



Integrated Re-Development of Puri Railway Station at Puri, (on EPC)

CONTRACT NO: 12/CE/CON/III/BBS/ECOR/2022, Dated 7-11-2022

EXECUTIVE AGENCY



BCBCPL

B. C. BHUYAN CONSTRUCTIONS PVT. LTD.

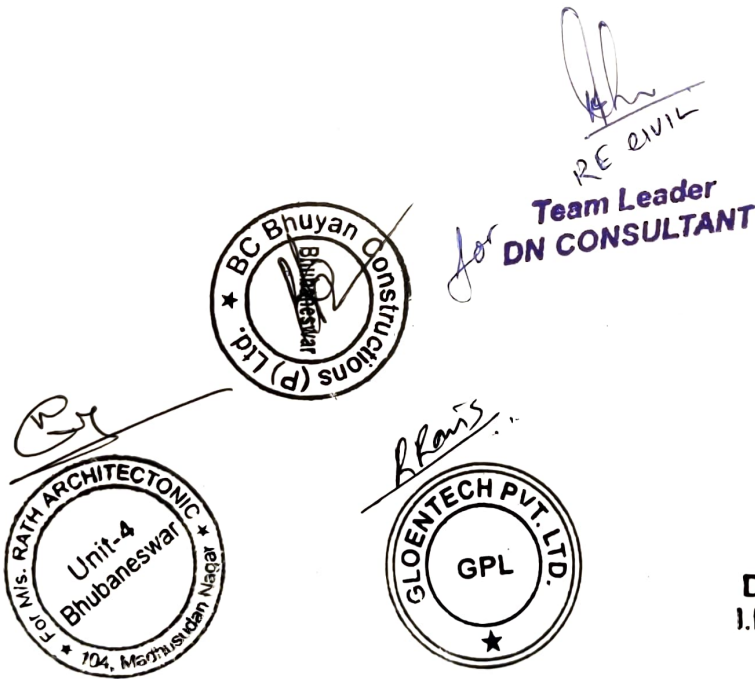
DESIGN BASIC REPORT



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Reviewed & Approved by (TL, DN Consultant): Or By Dy. Chief Engineer			 Team Leader DN CONSULTANT	



DESIGN BASIC REPORT
OF
PROPOSED RE-DEVELOPMENT OF RAILWAY STATION
AT PURI, ODISHA



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CLIENT:



EAST COAST
RAILWAY

EXECUTING AGENCY:



BC BHUYAN
CONSTRUCTIONS PVT. LTD.
BHUBANESHWAR

ARCHITECT:



RATH
ARCHITECTONIC

STRUCTURAL CONSULTANT:



GLOENTECH
PRIVATE
LIMITED



PROJECT: "PROPOSED RE-DEVELOPMENT OF RAILWAY STATION BUILDING AT PURI."

TITLE : Design Calculation Report

DOCUMENT NO : GPL/6170/STN/STR/DCR/R2

1. STRUCTURAL SERVICES

DATE	ISSUE	PREPARED	CHECKED	REVISION
17-11-2022	Report	DARSHANA	VG	R0
05-04-2023	Report	DARSHANA	VG	R1
12-05-2023	Report	PRERNA	VG	R2

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PROJECT BRIEF

The client East Coast Railway intends to construct RAILWAY STATION BUILDING AT PURI. There are single building configurations with G+3+Terrace floors. The architect has been appointed for comprehensive consultancy services which includes Architectural, Structural, MEP etc. We, GLOENTECH PVT LTD, is working with Architect RATH ARCHITECTONIC as a team for Structural Engineering and Electro-Mechanical services. The executive agency being BC BHUYAN CONSTRUCTIONS PVT LTD, BHUBANESHWAR. Our scope includes concept designs and detailed designs with GFC for Structural Engineering and services.

Floors	Details
Basement Floor	No Basement
Ground/Plinth floor	Offices, Lobby Area, Seating and concourse area, Electrical panel room, Storerooms, Toilets, etc. (Height -5.0m)
First Floor	Food court, Seating area, shops, passages, Lounge, Balcony Toilets(Height 4.5m)
Second Floor	Offices, Rest Rooms, Store rooms, Seating areas, System rooms, Passages, LibraryLounges, Toilets, etc. (Height 4.0m)
Third Floor	Rooms, Dormitory, Balcony, Passages, Store rooms, Toilets, etc. (Height 4.0m)
Terrace LMR	Height 3.0 m above terrace
Elevation above terrace.	Overall Height 9.7 m above terrace

STRUCTURAL SERVICES

1.1 DESIGN DATA

1.1.1. Dead Loads:

Dead load shall include weight of all structural and Architectural components. Self-weight of the materials shall be calculated on the basis of unit weights given in IS: 875.

Floor finish of 50mm thick for Residential Floors	: 100kg/sq.m (1.0kN/sq.m)
Floor finishes in various areas to be as per arch drawings.	
For Granite flooring average density (Avg. 70mm screed & stone)	: 180kg/cum (1.8kN/sqm)
▪ Floor finish of 50mm thick for Parking Areas	: 100kg/sq.m (1.0kN/sq.m)
▪ False ceiling + ducting + Sprinklers	: 75 kg/sq.m (0.75 kN/sq.m)
▪ Partition walls (Aerated block masonry)	: 865 kg/cu.m (8.65 kN/cu.m)
▪ Int/Ext Wall (Aerated block masonry)	: 865 kg/cu.m (8.65 kN/cu.m)
▪ Self-weight of Plain Concrete	: 2400 kg/cu.m (24 kN/cu.m)
▪ Self-weight of RCC	: 2500 kg/cu.m (25 kN/cu.m)
▪ Solid block masonry	: 2000 kg/cu.m (20 kN/cu.m)
▪ Brick Wall (Including Joint mortar & Plaster)	: 2200 kg/cu.m (22 kN/cu.m)
▪ Soil (Dry)	: 1800 kg/cu.m (18 kN/cu.m)
▪ Soil (Wet)	: 2000 kg/cu.m (20 kN/cu.m)
▪ Water	: 1000 kg/cu.m (10 kN/cu.m)
▪ Glass	: 2500 kg/cu.m (25 kN/cu.m)
▪ Stainless steel	: 8000 kg/cu.m (80 kN/cu.m)
▪ Masonry with plastering	: 2200 kg/cu.m (22 kN/cu.m)
▪ Filling for sunken portion (Wherever filling is required).	: 1000 kg/cu.m (10 kN/cu.m)
(Only light weight filling is considered)	
▪ Waterproofing (membrane).	: 15kg/sq.m (0.15kN/sq.m)
Terrace for slope screeding done (Avg. 50mm)	: 100kg/sqm (1kN/Sqm)
▪ External finishes	: As per actuals.
▪ Gardening/Landscape loads	: 600mm filling, Planter box at column capital locations (2.5x2.5M)
▪ Equipment loads	: As per Drawing and details.

1.1.2 Live Loads :

The superimposed loads shall be calculated in accordance with IS: 875 (Part-2) based on Occupancy Classification. For multiple occupancies of use in the building shall be referred with the other appropriate comparable occupancy classification as per Table. 1 of IS 875 (Part-2)-1987.

Following live loads are considered while designing the structural elements apart from the dead loads as per codes:

▪ Food Court	500 kg/sq.m (5 kN/sq.m)
▪ Passage/Corridor	500 kg/sq.m (5 kN/sq.m)
▪ Seating Area (For sleeper/general class/first class passengers)	500 kg/sq.m (5 kN/sq.m)
▪ Food Plaza	500 kg/sq.m (5 kN/sq.m)
▪ Shop	500 kg/sq.m (5 kN/sq.m)
▪ Toilets	300 kg/sq.m (3 kN/sq.m)
▪ Mini-Cloak Room	500 kg/sq.m (5 kN/sq.m)
▪ Smoking Room	500 kg/sq.m (5 kN/sq.m)
▪ Chi Room	500 kg/sq.m (5 kN/sq.m)
▪ Children's Play Room	500 kg/sq.m (5 kN/sq.m)
▪ Baby Feed Room	500 kg/sq.m (5 kN/sq.m)
▪ Mini Electrical/Tele. Panel Room	500 kg/sq.m (5 kN/sq.m)
▪ Paid Lounge	500 kg/sq.m (5 kN/sq.m)
▪ Caretaker Room/TTE Store	400 kg/sq.m (4 kN/sq.m)
▪ TTE Restroom	400 kg/sq.m (4 kN/sq.m)
▪ Camp Court	400 kg/sq.m (4 kN/sq.m)
▪ SSE Works/Pway	400 kg/sq.m (4 kN/sq.m)
▪ SSEE/P Store	400 kg/sq.m (4 kN/sq.m)
▪ SMR Store	400 kg/sq.m (4 kN/sq.m)
▪ DTI Office	400 kg/sq.m (4 kN/sq.m)
▪ Station Director Room	400 kg/sq.m (4 kN/sq.m)
▪ Staff Restroom (Gents/Ladies)	400 kg/sq.m (4 kN/sq.m)
▪ Mini Kitchen + Pantry	400 kg/sq.m (4 kN/sq.m)
▪ Dining Room	400 kg/sq.m (4 kN/sq.m)
▪ Balconies	500 kg/sq.m (5 kN/sq.m)
▪ Chajjas	150 kg/sq.m (1.5 kN/sq.m)
▪ Seating Area	400 kg/sq.m (4 kN/sq.m)
▪ BMS Room/Telephone Exchange/PA System Room/RCIL (POP)/CCTV	400 kg/sq.m (4 kN/sq.m)
▪ Yoga Room	500 kg/sq.m (5 kN/sq.m)
▪ Library	500 kg/sq.m (5 kN/sq.m)
▪ SSEE/AC & TL Room	400 kg/sq.m (4 kN/sq.m)
▪ SSE Signal/Maintenance Room	400 kg/sq.m (4 kN/sq.m)
▪ VIP Lounge	400 kg/sq.m (4 kN/sq.m)
▪ SSE Tele./Elec.	400 kg/sq.m (4 kN/sq.m)
▪ Rail Tail	400 kg/sq.m (4 kN/sq.m)
▪ Retiring Room	400 kg/sq.m (4 kN/sq.m)
▪ Bedroom	400 kg/sq.m (4 kN/sq.m)
▪ Dormitory	400 kg/sq.m (4 kN/sq.m)
▪ Room	400 kg/sq.m (4 kN/sq.m)
▪ Stairs	300 kg/sq.m (3 kN/sq.m)

Actual loading due to lifts loads shall be ascertained and design live loads are suitably modified (if required) and considered.

1.1.3 Gardening/Landscape Loads: As per architectural detailed drawings as per requirements.

- ☐ Basic Wind Speed, V_b : 70 m/sec
- ☐ Risk Coefficient, K_1 : 1.00 (k_1 corresponds to 50 years Mean Probable Design Life of Structure)
- ☐ Terrain, height, structure size factor K_2 : To suit the height of the structure for terrain

Category 2, it varies with the height of the structure.

- ☐ Topography factor, K_3 : 1.00
- ☐ Topography factor, K_4 : 1.00 (Importance Factor)
- ☐ The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)-2015
- ☐ Design wind speed, V_z : $V_b \times k_1 \times k_2 \times k_3 \times k_4$
- ☐ Design wind pressure, P_z : $0.6 \times V_z^2$

k_2 - By Interpolations for 30.2 m (17.5+12.7 elevation ht.): 1.04

Wind Pressure : $0.6 \times (70 \times 1 \times 1.04 \times 1 \times 1)^2 = 3179.9 \text{ kg/m}^2 = 31.18 \text{ kN/m}^2$

Wind loads are applied in the ETABS model by defining wind speed, category, class and force coefficients as per IS-875 (part-3) 2015.

1.1.5 Seismic Forces

Puri station building falls under seismic zone III as per IS 1893-2016 (Part 1) (Fifth Revision) and has the following factors to be considered for designs. (Please refer attached map).

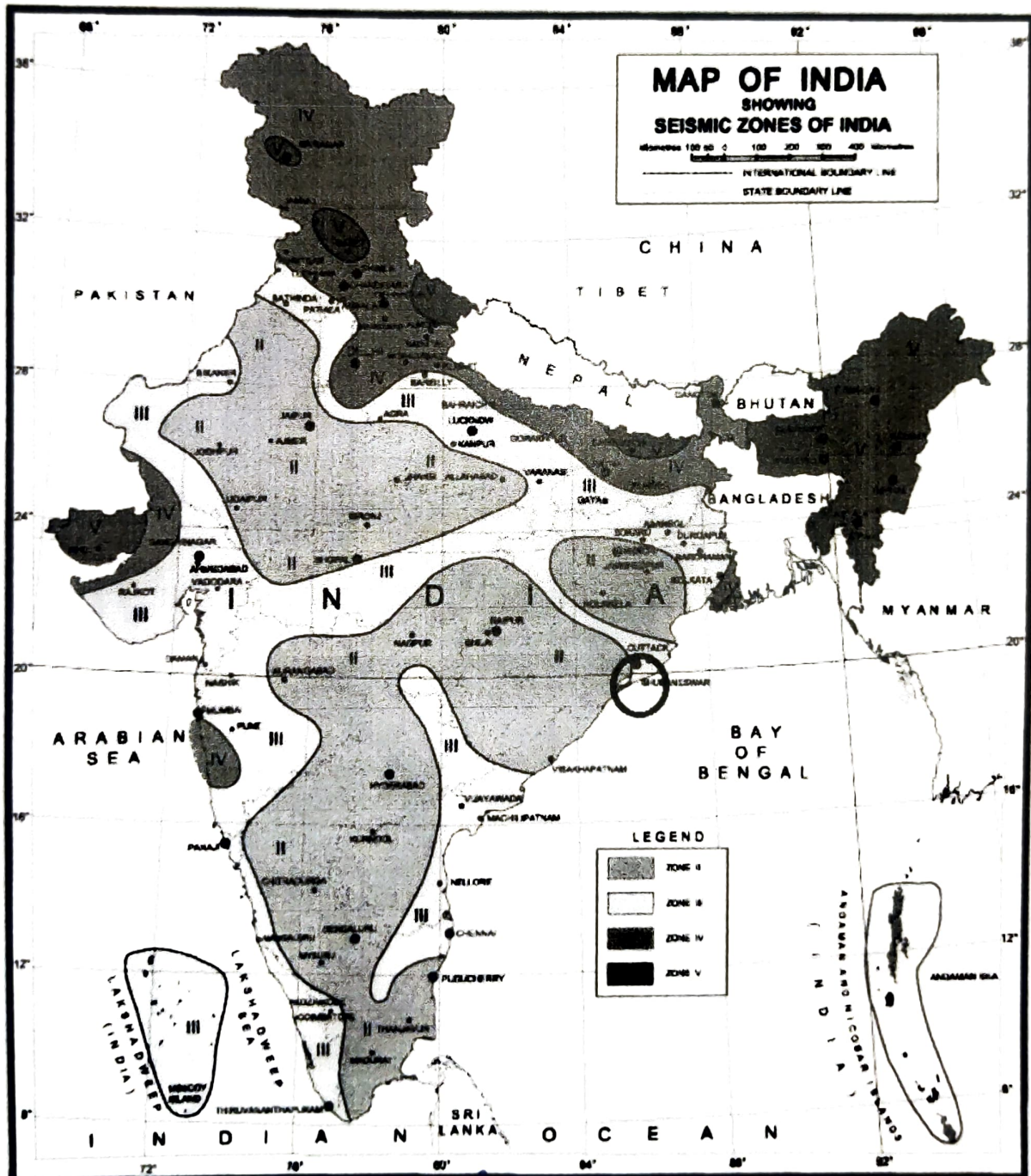
- ☐ Seismic Zone : III IS 1893 (Part-1):2016
- ☐ Seismic Zone factor, Z : 0.16 IS 1893 (Part-1):2016
- ☐ Design horizontal seismic coefficient (A_h) : $(Z/2) \times (S_a/g) \times (I/R)$.
- ☐ I-Importance factor : 1.5 IS 1893 (Part-1):2016
- ☐ Response reduction Factor : 5 (RCC Shear walls) Structural system adopted as per

Table 9 of IS:1893-2016 Gravity elements are designed for displacement compatibility.

