Plan
  - ✓ Inspection and Testing Plan
  - ✓ Water Intrusion Management Plan

10.5 Relevance and Importance of Test

Material testing is a must in all industries, particularly the building sectors. This is because an incorrect assessment of a material would ultimately be harmful to people and the environment.

The infrastructural development of a nation, eventually leads to the prosperity and growth of that country. Utilization of high quality construction materials leads to high quality infrastructures. The quality of such materials should be assessed properly in an accepted laboratory, using standard test methods as well as on the field.

10.5.1 Laboratory Test

In today's global markets and increasing emphasis on quality, need for laboratory data has increased many fold and top of that accuracy and reliability of data is an another concern. So for the quality assurance we need to conduct some tests of building materials inside the laboratory. Such tests are listed below.

For soil

- CBR test
- FSI test
- Gradation
- Plasticity index
- OMC &MDD
- Plate load test
- Direct shear test

For Cement:

- Soundness of Cement
- Fineness of Cement
- Normal consistency
- Setting time of cement

For Sand:-

- Fineness modulus of fine aggregate

For Aggregate

- Specific Gravity And Water Absorption
- Flakiness Index
- Impact Test
- Fineness modulus of course aggregate

For Concrete

- Slump Test
- Flow table Test
- Compressive Strength of Cube

Reinforcement test

- Tensile strength
- Yield stress
- Elongation
- Bend

These tests of reinforcement should be done by using code IS-1786:2008

10.5.2 Field Test NDT

Generally, expert opinions are sought to carry out the investigation for condition assessment after any visible sign of deterioration of the structure. Many of us conduct a visual inspection before using any non-destructive evaluation techniques. NDT methods have the capability of diagnosing the internal concrete conditions, enhance the repair design, assure the quality of the repairs and monitor the performance of concrete repairs for a longer period.

The various types of NDT equipment used are the rebound hammer and the ultrasonic pulse velocity meter (UPV).

- Rebound Hammer
- Ultrasonic Pulse Velocity Meter (UPV)

CHAPTER 11

IMPORTANCE OF METHOD STATEMENT

11.0 Method Statement

A method statement also known as Safe System of Work. A form of document wherein it states the procedure of an activity of the site including safety. It also includes site preparation, materials, and tool to be used.

The statement is generally used as part of a safety induction and then referred to as required throughout a workplace, they should outline all the hazards that are likely to be encountered when undertaking a task or process and provide detailed guidance on how to carry out the task safely.

11.1 Purpose of Method Statement

All businesses have a legal requirement to risk assess the health and safety risks arising from the work you carry out. If you employ 5 or more employees, then you also need to keep a record of your assessment.
In the construction industry, for example, you will be asked for your health and safety documentation on nearly every project your start.

There are a variety of benefits that can be gained other than complying with the law. After all, if the regulations place a legal duty on to do something, it is not usually just for the sake of it.The purpose of writing method statements and risk assessments is ultimately to get you to plan your work and health and safety management, to minimize and control the risks in an appropriate way, to protect your workforce and those that may be exposed.

Writing out your risk assessment and method of work gives a degree of commitment to what is written down. Rather than a brief consideration, and perhaps discussing a few options, but not actually reaching a formal decision, by writing down your assessment you are committing to your decisions. The document then forms a basis to the management of the activity that can be developed and amended in the future.

The purpose of writing your documents is that they then communicate thoughts from those planning to those doing. Verbal instructions passed down through the management structure can get forgotten or misunderstood, whereas detailed risk assessments and method statements provide clear instructions to your workforce.

Having written risk assessments and method statements allows coordination with other activities. Where an activity is in close proximity to a high risk task, the risk assessment for the other task can be accessed, and the risks and controls associated taken into consideration for the task at hand. This sharing of information can help reduce the combined risks involved with multiple activities.

11.2 Importance of Method Statement

One of the most important documents in a project is method statement or in other term work procedure. It is usually stated contract as one of the requirement.

A form of document where in it states the procedure of an activity at the site including safety. It also includes site preparation. Material and tools to be used. Risk assessment for an activity is usually included.

A work method statement sometimes called a safe system of work is a document that details the way a work task or process is to be completed. The method statement should outline the hazards involved and include the step by step guide also to take which control measures have been introduce to ensure the safety of anyone who is affected by the task and process.

Method statement are frequently requested as a part of a tender process which allows the company to gain an insight in to your organisation and the way it operates.

They allows your company to demonstrate how it can provide goals and services in safe and high quality manner. For this reason method statement becomes another brochure for your company and it is necessary to have well-presented documentation to gain a competitive advantages over your competition.

Writing a method statement may seem like a daunting task but this article will guide you through the process and enable you to approach method statement confidence.

Method statement includes:

- Method statement or standard operation procedure
- A brief description of the works, tasks, or process.
- Your company details logo name address etc.
- Start date, completion elate.
- Site address.
- Site contact details including emergency number etc.
- Document author, hands contact.
- Document number, issue date, revision date, revision number etc.

Method statement is a safe system procedure which is usually seen in construction projects. In order to perform the project fully while maintaining the safety of all personnel and people around the construction site. This presenting tool is prepared by the contractor to have a backup plan when unexpected event happen in the site that may passé risk or danger to the employee or people around the site.

Construction methodology or project execution methodology refers to the planned method of construction taking into account all contractual and legal requirements. Project methodology includes the temporary and permanent works and the services required to complete the construction works.

11.3 Relation between Quality Control and Method Statement

You place here the *quality requirements table* where you will write the document references like specification, drawing, materials, Inspection & Test Plan etc. Make sure that the references you placed is correct. You can review it many times before you'll submit to the consultant. These are some aspects which normally as parts of a Method Statement could be utilized to control the quality during construction:

- Working system to be used; Quality controller will be able to check whether the working system comply with the acceptable and approved working standard or not.
- Materials required; Quality controller will be able to check whether the materials are the correct one or not. Furthermore, the material should

comply with the other common quality requirements such as: material certificate availability and traceability.

- Equipment or tools to be used; some equipment and tools need to be inspected prior and during the work execution. An equipment or tool that working properly will guarantee a good result.
- Training requirement; all worker/executor/operator shall be suitably competent and hold the relevant training skill. For example, in all welding activities, one of a duty of a welding inspector is to control the welder's competency by checking his Welder Identification Card (which is the evidence that he is well trained and passed the Welder Qualification). In quality perspective, the welder competency is the part of quality assurance system to get qualified welds.
- Fall Protection; in quality control perspective, a worker will not be able to working properly to get a good quality, if he has to work in a risky and dangerous environment (in this case is working at height). A proper scaffolding, railings and full body harness will let him feel comfortable to work, and in turn will provide a good work quality.
- Health Protection arrangements; similar to no.4, an unfit worker will not be able to provide a good work quality.

Normally, Method Statements must be written or prepared by a competent person familiar with the work process, health and safety control measures and the requirements of a method statement. In this case, the QA/QC team has to play its role during development stage of a method statement, so the Method Statement will be ensuring a good quality as well as a healthy and safe.

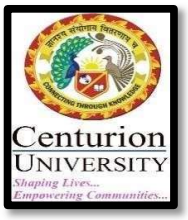
11.4 Advantages of Method Statement

A method statement helps manage the work and ensure that the necessary precaution have been communicated to the involved.

The process of preparing a written method statement provides evidence that

- Significant health and safety risk have been identified.
- The co-operation of workers has been ensured.
- Safe, co-ordinated systems of work have been put in place.
- Workers have been involved in the process.

11.5 Method Statement



CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT: ODISHA

CUTM: DEPARTMENT OF CIVIL ENGINEERING

Contractor	**Name:** Chitranjan Kumar	**Address:** Paralakhemundi, Odisha	**Ph:** +7050016387 **E-mail:** chitranjan1135@gmail.com
Project Name	SHOPPING COMPLEX FOR QUALITY CONTROL IN CONSTRUCTION INDUSTRY		
Description of the Task / Activity	QUALITY CONTROL OF SHOPPING COMPLEX FOR PARALAKHEMUNDI, ODISHA		
Location	ODISHA	**Start Date / Time:**	
		Finish Date / Time	

Personnel Involved	**Name**	**Role/Trade**
	MD GULAM RAZA	CONTRACTOR
	CHITRANJAN KUMAR	DESIGN ENGINEER
	SABAWOON AKABRI	SAFETY OFFICER
	ANIL KUMAR	CONSULTANT
	MD GULAM RAZA	PLANNING AND SITE SUPERVISOR
	CHITRANJAN KUMAR	EXTERIOR DEVELOPMENT

Subcontractor Site Supervisor:	ANIL KUMAR	**Tel:**	6287549767
Safety Officer	SABAWOON AKABRI	**Tel:**	9599103357

(include sketches if required)	4. APPROVAL OF DRAWING FROM THE CITY DEVELOPMENT AUTHORITY. 5. START CONSTRUCTION WORK EITHER THROUGH CONTRACTOR OR LABOR HIRED ON DAILY BASIS. 6. MARKING OF PLOT BOUNDARIES. 7. CLEANING OF PLOT. 8. PREPARATION OF SITE LAYOUT AS PER DRAWING. AFTER COMPLETION OF DOCUMENTATION WORK ACTUAL WORK WILL START. 9. EARTH WORK 10. CONCRETE WORK IN FOUNDDATION 11. DAMP PROOF COARSE 12. MASONARY WORK 13. LINTEL 14. ROOFING 15. PLASTERING AND POINTING 16. DOOR AND WINDOW 17. SERVICES (ELECTRICITY SUPPLY , WATER SUPPLY, GAS SUPPLY, SANITARY)
Temporary Supports and Props needed to facilitate the works:	CENTERING, CENTERING EQUIPMENTS AND PILLAR BOX,
Method of Access and Egress to the work area:	(i.e. Ladders / MEWPS / Scaffold / Trestles / Step Ladder, etc.) **Ladders may only be used as a** LADDER, SCAFFOLD

Fall Protection	(i.e. Guard Rails / Toe Boards/Brick Guard / Safety Harnesses / Exclusion Zones, etc.)

	Litter	YES	Working on a site of value to Wildlife and Natural Features	YES
	Storage of hazardous resources on site	NO	Contamination from firewater	NO
	Odour and Dust	YES	Contractor Activity	YES
Storage Arrangements:	CEMENT, REBAR, TOOLS AND EQUIPMENTS			
Details of Permits to Work:	MUNICIPALITY, FOREST DEPT., PWD, REVENUE OFFICE			

Required Personnel Protective Equip.:	 Safety Boots	 Hard Hats	 Safety Gloves	 Hearing Protection	 Eye Protection	 Respiratory Protection
Applicable Y/N:	YES	YES	YES	NO	**NO**	**NO**

CHAPTER 12

PROJECT QUALITY PLAN (PQP)

12.0 Introduction

A project quality plan is a written plan that details how you will manage quality on a specific construction project. This is different from a company quality manual, which explains your quality policies and procedures in general, but not with information specific to each project.

Clients may ask for project quality plans in different ways. One way may be that your contract says you need to submit a quality control plan. Another way may be that your client comes out and asks for a project quality plan.

A Quality Control Organizational Chart may strike you as a trivial part of your construction quality plan. However, without organization chart, your quality plan will most likely be rejected. Plus, when it comes to managing quality, creating a project quality organization chart is the first step in identifying who is responsible for what on your project.

