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ALLIANCE SIRUSERI, CHENNAI

BLOCK-J (CLUB HOUSE)

STRUCTURAL DESIGN CALCULATIONS

DesignTree Service Consultants Pvt Ltd
Consulting Engineers
7 Laxmi Narasimha Complex
15th Cross 100 Feet Road 4 Phase,
J.P.Nagar, Bangalore 560 078. INDIA
T: +91 80 4122 5481 F: +918041225479
EMAIL: info@designtreeconsultants.com
www.designtreeconsultants.com

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone-97411 10384

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ALLIANCE SIRUSERI, CHENNAI

DESIGN BRIEF REPORT

Client	:	**ALLIANCE GROUP** Chennai
SMEP Consultants	:	**Design Tree Service Consultants Pvt Ltd** # 7, Laxmi Narasimha Complex 15th Cross, 100ft Ring Road, 4th Phase, JP Nagar Bangalore - 560 078
Architects	:	**LAVANYA & SHANKAR ARCHITECTS** Chennai

ISSUE RECORD

PROJECT : **ALLIANCE SIRUSERI , CHENNAI**

TITLE : **Preliminary Design Brief Report**

DOCUMENT NO : **DTSC / 406 F**

1. STRUCTURAL

DATE	ISSUE	PREPARED	CHECKED	REMARKS / REVISION
20.02.19	Prelim report	SWAPNA	B.SRINIVASARAO	R0
22.07.19	Prelim report	SUNIL	B.SRINIVASARAO	R1
25.10.21	Prelim report	SUNIL	B.SRINIVASARAO	R2

1. STRUCTURE

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1- STRUCTURE

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1.2 Design standards

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1.4 Materials

1.5 Structural concept

1.6 Water Proofing

1.7 Design Philosophy

1.1 PROJECT BRIEF

The clients M/S ALLIANCE GROUP Intends to develop residential building, at Chennai. Project is architectured by LAVANYA & SHANKAR ARCHITECTSChennai.Structures, Plumbing, Fire Protection, HVAC and Electrical Engineering Services are provided by M/S Design Tree Service Consultants Pvt. Ltd, Bangalore.

All service facilities like underground sump and pump are to be provided as per the requirements given by clients.

The proposed residential building having 10 blocks A,B,C,D, E,F,G,H,I &J.

- Residential blocks A,B,C,D,E,F& G having 1 Basement + stilt+19 upper floors+Terrace floor.
- Residential block H having 1 Basement + stilt+17 upper floors+Terrace floor.
- Block I (Club house) having1 Basement + Ground +3+Terrace.
- Block J (Learning hub) having Ground+3+Terrace.

The height of the proposed Building from FGL is up to 59.85 /53.90/ 22.05 / 14.85 mts.

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- NationalBuilding Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

1.2 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.

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.
IS: 6313 (part II)	: Standards for anti-termite treatment.
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 -2012	: Code of practice for pre stressed concrete.
IS: 14268 - 1995	: Uncoated stress relieved low relaxation seven-ply strand for pre stressed 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: 13920-2016	: Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice.
IS: 16700 -2017	: Criteria for structural safety of tall 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 - 1984 (reaffirmed 1998)	: 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.

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

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 hard drawn 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 DATA:

Loads:

1.3.1 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	:	120kg/sq.m (1.2kN/sq.m).
• Floor finish of 75mm thick for Parking Areas	:	180kg/sq.m (1.8kN/sq.m).
• False ceiling + ducting + Sprinklers(services)	:	40 kg/sq.m (0.4 kN/sq.m).
• Partitions	:	100kg/sq.m (1.0kN/sq.m).
• Wall loads	:	As per actuals.
• 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	:	1900 kg/cu.m (19 kN/cu.m).

• Aerated block masonry	:	865 kg/cu.m (8.65 kN/cu.m).
• Soil (Dry)	:	1800 kg/cu.m (18 kN/cu.m).
• Soil (Saturated)	:	2000 kg/cu.m (20 kN/cu.m).
• Water	:	1000 kg/cu.m (10 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)
• Waterproofing (membrane).	:	15kg/sq.m (0.15kN/sq.m).
• External finishes	:	As per actuals.
• Gardening/Landscape loads	:	As per actuals
• Equipment loads	:	As per Vendor details.

1.3.2 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.

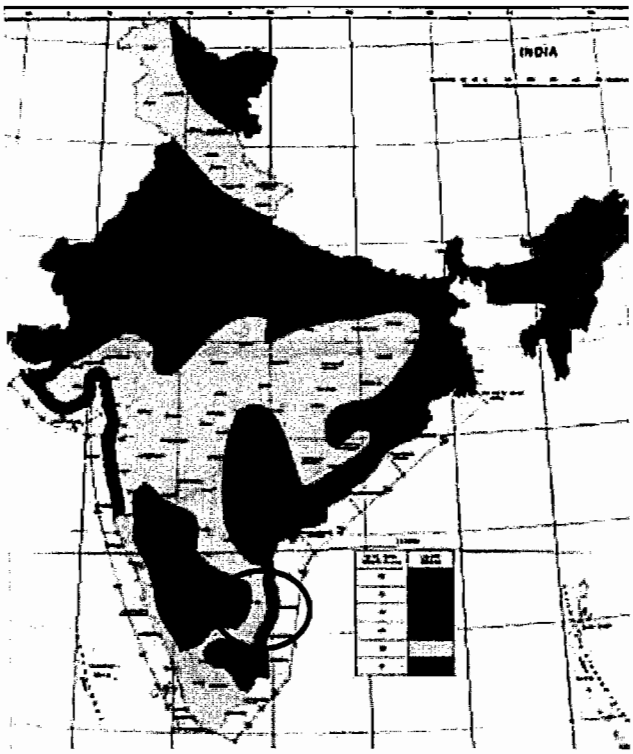
Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Living /Dining hall/ kitchens/Bed rooms	: 200 kg/sq.m (2.0 kN/sq.m)
Toilet and bathrooms	: 200 kg/sq.m (2.0 kN/sq.m)
Stairs	: 300 kg/sq.m (3.0 kN/sq.m)
Corridors / Balcony/utility	: 300 kg/sq.m (3.0 kN/sq.m)
Lift Machine room	: 1000 kg/ sq.m or as per actuals.
Balconies	: 300 kg/ sq.m or as per actuals.
Parking Area	: 250 kg/ sq.m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 1500 kg/sq.m (15.0 kN/sq.m).
Ramps	: 300 kg/sq.m (3 kN/sq.m)+ 25% Impact (Without fire truck movement
Communication Room /Meter Room	: 300 kg/sq.m (3.0 kN/sq.m)

1.3.3 Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3).

Chennai, which is located in Tamil nadu, is having wind speed of 50m/sec.

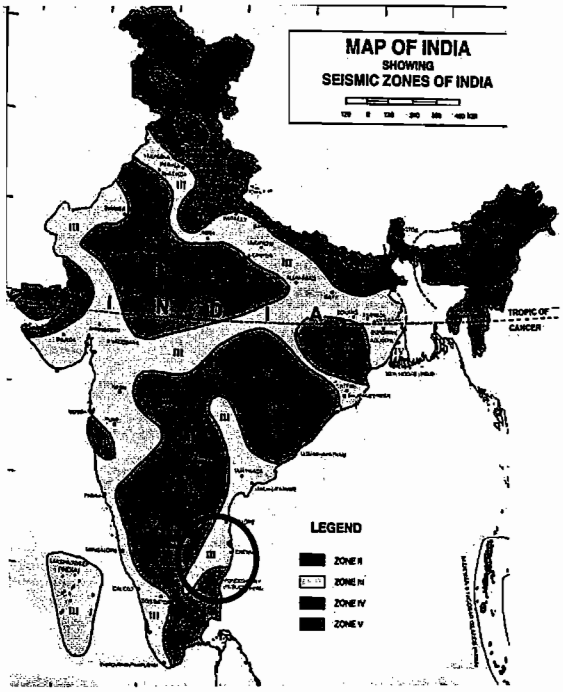


- Basic Wind Speed Vb : 50 m/sec
- Risk Coefficient K1 : 1.00 (k1 corresponds to 50 years Mean Probable Design Life of Structure)
- Terrain, height, structure size factor K2 : To suit the height of the structure for terrain Category 3 & Class C and also it varies with the height of the structure.
- Topography factor K3 : 1.00
- Importance factor for the cyclonic region K4 : 1.00
- The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)
- Design wind speed Vz : $Vb \times k1 \times k2 \times k3 \times k4$
- Design wind pressure Pz : $0.6 \times Vz^2$

Height of the building (m)	K2	$Vz = Vb \times k1 \times k2 \times k3 \times k4$ (m/s)	$Pz = 0.6 \times Vz^2$ (kN/m^2)

10	0.91	45.5	1.242
20	1.01	50.5	1.53
30	1.06	53	1.68
40	1.09	54.5	1.78
50	1.12	56	1.88
60	1.136	56.8	1.94
70	1.152	57.6	1.99
80	1.168	58.4	2.05
100	1.2	60.0	2.16

Seismic Forces



1.3.4 Seismic Forces

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

Seismic Zone : III
Seismic Zone factor, Z : 0.16 (As per Table 2, IS: 1893-2016)
Design horizontal seismic coefficient (Ah) : (Z/2)*(Sa/g)*(I/R)

I -Importance factor : 1.2 (Ref Table 6, IS: 1893-2016)
Response reduction Factor : 4 (SMRF)

R as per Table 7 of IS: 1893-2016 is based on Special moment RC Moment -Resisting Frame (SMRF), with ductile detailing.

Sa/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 (Ah) : (Z/2)*(Sa/g)*(I/R)
: (0.16/2)*(1.2/4) * (Sa/g)
Ah : 0.016 * (Sa/g)
Design seismic base shear, Vb : Ah * W where, W - seismic weight of building
Detailing as per IS-13920-2002 : Special moment resistant frame with ductile detailing

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	0.36

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

- Environment : Moderate
- 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.
- Minimum grade of concrete : Moderate exposure - M30
- Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 30 mm
- Nominal covers for 2 hr. fire resistance :

Nominal Cover

Beams		Slabs		Ribs		Columns/Shear walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.3.6 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

1.3.7 Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

1.3.8 Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design.

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental hitting of vehicle on the façade
- Snow Load

1.4 MATERIALS:

Materials specified will 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.

1.4.1 Concrete:

- All structural concrete shall have cube crushing strength of M35 to M25 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation / Retaining Walls	M35/M30
Columns & Walls	M50 to M30
Girder beam	M40
Slab, beams & Ramps	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 415 N/sq.mm.
- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 500 N/sq.mm.

Structural Steel

All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm.

1.5 STRUCTURAL CONCEPT

- The Structural System comprises of regular Beam, slab and shear walls system for both car park and residential floors. Floor slabs and beams are considered to act as a rigid diaphragm to transfer the lateral forces to the columns.

- The slabs for toilet area sunk by 250mm. Balconies are sunk by 150mm.The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	
a)	Column grids	Varies
b)	Structural system	R.C.C Column and Girder Beam in 1st floor level and RC wall up to Terrace
c)	Slab thickness	175/150/125mm
d)	Column/RC Wall size	As per the design
g)	Peripheral beams	As per the design

Structural analysis and design:

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 2016** software package for both vertical and lateral loads.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, and seismic loads and for the load combinations as given in the relevant codes.
- The slabs are analyzed as two-way and one way slabs

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 deflection is considered as span/250

As per IS1893 (Part1) :2016, Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height design.

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 water retaining structures, crack width is limited to 0.2mm.

Load Combinations:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	EL	DL	LL	EL
DL + LL	1.5	1.5	–	1	1	–
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8

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

***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; EL - Earthquake Load

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 combination.

Expansion joint/Separation joint:

Expansion / separation joint is provided in this building.

1.6 WATERPROOFING:

Toilets and Balconies:

Water proofing is done with Acrylic cementitious coating, made on all wall faces and one coat crystallization method with water is made on floor areas.

Terrace:

In the Terrace areas, water proofing is done with Acrylic cementitious coating as first layer & 100mm thick (Average thickness) screed concrete or brick coba as a topping layer shall be used.

1.7 DESIGN PHILOSOPHY:

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 are required for all replaceable material for longer life.

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 to resist lateral forces. 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. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns. The type of footings proposed will be individual or Raft based on actual design

Foundation:

Foundations are designed depending upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. Individual / Combined footings is envisaged depending on the soil report.

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone - 97411 10384

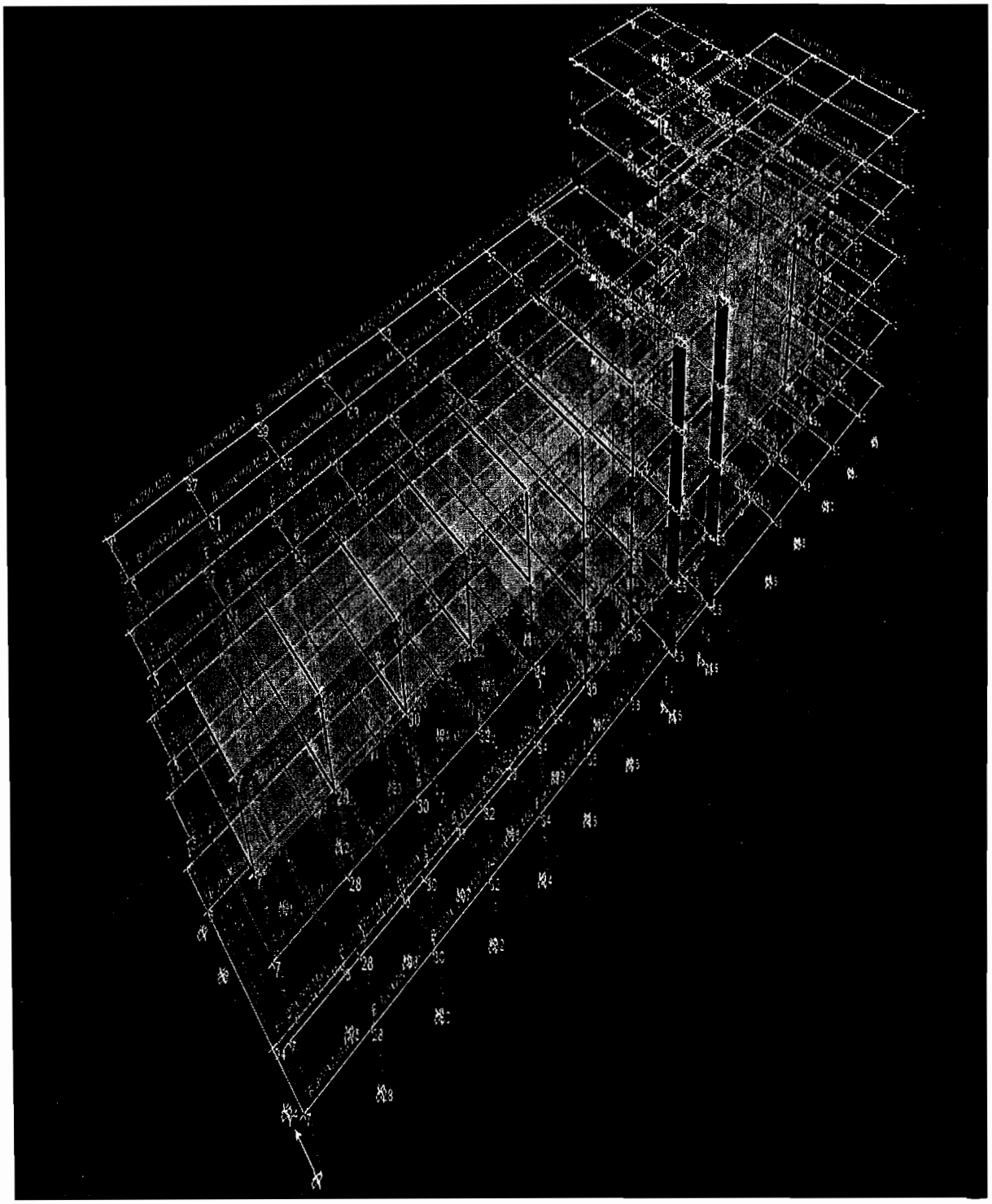
Table: Centers of Mass and Rigidity

Story	Diaphragm	Mass X	Mass Y	XCM	YCM	Cum Mass X	Cum Mass Y	XCCM	YCCM	XCR	YCR
		kg	kg	m	m	kg	kg	m	m	m	m
LMR TOP	D1	172269.55	172269.55	41.6403	10.9154	172269.55	172269.55	41.6403	10.9154	40.9419	10.7118
LMR BOTTOM	D1	231706.3	231706.3	41.2186	11.1579	403975.84	403975.84	41.3984	11.0545	39.4197	10.1067
TERRACE	D1	1167268.29	1167268.29	31.5528	7.5902	1571244.13	1571244.13	34.0842	8.4809	32.8778	7.8249
3RD FLOOR	D1	1357323.88	1357323.88	31.5376	7.5296	2928568.01	2928568.01	32.9039	8.04	33.168	7.739
2ND FLOOR	D1	1517715.85	1517715.85	32.955	7.4593	4446283.87	4446283.87	32.9213	7.8418	33.4736	7.631
1ST FLOOR	D1	999765.13	999765.13	42.0169	7.5136	5446049	5446049	34.5911	7.7815	34.8644	7.5113
GF	D1	1402702.11	1402702.11	31.2457	7.4517	6848751.1	6848751.1	33.9059	7.714	30.5308	7.3975

Table: Modal Participating Mass Ratios

Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec												
Modal	1	1.265	0.0467	0.6439	0	0.0467	0.6439	0	0.1905	0.0151	0.1005	0.1905	0.0151	0.1005
Modal	2	1.249	0.684	0.0786	0	0.7307	0.7224	0	0.0233	0.1979	0.0248	0.2138	0.213	0.1253
Modal	3	1.205	0.0588	0.0585	0	0.7895	0.781	0	0.017	0.0115	0.6604	0.2308	0.2245	0.7857
Modal	4	0.487	0.0433	0.0001	0	0.8328	0.7811	0	0.0004	0.2515	0.0009	0.2312	0.476	0.7866
Modal	5	0.404	0.0004	0.073	0	0.8332	0.8541	0	0.3738	0.0019	0.0285	0.6051	0.4779	0.8151
Modal	6	0.333	0.064	0.002	0	0.8973	0.856	0	0.0106	0.262	0.0035	0.6156	0.7399	0.8186
Modal	7	0.316	0.004	0.015	0	0.9012	0.8711	0	0.0804	0.0153	0.0489	0.6961	0.7552	0.8675
Modal	8	0.254	2.4E-05	0.0014	0	0.9012	0.8725	0	0.0061	0.0001	0.0037	0.7022	0.7553	0.8712
Modal	9	0.232	2.32E-05	0.0312	0	0.9013	0.9037	0	0.0525	4.64E-05	0.0062	0.7547	0.7554	0.8774
Modal	10	0.203	0.0563	3.13E-05	0	0.9576	0.9037	0	0.0001	0.1174	0.0001	0.7547	0.8728	0.8776
Modal	11	0.179	3.3E-06	0.013	0	0.9576	0.9167	0	0.0214	1.63E-05	0.0757	0.7761	0.8728	0.9532
Modal	12	0.167	6.41E-06	0.0442	0	0.9576	0.9609	0	0.1134	1.45E-05	0.0001	0.8895	0.8728	0.9534

3D MODEL



TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN. Grade of Concrete = M25.

Mx = 7.1 KN-m. Grade of Steel = Fe500.

My = 26 KN-m.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the limits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum moment for which the column is to be designed is
Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN.
Mx = 25.26KN-m.
My = 83 KN-m.

Grade of Concrete = M30
Grade of Steel = Fe500.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

M_u / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

M_u / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

TYPICAL BEAM DESIGN

(ANALYSIS WAS DONE BY ETABS USING DIFFERENT LOAD COMBINATIONS, THE DESIGN FORCES ARE TAKEN FOR DCON2 CASE)

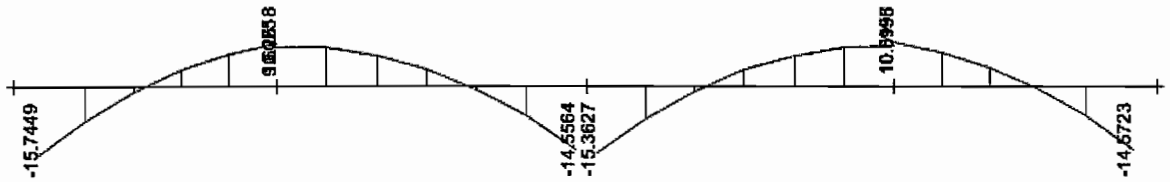
A Beam of 2 spans was considered for Typical Design Calculation.
Beam Location – Along Grid 33 to 46 (First Floor Shuttering)

Beam Size : 200mm x 450mm.

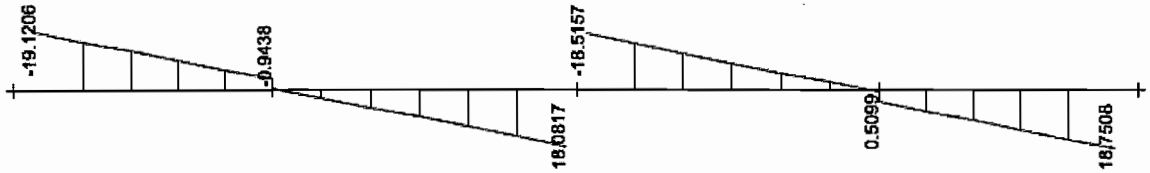
Grade of Concrete = M30;
Grade of Steel = Fe-500;
Effective depth – d' = 450-50 = 400 mm.

BENDING MOMENT, SHEAR FORCE AND TORSION DIAGRAMS TAKEN FROM ETABS

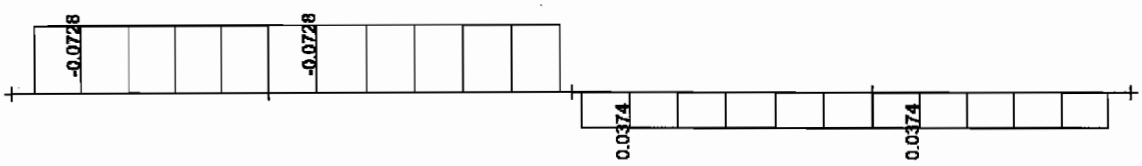
BENDING MOMENT DIAGRAM (KNm)



SHEAR FORCE DIAGRAM (KN)



TORSION DIAGRAM (KNm/m)



LEFT BEAM-(200X450)

Left End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 36KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 36 + 0.35
= 36.35 KN-m.

Mu/bd^2 = 36.35 x 10^6 /230 x 400^2
= **0.987**

Pt = 0.29 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
=0.29 x 230 x 400/ 100
= 267 mm^2.

Provide (2T16) ---- @ Top

Mid Span bottom

Mu = 41-KNm

Mu/bd^2 = 41x 10^6 /230 x 400^2
= 1.12

Pt = 1.12 % (From SP-16, Table 3)
As per IS : 13920 : 1993 minimum reinforcement provided will be 0.24%
Ast = Pt x b x D/100
= 0.24 x 230 x 450/ 100
= 249 mm^2.

Provide (2T16)

Right End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 35KN-m. Tu = 0.2 KN-m/m

M_t = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = M_u + Mt = 35 + 0.35
= 35.35 KN-m.

M_u/bd^2 = 35.35 x 10^6 /230 x 400^2
= **0.96**

P_t = 0.2789 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
= 0.2789 x 230 x 400/ 100
= 256 mm^2.
Provide (2T16) ---- @ Top

<u>Shear Reinforcement:</u>

V1 at Left End Support = 47 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 5.13/0.23 + 47 = 83 KN

ζv = Vu/bd = 83 x 10^3/ 230 x 400
= 0.90 N/mm^2
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm^2
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400

= .278

Therefore ζ_c = 0.39 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 83 x 10^3 – 0.39 x 230 x 400
= 47.12 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 47.12 x 10^3
= 306 mm.

V1 at Right End Support = 46 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 0.2/0.23 + 46 = 47.4 KN

ζ_v = Vu/bd = 47.4 x 10^3/ 230 x 400
= 0.52 N/mm²
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm²
Therefore $\zeta_v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400
= .28

Therefore ζ_c = 0.36 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 47.41 x 10^3 – 0.36 x 230 x 400
= 14.29 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 14.29 x 10^3
= 1013 mm.

As per code IS : 13920 : 1993 minimum spacing provided should be d/4 or 8 x diameter of smaller bar or 100mm whichever is less.

Hence Provide 2L-T8@100/200/100 c/c

Check for Deflection:

Maximum allowable Elastic short term deflection = l/250 = 4512/250
= 18.048 mm.

But actual deflection from ETABS = 1.4mm.

Maximum allowable long term deflection = l/350 = 4512/350
= 12.9 mm > 1.41 mm.

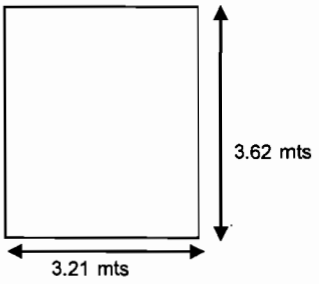
Therefore within the limits.

DESIGN TWOWAY SLAB

DESIGN OF TWO WAY SLAB

Short span	S=	3.21	m
Long span	L=	3.62	m
Assumed slab thickness	t=	0.125	m
Grade of concrete	fck=	25	N/mm^2
Grade of reinforcement	fy=	500	N/mm^2

Clear Span	
S	3.21
L	3.62



Type of panel One short edge discontinuous

Loads

Self weight of slab	w1=	3.13	kN/m^2	
Floor finish	w2=	1.50	kN/m^2	
Live load	w3=	2.00	kN/m^2	TOTAL
Miscellaneous	w4=	0.00	kN/m^2	6.63 kN/m^2

Ratio of long span to short span R= 1.15

Design Load with load factor of 1.5 Wu= 9.94 kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.046	**4.71**	0.46	0.11	**150.00**	8	335	101
Positive moment at midspan	0.034	**3.48**	0.34	0.08	**150.00**	8	335	101
						8	200	
Long span direction								
Negative moment at continuous edge	0.037	**3.79**	0.44	0.10	**150.00**	8	335	93
Positive moment at midspan	0.028	**2.87**	0.33	0.08	**150.00**	8	335	93

Minimum effective depth reqd	dre=	36.95 mm	
Clear cover to any reinforcement	c=	20 mm	
Minimum effective depth provided	dpr=	93 mm	greater than 'min. eff depth reqd'. Hence ok
Minimum reinforcement	Amin=	150 mm^2	

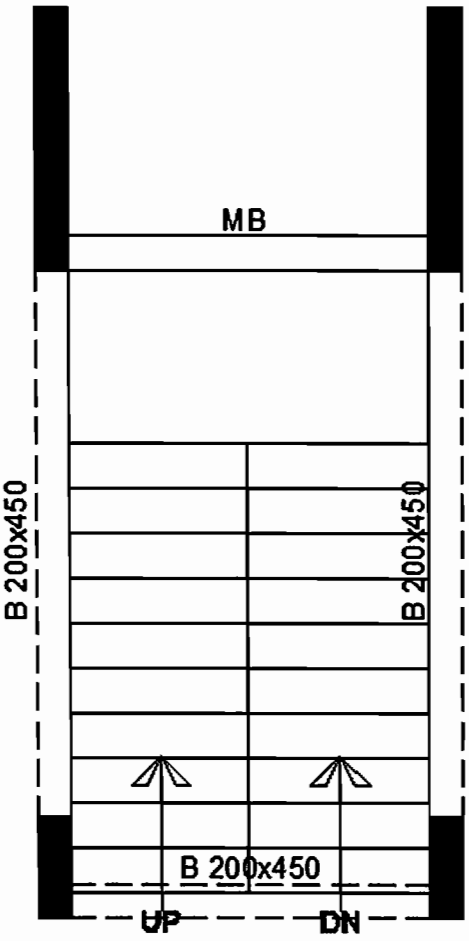
Deflection check

Reinf provided at midspan along short direction 251.33 mm^2 Dia 8 at 200 mm

Stress in reinforcement	fs=	173.081	N/mm^2
Percentage of reinforcement provided	pt=	0.24884	%
Modification factor as per fig 4 of IS:456-2000	MF=	2	

Type of slab for deflection check	Continuous	
Basic span to effective depth ratio	26	
Minimum effective depth reqd from deflection criteria	61.73 mm	
Effective depth provided	101 mm	greater than 'min. eff depth reqd'. Hence ok

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

SOIL EXPLORATION REPORT

PROJECT NO : **7364**

PROJECT NAME : **Construction of Proposed 2 Basement + Stilt + 19 Floors, Alliance Budget housing at Siruseri.**

1. INTRODUCTION

M/s. Alliance Group are proposing to construct 2 Basement + Stilt + 19 Floors Alliance Budget housing, Siruseri, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Alliance Group, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose eight boreholes were bored upto a depth varies from 6.0 to 8.5M below ground level. The boreholes were terminated after drilling for the required depth in the medium rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling techniques was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could not be collected since the soil layers met with were essentially cohesionless in nature. Core samples were collected from medium rock layers.

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 9 The top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

4. ANALYSIS OF TEST RESULTS

1. Standard Penetration Test
2. Grain Size Analysis
3 Determination of Specific Gravity
4. Crushing Strength of Rock

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 2 to 9. The relative density of the cohesionless layers obtained from the N values are given in the bore logs.

4. 2 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart .

4.3 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.4 Crushing Strength of Rock

Core samples collected from medium rock layers were tested for determining crushing strength of rock. The results are given in Table – 2.

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock / medium rock layer.

The safe bearing capacity of these cohesionless layers could be computed using the formula,

$$Q_a = (0.5\gamma \times B \times N_\gamma + \gamma D_f N_q) \div 2.5$$

Where,

B	=	Width of footing
γ	=	Submerged unit weight of soil taken as 1 gm/cc,
D_f	=	Depth of surcharge
$N\gamma$ Nq	=	Bearing capacity factors based on the N values taken from Fig 10

For an N value of over 50 the SBC computed over 5.0kg/cm^2 for the foundations are placed on the disintegrated rock layer. However, the SBC may be limited to 5.0kg/c^2 to allow for any non-uniformity.

When the foundations are taken to medium rock layer the SBC that could be adopted is 10kg/cm^2.

The settlement would be elastic and of small order.

Over excavations in disintegrated rock should be refilled by 1:3:6 concrete and in medium rock by 1:2:4 concrete.

6. EXCAVATION PROCEDURE

1. Vertical cuts could be given for excavation.

2. Normal excavators would be required for excavation in disintegrated rock and jack hammers would be required for excavation in medium rock.

3. Slush formed by any water accumulation should be removed and refilled by lean concrete.

4. If water accumulates in the foundation trenches, dewatering should be done by pumping out water from a level lower than the foundation level to maintain downward flow of water.

5 The exposed side of excavation should be covered by plastic sheet during rainy season and surface drain provided to prevent water from flowing on the cut surface.

8. CONCLUSIONS

1. The area explored has got top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

2. For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock /medium rock layer. The SBC that could be adopted is 5.0kg/cm^2 when the foundations are placed on the disintegrated rock layer and 10.0kg/cm^2 when the foundations are on the medium rock layer.

3. The settlement of the shallow foundation would be of small order and elastic in nature.

4. Over excavations in the foundation trenches should be refilled as suggested.

5. Suggested excavation procedure should be adopted while undertaking the construction.

F.S.ENGINEERS PVT.LTD
NEW NO.98,(Old No.109) VELACHERY ROAD
GUINDY
CHENNAI – 600 032

(Dr.A. Verghese Chummar)
Director
Dated: Feb 5th , 2018

P.N.7364

ALLIANCE SIRUSERI, CHENNAI

BLOCK-G

STRUCTURAL DESIGN CALCULATIONS

DesignTree Service Consultants Pvt Ltd
Consulting Engineers
7 Laxmi Narasimha Complex
15th Cross 100 Feet Road 4 Phase,
J.P.Nagar, Bangalore 560 078. INDIA
T: +91 80 4122 5481 F: +918041225479
EMAIL: info@designtreeconsultants.com
www.designtreeconsultants.com

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone - 97411 10384

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    - COLUMN DESIGN
    - BEAM DESIGN
    - SLAB DESIGN
    - STAIR CASE DESIGN
5. STRUCTURAL DRAWINGS
6. SOIL REPORT

ALLIANCE SIRUSERI, CHENNAI

DESIGN BRIEF REPORT

Client	:	**ALLIANCE GROUP** Chennai
SMEP Consultants	:	**Design Tree Service Consultants Pvt Ltd** # 7, Laxmi Narasimha Complex 15th Cross, 100ft Ring Road, 4th Phase, JP Nagar Bangalore - 560 078
Architects	:	**LAVANYA & SHANKAR ARCHITECTS** Chennai

ISSUE RECORD

PROJECT : **ALLIANCE SIRUSERI , CHENNAI**

TITLE : **Preliminary Design Brief Report**

DOCUMENT NO : **DTSC / 406 F**

1. STRUCTURAL

DATE	ISSUE	PREPARED	CHECKED	REMARKS / REVISION
20.02.19	Prelim report	SWAPNA	B.SRINIVASARAO	R0
22.07.19	Prelim report	SUNIL	B.SRINIVASARAO	R1
25.10.21	Prelim report	SUNIL	B.SRINIVASARAO	R2

1. STRUCTURE

CONTENTS

1- STRUCTURE

1.1 Project Brief/Introduction
1.2 Design standards
1.3 Design Data
1.4 Materials
1.5 Structural concept
1.6 Water Proofing
1.7 Design Philosophy

1.1 PROJECT BRIEF

The clients M/S ALLIANCE GROUP Intends to develop residential building, at Chennai. Project is architectured by LAVANYA & SHANKAR ARCHITECTSChennai.Structures, Plumbing, Fire Protection, HVAC and Electrical Engineering Services are provided by M/S Design Tree Service Consultants Pvt. Ltd, Bangalore.