- ☐ R as per Table 7 of IS: 1893-2016.
- ☐ S_a/g – Average response acceleration coefficient for soil sites as per Fig.2 of IS: 1893-2016 and it is arrived based on appropriate natural periods as per clause 7.6.1 of IS: 1893-2016.

- ☐ Design horizontal seismic coefficient (A_h) : $(Z/2) \times (S_a/g) \times (I/R)$.
- : $(0.16/2) \times (1.5/5) \times (S_a/g)$
- A_h : $0.024 \times (S_a/g)$
- ☐ Design seismic base shear, V_b : $A_h \times W$ where, W - seismic weight of building.
- ☐ Effect of infill panels : Considered in the analysis. Detailing
- as per IS 456:2000 & SP 34 : Ductile detailing will be followed

Table No : 02				
Zone Factor, Z				
(Clause 6.4.2)				
Seismic Zone	II	III	IV	V
Seismic Intensity	Low	Moderate	Severe	Very Severe
Z	0.10	0.16	0.24	0.3 6



1.1.6 Environmental conditions, Corrosion and Fire protection for concrete and structural steel

- ☐ Environment : Underground structures (Severe), Above ground structures Concealed (Moderate), Above ground exposed (Severe)
- ☐ Exposure conditions : Concrete surfaces sheltered from severe rain or freezing whilst wet environment
- ☐ Fire protection : Thickness of the structural elements as per table 15, 16 & 16A clause 26.4 of IS 456-2000. (Lift and staircase 2 hour fire rating, rest all elements minimum 1.5hr min fire rating.
- ☐ Minimum grade of concrete : M35 Grade
- ☐ Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 25 mm. For Isolated foundations 50mm cover, for piles and pile cap 75mm cover. Covers as per Table 16, IS 456:2000
- ☐ Nominal covers for 2 hr. fire resistance : As per IS 456:2000, Table 16A Clause 21.4 & 26.4.3

Table 16 Nominal Cover to Meet Durability Requirements
(Clause 26.4.2)

Exposure	Nominal Concrete Cover in mm not Less Than
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

Nominal Cover (2hour Fire rating)						
Beams		Slabs		Ribs		Columns
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
40 mm	30 mm	35 mm	25 mm	45 mm	35 mm	40 mm

1.1.7 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in concrete buildings. It will be taken care of by designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered.

1.1.8 Temperature Loads:

Temperature load considered at terrace floor level.

1.1.9 Exceptional Loads:

Expansion load is not considered for analysis.

1.2. MATERIALS

Materials specified conform to the latest edition of the relevant Indian Standard or other accepted standard. Specifications for materials will include sampling and testing as stipulated in the design standards. Detailed material specifications will be included in the Technical Specification.

1.2.1 Concrete

- ☐ All structural concrete shall have cube crushing strength of M40 to M35 N/sq.mm at 28 days.
- ☐ Plain cement concrete shall have cube crushing strength of 20 N/sq.mm (M20) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation	M35
Columns & Walls	M40
Slab, beams	M40

1.2.2 Reinforcement steel

All reinforcement shall conform to IS: 1786 – 2008 having minimum yield strength of 500 N/sq.mm.

1.2.3 Structural Steel:- No any requirement in Structural steel.

1.2.4 Expansion Joint Material

Expansion strips will be considered instead of expansion joints

1.2.5 Water Proofing Material

Chemical water proofing, membrane type water proofing will be considered

1.2.6 Mechanical Splicing Material

Moment Coupler – Threaded Type M

Mechanical couplers should be conforming to & compatible with the ductile requirements

1.2.7 IS STANDARDS – MATERIAL

- IS: 269 - 1989 : Specification for ordinary, rapid hardening and low heat Portland cement.
- IS: 455 - 1989 : Specification for Portland blast furnace slag cement.
- IS: 1489 – 1991 : Specification for Portland pozzolana cement
- IS: 4031 - 1991 : Method of physical tests for Portland cement.
- IS: 383 - 1970 : Specification for coarse and fine aggregates from natural sources for concrete.
- IS: 516 -1959 : Method of test for strength of concrete.
- IS: 1199 -1959 : Method of sampling and analysis of concrete.

- IS: 432 -1982 : Specification for mild steel and medium tensile steel bars and harddrawn steel wire for concrete reinforcement.
- IS: 1139 : Specification for hot rolled mild steel and Medium tensile steel deformed bars for concrete reinforcement.
- IS: 1566 -1982 : Specification for plain hard drawn steel wire fabric for concrete reinforcement.
- IS: 1786 -2008 : Specification for high tensile bars for concrete reinforcement.
- IS: 4990 -1993 : Specification for plywood for concrete shuttering works.
- IS: 2645 -1975 : Specification for integral cement water proofing compounds.
- BS: 4449: 1997 : Specification for carbon steel bars for the reinforcement of concrete.

1.3. DESIGN STANDARDS

Specific applicable codes and standards will be identified and adopted in the design philosophies as appropriate to the structural elements. The latest editions of the Codes and Standards will be used in designs. All design work shall be based on Indian Standards and Codes with latest revision, with amendments if any, as on date. Latest Versions including amendments shall be used.

- IS: 432(part 2) – 1982 : Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.
- IS: 1786-2008 : Specification for high strength deformed steel bars and wires for concrete reinforcements
- IS: 12269 : Ordinary Portland cement 53 grade Standards for anti-termite treatment
- IS: 6313 (part II) :
- IS: 875 (part 1)-1987 : Code of practice for design loads (other than earthquake) for buildings and structures - unit weights of buildings materials and stored material
- IS: 875 (part 2)-1987 : Code of practice for design loads (other than earthquake) for buildings and structures - imposed
- IS: 875 (part 3)-2015 : Code of practice for design loads (other than earthquake) for buildings and structures - wind loads
- IS: 875 (part 5)-1987 : Code of practice for design loads (other than earthquake) for buildings and structures - special loads and load combinations
- IS: 456-2000 : Code of practice for plain and reinforced concrete
- IS: 1343 – 1980 : Code of practice for prestressed concrete
- IS: 14268 – 1995 : Uncoated stress relieved low relaxation seven-ply strand for prestressed concrete – specification
- IS: 1893 part 1 – 2016 : Criteria for earthquake resistant design of structures (part-1 general provisions and buildings)
- IS: 4326 -1993 : Code of practice for earthquake resistant design and construction of buildings.
- IS: 2751 : Code of practice for welding of mild steel bars used for reinforced concrete

construction.

- ☐ IS: SP 34-1987 : Handbook on concrete reinforcement and detailing
- ☐ IS: 800 – 2007 : Code of practice in general construction in Steel
- ☐ IS: 1904 – 1986 : Code of practice for structural safety of building foundations.
- ☐ SP: 16 – 1980 : Design aid for reinforced concrete to IS 456.
- ☐ Reference : Major Development Plan
- ☐ IS 13920 – 2016 : Code of practice for Ductile detailing
- ☐ SP24 : Hand book for IS code

Wherever appropriate Indian Regulation does not exist for any particular item, appropriate ACI/British standards will be used.

1.4. STRUCTURAL CONCEPT

- ☐ The Structural System comprises of shear walls & columns. Upper floors from first floor, second floor, third floor and terrace roof will be comprised of beams, slabs and perimeter beams, flat slabs with drop panels are considered, shear walls are considered to have more carpet area and flexibility in interiors without offsets of columns and beams. Floor slabs are considered to act as a rigid diaphragm to transfer the lateral forces to the columns and shear walls which are vertical elements and are continuous from top to foundations.
- ☐ The slabs for balconies/dry balconies are with sunk as per requirement. The slabs for toilet areas are with fill. The cut outs in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Predetermined sleeves shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout. Structural Configuration – Conventional/ Post tension Beam and slab system.

1.5 STRUCTURAL ANALYSIS AND DESIGN

1.5.1. General

All R.C.C structures shall be designed according to the Limit State Method as specified in IS: 456 – 2000.

- ☐ The structure is idealized as 3D space frame and analyzed using ETABS software package for both vertical and lateral loads. Building have been idealized for lateral load resisting frames and gravity column system.
- ☐ Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- ☐ The foundations are designed for critical load combination. Open footing is suggested as per soil investigation report. Loads are assumed to be dispersed at an inclination of 45° from the column base
- ☐ The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.
- ☐ The slab is analyzed as two-way and one-way slabs, flat slab with drop panel & Cantilever Slabs.
- ☐ Design of structural steel members are made using elastic method as per IS: 800.

1.5.2. Deflection Limits:

For Reinforced concrete works:

Limiting values of deflection (Short and Long term) as per clause 35.3 of IS: 456-2000 is followed in the design. Limiting value for short-term and long-term deflection including dead and live load is considered as span/250. Differential incremental ($L/350$ or 20mm) deflection criteria for gravity loads.

As per IS 1893 (Part1):2016, Storey drift in any storey due to minimum specified design seismic lateral forces shall not exceed 0.004 times the storey height design. Lateral sway due to wind load should not exceed $H/500$ (H is the total height of structure).

1.5.3. Cracking Limits:

Limiting values of crack width as per clause 35.3 of IS: 456-2000 is followed in the design. In general, for slabs and beams, the crack width is limited to 0.3mm. For basement retaining wall and water retaining structures, foundations and other underground structures in contact with sub-stratum/backfill crack width is limited to 0.2 mm.

In model following parameters will be used for cracked properties

Ultimate Limit State (Design against Wind and Seismic loads)

Structural Elements	Stiffness Modifiers
Shearwalls	0.7 Ig
Beams	0.35 Ig
Slabs	0.25 Ig
Columns	0.7 Ig

1.5.4. Load Combinations:

The various loads are combined in accordance with the stipulations in IS: 875 (Part 5)-1987; whichever combination produces the most unfavourable effect in the building foundation or structural member concerned may be adopted.

Load Combination	Limit State of Collapse				Limit State of Serviceability		
	DL	LL	WL/E L	WL	DL	LL	WL/EL
DL + LL	1.5	1.5	—	—	1	1	—
DL + WL	1.5 or 0.9*	—	1.5	—	1	—	1
DL + EL	1.5 or 0.9*	—	1.5	—	1	—	1
DL+LL+WL	1.2	1.2	1.2	—	1	0.8	0.8
DL+LL+EL	1.2	1.2	1.2	—	1	0.8	0.8

*This value is to be considered when stability against overturning and stress reversal is critical where DL/LL/WL/EL denotes,

DL - Dead Load; LL - Live Load; WL - Wind Load; EL - Earthquake Load

Wind load and earthquake loads are considered for both X & Y directions. Whenever imposed load is combined with earthquake load, the appropriate part of imposed load as specified in IS: 1893-2016/Clause 7.3.1 of seismic code will be used both for evaluating earthquake effect and for combined load effects used in such combinations.

1.6. EXPANSION JOINTS

There is no expansion joint.

1.7. SOIL DATA

As per soil investigation report it was found that strata encountered bellow 4m depth from present NGL.

1.8 WATERPROOFING

Chemical and membrane type water proofing

1.8.2. Toilet & Balconies

Chemical and membrane type water proofing

1.8.3 Terrace

Brick bat coba for terrace water proofing will be used

1.8.4. Water Bodies

Chemical and membrane type water proofing

1.8.5 Fire Tender path

Chemical and membrane type water proofing

1.8.6. Landscape Areas

Chemical and membrane type water proofing

1.9. DESIGN PHILOSOPHY

1.9.1. Design Life

The design life of the building is assumed as 50 years. This requirement is applicable only for concrete works and not applicable to replaceable finishing materials, water proofing membrane and thermal insulations (if any). Hence periodic maintenance/refurbishment is required for all replaceable material for longer life

1.9.2. Design Interface

This structure has physical interface with almost all the disciplines like Geotechnical, MEP Services and Landscape etc. The Structure proposed is of cast in-situ concrete construction with columns suitably placed. The core walls around lifts, stairs are of cast in-situ concrete significantly used for lateral loads.

The Structural design of the proposed project is based on Indian Standard Codes and is analyzed for Dead, Live, Wind and Seismic Load conditions taking into relevant load combinations recommended by the codes.

The Vertical Loads including the dead and super imposed loads are transferred to the soil through columns, core

walls and footings. Open foundation is consideration to the safe bearing capacity of soil at the level of transfer of load recommended by soil investigation consultants.

The Lateral loads due to wind and seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns.

1.9.1. Foundation

Foundations are designed based upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below.

STRUCTURAL RESULT AND ANALYSIS

1.1 MATHEMATICAL 3D MODEL

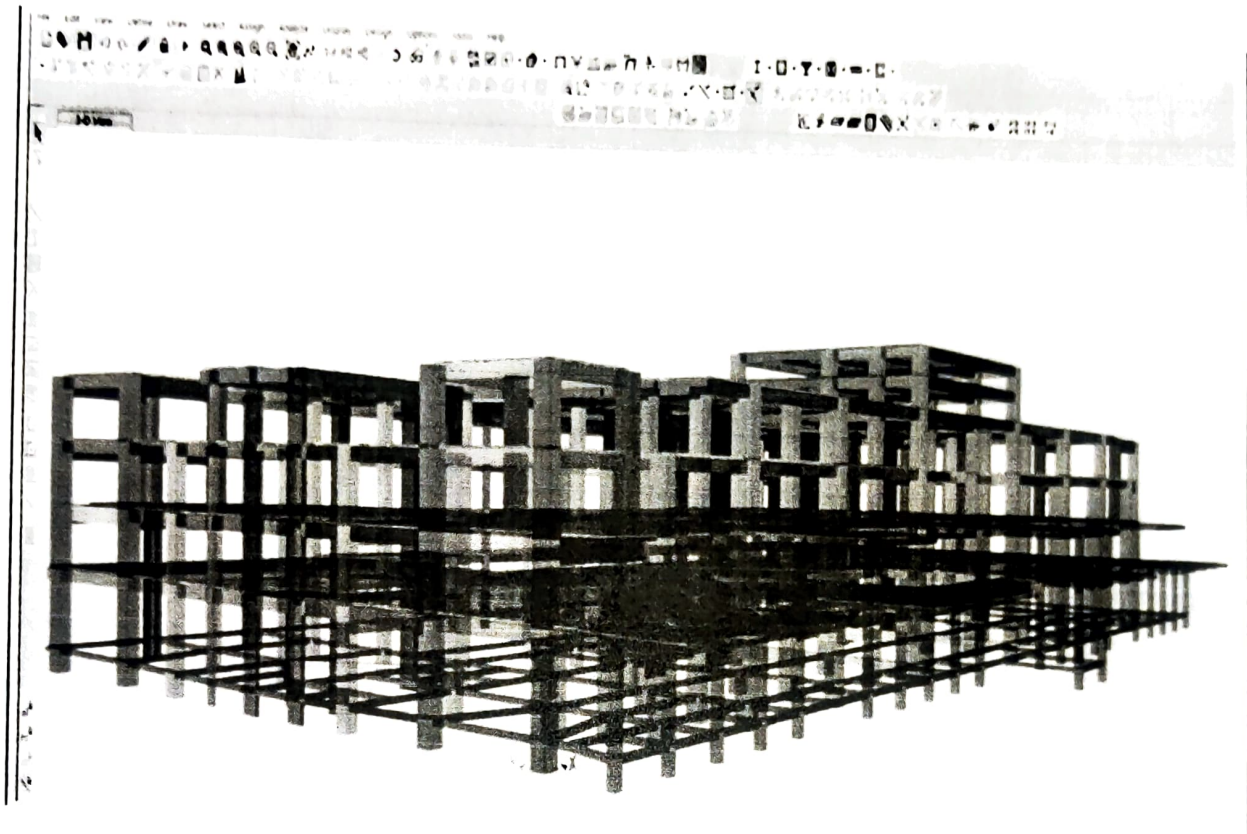


Fig. Mathematical 3D Model



12/5/23
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1.2 DEAD & LIVE LOAD CONTOURS