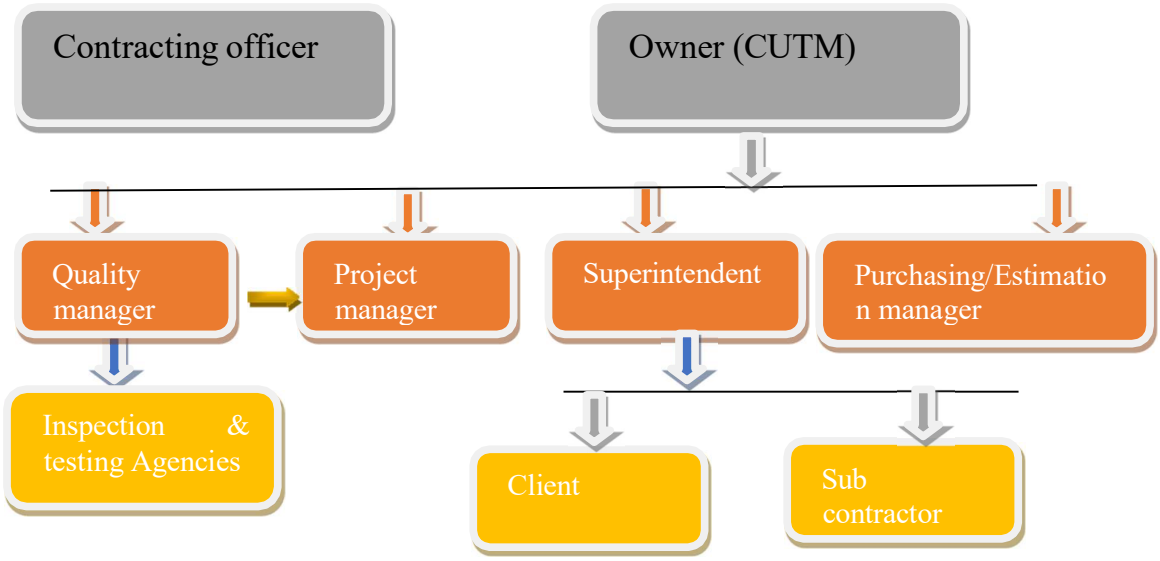


FIG.20:- Project Quality Control Organization Chart

12.1 Scope

The contents of this document are applicable to "**Shopping Complex in centurion university of technology and management paralakhemundi** and "**this project under Prof Bikram Narayan and Dr Prof. Rajiv Kumar Majhi** that will be carried out Chitranjan Kumar, Anil Kumar, Md Gulam Raza, Sabawoon Akabri, In preparation of this document, due regard has been paid to the requirements of ISO 9001: 2008 series of System Standards. This is our Domain project which helps us to learn and complete our degree.

12.2 Purpose:

This Project Quality Plan is prepared and formulated as a Management Summary of Quality related activities required to meet the terms of contract. This Quality plan sets out the Management practices and describes the Quality Management System.

12.3 Reference and Applicable Documents

The following documents are used as a source of reference for preparation of this Project Quality Plan:

- Prof Bikram Narayan and Prof (Dr). Rajiv Kumar Majhi
- Drawings prepared
- Codes of practices as listed in drawing, specifications above..
- ISO 9000-2005 – Quality Management systems – Fundamentals & vocabulary
- ISO 9001-2008 – Quality Management systems - Requirements

CHAPTER 13
QUALITY MANAGEMENT SYSTEM

13.0 QUALITY MANAGEMENT SYSTEM

13.1 GENERAL REQUIREMENTS:

Our Group has a well-established and documented Quality Management System (QMS) and is taking appropriate steps to improve its effectiveness in accordance with the requirements of ISO 9001:2008.

Relevant procedures established clearly specify the criteria and methods for effective operation, control and necessary resources and information to support the operation and monitoring of these processes.

We have prepared all documents which can help to establish procedure for monitoring, measuring and analyzing of these processes and to take necessary actions to achieve planned results and continual improvement of these processes. It has also maintained relevant procedures to identify and exercise required control over outsourced processes.

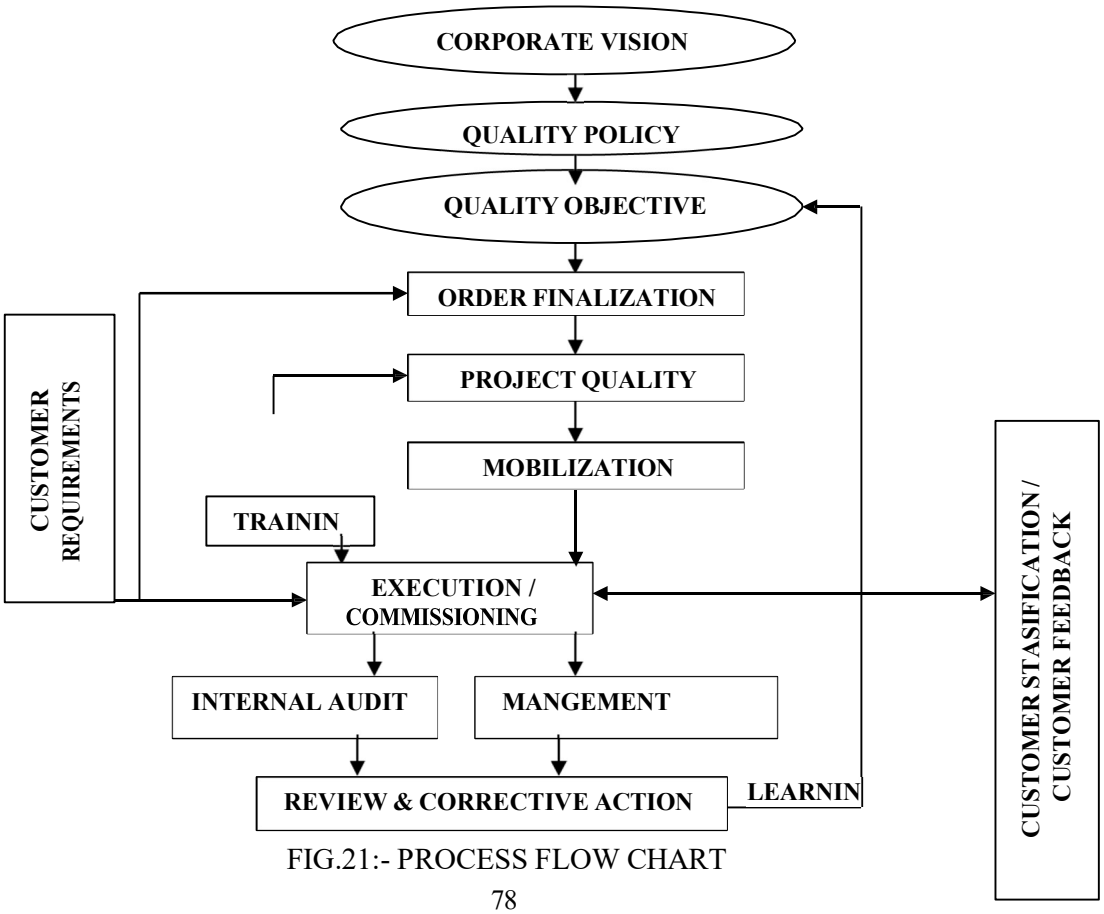


FIG.21:- PROCESS FLOW CHART

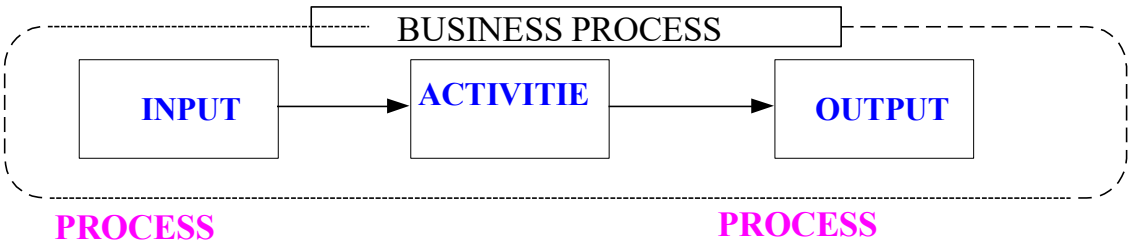


Fig 19: PROCESS MAPPING MODEL FOR SITE OPERATIONS

Typical Process mapping model and Process Flow Chart of the key business processes shown covers all the operations of Project Site. The process flow chart of operation and Process mapping for site operations clearly identify the processes covered under the Quality management system, their sequence and interaction with various processes for effective maintenance of system.

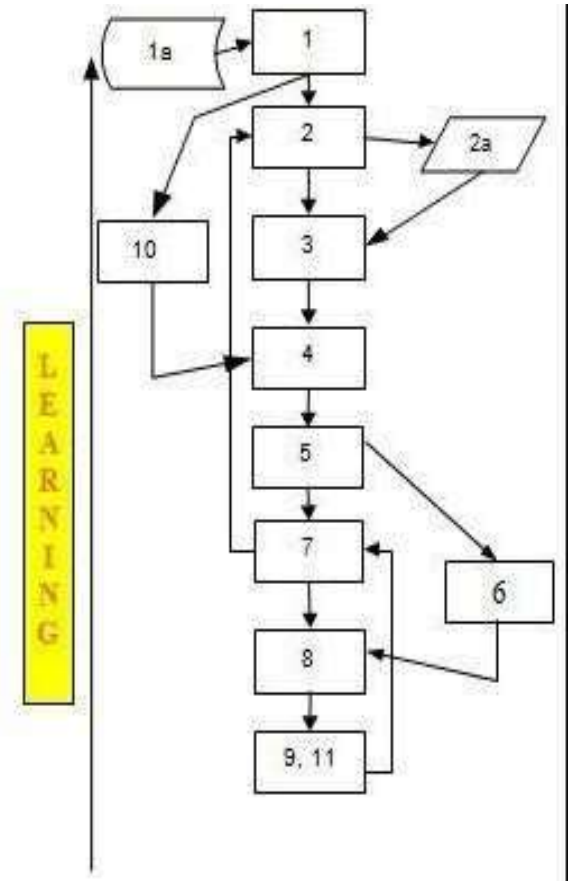
Sub-process	Input / Activity	Output	Process Owner	Process Controller
Planning & Scheduling	Tender, Contract, Proposal Engineering, Tendering Schedules, Customers' requirements, Budget	Project plan/ Work Plan, Schedules, Accepted Cost Estimate	PI / PE	CPM
PQP Preparation	Model PQP, Contract, Drawings, Contract Specifications, BOQ, Kick-off meeting	PQP with all the required Work Methods, ITPs, Formats and Product Quality Rating procedures.	QA/QC (Site)	CQM
Objective Setting	Cluster Quality Objectives, Budget, Customer requirements, Value drivers	Quality Objectives for the Project	PI	CPM
Mobilization	S3 & S4 schedules, Project Plan	Resource mobilization (Staff and P&M), Sub-contractor mobilization, Labour and Material Mobilization.	PE	CPM
Execution	Work Methods, ITP, BOQ, Drawings, Subcontractor Training	Recording in the formats, Approval from customer.	Section Engineers	PI

Manageme nt Informatio	Actual Progress reported by Site Engineers, Stock, Cost, Client Invoice,	JCR, MPR, System Compliance Report, Updating	PE	PI

Sub-process	Input / Activity	Output	Process Owner	Process Controller
n System (MIS)	Subcontractor Billing, Milestones	the data in EIP, Monthly updated Plan		
Monitoring & Review	JCR. MPR, SCR, MQR, Quality Objectives	Plan vs. Actual for all financial parameters, Customer Satisfaction reports, Achievement of Quality Objectives, Review of Audit results, Productivity, Reconciliation, Action plan for improvements, Inputs to structured review at Cluster.	PE	PI

Sub-process	Input	Output	Process Owner	Resource Controller
Preventive measures	Identification of Potential non-conformities and its causes, action plan to eliminate causes	Implementation of action plan, review results, improvements on action plan	Site Engineer	PI
Corrective action	Audit findings, Customer feedbacks, Product Quality rating, cost of rework	Detecting Causes of non-conformity, action plan to eliminate causes, implementation and checking effectiveness	Site Engineer	PI
Training	Identification of training needs based on competency level and requirement of special processes.	Training plan, training records, measuring training effectiveness.	Section heads	PI
Commissioning	Contract, Drawings, Manuals	Commissioning & Test run results, Customer Approval.	Site Engineer	PI
Demobilization	Progress, Surplus Materials	Demobilization Plan, Collectables.	PE / SA	CPM
After Sales Service	Customer feedback, Contractual requirements	Corrective Action, Improvements	PI	CPM

OPERATIONS



Step No.	AREA	Process Flow
1 1a	SITE	Receive input from Kickoff meeting. Input from Marketing, tendering.
2 2a	SITE	Prepare project Quality plan and MPCS in order to meet project delivery, Quality, acceptance criteria, Safety, cost, information systems, customer communication including contract amendment. Resource requirement & Schedules.
3	SITE	Requisition & Receive Resource from Clusters.
4	SITE	Execute project as per Project Quality plan in order to meet project objectives.
5	SITE	Send site performance to Clusters through MIS.
6	SITE	Effective closure of Project and Project Completion Report
7	CLUSTER	Review and suggest area of improvement to Site.
8	CLUSTER	Compile and send MIS and exception reports to, SBG, BU and SCM as applicable.
9	BU	Providing Procurement, Plant & Machinery support to Cluster.
10	BU	Provide Technology & commissioning support to cluster.
11	BU	Provide Operation and Monitoring services support deployment to cluste

13.2 Control of document

Documents would be controlled on merit. (Fig. 3.5 indicates types of documents, generally considered in Buildings.)