All service facilities like underground sump and pump are to be provided as per the requirements given by clients.

The proposed residential building having 10 blocks A,B,C,D, E,F,G,H,I &J.

- Residential blocks A,B,C,D,E,F& G having 1 Basement + stilt+19 upper floors+Terrace floor.
- Residential block H having 1 Basement + stilt+17 upper floors+Terrace floor.
- Block I (Club house) having1 Basement + Ground +3+Terrace.
- Block J (Learning hub) having Ground+3+Terrace.

The height of the proposed Building from FGL is up to 59.85 /53.90/ 22.05 / 14.85 mts.

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- NationalBuilding Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

1.2 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.

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.
IS: 6313 (part II)	: Standards for anti-termite treatment.
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 -2012	: Code of practice for pre stressed concrete.
IS: 14268 - 1995	: Uncoated stress relieved low relaxation seven-ply strand for pre stressed 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: 13920-2016	: Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice.
IS: 16700 -2017	: Criteria for structural safety of tall 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 - 1984 (reaffirmed 1998)	: 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.

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

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 hard drawn 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 DATA:

Loads:

1.3.1 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	:	120kg/sq.m (1.2kN/sq.m).
• Floor finish of 75mm thick for Parking Areas	:	180kg/sq.m (1.8kN/sq.m).
• False ceiling + ducting + Sprinklers(services)	:	40 kg/sq.m (0.4 kN/sq.m).
• Partitions	:	100kg/sq.m (1.0kN/sq.m).
• Wall loads	:	As per actuals.
• 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	:	1900 kg/cu.m (19 kN/cu.m).

- Aerated block masonry : 865 kg/cu.m (8.65 kN/cu.m).
- Soil (Dry) : 1800 kg/cu.m (18 kN/cu.m).
- Soil (Saturated) : 2000 kg/cu.m (20 kN/cu.m).
- Water : 1000 kg/cu.m (10 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)
- Waterproofing (membrane). : 15kg/sq.m (0.15kN/sq.m).
- External finishes : As per actuals.
- Gardening/Landscape loads : As per actuals
- Equipment loads : As per Vendor details.

1.3.2 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.

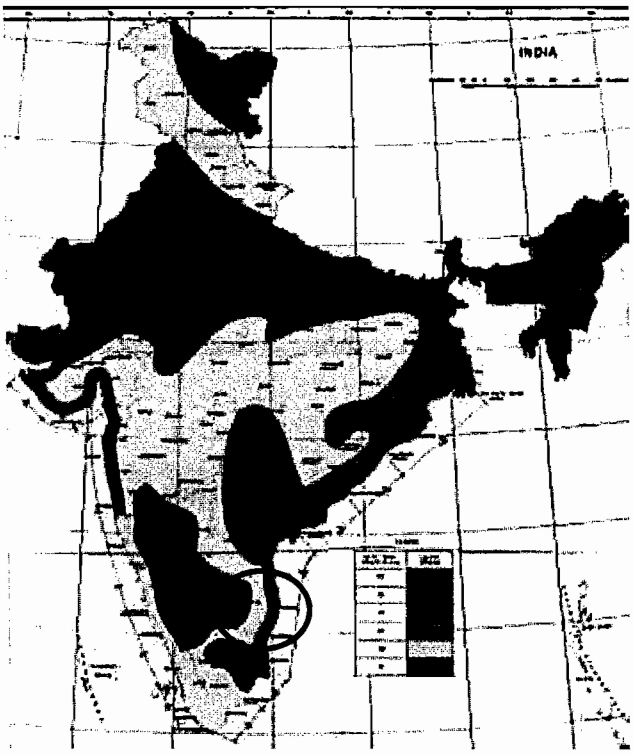
Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Living /Dining hall/ kitchens/Bed rooms	: 200 kg/sq.m (2.0 kN/sq.m)
Toilet and bathrooms	: 200 kg/sq.m (2.0 kN/sq.m)
Stairs	: 300 kg/sq.m (3.0 kN/sq.m)
Corridors / Balcony/utility	: 300 kg/sq.m (3.0 kN/sq.m)
Lift Machine room	: 1000 kg/ sq.m or as per actuals.
Balconies	: 300 kg/ sq.m or as per actuals.
Parking Area	: 250 kg/ sq.m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 1500 kg/sq.m (15.0 kN/sq.m).
Ramps	: 300 kg/sq.m (3 kN/sq.m)+ 25% Impact (Without fire truck movement
Communication Room /Meter Room	: 300 kg/sq.m (3.0 kN/sq.m)

1.3.3 Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3).

Chennai, which is located in Tamil nadu, is having wind speed of 50m/sec.

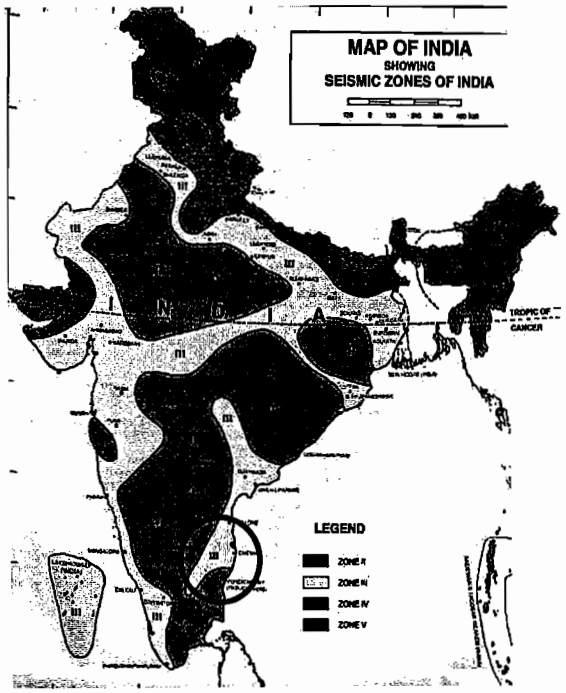


- Basic Wind Speed Vb : 50 m/sec
- Risk Coefficient K1 : 1.00 (k1 corresponds to 50 years Mean Probable Design Life of Structure)
- Terrain, height, structure size factor K2 : To suit the height of the structure for terrain Category 3 & Class C and also it varies with the height of the structure.
- Topography factor K3 : 1.00
- Importance factor for the cyclonic region K4 : 1.00
- The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)
- Design wind speed Vz : Vb x k1 x k2 x k3 x k4
- Design wind pressure Pz : $0.6 \times Vz^2$

Height of the building (m)	K2	Vz = Vb x k1 x k2 x k3 xk4 (m/s)	Pz = 0.6 x Vz^2 (kN/m^2)

10	0.91	45.5	1.242
20	1.01	50.5	1.53
30	1.06	53	1.68
40	1.09	54.5	1.78
50	1.12	56	1.88
60	1.136	56.8	1.94
70	1.152	57.6	1.99
80	1.168	58.4	2.05
100	1.2	60.0	2.16

Seismic Forces



1.3.4 Seismic Forces

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

Seismic Zone	: III
Seismic Zone factor, Z	: 0.16 (As per Table 2, IS: 1893-2016)
Design horizontal seismic coefficient (Ah)	: (Z/2)*(Sa/g)*(I/R)
I -Importance factor	: 1.2 (Ref Table 6, IS: 1893-2016)
Response reduction Factor	: 4 (SMRF)

R as per Table 7 of IS: 1893-2016 is based on Special moment RC Moment -Resisting Frame (SMRF), with ductile detailing.

Sa/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 (Ah)		: (Z/2)*(Sa/g)*(I/R)
		: (0.16/2)*(1.2/4) * (Sa/g)
	Ah	: 0.016 * (Sa/g)
Design seismic base shear, Vb		: Ah * W where, W - seismic weight of building
Detailing as per IS-13920-2002		: Special moment resistant frame with ductile detailing

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	0.36

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

- Environment : Moderate
- 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.
- Minimum grade of concrete : Moderate exposure - M30
- Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 30 mm
- Nominal covers for 2 hr. fire resistance :

Nominal Cover

Beams		Slabs		Ribs		Columns/Shear walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.3.6 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

1.3.7 Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

1.3.8 Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design.

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental hitting of vehicle on the façade
- Snow Load

1.4 MATERIALS:

Materials specified will 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.

1.4.1 Concrete:

- All structural concrete shall have cube crushing strength of M35 to M25 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation / Retaining Walls	M35/M30
Columns & Walls	M50 to M30
Girder beam	M40
Slab, beams & Ramps	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 415 N/sq.mm.
- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 500 N/sq.mm.

Structural Steel

All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm.

1.5 STRUCTURAL CONCEPT

- The Structural System comprises of regular Beam, slab and shear walls system for both car park and residential floors. Floor slabs and beams are considered to act as a rigid diaphragm to transfer the lateral forces to the columns.

- The slabs for toilet area sunk by 250mm. Balconies are sunk by 150mm.The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	
a)	Column grids	Varies
b)	Structural system	R.C.C Column and Girder Beam in 1st floor level and RC wall up to Terrace
c)	Slab thickness	175/150/125mm
d)	Column/RC Wall size	As per the design
g)	Peripheral beams	As per the design

Structural analysis and design:

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 2016** software package for both vertical and lateral loads.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, and seismic loads and for the load combinations as given in the relevant codes.
- The slabs are analyzed as two-way and one way slabs

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 deflection is considered as span/250

As per IS1893 (Part1) :2016, Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height design.

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 water retaining structures, crack width is limited to 0.2mm.

Load Combinations:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	EL	DL	LL	EL
DL + LL	1.5	1.5	–	1	1	–
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8

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

***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; EL - Earthquake Load

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 combination.

Expansion joint/Separation joint:

Expansion / separation joint is provided in this building.

1.6 WATERPROOFING:

Toilets and Balconies:

Water proofing is done with Acrylic cementitious coating, made on all wall faces and one coat crystallization method with water is made on floor areas.

Terrace:

In the Terrace areas, water proofing is done with Acrylic cementitious coating as first layer & 100mm thick (Average thickness) screed concrete or brick coba as a topping layer shall be used.

1.7 DESIGN PHILOSOPHY:

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 are required for all replaceable material for longer life.

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 to resist lateral forces. 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. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns. The type of footings proposed will be individual or Raft based on actual design

Foundation:

Foundations are designed depending upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. Individual / Combined footings is envisaged depending on the soil report.

N. ARUN KARANTH, M.Tech
...ural Engineer-Grade-I (SE)
Regn.No. SE/Gr.I /19/05/008
180/84, Third Floor, Trunk Road,
Porur, Chennai -600 116.
Phone - 97411 10384

Table: Centers Of Mass And Rigidity

Story	Diaphragm	Mass X	Mass Y	XCM	YCM	Cum Mass X	Cum Mass Y	XCCM	YCCM	XCR	YCR
		kg	kg	m	m	kg	kg	m	m	m	m
LMR TOP	D1	60064.4	60064.4	-19.4526	-15.1662	60064.4	60064.4	-19.4526	-15.1662	-11.3494	-8.9948
LMR BOTTOM	D1	95111.68	95111.68	-19.326	-15.2982	155176.08	155176.08	-19.375	-15.2471	-10.1004	-7.5887
TERRACE	D1	750574.15	750574.15	-10.4772	-6.084	905750.23	905750.23	-12.0016	-7.6539	-8.2073	-5.3943
19TH	D1	833384.18	833384.18	-10.4811	-6.1146	1739134.41	1739134.41	-11.273	-6.9162	-8.1513	-5.4909
18TH	D1	833384.18	833384.18	-10.4811	-6.1146	2572518.59	2572518.59	-11.0165	-6.6565	-8.0803	-5.6124
17TH	D1	833384.18	833384.18	-10.4811	-6.1146	3405902.78	3405902.78	-10.8855	-6.5239	-7.9986	-5.7527
16TH	D1	833384.18	833384.18	-10.4811	-6.1146	4239286.96	4239286.96	-10.806	-6.4434	-7.909	-5.9079
15TH	D1	833384.18	833384.18	-10.4811	-6.1146	5072671.14	5072671.14	-10.7526	-6.3894	-7.8133	-6.0767
14TH	D1	833384.18	833384.18	-10.4811	-6.1146	5906055.32	5906055.32	-10.7143	-6.3506	-7.7126	-6.2597
13TH	D1	833384.18	833384.18	-10.4811	-6.1146	6739439.5	6739439.5	-10.6855	-6.3214	-7.6074	-6.4585
12TH	D1	833384.18	833384.18	-10.4811	-6.1146	7572823.69	7572823.69	-10.663	-6.2987	-7.4981	-6.6758
11TH	D1	833384.18	833384.18	-10.4811	-6.1146	8406207.87	8406207.87	-10.645	-6.2804	-7.3847	-6.9152
10TH	D1	833384.18	833384.18	-10.4811	-6.1146	9239592.05	9239592.05	-10.6302	-6.2655	-7.2674	-7.1811
9TH FLOOR	D1	833384.18	833384.18	-10.4811	-6.1146	10072976.23	10072976.23	-10.6179	-6.253	-7.1461	-7.4792
8TH FLOOR	D1	833384.18	833384.18	-10.4811	-6.1146	10906360.41	10906360.41	-10.6074	-6.2424	-7.0208	-7.8168
7TH FLOOR	D1	833384.18	833384.18	-10.4811	-6.1146	11739744.6	11739744.6	-10.5985	-6.2333	-6.8923	-8.2033
6TH FLOOR	D1	833384.18	833384.18	-10.4811	-6.1146	12573128.78	12573128.78	-10.5907	-6.2254	-6.7624	-8.652
5TH FLOOR	D1	833384.18	833384.18	-10.4811	-6.1146	13406512.96	13406512.96	-10.5839	-6.2186	-6.6351	-9.1816
4TH FLOOR	D1	833384.18	833384.18	-10.4811	-6.1146	14239897.14	14239897.14	-10.5779	-6.2125	-6.5199	-9.822
3RD FLOOR	D1	833517.88	833517.88	-10.4789	-6.1129	15073415.02	15073415.02	-10.5724	-6.207	-6.4323	-10.6295
2ND FLOOR	D1	833116.79	833116.79	-10.4856	-6.1178	15906531.81	15906531.81	-10.5678	-6.2023	-6.3898	-11.7106
1ST FLOOR	D1	976254.18	976254.18	-10.3939	-6.196	16882785.99	16882785.99	-10.5578	-6.2019	-6.1141	-13.4247
STILT	D1	6582101.75	6582101.75	-10.5867	-17.322	23464887.74	23464887.74	-10.5659	-9.3212	-6.4748	-14.2301
LMR TOP	D2	60095.39	60095.39	-1.5181	1.7202	60095.39	60095.39	-1.5181	1.7202	-6.1888	-2.0023
LMR BOTTOM	D2	95070.42	95070.42	-1.4014	1.8565	155165.81	155165.81	-1.4466	1.8037	-7.1639	-3.814

Tables / Modal Participating Mass Ratios

Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec												
Modal	1	2.181	0.5247	1.18E-05	0	0.5247	1.18E-05	0	3.08E-05	0.478	0.0084	3.08E-05	0.478	0.0084
Modal	2	1.944	0.0003	0.3945	0	0.525	0.3945	0	0.3678	0.0001	0.0839	0.3679	0.4781	0.0923
Modal	3	1.625	0.0005	0.1208	0	0.5254	0.5152	0	0.1192	0.0001	0.2622	0.4871	0.4782	0.3545
Modal	4	0.554	0.1245	0.0041	0	0.65	0.5193	0	0.0031	0.1025	0.0141	0.4902	0.5807	0.3687
Modal	5	0.484	0.0135	0.0811	0	0.6635	0.6004	0	0.059	0.0084	0.0265	0.5491	0.5891	0.3952
Modal	6	0.381	0.002	0.0537	0	0.6655	0.6541	0	0.0343	0.0008	0.0674	0.5834	0.5899	0.4626
Modal	7	0.259	0.0542	0.0048	0	0.7196	0.6589	0	0.0038	0.0461	0.0138	0.5872	0.636	0.4764
Modal	8	0.215	0.0193	0.0383	0	0.7389	0.6973	0	0.0313	0.0175	0.0232	0.6186	0.6536	0.4996
Modal	9	0.157	0.063	0.0268	0	0.8019	0.7241	0	0.0254	0.0733	0.0068	0.644	0.7269	0.5064
Modal	10	0.139	0.0302	0.0511	0	0.8321	0.7752	0	0.0523	0.0378	0.0044	0.6963	0.7647	0.5108
Modal	11	0.096	0.1532	0.0002	0	0.9853	0.7754	0	0.0002	0.2099	0.0375	0.6965	0.9746	0.5483
Modal	12	0.078	0.0001	0.2001	0	0.9854	0.9755	0	0.2646	0.0002	0.0002	0.9611	0.9748	0.5485

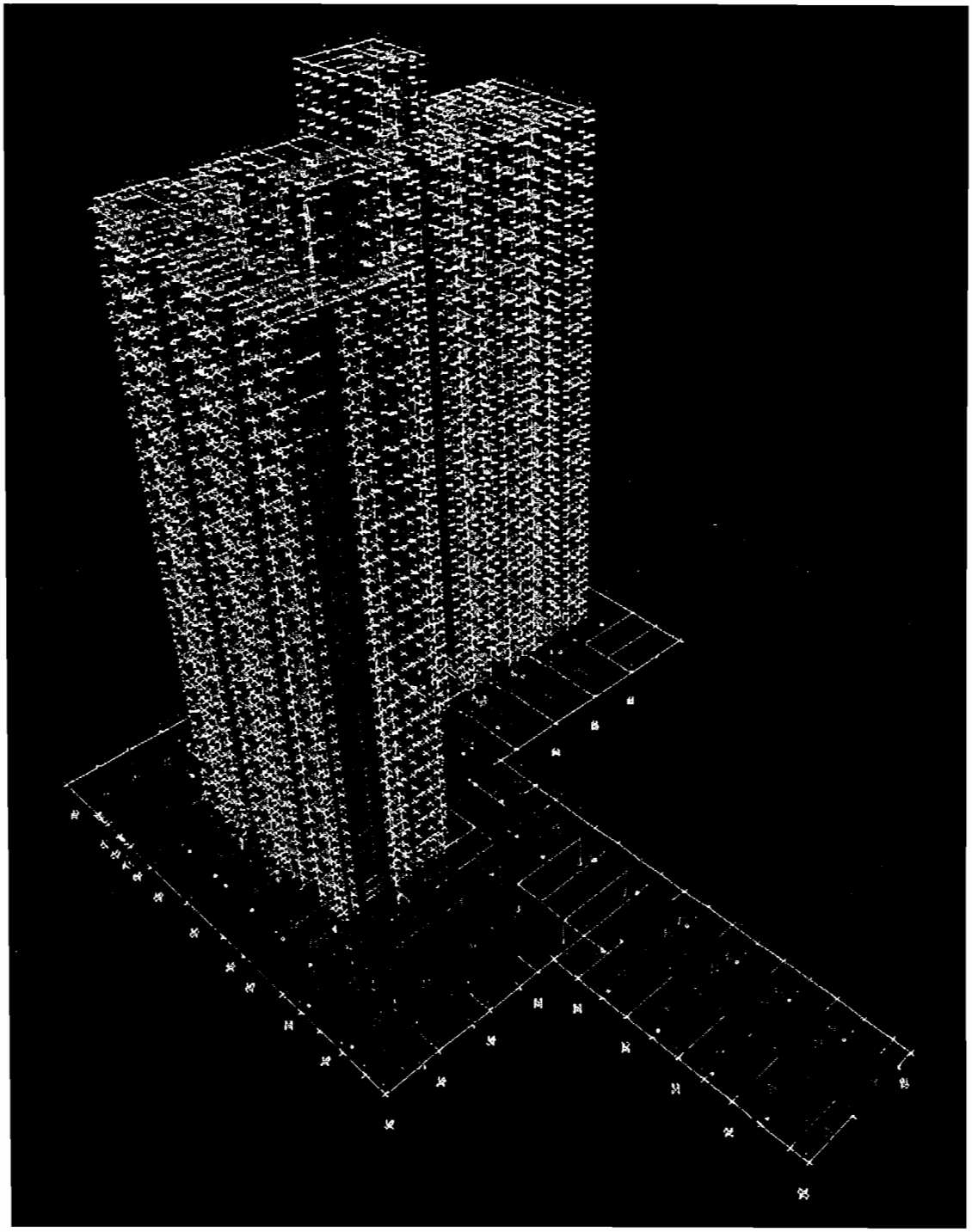
TABLE: Story Stiffness

Story	Output Case	Case Type	Shear X	Drift X	Stiff X	Shear Y	Drift Y	Stiff Y	
LMR TOP	SPECX-P	LinRespSpec	161.9401	1.917	84478.54	69.1769	0.295	234622.643	
LMR BOTTOM	SPECX-P	LinRespSpec	360.4636	1.826	197420.623	148.7991	0.291	510885.558	2.336932232
TERRACE	SPECX-P	LinRespSpec	954.3639	1.891	504557.556	360.2137	0.357	1010238.513	2.555748981
19TH	SPECX-P	LinRespSpec	1430.1265	1.937	738425.105	503.6716	0.352	1430959.018	1.463510151
18TH	SPECX-P	LinRespSpec	1742.58	1.979	880544.815	563.3478	0.349	1615332.503	1.19246327
17TH	SPECX-P	LinRespSpec	1928.2124	2.013	957969.728	555.8264	0.339	1641912.257	1.087928418
16TH	SPECX-P	LinRespSpec	2036.7666	2.037	1000034.571	509.2925	0.32	1593115.062	1.043910409
15TH	SPECX-P	LinRespSpec	2115.8899	2.05	1032171.187	462.2459	0.295	1568329.831	1.032135505
14TH	SPECX-P	LinRespSpec	2193.214	2.053	1068147.811	450.1116	0.267	1685198.195	1.034855288
13TH	SPECX-P	LinRespSpec	2270.8544	2.049	1108314.344	478.2957	0.24	1994338.997	1.037603909
12TH	SPECX-P	LinRespSpec	2339.3907	2.036	1149292.496	522.0754	0.214	2437811.682	1.036973402
11TH	SPECX-P	LinRespSpec	2399.2664	2.013	1191609.826	558.0111	0.19	2938267.389	1.036820331
10TH	SPECX-P	LinRespSpec	2470.8426	1.983	1246263.403	580.3049	0.167	3467669.186	1.045865329
9TH FLOOR	SPECX-P	LinRespSpec	2582.6275	1.942	1329852.359	596.7116	0.148	4041780.373	1.067071661
8TH FLOOR	SPECX-P	LinRespSpec	2745.0615	1.89	1452750.625	614.9898	0.135	4554859.149	1.09241497
7TH FLOOR	SPECX-P	LinRespSpec	2937.2801	1.821	1612781.491	631.9112	0.146	4322372.924	1.110157148
6TH FLOOR	SPECX-P	LinRespSpec	3125.9428	1.725	1812197.481	640.3321	0.167	3845318.358	1.123647246
5TH FLOOR	SPECX-P	LinRespSpec	3300.837	1.609	2051323.545	655.5477	0.188	3492751.7	1.131953646
4TH FLOOR	SPECX-P	LinRespSpec	3493.2118	1.453	2403477.71	733.0586	0.207	3536145.815	1.171671683
3RD FLOOR	SPECX-P	LinRespSpec	3745.0288	1.252	2990785.633	917.3465	0.269	3406719.077	1.244357549
2ND FLOOR	SPECX-P	LinRespSpec	4034.0222	1.095	3683209.671	1165.4753	0.197	5924696.967	1.231519113
1ST FLOOR	SPECX-P	LinRespSpec	4331.0181	0.926	4676904.422	1447.0025	0.196	7397220.192	1.269790438
STILT	SPECX-P	LinRespSpec	6888.4329	0.432	15928478.44	1502.345	0.123	12206977.14	3.405773777
LMR TOP	SPECY-P	LinRespSpec	51.3748	0.374	137495.816	91.9535	1.034	88931.872	#DIV/0!
LMR BOTTOM	SPECY-P	LinRespSpec	109.5161	0.365	299717.934	206.2476	0.99	208380.091	2.343142974
TERRACE	SPECY-P	LinRespSpec	252.3988	0.425	593696.565	554.0022	1.11	499187.685	2.395563235
19TH	SPECY-P	LinRespSpec	334.747	0.429	779591.29	848.9685	1.118	759226.156	1.52092325
18TH	SPECY-P	LinRespSpec	350.4064	0.429	816581.738	1060.6779	1.141	929603.768	1.224409566
17TH	SPECY-P	LinRespSpec	322.4527	0.425	759225.395	1200.8936	1.159	1036103.702	1.114564869
16TH	SPECY-P	LinRespSpec	289.557	0.419	691009.757	1285.741	1.172	1097331.517	1.059094292
15TH	SPECY-P	LinRespSpec	290.71	0.411	707659.412	1333.2714	1.177	1132875.766	1.032391532
14TH	SPECY-P	LinRespSpec	324.4468	0.401	808661.838	1360.7031	1.176	1156639.638	1.020976591
13TH	SPECY-P	LinRespSpec	354.6421	0.389	911886.029	1382.8119	1.171	1180649.585	1.020758364
12TH	SPECY-P	LinRespSpec	353.9186	0.375	944957.499	1412.1396	1.163	1213706.263	1.027998721
11TH	SPECY-P	LinRespSpec	318.8979	0.36	885461.597	1459.6442	1.152	1267491.343	1.044314742
10TH	SPECY-P	LinRespSpec	274.0966	0.349	784836.827	1533.2356	1.135	1350712.264	1.06565798
9TH FLOOR	SPECY-P	LinRespSpec	268.3887	0.342	784158.552	1633.9263	1.113	1467555.642	1.08650501
8TH FLOOR	SPECY-P	LinRespSpec	321.1751	0.339	947199.513	1753.6468	1.085	1616209.144	1.101293265
7TH FLOOR	SPECY-P	LinRespSpec	391.5269	0.338	1159480.617	1879.2122	1.048	1792838.145	1.109285981
6TH FLOOR	SPECY-P	LinRespSpec	438.9508	0.333	1317568.138	2001.839	1	2002216.651	1.116786062
5TH FLOOR	SPECY-P	LinRespSpec	450.7743	0.322	1399927.988	2125.838	0.936	2271537.32	1.134511252
4TH FLOOR	SPECY-P	LinRespSpec	448.9808	0.302	1487802.41	2266.6357	0.85	2667579.817	1.174349985
3RD FLOOR	SPECY-P	LinRespSpec	490.3033	0.271	1812360.127	2431.5402	0.731	3326296.717	1.246934279
2ND FLOOR	SPECY-P	LinRespSpec	608.8415	0.227	2681628.423	2595.0892	0.625	4152387.878	1.248351615
1ST FLOOR	SPECY-P	LinRespSpec	810.8198	0.178	4560979.437	2749.4547	0.455	6039791.877	1.454534609
STILT	SPECY-P	LinRespSpec	1020.3873	0.195	5235632.804	4818.8149	0.207	23299945.7	3.857739832

TABLE: Story Stiffness

Story	Output Case	Case Type	Shear X	Drift X	Stiff X	Shear Y	Drift Y	Stiff Y	
LMR TOP	SPECX-P	LinRespSpec	161.9401	1.917	84478.54	69.1769	0.295	234622.643	
LMR BOTTOM	SPECX-P	LinRespSpec	360.4636	1.826	197420.623	148.7991	0.291	510885.558	2.336932232
TERRACE	SPECX-P	LinRespSpec	954.3639	1.891	504557.556	360.2137	0.357	1010238.513	2.555748981
19TH	SPECX-P	LinRespSpec	1430.1265	1.937	738425.105	503.6716	0.352	1430959.018	1.463510151
18TH	SPECX-P	LinRespSpec	1742.58	1.979	880544.815	563.3478	0.349	1615332.503	1.19246327
17TH	SPECX-P	LinRespSpec	1928.2124	2.013	957969.728	555.8264	0.339	1641912.257	1.087928418
16TH	SPECX-P	LinRespSpec	2036.7666	2.037	1000034.571	509.2925	0.32	1593115.062	1.043910409
15TH	SPECX-P	LinRespSpec	2115.8899	2.05	1032171.187	462.2459	0.295	1568329.831	1.032135505
14TH	SPECX-P	LinRespSpec	2193.214	2.053	1068147.811	450.1116	0.267	1685198.195	1.034855288
13TH	SPECX-P	LinRespSpec	2270.8544	2.049	1108314.344	478.2957	0.24	1994338.997	1.037603909
12TH	SPECX-P	LinRespSpec	2339.3907	2.036	1149292.496	522.0754	0.214	2437811.682	1.036973402
11TH	SPECX-P	LinRespSpec	2399.2664	2.013	1191609.826	558.0111	0.19	2938267.389	1.036820331
10TH	SPECX-P	LinRespSpec	2470.8426	1.983	1246263.403	580.3049	0.167	3467669.186	1.045865329
9TH FLOOR	SPECX-P	LinRespSpec	2582.6275	1.942	1329852.359	596.7116	0.148	4041780.373	1.067071661
8TH FLOOR	SPECX-P	LinRespSpec	2745.0615	1.89	1452750.625	614.9898	0.135	4554859.149	1.09241497
7TH FLOOR	SPECX-P	LinRespSpec	2937.2801	1.821	1612781.491	631.9112	0.146	4322372.924	1.110157148
6TH FLOOR	SPECX-P	LinRespSpec	3125.9428	1.725	1812197.481	640.3321	0.167	3845318.358	1.123647246
5TH FLOOR	SPECX-P	LinRespSpec	3300.837	1.609	2051323.545	655.5477	0.188	34927S1.7	1.131953646
4TH FLOOR	SPECX-P	LinRespSpec	3493.2118	1.453	2403477.71	733.0586	0.207	3536145.815	1.171671683
3RD FLOOR	SPECX-P	LinRespSpec	3745.0288	1.252	2990785.633	917.3465	0.269	3406719.077	1.244357549
2ND FLOOR	SPECX-P	LinRespSpec	4034.0222	1.095	3683209.671	1165.4753	0.197	5924696.967	1.231519113
1ST FLOOR	SPECX-P	LinRespSpec	4331.0181	0.926	4676904.422	1447.0025	0.196	7397220.192	1.269790438
STILT	SPECX-P	LinRespSpec	6888.4329	0.432	15928478.44	1502.345	0.123	12206977.14	3.405773777
LMR TOP	SPECY-P	LinRespSpec	51.3748	0.374	137495.816	91.9535	1.034	88931.872	#DIV/0!
LMR BOTTOM	SPECY-P	LinRespSpec	109.5161	0.365	299717.934	206.2476	0.99	208380.091	2.343142974
TERRACE	SPECY-P	LinRespSpec	252.3988	0.425	593696.565	554.0022	1.11	499187.685	2.395563235
19TH	SPECY-P	LinRespSpec	334.747	0.429	779591.29	848.9685	1.118	759226.156	1.52092325
18TH	SPECY-P	LinRespSpec	350.4064	0.429	816581.738	1060.6779	1.141	929603.768	1.224409566
17TH	SPECY-P	LinRespSpec	322.4527	0.425	759225.395	1200.8936	1.159	1036103.702	1.114564869
16TH	SPECY-P	LinRespSpec	289.557	0.419	691009.757	1285.741	1.172	1097331.517	1.059094292
15TH	SPECY-P	LinRespSpec	290.71	0.411	707659.412	1333.2714	1.177	1132875.766	1.032391532
14TH	SPECY-P	LinRespSpec	324.4468	0.401	808661.838	1360.7031	1.176	1156639.638	1.020976591
13TH	SPECY-P	LinRespSpec	354.6421	0.389	911886.029	1382.8119	1.171	1180649.585	1.020758364
12TH	SPECY-P	LinRespSpec	353.9186	0.375	944957.499	1412.1396	1.163	1213706.263	1.027998721
11TH	SPECY-P	LinRespSpec	318.8979	0.36	885461.597	1459.6442	1.152	1267491.343	1.044314742
10TH	SPECY-P	LinRespSpec	274.0966	0.349	784836.827	1533.2356	1.135	1350712.264	1.06565798
9TH FLOOR	SPECY-P	LinRespSpec	268.3887	0.342	784158.552	1633.9263	1.113	1467555.642	1.08650501
8TH FLOOR	SPECY-P	LinRespSpec	321.1751	0.339	947199.513	1753.6468	1.085	1616209.144	1.101293265
7TH FLOOR	SPECY-P	LinRespSpec	391.5269	0.338	1159480.617	1879.2122	1.048	1792838.145	1.109285981
6TH FLOOR	SPECY-P	LinRespSpec	438.9508	0.333	1317568.138	2001.839	1	2002216.651	1.116786062
5TH FLOOR	SPECY-P	LinRespSpec	450.7743	0.322	1399927.988	2125.838	0.936	2271537.32	1.134511252
4TH FLOOR	5PECY-P	LinRespSpec	448.9808	0.302	1487802.41	2266.6357	0.85	2667579.817	1.174349985
3RD FLOOR	SPECY-P	LinRespSpec	490.3033	0.271	1812360.127	2431.5402	0.731	3326296.717	1.246934279
2ND FLOOR	SPECY-P	LinRespSpec	608.8415	0.227	2681628.423	2595.0892	0.625	4152387.878	1.248351615
1ST FLOOR	SPECY-P	LinRespSpec	810.8198	0.178	4560979.437	2749.4547	0.4S5	6039791.877	1.454534609
STILT	SPECY-P	LinRespSpec	1020.3873	0.195	5235632.804	4818.8149	0.207	23299945.7	3.857739832

3D MODEL



TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN. Grade of Concrete = M25.