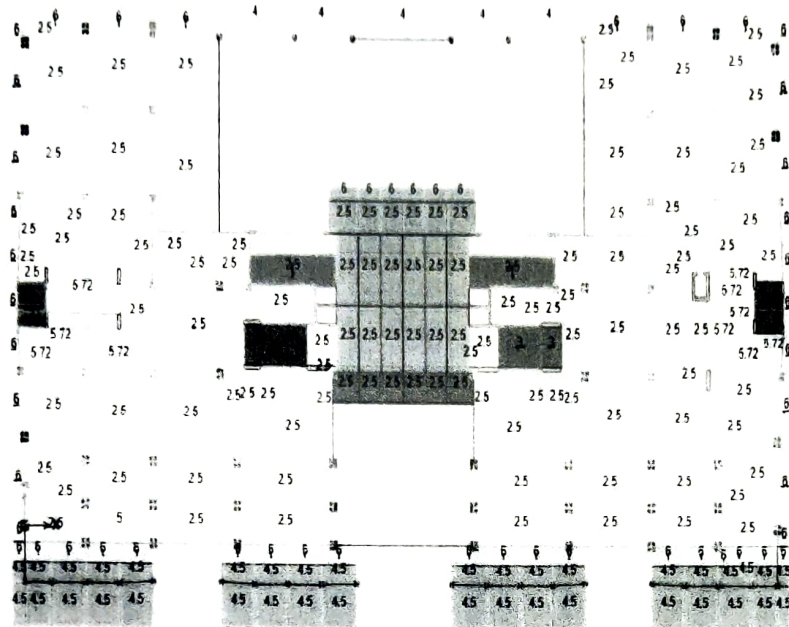


Fig. Plan showing Dead Load contour for First Floor

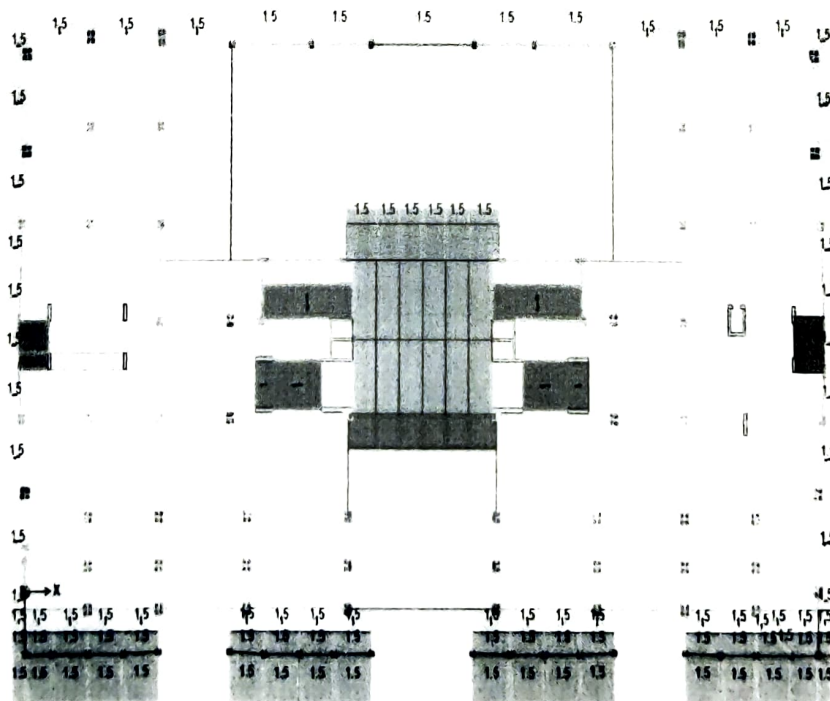


Fig. Plan showing Live Load (<3) contour for First Floor

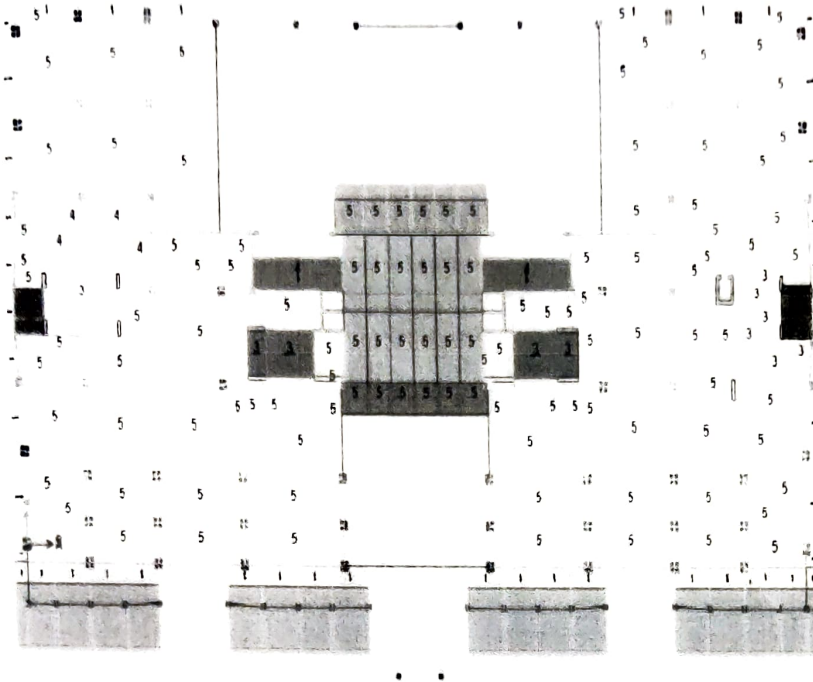


Fig. Plan showing Live Load (>3) contour for First Floor

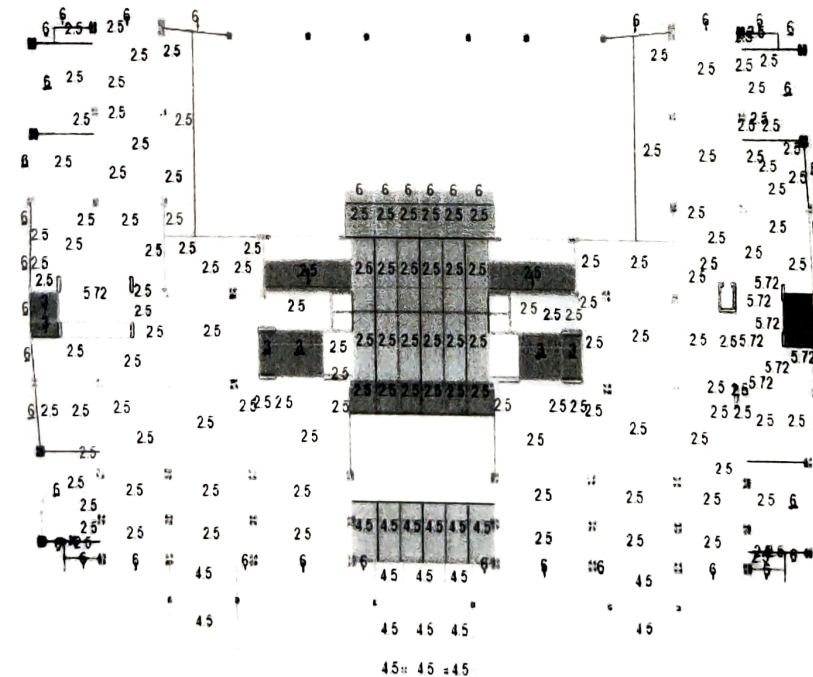


Fig. Plan showing Dead Load contour for Second Floor

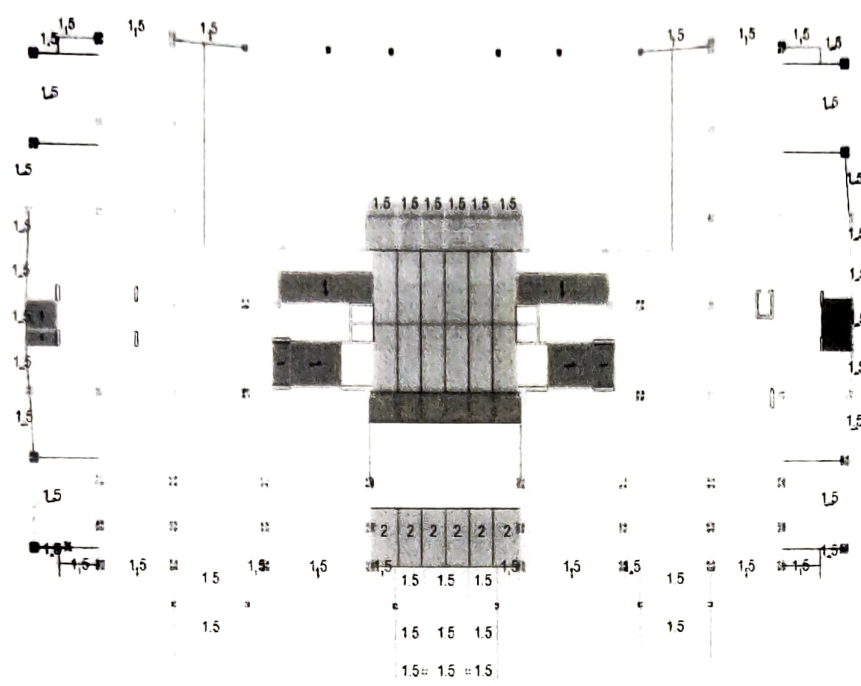


Fig. Plan showing Live Load (<3) contour for Second Floor

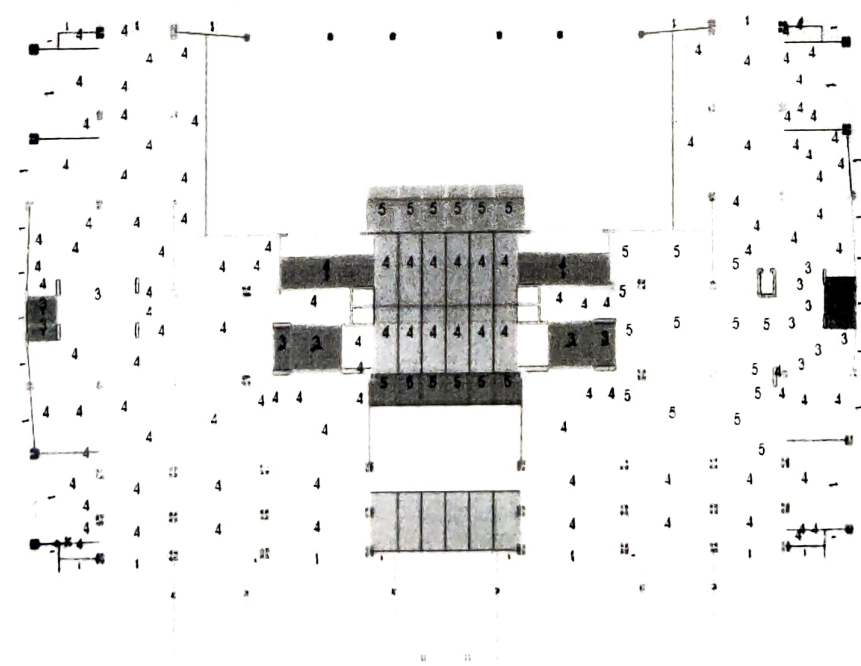


Fig. Plan showing Live Load (>3) contour for Second Floor

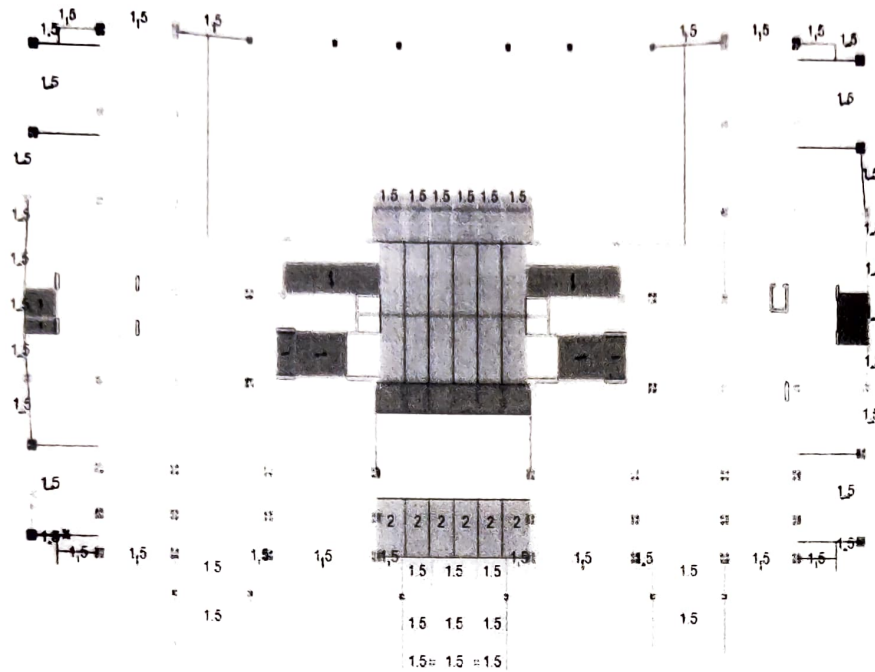


Fig. Plan showing Live Load (<3) contour for Second Floor

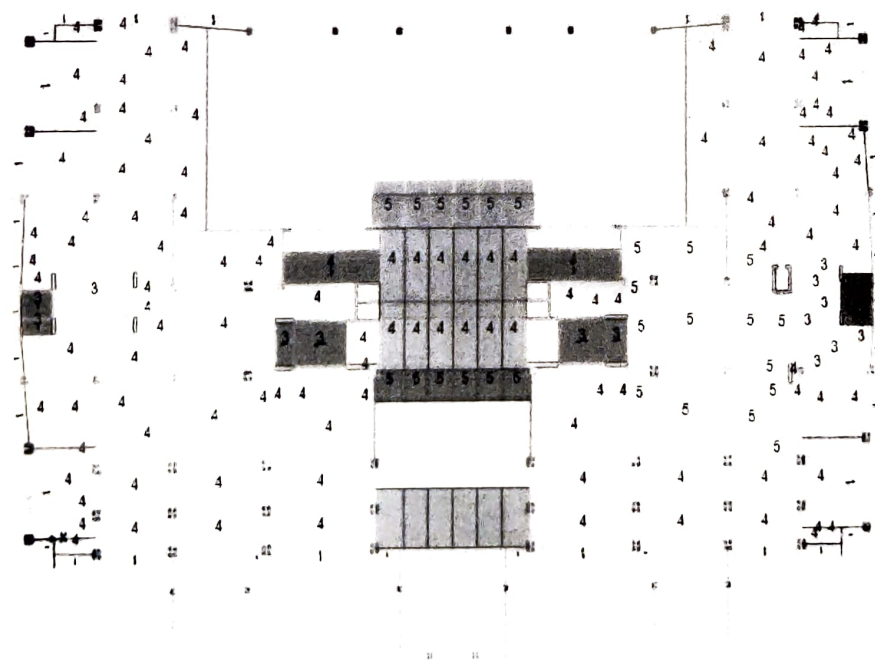


Fig. Plan showing Live Load (>3) contour for Second Floor

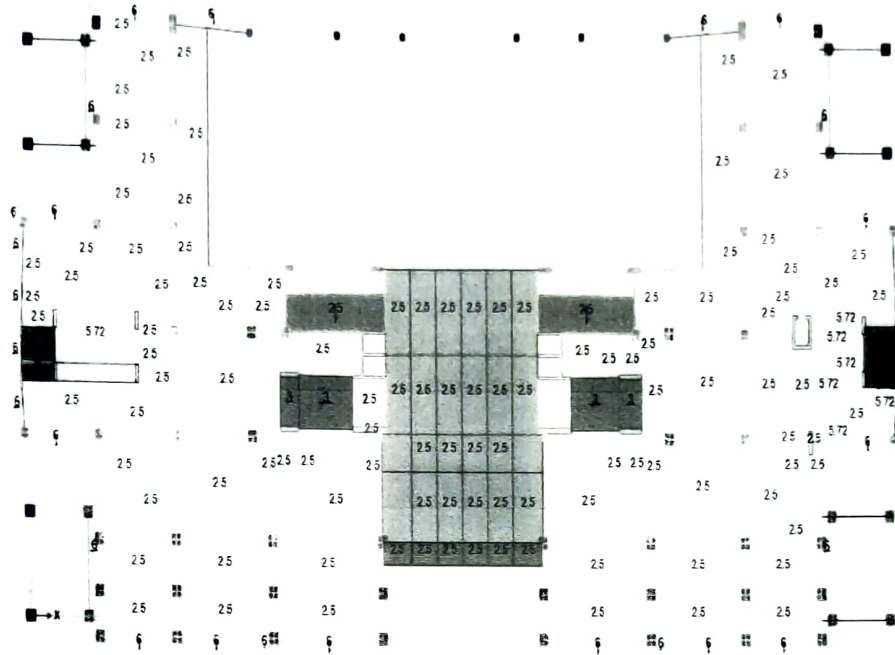


Fig. Plan showing Dead Load contour for Third Floor

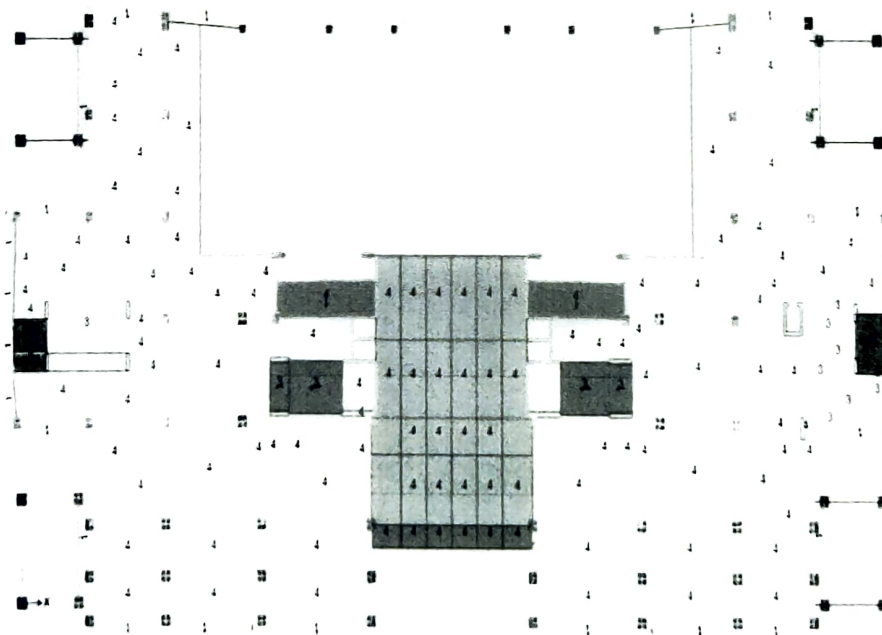


Fig. Plan showing Live Load (>3) contour for Third Floor

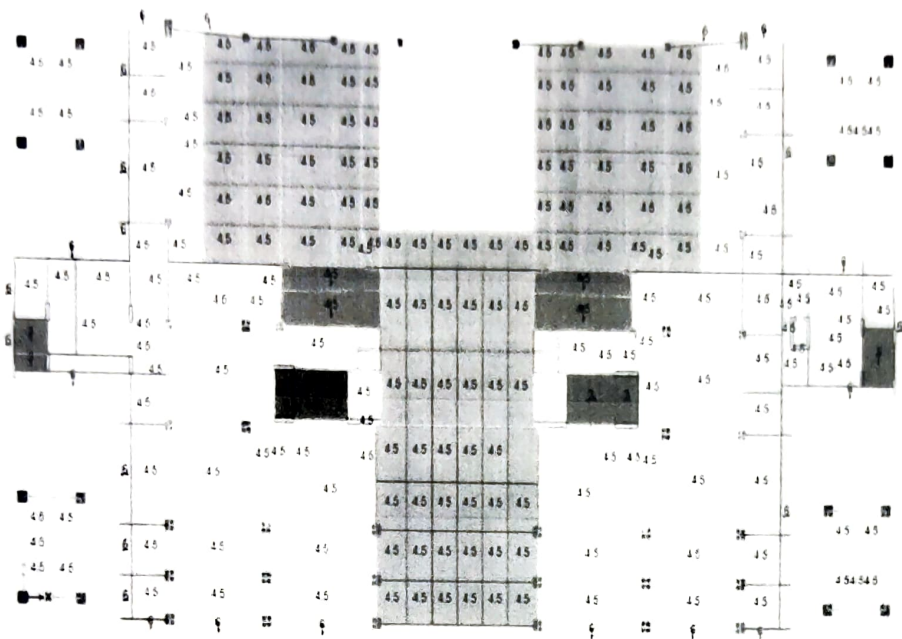


Fig. Plan showing Dead Load contour for Terrace Floor

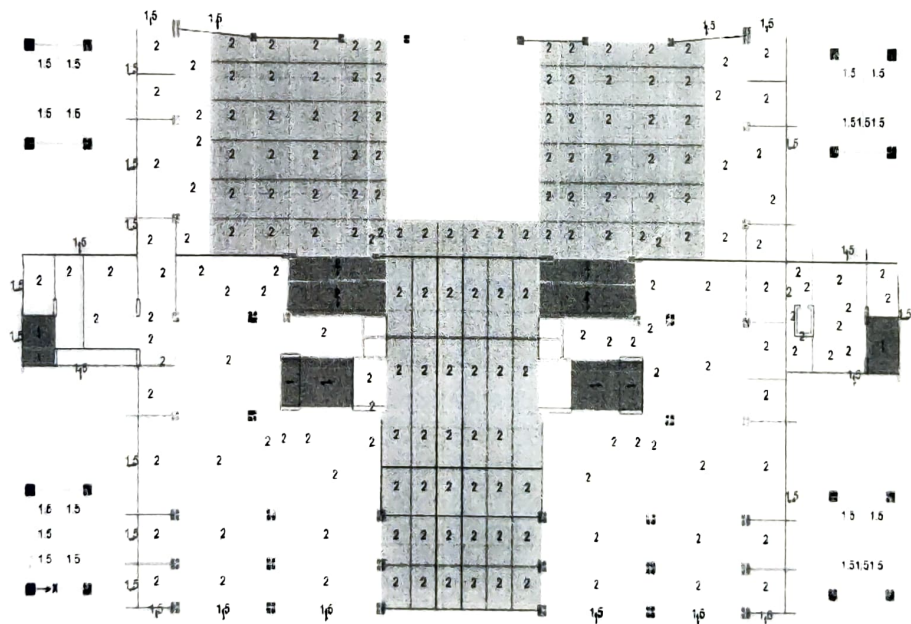
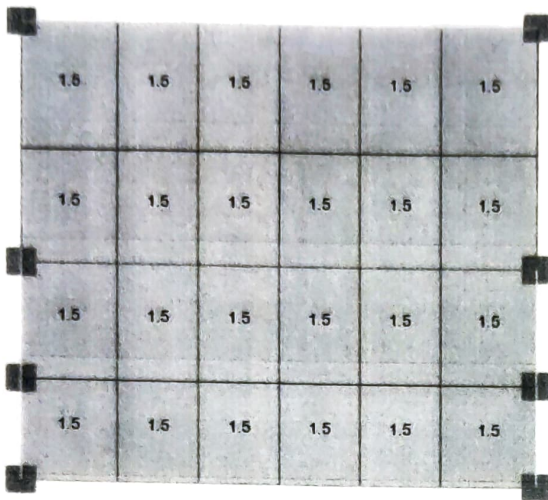


Fig. Plan showing Live Load (<3) contour for Terrace Floor

[Handwritten signature]

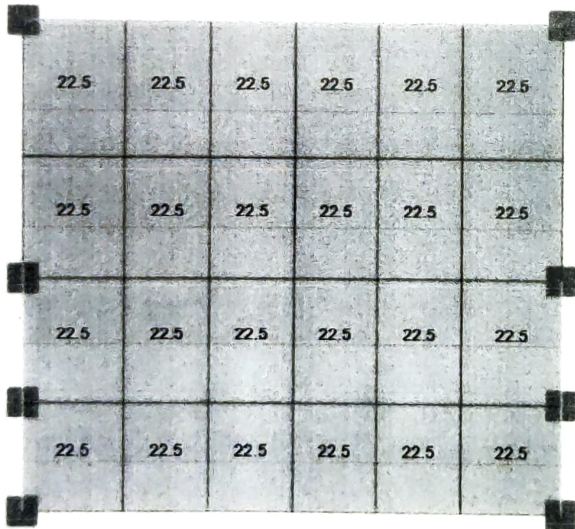


Dead

Gravity

OK Cancel Apply

Fig. Plan showing Dead Load contour for OHT Bottom Floor



Live23

Gravity

OK Cancel Apply

Fig. Plan showing Live Load (<3) contour OHT Bottom Floor



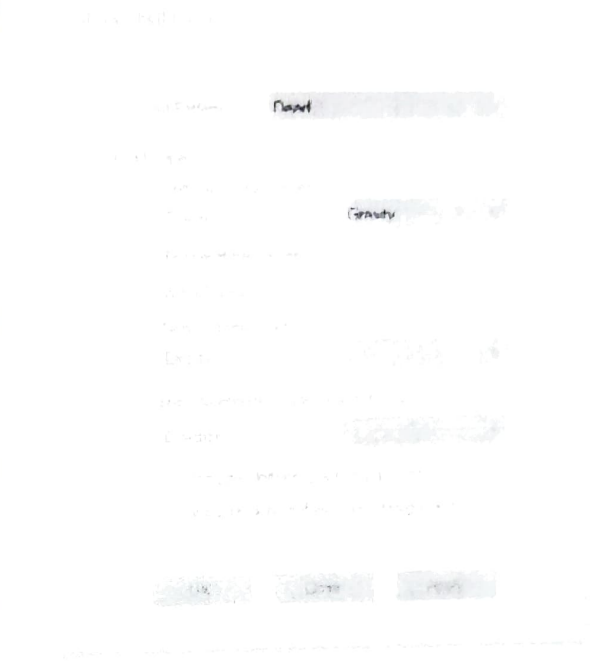
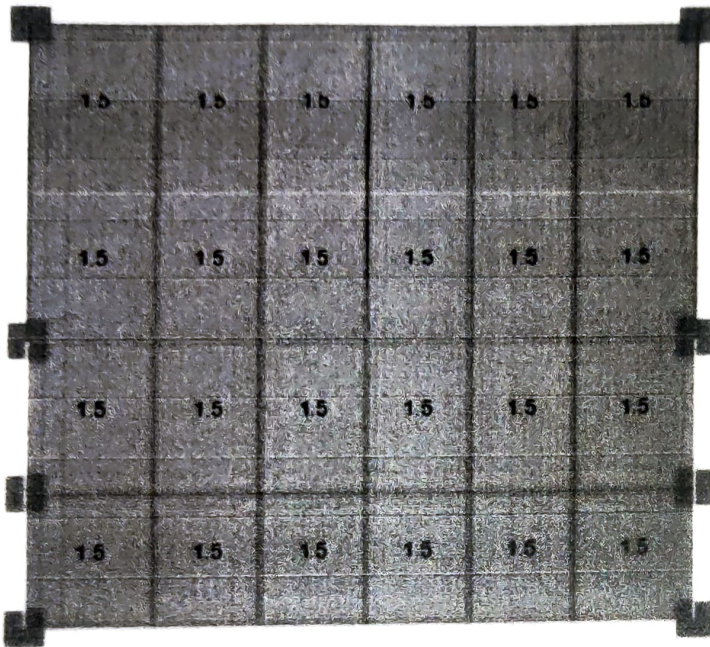


Fig. Plan showing Dead Load contour for OHT Top Floor