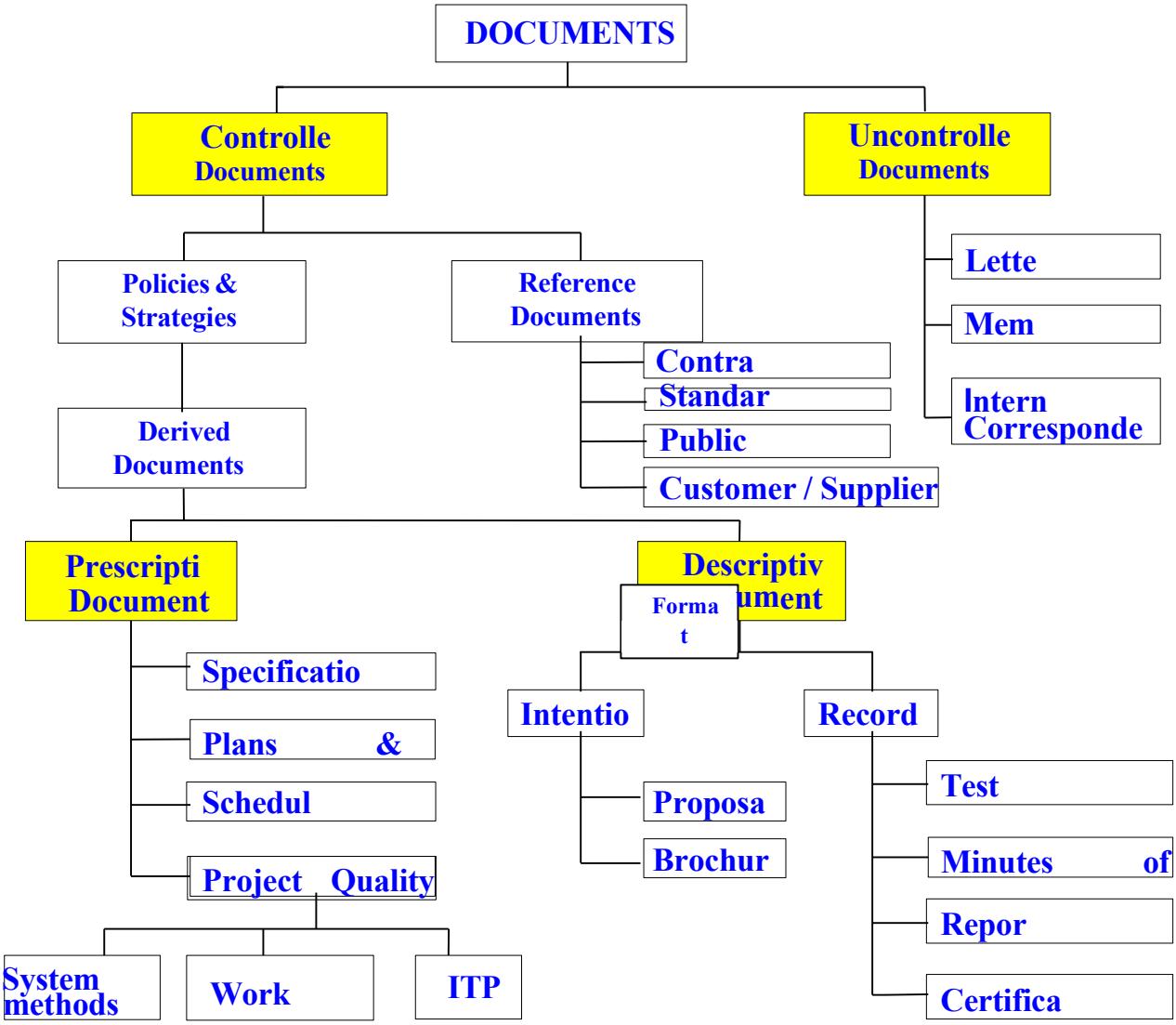


FIG.20:- DOCUMENTS - CONTROL

At the beginning of every project the PI/CM would decide on documents to be controlled and assign responsibilities to concerned persons at site.

13.2.1 Control of Documents at Project Site

Sl No	Procedure description	Responsibility	Reference document / data	Output Record / Document	Output Record distribution
DOCUMENT CHANGE					
1	Receive inputs through management review meeting/ Internal audits/ Customer suggestions/ additions or Changes in specification / Document change note from Users.	MR (Site)	MOM, customers' Suggestions	DCN QSF/4.2.3/ F 02	
2	Review the requirement of document change, discuss with PI / Department Heads. Raise DCN and seek review from CQM and revise the document. Additional work procedures as and when required are prepared and approved and added as annex to existing PQP.	MR (Site), CQM		Revised PQP / Annexure.	All controlled copy holders
3	Ensure superseded copies are destroyed except Master copy.	MR (Site)			
CONTROL OF DOCUMENTS					
4	Receive New drawings and enter in drawings register /computer and maintain master copy.	PE		Drawings Register	
5	Maintain drawing register including issue to users stamped as "controlled copy" in red colour.	PE			
6	Stamp Superseded drawings and withdraw from use.	PE		Superseded drawings file	
7	Maintain incoming letters, mails, fax register mentioning subject and date of receipt.	PE		Incoming register	
8	Maintain outgoing letters, mails, fax register mentioning subject and date of despatch.	PE		Outgoing register	
9	List requirements of Codes, validate for the latest issue and Standards and maintain at site.	QC Engineer		QSF/4.2.3/ F 03	
10	Identify Files as required and maintain file list for easy retrieval.	HODs, SHs	Section 4.2.4	File List	
11	Identify and maintain Receipt, storage and issue details of records.	All Department / Section Heads	Section 4.2.4	File List	
DOCUMENT CONTROL IN ELECTRONIC MEDIA					
12	Maintain a list of document in electronic media with backup detail for important files.	All Departments			
13	Ensure storage & preservation records in electronic media to avoid damage / deterioration / protection of confidentiality for data received through e-mail.	All Departments			
14	Print out & retain in file all electronic data that may be of future importance.	All Departments		Printed copies in file.	

TABLE 2: PROCEDURE FOR CONTROL OF DOCUMENTS AT SITE

13.3 Quality planning

13.3.1 Quality Objectives

The Quality objectives are derived from Quality policy. Table 5.1 below enumerates a list of Suggested Quality Objectives for operations applicable at project site. Various units / departments and individuals at functional level would derive list of objectives from the table.

For the project sites the objectives are set at the time of project commencement. The progress is reviewed at site.

No.	Objective	Measure	Target *	Report frequency
1	Customer Value	• Product Quality Rating • Customer feedback • Pre-commissioning Obligations		Quarterly
2	Process	Plan vs. Actual: • Project milestones • Financial performance • Cost prudence • Safety Records		Monthly
3	Improvements	• Safety performance • Cycle Time • Cost of poor Quality • Wastage Reduction • Product Quality rating		Monthly
4	Leadership	Development of future leaders		Half-yearly
5	Motivation	• New initiatives • Innovations • Staff training effectiveness – evaluation • Training evaluation for S/C		Quarterly
6	Partnerships	• Assimilation of technology from JV partners. • Vendors developed • Performance evaluation of vendors – of site purchases • Performance evaluation of sub-contractors		Quarterly

Table 3: SUGGESTED QUALITY OBJECTIVES

The desired / target values are set based on the following:

- Past performance in similar jobs;
- Growth over period of time;
- Contractual commitments;
- Meeting the PQP requirements.

For each of the key position value drivers are defined, monitored and measured which adds upto the Quality objectives for the function. Similarly, the target objectives of a department / unit are attained through value drivers of the key positions.

13.3.2 Procedure for Setting the Quality Objectives

OBJECTIVE: To establish, implement & maintain a procedure for deployment of Quality policy by setting Quality Objectives.

Sl. No.	Procedure Steps	Responsibility	Document	Record	Record Distribution
1.	Identify Quality objectives for the Site inline with Quality policy, project requirements and in line with Cluster objectives, covering each function/process.	PI SHs	PQP/ 5-4-1	Identified objectives	CPM
2.	Prepare resource plan, Roadmap for review and course correction mechanism to achieve Quality objectives.	PI, SHs	Draft Objectives		
3.	Incorporate suggestions from CPM and seek approval.	PI	Action Plan	Approved Quality objectives QSF/ 5.4.1/F01	QA/QC(Site)
4.	Implement action plan and report progress to CPM once in Quarterly	PI, SHs		Progress on Objectives QSF/ 5.4.1/F01	QA/QC(Site)
5.	Report progress in management review meeting and follow improvement plans based on Management review meeting.	QA/QC(Site)		MOM of MRM	CPM, CQM

Table 4: **Procedure for Setting & Reviewing Quality Objectives for Site**

13.3.3 Quality Management System Planning

OBJECTIVE: Establish a procedure to plan, monitor and achieve Quality Management System planning in order to fulfill customer requirements, statutory requirements and organization objectives based on contractual requirement.