Mx = 7.1 KN-m. Grade of Steel = Fe500.

My = 26 KN-m.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the limits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum moment for which the column is to be designed is
Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN.
Mx = 25.26KN-m.
My = 83 KN-m.

Grade of Concrete = M30
Grade of Steel = Fe500.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

Mu / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

Mu / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN. Grade of Concrete = M25.

Mx = 7.1 KN-m. Grade of Steel = Fe500.

My = 26 KN-m.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the limits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum moment for which the column is to be designed is
Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN.
Mx = 25.26KN-m.
My = 83 KN-m.

Grade of Concrete = M30
Grade of Steel = Fe500.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

M_u / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

M_u / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

TYPICAL BEAM DESIGN

(ANALYSIS WAS DONE BY ETABS USING DIFFERENT LOAD COMBINATIONS, THE DESIGN FORCES ARE TAKEN FOR DCON2 CASE)

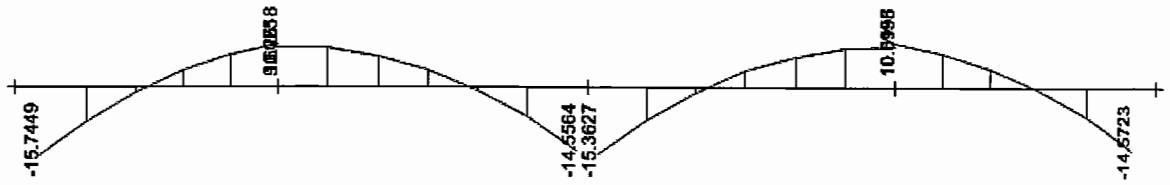
A Beam of 2 spans was considered for Typical Design Calculation.
Beam Location – Along Grid 33 to 46 (First Floor Shuttering)

Beam Size : 200mm x 450mm.

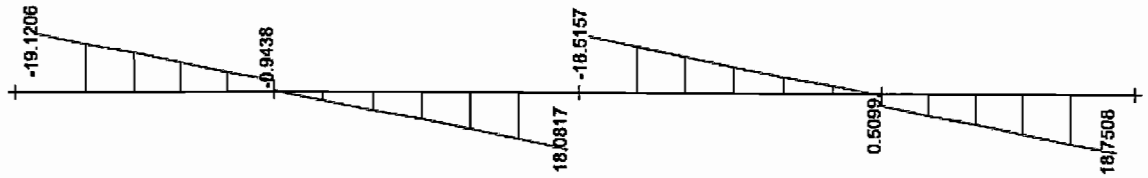
Grade of Concrete = M30;
Grade of Steel = Fe-500;
Effective depth – d' = 450-50 = 400 mm.

BENDING MOMENT, SHEAR FORCE AND TORSION DIAGRAMS TAKEN FROM ETABS

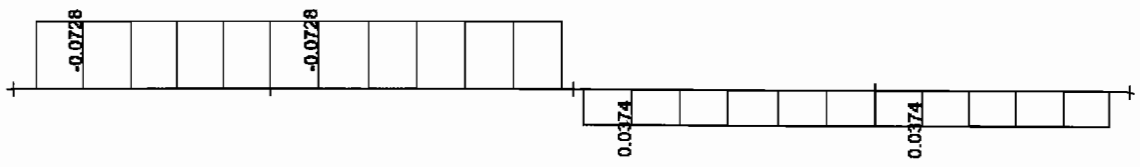
BENDING MOMENT DIAGRAM (KNm)



SHEAR FORCE DIAGRAM (KN)



TORSION DIAGRAM (KNm/m)



LEFT BEAM-(200X450)

Left End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 36KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 36 + 0.35
= 36.35 KN-m.

Mu/bd^2 = 36.35 x 10^6 /230 x 400^2
= **0.987**

Pt = 0.29 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
=0.29 x 230 x 400/ 100
= 267 mm^2.

Provide (2T16) ---- @ Top

Mid Span bottom

Mu = 41-KNm

Mu/bd^2 = 41x 10^6 /230 x 400^2
= 1.12

Pt = 1.12 % (From SP-16, Table 3)
As per IS : 13920 : 1993 minimum reinforcement provided will be 0.24%
Ast = Pt x b x D/100
= 0.24 x 230 x 450/ 100
= 249 mm^2.

Provide (2T16)

Right End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 35KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 35 + 0.35
= 35.35 KN-m.

Mu/bd^2 = 35.35 x 10^6 /230 x 400^2
= **0.96**

Pt = 0.2789 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
= 0.2789 x 230 x 400/ 100
= 256 mm^2.
Provide (2T16) ---- @ Top

Shear Reinforcement:

V1 at Left End Support = 47 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 5.13/0.23 + 47 = 83 KN

ζv = Vu/bd = 83 x 10^3/ 230 x 400
= 0.90 N/mm^2
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm^2
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400

= .278

Therefore ζ_c = 0.39 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 83 x 10^3 – 0.39 x 230 x 400
= 47.12 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 47.12 x 10^3
= 306 mm.

V1 at Right End Support = 46 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 0.2/0.23 + 46 = 47.4 KN

ζv = Vu/bd = 47.4 x 10^3/ 230 x 400
= 0.52 N/mm²
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm²
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400
= .28

Therefore ζ_c = 0.36 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 47.41 x 10^3 – 0.36 x 230 x 400
= 14.29 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 14.29 x 10^3
= 1013 mm.

As per code IS : 13920 : 1993 minimum spacing provided should be d/4 or 8 x diameter of smaller bar or 100mm whichever is less.

Hence Provide 2L-T8@100/200/100 c/c

Check for Deflection:

Maximum allowable Elastic short term deflection = l/250 = 4512/250
= 18.048 mm.

But actual deflection from ETABS = 1.4mm.

Maximum allowable long term deflection = l/350 = 4512/350
= 12.9 mm > 1.41 mm.

Therefore within the limits.

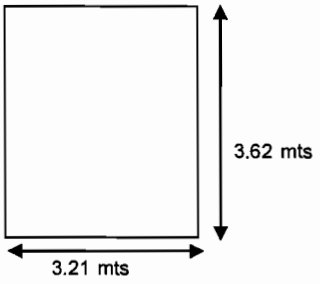
DESIGN TWOWAY SLAB

DESIGN OF TWO WAY SLAB

Short span	S=	3.21	m
Long span	L=	3.62	m
Assumed slab thickness	t=	0.125	m
Grade of concrete	fck=	25	N/mm^2
Grade of reinforcement	fy=	500	N/mm^2

Clear Span	
S	3.21
L	3.62

Type of panel One short edge discontinuous



Loads

Self weight of slab	w1=	3.13	kN/m^2	
Floor finish	w2=	1.50	kN/m^2	
Live load	w3=	2.00	kN/m^2	TOTAL
Miscellaneous	w4=	0.00	kN/m^2	6.63 kN/m^2

Ratio of long span to short span R= 1.15

Design Load with load factor of 1.5 Wu= 9.94 kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.046	**4.71**	0.46	0.11	**150.00**	8	335	101
Positive moment at midspan	0.034	**3.48**	0.34	0.08	**150.00**	8	335	101
						8	200	
Long span direction								
Negative moment at continuous edge	0.037	**3.79**	0.44	0.10	**150.00**	8	335	93
Positive moment at midspan	0.028	**2.87**	0.33	0.08	**150.00**	8	335	93

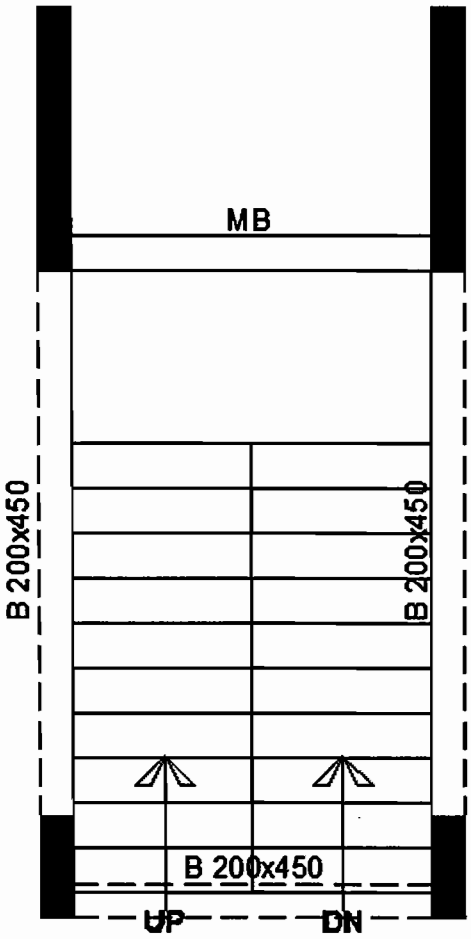
Minimum effective depth reqd	dre=	36.95 mm	
Clear cover to any reinforcement	c=	20 mm	
Minimum effective depth provided	dpr=	93 mm	greater than 'min. eff depth reqd'. Hence ok
Minimum reinforcement	Amin=	150 mm^2	

Deflection check

Reinf provided at midspan along short direction	251.33 mm^2	Dia	8	at	200	mm	
Stress in reinforcement	fs=	173.081 N/mm^2					
Percentage of reinforcement provided	pt=	0.24884 %					
Modification factor as per fig 4 of IS:456-2000	MF=	2					

Type of slab for deflection check	Continuous	
Basic span to effective depth ratio	26	
Minimum effective depth reqd from deflection criteria	61.73 mm	
Effective depth provided	101 mm	greater than 'min. eff depth reqd'. Hence ok

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

SOIL EXPLORATION REPORT

PROJECT NO : **7364**

PROJECT NAME : **Construction of Proposed 2 Basement + Stilt + 19 Floors, Alliance Budget housing at Siruseri.**

1. INTRODUCTION

M/s. Alliance Group are proposing to construct 2 Basement + Stilt + 19 Floors Alliance Budget housing, Siruseri, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Alliance Group, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose eight boreholes were bored upto a depth varies from 6.0 to 8.5M below ground level. The boreholes were terminated after drilling for the required depth in the medium rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling techniques was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could not be collected since the soil layers met with were essentially cohesionless in nature. Core samples were collected from medium rock layers.

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 9 The top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

4. ANALYSIS OF TEST RESULTS

1. Standard Penetration Test
2. Grain Size Analysis
3 Determination of Specific Gravity
4. Crushing Strength of Rock

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 2 to 9. The relative density of the cohesionless layers obtained from the N values are given in the bore logs.

4. 2 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart .

4.3 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.4 Crushing Strength of Rock

Core samples collected from medium rock layers were tested for determining crushing strength of rock. The results are given in Table – 2.

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock / medium rock layer.

The safe bearing capacity of these cohesionless layers could be computed using the formula,

$$Q_a = (0.5\gamma \times B \times N_\gamma + \gamma D_f N_q) \div 2.5$$

Where,

B	=	Width of footing
γ	=	Submerged unit weight of soil taken as 1 gm/cc,
D_f	=	Depth of surcharge
$N\gamma$ Nq	=	Bearing capacity factors based on the N values taken from Fig 10

For an N value of over 50 the SBC computed over 5.0kg/cm^2 for the foundations are placed on the disintegrated rock layer. However, the SBC may be limited to 5.0kg/c^2 to allow for any non-uniformity.

When the foundations are taken to medium rock layer the SBC that could be adopted is 10kg/cm^2.

The settlement would be elastic and of small order.

Over excavations in disintegrated rock should be refilled by 1:3:6 concrete and in medium rock by 1:2:4 concrete.

6. EXCAVATION PROCEDURE

1. Vertical cuts could be given for excavation.

2. Normal excavators would be required for excavation in disintegrated rock and jack hammers would be required for excavation in medium rock.

3. Slush formed by any water accumulation should be removed and refilled by lean concrete.

4. If water accumulates in the foundation trenches, dewatering should be done by pumping out water from a level lower than the foundation level to maintain downward flow of water.

5 The exposed side of excavation should be covered by plastic sheet during rainy season and surface drain provided to prevent water from flowing on the cut surface.

8. CONCLUSIONS

1. The area explored has got top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

2. For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock /medium rock layer. The SBC that could be adopted is 5.0kg/cm^2 when the foundations are placed on the disintegrated rock layer and 10.0kg/cm^2 when the foundations are on the medium rock layer.

3. The settlement of the shallow foundation would be of small order and elastic in nature.

4. Over excavations in the foundation trenches should be refilled as suggested.

5. Suggested excavation procedure should be adopted while undertaking the construction.

F.S.ENGINEERS PVT.LTD
NEW NO.98,(Old No.109) VELACHERY ROAD
GUINDY
CHENNAI – 600 032

(Dr.A. Verghese Chummar)
Director
Dated: Feb 5th , 2018

P.N.7364

ALLIANCE SIRUSERI, CHENNAI

BLOCK-F

STRUCTURAL DESIGN CALCULATIONS

DesignTree Service Consultants Pvt Ltd
Consulting Engineers
7 Laxmi Narasimha Complex
15th Cross 100 Feet Road 4 Phase,
J.P.Nagar, Bangalore 560 078. INDIA
T: +91 80 4122 5481 F: +918041225479
EMAIL: info@designtreeconsultants.com
www.designtreeconsultants.com

RUN KARANTH, M.Tech
...tural Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#16...84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone - 97411 10384

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ALLIANCE SIRUSERI, CHENNAI

DESIGN BRIEF REPORT

Client	:	**ALLIANCE GROUP** Chennai
SMEP Consultants	:	**Design Tree Service Consultants Pvt Ltd** # 7, Laxmi Narasimha Complex 15th Cross, 100ft Ring Road, 4th Phase, JP Nagar Bangalore - 560 078
Architects	:	**LAVANYA & SHANKAR ARCHITECTS** Chennai

ISSUE RECORD

PROJECT : **ALLIANCE SIRUSERI , CHENNAI**

TITLE : **Preliminary Design Brief Report**

DOCUMENT NO : **DTSC / 406 F**

1. STRUCTURAL

DATE	ISSUE	PREPARED	CHECKED	REMARKS / REVISION
20.02.19	Prelim report	SWAPNA	B.SRINIVASARAO	R0
22.07.19	Prelim report	SUNIL	B.SRINIVASARAO	R1
25.10.21	Prelim report	SUNIL	B.SRINIVASARAO	R2

1. STRUCTURE

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1- STRUCTURE

1.1 Project Brief/Introduction
1.2 Design standards
1.3 Design Data
1.4 Materials
1.5 Structural concept
1.6 Water Proofing
1.7 Design Philosophy

1.1 PROJECT BRIEF

The clients M/S ALLIANCE GROUP Intends to develop residential building, at Chennai. Project is architectured by LAVANYA & SHANKAR ARCHITECTSChennai.Structures, Plumbing, Fire Protection, HVAC and Electrical Engineering Services are provided by M/S Design Tree Service Consultants Pvt. Ltd, Bangalore.

All service facilities like underground sump and pump are to be provided as per the requirements given by clients.

The proposed residential building having 10 blocks A,B,C,D, E,F,G,H,I &J.

- Residential blocks A,B,C,D,E,F& G having 1 Basement + stilt+19 upper floors+Terrace floor.
- Residential block H having 1 Basement + stilt+17 upper floors+Terrace floor.
- Block I (Club house) having1 Basement + Ground +3+Terrace.
- Block J (Learning hub) having Ground+3+Terrace.

The height of the proposed Building from FGL is up to 59.85 /53.90/ 22.05 / 14.85 mts.

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- NationalBuilding Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

1.2 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.

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.
IS: 6313 (part II)	: Standards for anti-termite treatment.
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 -2012	: Code of practice for pre stressed concrete.
IS: 14268 - 1995	: Uncoated stress relieved low relaxation seven-ply strand for pre stressed 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: 13920-2016	: Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice.
IS: 16700 -2017	: Criteria for structural safety of tall 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 - 1984 (reaffirmed 1998)	: 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.

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

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 hard drawn 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 DATA:

Loads:

1.3.1 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	:	120kg/sq.m (1.2kN/sq.m).
• Floor finish of 75mm thick for Parking Areas	:	180kg/sq.m (1.8kN/sq.m).
• False ceiling + ducting + Sprinklers(services)	:	40 kg/sq.m (0.4 kN/sq.m).
• Partitions	:	100kg/sq.m (1.0kN/sq.m).
• Wall loads	:	As per actuals.
• 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	:	1900 kg/cu.m (19 kN/cu.m).

- Aerated block masonry : 865 kg/cu.m (8.65 kN/cu.m).
- Soil (Dry) : 1800 kg/cu.m (18 kN/cu.m).
- Soil (Saturated) : 2000 kg/cu.m (20 kN/cu.m).
- Water : 1000 kg/cu.m (10 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)
- Waterproofing (membrane). : 15kg/sq.m (0.15kN/sq.m).
- External finishes : As per actuals.
- Gardening/Landscape loads : As per actuals
- Equipment loads : As per Vendor details.

1.3.2 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.

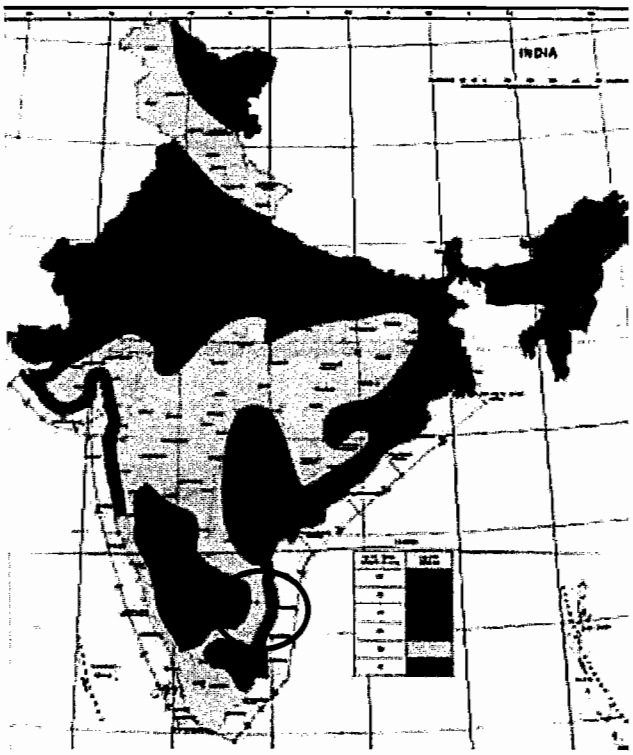
Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Living /Dining hall/ kitchens/Bed rooms	: 200 kg/sq.m (2.0 kN/sq.m)
Toilet and bathrooms	: 200 kg/sq.m (2.0 kN/sq.m)
Stairs	: 300 kg/sq.m (3.0 kN/sq.m)
Corridors / Balcony/utility	: 300 kg/sq.m (3.0 kN/sq.m)
Lift Machine room	: 1000 kg/ sq.m or as per actuals.
Balconies	: 300 kg/ sq.m or as per actuals.
Parking Area	: 250 kg/ sq.m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 1500 kg/sq.m (15.0 kN/sq.m).
Ramps	: 300 kg/sq.m (3 kN/sq.m)+ 25% Impact (Without fire truck movement
Communication Room /Meter Room	: 300 kg/sq.m (3.0 kN/sq.m)

1.3.3 Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3).

Chennai, which is located in Tamil nadu, is having wind speed of 50m/sec.

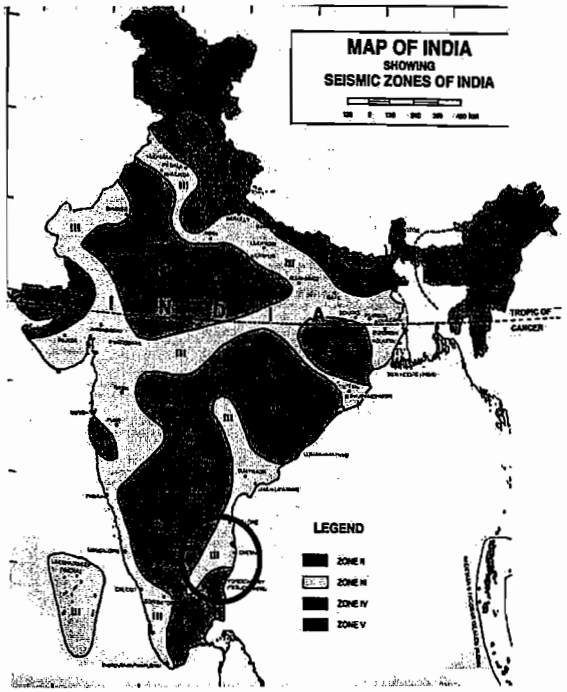


- Basic Wind Speed Vb : 50 m/sec
- Risk Coefficient K1 : 1.00 (k1 corresponds to 50 years Mean Probable Design Life of Structure)
- Terrain, height, structure size factor K2 : To suit the height of the structure for terrain Category 3 & Class C and also it varies with the height of the structure.
- Topography factor K3 : 1.00
- Importance factor for the cyclonic region K4 : 1.00
- The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)
- Design wind speed Vz : $Vb \times k1 \times k2 \times k3 \times k4$
- Design wind pressure Pz : $0.6 \times Vz^2$

Height of the building (m)	K2	$Vz = Vb \times k1 \times k2 \times k3 \times k4$ (m/s)	$Pz = 0.6 \times Vz^2$ (kN/m^2)

10	0.91	45.5	1.242
20	1.01	50.5	1.53
30	1.06	53	1.68
40	1.09	54.5	1.78
50	1.12	56	1.88
60	1.136	56.8	1.94
70	1.152	57.6	1.99
80	1.168	58.4	2.05
100	1.2	60.0	2.16

Seismic Forces



1.3.4 Seismic Forces

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

Seismic Zone : III
Seismic Zone factor, Z : 0.16 (As per Table 2, IS: 1893-2016)
Design horizontal seismic coefficient (Ah) : (Z/2)*(Sa/g)*(I/R)

I -Importance factor : 1.2 (Ref Table 6, IS: 1893-2016)
Response reduction Factor : 4 (SMRF)

R as per Table 7 of IS: 1893-2016 is based on Special moment RC Moment -Resisting Frame (SMRF), with ductile detailing.

Sa/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 (Ah)		: (Z/2)*(Sa/g)*(I/R)
		: (0.16/2)*(1.2/4) * (Sa/g)
	Ah	: 0.016 * (Sa/g)
Design seismic base shear, Vb		: Ah * W where, W - seismic weight of building
Detailing as per IS-13920-2002		: Special moment resistant frame with ductile detailing

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	0.36

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

- Environment : Moderate
- 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.
- Minimum grade of concrete : Moderate exposure - M30
- Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 30 mm
- Nominal covers for 2 hr. fire resistance :

Nominal Cover

Beams		Slabs		Ribs		Columns/Shear walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.3.6 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

1.3.7 Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

1.3.8 Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design.

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental hitting of vehicle on the façade
- Snow Load

1.4 MATERIALS:

Materials specified will 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.

1.4.1 Concrete:

- All structural concrete shall have cube crushing strength of M35 to M25 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation / Retaining Walls	M35/M30
Columns & Walls	M50 to M30
Girder beam	M40
Slab, beams & Ramps	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 415 N/sq.mm.
- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 500 N/sq.mm.

Structural Steel

All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm.

1.5 STRUCTURAL CONCEPT

- The Structural System comprises of regular Beam, slab and shear walls system for both car park and residential floors. Floor slabs and beams are considered to act as a rigid diaphragm to transfer the lateral forces to the columns.

- The slabs for toilet area sunk by 250mm. Balconies are sunk by 150mm.The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	
a)	Column grids	Varies
b)	Structural system	R.C.C Column and Girder Beam in 1st floor level and RC wall up to Terrace
c)	Slab thickness	175/150/125mm
d)	Column/RC Wall size	As per the design
g)	Peripheral beams	As per the design

Structural analysis and design:

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 2016** software package for both vertical and lateral loads.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, and seismic loads and for the load combinations as given in the relevant codes.
- The slabs are analyzed as two-way and one way slabs

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 deflection is considered as span/250

As per IS1893 (Part1) :2016, Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height design.

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 water retaining structures, crack width is limited to 0.2mm.

Load Combinations:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	EL	DL	LL	EL
DL + LL	1.5	1.5	–	1	1	–
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8

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

***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; EL - Earthquake Load

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 combination.

Expansion joint/Separation joint:

Expansion / separation joint is provided in this building.

1.6 WATERPROOFING:

Toilets and Balconies:

Water proofing is done with Acrylic cementitious coating, made on all wall faces and one coat crystallization method with water is made on floor areas.

Terrace:

In the Terrace areas, water proofing is done with Acrylic cementitious coating as first layer & 100mm thick (Average thickness) screed concrete or brick coba as a topping layer shall be used.

1.7 DESIGN PHILOSOPHY:

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 are required for all replaceable material for longer life.

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 to resist lateral forces. 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. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns. The type of footings proposed will be individual or Raft based on actual design

Foundation:

Foundations are designed depending upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. Individual / Combined footings is envisaged depending on the soil report.

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No. SE/Gr.I /19/05/008
#180/84, Third Floor, Trunk Road,
Porur, Chennai -600 116.
Phone - 97411 10384

TABLE: Centers Of Mass And Rigidity

Story	Diaphragm	Mass X	Mass Y	XCM	YCM	Cum Mass X	Cum Mass Y	XCCM	YCCM	XCR	YCR
		kg	kg	m	m	kg	kg	m	m	m	m
LMR TOP	D1	63178.76	63178.76	12.7769	15.1439	63178.76	63178.76	12.7769	15.1439	15.2992	21.9086
LMR BOT	D1	129044.65	129044.65	12.8638	14.6979	192223.41	192223.41	12.8352	14.8445	14.3553	26.0762
TERRACE	D1	1060849.65	1060849.65	8.0136	34.9113	1253073.06	1253073.06	8.7532	31.833	13.3037	34.1078
19TH	D1	1206154.07	1206154.07	7.9354	34.8871	2459227.13	2459227.13	8.3521	33.331	13.2967	34.1159
18TH	D1	1206154.07	1206154.07	7.9354	34.8871	3665381.2	3665381.2	8.215	33.843	13.2865	34.1205
17TH	D1	1206154.07	1206154.07	7.9354	34.8871	4871535.27	4871535.27	8.1458	34.1016	13.276	34.123
16TH	D1	1206154.07	1206154.07	7.9354	34.8871	6077689.34	6077689.34	8.104	34.2575	13.2643	34.1241
15TH	D1	1206154.07	1206154.07	7.9354	34.8871	7283843.4	7283843.4	8.0761	34.3617	13.2502	34.124
14TH	D1	1206154.07	1206154.07	7.9354	34.8871	8489997.47	8489997.47	8.0561	34.4364	13.2325	34.1231
13TH	D1	1206154.07	1206154.07	7.9354	34.8871	9696151.54	9696151.54	8.0411	34.4924	13.2093	34.1214
12TH	D1	1206154.07	1206154.07	7.9354	34.8871	10902305.61	10902305.61	8.0294	34.5361	13.1784	34.1191
11TH	D1	1206154.07	1206154.07	7.9354	34.8871	12108459.67	12108459.67	8.02	34.5711	13.1372	34.1161
10TH	D1	1206154.07	1206154.07	7.9354	34.8871	13314613.74	13314613.74	8.0124	34.5997	13.0824	34.1128
9TH	D1	1206154.07	1206154.07	7.9354	34.8871	14520767.81	14520767.81	8.006	34.6236	13.0099	34.1092
8TH	D1	1206154.07	1206154.07	7.9354	34.8871	15726921.88	15726921.88	8.0006	34.6438	12.9145	34.1056
7TH	D1	1206154.07	1206154.07	7.9354	34.8871	16933075.95	16933075.95	7.9959	34.6611	12.7895	34.1029
6TH	D1	1206154.07	1206154.07	7.9354	34.8871	18139230.01	18139230.01	7.9919	34.6762	12.6264	34.1026
5TH	D1	1206154.07	1206154.07	7.9354	34.8871	19345384.08	19345384.08	7.9884	34.6893	12.4147	34.1091
4TH	D1	1206154.07	1206154.07	7.9354	34.8871	20551538.15	20551538.15	7.9853	34.7009	12.1427	34.1324
3RD	D1	1206154.07	1206154.07	7.9354	34.8871	21757692.22	21757692.22	7.9825	34.7112	11.8062	34.1999
2ND	D1	1206154.07	1206154.07	7.9354	34.8871	22963846.28	22963846.28	7.98	34.7205	11.4489	34.3824
1ST	D1	1684679.3	1684679.3	8.0645	34.7208	24648525.58	24648525.58	7.9858	34.7205	11.4208	34.7849
STILT	D1	6380938.76	6380938.76	7.7141	36.2655	31029464.34	31029464.34	7.9299	35.0382	11.0348	35.4808
LMR TOP	D2	65741.29	65741.29	12.6825	56.0494	65741.29	65741.29	12.6825	56.0494	15.1521	48.5314
LMR BOT	D2	132057.81	132057.81	12.8337	55.6503	197799.09	197799.09	12.7834	55.7829	14.1801	42.9707

Table: Modal Participating Mass Ratios

Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec												
Modal	1	2.038	0.0009	0.5125	0	0.0009	0.5125	0	0.3221	0.0009	0.088	0.3221	0.0009	0.088
Modal	2	1.715	0.5047	0.0035	0	0.5056	0.5159	0	0.0019	0.4362	0.0293	0.324	0.4371	0.1173
Modal	3	1.562	0.0366	0.1175	0	0.5422	0.6334	0	0.0605	0.0307	0.3943	0.3846	0.4678	0.5116
Modal	4	0.565	0.0001	0.1636	0	0.5423	0.797	0	0.2735	1.46E-06	0.0063	0.6581	0.4678	0.5179
Modal	5	0.385	0.1216	0.0021	0	0.6639	0.7991	0	0.003	0.0816	0.0325	0.6611	0.5494	0.5504
Modal	6	0.362	0.0377	0.0093	0	0.7016	0.8084	0	0.0153	0.0259	0.1075	0.6764	0.5754	0.658
Modal	7	0.287	0.0001	0.0714	0	0.7016	0.8797	0	0.0999	0.0001	0.0072	0.7762	0.5755	0.6652
Modal	8	0.189	0.0002	0.0485	0	0.7018	0.9283	0	0.0923	0.0002	0.0004	0.8686	0.5757	0.6655
Modal	9	0.161	0.0702	0.0006	0	0.772	0.9289	0	0.0013	0.0685	0.001	0.8699	0.6442	0.6665
Modal	10	0.124	0.0063	0.0405	0	0.7784	0.9694	0	0.0739	0.0072	0.0035	0.9437	0.6514	0.6701
Modal	11	0.092	0.0328	0.025	0	0.8111	0.9944	0	0.046	0.0437	0.0046	0.9897	0.6951	0.6746
Modal	12	0.065	0.1411	0.0033	0	0.9523	0.9976	0	0.006	0.2152	0.0022	0.9957	0.9102	0.6769