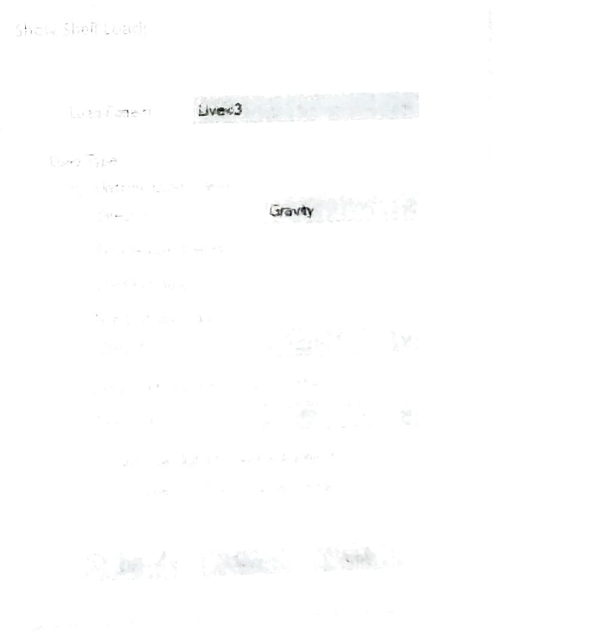
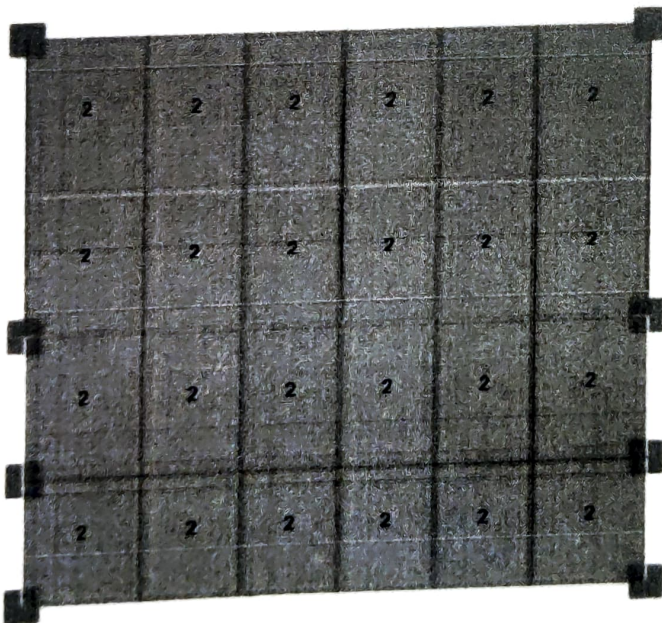


Fig. Plan showing Live Load (<3) contour for OHT Top Floor

1.3 STOREY DATA

TABLE: Storey Definitions		
Name	Height (m)	Master Story
OHT Top	2.0	none
OHT Bottom	2.25	none
Terrace Floor	4	Yes
Third Floor	4	Yes
Second Floor	4.5	No
First Floor	5	No
Ground Floor	1.5	No

1.4 LOAD CASES

TABLE: Load Cases - Summary	
Name	Type
Dead	Linear Static
Live	Linear Static
WX	Linear Static
WY	Linear Static
EQX	Linear Static
EQY	Linear Static
SPEC-X	Response Spectrum
SPEC-Y	Response Spectrum



1.5 LOAD COMBINATIONS

TABLE: Load Combination Definitions				
Name	Type	Auto	Load Name	Scale Factor
SComb1	Linear Add	No	Live<3	1
SComb1			Live>3	1
SComb1			Dead	1
SComb2	Linear Add	No	Dead	1
SComb2			Wx	1
SComb3	Linear Add	No	Dead	1
SComb3			Wy	1
SComb4	Linear Add	No	Dead	1
SComb4			Eqx	1
SComb5	Linear Add	No	Dead	1
SComb5			Egy	1
SComb6	Linear Add	No	Dead	0.8
SComb6			Live<3	0.8
SComb6			Live>3	0.8
SComb6			Wx	0.8
SComb7	Linear Add	No	Dead	0.8
SComb7			Live<3	0.8
SComb7			Live>3	0.8
SComb7			Wy	0.8
SComb8	Linear Add	No	Dead	0.8
SComb8			Live<3	0.8
SComb8			Live>3	0.8
SComb8			Eqx	0.8
SComb9	Linear Add	No	Dead	0.8
SComb9			Live<3	0.8
SComb9			Live>3	0.8
SComb9			Egy	0.8
UDCmpC1	Linear Add	No	Dead	1.4
UDCmpC2	Linear Add	No	Dead	1.2
UDCmpD1	Linear Add	No	Dead	1
UDCmpD2	Linear Add	No	Dead	1
UDCmpS1	Linear Add	No	Dead	1.4
UDCmpS2	Linear Add	No	Dead	1.2
UDConS1	Linear Add	No	Dead	1.5
UDConS2	Linear Add	No	Dead	1.5
UDConS3	Linear Add	No	Dead	1.2
UDConS3			Wx	1.2
UDConS4	Linear Add	No	Dead	1.2
UDConS4			Wx	-1.2