Sl. No.	Procedure Steps	Responsibility	Document	Record	Record Distribution
1.	Prepare strategy for the project to ensure a. Quality of product b. Safety c. Timely delivery	Site Engineer Site Engineer Planning Engineer	PQP/8.2.4 Safety Manual PQP/7.1		
2	Convert the strategy into initiatives for the site team and establish Quality Objectives for each position of the project and periodically review as planned.	PI	PQP/5.4		
3.	Document the needs / expectations of customer, organization and statutory bodies in PQP and implement.	All Sections	PQP		
4	Evaluate process and product performance by Audits.	All sections	PQP/8.2.2		
5	Improve performance of process and products following management review meeting.	All sections	PQP/5.6		
6	Maintain system integrity during changes in PQP for improvement.	MR (Site)	PQP/4.2.3.1		

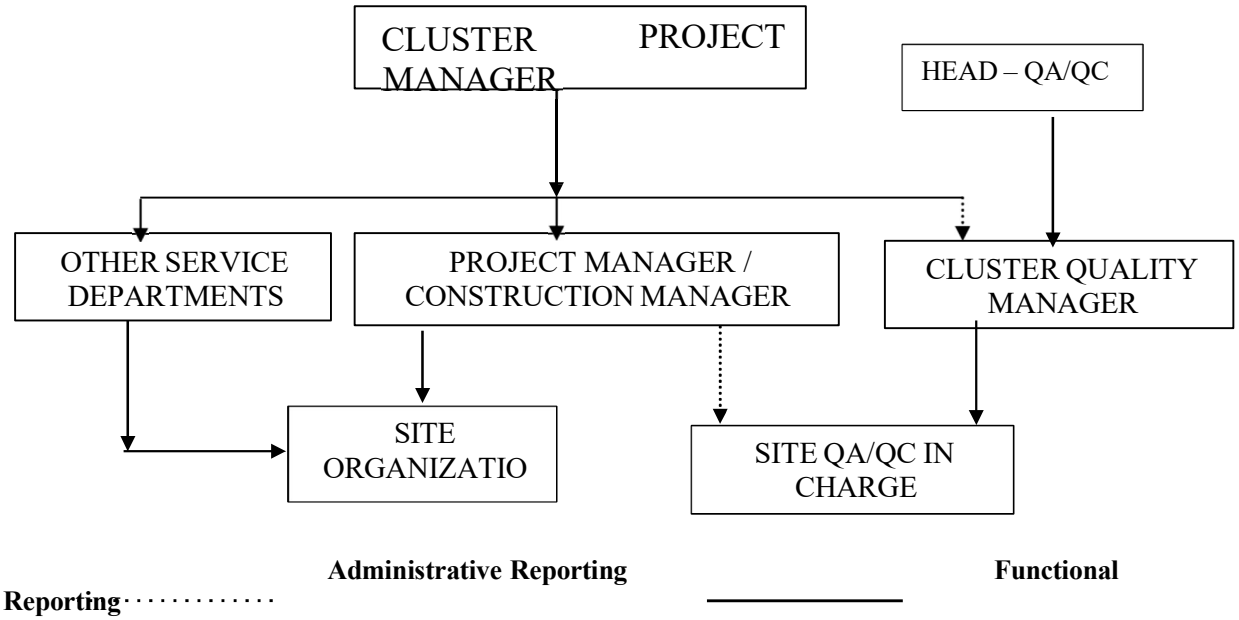
Table 5: Procedure for Quality Management System Planning

13.3.4 Responsibility, authority and communication

Responsibility and authority

Objective: To clearly identify & state roles and responsibilities for the site and it's supporting functions.

Organization chart with key positions marked for implementing / managing the Quality system Project level is as below:



CHAPTER 14
CHECKLIST IN CONSTRUCTION

14.1 Definition

The checklist is a list of items to be noted or checked in a completed part of activity. It is always attached with the Inspection Request (IR) to be signed-off by concern parties once the inspection is accepted.

A Checklist shall be made for each activity on site. It is the basis of confirmation that a part of activity has been done as per method or procedure of the work.

The checklist shall be done after a construction of method statement and Inspection and Test Plan.

14.2 ITP (Inspection and Test Plan)

For each activity on a construction site, there would be a corresponding Method Statement as well as Inspection and Test Plan including Checklist shall be developed.

An Inspection & Test Plan is the program of inspection, testing of materials, and survey shall be prepared and submitted by the contractor to the Engineer for approval before usage and application to the site.

A list of items shall be noted or checked in a completed activity. It is always attached to the Inspection Request. To be signed by concerns parties once the inspection is approved.

Inspection and Test Plan is made and issued by the Quality Engineer, it should then be reviewed by the Quality Manager, Construction Manager and approved by Project Manager before it shall submit to the Engineer.

As it is always required by the contract or specification, Method Statement and Inspection and Test Plan including Checklist shall be submitted to the Engineer for approval.

14.3 Inspection steps for our work

1.Inspection for functional planning

- ✓ Check weather all drawings should as per requirement of the owner or not.
- ✓ See all the drawings are in standard dimension or not.
- ✓ The drawing document shall be approved by the authorized person.

- ✓ Design should follow standard codes while considering the loads.

14.4 Inspection for earthwork excavation

Site location		
Date:	Time:	Competent person:
Soil Classification:	Excavation width:	Excavation depth:
Type of protective system:		

Inspection:

1. General inspection of site	Yes	No	NA
A. Excavations, adjacent areas, and protective systems inspected by a competent person daily before the start of work.			
B. Surface encumbrances removed or supported.			
C. Employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation.			
D. Hard hats worn by all employees.			
E. Spoils, materials, and equipment set back at least two feet from the edge of the excavation.			
F. Walkways and bridges over excavations four feet or more in depth are equipped with standard guardrails and toe boards.			
G. Employees prohibited from going under suspended loads.			
H. Employees prohibited from working on the faces of slopes or benched excavations above other employees.			
I. Warning vests or other highly visible clothing provided and worn by all employees exposed to public vehicular traffic.			
2. Utilities:			
A. Utility companies contacted and/or utilities located.			
B. Exact location of utilities marked.			
C. Underground installations protected, supported, or removed when excavation is open.			
3. Wet Condition			
A. Precautions taken to protect employees from the accumulation of water.			
B. Water removal equipment monitored by a competent person.			
C. Inspections made after every rainstorm or other hazard-increasing occurrence.			
4. Hazardous Atmosphere:			
A. Adequate precautions taken to protect employees fromexposure to an atmosphere containing less than 19.5% oxygen and/or to other hazardous atmospheres			

B. Testing conducted often to ensure that the atmosphere remains safe.			
C. Employees trained to use personal protective and other rescue equipment			
D. Safety harness and lifeline used and individually attended when entering bell bottom or other deep confined excavations.			

14.5 Inspection for PCC

Site:	Location:	Date:
Structure:		

PCC	**Yes**	**No**	**NA**
1. Check Surface Preparation			
2. Check Marking & levels to be done with respect to drawing			
3. Check for Form work			
4. Check for finished level			
5. Check for mixing of cement, sand and aggregate & adequate material			
6. Check for Pouring height			
7. Do not allow extra cement mortar on top of PCC for smooth finishing			
8. Check for Aggregate test report. (Fine aggregates/Cement /Water)			
9. Check for Ramming with proper tools			
10. Check for Button marking for PCC thickness			
11. Check for curing at least 7days			
Remark of Quality assurance engineer:			
Signature: **Date:** **Remark:**			
Checked By:			
Approved By:			

14.6 Inspection for Reinforcement

Site:	Location:	Date:
Structure:		

Reinforcement	**Yes**	**No**	**NA**
1. Structural Drg. No. and date as per which reinforcement checked. Bar Bending Schedule Prepared?			
2. Connecting of bars to existing dowels to be checked for alignment. OK?			
3. Placing of bar diameter, number, spacing match with the Construction Schedule?			
4. Lap Length, Position of lap, OK?			
5. Cleanliness of shuttering and Bars OK?			
6. Chairs provided?			
7. Cover for reinforcement ok?			
8. Provision of cover blocks/ preparation of cover blocks			
9. Maintaining records and getting approval for additional reinforcement not shown			
10. To check the construction joint for proper concrete bonding before placing reinforcement			
11. Laying of bars of required dia. As per requirement			
12. Check for Test Reports for steel and approved brand or not			
13. Check colour coding for identification			
14. Check for proper binding (double strand/quality of binding wire of 18 SWG)			
15. Check for any rework or alteration			

Remark of Quality assurance engineer:

Signature:	**Date:**	**Remark:**
Checked By:		
Approved By:		

14.7 Inspection for Shuttering

Site:	Location:	Date:
Structure:		

Shuttering	**Yes**	**No**	**NA**
16. Shuttering Material is new/ old?			
17. Repairs are OK?			
18. Cleanliness of Shuttering?			
19. Oiling of Shuttering?			
Fixed shuttering			
20. Shuttering Design OK? (Dimension, Diagonal, Sunken portions etc.,)			
21. Alignment/ Level/ Rigidity OK?			
22. Check Props. Are they OK?			
23. Check Arrow Span. Are they OK?			
24. Check Braces. Are they OK?			
25. Check sealing Joints/ Holes, OK?			
26. Check for any rework or alterations			
AFTER REMOVAL OF SHUTTER			
27. Surface of Concrete - good moderate, level and line?			
28. Repair of surface required?			
Remark of Quality assurance engineer:			
Signature: **Date:** **Remark:**			
Checked By:			
Approved By:			

14.8 Inspection for Concreting

Site:	Location:	Date:
Structure:	Max.Aggregate size	Slump:
Cement test cert no.	Steel test cert No.	

Pre Concreting	**Yes**	**No**	**NA**
1. Check surface preparation			
2. Check for Form work and staging			
3. Conduits/ Ducts opening/ Insert Plates provided?			
4. Check for provision of vibrators?			
5. Working condition of mixer/ vibrators checked and gaps between plates in mixer drum to be checked?			
6. Access platform and walkways (if required) provided?			
7. Check reinforcement as per drawings			
8. Check Embedded parts			
9. Check cover to Reinforcement			
10. Check Plumb			
11. Check Reduced levels			
12. Check for Concrete (Pour card)			
Remark of Quality assurance engineer:			
Signature: **Date:** **Remark:**			
Checked By:			
Approved By:			

14.9 Inspection for Masonry

Masonry	Yes	No	NA
13. Availability of material as per daily requirement & Test reports			
14. Cleaning work area off loose material/ concrete			
15. Proper stacking of bricks/ blocks			
16. Quality of Bricks/ sand, Tests performed and OK?			
17. Wetting of bricks			
19. Line out rechecked? (Room dimension, diagonals, alignment with one layer of brick work, Door opening position & verticality, etc.,			
20. Check Mortar Preparation & provision of platform			
21. Check Mortar Thickness			
22. Check Plumb			
23. Check finished level / Rt. Angle/ Proportion of mix			
24. Check hacking/ conduit/ silt content in sand			
25. Check cleaning of dead mortar			
26. Check curing / raking			
27. Check provision of Patti			
28. Check for any addition & alterations			
29. Check for proper pointing, packing & finishing			
Remark of Quality assurance engineer:			
Signature: Date: Re			
Checked By:			
Approved By:			

14.10 Inspection for Tiling

Site:	Location:	Date:
Structure:		

Before Tiling	Yes	No	NA
1. Check for any additions & alterations			
2. Cleaning slab off loose mortar/ material			
3. Check for levels, Button marking, Mortar thickness			
4. Availability of Material - Sand, Tiles			
5. Proper Stacking of Tiles			
6. Quality of Tiles/ Sand			
7. Check for any platform, B/w for wardrobe area			
During tiling			
8. Drg. No./ Date as per which pattern given / starting point			
9. Line/ Level fixed, checked & Slopes are as per requirement			
10. Check difference in colour shade of tiles and replace with same batch/ lot 11. Proportion of bedding mortar Mixing in A/2 tray			
12. Clearing waste tiles/ mortar			
13. Clearing for joints/ workmanship			
14. Check the skirting for projection, Right angle etc.,			
AFTER TILING			
15. No material stacked after fixing? (Crack or any damage)			
16. Tile surface cleaned properly before starting first coat?			
17. Check for any hollow sound			
18. Are there any Cracked tiles, should be replaced			
19. Check the pointing and grouting materials			
20. Curing for four days after grouting I.e. first coat?			
Remark of Quality assurance engineer:			
Signature: **Date:** **Remark:**			
Checked By:			
Approved By:			

14.11 Inspection for Painting

Site:	Location:	Date:
Structure:		

Reinforcement	**Yes**	**No**	**NA**
1. Check for any wall cracks, Curing period completed or not			
2. Check the material/paints as approved make			
3. Check colour shade approved			
4. Cleaning of walls to be checked (Scrapping), Surface finishing			
5. Cracks, Dampness, any leakages to be identified and repaired.			
6. Apply primary coat			
7. Application of coat as per specs to be checked			
8. Check others materials covered neatly with masking tape (protection of other materials from damage like Electrical switches plate, door/window joints, glass partitions, wardrobes)			
9. Check for no of coat applied & final touch up work are completed			
10. Check for overall coverage and brush marks			
11. Check for cleaning in flooring, window/door glasses & joinery fitting after painting			
12. Check for any incomplete and addition and alteration			
13. Check for floor polishing before final coat (in case of Marble flooring)			