TABLE: Story Stiffness

Story	Output Case	Case Type	Shear X	Drift X	Stiff X	Shear Y	Drift Y	Stiff Y	
LMR TOP	SPEC-X	LinRespSpec	166.629	1.709	97506.912	17.2626	0.157	110162.223	#DIV/0!
LMR BOT	SPEC-X	LinRespSpec	436.7149	1.701	256743.263	44.4886	0.147	303231.365	2.633077571
TERRACE	SPEC-X	LinRespSpec	1291.8368	1.777	727047.94	100.2634	0.17	0	2.831809223
19TH	SPEC-X	LinRespSpec	2030.4577	1.792	1133215.246	137.078	0.167	0	1.558652716
18TH	SPEC-X	LinRespSpec	2543.0407	1.806	1408291.452	152.7051	0.171	0	1.242739592
17TH	SPEC-X	LinRespSpec	2855.3966	1.812	1575948.193	168.4921	0.175	0	1.119049747
16TH	SPEC-X	LinRespSpec	3008.6516	1.81	1662479.996	203.5266	0.178	0	1.054907771
15TH	SPEC-X	LinRespSpec	3056.7147	1.798	1699722.448	252.0801	0.181	0	1.022401744
14TH	SPEC-X	LinRespSpec	3059.5076	1.778	1721042.087	295.1755	0.184	0	1.012543012
13TH	SPEC-X	LinRespSpec	3071.9761	1.748	1756933.965	321.6467	0.186	1731608.175	1.020854736
12TH	SPEC-X	LinRespSpec	3132.2242	1.711	1830200.928	336.638	0.187	1799736.031	1.041701603
11TH	SPEC-X	LinRespSpec	3255.9822	1.667	1953426.666	357.8455	0.188	1900258.667	1.067329076
10TH	SPEC-X	LinRespSpec	3441.8369	1.614	2131944.672	395.2973	0.19	2082769.852	1.091387104
9TH	SPEC-X	LinRespSpec	3682.1392	1.553	2370896.85	434.514	0.19	2283366.232	1.112081791
8TH	SPEC-X	LinRespSpec	3970.4834	1.481	2681095.652	450.7561	0.187	2408661.587	1.13083606
7TH	SPEC-X	LinRespSpec	4302.0875	1.395	3083452.168	438.9885	0.181	2420858.58	1.150071675
6TH	SPEC-X	LinRespSpec	4669.4122	1.292	3614265.118	436.2153	0.175	0	1.172148917
5TH	SPEC-X	LinRespSpec	5056.6631	1.166	4337547.852	490.1514	0.168	0	1.200118893
4TH	SPEC-X	LinRespSpec	5435.6217	1.004	5414962.776	568.6682	0.156	3638964.609	1.248392631
3RD	SPEC-X	LinRespSpec	5765.666	0.807	7142328.44	591.1981	0.157	3758559.989	1.318998622
2ND	SPEC-X	LinRespSpec	6004.9651	0.656	9152070.8	591.6263	0.132	0	1.281384758
1ST	SPEC-X	LinRespSpec	6214.2271	0.51	12188157.83	944.1686	0.208	4529060.885	1.331737713
STILT	SPEC-X	LinRespSpec	8120.757	0.215	37786267.43	1233.2125	0.133	9274933.504	3.100244348
LMR TOP	SPEC-Y	LinRespSpec	33.1708	0.679	48843.01	104.2341	0.932	111849.071	#DIV/0!
LMR BOT	SPEC-Y	LinRespSpec	79.0835	0.674	117261.664	274.95	0.865	317996.015	2.843081415
TERRACE	SPEC-Y	LinRespSpec	183.6182	0.658	279064.292	835.7823	0.964	866862.859	2.726017994
19TH	SPEC-Y	LinRespSpec	240.5401	0.664	362179.338	1324.5399	0.993	1333952.709	1.538827849
18TH	SPEC-Y	LinRespSpec	245.7189	0.67	366786.701	1664.7884	1.033	1612101.437	1.208514684
17TH	SPEC-Y	LinRespSpec	229.7626	0.675	340595.74	1876.0676	1.064	1762506.033	1.093297228
16TH	SPEC-Y	LinRespSpec	242.235	0.678	357520.24	1993.1599	1.087	1833651.825	1.040366269
15TH	SPEC-Y	LinRespSpec	302.2041	0.678	445642.78	2057.4216	1.101	1868672.284	1.019098751
14TH	SPEC-Y	LinRespSpec	373.7702	0.677	551909.836	2103.1086	1.107	1899769.92	1.016641568
13TH	SPEC-Y	LinRespSpec	417.3232	0.673	620013.963	2147.0495	1.108	1937885.105	1.020063053
12TH	SPEC-Y	LinRespSpec	412.4935	0.665	620375.484	2190.4064	1.104	1983306.112	1.023438442
11TH	SPEC-Y	LinRespSpec	365.055	0.653	559351.143	2231.0064	1.096	2035290.93	1.026211192
10TH	SPEC-Y	LinRespSpec	321.3275	0.636	505056.87	2274.5477	1.084	2097951.452	1.03078701
9TH	SPEC-Y	LinRespSpec	355.6268	0.615	577967.437	2334.8434	1.069	2184069.824	1.041048792
8TH	SPEC-Y	LinRespSpec	460.1434	0.589	781356.99	2423.8915	1.051	2306944.918	1.056259691
7TH	SPEC-Y	LinRespSpec	554.414	0.555	998089.026	2542.9607	1.028	2473334.377	1.072125458
6TH	SPEC-Y	LinRespSpec	578.2334	0.514	1125786.197	2685.0841	0.999	2687532.766	1.086603086
5TH	SPEC-Y	LinRespSpec	518.1044	0.462	1120453.947	2845.0087	0.961	2960909.728	1.10172042
4TH	SPEC-Y	LinRespSpec	450.0459	0.402	1120781.404	3022.8876	0.9	3357644.051	1.133990685
3RD	SPEC-Y	LinRespSpec	542.3525	0.326	1663419.843	3217.3729	0.839	3835093.26	1.142197684
2ND	SPEC-Y	LinRespSpec	761.8535	0.245	3106540.836	3421.4883	0.781	4380817.163	1.142297427
1ST	SPEC-Y	LinRespSpec	988.0501	0.182	5422468.499	3731.3361	1.209	3085423.165	0.704303113
STILT	SPEC-Y	LinRespSpec	1068.5413	0.075	14175209.98	4531.2539	0.715	6333983.569	2.052873538

Table: Joint Displacements

Story	Label	Unique Name	Output Case	Case Type	Ux	Uy	Uz	Rx	Ry	Rz
					mm	mm	mm	rad	rad	rad
TERRACE	1	18683	DL+LL	Combination	-4.563	-18.335	-7.362	-0.001916	-0.000266	0.000037
TERRACE	2	18685	DL+LL	Combination	-4.614	-18.041	-6.398	-0.001364	-0.000635	-0.000116
TERRACE	3	18686	DL+LL	Combination	-4.563	-18.671	-7.518	-0.001617	0.000035	0.000037
TERRACE	4	18688	DL+LL	Combination	-4.543	-18.387	-6.597	-0.002663	-0.000146	-0.000107
TERRACE	5	18698	DL+LL	Combination	-4.705	-18.062	-13.316	-0.000539	-0.000265	0.000037
TERRACE	6	18689	DL+LL	Combination	-4.705	-18.671	-14.66	-0.000529	0.000107	0.000037
TERRACE	7	18699	DL+LL	Combination	-4.825	-18.335	-12.144	0.000349	-0.000052	0.000037
TERRACE	8	18703	DL+LL	Combination	-4.825	-18.062	-14.199	-0.000025	-0.0003	0.000037
TERRACE	9	18704	DL+LL	Combination	-4.825	-18.671	-15.159	0.000205	-0.000046	0.000037
TERRACE	10	18708	DL+LL	Combination	-4.825	-18.398	-11.821	0.000348	-0.000124	0.000037
TERRACE	11	18709	DL+LL	Combination	-4.962	-18.335	-11.014	0.000154	-0.000081	0.000037
TERRACE	12	18714	DL+LL	Combination	-4.954	-18.067	-10.111	0.002434	-0.00018	0.000149
TERRACE	13	18715	DL+LL	Combination	-4.961	-18.67	-11.525	0.000984	0.000147	0.000018
TERRACE	14	18719	DL+LL	Combination	-4.962	-18.398	-10.537	0.000129	-0.000092	0.000037
TERRACE	15	18725	DL+LL	Combination	-5.099	-18.398	-11.108	0.000679	0.000035	0.000037
TERRACE	16	18720	DL+LL	Combination	-5.099	-18.654	-11.979	0.000025	0.000093	0.000037
TERRACE	17	18731	DL+LL	Combination	-5.218	-18.398	-9.796	0.000323	-0.000263	0.000037
TERRACE	18	18726	DL+LL	Combination	-5.218	-18.654	-11.171	0.000427	0.000047	0.000037
TERRACE	19	18732	DL+LL	Combination	-5.325	-18.654	-10.059	-0.000192	0.000039	0.000037
TERRACE	20	18735	DL+LL	Combination	-5.325	-18.398	-9.146	-0.000305	-0.000128	0.000037
TERRACE	21	18736	DL+LL	Combination	-5.462	-18.654	-11.723	-0.000084	0.000074	0.000037
TERRACE	22	18741	DL+LL	Combination	-5.462	-18.398	-10.694	0.00054	-0.000114	0.000037
TERRACE	23	18742	DL+LL	Combination	-5.582	-18.654	-11.117	0.000511	0.000044	0.000037
TERRACE	24	18745	DL+LL	Combination	-5.582	-18.398	-9.481	0.000321	-0.000175	0.000037
TERRACE	25	18746	DL+LL	Combination	-5.582	-18.335	-9.22	0.000844	-0.000159	0.000037
TERRACE	26	18747	DL+LL	Combination	-5.582	-18.207	-9.027	0.000889	0.00003	0.000037
TERRACE	27	18748	DL+LL	Combination	-5.688	-18.654	-9.825	-0.000259	0.000051	0.000037
TERRACE	28	18751	DL+LL	Combination	-5.688	-18.398	-8.839	-0.000279	-0.000201	0.000037
TERRACE	29	18752	DL+LL	Combination	-5.769	-18.335	-8.604	-0.000936	-0.000275	0.000037
TERRACE	30	18754	DL+LL	Combination	-5.789	-18.067	-7.441	-0.001049	-0.000196	-0.000084
TERRACE	31	18755	DL+LL	Combination	-5.902	-18.335	-12.607	0.000246	-0.000001	0.000037
TERRACE	32	18759	DL+LL	Combination	-5.902	-18.079	-11.826	-0.000111	-0.000268	0.000037
TERRACE	33	18760	DL+LL	Combination	-5.941	-18.63	-11.308	0.000423	-0.000039	0.000037
TERRACE	34	18827	DL+LL	Combination	-5.941	-18.398	-9.937	0.000278	-0.000029	0.000037
TERRACE	35	18681	DL+LL	Combination	-6.047	-18.654	-10.315	-0.000247	0.000038	0.000037
TERRACE	36	18828	DL+LL	Combination	-6.047	-18.398	-9.312	-0.000152	-0.000027	0.000037
TERRACE	37	18682	DL+LL	Combination	-6.18	-18.654	-11.819	0.000037	0.000073	0.000037
TERRACE	38	18773	DL+LL	Combination	-6.18	-18.398	-10.83	0.000461	-0.000109	0.000037
TERRACE	40	18779	DL+LL	Combination	-6.3	-18.398	-9.689	0.000293	-0.000095	0.000037
TERRACE	41	18667	DL+LL	Combination	-6.406	-18.654	-10.172	-0.000316	0.000026	0.000037
TERRACE	42	18783	DL+LL	Combination	-6.406	-18.398	-9.113	-0.000292	-0.000069	0.000037
TERRACE	43	18815	DL+LL	Combination	-7.175	-18.34	-6.607	0.001269	-0.000241	-0.000022
TERRACE	44	18843	DL+LL	Combination	-7.164	-18.398	-6.339	0.001544	-0.000219	0.000037
TERRACE	45	18687	DL+LL	Combination	-4.563	-18.547	-7.098	-0.001806	-0.000226	0.000037
TERRACE	46	18691	DL+LL	Combination	-4.705	-18.547	-14.186	0.000113	-0.0001	0.000037
TERRACE	47	18684	DL+LL	Combination	-4.563	-18.215	-7.642	-0.001118	0.000178	0.000037
TERRACE	48	18697	DL+LL	Combination	-4.705	-18.215	-13.095	0.000185	-0.000028	0.000037
TERRACE	49	18847	DL+LL	Combination	-4.628	-18.547	-12.35	-0.002495	-0.0001	0.000037
TERRACE	50	18816	DL+LL	Combination	-4.628	-18.398	-11.853	-0.002187	-0.000504	0.000037
TERRACE	51	18848	DL+LL	Combination	-4.628	-18.215	-11.882	-0.002053	0.00051	0.000037
TERRACE	52	18844	DL+LL	Combination	-4.628	-18.062	-10.69	-0.002324	-0.001315	0.000037
TERRACE	53	18582	DL+LL	Combination	-4.628	-18.489	-14.366	-0.001413	0.000414	0.000037
TERRACE	54	18583	DL+LL	Combination	-4.705	-18.489	-13.966	0.000362	-0.000158	0.000037
TERRACE	55	18584	DL+LL	Combination	-4.628	-18.156	-12.934	-0.001432	0.000227	0.000037
TERRACE	56	18585	DL+LL	Combination	-4.705	-18.156	-13.006	-0.000001	0.000089	0.000037
TERRACE	57	18785	DL+LL	Combination	-4.756	-18.335	-12.797	0.000352	-0.000011	0.000037
TERRACE	59	18784	DL+LL	Combination	-4.719	-18.335	-13.191	0.000369	0.000012	0.000037

TERRACE	61	18586	DL+LL	Combination	-4.705	-18.108	-13.461	-0.000266	0.000095	0.000037
TERRACE	62	18587	DL+LL	Combination	-4.825	-18.108	-14.428	-0.000105	-0.000027	0.000037
TERRACE	64	18692	DL+LL	Combination	-4.705	-18.459	-13.807	0.000426	-0.00036	0.000037
TERRACE	66	18693	DL+LL	Combination	-4.705	-18.425	-13.303	0.000455	-0.000365	0.000037
TERRACE	67	18713	DL+LL	Combination	-4.962	-18.093	-10.237	0.00037	-0.000178	0.000037
TERRACE	68	18855	DL+LL	Combination	-5.285	-18.088	-7.206	0.000348	-0.000123	0.000024
TERRACE	69	18791	DL+LL	Combination	-5.279	-18.335	-8.183	0.000003	-0.000137	0.000037
TERRACE	70	18858	DL+LL	Combination	-5.285	-18.081	-7.168	-0.001691	-0.000128	0.000022
TERRACE	71	18588	DL+LL	Combination	-5.174	-18.18	-8.619	0.000462	-0.000139	0.000037
TERRACE	72	18589	DL+LL	Combination	-5.286	-18.164	-7.571	0.000246	-0.000212	0.000057
TERRACE	73	18859	DL+LL	Combination	-5.174	-18.266	-8.96	0.000437	-0.000121	0.000037
TERRACE	74	18856	DL+LL	Combination	-5.279	-18.266	-7.922	0.00022	-0.000115	0.000037
TERRACE	75	18590	DL+LL	Combination	-4.705	-18.624	-14.627	-0.000284	-0.000154	0.000037
TERRACE	76	18591	DL+LL	Combination	-4.825	-18.624	-15.006	0.000004	-0.000146	0.000037
TERRACE	77	18861	DL+LL	Combination	-4.916	-18.22	-12.209	0.001093	0.000361	0.000037
TERRACE	78	18845	DL+LL	Combination	-4.916	-18.062	-13.077	0.001837	-0.000611	0.000037
TERRACE	79	18700	DL+LL	Combination	-4.825	-18.22	-11.887	-0.000198	0.000333	0.000037
TERRACE	80	18712	DL+LL	Combination	-4.962	-18.22	-10.8	0.000331	-0.000076	0.000037
TERRACE	81	18864	DL+LL	Combination	-4.916	-18.512	-13.151	0.001236	-0.000598	0.000037
TERRACE	82	18846	DL+LL	Combination	-4.916	-18.671	-13.571	0.001622	0.000583	0.000037
TERRACE	83	18707	DL+LL	Combination	-4.825	-18.512	-12.349	-0.000326	-0.000427	0.000037
TERRACE	84	18718	DL+LL	Combination	-4.962	-18.512	-10.939	0.00161	-0.000145	0.000037
TERRACE	86	18696	DL+LL	Combination	-4.705	-18.246	-13.107	0.000232	-0.000139	0.000037
TERRACE	88	18690	DL+LL	Combination	-4.705	-18.579	-14.332	-0.000043	-0.000303	0.000037
TERRACE	89	18818	DL+LL	Combination	-4.756	-18.398	-12.512	0.000397	-0.000122	0.000037
TERRACE	91	18817	DL+LL	Combination	-4.719	-18.398	-12.983	0.000458	-0.000119	0.000037
TERRACE	93	18701	DL+LL	Combination	-4.825	-18.156	-14.001	-0.000203	0.000954	0.000037
TERRACE	94	18862	DL+LL	Combination	-4.916	-18.156	-15.634	0.000622	0.000924	0.000037
TERRACE	95	18592	DL+LL	Combination	-4.859	-18.22	-12.485	-0.000663	0.000508	0.000037
TERRACE	96	18593	DL+LL	Combination	-4.859	-18.156	-14.968	-0.000891	0.000952	0.000037
TERRACE	97	18706	DL+LL	Combination	-4.825	-18.576	-14.532	-0.000254	-0.00094	0.000037
TERRACE	98	18863	DL+LL	Combination	-4.916	-18.576	-16.785	0.000546	-0.000876	0.000037
TERRACE	99	18595	DL+LL	Combination	-4.859	-18.512	-13.175	-0.000965	-0.000671	0.000037
TERRACE	100	18594	DL+LL	Combination	-4.859	-18.576	-15.794	-0.001202	-0.000922	0.000037
TERRACE	101	18717	DL+LL	Combination	-4.962	-18.536	-11.03	-0.001082	-0.000249	0.000037
TERRACE	102	18722	DL+LL	Combination	-5.099	-18.536	-11.579	0.000856	0.000007	0.000037
TERRACE	103	18716	DL+LL	Combination	-4.962	-18.654	-11.571	0.000715	0.000055	0.000037
TERRACE	104	18868	DL+LL	Combination	-5.821	-18.654	-11.936	-0.000041	0.000076	0.000037
TERRACE	105	18865	DL+LL	Combination	-5.024	-18.536	-13.039	-0.000346	-0.000103	0.000037
TERRACE	106	18819	DL+LL	Combination	-5.024	-18.398	-11.961	-0.000578	0.000163	0.000037
TERRACE	107	18788	DL+LL	Combination	-5.068	-18.335	-13.96	0.00042	0.000026	0.000037
TERRACE	108	18851	DL+LL	Combination	-5.068	-18.093	-9.338	0.000355	-0.000036	0.000037
TERRACE	109	18874	DL+LL	Combination	-5.635	-18.082	-6.659	0.000933	-0.000272	0.000037
TERRACE	110	18711	DL+LL	Combination	-4.962	-18.28	-10.888	0.000279	-0.000076	0.000037
TERRACE	111	18869	DL+LL	Combination	-5.068	-18.28	-12.207	-0.000012	-0.001931	0.000037
TERRACE	112	18596	DL+LL	Combination	-5.043	-18.335	-13.822	-0.00077	-0.000023	0.000037
TERRACE	113	18597	DL+LL	Combination	-5.043	-18.28	-12.731	0.000252	-0.001497	0.000037
TERRACE	114	18786	DL+LL	Combination	-4.994	-18.335	-11.95	-0.001656	-0.000077	0.000037
TERRACE	115	18875	DL+LL	Combination	-4.994	-18.28	-11.753	-0.001421	-0.000647	0.000037
TERRACE	116	18787	DL+LL	Combination	-5.026	-18.335	-13.336	-0.001344	-0.000049	0.000037
TERRACE	117	18876	DL+LL	Combination	-5.026	-18.28	-12.684	-0.000481	-0.001205	0.000037
TERRACE	118	18710	DL+LL	Combination	-4.962	-18.3	-10.933	0.000233	-0.000088	0.000037
TERRACE	120	18849	DL+LL	Combination	-4.981	-18.093	-10.064	0.000314	-0.000126	0.000037
TERRACE	122	18850	DL+LL	Combination	-5.048	-18.093	-9.521	0.000334	-0.000144	0.000037
TERRACE	124	18598	DL+LL	Combination	-5.024	-18.484	-13.923	0.000221	0.00009	0.000037
TERRACE	125	18599	DL+LL	Combination	-5.099	-18.484	-11.47	0.000814	-0.000181	0.000037
TERRACE	126	18600	DL+LL	Combination	-5.099	-18.608	-11.926	0.000344	-0.000168	0.000037
TERRACE	127	18601	DL+LL	Combination	-5.218	-18.608	-11.1	0.000273	-0.000181	0.000037
TERRACE	128	18879	DL+LL	Combination	-5.174	-18.315	-9.145	0.000607	-0.000147	0.000037
TERRACE	130	18790	DL+LL	Combination	-5.259	-18.335	-8.33	0.000416	-0.000138	0.000037

TERRACE	131	18860	DL+LL	Combination	-5.259	-18.266	-8.061	0.000296	-0.000116	0.000037
TERRACE	132	18602	DL+LL	Combination	-5.222	-18.335	-8.691	0.000321	-0.000145	0.000037
TERRACE	134	18604	DL+LL	Combination	-5.218	-18.579	-10.896	0.000176	-0.000352	0.000037
TERRACE	135	18605	DL+LL	Combination	-5.271	-18.579	-11.085	0.000171	-0.000372	0.000037
TERRACE	136	18606	DL+LL	Combination	-5.218	-18.542	-10.515	0.000157	-0.000306	0.000037
TERRACE	137	18607	DL+LL	Combination	-5.271	-18.542	-10.484	0.000276	-0.000723	0.000037
TERRACE	138	18866	DL+LL	Combination	-5.271	-18.654	-10.642	0.000506	0.000117	0.000037
TERRACE	139	18881	DL+LL	Combination	-5.271	-18.529	-10.22	0.000358	-0.000257	0.000037
TERRACE	140	18728	DL+LL	Combination	-5.218	-18.529	-10.416	0.000166	-0.000272	0.000037
TERRACE	141	18734	DL+LL	Combination	-5.325	-18.529	-9.594	-0.000081	-0.000272	0.000037
TERRACE	142	18857	DL+LL	Combination	-5.279	-18.218	-7.766	0.000224	-0.000155	0.000037
TERRACE	143	18567	DL+LL	Combination	-5.41	-18.218	-10.549	0.000177	-0.000087	0.000037
TERRACE	144	18608	DL+LL	Combination	-5.327	-18.165	-10.872	-0.001229	0.000655	0.000037
TERRACE	145	18609	DL+LL	Combination	-5.41	-18.165	-10.438	0.00019	0.000037	0.000037
TERRACE	146	18882	DL+LL	Combination	-5.327	-18.218	-9.281	-0.001498	-0.000046	0.000037
TERRACE	147	18871	DL+LL	Combination	-5.327	-18.082	-9.566	-0.001487	-0.000405	0.000037
TERRACE	148	18792	DL+LL	Combination	-5.41	-18.335	-10.855	0.000239	-0.000117	0.000037
TERRACE	149	18872	DL+LL	Combination	-5.41	-18.082	-10.445	0.00009	-0.000209	0.000037
TERRACE	150	18733	DL+LL	Combination	-5.325	-18.536	-9.648	-0.000093	-0.000265	0.000037
TERRACE	151	18738	DL+LL	Combination	-5.462	-18.536	-11.269	0.000529	-0.000014	0.000037
TERRACE	152	18610	DL+LL	Combination	-5.387	-18.484	-12.776	-0.000221	0.00027	0.000037
TERRACE	153	18611	DL+LL	Combination	-5.462	-18.484	-11.143	0.00056	-0.000184	0.000037
TERRACE	154	18883	DL+LL	Combination	-5.387	-18.536	-11.567	-0.000876	-0.00014	0.000037
TERRACE	155	18820	DL+LL	Combination	-5.387	-18.398	-11.04	-0.00081	-0.000109	0.000037
TERRACE	156	18612	DL+LL	Combination	-5.462	-18.608	-11.65	0.00015	-0.000182	0.000037
TERRACE	157	18613	DL+LL	Combination	-5.582	-18.608	-11.038	0.000316	-0.000195	0.000037
TERRACE	158	18867	DL+LL	Combination	-5.63	-18.654	-10.5	0.00058	0.000113	0.000037
TERRACE	159	18884	DL+LL	Combination	-5.63	-18.525	-9.95	0.000323	-0.000258	0.000037
TERRACE	160	18743	DL+LL	Combination	-5.582	-18.525	-10.117	0.000152	-0.000274	0.000037
TERRACE	161	18750	DL+LL	Combination	-5.688	-18.525	-9.314	-0.000097	-0.000308	0.000037
TERRACE	162	18568	DL+LL	Combination	-5.41	-18.128	-10.59	0.000118	-0.000003	0.000037
TERRACE	163	18614	DL+LL	Combination	-5.529	-18.128	-9.619	0.000558	-0.000247	0.000037
TERRACE	164	18793	DL+LL	Combination	-5.529	-18.335	-9.79	0.000257	-0.00013	0.000037
TERRACE	165	18873	DL+LL	Combination	-5.529	-18.082	-9.107	0.000719	-0.000581	0.000037
TERRACE	166	18615	DL+LL	Combination	-5.529	-18.248	-9.477	0.00019	-0.00006	0.000037
TERRACE	167	18616	DL+LL	Combination	-5.582	-18.248	-9.501	0.000842	-0.00032	0.000037
TERRACE	168	18885	DL+LL	Combination	-5.529	-18.207	-9.594	0.000271	0.000223	0.000037
TERRACE	169	18886	DL+LL	Combination	-5.635	-18.207	-7.175	0.00111	-0.000094	0.000037
TERRACE	170	18794	DL+LL	Combination	-5.635	-18.335	-7.746	0.000581	-0.000234	0.000037
TERRACE	171	18852	DL+LL	Combination	-5.089	-18.093	-9.135	0.000367	-0.000082	0.000037
TERRACE	173	18853	DL+LL	Combination	-5.156	-18.093	-8.417	0.000393	-0.000217	0.000037
TERRACE	175	18617	DL+LL	Combination	-5.582	-18.579	-10.817	0.000194	-0.000384	0.000037
TERRACE	176	18618	DL+LL	Combination	-5.63	-18.579	-10.915	0.000172	-0.000384	0.000037
TERRACE	177	18619	DL+LL	Combination	-5.582	-18.542	-10.249	0.00015	-0.000339	0.000037
TERRACE	178	18620	DL+LL	Combination	-5.63	-18.542	-10.305	0.000227	-0.000742	0.000037
TERRACE	179	18824	DL+LL	Combination	-5.821	-18.398	-10.999	0.000363	-0.000164	0.000037
TERRACE	180	18823	DL+LL	Combination	-5.75	-18.398	-10.716	-0.000953	-0.000386	0.000037
TERRACE	181	18892	DL+LL	Combination	-5.75	-18.536	-11.401	-0.000966	-0.000159	0.000037
TERRACE	182	18749	DL+LL	Combination	-5.688	-18.536	-9.405	-0.000119	-0.000294	0.000037
TERRACE	183	18889	DL+LL	Combination	-5.821	-18.536	-11.491	0.000309	-0.000048	0.000037
TERRACE	184	18621	DL+LL	Combination	-5.75	-18.484	-12.553	-0.000412	0.000236	0.000037
TERRACE	185	18622	DL+LL	Combination	-5.821	-18.484	-11.33	0.000386	-0.000182	0.000037
TERRACE	186	18896	DL+LL	Combination	-6.131	-18.077	-9.374	0.000006	-0.000418	0.000037
TERRACE	187	18909	DL+LL	Combination	-6.261	-18.079	-10.322	0.000409	-0.000278	0.000037
TERRACE	188	18799	DL+LL	Combination	-6.128	-18.335	-10.535	-0.000051	-0.000133	0.000037
TERRACE	189	18753	DL+LL	Combination	-5.769	-18.22	-8.064	-0.000922	-0.00015	0.000037
TERRACE	190	18757	DL+LL	Combination	-5.902	-18.22	-12.252	0.000164	-0.000103	0.000037
TERRACE	191	18898	DL+LL	Combination	-5.831	-18.079	-10.47	-0.001589	-0.000505	0.000037
TERRACE	192	18897	DL+LL	Combination	-5.831	-18.22	-11.338	-0.001616	-0.000099	0.000037
TERRACE	193	18623	DL+LL	Combination	-5.831	-18.168	-12.583	-0.000976	0.000272	0.000037

TERRACE	194	18624	DL+LL	Combination	-5.902	-18.168	-12.086	0.000091	-0.000076	0.000037
TERRACE	195	18625	DL+LL	Combination	-5.902	-18.138	-12.078	-0.000076	-0.00006	0.000037
TERRACE	196	18626	DL+LL	Combination	-6.022	-18.138	-11.663	0.000538	-0.000346	0.000037
TERRACE	197	18797	DL+LL	Combination	-6.022	-18.335	-11.639	0.000224	-0.000033	0.000037
TERRACE	198	18900	DL+LL	Combination	-6.022	-18.103	-11.217	0.000638	-0.000596	0.000037
TERRACE	199	18887	DL+LL	Combination	-5.821	-18.63	-11.939	0.000028	-0.000064	0.000037
TERRACE	200	18765	DL+LL	Combination	-6.047	-18.63	-10.304	-0.000222	-0.000071	0.000037
TERRACE	201	18627	DL+LL	Combination	-5.821	-18.595	-11.8	0.000129	-0.000226	0.000037
TERRACE	202	18628	DL+LL	Combination	-5.941	-18.595	-11.214	0.000315	-0.000178	0.000037
TERRACE	203	18629	DL+LL	Combination	-5.941	-18.569	-11.041	0.000235	-0.00033	0.000037
TERRACE	204	18630	DL+LL	Combination	-5.993	-18.569	-11.014	0.000265	-0.000293	0.000037
TERRACE	206	18632	DL+LL	Combination	-5.993	-18.538	-10.605	0.000309	-0.000593	0.000037
TERRACE	207	18901	DL+LL	Combination	-5.993	-18.63	-10.811	0.000467	0.000014	0.000037
TERRACE	208	18902	DL+LL	Combination	-5.993	-18.525	-10.385	0.000362	-0.000212	0.000037
TERRACE	209	18762	DL+LL	Combination	-5.941	-18.525	-10.606	0.000203	-0.000293	0.000037
TERRACE	210	18767	DL+LL	Combination	-6.047	-18.525	-9.772	-0.000072	-0.000183	0.000037
TERRACE	212	18895	DL+LL	Combination	-6.128	-18.103	-9.611	0.000029	-0.000318	0.000037
TERRACE	213	18798	DL+LL	Combination	-6.07	-18.335	-11.284	0.000476	0.000003	0.000037
TERRACE	214	18903	DL+LL	Combination	-6.07	-18.225	-11.169	0.00069	0.000147	0.000037
TERRACE	215	18899	DL+LL	Combination	-6.022	-18.225	-11.698	0.000281	0.000299	0.000037
TERRACE	216	18893	DL+LL	Combination	-6.128	-18.225	-10.015	0.000099	-0.000062	0.000037
TERRACE	217	18633	DL+LL	Combination	-6.022	-18.263	-11.4	0.000203	-0.000048	0.000037
TERRACE	218	18634	DL+LL	Combination	-6.07	-18.263	-11.529	0.000375	-0.000219	0.000037
TERRACE	219	18905	DL+LL	Combination	-6.187	-18.079	-10.491	-0.0006	-0.000603	0.000037
TERRACE	220	18904	DL+LL	Combination	-6.187	-18.22	-11.308	-0.000617	-0.00006	0.000037
TERRACE	221	18894	DL+LL	Combination	-6.128	-18.22	-10.009	0.000099	-0.000036	0.000037
TERRACE	222	18906	DL+LL	Combination	-6.261	-18.22	-10.771	0.00052	-0.000103	0.000037
TERRACE	223	18800	DL+LL	Combination	-6.261	-18.335	-11.143	0.000396	-0.000058	0.000037
TERRACE	224	18635	DL+LL	Combination	-6.187	-18.168	-12.497	-0.000063	0.00027	0.000037
TERRACE	225	18636	DL+LL	Combination	-6.261	-18.168	-10.6	0.000475	-0.000083	0.000037
TERRACE	226	18637	DL+LL	Combination	-6.261	-18.138	-10.584	0.000244	-0.000067	0.000037
TERRACE	227	18638	DL+LL	Combination	-6.381	-18.138	-10.046	0.000052	-0.000345	0.000037
TERRACE	228	18911	DL+LL	Combination	-6.381	-18.103	-9.598	0.000178	-0.000603	0.000037
TERRACE	229	18803	DL+LL	Combination	-6.381	-18.335	-10.187	0.000035	-0.000117	0.000037
TERRACE	230	18908	DL+LL	Combination	-6.261	-18.103	-10.47	0.000341	-0.000185	0.000037
TERRACE	231	18912	DL+LL	Combination	-6.487	-18.103	-10.213	0.000354	-0.000212	0.000037
TERRACE	232	18910	DL+LL	Combination	-6.381	-18.225	-10.116	-0.000274	0.000249	0.000037
TERRACE	233	18914	DL+LL	Combination	-6.487	-18.225	-10.863	0.000101	-0.000178	0.000037
TERRACE	234	18639	DL+LL	Combination	-6.381	-18.263	-9.908	-0.000286	0.000011	0.000037
TERRACE	235	18640	DL+LL	Combination	-6.43	-18.263	-10.984	-0.000638	-0.000099	0.000037
TERRACE	236	18913	DL+LL	Combination	-6.43	-18.225	-10.818	-0.000434	0.000087	0.000037
TERRACE	237	18804	DL+LL	Combination	-6.43	-18.335	-10.744	-0.000532	-0.000069	0.000037
TERRACE	238	18805	DL+LL	Combination	-6.487	-18.335	-11.43	-0.000602	-0.000135	0.000037
TERRACE	239	18917	DL+LL	Combination	-6.487	-18.093	-10.16	0.000374	-0.000216	0.000037
TERRACE	240	18922	DL+LL	Combination	-6.816	-18.102	-6.932	0.000365	-0.00017	0.000048
TERRACE	241	18916	DL+LL	Combination	-6.487	-18.28	-11.141	-0.000069	-0.000218	0.000037
TERRACE	242	18923	DL+LL	Combination	-6.594	-18.28	-12.217	-3.853E-08	-0.001923	0.000037
TERRACE	243	18915	DL+LL	Combination	-6.487	-18.3	-11.26	-0.000266	-0.000215	0.000037
TERRACE	245	18919	DL+LL	Combination	-6.594	-18.093	-9.154	0.000376	-0.000121	0.000037
TERRACE	246	18806	DL+LL	Combination	-6.594	-18.335	-13.992	0.000581	0.000573	0.000037
TERRACE	247	18978	DL+LL	Combination	-6.552	-18.335	-13.689	-0.001026	0.000331	0.000037
TERRACE	248	18979	DL+LL	Combination	-6.552	-18.28	-12.691	-0.000324	-0.001255	0.000037
TERRACE	249	18980	DL+LL	Combination	-6.52	-18.335	-12.529	-0.001503	0.000116	0.000037
TERRACE	250	18981	DL+LL	Combination	-6.52	-18.28	-11.955	-0.001183	-0.000743	0.000037
TERRACE	251	18642	DL+LL	Combination	-6.569	-18.28	-12.691	0.000304	-0.001523	0.000037
TERRACE	252	18641	DL+LL	Combination	-6.569	-18.335	-14.029	-0.00044	0.000435	0.000037
TERRACE	253	18918	DL+LL	Combination	-6.574	-18.093	-9.351	0.000365	-0.000185	0.000037
TERRACE	255	18985	DL+LL	Combination	-6.507	-18.093	-9.974	0.000345	-0.000202	0.000037
TERRACE	257	18807	DL+LL	Combination	-6.702	-18.335	-9.154	0.000748	-0.000084	0.000037
TERRACE	258	18921	DL+LL	Combination	-6.702	-18.093	-7.965	0.000395	-0.000283	0.000037