UDConS5	Linear Add	No	Dead	1.2
UDConS5			Wy	1.2
UDConS6	Linear Add	No	Dead	1.2
UDConS6			Wy	-1.2
UDConS7	Linear Add	No	Dead	1.5
UDConS7			Wx	1.5
UDConS8	Linear Add	No	Dead	1.5
UDConS8			Wx	-1.5
UDConS9	Linear Add	No	Dead	1.5
UDConS9			Wy	1.5
UDConS10	Linear Add	No	Dead	1.5
UDConS10			Wy	-1.5
UDConS11	Linear Add	No	Dead	0.9
UDConS11			Wx	1.5
UDConS12	Linear Add	No	Dead	0.9
UDConS12			Wx	-1.5
UDConS13	Linear Add	No	Dead	0.9
UDConS13			Wy	1.5
UDConS14	Linear Add	No	Dead	0.9
UDConS14			Wy	-1.5
UDConS15	Linear Add	No	Dead	1.2
UDConS15			Eqx	1.2
UDConS16	Linear Add	No	Dead	1.2
UDConS16			Eqy	1.2
UDConS17	Linear Add	No	Dead	1.5
UDConS17			Eqx	1.5
UDConS18	Linear Add	No	Dead	1.5
UDConS18			Eqy	1.5
UDConS19	Linear Add	No	Dead	0.9
UDConS19			Eqx	1.5
UDConS20	Linear Add	No	Dead	0.9
UDConS20			Eqy	1.5
UDS1bS1	Linear Add	No	Dead	1.5
UDS1bS2	Linear Add	No	Dead	1.5
UDS1bS3	Linear Add	No	Dead	1.2
UDS1bS3			Wx	1.2
UDS1bS4	Linear Add	No	Dead	1.2
UDS1bS4			Wx	-1.2
UDS1bS5	Linear Add	No	Dead	1.2
UDS1bS5			Wy	1.2
UDS1bS6	Linear Add	No	Dead	1.2
UDS1bS6			Wy	-1.2
UDS1bS7	Linear Add	No	Dead	1.5
UDS1bS7			Wx	1.5
UDS1bS8	Linear Add	No	Dead	1.5

UDSIbS8			Wx	-1.5
UDSIbS9	Linear Add	No	Dead	1.5
UDSIbS9			Wy	1.5
UDSIbS10	Linear Add	No	Dead	1.5
UDSIbS10			Wy	-1.5
UDSIbS11	Linear Add	No	Dead	0.9
UDSIbS11			Wx	1.5
UDSIbS12	Linear Add	No	Dead	0.9
UDSIbS12			Wx	-1.5
UDSIbS13	Linear Add	No	Dead	0.9
UDSIbS13			Wy	1.5
UDSIbS14	Linear Add	No	Dead	0.9
UDSIbS14			Wy	-1.5
UDSIbS15	Linear Add	No	Dead	1.2
UDSIbS15			Eqx	1.2
UDSIbS16	Linear Add	No	Dead	1.2
UDSIbS16			Eqy	1.2
UDSIbS17	Linear Add	No	Dead	1.5
UDSIbS17			Eqx	1.5
UDSIbS18	Linear Add	No	Dead	1.5
UDSIbS18			Eqy	1.5
UDSIbS19	Linear Add	No	Dead	0.9
UDSIbS19			Eqx	1.5
UDSIbS20	Linear Add	No	Dead	0.9
UDSIbS20			Eqy	1.5
UDWalS1	Linear Add	No	Dead	1.5
UDWalS2	Linear Add	No	Dead	1.5
UDWalS3	Linear Add	No	Dead	1.2
UDWalS3			Wx	1.2
UDWalS4	Linear Add	No	Dead	1.2
UDWalS4			Wx	-1.2
UDWalS5	Linear Add	No	Dead	1.2
UDWalS5			Wy	1.2
UDWalS6	Linear Add	No	Dead	1.2
UDWalS6			Wy	-1.2
UDWalS7	Linear Add	No	Dead	1.5
UDWalS7			Wx	1.5
UDWalS8	Linear Add	No	Dead	1.5
UDWalS8			Wx	-1.5
UDWalS9	Linear Add	No	Dead	1.5
UDWalS9			Wy	1.5
UDWalS10	Linear Add	No	Dead	1.5
UDWalS10			Wy	-1.5
UDWalS11	Linear Add	No	Dead	0.9
UDWalS11			Wx	1.5

UDWalS12	Linear Add	No	Dead	0.9
UDWalS12			Wx	-1.5
UDWalS13	Linear Add	No	Dead	0.9
UDWalS13			Wy	1.5
UDWalS14	Linear Add	No	Dead	0.9
UDWalS14			Wy	-1.5
UDWalS15	Linear Add	No	Dead	1.2
UDWalS15			Eqx	1.2
UDWalS16	Linear Add	No	Dead	1.2
UDWalS16			Eqy	1.2
UDWalS17	Linear Add	No	Dead	1.5
UDWalS17			Eqx	1.5
UDWalS18	Linear Add	No	Dead	1.5
UDWalS18			Eqy	1.5
UDWalS19	Linear Add	No	Dead	0.9
UDWalS19			Eqx	1.5
UDWalS20	Linear Add	No	Dead	0.9
UDWalS20			Eqy	1.5
SComb1	Linear Add	No	Live<3	1
SComb1			Live>3	1
SComb1			Dead	1
SComb2	Linear Add	No	Dead	1
SComb2			Wx	1
SComb3	Linear Add	No	Dead	1
SComb3			Wy	1
SComb4	Linear Add	No	Dead	1
SComb4			Eqx	1
SComb5	Linear Add	No	Dead	1
SComb5			Eqy	1
SComb6	Linear Add	No	Dead	0.8
SComb6			Live<3	0.8
SComb6			Live>3	0.8
SComb6			Wx	0.8
SComb7	Linear Add	No	Dead	0.8
SComb7			Live<3	0.8
SComb7			Live>3	0.8
SComb7			Wy	0.8
SComb8	Linear Add	No	Dead	0.8
SComb8			Live<3	0.8
SComb8			Live>3	0.8
SComb8			Eqx	0.8
SComb9	Linear Add	No	Dead	0.8
SComb9			Live<3	0.8
SComb9			Live>3	0.8
SComb9			Eqy	0.8

UDCmpC1	Linear Add	No	Dead	1.4
UDCmpC2	Linear Add	No	Dead	1.2
UDCmpD1	Linear Add	No	Dead	1
UDCmpD2	Linear Add	No	Dead	1
UDCmpS1	Linear Add	No	Dead	1.4
UDCmpS2	Linear Add	No	Dead	1.2
UDConS1	Linear Add	No	Dead	1.5
UDConS2	Linear Add	No	Dead	1.5
UDConS3	Linear Add	No	Dead	1.2
UDConS3			Wx	1.2
UDConS4	Linear Add	No	Dead	1.2
UDConS4			Wx	-1.2
UDConS5	Linear Add	No	Dead	1.2
UDConS5			Wy	1.2
UDConS6	Linear Add	No	Dead	1.2
UDConS6			Wy	-1.2
UDConS7	Linear Add	No	Dead	1.5
UDConS7			Wx	1.5
UDConS8	Linear Add	No	Dead	1.5
UDConS8			Wx	-1.5
UDConS9	Linear Add	No	Dead	1.5
UDConS9			Wy	1.5
UDConS10	Linear Add	No	Dead	1.5
UDConS10			Wy	-1.5
UDConS11	Linear Add	No	Dead	0.9
UDConS11			Wx	1.5
UDConS12	Linear Add	No	Dead	0.9
UDConS12			Wx	-1.5
UDConS13	Linear Add	No	Dead	0.9
UDConS13			Wy	1.5
UDConS14	Linear Add	No	Dead	0.9
UDConS14			Wy	-1.5
UDConS15	Linear Add	No	Dead	1.2
UDConS15			Eqx	1.2
UDConS16	Linear Add	No	Dead	1.2
UDConS16			Eqy	1.2
UDConS17	Linear Add	No	Dead	1.5
UDConS17			Eqx	1.5
UDConS18	Linear Add	No	Dead	1.5
UDConS18			Eqy	1.5
UDConS19	Linear Add	No	Dead	0.9
UDConS19			Eqx	1.5
UDConS20	Linear Add	No	Dead	0.9
UDConS20			Eqy	1.5
UDSlbS1	Linear Add	No	Dead	1.5

UDSIbS2	Linear Add	No	Dead	1.5
UDSIbS3	Linear Add	No	Dead	1.2
UDSIbS3			Wx	1.2
UDSIbS4	Linear Add	No	Dead	1.2
UDSIbS4			Wx	-1.2
UDSIbS5	Linear Add	No	Dead	1.2
UDSIbS5			Wy	1.2
UDSIbS6	Linear Add	No	Dead	1.2
UDSIbS6			Wy	-1.2
UDSIbS7	Linear Add	No	Dead	1.5
UDSIbS7			Wx	1.5
UDSIbS8	Linear Add	No	Dead	1.5
UDSIbS8			Wx	-1.5
UDSIbS9	Linear Add	No	Dead	1.5
UDSIbS9			Wy	1.5
UDSIbS10	Linear Add	No	Dead	1.5
UDSIbS10			Wy	-1.5
UDSIbS11	Linear Add	No	Dead	0.9
UDSIbS11			Wx	1.5
UDSIbS12	Linear Add	No	Dead	0.9
UDSIbS12			Wx	-1.5
UDSIbS13	Linear Add	No	Dead	0.9
UDSIbS13			Wy	1.5
UDSIbS14	Linear Add	No	Dead	0.9
UDSIbS14			Wy	-1.5
UDSIbS15	Linear Add	No	Dead	1.2
UDSIbS15			Eqx	1.2
UDSIbS16	Linear Add	No	Dead	1.2
UDSIbS16			Eqy	1.2
UDSIbS17	Linear Add	No	Dead	1.5
UDSIbS17			Eqx	1.5
UDSIbS18	Linear Add	No	Dead	1.5
UDSIbS18			Eqy	1.5
UDSIbS19	Linear Add	No	Dead	0.9
UDSIbS19			Eqx	1.5
UDSIbS20	Linear Add	No	Dead	0.9
UDSIbS20			Eqy	1.5
UDWalS1	Linear Add	No	Dead	1.5
UDWalS2	Linear Add	No	Dead	1.5
UDWalS3	Linear Add	No	Dead	1.2
UDWalS3			Wx	1.2
UDWalS4	Linear Add	No	Dead	1.2
UDWalS4			Wx	-1.2
UDWalS5	Linear Add	No	Dead	1.2
UDWalS5			Wy	1.2

UDWalS6	Linear Add	No	Dead	1.2
UDWalS6			Wy	-1.2
UDWalS7	Linear Add	No	Dead	1.5
UDWalS7			Wx	1.5
UDWalS8	Linear Add	No	Dead	1.5
UDWalS8			Wx	-1.5
UDWalS9	Linear Add	No	Dead	1.5
UDWalS9			Wy	1.5
UDWalS10	Linear Add	No	Dead	1.5
UDWalS10			Wy	-1.5
UDWalS11	Linear Add	No	Dead	0.9
UDWalS11			Wx	1.5
UDWalS12	Linear Add	No	Dead	0.9
UDWalS12			Wx	-1.5
UDWalS13	Linear Add	No	Dead	0.9
UDWalS13			Wy	1.5
UDWalS14	Linear Add	No	Dead	0.9
UDWalS14			Wy	-1.5
UDWalS15	Linear Add	No	Dead	1.2
UDWalS15			Eqx	1.2
UDWalS16	Linear Add	No	Dead	1.2
UDWalS16			Eqy	1.2
UDWalS17	Linear Add	No	Dead	1.5
UDWalS17			Eqx	1.5
UDWalS18	Linear Add	No	Dead	1.5
UDWalS18			Eqy	1.5
UDWalS19	Linear Add	No	Dead	0.9
UDWalS19			Eqx	1.5
UDWalS20	Linear Add	No	Dead	0.9
UDWalS20			Eqy	1.5
SComb1	Linear Add	No	Live<3	1
SComb1			Live>3	1
SComb1			Dead	1
SComb2	Linear Add	No	Dead	1
SComb2			Wx	1
SComb3	Linear Add	No	Dead	1
SComb3			Wy	1
SComb4	Linear Add	No	Dead	1
SComb4			Eqx	1
SComb5	Linear Add	No	Dead	1
SComb5			Eqy	1
SComb6	Linear Add	No	Dead	0.8
SComb6			Live<3	0.8
SComb6			Live>3	0.8
SComb6			Wx	0.8

Project- RAILWAY STATION BUILDING AT PURI.



SComb7	Linear Add	No	Dead	0.8
SComb7			Live<3	0.8
SComb7			Live>3	0.8
SComb7			Wy	0.8
SComb8	Linear Add	No	Dead	0.8
SComb8			Live<3	0.8

1.6 MODAL PARTICIPATION FACTORS

TABLE: Modal Participation Factors										
Case	Mode	Period	UX	UY	U Z	RX	RY	RZ	ModalMass	ModalStiff
		sec	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m-s ²	kN-m
Modal	1	0.934	0.000187	-	0	0.047921	0.664415	0.861825	0.000001	0.00005
Modal	2	0.926	-0.00002	-	0	0.615197	0.066472	2.156565	0.000001	0.00005
Modal	3	0.847	0.000018	-	0	0.192032	0.048545	7.426823	0.000001	0.00006
Modal	4	0.251	-	-	0	0.61292	0.123474	1.759158	0.000001	0.00063
Modal	5	0.231	-0.00005	-	0	0.437101	0.438732	1.723101	0.000001	0.00074
Modal	6	0.217	-	-	0	0.203011	0.572687	1.777399	0.000001	0.00084
Modal	7	0.148	-	-	0	0.265573	0.09402	0.127366	0.000001	0.00181
Modal	8	0.145	-	-	0	0.082493	0.302502	-0.48311	0.000001	0.00187
Modal	9	0.125	-	-	0	0.013501	0.004169	0.486712	0.000001	0.00255
Modal	10	0.119	-	-1.701E-08	0	0.000194	0.036878	0.038891	0.000001	0.00277
Modal	11	0.108	-	-	0	0.037511	-	-	0.000001	0.00338
Modal	12	0.101	-	-	0	0.151777	0.046436	1.304827	0.000001	0.0039