Remark of Quality assurance engineer:			
Signature: **Date:** **Remark:**			
Checked By:			
Approved By:			

14.12 Inspection for Safety

Site:	Location:	Date:
Structure:		

Safety and risk management	**Yes**	**No**	**NA**
1. Hard hats supplied by employer			
2. Boots are used when it requires			
3. Using the hearing protection			
4. Using the eye protector			
5. Using the Respiratory protector			
Ladder			
6. Correct size for the job			
7. Fully opened and spreader bars locked			
8. Firm foundation for ladder feet			
9. Proper climbing procedures			
10. Three-point contact rule followed			
11. Free from obvious defects			
12. Workers stand below top 2 steps			
13. extend more than three feet above support			
At Work site			
14. Fall protection used if over 10 feet tall			
15. Set up on level, stable footing			
16. Platform is appropriate width for type of scaffold			
Fall protection			
17. Fall protection provided for heights 6 ft. or more			
18. Harness is worn properly and attached to secure anchorage			
19. Slide guards are installed across full width and all sides			
20. guardrails set up for openings >6’ above lower level			
21. guardrails are constructed sturdily with 2 x 4s			
Machinery Hazards			
22. Workers are trained on the use of power tools.			
23. Workers have appropriate PPE and keep clothing away			
24. Workers are trained prior to using nail guns			
25. Tile and concrete are cut with wet methods			

Remark of Quality assurance engineer:		
Signature:	**Date:**	**Remark:**
Checked By:		
Approved By:		

CHAPTER 15
MAINTENANCE AND RECOMMENDATION

15.1 Introduction

It has always been the vision of the Buildings Department to create and maintain a safe, healthy and pleasant built environment for our city. Prevention is always better than cure. Building owners are well advised to carry out timely maintenance works to their buildings. It is indeed their responsibility to do so. A good knowledge in building maintenance and management is, however, essential if they are to fulfill their responsibilities.

Maintenance and Management are two closely related issues. Building management, apart from covering the basic security and cleanliness aspects of buildings, should also coordinate or even include implementation of maintenance plans to ensure a safe and pleasant living environment. As explained in the coming sections of this chapter, surveillance can be strategically combined with inspection for maintenance. It would be beneficial to owners in engaging the same personnel in carrying out both duties.

Defects create hazards leading to serious or fatal injuries. Most defects can, at their early stages, be discovered through visible or detectable symptoms. If not promptly rectified, minor defects can develop into serious ones, causing failure or sudden collapse, endangering lives and becoming more costly to rectify. This is the spirit of timely maintenance.

15.2 Repair and maintenance

Building repairs and maintenance services mainly includes works undertaken for maintaining proper condition of buildings, its services and works in ordinary use. The use for which buildings are designed is the main factor in determining the required standard of maintenance. Excessive building maintenance should be avoided. At the same time, building maintenance should ensure safety to the occupant or the public and should comply with the statutory requirements. The need also depends upon intensity of usage.

15.3 Types of Building Repair and Maintenance Services

The types of building repair and maintenance service works are:

- Day to day repairs service facilities
- Annual repairs
- Special repairs

- Addition and alternation

- Preventive maintenance

In addition to above, additions and alterations Works in the buildings, Supply &maintenance of furniture & furnishing articles should also be done.

15.4 Day to Day maintenance

Day to day repairs include service repairs which arises from time to time in the services of the buildings such as in plumbing works, water supply, etc.

Examples for such repairs are removing choke of drainage pipes, manholes, restoration of water supply, replacement of blown fuses, repairs to faulty switches, watering of plants, lawn mowing, hedge cutting, sweeping of leaf falls etc.

The purpose of this maintenance service is to ensure satisfactory continuous functioning of various services in the buildings.

15.5 Annual maintenance

This maintenance service is carried out to maintain the aesthetics of buildings and services as well as to preserve their life, some works like white washing, distempering, painting, cleaning of lines, tanks etc. are carried out periodically. These works are planned on year to year basis.

15.6 Special Repairs and maintenance

Special repairs of building are undertaken to replace the existing parts of buildings and services which get deteriorated on ageing of buildings. It is necessary to prevent the structure & services from deterioration and restore it back to its original conditions to the extent possible.

15.7 Additions and Alterations

The works of additions/alterations are carried out in buildings to suit the special requirements of occupants for functional efficiency. The facilities in buildings are updated by carrying out such works.

15.8 Preventive Maintenance

Preventive maintenance is carried out to avoid breakdown of machinery and occurrence of maintenance problems in buildings and services. Works of preventive maintenance are carried out on the basis of regular inspection survey.

Preventive maintenance includes works to prevent deterioration of building parts (which depends on climatic conditions), pollution, fungi, the insect attack, subsidence, flooding, intensity of usage, careless usage, seepage etc.

CHAPTER-16

SAFETY AND RISK MANAGEMENT

16.1 Safety Policy

Safety is one of our core business functions. We are committed to developing, implementing, maintaining and constantly improving strategies and processes to ensure that all our aviation activities take place under a balanced allocation of organization resources, aimed at achieving the highest level of safety performance and meeting national and international standards, while delivering our services.

All level of management and all employees are accountable for the delivery of this highest level of safety performance, starting with the [chief executive officer (CEO)/managing director/ or as appropriate to the organization].

16.2 Safety Objectives

The objectives of Safety Management system is:

a) To provides a structured management system to eliminates or control risk in operations into acceptable level.
b) To set up safety management system unit to oversee the development and implementation of the Aerodrome Safety Management unit and to ensure that the application of effectives safety management system is integral to all our activities.
c) Develop and embed a safety culture in all our activities that recognize the importance and value of effective safety management and acknowledge at all times that safety is paramount.
d) Clearly define for all staff strategy and performance. Ensure that all staff is provided with adequate and appropriate safety information and training are competent in safety matters and are only allocated tasks commensurate with their skills
e) To ensure that all staff is provided with adequate and appropriate safety information
f) To provide the necessary training to build and maintain a meaningful aerodrome operation safety leadership skills.

g) To ensure that the measurement of the organizational safety performance and safety targets are in place.

16.3 Safety Risk Management

- To assess the risks associated with identified Hazard
- To develop & implement effective Mitigation

16.4 Safety Assurance

- Safety performance monitoring and measurement
- Internal safety investigation
- The management of change
- Continuous improvement of the SMS

16.5 Safety Promotion

- Training and education
- Safety communication

16.6 Personal Protective Equipment (PPE)

Employers have duties concerning the provision and use of Personal Protective Equipment (PPE) at work.

PPE is equipment that will protect the user against health or safety risks at work. It can include items such as safety helmets, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses. It also includes Respiratory Protective Equipment (RPE).

16.7 What Do the Regulations Require?
Why is PPE important?

Making the workplace safe includes providing instructions, procedures, training and supervision to encourage people to work safely and responsibly.

16.8 PPE Signage

i. PPE signage must be provided and maintained by employers.
ii. PPE signage must be respected by employees, visitors and the general public.

FIG.23:- PPE

iii. Offers recognizable visual guidance and instruction to employees, visitors and the generate public.
iv. Warms about the specific need to use or wear items of PPE.
v. Should be located close to the area of risk.
vi. All PPE signage should be blue and white for easy identification.

PPE (Personal Protective Equipment)-

FIG.24:- SAFETY HELMET

HELMET-Safety Helmets will protect the user's head against:

1. It used for objects falling from above, bumps to the head from fixed objects or of accidental head contact with electrical hazards.

2. Lateral forces - this would depend on the type of hard hat selected. Traditional hard hats are not designed to protect users from impacts to the front, side or back of the head.
3. Open flame, molten metals splash, electric shock, high temperature-this would depend on the standard of the hard hat selected for example a standard hard hat will not protect against an electric shock.

SAFETY SHOE-Foot injuries can be debilitating, resulting in time away from work or difficulty performing a job. Wearing safety shoes or boots can help prevent many foot injuries in the following ways.

FIG.25:- SAFETY SHOES

1. PROTECT FROM FALLING & FLYING OBJECTS-When workers carry heavy materials or work in dynamic environments where many people, machines and vehicles are operating at once, falling and flying objects are common hazards. Protective shoes like steel toe boots can effectively prevent crushing injuries to the feet.

2. PROTECT FROM CUTTING HAZARD- Machinery that is sharp or contains moving parts can pose cutting hazard. Worker in the logging industry, for example, face danger from chainsaws. If a chainsaw were to come in contact with someone's foot, the result could be catastrophic. Logging boots- which are required by OSHA under standard 29 CFR 1910.266(d)(1)(v)-made with cut-resistant material will protect those worker who use chainsaws. These boots are also waterproof or water repellent and support the ankles.

3. PROTECT FROM ELECTRICAL HAZARDS-Electricity poses a variety of risks in the workplace. Workers could face potential electric shocks or accumulate static electricity, which can lead to electric sparks in certain environments.

To reduce the chances of an electrical accident, non-conductive footwear made from leather, rubber or other materials that don't conduct electricity can be worn. In locations where the build-up of static on the body poses a hazard, anti-static or conductive footwear can be used. These options reduce the amount of static that accumulates on the body, preventing static electric sparks.

4. **PREVENT SLIPS, TRIPS & FALLS-** Shoes with appropriate traction can help prevent falls on the same level in slippery environments. They can also prevent falls from ladders, which are all too common when people don't wear shoes with proper treads. Footwear that fits well and feels comfortable can also improve balance, which will help prevent slips, trips and falls, too.

REFLECTIVE JACKET-

It is use for high visibility and easy for identification in low light in construction site. Different colour of Jacket is helping us to identify the post of the employs in site.

FIG.26:- SAFETY JACKET

EMPLOYEES	JACKET
Visitor	Yellow
Staff + Company Supervisor + Electrician	Green
Workman	Orange
De-Sheltering	Blue

SAFETY BELT-

It is used in high risky area, if any worker fall from height then he will be hanging by the safety belt. It is mandatory above 1.8 meter height & edge area.

FIG.27:- SAFETY BELT

GLOVES-Worker should wear the right gloves for the job (examples: heavy duty rubber gloves for concrete work, welding gloves for welding, insulated gloves & sleeves when expose to electrical hazards)

fig.28:- SAFETY GLOVES

SAFETY GLASSES-Safety glasses or face shields at worn any time or operation can caused foreign object to get in the eyes, for examples-during

FIG.29:- SAFETY GLASS

welding, cutting, grinding, nailing (or when working with concrete & harmful chemicals or when exposed to flying particles).

ROPE GRAB FALL ARRESTOR-

Miller rope grab moves easily up and down vertical; lifeline to provide continuous fall protection. Designed for use with miller synthetic rope lifeline secured to an anchorage independent of the worker's platform

- Compact designed; corrosion-resistant stainless steel construction.
- Lightweight and east to use.
- Rated to 140.6kg capacity

Fig (30)

RESPIRATORS- A respirator is a device designed to protect the wearer from inhaling particulate matter, including airborne microorganisms, fumes, vapors, i.e. gases. Respirators range from relatively inexpensive single-use, disposal face mask to more robust reusable models with replaceable cartridges and are used by the military, private industry and the public.