TERRACE	259	18931	DL+LL	Combination	-6.815	-18.08	-6.866	-0.001083	-0.000175	0.000056
TERRACE	260	18809	DL+LL	Combination	-6.805	-18.335	-8.161	-0.000031	-0.000216	0.000037
TERRACE	262	18935	DL+LL	Combination	-7.164	-18.103	-5.475	0.001183	-0.000324	0.000037
TERRACE	263	18936	DL+LL	Combination	-6.938	-18.103	-10.15	0.00014	-0.000201	0.000037
TERRACE	264	18810	DL+LL	Combination	-6.938	-18.335	-10.771	0.000285	-0.00016	0.000037
TERRACE	265	18940	DL+LL	Combination	-6.938	-18.079	-9.991	0.000156	-0.00029	0.000037
TERRACE	266	18926	DL+LL	Combination	-6.702	-18.315	-9.101	0.000863	-0.000123	0.000037
TERRACE	268	18808	DL+LL	Combination	-6.785	-18.335	-8.297	0.000417	-0.00018	0.000037
TERRACE	269	18942	DL+LL	Combination	-6.785	-18.266	-7.987	0.000312	-0.000149	0.000037
TERRACE	270	18643	DL+LL	Combination	-6.748	-18.335	-8.658	0.000316	-0.000131	0.000037
TERRACE	272	18645	DL+LL	Combination	-6.702	-18.18	-8.425	0.000448	-0.0002	0.000037
TERRACE	273	18646	DL+LL	Combination	-6.813	-18.177	-7.388	0.000296	-0.000237	0.000039
TERRACE	274	18928	DL+LL	Combination	-6.702	-18.266	-8.877	0.000443	-0.000138	0.000037
TERRACE	275	18929	DL+LL	Combination	-6.805	-18.266	-7.839	0.000237	-0.000152	0.000037
TERRACE	276	18930	DL+LL	Combination	-6.805	-18.22	-7.634	0.000263	-0.000199	0.000037
TERRACE	277	18939	DL+LL	Combination	-6.938	-18.22	-10.365	0.000235	-0.000117	0.000037
TERRACE	278	18647	DL+LL	Combination	-6.867	-18.168	-11.142	-0.000633	0.000418	0.000037
TERRACE	279	18648	DL+LL	Combination	-6.938	-18.168	-10.197	0.00025	-0.000032	0.000037
TERRACE	280	18944	DL+LL	Combination	-6.867	-18.079	-9.476	-0.001133	-0.000465	0.000037
TERRACE	281	18943	DL+LL	Combination	-6.867	-18.22	-9.722	-0.001283	-0.00012	0.000037
TERRACE	282	18937	DL+LL	Combination	-7.058	-18.103	-8.737	0.000809	-0.000556	0.000037
TERRACE	283	18842	DL+LL	Combination	-7.058	-18.398	-10.07	0.000296	-0.000268	0.000037
TERRACE	284	18649	DL+LL	Combination	-6.938	-18.136	-10.26	0.000121	-0.000041	0.000037
TERRACE	285	18650	DL+LL	Combination	-7.058	-18.136	-9.136	0.000722	-0.000338	0.000037
TERRACE	286	18814	DL+LL	Combination	-7.106	-18.335	-8.863	0.001078	-0.000148	0.000037
TERRACE	287	18946	DL+LL	Combination	-7.106	-18.225	-8.376	0.001191	0.000024	0.000037
TERRACE	288	18945	DL+LL	Combination	-7.058	-18.225	-9.328	0.000483	0.000126	0.000037
TERRACE	289	18934	DL+LL	Combination	-7.164	-18.225	-6.069	0.001061	-0.000083	0.000037
TERRACE	291	18841	DL+LL	Combination	-7.027	-18.398	-10.232	0.000296	-0.000227	0.000037
TERRACE	292	18949	DL+LL	Combination	-7.027	-18.503	-10.863	-0.000106	-0.000594	0.000037
TERRACE	293	18933	DL+LL	Combination	-7.164	-18.503	-6.852	0.001419	-0.000252	0.000037
TERRACE	295	18952	DL+LL	Combination	-7.119	-18.503	-9.59	0.002116	-0.000613	0.000037
TERRACE	296	18953	DL+LL	Combination	-7.027	-18.567	-12.935	-0.000047	-0.000763	0.000037
TERRACE	297	18951	DL+LL	Combination	-7.119	-18.567	-13.144	0.001498	-0.000871	0.000037
TERRACE	298	18651	DL+LL	Combination	-7.062	-18.567	-13.537	-0.000391	-0.000817	0.000037
TERRACE	299	18652	DL+LL	Combination	-7.062	-18.503	-11.139	-0.000094	-0.000727	0.000037
TERRACE	300	18653	DL+LL	Combination	-6.907	-18.646	-12.581	-0.000207	-0.000028	0.000037
TERRACE	301	18654	DL+LL	Combination	-7.027	-18.646	-13.495	0.000165	-0.000104	0.000037
TERRACE	302	18838	DL+LL	Combination	-6.907	-18.398	-11.325	0.000432	-0.000225	0.000037
TERRACE	303	18658	DL+LL	Combination	-6.907	-18.662	-12.567	-0.000287	0.000094	0.000037
TERRACE	304	18655	DL+LL	Combination	-7.058	-18.263	-9.326	0.000397	-0.000121	0.000037
TERRACE	305	18656	DL+LL	Combination	-7.106	-18.263	-8.966	0.000874	-0.000383	0.000037
TERRACE	306	18657	DL+LL	Combination	-6.765	-18.662	-10.031	-0.000367	0.000049	0.000037
TERRACE	307	18837	DL+LL	Combination	-6.765	-18.398	-8.853	-0.000223	-0.000188	0.000037
TERRACE	308	18959	DL+LL	Combination	-6.765	-18.545	-9.495	-0.000231	-0.000233	0.000037
TERRACE	309	18955	DL+LL	Combination	-6.907	-18.545	-12.018	0.000296	-0.000042	0.000037
TERRACE	310	18659	DL+LL	Combination	-6.907	-18.605	-12.413	-0.000008	-0.000267	0.000037
TERRACE	311	18660	DL+LL	Combination	-7.027	-18.605	-13.295	0.000063	-0.000237	0.000037
TERRACE	312	18961	DL+LL	Combination	-6.831	-18.545	-11.951	-0.001113	-0.000137	0.000037
TERRACE	313	18962	DL+LL	Combination	-6.831	-18.398	-11.044	-0.001111	-0.000439	0.000037
TERRACE	314	18983	DL+LL	Combination	-6.711	-18.525	-10.138	0.000518	-0.000217	0.000037
TERRACE	315	18982	DL+LL	Combination	-6.711	-18.63	-10.578	0.000608	-0.000012	0.000037
TERRACE	316	18963	DL+LL	Combination	-6.54	-18.63	-11.983	0.000061	-0.000082	0.000037
TERRACE	317	18958	DL+LL	Combination	-6.765	-18.63	-10.001	-0.000325	-0.000114	0.000037
TERRACE	318	18668	DL+LL	Combination	-6.54	-18.654	-11.991	-0.000009	0.000059	0.000037
TERRACE	319	18833	DL+LL	Combination	-6.54	-18.398	-11.013	0.000491	0.000003	0.000037
TERRACE	320	18964	DL+LL	Combination	-6.659	-18.63	-11.263	0.000501	-0.000059	0.000037
TERRACE	321	18836	DL+LL	Combination	-6.659	-18.398	-9.836	0.000349	-0.000106	0.000037
TERRACE	322	18661	DL+LL	Combination	-6.54	-18.595	-11.827	0.000164	-0.000243	0.000037
TERRACE	323	18662	DL+LL	Combination	-6.659	-18.595	-11.153	0.000398	-0.000191	0.000037

TERRACE	324	18766	DL+LL	Combination	-6.047	-18.536	-9.833	-0.000139	-0.000211	0.000037
TERRACE	325	18770	DL+LL	Combination	-6.18	-18.536	-11.335	0.000417	-0.000114	0.000037
TERRACE	326	18663	DL+LL	Combination	-6.659	-18.538	-10.656	0.000291	-0.000327	0.000037
TERRACE	327	18664	DL+LL	Combination	-6.711	-18.538	-10.366	0.000461	-0.000615	0.000037
TERRACE	328	18665	DL+LL	Combination	-6.659	-18.569	-10.974	0.000321	-0.000331	0.000037
TERRACE	329	18666	DL+LL	Combination	-6.711	-18.569	-10.788	0.000409	-0.0003	0.000037
TERRACE	330	18669	DL+LL	Combination	-6.831	-18.489	-13.378	-0.000376	0.000274	0.000037
TERRACE	331	18670	DL+LL	Combination	-6.907	-18.489	-11.832	0.000433	-0.00022	0.000037
TERRACE	332	18781	DL+LL	Combination	-6.406	-18.536	-9.665	-0.000172	-0.00022	0.000037
TERRACE	333	18966	DL+LL	Combination	-6.54	-18.536	-11.485	0.000363	-0.000122	0.000037
TERRACE	334	18671	DL+LL	Combination	-6.469	-18.484	-12.727	-0.000301	0.000256	0.000037
TERRACE	335	18672	DL+LL	Combination	-6.54	-18.484	-11.251	0.000502	-0.000173	0.000037
TERRACE	336	18974	DL+LL	Combination	-6.469	-18.536	-11.578	-0.000857	-0.000158	0.000037
TERRACE	337	18832	DL+LL	Combination	-6.469	-18.398	-11.086	-0.000903	0.000039	0.000037
TERRACE	338	18673	DL+LL	Combination	-6.11	-18.484	-12.708	-0.000195	0.000227	0.000037
TERRACE	339	18674	DL+LL	Combination	-6.18	-18.484	-11.112	0.000529	-0.000168	0.000037
TERRACE	340	18973	DL+LL	Combination	-6.11	-18.536	-11.605	-0.000748	-0.000154	0.000037
TERRACE	341	18829	DL+LL	Combination	-6.11	-18.398	-10.976	-0.000754	-0.000109	0.000037
TERRACE	342	18675	DL+LL	Combination	-6.18	-18.599	-11.692	0.0002	-0.000224	0.000037
TERRACE	343	18676	DL+LL	Combination	-6.3	-18.599	-11.02	0.000324	-0.00017	0.000037
TERRACE	345	18780	DL+LL	Combination	-6.406	-18.63	-10.153	-0.000283	-0.000082	0.000037
TERRACE	346	18677	DL+LL	Combination	-6.3	-18.569	-10.824	0.00021	-0.00033	0.000037
TERRACE	347	18678	DL+LL	Combination	-6.348	-18.569	-10.803	0.000234	-0.000285	0.000037
TERRACE	348	18679	DL+LL	Combination	-6.3	-18.538	-10.498	0.00019	-0.000333	0.000037
TERRACE	349	18680	DL+LL	Combination	-6.348	-18.538	-10.415	0.000269	-0.00056	0.000037
TERRACE	350	18776	DL+LL	Combination	-6.3	-18.525	-10.389	0.000194	-0.000296	0.000037
TERRACE	351	18782	DL+LL	Combination	-6.406	-18.525	-9.6	-0.000107	-0.000193	0.000037
TERRACE	352	18970	DL+LL	Combination	-6.659	-18.525	-10.548	0.000289	-0.000292	0.000037
TERRACE	353	18960	DL+LL	Combination	-6.765	-18.525	-9.383	-0.000098	-0.000191	0.000037
TERRACE	355	18976	DL+LL	Combination	-6.348	-18.525	-10.207	0.000318	-0.000214	0.000037
TERRACE	357	18702	DL+LL	Combination	-4.825	-18.125	-14.409	-0.000136	0.000113	0.000037
TERRACE	358	18870	DL+LL	Combination	-5.068	-18.233	-9.962	-0.000046	-0.000431	0.000037
TERRACE	361	18705	DL+LL	Combination	-4.825	-18.608	-14.944	-0.000086	-0.000172	0.000037
TERRACE	363	18721	DL+LL	Combination	-5.099	-18.568	-11.675	0.000622	-0.000278	0.000037
TERRACE	365	18723	DL+LL	Combination	-5.099	-18.453	-11.271	0.000782	-0.000302	0.000037
TERRACE	367	18724	DL+LL	Combination	-5.099	-18.42	-11.115	0.000727	-0.00006	0.000037
TERRACE	369	18727	DL+LL	Combination	-5.218	-18.546	-10.547	0.000157	-0.000324	0.000037
TERRACE	371	18729	DL+LL	Combination	-5.218	-18.525	-10.388	0.000169	-0.000271	0.000037
TERRACE	373	18730	DL+LL	Combination	-5.218	-18.494	-10.206	0.000206	-0.0001	0.000037
TERRACE	375	18737	DL+LL	Combination	-5.462	-18.568	-11.384	0.000356	-0.000294	0.000037
TERRACE	377	18739	DL+LL	Combination	-5.462	-18.453	-10.941	0.000571	-0.000307	0.000037
TERRACE	379	18740	DL+LL	Combination	-5.462	-18.42	-10.755	0.000561	-0.000123	0.000037
TERRACE	380	18821	DL+LL	Combination	-5.476	-18.398	-10.513	0.000441	-0.00012	0.000037
TERRACE	382	18822	DL+LL	Combination	-5.513	-18.398	-10.126	0.000355	-0.000139	0.000037
TERRACE	384	18744	DL+LL	Combination	-5.582	-18.494	-9.908	0.000196	-0.000204	0.000037
TERRACE	386	18888	DL+LL	Combination	-5.821	-18.568	-11.606	0.000211	-0.000299	0.000037
TERRACE	389	18890	DL+LL	Combination	-5.821	-18.46	-11.197	0.000416	-0.000228	0.000037
TERRACE	391	18891	DL+LL	Combination	-5.821	-18.426	-11.096	0.000411	-0.000097	0.000037
TERRACE	393	18763	DL+LL	Combination	-5.941	-18.521	-10.577	0.000204	-0.000289	0.000037
TERRACE	395	18761	DL+LL	Combination	-5.941	-18.542	-10.748	0.000206	-0.000351	0.000037
TERRACE	397	18764	DL+LL	Combination	-5.941	-18.489	-10.358	0.000226	-0.000213	0.000037
TERRACE	398	18826	DL+LL	Combination	-5.873	-18.398	-10.551	0.000322	-0.000078	0.000037
TERRACE	400	18825	DL+LL	Combination	-5.835	-18.398	-10.868	0.000333	-0.000135	0.000037
TERRACE	402	18769	DL+LL	Combination	-6.18	-18.568	-11.466	0.000294	-0.00031	0.000037
TERRACE	405	18771	DL+LL	Combination	-6.18	-18.46	-11.013	0.000535	-0.000133	0.000037
TERRACE	407	18772	DL+LL	Combination	-6.18	-18.426	-10.92	0.00051	-0.000115	0.000037
TERRACE	408	18830	DL+LL	Combination	-6.195	-18.398	-10.671	0.000394	-0.000106	0.000037
TERRACE	410	18831	DL+LL	Combination	-6.232	-18.398	-10.318	0.000338	-0.0001	0.000037
TERRACE	413	18775	DL+LL	Combination	-6.3	-18.542	-10.532	0.00019	-0.00035	0.000037
TERRACE	415	18777	DL+LL	Combination	-6.3	-18.521	-10.36	0.000196	-0.000293	0.000037

TERRACE	417	18778	DL+LL	Combination	-6.3	-18.489	-10.135	0.000223	-0.000221	0.000037
TERRACE	419	18965	DL+LL	Combination	-6.54	-18.568	-11.622	0.000248	-0.000314	0.000037
TERRACE	421	18967	DL+LL	Combination	-6.54	-18.46	-11.151	0.000522	-0.000127	0.000037
TERRACE	423	18968	DL+LL	Combination	-6.54	-18.426	-11.078	0.000518	-0.000101	0.000037
TERRACE	424	18834	DL+LL	Combination	-6.554	-18.398	-10.844	0.000414	1.441E-07	0.000037
TERRACE	429	18969	DL+LL	Combination	-6.659	-18.542	-10.689	0.000293	-0.000343	0.000037
TERRACE	431	18971	DL+LL	Combination	-6.659	-18.521	-10.519	0.000289	-0.000289	0.000037
TERRACE	433	18972	DL+LL	Combination	-6.659	-18.489	-10.298	0.000303	-0.000223	0.000037
TERRACE	435	18954	DL+LL	Combination	-6.907	-18.576	-12.165	0.000138	-0.00036	0.000037
TERRACE	439	18957	DL+LL	Combination	-6.907	-18.426	-11.446	0.000505	-0.000137	0.000037
TERRACE	440	18839	DL+LL	Combination	-6.922	-18.398	-11.178	0.000359	-0.000208	0.000037
TERRACE	442	18840	DL+LL	Combination	-6.959	-18.398	-10.844	0.00033	-0.000201	0.000037
TERRACE	445	18948	DL+LL	Combination	-7.027	-18.599	-13.257	0.000047	-0.000242	0.000037
TERRACE	447	18977	DL+LL	Combination	-5.174	-18.303	-9.097	0.00056	-0.000144	0.000037
TERRACE	449	18756	DL+LL	Combination	-5.902	-18.252	-12.317	0.000191	-0.0001	0.000037
TERRACE	450	18796	DL+LL	Combination	-6.008	-18.335	-11.735	0.000263	-0.000018	0.000037
TERRACE	452	18795	DL+LL	Combination	-5.97	-18.335	-12.009	0.00034	0.000013	0.000037
TERRACE	454	18907	DL+LL	Combination	-6.261	-18.252	-10.833	0.000496	-0.0001	0.000037
TERRACE	456	18802	DL+LL	Combination	-6.367	-18.335	-10.244	0.000207	-0.000107	0.000037
TERRACE	458	18801	DL+LL	Combination	-6.33	-18.335	-10.525	0.000321	-0.000084	0.000037
TERRACE	461	18927	DL+LL	Combination	-6.702	-18.303	-9.056	0.000934	-0.000154	0.000037
TERRACE	463	18938	DL+LL	Combination	-6.938	-18.252	-10.432	0.000238	-0.000105	0.000037
TERRACE	464	18811	DL+LL	Combination	-7.006	-18.335	-10.136	0.000381	-0.000168	0.000037
TERRACE	466	18812	DL+LL	Combination	-7.044	-18.335	-9.786	0.000341	-0.000182	0.000037
TERRACE	468	18984	DL+LL	Combination	-6.682	-18.093	-8.186	0.00041	-0.000255	0.000037
TERRACE	470	18920	DL+LL	Combination	-6.615	-18.093	-8.943	0.000384	-0.000155	0.000037
TERRACE	472	18789	DL+LL	Combination	-5.174	-18.335	-9.226	0.000683	-0.00016	0.000037
TERRACE	473	18854	DL+LL	Combination	-5.174	-18.093	-8.234	0.000383	-0.000251	0.000037
TERRACE	474	18758	DL+LL	Combination	-5.902	-18.103	-11.969	-0.000097	-0.000179	0.000037
TERRACE	475	18835	DL+LL	Combination	-6.591	-18.398	-10.482	0.000333	-0.000018	0.000037
TERRACE	211	18694	DL+LL	Combination	-4.705	-18.398	-13.155	0.000433	-0.000118	0.000037
TERRACE	426	18695	DL+LL	Combination	-4.705	-18.335	-13.325	0.00031	0.000021	0.000037
TERRACE	476	18813	DL+LL	Combination	-7.058	-18.335	-9.659	0.000334	-0.000189	0.000037
TERRACE	477	18877	DL+LL	Combination	-4.994	-18.3	-11.89	-0.00153	-0.000177	0.000037
TERRACE	478	18924	DL+LL	Combination	-6.52	-18.3	-12.201	-0.001326	-0.000414	0.000037
TERRACE	480	18774	DL+LL	Combination	-6.3	-18.63	-11.104	0.000443	-0.000046	0.000037
TERRACE	481	18768	DL+LL	Combination	-6.18	-18.63	-11.818	0.000109	-0.000075	0.000037
TERRACE	482	18975	DL+LL	Combination	-6.348	-18.63	-10.637	0.000441	-0.000002	0.000037
TERRACE	39	18569	DL+LL	Combination	-6.594	-18.233	-9.958	-0.000039	-0.000443	0.000037
TERRACE	344	18570	DL+LL	Combination	-6.487	-18.273	-11.101	0.000001	-0.000206	0.000037
TERRACE	354	18571	DL+LL	Combination	-5.515	-18.335	-9.899	0.000304	-0.000128	0.000037
TERRACE	418	18572	DL+LL	Combination	-5.478	-18.335	-10.232	0.000385	-0.000124	0.000037
TERRACE	420	18573	DL+LL	Combination	-5.41	-18.25	-10.588	0.000184	-0.000074	0.000037
TERRACE	422	18574	DL+LL	Combination	-5.41	-18.132	-10.587	0.000127	0.000045	0.000037
TERRACE	427	18575	DL+LL	Combination	-4.962	-18.273	-10.875	0.000296	-0.000066	0.000037
TERRACE	254	18576	DL+LL	Combination	-4.705	-18.111	-13.452	-0.00025	0.000127	0.000037
TERRACE	58	18577	DL+LL	Combination	-5.113	-18.398	-10.887	0.000523	-0.000001	0.000037
TERRACE	60	18578	DL+LL	Combination	-5.15	-18.398	-10.458	0.000375	-0.000097	0.000037
TERRACE	65	18579	DL+LL	Combination	-5.582	-18.546	-10.284	0.000151	-0.000373	0.000037
TERRACE	63	18631	DL+LL	Combination	-5.941	-18.538	-10.714	0.000205	-0.000332	0.000037
TERRACE	123	19422	DL+LL	Combination	-7.058	-18.277	-9.377	0.000382	-0.000159	0.000037
TERRACE	172	19430	DL+LL	Combination	-6.938	-18.273	-10.502	0.000246	-0.000149	0.000037
TERRACE	205	19435	DL+LL	Combination	-6.765	-18.459	-9.079	0.000304	-0.00016	0.000037
TERRACE	376	19439	DL+LL	Combination	-6.659	-18.456	-10.109	0.000322	-0.000206	0.000037
TERRACE	121	19444	DL+LL	Combination	-6.406	-18.46	-9.309	0.000225	-0.000159	0.000037
TERRACE	387	19449	DL+LL	Combination	-6.381	-18.277	-9.926	-0.000232	-0.000111	0.000037
TERRACE	390	19457	DL+LL	Combination	-6.261	-18.273	-10.903	0.000472	-0.000157	0.000037
TERRACE	416	19453	DL+LL	Combination	-6.3	-18.455	-9.948	0.000254	-0.0002	0.000037
TERRACE	444	19462	DL+LL	Combination	-6.128	-18.273	-10.213	0.000064	-0.000207	0.000037
TERRACE	446	19467	DL+LL	Combination	-6.047	-18.46	-9.493	0.00027	-0.000157	0.000037

TERRACE	404	19471	DL+LL	Combination	-5.941	-18.456	-10.177	0.00025	-0.000202	0.000037
TERRACE	412	19475	DL+LL	Combination	-5.902	-18.273	-12.387	0.000207	-0.000159	0.000037
TERRACE	460	19480	DL+LL	Combination	-5.769	-18.273	-8.28	-0.00079	-0.000154	0.000037
TERRACE	462	19490	DL+LL	Combination	-5.635	-18.276	-7.451	0.000789	-0.000161	0.000037
TERRACE	465	19499	DL+LL	Combination	-5.529	-18.276	-9.555	0.000206	-0.000143	0.000037
TERRACE	467	19503	DL+LL	Combination	-5.41	-18.276	-10.654	0.000197	-0.000118	0.000037
TERRACE	479	19508	DL+LL	Combination	-5.325	-18.46	-9.312	0.000007	-0.000099	0.000037
TERRACE	483	19531	DL+LL	Combination	-4.563	-18.273	-7.17	-0.000969	0.000318	0.000037
TERRACE	491	19532	DL+LL	Combination	-4.554	-18.901	-6.806	0.001217	-0.00009	0.000128
TERRACE	495	19520	DL+LL	Combination	-4.825	-18.273	-11.961	0.000049	-0.000174	0.000037
TERRACE	498	19515	DL+LL	Combination	-4.962	-18.459	-10.732	0.000859	-0.00014	0.000037
TERRACE	499	19494	DL+LL	Combination	-5.582	-18.46	-9.741	0.000245	-0.000162	0.000037
TERRACE	514	19485	DL+LL	Combination	-5.688	-18.46	-9.03	0.000107	-0.000092	0.000037
TERRACE	525	18932	DL+LL	Combination	-7.145	-18.672	-7.606	0.001974	-0.000021	-0.000092
TERRACE	526	18947	DL+LL	Combination	-7.027	-18.662	-13.521	0.000207	-0.000012	0.000037
TERRACE	527	18950	DL+LL	Combination	-7.119	-18.662	-10.838	0.002473	0.001358	0.000037
TERRACE	528	18580	DL+LL	Combination	-7.164	-18.459	-6.624	0.001414	-0.00016	0.000037
TERRACE	529	18581	DL+LL	Combination	-7.027	-18.459	-10.541	0.000072	-0.000156	0.000037
TERRACE	530	18956	DL+LL	Combination	-6.907	-18.459	-11.616	0.000498	-0.000318	0.000037
TERRACE	532	18986	DL+LL	Combination	-6.777	-17.726	-6.83	0.000058	-0.00019	0.000037
TERRACE	548	18987	DL+LL	Combination	-6.767	-17.97	-7.591	-0.000061	-0.000165	0.000201
TERRACE	549	18988	DL+LL	Combination	-7.006	-17.82	-6.844	0.000387	-0.000148	0.000018
TERRACE	674	18989	DL+LL	Combination	-7.027	-17.821	-7.601	0.000333	-0.000237	-0.000265
TERRACE	675	19415	DL+LL	Combination	-6.767	-17.744	-6.316	0.000038	-0.00019	-0.000108
TERRACE	705	19417	DL+LL	Combination	-7.014	-17.709	-6.327	0.000306	-0.000162	0.000185
TERRACE	715	18990	DL+LL	Combination	-6.643	-17.829	-13.192	0.000429	-0.000185	0.000072
TERRACE	724	18991	DL+LL	Combination	-6.64	-17.914	-13.497	0.000399	-0.000183	0.000037
TERRACE	725	18992	DL+LL	Combination	-6.881	-18.415	-13.228	0.000363	-0.000135	-0.000019
TERRACE	726	18993	DL+LL	Combination	-6.901	-18.448	-13.518	0.000335	-0.000228	0.00005
TERRACE	730	18995	DL+LL	Combination	-6.632	-17.647	-10.205	0.000329	-0.000199	0.000033
TERRACE	731	19424	DL+LL	Combination	-6.651	-17.73	-10.764	0.000462	-0.000169	0.000001
TERRACE	734	18997	DL+LL	Combination	-6.879	-18.121	-10.219	0.000368	-0.000163	0.000072
TERRACE	736	19426	DL+LL	Combination	-6.862	-18.374	-10.798	0.000365	-0.000097	0.000115
TERRACE	737	18994	DL+LL	Combination	-6.572	-17.653	-10.828	0.000362	-0.000155	0.000029
TERRACE	740	18996	DL+LL	Combination	-6.799	-18.124	-10.843	0.000332	-0.000193	0.000035
TERRACE	741	18998	DL+LL	Combination	-6.541	-17.761	-12.125	0.000393	-0.000195	0.00005
TERRACE	744	18999	DL+LL	Combination	-6.514	-17.777	-12.535	0.000484	-0.000166	-0.000077
TERRACE	745	19000	DL+LL	Combination	-6.752	-18.364	-12.154	0.000375	-0.000077	0.000059
TERRACE	748	19001	DL+LL	Combination	-6.791	-18.554	-12.554	0.000451	-0.000291	0.000166
TERRACE	750	19002	DL+LL	Combination	-6.531	-17.721	-11.581	0.000311	-0.000177	0.000015
TERRACE	751	19003	DL+LL	Combination	-6.517	-17.783	-11.984	0.000374	-0.000173	0.000021
TERRACE	756	19004	DL+LL	Combination	-6.75	-18.134	-11.601	0.000342	-0.000118	0.000079
TERRACE	759	19005	DL+LL	Combination	-6.776	-18.285	-12.009	0.000346	-0.000241	0.000083
TERRACE	761	19006	DL+LL	Combination	-6.525	-17.663	-11.287	0.000346	-0.000177	0.000037
TERRACE	764	19007	DL+LL	Combination	-6.527	-17.698	-11.425	0.000325	-0.000183	0.000053
TERRACE	770	19008	DL+LL	Combination	-6.768	-18.118	-11.306	0.000311	-0.00016	0.000008
TERRACE	771	19009	DL+LL	Combination	-6.772	-18.115	-11.444	0.000324	-0.000196	-0.000014
TERRACE	772	19010	DL+LL	Combination	-6.539	-17.661	-11.154	0.000352	-0.000172	0.000035
TERRACE	773	19011	DL+LL	Combination	-6.773	-18.117	-11.182	0.00034	-0.000175	0.000014
TERRACE	774	19012	DL+LL	Combination	-6.398	-17.746	-9.462	0.000487	-0.000181	0.000013
TERRACE	775	19013	DL+LL	Combination	-6.381	-17.814	-10.006	0.000525	-0.000171	-0.000064
TERRACE	776	19014	DL+LL	Combination	-6.616	-18.445	-9.481	0.000387	-0.000139	0.000079
TERRACE	777	19015	DL+LL	Combination	-6.648	-18.619	-10.023	0.000401	-0.000256	0.000165
TERRACE	778	19432	DL+LL	Combination	-6.388	-17.564	-8.798	0.000468	-0.000177	0.000151
TERRACE	781	19434	DL+LL	Combination	-6.626	-18.263	-8.822	0.000427	-0.000148	-0.000092
TERRACE	782	19016	DL+LL	Combination	-6.763	-17.498	-6.055	0.000158	-0.000169	0.000031
TERRACE	783	19017	DL+LL	Combination	-6.783	-17.67	-6.591	0.000119	-0.000197	0.000152
TERRACE	784	19018	DL+LL	Combination	-7.029	-17.692	-6.065	0.000345	-0.000234	0.000043
TERRACE	785	19019	DL+LL	Combination	-7.017	-17.753	-6.602	0.000306	-0.000146	-0.000011
TERRACE	786	19020	DL+LL	Combination	-6.777	-17.45	-5.46	0.000132	-0.000196	-0.000079