1.7 MODAL LOAD PARTICIPATION RATIOS

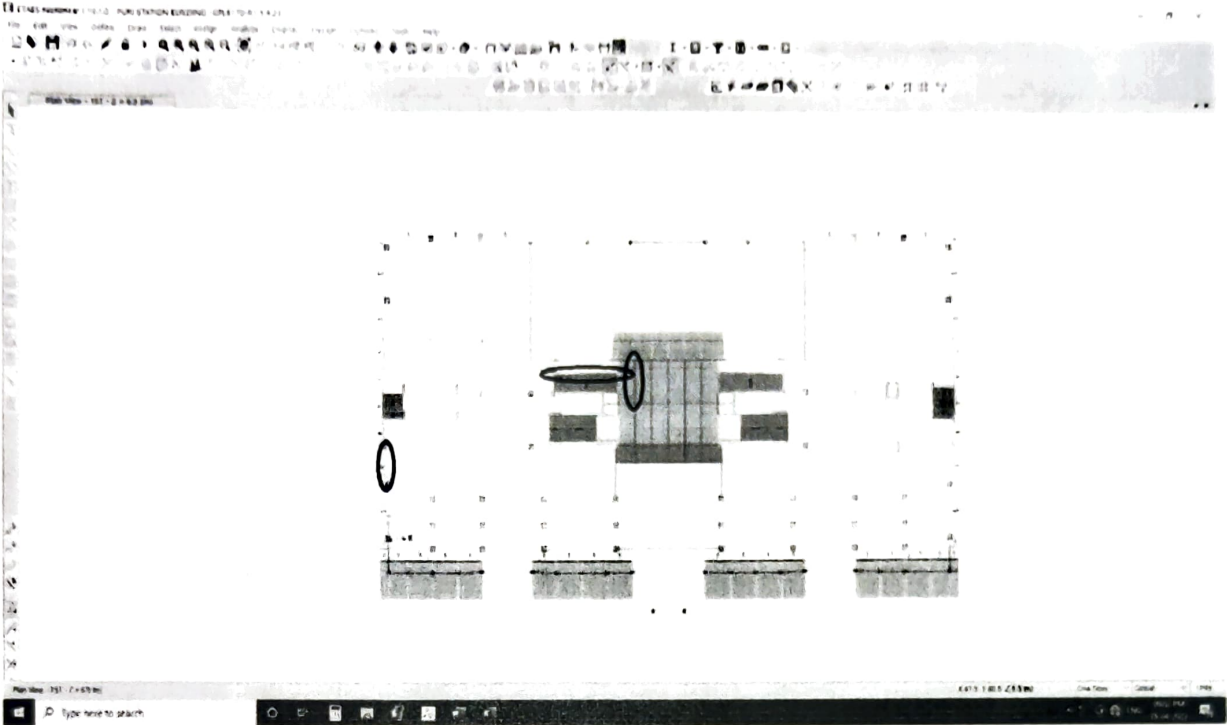
TABLE: Modal Load Participation Ratios				
Case	Item Type	Item	Static	Dynami c
			%	%
Modal	Acceleration	UX	99.96	89.63
Modal	Acceleration	UY	99.96	90.73
Modal	Acceleration	UZ	0	0

1.8 MODAL PARTICIPATING MASS RATIOS

TABLE: Modal Participating Mass Ratios														
Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
Modal	1	0.934	0.7174	0.0042	0	0.7174	0.0042	0	0.0014	0.2718	0.0095	0.0014	0.2718	0.0095
Modal	2	0.926	0.008	0.6905	0	0.7254	0.6947	0	0.233	0.0027	0.0593	0.2345	0.2745	0.0688
Modal	3	0.847	0.0065	0.0566	0	0.7319	0.7513	0	0.0227	0.0015	0.7034	0.2572	0.276	0.7722
Modal	4	0.251	0.0049	0.0759	0	0.7368	0.8273	0	0.2313	0.0094	0.0395	0.4885	0.2854	0.8116
Modal	5	0.231	0.0508	0.0433	0	0.7876	0.8706	0	0.1176	0.1185	0.0379	0.6061	0.4039	0.8495
Modal	6	0.217	0.0791	0.0099	0	0.8667	0.8805	0	0.0254	0.2019	0.0403	0.6315	0.6058	0.8898
Modal	7	0.148	0.0025	0.0192	0	0.8692	0.8998	0	0.0434	0.0054	0.0002	0.6749	0.6113	0.89
Modal	8	0.145	0.0263	0.0019	0	0.8954	0.9017	0	0.0042	0.0563	0.003	0.6791	0.6676	0.893
Modal	9	0.125	0.00001779	0.0001	0	0.8955	0.9017	0	0.0001	1.07E-05	0.003	0.6792	0.6676	0.896
Modal	10	0.119	0.0002	0	0	0.8957	0.9017	0	0	0.0008	1.929E-05	0.6792	0.6685	0.896
Modal	11	0.108	5.158E-06	0.0003	0	0.8957	0.902	0	0.0009	1.11E-05	0.0001	0.6801	0.6685	0.8961
Modal	12	0.101	0.0006	0.0052	0	0.8963	0.9073	0	0.0142	0.0013	0.0217	0.6943	0.6698	0.9179



1.9 DESIGN OF BEAM

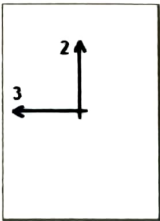


Beam design for 1st Floor:

Beam no. - 1 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
1ST	B208	495	B 450 X 600	DConS2	0	8203.5	1

Section Properties

b (mm)	h (mm)	b _f (mm)	d _s (mm)	d _{cl} (mm)	d _{cb} (mm)
450	600	450	0	41	41

Material Properties

E _s (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ _c	γ _s
1.5	1.15

Factored Forces and Moments

Factored M _{u3} kN-m	Factored T _u kN-m	Factored V _{u2} kN	Factored P _u kN
-196.8033	160.1342	118.3294	0

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M _t kN-m	Positive Moment kN-m	Negative Moment kN-m
-196.8033	219.792	22.9887	-505.372

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-505.372		2228	0	2228	810
Bottom (-2 Axis)		22.9887	1114	95	0	1114

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V _c kN	Shear V _c kN	Shear V _s kN	Shear V _p kN	Rebar A _{sv} /s mm ² /m
118.3294	161.8408	525.8547	119.0607	2606.78

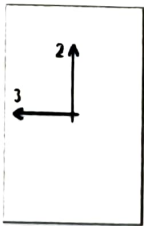
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u2}

T _u kN-m	V _u kN	Core b ₁ mm	Core d ₁ mm	Rebar A _{st} /s mm ² /m
160.1342	118.3294	388	538	2606.78

Beam no. - 2 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
1ST	B301	973	B600X1000	DConS2	12984.5	12984.5	0.944

Section Properties

b (mm)	h (mm)	b _f (mm)	d _s (mm)	d _{st} (mm)	d _{stn} (mm)
600	1000	600	0	41	41

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ _c	γ _s
1.5	1.15

Factored Forces and Moments

Factored M _{ed} kN-m	Factored T _u kN-m	Factored V _{ed} kN	Factored P _u kN
-1315.8749	54.4711	410.478	0

Design Moments, M_{ed} & M_t

Factored Moment kN-m	Factored M _t kN-m	Positive Moment kN-m	Negative Moment kN-m
-1315.8749	85.4448	0	-1401.3197

Design Moment and Flexural Reinforcement for Moment, M_{ed} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-1401.3197		3617	0	3617	1853
Bottom (-2 Axis)		0	1809	0	0	1809

Shear Force and Reinforcement for Shear, V_{ed} & T_u

Shear V _e kN	Shear V _c kN	Shear V _s kN	Shear V _p kN	Rebar A _{sv} /s mm ² /m
410.478	320.0991	235.6351	236.2111	680.88

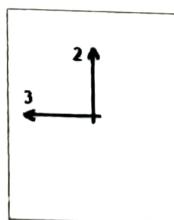
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T _u kN-m	V _u kN	Core b ₁ mm	Core d ₁ mm	Rebar A _{svt} /s mm ² /m
54.4711	410.478	538	938	784.17

Beam no. - 3 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
1ST	B31	2638	B 600X750	DCouS18	6926.5	7514.1	0.843

Section Properties

b (mm)	h (mm)	b _f (mm)	d _s (mm)	d _{cl} (mm)	d _{ch} (mm)
600	750	600	0	41	41

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ _c	γ _s
1.5	1.15

Factored Forces and Moments

Factored M _{u3} kN-m	Factored T _u kN-m	Factored V _{u3} kN	Factored P _u kN
-104.9504	425.4304	476.5293	0

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M _t kN-m	Positive Moment kN-m	Negative Moment kN-m
-104.9504	563.0697	458.1193	-1133.3488

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

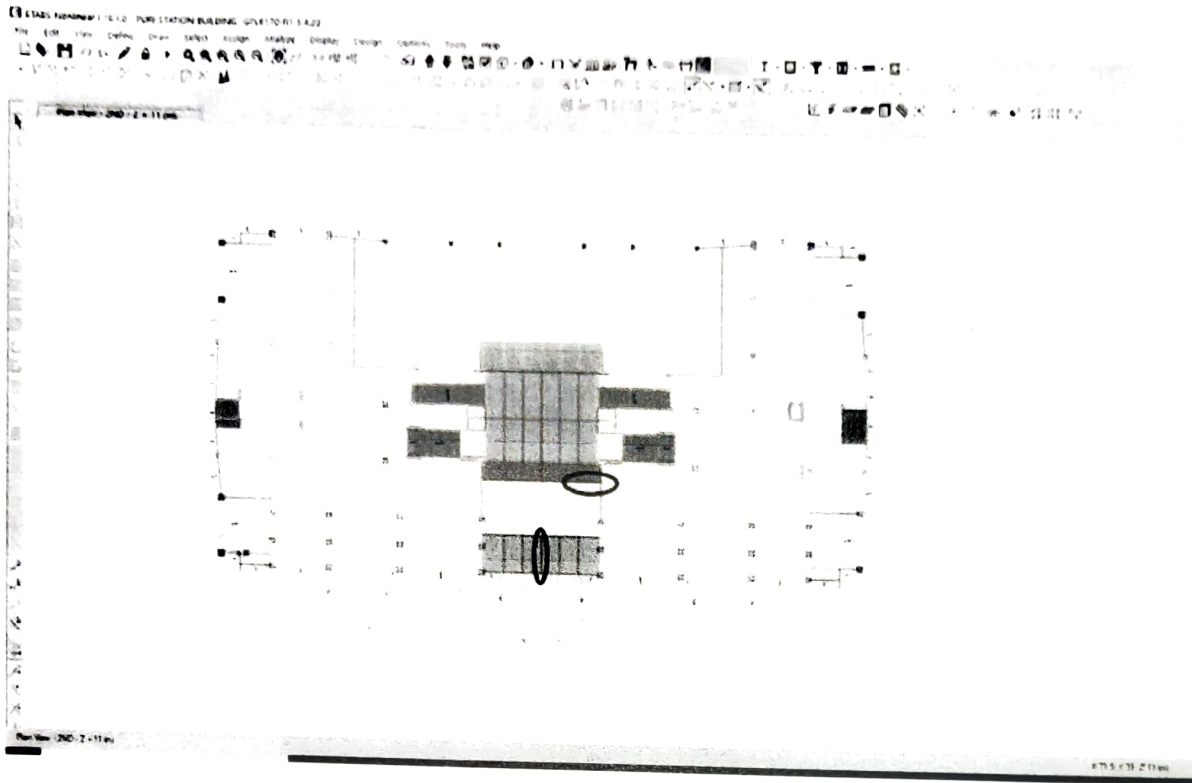
	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-1133.3488		3953	0	3953	1370
Bottom (-2 Axis)		458.1193	1976	1527	0	1976

Shear Force and Reinforcement for Shear, V_{u3} & T_u

Shear V _s kN	Shear V _c kN	Shear V _s kN	Shear V _p kN	Rebar A _{sv} /s mm ² /m
O/S #45	0	0	376.6726	0

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u3}

T _u kN-m	V _u kN	Core b ₁ mm	Core d ₁ mm	Rebar A _{ext} /s mm ² /m
425.4304	476.5293	538	688	5188.73

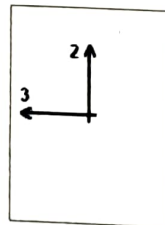


Beam design for 2nd Floor:

Beam no. - 1 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
2ND	B279	I215	B 450 X 600	DConS2	2824.5	6590.6	1

Section Properties

b (mm)	h (mm)	b _f (mm)	d _s (mm)	d _a (mm)	d _{ab} (mm)
450	600	450	0	41	41

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u1} kN-m	Factored T_u kN-m	Factored V_{u1} kN	Factored P_u kN
219.8939	0.5978	10.9312	0

Design Moments, M_{u1} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
219.8939	0.8206	220.7145	0

Design Moment and Flexural Reinforcement for Moment, M_{u1} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	0		202	0	0	202
Bottom (-2 Axis)		220.7145	934	934	0	810

Shear Force and Reinforcement for Shear, V_{u1} & T_u

Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm ² /m
10.9312	111.4659	100.62	81.6119	498.8

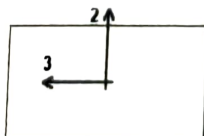
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u1}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm ² /m
0.5978	10.9312	388	538	0

Beam no. - 2 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
2ND	B336	733	B 300X600	DCorS2	3993.4	3995.3	1

Section Properties

b (mm)	h (mm)	b _r (mm)	d _s (mm)	d _{et} (mm)	d _{es} (mm)
600	300	600	0	41	41

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ _c	γ _s
1.5	1.15

Factored Forces and Moments

Factored M _{a3} kN-m	Factored T _a kN-m	Factored V _{a2} kN	Factored P _a kN
-141.4544	1.7061	48.1309	0

Design Moments, M_{a3} & M_t

Factored Moment kN-m	Factored M _t kN-m	Positive Moment kN-m	Negative Moment kN-m
-141.4544	1.5054	0	-142.9598

Design Moment and Flexural Reinforcement for Moment, M_{a3} & T_a

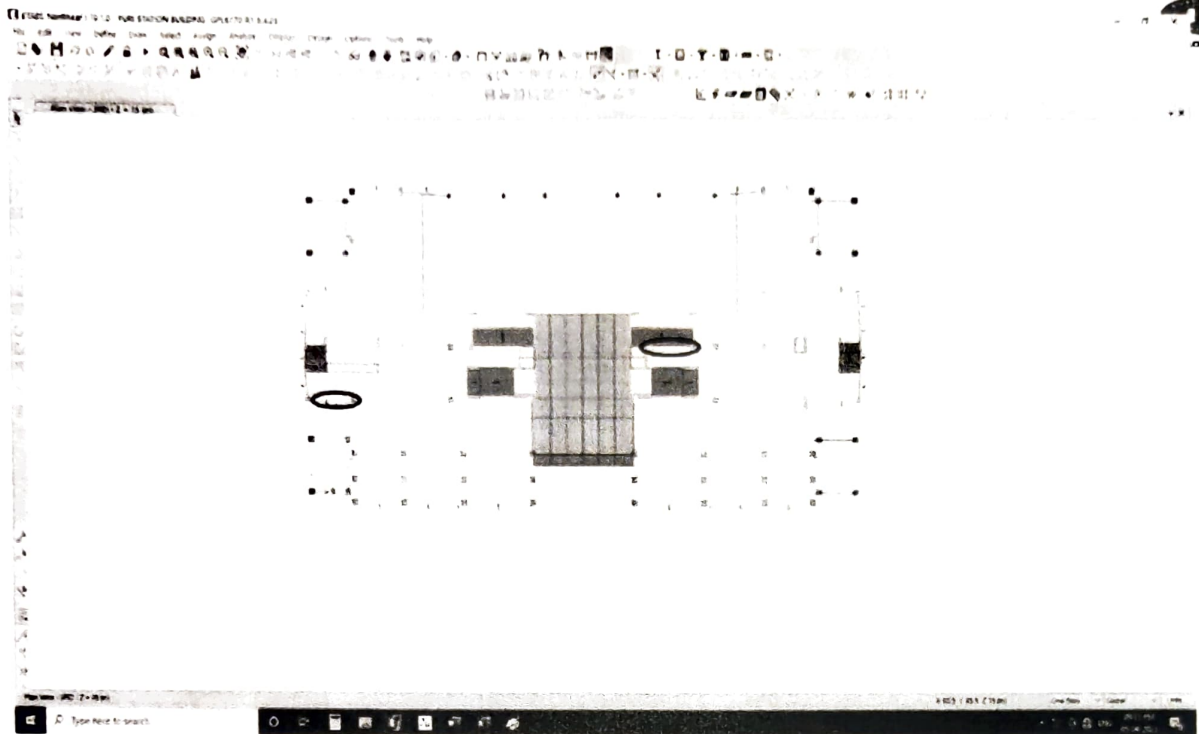
	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-142.9598		1359	0	1359	500
Bottom (-2 Axis)		0	500	0	0	500