(fig 31)

EAR MUFF/PLUG- Wearing high quality industrial earplugs or ear muff helps protect ears and hearing

(fig .32)

(fig. 33)

16.9 LADDER LENGTH

- Overall length not more than 10m.
- Ratio of 1:4
- Tied at the top
- 1m extended above platform.
- Anchorage arrangement for full body harness.
- Provide above 1.2m height.
- Sufficient enough to take at least 2000kgf
- Avoiding overloading of the platform.
- Strictly overloading

16.10 Types of PPE you can use

EYES

Hazards
Chemical or metal splash, dust, projectiles, gas and vapour, radiation
Option
Safety spectacles, goggles, face screen, face shields, visors

Note

Make sure the eye protection chosen has the right combination of impact/ dust/ splash/ molten metal eye protection for the task and fits the user properly.

HEAD and NECK

Hazard

Impact from falling or flying objects, risk of head bumping, hair getting tangled in machinery, chemical drips or splash, climates or temperature.

Option

Industrial safety helmets, bump caps, hairnet and firefighter's helmets.

Note

- Some safety helmets incorporate or can be fitted with specially-designed eye or hearing protection
- Don't forget neck protection, eg: scarves for use during welding replace head protection if it is damaged

EARS

Hazard

Noise – a combination of sound level and duration of exposure, very high-level sound are a hazard even with short duration.

Option

Earplugs, earmuffs, semi-insert/canal caps

Note

- Provides the right hearing protectors for the type of work, and make sure workers know how to fit them
- Choose protectors that reduce noise to an acceptable level, while allowing for safety and communication.

HANDS AND ARMS

HAZARD

Abrasion, temperature extremes, cuts and punctures, impact, chemical electric shock, radiation, vibration, biological agents and prolonged immersion in water.

Option

Gloves, gloves with a cuff, gauntlets and sleeving that covers part or all of the arm.

Note

- Avoid gloves when operating machine such as bench driilswgre the gloves might get caught

- Some material are quickly penetrated by chemicals- take care in selection, see HSE's

Skin at work website

Barrier creams are unreliable and are no substitute for proper PPE.

FEET AND LEGS

Hazard

Wet, hot and cold conditions, electrostatic built-up, slipping, cuts and punctures, falling objects, heavy loads metal and chemical splash, vehicles

Options

Safety boots and shoes with protective toecaps and penetration-resistant, mid-sole wellington boots and specific footwear, eg. foundry boots and chainsaw boots

Note

- Footwear can have a variety of sole patterns and material to help prevent slips in different conditions, including oil- or chemical-resistant soles. It can also be anti-static, electrically conductive or thermally insulating
- Appropriate footwear should be selected for the risk identified.
- **LUNGS**

Hazards

Oxygen-deficient atmospheres, dusts, gases and vapours

Options – respiratory protective equipment (RPE)

- Some respirators rely on filtering contaminants from workplace air. These include simple filtering face pieces and respirators and power-assisted respirators
- Make sure it fits properly, eg for tight-fitting respirators.
- There are also types of breathing apparatus which give an independent supply of breathable air, eg fresh-air hose, compressed airline and self-contained breathing apparatus

Note

- The right type of respirator filter must be used as each is effective for only a limited range of substances.
- Filters have only a limited life. Where there is a shortage of oxygen or danger of losing consciousness due to exposure to high levels of harmful fumes, only use breathing apparatus- never use a filtering cartridge.

16.11 FIRE HAZARD

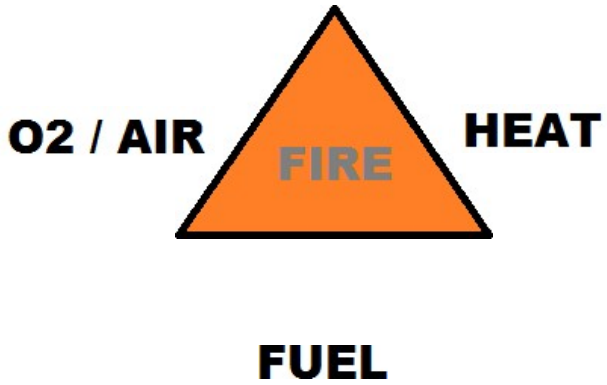
Fire Prevention & Protection
We have to control within 5 minutes

OBJECTIVE

To identifies the fire hazard in construction sites & takes appropriate safety measure to prevent fire for preventing injuries/ properly damage.

CAUSE

Fire triangle- Fire is a chemical reaction in which the substance (fuel) combine with oxygen & fire gives rise to fire



HEAT

- Welding
- Smoking
- Overload (electric circuit)

FUEL

- Paper
- Shade net
- Plastic
- Oil
- LPG gas

❖ Oxygen+Fuel+Heat= Chain REACTION

❖ If anyone of the three is remove, then fire is impossible.
❖ Good house keeping
❖ Clean flammable liquid leaks & spills immediately
❖ Repair any flammable.

Method

- Cooling is the fire to remove the heat.
- Starving the fire by separating the fuel.
- Smoothing the fire by limiting its oxygen supply.
- Blanketing the fire by separating the fire from the atmosphere.

Type of Fire

Class A fire – [Total solid i.e. paper, wood, cloth, rubber]
Combust bit material

Method	Type of fire extinguisher
Cooling	Water
Smothering	CO2, DCP

Class B fire – [Liqiud i.e. Oil, Liquid, Paints, Solvents, Inflammable]

Method	Type of fire extinguisher
Smothering	CO2, DCP
Blanketing	Form (Oil Type)

Class C fire – [Gas compressed form]
LPG

Method	Type of fire extinguisher
Smothering	LPG

Class D fire – [Metal i.e. reactive metal Mg, Na, K etc.]

Method	Type of fire extinguisher
Smothering	DCP

Class E fire – [Electricity & electrical appliance]

Method	Type of fire extinguisher
Smothering	CO2

CHAPTER – 17
ESTIMATION

17.1 Estimation of Shopping Complex

ESTIMATION OF HOSTEL BUILDING

Prepared By: Chitranjan Kumar Date 20- Feb- 2023
Prepared By: BIKRAM NARAYAN Date 22 - April - 2018
Built Up Area: 2437.8 Sq.M Stories: 3
Plinth Area : 812.60 Sq.M Builtup Area : 4,063.02 Sq.M Floors : 5

SlNo	Description	Quantity	Unit	Rate	Amount
	GROUND FLOOR				
	EARTH WORKS				
1	**EARTH WORKS SITE CLEARING LS** : Clearing grass and other growths of vegetation **and small trees of girth up to 30 cm including** rooting out and removal of rubbish up to a **distance of 150 m outside the periphery of the area** cleared.		L.S.	5,000.00	5000.00
2	**EARTH WORKS EXCAVATION HARD SOIL** : Earth work excavation for foundation trenches in hard soil and depositing on bank with **initial lead upto 50 mt. and lift upto 1.5 m including breaking clods , watering ramming and sectioning of spoil bank etc. complete.**	220.32	Cu.M	143.00	31505.76
3	**EARTH WORKS FILLING FOUNDATION** : Filling the foundation trenches with the cut earth **available at site in layers not exceeding 20 cms in** depth consolidating each deposited layers by **ramming and watering. Measurements will be** taken only the filled and compacted earth.	22.03	Cu.M	49.00	1079.47
4	**EARTH WORKS FILLING FOUNDATION USING SAND** : Filling the foundation trenches with the sand brought from outside the site including breaking **clodes,levelling,watering,ramming etc. complete as instructed by the site engineers. Measurements** will be taken only the filled and compacted sand.	22.03	Cu.M	769.00	16941.07
		67.10	**/Sq.M**		**54526.30**
	PCC				
5	**PCC FOUNDATION 1:4:8** : Providing and **laying P.C.C. 1:4:8 using 40mm nominal size** broken stone well consolidated including curing **etc. complete for foundation.**	22.03	Cu.M	2,676.00	58952.28
6	**PCC FLOORING 1:2:4 CuM** : Providing and **laying P.C.C . 1:2:4 using 40 mm nominal size broken stone well consolidated 100 mm thick** including	75.62	Cu.M	3,233.00	244479.46
		373.41	**/Sq.M**		**303431.74**
	RCC **Reinforced cement concrete using 20mm machine** crushed blue metal including all form work, **watering, curing etc. complete, but excluding the cost of reinforcement. Steel staging and supports** along with shutter ply or steel plates to be used and machine mixing and mechanical vibration to **be done to the satisfaction of the site engineer.The** rate includes application of double stage form work and the application of approved brand of **mould releasing agents.**				

SlNo	Description	Quantity	Unit	Rate	Amount
7	**RCC LINTELS M15** : RCC for Lintels using M15.	16.15	Cu.M	3,605.00	58220.75
8	**RCC STEPS M20** : RCC for Steps using M20.	1.54	Cu.M	3,917.00	6032.18
9	**RCC WAIST SLABS M20** : RCC for Waist Slabs using M20.	2.30	Cu.M	3,937.00	9055.10
10	**RCC FOOTINGS M25** : RCC for Footings using M25.	52.43	Cu.M	4,196.00	219996.28
11	**RCC PLINTH BEAMS M25** : RCC for Plinth Beams using M25.	96.91	Cu.M	4,500.00	436095.00
12	**RCC COLUMNS M25** : RCC for Columns using M25.	27.54	Cu.M	4,418.00	121671.72
13	**RCC BEAMS M25** : RCC for Beams using M25.	48.45	Cu.M	4,640.00	224808.00
14	**RCC SLABS M25** : RCC for Slabs using M25.	11.90	Cu.M	4,528.00	53883.20
15	**RCC WAIST SLABS M25** : RCC for Waist Slabs using M25.	2.30	Cu.M	4,528.00	10414.40
	1,403.12	**/Sq.M**			**1140176.63**
	FORM WORKS **Supplying, fitting, fixing and removing shuttering and staging. Measurements shall be taken as the** actual surfaces in contact with the concrete or any other materials requiring formwork.				
16	**FORM WORK RCC** : Form work for rcc.	1,772.52	Sq.M	150.00	265878.00
	327.19	**/Sq.M**			**265878.00**
	STEEL REQUIREMENTS **Supplying, cutting, bending and straightening reinforcement for R.C.C work; binding with 22 gauge binding wire etc. complete in all respects with deformed bars conforming to I.S 1786-1961 or IS 1139 and placing in position.Weight of steel=7850 Kg/m3.**				
17	**STEEL REQUIREMENTS** : Steel Requirements **for Columns, Beams, Lintels, Slabs etc.**	29,288.42	Kg	30.00	878652.60
	1,081.29	**/Sq.M**			**878652.60**
	BRICK WORKS				
18	**BRICK WORKS SOLING IN FOUNDATION** : Brick work soling in foundation including filling joints with local sand.	146.88	Cu.M	130.00	19094.40
19	**BRICK WORKS CM 1:6** : First class brick work **masonry in C. M. 1:6 (1 cement 6 coarse sand)** with approved good quality country burnt bricks **of compressive strength 35 kg/m2 of standard size of on super structure of all thickness. The rate** shall include cost of all materials labour and other incidental charges of all materials to complete the work.	363.15	Cu.M	2,278.00	827255.70
	1,041.53	**/Sq.M**			**846350.10**
	FLOOR AND WALL FINISHES				
20	**FLOOR FINISHING VITRIFIED TILES** : **Flooring with vitrified tiles 225mm x 225mm (NS) laid in 12mm thick cement mortar 1:3 one** coat and pointing with coloured cement to mortar the tiles including cost of materials labour charges **etc. complete for all levels.**	414.72	Sq.M	1,000.00	414720.00