TERRACE	787	19021	DL+LL	Combination	-7.002	-17.549	-5.469	0.000297	-0.000116	0.00017
TERRACE	788	19022	DL+LL	Combination	-6.671	-17.589	-9.632	0.000339	-0.000184	0.000029
TERRACE	789	19023	DL+LL	Combination	-6.659	-17.59	-9.761	0.000342	-0.000188	0.000032
TERRACE	790	19024	DL+LL	Combination	-6.913	-18.057	-9.649	0.000353	-0.000171	0.000036
TERRACE	791	19025	DL+LL	Combination	-6.9	-18.058	-9.784	0.000355	-0.000177	0.000034
TERRACE	792	19419	DL+LL	Combination	-6.66	-17.545	-9.288	0.00034	-0.00019	0.000021
TERRACE	793	19421	DL+LL	Combination	-6.913	-17.981	-9.301	0.000327	-0.000199	0.000042
TERRACE	794	19026	DL+LL	Combination	-6.701	-17.462	-8.709	0.000246	-0.00019	-0.000043
TERRACE	795	19027	DL+LL	Combination	-6.633	-17.529	-9.296	0.000316	-0.000175	0.000045
TERRACE	796	19028	DL+LL	Combination	-6.866	-17.7	-8.725	0.000273	-0.000008	0.000135
TERRACE	797	19029	DL+LL	Combination	-6.955	-17.907	-9.317	0.00032	-0.000332	0.000036
TERRACE	798	19030	DL+LL	Combination	-6.563	-17.591	-10.753	0.000356	-0.000176	0.000035
TERRACE	799	19031	DL+LL	Combination	-6.615	-17.592	-10.111	0.000345	-0.000188	0.000025
TERRACE	800	19032	DL+LL	Combination	-6.802	-18.066	-10.765	0.000363	-0.000168	0.000027
TERRACE	801	19033	DL+LL	Combination	-6.866	-18.055	-10.129	0.000333	-0.000184	0.000037
TERRACE	802	19428	DL+LL	Combination	-6.554	-17.503	-10.372	0.000375	-0.000218	0.000038
TERRACE	803	19042	DL+LL	Combination	-6.814	-18.018	-10.413	0.000335	-0.000134	0.000023
TERRACE	804	19034	DL+LL	Combination	-6.555	-17.429	-10.121	0.000366	-0.00018	0.000042
TERRACE	805	19035	DL+LL	Combination	-6.562	-17.478	-10.377	0.000377	-0.000212	0.000026
TERRACE	806	19036	DL+LL	Combination	-6.816	-17.928	-10.157	0.000344	-0.000206	0.000029
TERRACE	807	19037	DL+LL	Combination	-6.823	-17.986	-10.378	0.000337	-0.000133	0.00005
TERRACE	808	19038	DL+LL	Combination	-6.554	-17.325	-9.96	0.000384	-0.000173	0.000054
TERRACE	809	19039	DL+LL	Combination	-6.548	-17.375	-10.229	0.000392	-0.000185	0.000009
TERRACE	810	19040	DL+LL	Combination	-6.786	-17.87	-9.978	0.000351	-0.000133	0.000011
TERRACE	811	19041	DL+LL	Combination	-6.803	-17.932	-10.251	0.000359	-0.000229	0.000072
TERRACE	812	19043	DL+LL	Combination	-6.427	-17.493	-7.785	0.000343	-0.000189	0.000036
TERRACE	813	19044	DL+LL	Combination	-6.34	-17.543	-8.767	0.000364	-0.000181	0.000029
TERRACE	814	19045	DL+LL	Combination	-6.67	-17.988	-7.822	0.000422	-0.000186	0.000042
TERRACE	815	19046	DL+LL	Combination	-6.581	-17.982	-8.833	0.000298	-0.00016	0.000025
TERRACE	816	19047	DL+LL	Combination	-6.424	-17.402	-7.346	0.000377	-0.000169	0.000031
TERRACE	817	19048	DL+LL	Combination	-6.658	-17.897	-7.376	0.00038	-0.000179	0.000043
TERRACE	818	19049	DL+LL	Combination	-6.327	-17.447	-8.324	0.00032	-0.000162	0.000025
TERRACE	819	19050	DL+LL	Combination	-6.547	-17.889	-8.384	0.000331	-0.000178	0.000048
TERRACE	820	19051	DL+LL	Combination	-6.406	-17.327	-6.911	0.000368	-0.000196	0.000125
TERRACE	821	19052	DL+LL	Combination	-6.665	-17.821	-6.928	0.00037	-0.000199	-0.000072
TERRACE	822	19053	DL+LL	Combination	-6.405	-17.254	-6.836	0.000589	-0.000186	0.000226
TERRACE	823	19054	DL+LL	Combination	-6.665	-17.874	-6.851	0.000608	-0.000194	-0.000175
TERRACE	824	19055	DL+LL	Combination	-6.357	-17.363	-7.9	0.000326	-0.000149	0.00002
TERRACE	825	19056	DL+LL	Combination	-6.54	-17.805	-7.944	0.000347	-0.000148	0.000051
TERRACE	826	19057	DL+LL	Combination	-6.441	-17.574	-8.115	0.000375	-0.000177	0.000042
TERRACE	827	19058	DL+LL	Combination	-6.67	-18.072	-8.138	0.000445	-0.000151	0.000042
TERRACE	828	19059	DL+LL	Combination	-6.325	-17.602	-9.079	0.000343	-0.000194	0.000042
TERRACE	829	19060	DL+LL	Combination	-6.592	-18.035	-9.113	0.000233	-0.000179	0.00002
TERRACE	832	19063	DL+LL	Combination	-6.296	-17.794	-10.942	0.00035	-0.000164	0.000053
TERRACE	833	19064	DL+LL	Combination	-6.288	-17.876	-11.225	0.000317	-0.000176	0.000057
TERRACE	834	19065	DL+LL	Combination	-6.51	-18.279	-10.965	0.000375	-0.000116	0.000021
TERRACE	835	19066	DL+LL	Combination	-6.531	-18.307	-11.247	0.000343	-0.000222	0.000005
TERRACE	836	19067	DL+LL	Combination	-6.298	-17.74	-10.54	0.000361	-0.000089	0.000041
TERRACE	837	19068	DL+LL	Combination	-6.3	-17.759	-10.599	0.000362	-0.000113	0.000028
TERRACE	838	19069	DL+LL	Combination	-6.471	-18.255	-10.536	0.000361	-0.000225	0.000032
TERRACE	839	19070	DL+LL	Combination	-6.474	-18.275	-10.636	0.000371	-0.000132	0.000041
TERRACE	840	19072	DL+LL	Combination	-6.279	-17.644	-9.817	0.000346	-0.00017	0.00003
TERRACE	841	19437	DL+LL	Combination	-6.291	-17.72	-10.247	0.000361	-0.000144	0.000027
TERRACE	842	19074	DL+LL	Combination	-6.521	-18.115	-9.829	0.000351	-0.000204	0.000025
TERRACE	843	19075	DL+LL	Combination	-6.503	-18.221	-10.281	0.000357	-0.000209	0.000047
TERRACE	844	19071	DL+LL	Combination	-6.218	-17.649	-10.451	0.000346	-0.000213	0.000039
TERRACE	845	19073	DL+LL	Combination	-6.512	-18.116	-10.473	0.000358	-0.000163	0.000001
TERRACE	846	19076	DL+LL	Combination	-6.056	-17.74	-9.633	0.000474	-0.000166	0.000014
TERRACE	847	19077	DL+LL	Combination	-6.041	-17.807	-10.148	0.00051	-0.000166	-0.000059
TERRACE	848	19078	DL+LL	Combination	-6.264	-18.419	-9.651	0.000384	-0.000137	0.000072

TERRACE	849	19079	DL+LL	Combination	-6.293	-18.591	-10.165	0.000403	-0.000233	0.000157
TERRACE	850	19441	DL+LL	Combination	-6.043	-17.555	-9.049	0.000486	-0.000168	0.000158
TERRACE	851	19443	DL+LL	Combination	-6.28	-18.288	-9.076	0.00043	-0.000169	-0.000099
TERRACE	852	19080	DL+LL	Combination	-6.188	-17.779	-11.579	0.000369	-0.000184	0.000044
TERRACE	853	19081	DL+LL	Combination	-6.168	-17.829	-11.966	0.000429	-0.000158	-0.000024
TERRACE	854	19082	DL+LL	Combination	-6.394	-18.319	-11.608	0.000367	-0.000086	0.000058
TERRACE	855	19083	DL+LL	Combination	-6.427	-18.472	-11.982	0.000404	-0.00026	0.000112
TERRACE	856	19084	DL+LL	Combination	-6.172	-17.745	-11.22	0.000315	-0.00017	0.00003
TERRACE	857	19085	DL+LL	Combination	-6.177	-17.784	-11.456	0.000353	-0.000167	0.000026
TERRACE	858	19086	DL+LL	Combination	-6.404	-18.16	-11.241	0.000338	-0.00016	0.000055
TERRACE	859	19087	DL+LL	Combination	-6.407	-18.25	-11.479	0.000349	-0.000186	0.000072
TERRACE	860	19088	DL+LL	Combination	-6.17	-17.727	-11.114	0.000307	-0.000168	0.000022
TERRACE	861	19089	DL+LL	Combination	-6.402	-18.124	-11.133	0.000338	-0.000185	0.000063
TERRACE	862	19090	DL+LL	Combination	-6.172	-17.668	-10.945	0.000326	-0.000188	0.000031
TERRACE	863	19091	DL+LL	Combination	-6.176	-17.703	-11.089	0.000329	-0.0002	0.000058
TERRACE	864	19092	DL+LL	Combination	-6.432	-18.098	-10.972	0.000295	-0.000204	0.000048
TERRACE	865	19093	DL+LL	Combination	-6.433	-18.111	-11.102	0.000326	-0.000148	-0.000005
TERRACE	866	19094	DL+LL	Combination	-6.181	-17.666	-10.824	0.000315	-0.000203	0.000019
TERRACE	867	19095	DL+LL	Combination	-6.456	-18.097	-10.85	0.000349	-0.000183	0.000074
TERRACE	868	19096	DL+LL	Combination	-6.184	-17.371	-9.092	0.00033	-0.000155	0.000038
TERRACE	869	19097	DL+LL	Combination	-6.268	-17.426	-9.825	0.000427	-0.000178	-0.000036
TERRACE	870	19098	DL+LL	Combination	-6.454	-17.81	-9.135	0.000332	-0.000269	0.000047
TERRACE	871	19099	DL+LL	Combination	-6.441	-18.071	-9.904	0.000393	-0.000064	0.000129
TERRACE	872	19100	DL+LL	Combination	-6.169	-17.373	-9.262	0.000326	-0.000124	0.000025
TERRACE	873	19101	DL+LL	Combination	-6.427	-17.814	-9.324	0.000358	-0.000181	0.00005
TERRACE	874	19102	DL+LL	Combination	-6.215	-17.374	-8.884	0.000388	-0.00013	0.000063
TERRACE	875	19103	DL+LL	Combination	-6.475	-17.801	-8.945	0.000353	-0.000181	0.000034
TERRACE	876	19104	DL+LL	Combination	-6.119	-17.374	-10.104	0.000356	-0.000111	0.000022
TERRACE	877	19105	DL+LL	Combination	-6.135	-17.371	-9.909	0.00037	-0.000146	0.000032
TERRACE	878	19106	DL+LL	Combination	-6.332	-17.827	-10.14	0.000312	-0.000211	0.000044
TERRACE	879	19107	DL+LL	Combination	-6.352	-17.823	-9.971	0.000328	-0.000182	0.000035
TERRACE	880	19108	DL+LL	Combination	-6.123	-17.381	-11.001	0.000387	-0.00022	0.000005
TERRACE	881	19109	DL+LL	Combination	-6.356	-18.072	-11.066	0.000453	-0.000145	0.000073
TERRACE	882	19110	DL+LL	Combination	-6.136	-17.321	-11.303	0.000509	-0.000155	-0.000152
TERRACE	883	19111	DL+LL	Combination	-6.364	-18.28	-11.375	0.000551	-0.000205	0.000242
TERRACE	884	19112	DL+LL	Combination	-6.34	-17.377	-8.086	0.000345	-0.00017	0.000034
TERRACE	885	19113	DL+LL	Combination	-6.516	-17.798	-8.156	0.000383	-0.000171	0.00004
TERRACE	886	19114	DL+LL	Combination	-6.029	-17.582	-10.136	0.000418	-0.000156	0.00005
TERRACE	887	19115	DL+LL	Combination	-6.012	-17.585	-10.296	0.000447	-0.000183	0.000044
TERRACE	888	19116	DL+LL	Combination	-6.249	-18.126	-10.16	0.000399	-0.000165	-0.000006
TERRACE	889	19117	DL+LL	Combination	-6.25	-18.124	-10.282	0.000266	-0.000167	-0.000001
TERRACE	890	19446	DL+LL	Combination	-6.013	-17.442	-9.841	0.000487	-0.000193	0.000085
TERRACE	891	19448	DL+LL	Combination	-6.254	-18.194	-9.857	0.000391	-0.000217	-0.000056
TERRACE	892	19118	DL+LL	Combination	-6.069	-17.362	-9.561	0.000387	-0.000166	0.000029
TERRACE	893	19119	DL+LL	Combination	-5.979	-17.416	-10.086	0.000484	-0.00017	-0.000047
TERRACE	894	19120	DL+LL	Combination	-6.192	-17.898	-9.58	0.000336	0.00004	0.00004
TERRACE	895	19121	DL+LL	Combination	-6.305	-18.141	-10.107	0.000394	-0.000354	0.000169
TERRACE	896	19124	DL+LL	Combination	-5.969	-17.589	-10.494	0.00036	-0.000196	0.000021
TERRACE	897	19122	DL+LL	Combination	-6.234	-18.073	-10.516	0.000343	-0.000157	0.000047
TERRACE	898	19123	DL+LL	Combination	-5.916	-17.601	-11.13	0.000344	-0.000166	0.000036
TERRACE	899	19125	DL+LL	Combination	-6.144	-18.06	-11.141	0.000327	-0.000181	0.000057
TERRACE	900	19455	DL+LL	Combination	-5.912	-17.52	-10.778	0.000297	-0.000192	0.000034
TERRACE	901	19126	DL+LL	Combination	-6.146	-17.918	-10.819	0.000361	-0.00013	0.000064
TERRACE	902	19129	DL+LL	Combination	-5.917	-17.496	-10.768	0.000295	-0.000191	0.00005
TERRACE	903	19127	DL+LL	Combination	-6.154	-17.885	-10.776	0.000347	-0.000134	0.000014
TERRACE	904	19128	DL+LL	Combination	-5.912	-17.445	-10.535	0.000309	-0.00016	0.00002
TERRACE	905	19130	DL+LL	Combination	-6.144	-17.846	-10.568	0.000334	-0.000177	0.000045
TERRACE	906	19131	DL+LL	Combination	-5.906	-17.375	-10.549	0.000355	-0.000164	0.000013
TERRACE	907	19132	DL+LL	Combination	-5.911	-17.337	-10.295	0.000323	-0.000159	0.000028
TERRACE	908	19133	DL+LL	Combination	-6.136	-17.878	-10.572	0.00037	-0.000205	0.000063

TERRACE	909	19134	DL+LL	Combination	-6.121	-17.79	-10.312	0.00034	-0.000122	0.000056
TERRACE	910	19136	DL+LL	Combination	-5.771	-17.469	-9.974	0.000406	-0.000148	0.000035
TERRACE	911	19459	DL+LL	Combination	-5.787	-17.53	-10.48	0.000438	-0.000146	-0.000024
TERRACE	912	19138	DL+LL	Combination	-6.016	-18.032	-9.994	0.000348	-0.000227	0.000038
TERRACE	913	19461	DL+LL	Combination	-6	-18.179	-10.504	0.000385	-0.000197	0.000097
TERRACE	914	19135	DL+LL	Combination	-5.798	-17.322	-9.355	0.000422	-0.000176	0.000071
TERRACE	915	19137	DL+LL	Combination	-5.973	-17.917	-9.369	0.000353	-0.000054	-0.000022
TERRACE	916	19139	DL+LL	Combination	-5.685	-17.594	-11.622	0.000392	-0.000148	0.000046
TERRACE	917	19140	DL+LL	Combination	-5.666	-17.596	-11.771	0.000416	-0.000188	0.000053
TERRACE	918	19141	DL+LL	Combination	-5.908	-18.101	-11.637	0.000349	-0.000172	0.00001
TERRACE	919	19142	DL+LL	Combination	-5.909	-18.1	-11.755	0.00028	-0.000174	-0.000013
TERRACE	920	19143	DL+LL	Combination	-5.679	-17.485	-11.353	0.000373	-0.000173	0.00008
TERRACE	921	19144	DL+LL	Combination	-5.902	-18.03	-11.374	0.000363	-0.000156	0.000029
TERRACE	922	19145	DL+LL	Combination	-5.732	-17.417	-11.187	0.000278	-0.000161	-0.00002
TERRACE	923	19146	DL+LL	Combination	-5.633	-17.468	-11.68	0.000352	-0.00016	0.000005
TERRACE	924	19147	DL+LL	Combination	-5.839	-17.746	-11.201	0.000304	0.000059	0.000109
TERRACE	925	19148	DL+LL	Combination	-5.954	-17.958	-11.694	0.000362	-0.000362	0.00007
TERRACE	926	19149	DL+LL	Combination	-5.572	-17.594	-12.602	0.00035	-0.000159	0.000046
TERRACE	927	19150	DL+LL	Combination	-5.62	-17.595	-11.971	0.000362	-0.000211	0.000013
TERRACE	928	19151	DL+LL	Combination	-5.795	-18.072	-12.609	0.000368	-0.000188	0.000041
TERRACE	929	19152	DL+LL	Combination	-5.911	-18.071	-11.996	0.000316	-0.000149	0.000065
TERRACE	930	19473	DL+LL	Combination	-5.573	-17.478	-12.266	0.000383	-0.000177	0.000049
TERRACE	931	19165	DL+LL	Combination	-5.792	-18.03	-12.305	0.000341	-0.00013	0.000014
TERRACE	932	19153	DL+LL	Combination	-5.569	-17.375	-12.026	0.00039	-0.000152	0.000074
TERRACE	933	19154	DL+LL	Combination	-5.575	-17.434	-12.247	0.000386	-0.000179	0.000013
TERRACE	934	19155	DL+LL	Combination	-5.79	-17.961	-12.057	0.000389	-0.00017	-1.42E-07
TERRACE	935	19156	DL+LL	Combination	-5.798	-18.004	-12.256	0.000357	-0.000127	0.000052
TERRACE	936	19157	DL+LL	Combination	-5.57	-17.23	-11.8	0.000431	-0.000151	0.000121
TERRACE	937	19158	DL+LL	Combination	-5.565	-17.313	-12.042	0.00042	-0.000156	-0.000011
TERRACE	938	19159	DL+LL	Combination	-5.768	-17.929	-11.817	0.000419	-0.000115	-0.000034
TERRACE	939	19160	DL+LL	Combination	-5.784	-17.987	-12.065	0.000402	-0.000196	0.000105
TERRACE	940	19162	DL+LL	Combination	-5.441	-17.472	-8.042	0.000672	-0.000161	0.000032
TERRACE	941	19477	DL+LL	Combination	-5.449	-17.418	-8.546	0.000661	-0.000156	-0.000159
TERRACE	942	19164	DL+LL	Combination	-5.651	-18.397	-8.056	0.000339	-0.000152	0.00002
TERRACE	943	19479	DL+LL	Combination	-5.64	-18.471	-8.57	0.000444	-0.000132	0.000192
TERRACE	944	19161	DL+LL	Combination	-5.436	-17.28	-7.43	0.000697	-0.000157	0.000184
TERRACE	945	19163	DL+LL	Combination	-5.649	-18.288	-7.439	0.000356	-0.000161	-0.000191
TERRACE	946	19167	DL+LL	Combination	-5.31	-17.5	-7.155	0.000154	-0.000147	0.000023
TERRACE	947	19487	DL+LL	Combination	-5.321	-17.596	-7.695	0.000271	-0.000144	0.000054
TERRACE	948	19169	DL+LL	Combination	-5.523	-17.677	-7.167	0.000321	-0.000178	0.000059
TERRACE	949	19489	DL+LL	Combination	-5.511	-17.958	-7.716	0.00036	-0.000146	0.000046
TERRACE	950	19166	DL+LL	Combination	-5.322	-17.397	-6.645	0.000186	-0.000153	-0.000037
TERRACE	951	19168	DL+LL	Combination	-5.503	-17.598	-6.655	0.000325	-0.000102	0.000115
TERRACE	952	19170	DL+LL	Combination	-5.219	-17.583	-9.757	0.000361	-0.000145	0.000034
TERRACE	953	19171	DL+LL	Combination	-5.207	-17.585	-9.894	0.000367	-0.000156	0.000034
TERRACE	954	19172	DL+LL	Combination	-5.414	-18.074	-9.775	0.000367	-0.000145	0.000023
TERRACE	955	19173	DL+LL	Combination	-5.405	-18.074	-9.908	0.000341	-0.000143	0.000026
TERRACE	956	19496	DL+LL	Combination	-5.208	-17.501	-9.43	0.000384	-0.000155	0.000039
TERRACE	957	19498	DL+LL	Combination	-5.415	-18.029	-9.446	0.000346	-0.000163	0.000016
TERRACE	958	19174	DL+LL	Combination	-5.256	-17.428	-9.078	0.000267	-0.000154	-0.000037
TERRACE	959	19175	DL+LL	Combination	-5.173	-17.483	-9.561	0.000363	-0.000143	0.000016
TERRACE	960	19176	DL+LL	Combination	-5.357	-17.709	-9.094	0.00028	0.000055	0.000129
TERRACE	961	19177	DL+LL	Combination	-5.464	-17.954	-9.583	0.00034	-0.000325	0.000079
TERRACE	962	19180	DL+LL	Combination	-5.163	-17.594	-10.202	0.000352	-0.000155	0.000026
TERRACE	963	19178	DL+LL	Combination	-5.37	-18.059	-10.223	0.000318	-0.000147	0.000042
TERRACE	964	19179	DL+LL	Combination	-5.109	-17.59	-10.84	0.000354	-0.000144	0.000037
TERRACE	965	19181	DL+LL	Combination	-5.303	-18.07	-10.851	0.000378	-0.000135	0.000023
TERRACE	966	19501	DL+LL	Combination	-5.101	-17.498	-10.529	0.000391	-0.000174	0.000038
TERRACE	967	19186	DL+LL	Combination	-5.314	-18.037	-10.568	0.00033	-0.000106	0.000018
TERRACE	968	19182	DL+LL	Combination	-5.1	-17.418	-10.357	0.00038	-0.000149	0.00005

TERRACE	969	19183	DL+LL	Combination	-5.109	-17.469	-10.563	0.000393	-0.000175	0.000022
TERRACE	970	19184	DL+LL	Combination	-5.318	-17.945	-10.394	0.000351	-0.000179	0.000022
TERRACE	971	19185	DL+LL	Combination	-5.323	-18.004	-10.563	0.000336	-0.000092	0.000058
TERRACE	972	19187	DL+LL	Combination	-5.094	-17.365	-10.568	0.000392	-0.000161	0.000023
TERRACE	973	19188	DL+LL	Combination	-5.1	-17.314	-10.394	0.000398	-0.000137	0.000065
TERRACE	974	19189	DL+LL	Combination	-5.311	-17.927	-10.588	0.000358	-0.000181	0.000056
TERRACE	975	19190	DL+LL	Combination	-5.296	-17.888	-10.418	0.000363	-0.000108	0.000002
TERRACE	976	19191	DL+LL	Combination	-5.095	-17.367	-10.588	0.000394	-0.000188	0.000018
TERRACE	977	19192	DL+LL	Combination	-5.311	-17.934	-10.609	0.00036	-0.000193	0.000062
TERRACE	978	19193	DL+LL	Combination	-4.977	-17.494	-7.874	0.000345	-0.000153	0.000041
TERRACE	979	19194	DL+LL	Combination	-4.865	-17.543	-8.871	0.000361	-0.000123	0.000046
TERRACE	980	19195	DL+LL	Combination	-5.173	-17.992	-7.906	0.000423	-0.000148	0.000043
TERRACE	981	19196	DL+LL	Combination	-5.056	-17.981	-8.929	0.000295	-0.000157	0.000024
TERRACE	982	19197	DL+LL	Combination	-4.977	-17.398	-7.527	0.000391	-0.000129	0.000033
TERRACE	983	19198	DL+LL	Combination	-4.878	-17.449	-8.525	0.000308	-0.000136	0.000025
TERRACE	984	19199	DL+LL	Combination	-5.16	-17.898	-7.558	0.000383	-0.000137	0.000041
TERRACE	985	19200	DL+LL	Combination	-5.056	-17.882	-8.582	0.000328	-0.000141	0.000038
TERRACE	986	19201	DL+LL	Combination	-4.956	-17.33	-7.173	0.000368	-0.000162	0.000115
TERRACE	987	19202	DL+LL	Combination	-4.906	-17.361	-8.171	0.00032	-0.000114	0.000021
TERRACE	988	19203	DL+LL	Combination	-5.167	-17.814	-7.196	0.000357	-0.000163	-0.000066
TERRACE	989	19204	DL+LL	Combination	-5.04	-17.805	-8.213	0.000349	-0.00011	0.00005
TERRACE	990	19205	DL+LL	Combination	-4.954	-17.274	-7.124	0.000644	-0.000153	0.000215
TERRACE	991	19206	DL+LL	Combination	-5.166	-17.856	-7.147	0.000661	-0.000157	-0.000171
TERRACE	992	19207	DL+LL	Combination	-4.988	-17.572	-8.14	0.000374	-0.000144	0.000039
TERRACE	993	19208	DL+LL	Combination	-5.174	-18.067	-8.161	0.00044	-0.000131	0.000044
TERRACE	994	19209	DL+LL	Combination	-4.892	-17.6	-9.144	0.000335	-0.000142	0.00002
TERRACE	995	19210	DL+LL	Combination	-5.067	-18.032	-9.187	0.000261	-0.000111	0.000059
TERRACE	996	19211	DL+LL	Combination	-4.885	-17.594	-9.029	0.000296	-0.000129	-0.000003
TERRACE	997	19212	DL+LL	Combination	-5.06	-17.968	-9.085	0.000326	-0.000133	0.000071
TERRACE	998	19213	DL+LL	Combination	-4.734	-17.365	-9.271	0.000337	-0.000109	0.000039
TERRACE	999	19214	DL+LL	Combination	-4.822	-17.437	-9.858	0.00043	-0.000151	-0.000029
TERRACE	1000	19215	DL+LL	Combination	-4.965	-17.818	-9.316	0.000338	-0.000253	0.000052
TERRACE	1001	19216	DL+LL	Combination	-4.941	-18.076	-9.921	0.000383	-0.000004	0.000128
TERRACE	1002	19217	DL+LL	Combination	-4.72	-17.363	-9.437	0.000312	-0.000088	0.000025
TERRACE	1003	19218	DL+LL	Combination	-4.938	-17.826	-9.503	0.000342	-0.000134	0.000047
TERRACE	1004	19219	DL+LL	Combination	-4.671	-17.372	-10.181	0.000353	-0.000088	-0.000058
TERRACE	1005	19220	DL+LL	Combination	-4.673	-17.484	-10.787	0.000346	-0.000165	0.000029
TERRACE	1006	19221	DL+LL	Combination	-4.835	-17.824	-10.217	0.000311	-0.000144	0.000203
TERRACE	1007	19222	DL+LL	Combination	-4.869	-18.001	-10.839	0.000382	-0.000125	0.000054
TERRACE	1008	19223	DL+LL	Combination	-4.664	-17.571	-10.072	-0.000019	-0.000153	-0.000371
TERRACE	1009	19224	DL+LL	Combination	-4.836	-17.444	-10.1	-0.000041	-0.000122	0.000608
TERRACE	1010	19225	DL+LL	Combination	-4.675	-17.362	-9.993	0.000351	-0.000123	0.000037
TERRACE	1011	19226	DL+LL	Combination	-4.894	-17.828	-10.054	0.000319	-0.000115	0.000068
TERRACE	1012	19227	DL+LL	Combination	-4.687	-17.576	-10.952	0.000348	-0.000122	0.000052
TERRACE	1013	19228	DL+LL	Combination	-4.871	-18.075	-10.991	0.000393	-0.000115	0.000047
TERRACE	1014	19229	DL+LL	Combination	-4.769	-17.369	-9.063	0.000384	-0.000102	0.000073
TERRACE	1015	19230	DL+LL	Combination	-4.989	-17.808	-9.13	0.000345	-0.000145	0.000038
TERRACE	1016	19231	DL+LL	Combination	-4.893	-17.371	-8.324	0.000335	-0.000137	0.00003
TERRACE	1017	19232	DL+LL	Combination	-5.02	-17.802	-8.393	0.000381	-0.000134	0.000038
TERRACE	1018	19517	DL+LL	Combination	-4.53	-17.411	-11.797	0.000462	-0.000142	0.000099
TERRACE	1019	19233	DL+LL	Combination	-4.548	-17.603	-12.138	0.000338	-0.000127	0.000048
TERRACE	1020	19519	DL+LL	Combination	-4.745	-18.109	-11.831	0.000391	-0.000232	-0.00006
TERRACE	1021	19235	DL+LL	Combination	-4.731	-18.055	-12.147	0.000314	-0.000154	0.000006
TERRACE	1022	19234	DL+LL	Combination	-4.477	-17.592	-12.767	0.000336	-0.00017	0.000042
TERRACE	1023	19236	DL+LL	Combination	-4.702	-18.054	-12.787	0.000365	-0.000115	0.000019
TERRACE	1024	19237	DL+LL	Combination	-4.433	-17.579	-13.32	0.000347	-0.000111	0.000032
TERRACE	1025	19238	DL+LL	Combination	-4.443	-17.578	-13.19	0.000324	-0.000161	0.000023
TERRACE	1026	19239	DL+LL	Combination	-4.62	-18.047	-13.328	0.000367	-0.000167	0.000055
TERRACE	1027	19240	DL+LL	Combination	-4.645	-18.046	-13.189	0.000373	-0.000144	0.000073
TERRACE	1028	19241	DL+LL	Combination	-4.438	-17.453	-13.057	0.000366	-0.000149	0.000076

TERRACE	1029	19242	DL+LL	Combination	-4.615	-18.002	-13.088	0.00037	-0.000069	1.78E-07
TERRACE	1030	19243	DL+LL	Combination	-4.43	-17.313	-12.919	0.000397	-0.000134	0.000105
TERRACE	1031	19244	DL+LL	Combination	-4.441	-17.395	-13.115	0.000369	-0.00016	0.000009
TERRACE	1032	19245	DL+LL	Combination	-4.628	-17.957	-12.959	0.000431	-0.000164	-0.000025
TERRACE	1033	19246	DL+LL	Combination	-4.634	-17.984	-13.112	0.000378	-0.000083	0.000044
TERRACE	1034	19247	DL+LL	Combination	-4.434	-17.119	-13.272	0.000504	-0.000129	0.000175
TERRACE	1035	19248	DL+LL	Combination	-4.424	-17.199	-13.44	0.00045	-0.000141	-0.000044
TERRACE	1036	19249	DL+LL	Combination	-4.601	-18.011	-13.292	0.0005	-0.000052	-0.000111
TERRACE	1037	19250	DL+LL	Combination	-4.619	-18.017	-13.456	0.000447	-0.000211	0.00011
TERRACE	1038	19251	DL+LL	Combination	-4.551	-17.296	-14.151	0.00043	-0.000138	0.00007
TERRACE	1039	19252	DL+LL	Combination	-4.537	-17.34	-14.37	0.000453	-0.00013	-0.000023
TERRACE	1040	19253	DL+LL	Combination	-4.708	-17.92	-14.18	0.000354	-0.000046	-0.000014
TERRACE	1041	19254	DL+LL	Combination	-4.738	-18.002	-14.396	0.000376	-0.000223	0.000117
TERRACE	1042	19525	DL+LL	Combination	-4.347	-17.264	-6.39	0.000771	-0.000173	0.000177
TERRACE	1043	19524	DL+LL	Combination	-4.319	-17.384	-7.36	0.000901	-0.000191	-0.000294
TERRACE	1044	19530	DL+LL	Combination	-4.424	-18.366	-6.395	0.000356	0.000092	-0.000274
TERRACE	1045	19529	DL+LL	Combination	-4.462	-18.777	-7.366	0.000484	0.000021	0.000428
TERRACE	1046	19255	DL+LL	Combination	-5.954	-17.777	-10.795	0.000374	-0.000155	0.000069
TERRACE	1047	19256	DL+LL	Combination	-5.946	-17.866	-11.063	0.000331	-0.000167	0.000052
TERRACE	1048	19257	DL+LL	Combination	-6.157	-18.311	-10.818	0.000388	-0.000107	0.000001
TERRACE	1049	19258	DL+LL	Combination	-6.178	-18.329	-11.086	0.000347	-0.000217	0.000011
TERRACE	1050	19259	DL+LL	Combination	-5.957	-17.728	-10.386	0.000388	-0.000071	0.000045
TERRACE	1051	19260	DL+LL	Combination	-5.958	-17.747	-10.436	0.00039	-0.000098	0.000021
TERRACE	1052	19261	DL+LL	Combination	-6.113	-18.29	-10.379	0.000355	-0.000224	0.000027
TERRACE	1053	19262	DL+LL	Combination	-6.116	-18.31	-10.475	0.000379	-0.000122	0.000048
TERRACE	1054	19264	DL+LL	Combination	-5.937	-17.643	-9.667	0.000345	-0.000165	0.000028
TERRACE	1055	19451	DL+LL	Combination	-5.949	-17.714	-10.082	0.000385	-0.000134	0.000025
TERRACE	1056	19266	DL+LL	Combination	-6.168	-18.12	-9.68	0.000366	-0.000196	0.00004
TERRACE	1057	19287	DL+LL	Combination	-6.148	-18.253	-10.117	0.00035	-0.000203	0.000057
TERRACE	1058	19263	DL+LL	Combination	-5.879	-17.652	-10.295	0.00035	-0.000178	0.000034
TERRACE	1059	19265	DL+LL	Combination	-6.128	-18.119	-10.314	0.000342	-0.000156	0.00002
TERRACE	1060	19267	DL+LL	Combination	-5.831	-17.664	-10.779	0.000332	-0.000168	0.000035
TERRACE	1061	19268	DL+LL	Combination	-5.834	-17.7	-10.91	0.000327	-0.000178	0.000056
TERRACE	1062	19269	DL+LL	Combination	-6.064	-18.105	-10.801	0.000306	-0.000171	0.000031
TERRACE	1063	19270	DL+LL	Combination	-6.066	-18.113	-10.927	0.000326	-0.000161	-0.000006
TERRACE	1064	19271	DL+LL	Combination	-5.843	-17.663	-10.653	0.000328	-0.000171	0.000029
TERRACE	1065	19272	DL+LL	Combination	-6.079	-18.104	-10.677	0.000349	-0.000164	0.000047
TERRACE	1066	19273	DL+LL	Combination	-5.832	-17.748	-11.08	0.000308	-0.000162	0.000031
TERRACE	1067	19274	DL+LL	Combination	-5.829	-17.73	-10.98	0.000304	-0.000158	0.000021
TERRACE	1068	19275	DL+LL	Combination	-6.05	-18.15	-11.101	0.000335	-0.000152	0.00005
TERRACE	1069	19276	DL+LL	Combination	-6.049	-18.117	-10.998	0.000339	-0.000175	0.000061
TERRACE	1070	19277	DL+LL	Combination	-5.835	-17.79	-11.306	0.000339	-0.000159	0.000031
TERRACE	1071	19278	DL+LL	Combination	-6.054	-18.232	-11.328	0.000349	-0.000179	0.000064
TERRACE	1072	19279	DL+LL	Combination	-5.847	-17.783	-11.425	0.000356	-0.000176	0.00004
TERRACE	1073	19280	DL+LL	Combination	-5.826	-17.835	-11.793	0.000418	-0.000149	-0.000018
TERRACE	1074	19281	DL+LL	Combination	-6.041	-18.301	-11.453	0.000369	-0.000076	0.000065
TERRACE	1075	19282	DL+LL	Combination	-6.075	-18.458	-11.809	0.000399	-0.000255	0.000106
TERRACE	1076	19283	DL+LL	Combination	-5.714	-17.743	-9.801	0.000465	-0.000157	0.000015
TERRACE	1077	19284	DL+LL	Combination	-5.699	-17.818	-10.291	0.000495	-0.000159	-0.000049
TERRACE	1078	19285	DL+LL	Combination	-5.911	-18.407	-9.82	0.000383	-0.00013	0.000072
TERRACE	1079	19286	DL+LL	Combination	-5.941	-18.57	-10.308	0.000395	-0.000226	0.000143
TERRACE	1080	19464	DL+LL	Combination	-5.7	-17.574	-9.247	0.000454	-0.000162	0.000135
TERRACE	1081	19466	DL+LL	Combination	-5.929	-18.248	-9.274	0.000415	-0.000171	-0.000007
TERRACE	1082	19288	DL+LL	Combination	-4.302	-17.718	-7.074	0.000865	-0.000131	-0.000105
TERRACE	1083	19289	DL+LL	Combination	-4.288	-17.78	-7.498	0.000874	-0.000122	-0.000175
TERRACE	1084	19290	DL+LL	Combination	-4.449	-18.933	-7.088	0.000448	-0.000084	0.000121
TERRACE	1085	19291	DL+LL	Combination	-4.482	-19.117	-7.511	0.000376	-0.000191	0.000386
TERRACE	1086	19522	DL+LL	Combination	-4.286	-17.314	-6.565	0.000962	-0.000139	0.000645
TERRACE	1087	19527	DL+LL	Combination	-4.451	-18.883	-6.581	0.000704	-0.000091	-0.000498
TERRACE	1088	19292	DL+LL	Combination	-4.447	-17.71	-14.309	0.000433	-0.000126	0.000077