Shear Force and Reinforcement for Shear, V_{a2} & T_a

Shear V _a kN	Shear V _c kN	Shear V _s kN	Shear V _p kN	Rebar A _{sv} /s mm ² /m
48.1309	99.426	62.16	38.5341	665.06

Torsion Force and Torsion Reinforcement for Torsion, T_a & V_{U3}

T _a kN-m	V _a kN	Core b ₁ mm	Core d ₁ mm	Rebar A _{svt} /s mm ² /m
1.7061	48.1309	538	238	0

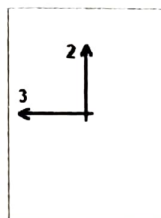


Beam design for 3rd Floor:

Beam no. - 1 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
3RD	B179	805	B 600X750	DConS17	8996.2	9496.2	0.849

Section Properties

b (mm)	h (mm)	b _f (mm)	d _s (mm)	d _{cl} (mm)	d _{cb} (mm)
600	750	600	0	41	41

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u3} kN	Factored P_u kN
-202.402	246.2249	402.4989	0

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-202.402	325.8859	123.4839	-842.1547

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-842.1547		2878	0	2878	1370
Bottom (-2 Axis)		123.4839	1439	403	0	1439

Shear Force and Reinforcement for Shear, V_{u3} & T_u

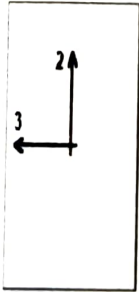
Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm ² /m
554.0764	0	1210.6762	206.663	4731.86

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u3}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{st}/s mm ² /m
246.2249	402.4989	538	688	3185.76

Beam no. - 2 design:

ETABS Concrete Frame Design
IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
3RD	B204	1039	B400X850	DConS17	9506.6	10006.6	0.878

Section Properties

b (mm)	h (mm)	b _f (mm)	d _t (mm)	d _{cl} (mm)	d _{cb} (mm)
400	850	400	0	41	41

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ _c	γ _s
1.5	1.15

Factored Forces and Moments

Factored M _{ed} kN-m	Factored T _e kN-m	Factored V _{ed} kN	Factored P _e kN
-514.9682	46.8552	272.3042	0

Design Moments, M_{ed} & M_t

Factored Moment kN-m	Factored M _t kN-m	Positive Moment kN-m	Negative Moment kN-m
-514.9682	86.131	0	-601.0992

Design Moment and Flexural Reinforcement for Moment, M_{ed} & T_e

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-601.0992		1783	0	1783	1042
Bottom (-2 Axis)		0	1042	0	0	1042

Shear Force and Reinforcement for Shear, V_{ed} & T_e

Shear V _e kN	Shear V _c kN	Shear V _s kN	Shear V _p kN	Rebar A _{sv} /s mm ² /m
373.9903	0	561.4113	141.189	1923.01

Torsion Force and Torsion Reinforcement for Torsion, T_e & V_{U2}

T _e kN-m	V _e kN	Core b ₁ mm	Core d ₁ mm	Rebar A _{sv} /s mm ² /m
46.8552	272.3042	338	788	989.09

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u1} kN-m	Factored T_u kN-m	Factored V_{u1} kN	Factored P_u kN
381.3301	91.7175	12.1238	0

Design Moments, M_{u1} & M_{u2}

Factored Moment kN-m	Factored M_{u2} kN-m	Positive Moment kN-m	Negative Moment kN-m
381.3301	143.8705	525.2006	0

Design Moment and Flexural Reinforcement for Moment, M_{u1} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	0		417	0	0	417
Bottom (-2 Axis)		525.2006	1821	1821	0	1027

Shear Force and Reinforcement for Shear, V_{u1} & T_u

Shear V_u kN	Shear V_{u2} kN	Shear V_u kN	Shear V_{u2} kN	Rebar A_{sv} /s mm ² /m
12.1238	170.8388	167.3915	209.2103	654.24

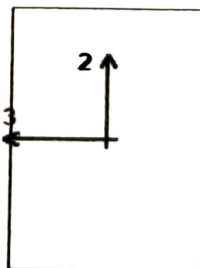
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u2}

T_u kN-m	V_{u2} kN	Core b_1 mm	Core d_1 mm	Rebar A_{sv} /s mm ² /m
91.7175	12.1238	388	688	971.63

Beam no. - 2 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
TERRACE	B152	905	B 450 X 600	DConS2	5500.4	5500.4	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ef} (mm)	d_{sb} (mm)
450	600	450	0	41	41

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)		f_y (MPa)	f_{yk} (MPa)
31622.77	45	1		500	500

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{x3} kN-m	Factored T_u kN-m	Factored V_{u1} kN	Factored P_u kN
-465.7888	5.7724	205.1884	0

Design Moments, M_{x3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-465.7888	7.9228	0	-473.7117

Design Moment and Flexural Reinforcement for Moment, M_{x3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-473.7117		2158	0	2158	810
Bottom (-2 Axis)		0	1079	0	0	1079

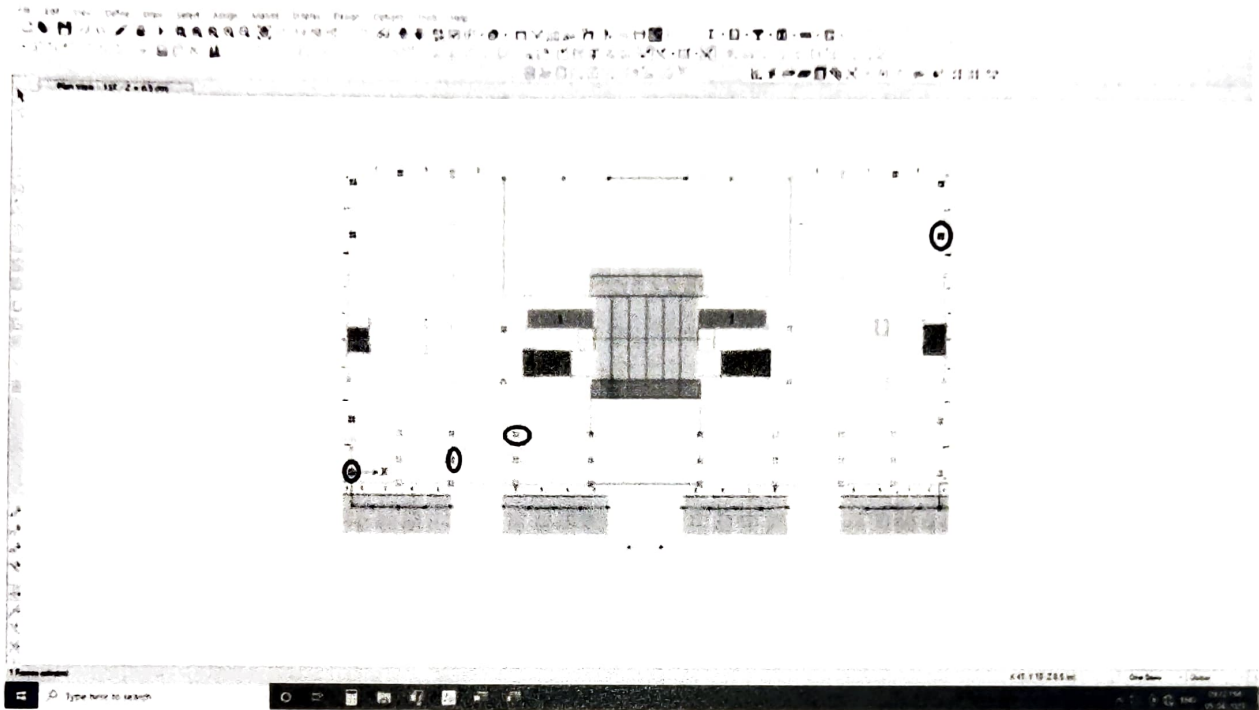
Shear Force and Reinforcement for Shear, V_{u1} & T_u

Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm ² /m
205.1884	159.6046	100.62	189.6845	498.8

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u1}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt}/s mm ² /m
5.7724	205.1884	388	538	499.38

1.10 DESIGN OF COLUMN

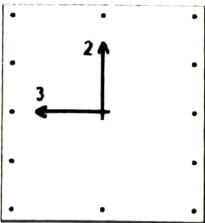


Column design for First Floor:

Column no. - 1 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Column Section Design



Column Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
1ST	C61	243	C 1175X1200	UDConS17	0	5000	0.506

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
1175	1200	40	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ_c	γ_s
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm ²	Rebar % %
4925.3686	-549.0078	-733.5355	234.7759	253.6565	11280	0.8

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M_3)	0.695225	5750	-293.4142	0	253.6565
Minor Bend(M_2)	0.980505	4250	-275.8436	0	234.7759

Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm ² /m
Major, V_{u2}	140.869	741.8651	535.8009	0	1302.41
Minor, V_{u3}	408.5142	741.4222	535.2009	408.5142	1330.12

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u, Tot}$ kN	Shear V_c kN	Joint Area cm ²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm ²	A_{sc} cm ²	P_m kN	P_b kN	P_u kN	k Unitless
14100	112.8	32782.5	13953.665	4925.3686	1

Additional Moment (IS 39.7.1)

	Consider M_s	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_u Moment (kN-m)
Major Bending (M_3)	Yes	1.15	1200	3.331	12	No	0
Minor Bending (M_2)	Yes	0.85	1175	3.547	12	No	0

Notes:

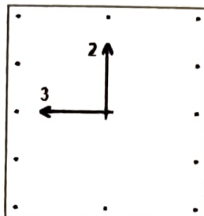
N/A: Not Applicable

N/C: Not Calculated

N/N: Not Needed

Column no. - 2 design:**ETABS Concrete Frame Design**

IS 456:2000 + IS 13920:2016 Column Section Design

**Column Element Details Type: Ductile Frame (Summary)**

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
1ST	C84	335	C 1175X1200	UDConS18	0	5000	0.447

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
1175	1200	40	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ_c	γ_s
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u1} , M_{u2}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_1 kN-m	Minimum M_3 kN-m	Rebar Area mm ²	Rebar % %
6152.2747	-1011.3084	479.5525	293.2584	316.8421	11280	0.8

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	0.695213	5750	191.821	0	316.8421
Minor Bend(M2)	0.985001	4250	-546.6913	0	293.2584

Shear Design for V_{u1} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm ² /m
Major, V_{u2}	120.8323	775.3762	535.8009	21.6183	1302.41
Minor, V_{u3}	479.5495	774.9134	535.2009	479.5495	1330.12

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Top}$ kN	Shear V_c kN	Joint Area cm ²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A _g cm ²	A _{sc} cm ²	P _{sc} kN	P _b kN	P _r kN	k Unitless
14100	112.8	32782.5	13953.665	6152.2747	1

Additional Moment (IS 39.7.1)

	Consider M _a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M _a Moment (kN-m)
Major Bending (M ₁)	Yes	1.15	1200	3.331	12	No	0
Minor Bending (M ₂)	Yes	0.85	1175	3.563	12	No	0

Notes:

N/A: Not Applicable

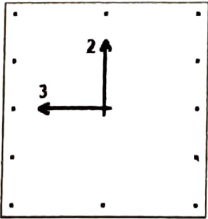
N/C: Not Calculated

N/N: Not Needed

Column no. - 3 design:

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Column Section Design



Column Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
18T	C25	99	C 1200X1200	DConS18	0	5000	0.418

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
1200	1200	40	30

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{yk} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ _c	γ _s
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u1} , M_{u2}

Design P_u kN	Design M_{u1} kN-m	Design M_{u2} kN-m	Minimum M_1 kN-m	Minimum M_2 kN-m	Rebar Area mm ²	Rebar % %
4699.2701	-1219.5705	234.9635	234.9635	234.9635	11520	0.8

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	0.998029	5000	75.425	0	234.9635
Minor Bend(M2)	0.995404	5000	-679.8072	0	234.9635

Shear Design for V_{u1} , V_{u2}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm ² /m
Major, V_{u2}	62.06	773.019	547.2009	0	1330.12
Minor, V_{u1}	242.4659	773.019	547.2009	0	1330.12

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm ²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u1}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm ²	A_{sc} cm ²	P_{uz} kN	P_b kN	P_u kN	k Unitless
14400	115.2	33480	14261.7067	4699.2701	1

Additional Moment (IS 39.7.1)

	Consider M_u	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_u Moment (kN-m)
Major Bending (M_1)	Yes	1	1200	4.158	12	No	0
Minor Bending (M_2)	Yes	1	1200	4.148	12	No	0

Notes:

N/A: Not Applicable

N/C: Not Calculated

N/N: Not Needed

Column no. - 4 design:**ETABS Concrete Frame Design**

IS 456:2000 + IS 13920:2016 Column Section Design(Envelope)

Column Element Details

Level	Element	Unique Name	Section ID	Length (mm)	LLRF
1ST	C27	107	C 1200X1200	5000	0.4

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
1200	1200	40	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{yr} (MPa)
31622.77	45	1	500	500

Design Code Parameters

γ_c	γ_s
1.5	1.15

Longitudinal Reinforcement Design for $P_u - M_{u2} - M_{u3}$ Interaction

Column End	Rebar Area mm ²	Rebar %
Top	11520	0.8
Bottom	11520	0.8

Design Axial Force & Biaxial Moment for $P_u - M_{u2} - M_{u3}$ Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
	kN	kN-m	kN-m	mm	
Top	10162.0047	301.3601	508.1002	5000	DConS2
Bottom	10432.0047	-86.6998	521.6002	0	DConS2

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm ² /m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	1330.12	34.3526	5000	DConS20
Bottom	1330.12	34.3526	0	DConS20

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm ² /m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1330.12	234.7835	5000	DConS20
Bottom	1330.12	234.7835	0	DConS20



TWO-WAY SLAB

Job No. 1ST FLOOR

DESIGN OF TWO-WAY SLAB (Limit State Method)

Slab S5

Data

New Slab

fck	40	N/mm ²
Panel Type	9	
Slab Thickness	200	mm
Short Span (lx)	4.675	m
Long Span (ly)	5.054	m
Span / defl	20	

Clear Cover	25	mm
Working Loads		
Dead Load	5	KN/m ²
Live Load	1.50	KN/m ²
Finish Load	1.50	KN/m ²
W/proof Load	3.00	KN/m ²

Load Factor	1.5	
Design Parameters		
Mod Span / defl	20	
Total Load	11.00	KN/m ²
ly / lx	1.081	
Effective Span	4.845	m

Design

Proceed with design

Rebars: fy & Dia	500	10
Spacing (Strength)	234	mm c/c
(Deflection)	234	mm c/c
(IS 456)	300	mm c/c
Critical spacing	234	mm c/c
Provide spacing	100	mm c/c

500	10
246	mm c/c
300	mm c/c
246	mm c/c
100	mm c/c

500	10
	mm c/c
300	mm c/c
300	mm c/c
200	mm c/c

500	10
	mm c/c
300	mm c/c
300	mm c/c
200	mm c/c

Short Bars at Bottom

Long Bars at Bottom

Short Bars at Support

Long Bars at Support

Strength aspects

Effective depth	170.0	mm
Coeff. Alpha	0.062	
Ultimate BM	24.202	KN/m
xu / d	0.060	
xumax / d	0.456	
Reinforcement	0.197	%
Area of bars	3.36	cm ² /m

160.0	mm
0.056	
21.690	KN/m
0.060	
0.456	
0.200	%
3.20	cm ² /m

170.0	mm
0.000	
0.000	KN/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

160.0	mm
0.000	
0.000	KN/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

Deflection aspects

Service Stress	290.0	N/mm ²
Allowable Span/ defl	27.84	>= 27.50
Reinforcement	0.197	%
Area of bars	3.36	cm ² /m

IS 456 guidelines

Reinforcement	0.12	%
Spacing of bars	327.2	mm c/c
Max Spacing	300.0	mm c/c

0.12	%
327.2	mm c/c
300.0	mm c/c

0.12	%
327.2	mm c/c
300.0	mm c/c

0.12	%
327.2	mm c/c
300.0	mm c/c

Job No. 2nd floor

DESIGN OF TWO-WAY SLAB (Limit State Method)

Slab S5

Data

New Slab

fck	40	N/mm ²
Panel Type	9	
Slab Thickness	200	mm
Short Span (lx)	4.000	m
Long Span (ly)	5.500	m
Span / defl	20	

Clear Cover	25	mm
Working Loads		
Dead Load	5	KN/m ²
Live Load	2.00	KN/m ²
Finish Load	1.50	KN/m ²
W/proof Load	3.00	KN/m ²

Load Factor	1.5	
Design Parameters		
Mod Span / defl	20	
Total Load	11.50	KN/m ²
ly / lx	1.400	
Effective Span	4.170	m

Design

Proceed with design

Rebars: fy & Dia	500	10
Spacing (Strength)	222	mm c/c
(Deflection)	222	mm c/c
(IS 456)	300	mm c/c
Critical spacing	222	mm c/c
Provide spacing	150	mm c/c

500	8
206	mm c/c
209	mm c/c
206	mm c/c
125	mm c/c

500	10
	mm c/c
300	mm c/c
300	mm c/c
300	mm c/c

500	8
	mm c/c
209	mm c/c
209	mm c/c
250	mm c/c

Short Bars at Bottom

Long Bars at Bottom

Short Bars at Support

Long Bars at Support

Strength aspects

Effective depth	170.0	mm
Coeff. Alpha	0.085	
Ultimate BM	25.496	KN/m
xu / d	0.063	
xumax / d	0.456	
Reinforcement	0.208	%
Area of bars	3.54	cm ² /m

161.0	mm
0.056	
16.798	KN/m
0.046	
0.456	
0.152	%
2.45	cm ² /m

170.0	mm
0.000	
0.000	KN/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

161.0	mm
0.000	
0.000	KN/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

Deflection aspects

Service Stress	290.0	N/mm ²
Allowable Span/ defl	27.29	>= 23.53
Reinforcement	0.208	%
Area of bars	3.54	cm ² /m

IS 456 guidelines

Reinforcement	0.12	%
Spacing of bars	327.2	mm c/c
Max Spacing	300.0	mm c/c

0.12	%
209.4	mm c/c
209.4	mm c/c

0.12	%
327.2	mm c/c
300.0	mm c/c

0.12	%
209.4	mm c/c
209.4	mm c/c

Job No.