SlNo	Description	Quantity	Unit	Rate	Amount
21	**FLOOR FINISHING TERRAZZO TILES** : Supplying, paving and polishing terrazo silver grey colour tiles of 30x30cm size and 20mm thick (machine pressed) having mosaic thickness of not less than 6mm, in white base (using JK white or Birla white cement) with approved colour chips no. 3 and 4 over a bed of 20mm thick cement mortar 1:4 adding necessary cement grout for proper bending of tiles to mortar including pointing the joints and closing the voids with cement of the colour to match and polishing with machine three coats to smooth finish cleaning with oxalic acid and mansion polishinng for floors, skirtings, steps etc. Necessary grovees my be provided for steps as per paviou drawing and instruction of the Engeneer in charge.	341.45	Sq.M	295.00	100727.75
22	**SKIRTING VITRIFIED TILES IN SqM** : Skirting using Vitrified Tiles	32.64	Sq.M	600.00	19584.00
23	**SKIRTING TERRAZZO TILES IN SqM** : Skirting using Terrazzo Tiles	44.52	Sq.M	300.00	13356.00
	674.86 /Sq.M				**548387.75**
	DOORS AND WINDOWS				
24	**FRAMES WOOD** : Supplying and fixing of doors and windows frames using good quality wood including M.S. clamps and fittings,fixing complete including a coat of tar at the contact surface of the frame.	1.49	Cu.M	27,840.00	41481.60
25	**SHUTTERS WOOD PANELLED** : Supplying and fixing of shutters of good quality panelled wood.	65.60	Sq.M	1,800.00	118080.00
26	**SHUTTERS SYNTHETIC PANELLED** : Supplying and fixing of glazed shutters of good quality synthetic material.	19.68	Sq.M	800.00	15744.00
27	**DOORS** : Supplying and fixing of doors using good quality wood including M.S. clamps and fittings,fixing complete including a coat of tar at the contact surface of the frame.	97.44	Sq.M	2,780.00	270883.20
28	**WINDOWS** : Supplying and fixing of windows and vents using good quality wood including M.S. clamps and fittings,fixing complete including a coat of tar at the contact surface of the frame.	17.28	Sq.M	2,780.00	48038.40
	608.20 /Sq.M				**494227.20**
	PLASTERING AND POINTING				
29	**PLASTERING WALLS EXT. CM 1:6 12 MM** : Plastering witth cement mortar to exterial walls, columns and other structural architectural features at all heights, floated hard and trowelled get smooth finish. The rate shall include provision of grooves scaffolding at any height curing etc. complete as directed by the Engineer.	195.00	Sq.M	88.00	17160.00
30	**PLASTERING WALLS INT. CM 1:6 12 MM** : Plastering witth cement mortar to inner walls, columns and other structural architectural features at all heights, floated hard and trowelled get smooth finish. The rate shall include provision of grooves scaffolding at any height curing etc. complete as directed by the Engineer.	2,630.63	Sq.M	88.00	231495.44
	306.00 /Sq.M				**248655.44**

SlNo	Description	Quantity	Unit	Rate	Amount
	PAINTING				
31	**PAINTING WOOD ENAMEL** : Painting wood work using two coats of enamel paint over a coat of priming.	192.19	Sq.M	65.00	12492.35
32	**PAINTING WOOD VARNISH** : Varnishing wood work two coats including cleaning and preparing the surface.	192.19	Sq.M	44.00	8456.36
33	**PAINTING WOOD POLISH** : Polishing wood including preparing and smoothening the surface.	192.19	Sq.M	28.00	5381.32
34	**PAINTING WALLS EXT. WHITE WASHING** : White washing three coats to the walls.	195.00	Sq.M	11.00	2145.00
35	**PAINTING WALLS EXT. PLASTIC EMULSION** : Applying plastic emulsion paint two coats including cement primer on prepared plastered surface and sand papering to all intermediate coats including putty.	195.00	Sq.M	48.00	9360.00
36	**PAINTING WALLS EXT. CEMENT PAINT** : Providing and applying two coats of approved brand and shade water proof cement paint over a coat of cement primer to give an ever shade on plastered surfase thereof includes watering and cleaning surface etc. complete as per the instruction of the site engineer for exterial walls.	195.00	Sq.M	35.00	6825.00
37	**PAINTING WALLS INT. PLASTIC EMULSION** : Applying plastic emulsion paint two coats including cement primer on prepared plastered surface and sand papering to all intermediate coats including putty.	2,630.63	Sq.M	48.00	126270.24
38	**PAINTING WALLS INT. WHITE CEMENT** : Painting walls using white cement.	2,630.63	Sq.M	31.00	81549.53
39	**PAINTING WALLS INT. CEMENT PAINT** : Providing and applying two coats of approved brand and shade water proof cement paint over a coat of cement primer to give an ever shade on plastered surfase thereof includes watering and cleaning surface etc. complete as per the instruction of the site engineer for inner walls.	2,630.63	Sq.M	35.00	92072.05
	424.01	**/Sq.M**			**344551.85**
	ELECTRICAL				
40	**ELECTRIFICATION L.S.** : Electrification Works.		L.S.	10,000.00	10000.00
	12.31	**/Sq.M**			**10000.00**
	PLUMBING				
41	**PLUMBING L.S.** : Plumbing and Sanitary works.		L.S.	10,000.00	10000.00
	12.31	**/Sq.M**			**10000.00**
Total for GROUND FLOOR	**6,331.33**	**/Sq.M for 812.60 Sq.M**			**5144837.61**
	FIRST FLOOR				
	PCC				
1	**PCC FLOORING 1:2:4 CuM** : Providing and laying P.C.C . 1:2:4 using 40 mm nominal size broken stone well consolidated 100 mm thick including	75.62	Cu.M	3,233.00	244479.46
	300.86	**/Sq.M**			**244479.46**
	RCC Reinforced cement concrete using 20mm machine crushed blue metal including all form work,				

SlNo	Description	Quantity	Unit	Rate	Amount
	watering, curing etc. complete, but excluding the cost of reinforcement. Steel staging and supports along with shutter ply or steel plates to be used and machine mixing and mechanical vibration to **be done to the satisfaction of the site engineer.The** rate includes application of double stage form work and the application of approved brand of mould releasing agents.				
2	**RCC LINTELS M15** : RCC for Lintels using M15.	16.15	Cu.M	3,605.00	58220.75
3	**RCC STEPS M20** : RCC for Steps using M20.	1.54	Cu.M	3,917.00	6032.18
4	**RCC WAIST SLABS M20** : RCC for Waist Slabs using M20.	2.30	Cu.M	3,937.00	9055.10
5	**RCC COLUMNS M25** : RCC for Columns using M25.	27.54	Cu.M	4,418.00	121671.72
6	**RCC BEAMS M25** : RCC for Beams using M25.	48.45	Cu.M	4,640.00	224808.00
7	**RCC SLABS M25** : RCC for Slabs using M25.	11.90	Cu.M	4,528.00	53883.20
8	**RCC WAIST SLABS M25** : RCC for Waist Slabs using M25.	2.30	Cu.M	4,528.00	10414.40
	595.72	**/Sq.M**			**484085.35**
	FORM WORKS **Supplying, fitting, fixing and removing shuttering and staging. Measurements shall be taken as the** actual surfaces in contact with the concrete or any other materials requiring formwork.				
9	**FORM WORK RCC** : Form work for rcc.	1,772.52	Sq.M	150.00	265878.00
	327.19	**/Sq.M**			**265878.00**
	STEEL REQUIREMENTS **Supplying, cutting, bending and straightening reinforcement for R.C.C work; binding with 22 gauge binding wire etc. complete in all respects with deformed bars conforming to I.S 1786-1961 or IS 1139 and placing in position.Weight of steel=7850 Kg/m3.**				
10	**STEEL REQUIREMENTS** : Steel Requirements **for Columns, Beams, Lintels, Slabs etc.**	14,584.67	Kg	30.00	437540.10
	538.44	**/Sq.M**			**437540.10**
	BRICK WORKS				
11	**BRICK WORKS CM 1:6** : First class brick work **masonry in C. M. 1:6 (1 cement 6 coarse sand)** with approved good quality country burnt bricks **of compressive strength 35 kg/m2 of standard size of on super structure of all thickness. The rate** shall include cost of all materials labour and other incidental charges of all materials to complete the work.	363.15	Cu.M	2,278.00	827255.70
	1,018.04	**/Sq.M**			**827255.70**
	FLOOR AND WALL FINISHES				
12	**FLOOR FINISHING VITRIFIED TILES** : **Flooring with vitrified tiles 225mm x 225mm (NS) laid in 12mm thick cement mortar 1:3 one** coat and pointing with coloured cement to mortar the tiles including cost of materials labour charges **etc. complete for all levels.**	414.72	Sq.M	1,000.00	414720.00

SlNo	Description	Quantity	Unit	Rate	Amount
13	**FLOOR FINISHING TERRAZZO TILES** : **Supplying, paving and polishing terrazo silver grey colour tiles of 30x30cm size and 20mm thick (machine pressed) having mosaic thickness of not less than 6mm, in white base (using JK white or** Birla white cement) **with approved colour chips no. 3 and 4 over a bed of 20mm thick cement mortar 1:4 adding necessary cement grout for** proper bending of tiles to mortar including pointing the joints and closing the voids with cement of the colour to match and polishing with machine three coats to smooth finish cleaning with oxalic acid and mansion polishinng for floors, **skirtings, steps etc. Necessary grovees my be** provided for steps as per paviou drawing and instruction of the Engeneer in charge.	341.45	Sq.M	295.00	100727.75
14	**SKIRTING VITRIFIED TILES IN SqM** : Skirting using Vitrified Tiles	32.64	Sq.M	600.00	19584.00
15	**SKIRTING TERRAZZO TILES IN SqM** : Skirting using Terrazzo Tiles	44.52	Sq.M	300.00	13356.00
	674.86 /Sq.M				**548387.75**
	DOORS AND WINDOWS				
16	**FRAMES WOOD** : Supplying and fixing of doors and windows frames using good quality **wood including M.S. clamps and fittings,fixing** complete including a coat of tar at the contact surface of the frame.	1.49	Cu.M	27,840.00	41481.60

17	**SHUTTERS WOOD PANELLED** : Supplying and fixing of shutters of good quality panelled wood.	65.60	Sq.M	1,800.00	118080.00
18	**SHUTTERS SYNTHETIC PANELLED** : Supplying and fixing of glazed shutters of good quality synthetic material.	19.68	Sq.M	800.00	15744.00
19	**DOORS** : Supplying and fixing of doors using **good quality wood including M.S. clamps and fittings,fixing complete including a coat of tar at the contact surface of the frame.**	97.44	Sq.M	2,780.00	270883.20
20	**WINDOWS** : Supplying and fixing of windows **and vents using good quality wood including M.S. clamps and fittings,fixing complete including a coat of tar at the contact surface of the frame.**	17.28	Sq.M	2,780.00	48038.40
	608.20	**/Sq.M**			**494227.20**
	PLASTERING AND POINTING				
21	**PLASTERING WALLS EXT. CM 1:6 12 MM** : Plastering witth cement mortar to exterial walls, columns and other structural architectural features **at all heights, floated hard and trowelled get smooth finish. The rate shall include provision of** grooves scaffolding at any height curing etc. complete as directed by the Engineer.	195.00	Sq.M	88.00	17160.00
22	**PLASTERING WALLS INT. CM 1:6 12 MM** : Plastering witth cement mortar to inner walls, columns and other structural architectural features **at all heights, floated hard and trowelled get smooth finish. The rate shall include provision of** grooves scaffolding at any height curing etc. complete as directed by the Engineer.	2,630.63	Sq.M	88.00	231495.44
	306.00	**/Sq.M**			**248655.44**