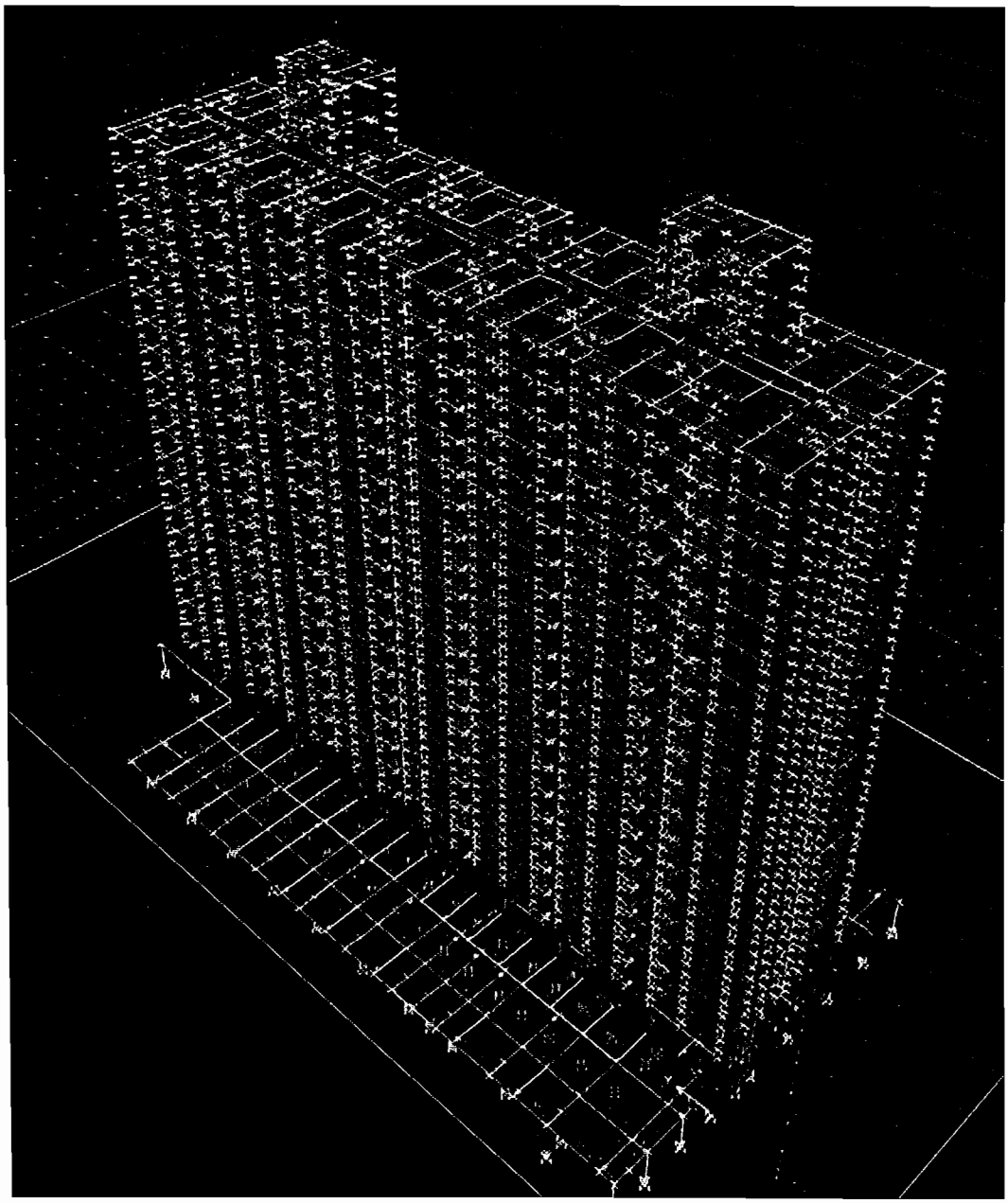
TERRACE	1089	19293	DL+LL	Combination	-4.417	-17.714	-14.63	0.000524	-0.000129	-0.000128
TERRACE	1090	19294	DL+LL	Combination	-4.582	-18.42	-14.326	0.0004	-0.000051	0.000041
TERRACE	1091	19295	DL+LL	Combination	-4.626	-18.623	-14.647	0.000506	-0.000225	0.000204
TERRACE	1092	19296	DL+LL	Combination	-4.431	-17.7	-13.935	0.000338	-0.000136	0.000028
TERRACE	1093	19297	DL+LL	Combination	-4.427	-17.73	-14.152	0.000413	-0.000123	-0.000008
TERRACE	1094	19298	DL+LL	Combination	-4.591	-18.197	-13.947	0.000378	-0.000131	0.000068
TERRACE	1095	19299	DL+LL	Combination	-4.599	-18.336	-14.178	0.000372	-0.00016	0.000118
TERRACE	1096	19300	DL+LL	Combination	-4.434	-17.677	-13.83	0.000317	-0.000094	0.000031
TERRACE	1097	19301	DL+LL	Combination	-4.586	-18.147	-13.838	0.000367	-0.000103	0.000062
TERRACE	1098	19302	DL+LL	Combination	-4.442	-17.621	-13.127	0.000294	-0.000144	0.000039
TERRACE	1099	19303	DL+LL	Combination	-4.445	-17.657	-13.232	0.0003	-0.000109	0.000053
TERRACE	1100	19304	DL+LL	Combination	-4.59	-18.056	-13.158	0.000375	-0.000161	0.000066
TERRACE	1101	19305	DL+LL	Combination	-4.592	-18.097	-13.251	0.000378	-0.000062	0.000046
TERRACE	1102	19306	DL+LL	Combination	-4.456	-17.619	-13.023	0.000228	-0.000125	0.000039
TERRACE	1103	19307	DL+LL	Combination	-4.613	-18.056	-12.997	0.000463	-0.000131	0.00006
TERRACE	1104	19308	DL+LL	Combination	-4.524	-17.654	-11.818	0.000355	-0.000125	0.000025
TERRACE	1105	19309	DL+LL	Combination	-4.484	-17.651	-12.469	0.000325	-0.000126	0.000018
TERRACE	1106	19310	DL+LL	Combination	-4.722	-18.113	-11.826	0.000342	-0.000186	0.000058
TERRACE	1107	19311	DL+LL	Combination	-4.655	-18.099	-12.496	0.000371	-0.00011	0.000029
TERRACE	1108	19312	DL+LL	Combination	-4.566	-17.673	-12.287	0.000497	-0.000142	-0.000066
TERRACE	1109	19313	DL+LL	Combination	-4.697	-18.442	-12.319	0.000414	-0.000037	0.000213
TERRACE	1110	19314	DL+LL	Combination	-4.546	-17.83	-14.957	0.000432	-0.000129	0.000052
TERRACE	1111	19315	DL+LL	Combination	-4.548	-17.888	-15.121	0.000396	-0.000137	0.000032
TERRACE	1112	19316	DL+LL	Combination	-4.719	-18.447	-14.987	0.000383	-0.000117	-0.000003
TERRACE	1113	19317	DL+LL	Combination	-4.729	-18.455	-15.147	0.000351	-0.000148	0.000027
TERRACE	1114	19318	DL+LL	Combination	-4.544	-17.804	-14.902	0.000446	-0.000118	0.00007
TERRACE	1115	19319	DL+LL	Combination	-4.717	-18.452	-14.931	0.000391	-0.000134	-0.000027
TERRACE	1116	19320	DL+LL	Combination	-4.687	-17.676	-11.002	0.000591	-0.000144	-0.000179
TERRACE	1117	19321	DL+LL	Combination	-4.66	-17.993	-11.495	0.000274	-0.000125	0.000067
TERRACE	1118	19322	DL+LL	Combination	-4.84	-18.507	-11.02	0.000585	-0.000074	0.000495
TERRACE	1119	19323	DL+LL	Combination	-4.883	-18.322	-11.513	0.000199	-0.000251	-0.000114
TERRACE	1120	19511	DL+LL	Combination	-4.671	-17.636	-10.507	0.000356	-0.000128	0.000059
TERRACE	1121	19510	DL+LL	Combination	-4.679	-17.831	-10.913	0.000186	-0.00012	-0.000166
TERRACE	1122	19514	DL+LL	Combination	-4.856	-18.137	-10.524	0.00043	-0.00014	-0.000053
TERRACE	1123	19513	DL+LL	Combination	-4.848	-18.124	-10.931	0.000077	-0.000154	0.000477
TERRACE	1124	19324	DL+LL	Combination	-4.803	-17.667	-11.014	0.000263	-0.000184	0.00004
TERRACE	1125	19325	DL+LL	Combination	-4.805	-17.703	-11.124	0.000275	-0.000185	0.000079
TERRACE	1126	19326	DL+LL	Combination	-5.032	-18.045	-11.049	0.000269	-0.000169	0.000017
TERRACE	1127	19327	DL+LL	Combination	-5.034	-18.04	-11.136	0.000325	-0.000123	-0.000034
TERRACE	1128	19328	DL+LL	Combination	-4.816	-17.665	-10.918	0.000227	-0.000165	0.000027
TERRACE	1129	19329	DL+LL	Combination	-5.041	-18.045	-10.917	0.000417	-0.000136	0.00003
TERRACE	1130	19332	DL+LL	Combination	-4.859	-17.649	-10.422	0.000327	-0.000136	0.000032
TERRACE	1131	19330	DL+LL	Combination	-5.048	-18.1	-10.448	0.000361	-0.000147	0.000013
TERRACE	1132	19331	DL+LL	Combination	-4.919	-17.638	-9.79	0.000353	-0.000149	0.000035
TERRACE	1133	19333	DL+LL	Combination	-5.092	-18.114	-9.795	0.000361	-0.000099	0.000038
TERRACE	1134	19334	DL+LL	Combination	-4.911	-17.714	-10.163	0.000382	-0.000119	0.000014
TERRACE	1135	19335	DL+LL	Combination	-5.099	-18.262	-10.192	0.000361	-0.000192	0.000073
TERRACE	1136	19338	DL+LL	Combination	-4.933	-17.731	-10.413	0.000396	-0.000065	0.000046
TERRACE	1137	19336	DL+LL	Combination	-5.059	-18.305	-10.411	0.00035	-0.000173	0.000028
TERRACE	1138	19337	DL+LL	Combination	-4.934	-17.75	-10.455	0.000399	-0.000077	0.00002
TERRACE	1139	19339	DL+LL	Combination	-5.061	-18.326	-10.488	0.00038	-0.000101	0.000052
TERRACE	1140	19340	DL+LL	Combination	-4.933	-17.785	-10.858	0.000384	-0.000137	0.000074
TERRACE	1141	19341	DL+LL	Combination	-4.912	-17.895	-11.14	0.000337	-0.000137	0.000052
TERRACE	1142	19342	DL+LL	Combination	-5.09	-18.335	-10.882	0.000387	-0.000051	-0.000006
TERRACE	1143	19343	DL+LL	Combination	-5.126	-18.358	-11.159	0.000345	-0.00022	0.000012
TERRACE	1144	19344	DL+LL	Combination	-5.032	-17.749	-9.562	0.000457	-0.000148	0.000023
TERRACE	1145	19345	DL+LL	Combination	-5.01	-17.816	-10.033	0.000479	-0.000135	-0.000048
TERRACE	1146	19346	DL+LL	Combination	-5.197	-18.393	-9.581	0.000366	-0.000082	0.000046
TERRACE	1147	19347	DL+LL	Combination	-5.233	-18.545	-10.051	0.000401	-0.000218	0.000131
TERRACE	1148	19505	DL+LL	Combination	-5.018	-17.559	-9.086	0.000497	-0.000152	0.00014

TERRACE	1149	19507	DL+LL	Combination	-5.214	-18.312	-9.112	0.000414	-0.000113	-0.000077
TERRACE	1150	19348	DL+LL	Combination	-4.819	-17.795	-11.636	0.00026	-0.000159	0.000013
TERRACE	1151	19349	DL+LL	Combination	-4.799	-17.84	-11.951	0.00042	-0.00012	-0.000014
TERRACE	1152	19350	DL+LL	Combination	-4.982	-18.185	-11.665	0.000379	-0.000048	0.000143
TERRACE	1153	19351	DL+LL	Combination	-5.011	-18.454	-11.967	0.000397	-0.000233	0.000147
TERRACE	1154	19352	DL+LL	Combination	-4.813	-17.737	-11.24	0.000238	-0.000135	-0.000014
TERRACE	1155	19353	DL+LL	Combination	-4.797	-17.814	-11.543	0.000223	-0.000133	0.000071
TERRACE	1156	19354	DL+LL	Combination	-4.972	-18.02	-11.259	0.00033	-0.00007	0.000088
TERRACE	1157	19355	DL+LL	Combination	-5.003	-18.088	-11.568	0.000347	-0.000203	0.000015
TERRACE	1158	19356	DL+LL	Combination	-5.163	-17.786	-11.351	0.000337	-0.000162	0.00003
TERRACE	1159	19357	DL+LL	Combination	-5.143	-17.82	-11.689	0.000445	-0.000133	-0.000037
TERRACE	1160	19358	DL+LL	Combination	-5.335	-18.283	-11.377	0.000368	-0.000063	0.00009
TERRACE	1161	19359	DL+LL	Combination	-5.366	-18.49	-11.708	0.000412	-0.000239	0.000142
TERRACE	1162	19360	DL+LL	Combination	-5.158	-17.723	-10.911	0.000293	-0.000142	0.00001
TERRACE	1163	19361	DL+LL	Combination	-5.142	-17.801	-11.234	0.000313	-0.000141	0.000049
TERRACE	1164	19362	DL+LL	Combination	-5.329	-18.098	-10.93	0.000337	-0.000081	0.000073
TERRACE	1165	19363	DL+LL	Combination	-5.357	-18.202	-11.258	0.00034	-0.000209	0.000049
TERRACE	1166	19364	DL+LL	Combination	-5.151	-17.661	-10.637	0.000304	-0.000163	0.00004
TERRACE	1167	19365	DL+LL	Combination	-5.153	-17.691	-10.735	0.000308	-0.000162	0.000061
TERRACE	1168	19366	DL+LL	Combination	-5.36	-18.08	-10.662	0.000301	-0.000149	0.000022
TERRACE	1169	19367	DL+LL	Combination	-5.363	-18.085	-10.752	0.000332	-0.000145	-0.000005
TERRACE	1170	19368	DL+LL	Combination	-5.166	-17.659	-10.523	0.000287	-0.00015	0.000035
TERRACE	1171	19369	DL+LL	Combination	-5.37	-18.08	-10.531	0.000385	-0.00014	0.000029
TERRACE	1172	19370	DL+LL	Combination	-5.277	-17.786	-10.784	0.000378	-0.000158	0.000074
TERRACE	1173	19371	DL+LL	Combination	-5.256	-17.905	-11.082	0.000319	-0.000132	0.000065
TERRACE	1174	19372	DL+LL	Combination	-5.445	-18.326	-10.806	0.000389	-0.000046	-0.000007
TERRACE	1175	19373	DL+LL	Combination	-5.481	-18.334	-11.103	0.000336	-0.000242	-0.000006
TERRACE	1176	19374	DL+LL	Combination	-5.271	-17.726	-10.141	0.000399	-0.000055	0.000048
TERRACE	1177	19375	DL+LL	Combination	-5.272	-17.745	-10.182	0.000401	-0.000081	0.00002
TERRACE	1178	19376	DL+LL	Combination	-5.406	-18.308	-10.136	0.000354	-0.000216	0.000027
TERRACE	1179	19377	DL+LL	Combination	-5.408	-18.329	-10.224	0.000382	-0.000096	0.000052
TERRACE	1180	19492	DL+LL	Combination	-5.265	-17.715	-9.858	0.000394	-0.000124	0.000021
TERRACE	1181	19378	DL+LL	Combination	-5.443	-18.266	-9.892	0.00035	-0.000177	0.000067
TERRACE	1182	19380	DL+LL	Combination	-5.258	-17.642	-9.465	0.000349	-0.000145	0.000029
TERRACE	1183	19382	DL+LL	Combination	-5.457	-18.117	-9.476	0.000359	-0.000151	0.000045
TERRACE	1184	19379	DL+LL	Combination	-5.204	-17.651	-10.098	0.000339	-0.000144	0.000028
TERRACE	1185	19381	DL+LL	Combination	-5.398	-18.111	-10.119	0.000353	-0.000144	0.000028
TERRACE	1186	19383	DL+LL	Combination	-5.379	-17.74	-9.283	0.000459	-0.000161	0.000016
TERRACE	1187	19384	DL+LL	Combination	-5.353	-17.807	-9.799	0.000494	-0.000139	-0.000058
TERRACE	1188	19385	DL+LL	Combination	-5.551	-18.39	-9.301	0.000373	-0.000076	0.000061
TERRACE	1189	19386	DL+LL	Combination	-5.592	-18.567	-9.817	0.000406	-0.00024	0.000149
TERRACE	1190	19482	DL+LL	Combination	-5.365	-17.556	-8.787	0.000488	-0.000164	0.000148
TERRACE	1191	19484	DL+LL	Combination	-5.567	-18.294	-8.809	0.000421	-0.000102	-0.000081
TERRACE	1192	19387	DL+LL	Combination	-5.506	-17.777	-11.564	0.000381	-0.000173	0.000046
TERRACE	1193	19388	DL+LL	Combination	-5.486	-17.823	-11.912	0.000435	-0.000136	-0.00003
TERRACE	1194	19389	DL+LL	Combination	-5.691	-18.333	-11.593	0.000364	-0.000063	0.00005
TERRACE	1195	19390	DL+LL	Combination	-5.721	-18.482	-11.927	0.000409	-0.000247	0.000115
TERRACE	1196	19391	DL+LL	Combination	-5.494	-17.714	-11.157	0.000331	-0.000154	0.000027
TERRACE	1197	19392	DL+LL	Combination	-5.489	-17.778	-11.465	0.000368	-0.000151	0.000027
TERRACE	1198	19393	DL+LL	Combination	-5.691	-18.16	-11.179	0.000347	-0.000115	0.000058
TERRACE	1199	19394	DL+LL	Combination	-5.709	-18.272	-11.486	0.000347	-0.000192	0.000066
TERRACE	1200	19395	DL+LL	Combination	-5.493	-17.663	-10.966	0.000365	-0.00015	0.000035
TERRACE	1201	19396	DL+LL	Combination	-5.495	-17.691	-11.083	0.000351	-0.00016	0.00004
TERRACE	1202	19397	DL+LL	Combination	-5.705	-18.133	-10.982	0.000321	-0.000142	0.00003
TERRACE	1203	19398	DL+LL	Combination	-5.707	-18.146	-11.099	0.000326	-0.000165	0.000009
TERRACE	1204	19399	DL+LL	Combination	-5.505	-17.661	-10.826	0.000376	-0.000158	0.000031
TERRACE	1205	19400	DL+LL	Combination	-5.72	-18.132	-10.862	0.000317	-0.000148	0.000047
TERRACE	1206	19401	DL+LL	Combination	-5.613	-17.78	-11.011	0.000369	-0.000147	0.000064
TERRACE	1207	19402	DL+LL	Combination	-5.604	-17.862	-11.267	0.000335	-0.000159	0.000046
TERRACE	1208	19403	DL+LL	Combination	-5.804	-18.306	-11.034	0.000384	-0.000096	0.000007

TERRACE	1209	19404	DL+LL	Combination	-5.825	-18.332	-11.29	0.000352	-0.000209	0.000016
TERRACE	1210	19405	DL+LL	Combination	-5.616	-17.732	-10.605	0.000386	-0.00006	0.000044
TERRACE	1211	19406	DL+LL	Combination	-5.617	-17.75	-10.65	0.000387	-0.000087	0.000022
TERRACE	1212	19407	DL+LL	Combination	-5.759	-18.287	-10.597	0.000354	-0.000217	0.000026
TERRACE	1213	19408	DL+LL	Combination	-5.761	-18.307	-10.689	0.000376	-0.000112	0.000046
TERRACE	1214	19410	DL+LL	Combination	-5.593	-17.646	-9.908	0.00034	-0.000159	0.000027
TERRACE	1215	19469	DL+LL	Combination	-5.609	-17.716	-10.304	0.000384	-0.000121	0.000026
TERRACE	1216	19412	DL+LL	Combination	-5.82	-18.123	-9.925	0.00037	-0.000204	0.000039
TERRACE	1217	19413	DL+LL	Combination	-5.795	-18.253	-10.339	0.000349	-0.000201	0.000054
TERRACE	1218	19409	DL+LL	Combination	-5.532	-17.653	-10.534	0.000361	-0.000174	0.000037
TERRACE	1219	19411	DL+LL	Combination	-5.782	-18.127	-10.549	0.000333	-0.000147	0.000022
TERRACE	1220	19414	DL+LL	Combination	-6.767	-17.717	-6.615	0.000064	-0.000172	0.000002
TERRACE	1221	19416	DL+LL	Combination	-7.016	-17.794	-6.626	0.000359	-0.000204	0.000015
TERRACE	1222	19418	DL+LL	Combination	-6.661	-17.553	-9.355	0.000341	-0.000178	0.000023
TERRACE	1223	19420	DL+LL	Combination	-6.914	-17.996	-9.372	0.00033	-0.000192	0.00004
TERRACE	1224	19423	DL+LL	Combination	-6.635	-17.699	-10.533	0.000421	-0.000174	0.000034
TERRACE	1225	19425	DL+LL	Combination	-6.874	-18.275	-10.552	0.000355	-0.000236	0.000084
TERRACE	1226	19427	DL+LL	Combination	-6.557	-17.524	-10.479	0.000371	-0.000179	0.000037
TERRACE	1227	19429	DL+LL	Combination	-6.809	-18.032	-10.496	0.000347	-0.000174	0.000024
TERRACE	1228	19431	DL+LL	Combination	-6.388	-17.718	-9.07	0.000374	-0.000163	0.000047
TERRACE	1229	19433	DL+LL	Combination	-6.629	-18.231	-9.083	0.000318	-0.000186	0.000046
TERRACE	1230	19436	DL+LL	Combination	-6.286	-17.691	-10.094	0.00035	-0.000178	0.000032
TERRACE	1231	19438	DL+LL	Combination	-6.511	-18.181	-10.108	0.000361	-0.00016	0.000047
TERRACE	1232	19440	DL+LL	Combination	-6.048	-17.71	-9.303	0.00039	-0.000158	0.000047
TERRACE	1233	19442	DL+LL	Combination	-6.276	-18.255	-9.316	0.000326	-0.000163	0.000042
TERRACE	1234	19445	DL+LL	Combination	-6.015	-17.468	-9.906	0.000476	-0.000168	0.000067
TERRACE	1235	19447	DL+LL	Combination	-6.253	-18.18	-9.926	0.000386	-0.000169	-0.000031
TERRACE	1236	19450	DL+LL	Combination	-5.945	-17.686	-9.934	0.000371	-0.00017	0.000032
TERRACE	1237	19452	DL+LL	Combination	-6.158	-18.205	-9.948	0.000363	-0.000153	0.000055
TERRACE	534	19454	DL+LL	Combination	-5.916	-17.541	-10.875	0.000314	-0.000166	0.000039
TERRACE	537	19456	DL+LL	Combination	-6.142	-17.953	-10.894	0.000339	-0.000143	0.000062
TERRACE	544	19458	DL+LL	Combination	-5.787	-17.508	-10.204	0.000411	-0.000181	0.000025
TERRACE	546	19460	DL+LL	Combination	-5.998	-18.092	-10.219	0.000359	-0.000127	0.000041
TERRACE	1238	19463	DL+LL	Combination	-5.707	-17.712	-9.487	0.000379	-0.000151	0.000043
TERRACE	1239	19465	DL+LL	Combination	-5.923	-18.237	-9.5	0.000326	-0.000151	0.000048
TERRACE	1240	19468	DL+LL	Combination	-5.604	-17.687	-10.166	0.000375	-0.000164	0.000032
TERRACE	1241	19470	DL+LL	Combination	-5.805	-18.207	-10.179	0.000361	-0.000135	0.000053
TERRACE	1242	19472	DL+LL	Combination	-5.576	-17.503	-12.356	0.000385	-0.000161	0.000046
TERRACE	1243	19474	DL+LL	Combination	-5.789	-18.041	-12.375	0.00036	-0.000125	0.000018
TERRACE	1244	19476	DL+LL	Combination	-5.442	-17.485	-8.273	0.000635	-0.000152	-0.000002
TERRACE	1245	19478	DL+LL	Combination	-5.645	-18.401	-8.285	0.000359	-0.000172	-0.000007
TERRACE	1246	19481	DL+LL	Combination	-5.361	-17.698	-9.022	0.000414	-0.000128	0.000046
TERRACE	1247	19483	DL+LL	Combination	-5.572	-18.284	-9.036	0.00034	-0.000189	0.000039
TERRACE	1248	19486	DL+LL	Combination	-5.316	-17.539	-7.445	0.000226	-0.000157	0.000026
TERRACE	1249	19488	DL+LL	Combination	-5.514	-17.837	-7.456	0.00035	-0.00015	0.000092
TERRACE	1250	19491	DL+LL	Combination	-5.26	-17.688	-9.723	0.00037	-0.00015	0.000031
TERRACE	1251	19493	DL+LL	Combination	-5.453	-18.211	-9.737	0.000365	-0.000153	0.000058
TERRACE	1252	19495	DL+LL	Combination	-5.212	-17.527	-9.538	0.000378	-0.000142	0.000033
TERRACE	1253	19497	DL+LL	Combination	-5.414	-18.047	-9.556	0.000349	-0.000142	0.000023
TERRACE	1254	19500	DL+LL	Combination	-5.105	-17.522	-10.633	0.000386	-0.000141	0.000037
TERRACE	1255	19502	DL+LL	Combination	-5.308	-18.052	-10.649	0.000349	-0.000137	0.000017
TERRACE	1256	19504	DL+LL	Combination	-5.018	-17.688	-9.304	0.000436	-0.000125	0.000047
TERRACE	1257	19506	DL+LL	Combination	-5.216	-18.309	-9.318	0.000352	-0.000166	0.000034
TERRACE	1258	19509	DL+LL	Combination	-4.675	-17.77	-10.72	0.000229	-0.00014	0.000101
TERRACE	1259	19512	DL+LL	Combination	-4.854	-17.984	-10.732	0.000319	-0.000123	-0.000076
TERRACE	1260	19516	DL+LL	Combination	-4.553	-17.496	-11.951	0.000415	-0.000132	0.000057
TERRACE	1261	19518	DL+LL	Combination	-4.727	-18.09	-11.968	0.000378	-0.000062	-0.000012
TERRACE	1262	19521	DL+LL	Combination	-4.285	-17.994	-6.803	0.000363	-0.000113	0.000066
TERRACE	1263	19523	DL+LL	Combination	-4.257	-17.536	-7.143	0.000699	-0.000101	0.000032
TERRACE	1264	19526	DL+LL	Combination	-4.458	-18.477	-6.81	0.000263	-0.000152	0.000063

TERRACE	1265	19528	DL+LL	Combination	-4.524	-18.496	-7.16	0.000311	-0.000333	0.000043
TERRACE	1295	19909	DL+LL	Combination	-6.776	-18.335	-8.39	0.000386	-0.000164	0.000037
TERRACE	1296	19946	DL+LL	Combination	-6.41	-17.584	-8.38	0.000343	-0.000188	0.000042
TERRACE	1297	19947	DL+LL	Combination	-6.644	-18.065	-8.4	0.000278	-0.000166	0.000029
TERRACE	1305	20140	DL+LL	Combination	-6.37	-17.584	-8.658	0.000316	-0.000185	0.000032
TERRACE	1306	20141	DL+LL	Combination	-6.624	-18.046	-8.671	0.000433	-0.000172	0.000028
TERRACE	1307	20180	DL+LL	Combination	-6.731	-18.335	-8.788	0.000296	-0.000113	0.000037
TERRACE	1310	20238	DL+LL	Combination	-6.731	-18.266	-8.536	0.000428	-0.000143	0.000037
TERRACE	1311	20239	DL+LL	Combination	-6.776	-18.266	-8.062	0.000341	-0.000148	0.000037
TERRACE	1312	18925	DL+LL	Combination	-6.569	-18.3	-13.264	3.904E-07	-0.000967	0.000037
TERRACE	1313	20261	DL+LL	Combination	-5.254	-18.335	-8.39	0.000391	-0.000139	0.000037
TERRACE	1314	20281	DL+LL	Combination	-5.226	-18.335	-8.661	0.000338	-0.000144	0.000037
TERRACE	1315	20354	DL+LL	Combination	-4.961	-17.58	-8.376	0.000336	-0.000146	0.00004
TERRACE	1316	20355	DL+LL	Combination	-4.936	-17.577	-8.655	0.000325	-0.000143	0.000036
TERRACE	1317	20356	DL+LL	Combination	-5.145	-18.061	-8.399	0.00029	-0.000134	0.000042
TERRACE	1318	20357	DL+LL	Combination	-5.116	-18.045	-8.671	0.00042	-0.000136	0.00003
TERRACE	1322	20456	DL+LL	Combination	-5.209	-18.335	-8.802	0.00031	-0.000149	0.000037
TERRACE	1324	20417	DL+LL	Combination	-5.254	-18.266	-8.107	0.000317	-0.000117	0.000037
TERRACE	1325	20457	DL+LL	Combination	-5.209	-18.266	-8.554	0.000414	-0.000119	0.000037
TERRACE	1326	20459	DL+LL	Combination	-5.043	-18.3	-13.235	-0.000297	-0.000811	0.000037
TERRACE	1337	271	DL+LL	Combination	-5.864	-18.372	0	0	0	0.000037
TERRACE	1274	4388	DL+LL	Combination	-5.863	-18.366	0	0	0	0.000037
TERRACE	1362	7470	DL+LL	Combination	-5.863	-18.366	0	0	0	0.000037

3D MODEL



TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN.

Mx = 7.1 KN-m.

My = 26 KN-m.

Grade of Concrete = M25.

Grade of Steel = Fe500.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the limits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum moment for which the column is to be designed is Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN. Grade of Concrete = M30

Mx = 25.26KN-m. Grade of Steel = Fe500.

My = 83 KN-m.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

M_u / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

M_u / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

TYPICAL BEAM DESIGN

(ANALYSIS WAS DONE BY ETABS USING DIFFERENT LOAD COMBINATIONS, THE DESIGN FORCES ARE TAKEN FOR DCON2 CASE)

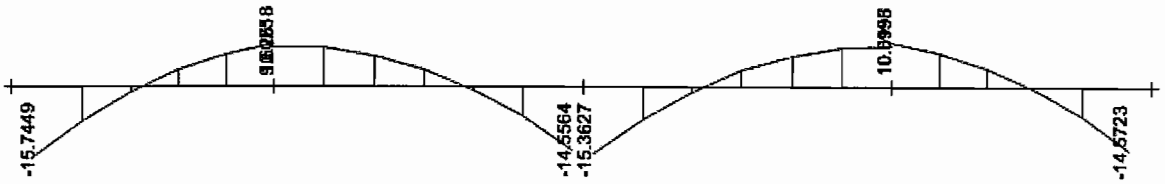
A Beam of 2 spans was considered for Typical Design Calculation.
Beam Location – Along Grid 33 to 46 (First Floor Shuttering)

Beam Size : 200mm x 450mm.

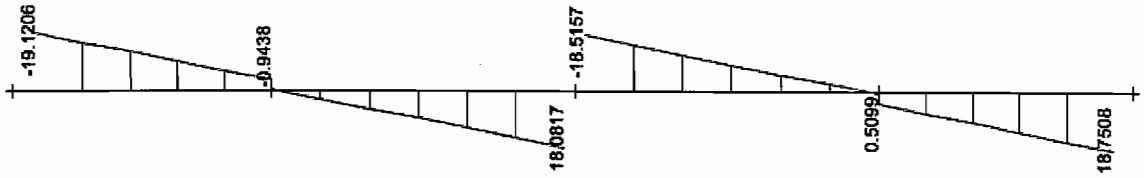
Grade of Concrete = M30;
Grade of Steel = Fe-500;
Effective depth – d' = 450-50 = 400 mm.