3rd floor

DESIGN OF TWO-WAY SLAB (Limit State Method)

Slab

36

Data

New Slab

fck	40	N/mm ²
Panel Type	9	
Slab Thickness	200	mm
Short Span (lx)	4.000	m
Long Span (ly)	5.700	m
Span / deff	20	

Clear Cover	25	mm
Working Loads		
Dead Load	5	KN/m ²
Live Load	4.00	KN/m ²
Finish Load	2.50	KN/m ²
W/proof Load		KN/m ²

Load Factor	1.5	
Design Parameters		
Mod Span / deff	20	
Total Load	11.50	KN/m ²
ly / lx	1.425	
Effective Span	4.170	m

Design

Proceed with design

Rebars: fy & Dia	500	10
Spacing (Strength)	219	mm c/c
(Deflection)	219	mm c/c
(IS 456)	300	mm c/c
Critical spacing	219	mm c/c
Provide spacing	150	mm c/c

500	10
319	mm c/c
300	mm c/c
300	mm c/c
150	mm c/c

500	10
	mm c/c
300	mm c/c
300	mm c/c
300	mm c/c

500	8
	mm c/c
209	mm c/c
209	mm c/c
250	mm c/c

Short Bars at Bottom

Long Bars at Bottom

Short Bars at Support

Long Bars at Support

Strength aspects

Effective depth	170.0	mm
Coeff Alpha	0.086	
Ultimate BM	25.796	KNm/m
xu / d	0.064	
xumax / d	0.456	
Reinforcement	0.211	%
Area of bars	3.58	cm ² /m

160.0	mm
0.056	
16.798	KNm/m
0.046	
0.456	
0.154	%
2.46	cm ² /m

170.0	mm
0.000	
0.000	KNm/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

161.0	mm
0.000	
0.000	KNm/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

Deflection aspects

Service Stress	290.0	N/mm ²
Allowable Span/ deff	27.17	>= 23.53
Reinforcement	0.211	%
Area of bars	3.58	cm ² /m

IS 456 guidelines

Reinforcement	0.12	%
Spacing of bars	327.2	mm c/c
Max Spacing	300.0	mm c/c

0.12	%
327.2	mm c/c
300.0	mm c/c

0.12	%
327.2	mm c/c
300.0	mm c/c

0.12	%
209.4	mm c/c
209.4	mm c/c

Job No.

TERRACE FLOOR

DESIGN OF TWO-WAY SLAB (Limit State Method)

Slab

S2

Data

New Slab

fck	40	N/mm ²
Panel Type	9	
Slab Thickness	200	mm
Short Span (lx)	4.000	m
Long Span (ly)	5.300	m
Span / deff	20	

Clear Cover	25	mm
Working Loads		
Dead Load	5	KN/m ²
Live Load	2.00	KN/m ²
Finish Load	1.50	KN/m ²
W/proof Load	3.00	KN/m ²

Load Factor	1.5	
Design Parameters		
Mod Span / deff	20	
Total Load	11.50	KN/m ²
ly / lx	1.325	
Effective Span	4.171	m

Design

Proceed with design

Rebars: fy & Dia	50	8
Spacing (Strength)	151	mm c/c
(Deflection)	151	mm c/c
(IS 456)	209	mm c/c
Critical spacing	151	mm c/c
Provide spacing	125	mm c/c

500	8
208	mm c/c
209	mm c/c
208	mm c/c
125	mm c/c

500	8
	mm c/c
209	mm c/c
209	mm c/c
250	mm c/c

500	8
	mm c/c
209	mm c/c
209	mm c/c
250	mm c/c

Short Bars at Bottom

Long Bars at Bottom

Short Bars at Support

Long Bars at Support

Strength aspects

Effective depth	171.0	mm
Coeff Alpha	0.081	
Ultimate BM	24.158	KNm/m
xu / d	0.059	
xumax / d	0.456	
Reinforcement	0.195	%
Area of bars	3.33	cm ² /m

163.0	mm
0.056	
16.806	KNm/m
0.045	
0.456	
0.148	%
2.42	cm ² /m

171.0	mm
0.000	
0.000	KNm/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

163.0	mm
0.000	
0.000	KNm/m
0.000	
0.456	
0.000	%
0.00	cm ² /m

Deflection aspects

Service Stress	290.0	N/mm ²
Allowable Span/ deff	27.99	>= 23.39
Reinforcement	0.195	%
Area of bars	3.33	cm ² /m

IS 456 guidelines

Reinforcement	0.12	%
Spacing of bars	209.4	mm c/c
Max Spacing	209.4	mm c/c

0.12	%
209.4	mm c/c
209.4	mm c/c

0.12	%
209.4	mm c/c
209.4	mm c/c

0.12	%
209.4	mm c/c
209.4	mm c/c

1.1 DESIGN OF FOOTING

SAFE - FOUNDATION DESIGN

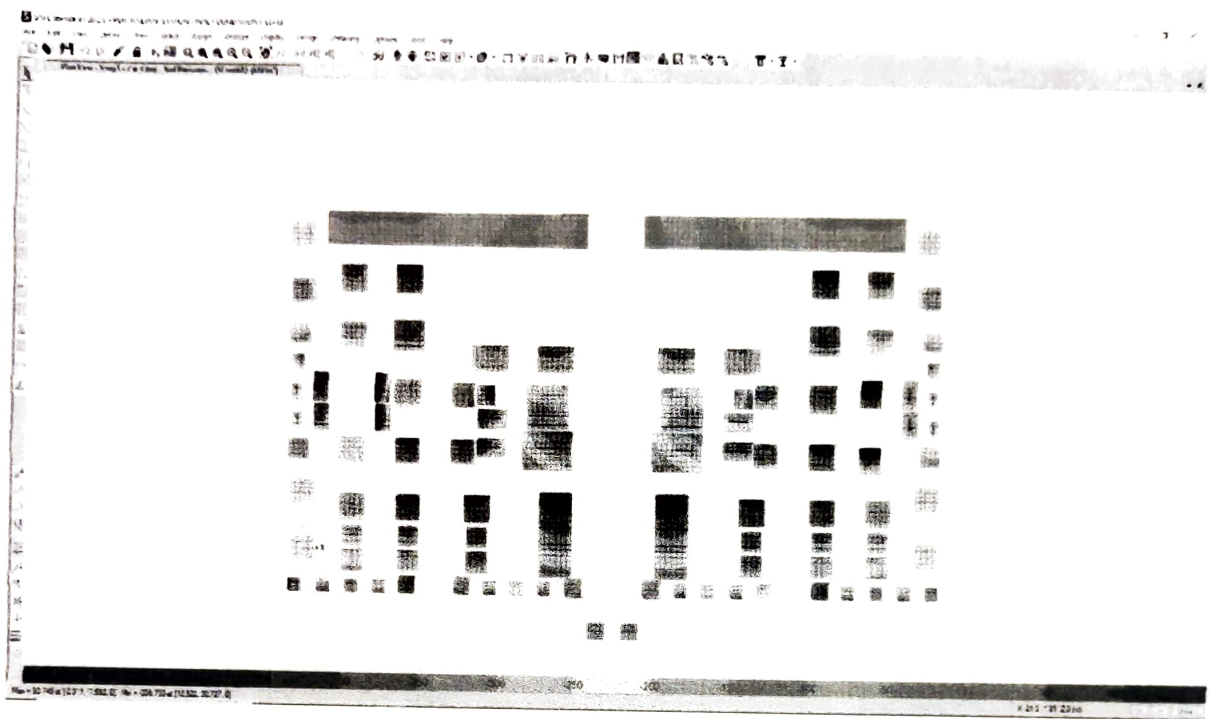


Fig. Soil Pressure Diagram

[Handwritten signature]

FOOTING DESIGN CALCULATION-

Footing Design

pro

hirco

Job no **6170**Col no **C29**

Footing load "P"(including 10% for self wt in tons) 870.00

Mx(moment @X axis in ton meter) 6.00

My(moment @Y axis in ton meter) 7.30

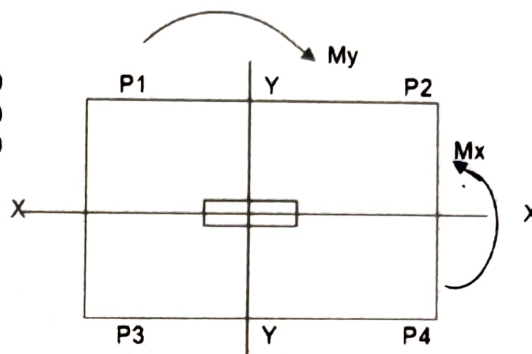
S.B.C.of soil 45.00

Concrete mix 35.00

Steel grade 500.00

PCC length in meters "L" 6.90 Meter

PCC breadth "B" 4.70 Meter



Pressure on PCC size

$$\begin{aligned}
 P1 &= P/(L \times B) + M_x(L/2)/(B \times L \times L/12) - M_y(B/2)/(L \times B \times B/12) = 26.87 \text{ Ton / sq m} \\
 P2 &= P/(L \times B) + M_x(L/2)/(B \times L \times L/12) + M_y(B/2)/(L \times B \times B/12) = 27.26 \text{ Ton / sq m} \\
 P3 &= P/(L \times B) - M_x(L/2)/(B \times L \times L/12) - M_y(B/2)/(L \times B \times B/12) = 26.40 \text{ Ton / sq m} \\
 P4 &= P/(L \times B) - M_x(L/2)/(B \times L \times L/12) + M_y(B/2)/(L \times B \times B/12) = 26.79 \text{ Ton / sq m}
 \end{aligned}$$

P2 is less than S.B.C.of soil THEREFORE O.K.

P1 is greater than zero THEREFORE O.K.

RCC Size

Footing length in meters "L" 6.60 Meter

Footing breadth "B" (in meter) 4.40 Meter

Column length (in meter) 2.00 Meter

Column breadth (in meter) 0.60 Meter

Pressure on RCC size

$$\begin{aligned}
 P1 &= P/(1.1 \times L \times B) + M_x(L/2)/(B \times L \times L/12) - M_y(B/2)/(L \times B \times B/12) = 27.29 \text{ Ton / sq m} \\
 \text{Max Pressure } P2 &= P/(1.1 \times L \times B) + M_x(L/2)/(B \times L \times L/12) + M_y(B/2)/(L \times B \times B/12) = 27.75 \text{ Ton / sq m} \\
 \text{Min Pressure } P3 &= P/(1.1 \times L \times B) - M_x(L/2)/(B \times L \times L/12) - M_y(B/2)/(L \times B \times B/12) = 26.72 \text{ Ton / sq m} \\
 P4 &= P/(1.1 \times L \times B) - M_x(L/2)/(B \times L \times L/12) + M_y(B/2)/(L \times B \times B/12) = 27.18 \text{ Ton / sq m}
 \end{aligned}$$

Projection From face of Column X Dir (c1) = 2300.00 mm

Projection From face of Column Y Dir (c2) = 1900.00 mm

Design pressure for short span (prs)=(P1+P2)/2= 27.52 Ton / sq m

Design pressure for long span (prl)=(P2+P4)/2= 27.46 Ton / sq m

Bending moment for short span=(prs)x(c1)x(c1)xL/2= 327.81 Ton m

Bending moment for long span=(prl)x(c2)x(c2)xL/2= 319.62 Ton m

Effective depth required for short span(from moment consideration)= SQRT(B.M / Q x B)= 770.62 mm

Effective depth required for long span(from moment consideration)= SQRT(B.M / Q x B)= 1389.28 mm

Effective depth required (from shear consideration)= 1900 mm

Provide depth of footing = 1550 mm

Footing Depth at edge of footing = 1550 mm

Effective cover = 50 mm

Ast Req'd for short span =	7829.18 sq mm		
Ast Req'd for Long span =	8500.28 sq mm		
Ast Provide short span	Dia 20	Nos 49	15386.00 sq mm
Ast Provide Long span	Dia 20	Nos 66	20724.00 sq mm

Check For One way Shear

Short Span

Dist from edge of footing at deff from face of column	=	400 mm
Shear at deff from face of column	=	72.64 Ton
deff	=	1500.00 mm
Shear Stress = Vu / (B x deff)	=	0.129 N/sq.mm
Ast Provided at a distance deff	=	15386.00 sq mm
Pt at a distance deff	=	0.16 %
Allowable Shear Stress (Tc)	=	0.30 N/sq.mm

Hence SHEAR CHECK O.K.

Long Span

Dist from edge of footing at deff from face of column	=	800 mm
Shear at deff from face of column	=	96.67 Ton
deff at section	=	1475.00 mm
Shear Stress = $V_u / (B \times deff)$	=	0.319 N/sq.mm
Ast Provided at a distance deff	=	20724.00 sq mm
Pt at a distance deff	=	0.32 %
Allowable Shear Stress	=	0.41 N/sq.mm

Hence SHEAR CHECK O.K.

Check For Two way Shear

Dist from edge of footing at d/2 from face of column (short span) =	1150 mm
Dist from edge of footing at d/2 from face of column (long span) =	1550 mm
Perimeter at d/2 from face of column =	11200 mm
deff at d/2 (short span) =	1500.00 mm
deff at d/2 (long span) =	1500.00 mm
Pressure due to axial load (P5) =	27.24 Ton / sq mm
Total Shear = P5 x footing area - P5 x footing area upto d/2 =	590.73 Ton
Average footing depth at d/2 =	1500.00 mm
Shear stress = (Vu / perimeter x deff) =	0.53 N/sq.mm
Allowable Shear Stress = 0.25 x sqrt(Fck) =	1.48 N/sq.mm

Hence SHEAR CHECK O.K.



GLOENTECH PVT.

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DN CONSULTANT

GPL/6170/STN/STR/DCR/R2

THANK YOU