SlNo	Description	Quantity	Unit	Rate	Amount
	PAINTING				
23	**PAINTING WOOD ENAMEL** : Painting wood work using two coats of enamel paint over a coat of priming.	192.19	Sq.M	65.00	12492.35
24	**PAINTING WOOD VARNISH** : Varnishing wood work two coats including cleaning and preparing the surface.	192.19	Sq.M	44.00	8456.36
25	**PAINTING WOOD POLISH** : Polishing wood including preparing and smoothening the surface.	192.19	Sq.M	28.00	5381.32
26	**PAINTING WALLS EXT. WHITE WASHING** : White washing three coats to the walls.	195.00	Sq.M	11.00	2145.00
27	**PAINTING WALLS EXT. PLASTIC EMULSION** : Applying plastic emulsion paint two coats including cement primer on prepared plastered surface and sand papering to all intermediate coats including putty.	195.00	Sq.M	48.00	9360.00
28	**PAINTING WALLS EXT. CEMENT PAINT** : Providing and applying two coats of approved brand and shade water proof cement paint over a coat of cement primer to give an ever shade on plastered surfase thereof includes watering and cleaning surface etc. complete as per the instruction of the site engineer for exterial walls.	195.00	Sq.M	35.00	6825.00
29	**PAINTING WALLS INT. PLASTIC EMULSION** : Applying plastic emulsion paint two coats including cement primer on prepared plastered surface and sand papering to all intermediate coats including putty.	2,630.63	Sq.M	48.00	126270.24
30	**PAINTING WALLS INT. WHITE CEMENT** : Painting walls using white cement.	2,630.63	Sq.M	31.00	81549.53

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	424.01	**/Sq.M**			**344551.85**
	ELECTRICAL				
32	**ELECTRIFICATION L.S.** : Electrification Works.		L.S.	10,000.00	10000.00
	12.31	**/Sq.M**			**10000.00**
	PLUMBING				
33	**PLUMBING L.S.** : Plumbing and Sanitary works.		L.S.	10,000.00	10000.00
	12.31	**/Sq.M**			**10000.00**
Total for FIRST FLOOR	**4,817.94**	**/Sq.M for 812.60 Sq.M**			**3915060.85**
	SECOND FLOOR				
	PCC				
1	**PCC FLOORING 1:2:4 CuM** : Providing and laying P.C.C . 1:2:4 using 40 mm nominal size broken stone well consolidated 100 mm thick including	75.62	Cu.M	3,233.00	244479.46
	300.86	**/Sq.M**			**244479.46**
	RCC Reinforced cement concrete using 20mm machine crushed blue metal including all form work,				

SlNo	Description	Quantity	Unit	Rate	Amount
	watering, curing etc. complete, but excluding the cost of reinforcement. Steel staging and supports along with shutter ply or steel plates to be used and machine mixing and mechanical vibration to be done to the satisfaction of the site engineer.The rate includes application of double stage form work and the application of approved brand of mould releasing agents.				
2	**RCC LINTELS M15** : RCC for Lintels using M15.	16.15	Cu.M	3,605.00	58220.75
3	**RCC STEPS M20** : RCC for Steps using M20.	1.54	Cu.M	3,917.00	6032.18
4	**RCC WAIST SLABS M20** : RCC for Waist Slabs using M20.	2.30	Cu.M	3,937.00	9055.10
5	**RCC COLUMNS M25** : RCC for Columns using M25.	27.54	Cu.M	4,418.00	121671.72
6	**RCC BEAMS M25** : RCC for Beams using M25.	48.45	Cu.M	4,640.00	224808.00
7	**RCC SLABS M25** : RCC for Slabs using M25.	11.90	Cu.M	4,528.00	53883.20
8	**RCC WAIST SLABS M25** : RCC for Waist Slabs using M25.	2.30	Cu.M	4,528.00	10414.40
	595.72	**/Sq.M**			**484085.35**
	FORM WORKS Supplying, fitting, fixing and removing shuttering and staging. Measurements shall be taken as the actual surfaces in contact with the concrete or any other materials requiring formwork.				
9	**FORM WORK RCC** : Form work for rcc.	1,772.52	Sq.M	150.00	265878.00
	327.19	**/Sq.M**			**265878.00**

	STEEL REQUIREMENTS **Supplying, cutting, bending and straightening reinforcement for R.C.C work; binding with 22 gauge binding wire etc. complete in all respects with deformed bars conforming to I.S 1786-1961 or IS 1139 and placing in position.Weight of steel=7850 Kg/m3.**				
10	**STEEL REQUIREMENTS** : Steel Requirements **for Columns, Beams, Lintels, Slabs etc.**	14,584.67	Kg	30.00	437540.10
	538.44	**/Sq.M**			**437540.10**
	BRICK WORKS				
11	**BRICK WORKS CM 1:6** : First class brick work **masonry in C. M. 1:6 (1 cement 6 coarse sand)** with approved good quality country burnt bricks **of compressive strength 35 kg/m2 of standard size** of on super structure of all thickness. The rate shall include cost of all materials labour and other incidental charges of all materials to complete the work.	363.15	Cu.M	2,278.00	827255.70
	1,018.04	**/Sq.M**			**827255.70**
	FLOOR AND WALL FINISHES				
12	**FLOOR FINISHING VITRIFIED TILES** : **Flooring with vitrified tiles 225mm x 225mm (NS) laid in 12mm thick cement mortar 1:3 one** coat and pointing with coloured cement to mortar the tiles including cost of materials labour charges **etc. complete for all levels.**	414.72	Sq.M	1,000.00	414720.00

SlNo	Description	Quantity	Unit	Rate	Amount
13	**FLOOR FINISHING TERRAZZO TILES** : **Supplying, paving and polishing terrazo silver grey colour tiles of 30x30cm size and 20mm thick (machine pressed) having mosaic thickness of not less than 6mm, in white base (using JK white or Birla white cement) with approved colour chips no. 3 and 4 over a bed of 20mm thick cement mortar 1:4 adding necessary cement grout for** proper bending of tiles to mortar including pointing the joints and closing the voids with cement of the colour to match and polishing with machine three coats to smooth finish cleaning with oxalic acid and mansion polishinng for floors, **skirtings, steps etc. Necessary grovees my be** provided for steps as per paviou drawing and instruction of the Engeneer in charge.	341.45	Sq.M	295.00	100727.75
14	**SKIRTING VITRIFIED TILES IN SqM** : Skirting using Vitrified Tiles	32.64	Sq.M	600.00	19584.00
15	**SKIRTING TERRAZZO TILES IN SqM** : Skirting using Terrazzo Tiles	44.52	Sq.M	300.00	13356.00
	674.86	**/Sq.M**			**548387.75**
	DOORS AND WINDOWS				
16	**FRAMES WOOD** : Supplying and fixing of doors and windows frames using good quality **wood including M.S. clamps and fittings,fixing** complete including a coat of tar at the contact surface of the frame.	1.49	Cu.M	27,840.00	41481.60
17	**SHUTTERS WOOD PANELLED** : Supplying and fixing of shutters of good quality panelled wood.	65.60	Sq.M	1,800.00	118080.00

18	**SHUTTERS SYNTHETIC PANELLED** : Supplying and fixing of glazed shutters of good quality synthetic material.	19.68	Sq.M	800.00	15744.00
19	**DOORS** : Supplying and fixing of doors using **good quality wood including M.S. clamps and fittings,fixing complete including a coat of tar at** the contact surface of the frame.	97.44	Sq.M	2,780.00	270883.20
20	**WINDOWS** : Supplying and fixing of windows **and vents using good quality wood including M.S. clamps and fittings,fixing complete including a** coat of tar at the contact surface of the frame.	17.28	Sq.M	2,780.00	48038.40
		608.20	**/Sq.M**		**494227.20**
	PLASTERING AND POINTING				
21	**PLASTERING WALLS EXT. CM 1:6 12 MM** : Plastering witth cement mortar to exterial walls, columns and other structural architectural features **at all heights, floated hard and trowelled get smooth finish. The rate shall include provision of** grooves scaffolding at any height curing etc. complete as directed by the Engineer.	195.00	Sq.M	88.00	17160.00
22	**PLASTERING WALLS INT. CM 1:6 12 MM** : Plastering witth cement mortar to inner walls, columns and other structural architectural features **at all heights, floated hard and trowelled get smooth finish. The rate shall include provision of** grooves scaffolding at any height curing etc. complete as directed by the Engineer.	2,630.63	Sq.M	88.00	231495.44
		306.00	**/Sq.M**		**248655.44**

SlNo	Description	Quantity	Unit	Rate	Amount
	PAINTING				
23	**PAINTING WOOD ENAMEL** : Painting wood work using two coats of enamel paint over a coat of priming.	192.19	Sq.M	65.00	12492.35
24	**PAINTING WOOD VARNISH** : Varnishing wood work two coats including cleaning and preparing the surface.	192.19	Sq.M	44.00	8456.36
25	**PAINTING WOOD POLISH** : Polishing wood including preparing and smoothening the surface.	192.19	Sq.M	28.00	5381.32
26	**PAINTING WALLS EXT. WHITE WASHING** : White washing three coats to the walls.	195.00	Sq.M	11.00	2145.00
27	**PAINTING WALLS EXT. PLASTIC EMULSION** : Applying plastic emulsion paint two coats including cement primer on prepared plastered surface and sand papering to all intermediate coats including putty.	195.00	Sq.M	48.00	9360.00
28	**PAINTING WALLS EXT. CEMENT PAINT** : Providing and applying two coats of approved brand and shade water proof cement paint over a coat of cement primer to give an ever shade on plastered surfase thereof includes watering and **cleaning surface etc. complete as per the** instruction of the site engineer for exterial walls.	195.00	Sq.M	35.00	6825.00
29	**PAINTING WALLS INT. PLASTIC EMULSION** : Applying plastic emulsion paint two coats including cement primer on prepared plastered surface and sand papering to all intermediate coats including putty.	2,630.63	Sq.M	48.00	126270.24
30	**PAINTING WALLS INT. WHITE CEMENT** : Painting walls using white cement.	2,630.63	Sq.M	31.00	81549.53

31	**PAINTING WALLS INT. CEMENT PAINT** : Providing and applying two coats of approved brand and shade water proof cement paint over a coat of cement primer to give an ever shade on plastered surfase thereof includes watering and cleaning surface etc. complete as per the instruction of the site engineer for inner walls.	2,630.63	Sq.M	35.00	92072.05
	424.01	**/Sq.M**			**344551.85**
	ELECTRICAL				
32	**ELECTRIFICATION L.S.** : Electrification Works.		L.S.	10,000.00	10000.00
	12.31	**/Sq.M**			**10000.00**
	PLUMBING				
33	**PLUMBING L.S.** : Plumbing and Sanitary works.		L.S.	10,000.00	10000.00
	12.31	**/Sq.M**			**10000.00**
Total for SECOND FLOOR	**4,817.94**	**/Sq.M for 812.60 Sq.M**			**3915060.85**

		GF+FF+SF = 12,974,959.3
Add 2.50% for Electrification		**324,373.983**
Add 2.50% for Plumbing		**324,373.983**
Unforeseen Works		**4665.00**
Net Amount	**2437.8 Sq.M**	**13,623,707.3**

Estimation of Shopping Complex is done by using Estimator 2.0 and found to be rupees 13,623,707.3

CHAPTER – 18
CONCLUSION

We have successfully completed our Domain project in the domain program of Construction Planning and Project Management. The project was all about the planning, design and estimation of the assigned buildings i.e. Shopping Complex of CUTM, PKD Campus. The project was also about consideration of the Quality control and assurance of the buildings and the material, time and cost management through project scheduling.

The project enhanced the knowledge of software like AutoCAD, Staad Pro., Sketch Up, MS Project and Estimator.

We have prepared the plan elevation and section by using AutoCAD, designed the beams and columns and its reinforcement by using Staad Pro. And designed the slab and footings manually. After that we have estimated the entire building by using Estimator software and prepared the Gantt Chart and Network Diagram by using MS Project software.

We have been introduced to almost all the aspects of the construction industry by this project in CPPM Domain Program. This knowledge will definitely help us in future. The matchless effort of the coordinators of the domain program was very much appreciating and we are pleased to get this opportunity.