BENDING MOMENT, SHEAR FORCE AND TORSION DIAGRAMS TAKEN FROM ETABS

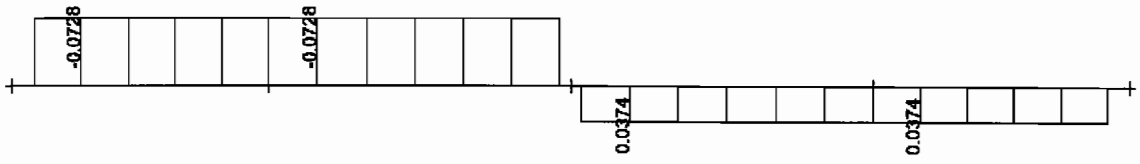
BENDING MOMENT DIAGRAM (KNm)



SHEAR FORCE DIAGRAM (KN)



TORSION DIAGRAM (KNm/m)



LEFT BEAM-(200X450)

Left End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 36KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 36 + 0.35
= 36.35 KN-m.

Mu/bd^2 = 36.35 x 10^6 /230 x 400^2
= **0.987**

Pt = 0.29 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
=0.29 x 230 x 400/ 100
= 267 mm^2.

Provide (2T16) ---- @ Top

Mid Span bottom

Mu = 41-KNm

Mu/bd^2 = 41x 10^6 /230 x 400^2
= 1.12

Pt = 1.12 % (From SP-16, Table 3)
As per IS : 13920 : 1993 minimum reinforcement provided will be 0.24%
Ast = Pt x b x D/100
= 0.24 x 230 x 450/ 100
= 249 mm^2.

Provide (2T16)

Right End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 35KN-m. Tu = 0.2 KN-m/m

M_t = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 35 + 0.35
= 35.35 KN-m.

M_u/bd^2 = 35.35 x 10^6 /230 x 400^2
= **0.96**

P_t = 0.2789 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
= 0.2789 x 230 x 400/ 100
= 256 mm^2.
Provide (2T16) ---- @ Top

<u>Shear Reinforcement:</u>

V1 at Left End Support = 47 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 5.13/0.23 + 47 = 83 KN

ζv = Vu/bd = 83 x 10^3/ 230 x 400
= 0.90 N/mm^2
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm^2
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400

= .278

Therefore **ζ_c =** 0.39 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 83 x 10^3 – 0.39 x 230 x 400
= 47.12 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 47.12 x 10^3
= 306 mm.

V1 at Right End Support = 46 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 0.2/0.23 + 46 = 47.4 KN

ζv = Vu/bd = 47.4 x 10^3/ 230 x 400
= 0.52 N/mm²
Max Allowable shear stress for M25 grade (**ζ_{cmax}**) = 3.1 N/mm²
Therefore $\zeta v <$ **ζ_{cmax}, hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400
= .28

Therefore **ζ_c =** 0.36 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 47.41 x 10^3 – 0.36 x 230 x 400
= 14.29 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 14.29 x 10^3
= 1013 mm.

As per code IS : 13920 : 1993 minimum spacing provided should be d/4 or 8 x diameter of smaller bar or 100mm whichever is less.

Hence Provide 2L-T8@100/200/100 c/c

Check for Deflection:

Maximum allowable Elastic short term deflection = l/250 = 4512/250
= 18.048 mm.

But actual deflection from ETABS = 1.4mm.

Maximum allowable long term deflection = l/350 = 4512/350
= 12.9 mm > 1.41 mm.

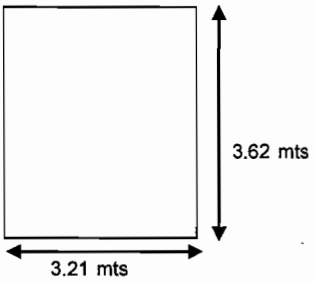
Therefore within the limits.

DESIGN TWOWAY SLAB

DESIGN OF TWO WAY SLAB

Short span	S=	3.21	m
Long span	L=	3.62	m
Assumed slab thickness	t=	0.125	m
Grade of concrete	fck=	25	N/mm^2
Grade of reinforcement	fy=	500	N/mm^2

Clear Span	
S	3.21
L	3.62



Type of panel One short edge discontinuous

Loads

Self weight of slab	w1=	3.13	kN/m^2	
Floor finish	w2=	1.50	kN/m^2	
Live load	w3=	2.00	kN/m^2	TOTAL
Miscellaneous	w4=	0.00	kN/m^2	6.63 kN/m^2

Ratio of long span to short span R= 1.15

Design Load with load factor of 1.5 Wu= 9.94 kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.046	**4.71**	0.46	0.11	**150.00**	8	335	101
Positive moment at midspan	0.034	**3.48**	0.34	0.08	**150.00**	8	335	101
						8	200	
Long span direction								
Negative moment at continuous edge	0.037	**3.79**	0.44	0.10	**150.00**	8	335	93
Positive moment at midspan	0.028	**2.87**	0.33	0.08	**150.00**	8	335	93

Minimum effective depth reqd	dre=	36.95	mm
Clear cover to any reinforcement	c=	20	mm
Minimum effective depth provided	dpr=	93	mm
Minimum reinforcement	Amin=	150	mm^2

greater than 'min. eff depth reqd'. Hence ok

Deflection check

Reinf provided at midspan along short direction 251.33 mm^2 Dia 8 at 200 mm

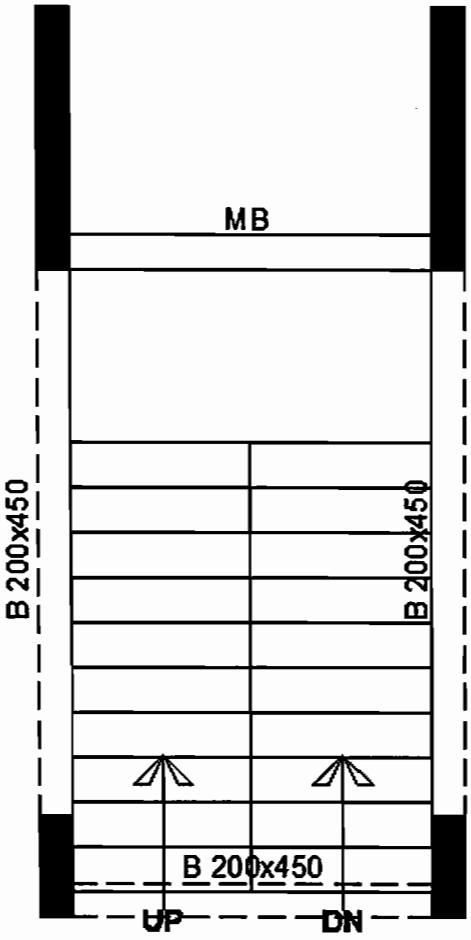
Stress in reinforcement	fs=	173.081	N/mm^2
Percentage of reinforcement provided	pt=	0.24884	%
Modification factor as per fig 4 of IS:456-2000	MF=	2	

Type of slab for deflection check: Continuous

Basic span to effective depth ratio	26	
Minimum effective depth reqd from deflection criteria	61.73	mm
Effective depth provided	101	mm

greater than 'min. eff depth reqd'. Hence ok

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

SOIL EXPLORATION REPORT

PROJECT NO : **7364**

PROJECT NAME : **Construction of Proposed 2 Basement + Stilt + 19 Floors, Alliance Budget housing at Siruseri.**

1. INTRODUCTION

M/s. Alliance Group are proposing to construct 2 Basement + Stilt + 19 Floors Alliance Budget housing, Siruseri, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Alliance Group, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose eight boreholes were bored upto a depth varies from 6.0 to 8.5M below ground level. The boreholes were terminated after drilling for the required depth in the medium rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling techniques was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could not be collected since the soil layers met with were essentially cohesionless in nature. Core samples were collected from medium rock layers.

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 9 The top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

4. ANALYSIS OF TEST RESULTS

1. Standard Penetration Test
2. Grain Size Analysis
3 Determination of Specific Gravity
4. Crushing Strength of Rock

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 2 to 9. The relative density of the cohesionless layers obtained from the N values are given in the bore logs.

4. 2 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart .

4.3 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.4 Crushing Strength of Rock

Core samples collected from medium rock layers were tested for determining crushing strength of rock. The results are given in Table – 2.

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock / medium rock layer.

The safe bearing capacity of these cohesionless layers could be computed using the formula,

$$Q_a = (0.5\gamma \times B \times N_\gamma + \gamma D_f N_q) \div 2.5$$

Where,

B	=	Width of footing
γ	=	Submerged unit weight of soil taken as 1 gm/cc,
D_f	=	Depth of surcharge
$N\gamma$ Nq	=	Bearing capacity factors based on the N values taken from Fig 10

For an N value of over 50 the SBC computed over 5.0kg/cm^2 for the foundations are placed on the disintegrated rock layer. However, the SBC may be limited to 5.0kg/c^2 to allow for any non-uniformity.

When the foundations are taken to medium rock layer the SBC that could be adopted is 10kg/cm^2.

The settlement would be elastic and of small order.

Over excavations in disintegrated rock should be refilled by 1:3:6 concrete and in medium rock by 1:2:4 concrete.

6. EXCAVATION PROCEDURE

1. Vertical cuts could be given for excavation.

2. Normal excavators would be required for excavation in disintegrated rock and jack hammers would be required for excavation in medium rock.

3. Slush formed by any water accumulation should be removed and refilled by lean concrete.

4. If water accumulates in the foundation trenches, dewatering should be done by pumping out water from a level lower than the foundation level to maintain downward flow of water.

5 The exposed side of excavation should be covered by plastic sheet during rainy season and surface drain provided to prevent water from flowing on the cut surface.

8. CONCLUSIONS

1. The area explored has got top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

2. For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock /medium rock layer. The SBC that could be adopted is 5.0kg/cm^2 when the foundations are placed on the disintegrated rock layer and 10.0kg/cm^2 when the foundations are on the medium rock layer.

3. The settlement of the shallow foundation would be of small order and elastic in nature.

4. Over excavations in the foundation trenches should be refilled as suggested.

5. Suggested excavation procedure should be adopted while undertaking the construction.

F.S.ENGINEERS PVT.LTD
NEW NO.98,(Old No.109) VELACHERY ROAD
GUINDY
CHENNAI – 600 032

(Dr.A. Verghese Chummar)
Director
Dated: Feb 5th , 2018

P.N.7364

ALLIANCE SIRUSERI, CHENNAI

BLOCK-K (LEARNING HUB)

STRUCTURAL DESIGN CALCULATIONS

DesignTree Service Consultants Pvt Ltd
Consulting Engineers
7 Laxmi Narasimha Complex
15th Cross 100 Feet Road 4 Phase,
J.P.Nagar, Bangalore 560 078. INDIA
T: +91 80 4122 5481 F: +918041225479
EMAIL: info@designtreeconsultants.com
www.designtreeconsultants.com

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone - 97411 10384

ALLIANCE SIRUSERI, CHENNAI

DESIGN BRIEF REPORT

Client	:	**ALLIANCE GROUP** Chennai
SMEP Consultants	:	**Design Tree Service Consultants Pvt Ltd** # 7, Laxmi Narasimha Complex 15th Cross, 100ft Ring Road, 4th Phase, JP Nagar Bangalore - 560 078
Architects	:	**LAVANYA & SHANKAR ARCHITECTS** Chennai

ISSUE RECORD

PROJECT : **ALLIANCE SIRUSERI , CHENNAI**

TITLE : **Preliminary Design Brief Report**

DOCUMENT NO : **DTSC / 406 F**

1. STRUCTURAL

DATE	ISSUE	PREPARED	CHECKED	REMARKS / REVISION
20.02.19	Prelim report	SWAPNA	B.SRINIVASARAO	R0
22.07.19	Prelim report	SUNIL	B.SRINIVASARAO	R1
25.10.21	Prelim report	SUNIL	B.SRINIVASARAO	R2

1. STRUCTURE

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1- STRUCTURE

1.1 Project Brief/Introduction
1.2 Design standards
1.3 Design Data
1.4 Materials
1.5 Structural concept
1.6 Water Proofing
1.7 Design Philosophy

1.1 PROJECT BRIEF

The clients M/S ALLIANCE GROUP Intends to develop residential building, at Chennai. Project is architectured by LAVANYA & SHANKAR ARCHITECTSChennai.Structures, Plumbing, Fire Protection, HVAC and Electrical Engineering Services are provided by M/S Design Tree Service Consultants Pvt. Ltd, Bangalore.

All service facilities like underground sump and pump are to be provided as per the requirements given by clients.

The proposed residential building having 10 blocks A,B,C,D, E,F,G,H,I &J.

- Residential blocks A,B,C,D,E,F& G having 1 Basement + stilt+19 upper floors+Terrace floor.
- Residential block H having 1 Basement + stilt+17 upper floors+Terrace floor.
- Block I (Club house) having1 Basement + Ground +3+Terrace.
- Block J (Learning hub) having Ground+3+Terrace.

The height of the proposed Building from FGL is up to 59.85 /53.90/ 22.05 / 14.85 mts.

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- NationalBuilding Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

1.2 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.

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.
IS: 6313 (part II)	: Standards for anti-termite treatment.
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 -2012	: Code of practice for pre stressed concrete.
IS: 14268 - 1995	: Uncoated stress relieved low relaxation seven-ply strand for pre stressed 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: 13920-2016	: Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice.
IS: 16700 -2017	: Criteria for structural safety of tall 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 - 1984 (reaffirmed 1998)	: 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.

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

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 hard drawn 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 DATA:

Loads:

1.3.1 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	:	120kg/sq.m (1.2kN/sq.m).
• Floor finish of 75mm thick for Parking Areas	:	180kg/sq.m (1.8kN/sq.m).
• False ceiling + ducting + Sprinklers(services)	:	40 kg/sq.m (0.4 kN/sq.m).
• Partitions	:	100kg/sq.m (1.0kN/sq.m).
• Wall loads	:	As per actuals.
• 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	:	1900 kg/cu.m (19 kN/cu.m).

• Aerated block masonry	:	865 kg/cu.m (8.65 kN/cu.m).
• Soil (Dry)	:	1800 kg/cu.m (18 kN/cu.m).
• Soil (Saturated)	:	2000 kg/cu.m (20 kN/cu.m).
• Water	:	1000 kg/cu.m (10 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)
• Waterproofing (membrane).	:	15kg/sq.m (0.15kN/sq.m).
• External finishes	:	As per actuals.
• Gardening/Landscape loads	:	As per actuals
• Equipment loads	:	As per Vendor details.

1.3.2 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.

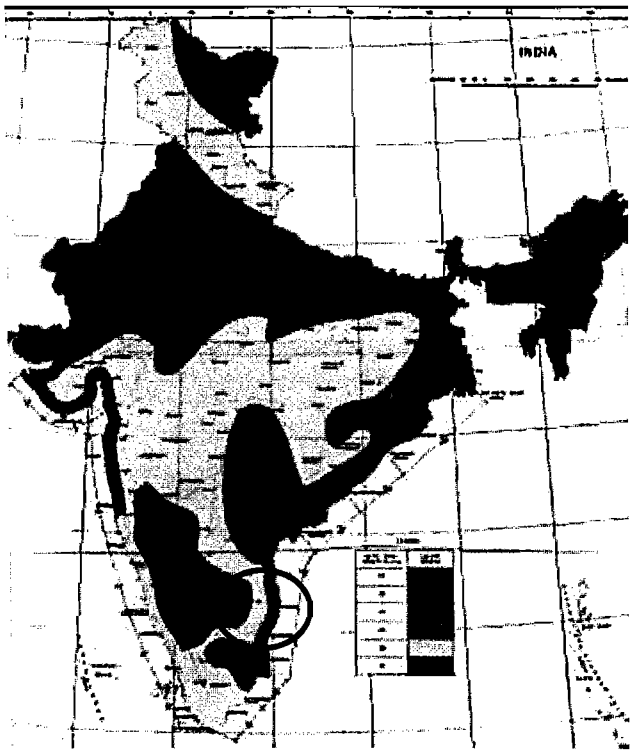
Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Living /Dining hall/ kitchens/Bed rooms	: 200 kg/sq.m (2.0 kN/sq.m)
Toilet and bathrooms	: 200 kg/sq.m (2.0 kN/sq.m)
Stairs	: 300 kg/sq.m (3.0 kN/sq.m)
Corridors / Balcony/utility	: 300 kg/sq.m (3.0 kN/sq.m)
Lift Machine room	: 1000 kg/ sq.m or as per actuals.
Balconies	: 300 kg/ sq.m or as per actuals.
Parking Area	: 250 kg/ sq.m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 1500 kg/sq.m (15.0 kN/sq.m).
Ramps	: 300 kg/sq.m (3 kN/sq.m)+ 25% Impact (Without fire truck movement
Communication Room /Meter Room	: 300 kg/sq.m (3.0 kN/sq.m)

1.3.3 Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3).

Chennai, which is located in Tamil nadu, is having wind speed of 50m/sec.

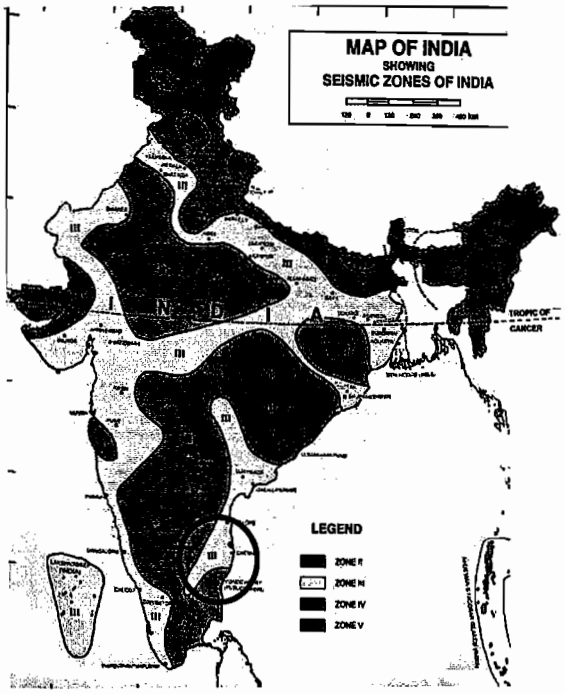


- Basic Wind Speed Vb : 50 m/sec
- Risk Coefficient K1 : 1.00 (k1 corresponds to 50 years Mean Probable Design Life of Structure)
- Terrain, height, structure size factor K2 : To suit the height of the structure for terrain Category 3 & Class C and also it varies with the height of the structure.
- Topography factor K3 : 1.00
- Importance factor for the cyclonic region K4 : 1.00
- The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)
- Design wind speed Vz : Vb x k1 x k2 x k3 x k4
- Design wind pressure Pz : $0.6 \times Vz^2$

Height of the building (m)	K2	Vz = Vb x k1 x k2 x k3 xk4 (m/s)	Pz = 0.6 x Vz^2 (kN/m^2)

10	0.91	45.5	1.242
20	1.01	50.5	1.53
30	1.06	53	1.68
40	1.09	54.5	1.78
50	1.12	56	1.88
60	1.136	56.8	1.94
70	1.152	57.6	1.99
80	1.168	58.4	2.05
100	1.2	60.0	2.16

Seismic Forces



1.3.4 Seismic Forces

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

Seismic Zone : III
Seismic Zone factor, Z : 0.16 (As per Table 2, IS: 1893-2016)
Design horizontal seismic coefficient (Ah) : (Z/2)*(Sa/g)*(I/R)

I -Importance factor : 1.2 (Ref Table 6, IS: 1893-2016)
Response reduction Factor : 4 (SMRF)

R as per Table 7 of IS: 1893-2016 is based on Special moment RC Moment -Resisting Frame (SMRF), with ductile detailing.

Sa/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 (Ah)		: (Z/2)*(Sa/g)*(I/R)
		: (0.16/2)*(1.2/4) * (Sa/g)
	Ah	: 0.016 * (Sa/g)
Design seismic base shear, Vb		: Ah * W where, W - seismic weight of building
Detailing as per IS-13920-2002		: Special moment resistant frame with ductile detailing

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	0.36

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

- Environment : Moderate
- 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.
- Minimum grade of concrete : Moderate exposure - M30
- Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 30 mm
- Nominal covers for 2 hr. fire resistance :

Nominal Cover

Beams		Slabs		Ribs		Columns/Shear walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.3.6 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

1.3.7 Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

1.3.8 Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design.

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental hitting of vehicle on the façade
- Snow Load

1.4 MATERIALS:

Materials specified will 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.

1.4.1 Concrete:

- All structural concrete shall have cube crushing strength of M35 to M25 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation / Retaining Walls	M35/M30
Columns & Walls	M50 to M30
Girder beam	M40
Slab, beams & Ramps	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 415 N/sq.mm.
- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 500 N/sq.mm.

Structural Steel

All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm.

1.5 STRUCTURAL CONCEPT

- The Structural System comprises of regular Beam, slab and shear walls system for both car park and residential floors. Floor slabs and beams are considered to act as a rigid diaphragm to transfer the lateral forces to the columns.

- The slabs for toilet area sunk by 250mm. Balconies are sunk by 150mm.The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	
a)	Column grids	Varies
b)	Structural system	R.C.C Column and Girder Beam in 1st floor level and RC wall up to Terrace
c)	Slab thickness	175/150/125mm
d)	Column/RC Wall size	As per the design
g)	Peripheral beams	As per the design

Structural analysis and design:

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 2016** software package for both vertical and lateral loads.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, and seismic loads and for the load combinations as given in the relevant codes.
- The slabs are analyzed as two-way and one way slabs

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 deflection is considered as span/250

As per IS1893 (Part1) :2016, Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height design.

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 water retaining structures, crack width is limited to 0.2mm.

Load Combinations:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	EL	DL	LL	EL
DL + LL	1.5	1.5	–	1	1	–
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8

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

***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; EL - Earthquake Load

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 combination.

Expansion joint/Separation joint:

Expansion / separation joint is provided in this building.

1.6 WATERPROOFING:

Toilets and Balconies:

Water proofing is done with Acrylic cementitious coating, made on all wall faces and one coat crystallization method with water is made on floor areas.

Terrace:

In the Terrace areas, water proofing is done with Acrylic cementitious coating as first layer & 100mm thick (Average thickness) screed concrete or brick coba as a topping layer shall be used.

1.7 DESIGN PHILOSOPHY:

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 are required for all replaceable material for longer life.

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 to resist lateral forces. 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. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns. The type of footings proposed will be individual or Raft based on actual design

Foundation:

Foundations are designed depending upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. Individual / Combined footings is envisaged depending on the soil report.

V. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone-97411 10384

TABLE: Joint Displacements

Story	Label	Unique Name	Output Case	Case Type	Ux	Uy	Uz	Rx	Ry	Rz
					mm	mm	mm	rad	rad	rad
TERRACE	2	409	DL+LL	Combination	1.019	-1.096	-1.683	-0.000417	-0.000494	-0.000044
TERRACE	4	413	DL+LL	Combination	1.241	-1.1	-1.637	0.000242	-0.000436	-0.00004
TERRACE	5	420	DL+LL	Combination	1.625	-0.161	-1.205	0.000228	0.00022	-0.000057
TERRACE	6	407	DL+LL	Combination	1.014	-0.332	-1.734	-0.000487	0.000582	-0.00005
TERRACE	7	426	DL+LL	Combination	1.438	-0.34	-2.627	-0.000062	-0.000132	-0.000045
TERRACE	8	423	DL+LL	Combination	1.262	-0.495	-2.715	0.000305	-0.000187	-0.00005
TERRACE	9	417	DL+LL	Combination	1.478	-0.489	-1.776	-0.000014	-0.000134	-0.000041
TERRACE	10	408	DL+LL	Combination	1.013	-0.54	-2.876	-0.000542	0.000042	-0.000046
TERRACE	11	412	DL+LL	Combination	1.261	-0.547	-2.562	0.000367	0.000061	-0.00005
TERRACE	12	387	DL+LL	Combination	1.016	-0.737	-2.888	-0.000536	0.000016	-0.000046
TERRACE	13	388	DL+LL	Combination	1.253	-0.745	-2.597	0.000386	0.00002	-0.000045
TERRACE	14	389	DL+LL	Combination	1.357	-0.704	-2.733	-0.000199	0.000257	-0.000047
TERRACE	15	390	DL+LL	Combination	1.615	-0.701	-3.509	-0.000027	-0.000444	-0.000043
TERRACE	16	391	DL+LL	Combination	1.349	-0.895	-2.616	-0.000333	-0.000096	-0.000047
TERRACE	17	392	DL+LL	Combination	1.599	-0.904	-2.87	0.000552	-0.000146	-0.00005
TERRACE	18	415	DL+LL	Combination	1.598	-1.103	-1.662	0.000479	-0.000468	-0.000046
TERRACE	19	424	DL+LL	Combination	1.435	-0.392	-2.365	-0.000153	-0.000195	-0.000046
TERRACE	20	395	DL+LL	Combination	1.62	-0.39	-2.755	-0.000004	0.00058	-0.000033
TERRACE	21	393	DL+LL	Combination	1.361	-0.583	-2.03	-0.000001	0.000179	-0.000039
TERRACE	22	394	DL+LL	Combination	1.472	-0.581	-2.117	-0.000047	0.000413	-0.000039
TERRACE	23	425	DL+LL	Combination	1.608	-0.391	-2.753	-0.000009	0.000399	-0.000035
TERRACE	24	422	DL+LL	Combination	1.466	-0.702	-4.546	-0.000374	0.000141	-0.000047
TERRACE	25	421	DL+LL	Combination	1.482	-0.394	-2.638	-0.000222	-0.000004	-0.00005
TERRACE	26	414	DL+LL	Combination	1.343	-1.098	-1.598	-0.000184	-0.000437	-0.000051
TERRACE	27	416	DL+LL	Combination	1.365	-0.493	-1.788	0.000128	0.000024	-0.000038
TERRACE	28	419	DL+LL	Combination	1.448	-0.159	-1.455	-0.000099	0.000273	-0.000041
TERRACE	29	397	DL+LL	Combination	1.558	-0.393	-2.757	0.000017	-0.000202	-0.000042
TERRACE	30	396	DL+LL	Combination	1.56	-0.186	-1.808	0.000251	0.000338	-0.000046
TERRACE	31	399	DL+LL	Combination	1.499	-0.394	-2.711	-0.000161	0.000002	-0.000048
TERRACE	32	398	DL+LL	Combination	1.503	-0.185	-1.868	-0.000138	0.000358	-0.000043
TERRACE	33	400	DL+LL	Combination	1.448	-0.184	-1.605	-0.00004	0.000288	-0.000045
TERRACE	34	401	DL+LL	Combination	1.625	-0.189	-1.326	0.000325	0.00023	-0.000047
TERRACE	35	418	DL+LL	Combination	1.6	-0.701	-3.492	0.000017	0.000032	-0.000044
TERRACE	36	402	DL+LL	Combination	1.019	-0.922	-2.826	-0.000523	-0.000067	-0.000043
TERRACE	37	403	DL+LL	Combination	1.246	-0.93	-2.54	0.000389	-0.000036	-0.000043
TERRACE	38	405	DL+LL	Combination	1.448	-0.491	-1.778	-0.00001	-0.000182	-0.000045
TERRACE	39	404	DL+LL	Combination	1.449	-0.393	-2.436	-0.000236	-0.000115	-0.000046
TERRACE	41	411	DL+LL	Combination	1.265	-0.337	-2.04	0.000069	0.000397	-0.000047
TERRACE	40	381	DL+LL	Combination	1.625	-0.2	-1.387	0.000369	0.000259	-0.00004
TERRACE	42	382	DL+LL	Combination	1.448	-0.195	-1.681	-0.000012	0.000328	-0.000045
TERRACE	44	384	DL+LL	Combination	1.56	-0.393	-2.756	0.000015	-0.000181	-0.000042
TERRACE	46	386	DL+LL	Combination	1.379	-0.339	-2.612	-0.000133	0.000021	-0.00005
TERRACE	56	101	DL+LL	Combination	1.448	-0.153	-1.414	-0.000114	0.000277	-0.000038
TERRACE	57	102	DL+LL	Combination	1.625	-0.152	-1.172	0.000202	0.000224	-0.000061
TERRACE	58	103	DL+LL	Combination	1.372	-0.339	-2.589	-0.000173	0.000041	-0.000051
TERRACE	59	104	DL+LL	Combination	1.382	-0.152	-3.939	0.002586	0.00006	-0.000046
TERRACE	52	79	DL+LL	Combination	1.434	-0.492	-1.774	-0.000018	-0.000182	-0.000047

TABLE: Joint Reactions

Story	Label	Unique Name	Output Case	Case Type	FX	FY	FZ	MX	MY	MZ
					kN	kN	kN	kN-m	kN-m	kN-m
Base	1	43	DL+LL	Combination	2.8393	7.8347	211.0565	-9.9653	2.7842	-0.0077
Base	2	48	DL+LL	Combination	-4.2934	8.7333	543.0819	-11.2562	-5.6988	0.0068
Base	3	49	DL+LL	Combination	3.6688	-4.0114	312.5322	2.9143	3.5434	0.0366
Base	4	54	DL+LL	Combination	-4.8297	-6.7128	701.3166	5.3757	-6.5893	0.0397
Base	5	42	DL+LL	Combination	73.6723	-2.1988	395.2429	3.6847	0.6302	-0.6091
Base	6	44	DL+LL	Combination	-0.0282	11.1192	627.0686	-13.8237	-0.6278	0.0117
Base	9	63	DL+LL	Combination	-2.3969	-0.2926	493.1844	-0.4442	-3.4975	0.0079
Base	10	45	DL+LL	Combination	-0.6805	10.2038	917.3399	-12.7947	-1.4047	0.0075
Base	11	51	DL+LL	Combination	-2.6514	-10.7027	1128.62	10.4563	-3.9783	0.0134
Base	12	46	DL+LL	Combination	-0.7701	10.0372	921.5103	-12.6452	-1.5115	0.0086
Base	13	52	DL+LL	Combination	-1.9034	-10.2091	1111.4343	9.7552	-3.0991	0.0216
Base	14	55	DL+LL	Combination	0.9231	17.8649	1085.1787	-22.5886	0.2424	0.0028
Base	16	56	DL+LL	Combination	-1.4961	13.5295	1107.0772	-17.8238	-2.6415	0.0379
Base	17	58	DL+LL	Combination	-1.2084	-9.5216	919.5769	10.2593	-2.1208	-0.0018
Base	18	59	DL+LL	Combination	-4.3069	-7.7662	536.5485	8.1316	-5.8044	0.0269
Base	19	428	DL+LL	Combination	-5.1228	-0.1305	911.3828	-0.8986	-6.8074	0.0262
Base	20	72	DL+LL	Combination	0.5684	-243.6915	882.172	-58.6693	-0.6368	-0.0772
Base	21	61	DL+LL	Combination	-0.501	2.1099	585.8977	-3.2963	-1.2343	0.0102
Base	22	60	DL+LL	Combination	3.0663	-0.4402	594.3174	-0.2968	2.9956	0.0062
Base	26	57	DL+LL	Combination	-4.8205	9.8666	681.7495	-13.7337	-6.6001	-0.0062
Base	27	62	DL+LL	Combination	-0.4023	-2.2477	558.3442	1.8531	-1.1157	0.0165
Base	28	68	DL+LL	Combination	90.3911	2.002	480.441	-4.0781	0.4149	0.6933
Base	35	65	DL+LL	Combination	-0.5917	-18.8135	1638.9949	17.2173	-1.8338	0.0596
Base	36	47	DL+LL	Combination	-0.8218	9.9847	905.929	-12.6527	-1.573	0.0175
Base	37	53	DL+LL	Combination	-0.9537	-10.5971	1072.2423	10.0617	-1.9793	0.0157
Base	41	50	DL+LL	Combination	2.0103	-13.2595	958.3635	13.4397	1.5703	-0.0006
Base	40	66	DL+LL	Combination	-60.9236	-4.5622	379.62	3.9447	0.6524	0.673
Base	42	69	DL+LL	Combination	-75.9281	4.5088	460.1877	-4.3544	1.1177	-0.7605
Base	44	73	DL+LL	Combination	-2.5089	237.3627	899.6013	59.4016	-1.4824	0.2177
Base	33	1389	DL+LL	Combination	-17.1372	-270.762	1809.8674	35.4073	-11.6272	-1.5191
Base	41	350	DL+LL	Combination	3.0175	-379.3197	3122.5844	51.9658	4.828	0.1024
Base	92	285	DL+LL	Combination	1188.1688	1.0589	2768.9531	-0.8894	-28.6975	0.4496
Base	93	769	DL+LL	Combination	-1.531	-98.8008	554.1625	2.3938	-0.8069	-0.0481
Base	94	643	DL+LL	Combination	-20.0044	-833.2979	1910.6483	-74.422	-9.767	-9.4454
Base	95	518	DL+LL	Combination	37.4223	1030.8289	2617.6353	28.9079	28.0518	-6.6644
Base	96	283	DL+LL	Combination	10.1744	-1114.6012	2425.2483	-29.9347	8.2261	4.2997
Base	97	688	DL+LL	Combination	-1.6837	1130.0669	2762.6719	118.3045	0.0741	-0.1975
Base	98	386	DL+LL	Combination	0.8234	-1149.0853	2639.1202	-103.8947	1.8196	0.4006
Base	99	1391	DL+LL	Combination	2.5081	796.036	1876.9092	75.6694	3.7675	0.7069
Base	100	803	DL+LL	Combination	-0.5368	-754.8428	1794.7868	-73.422	1.6609	-0.9446
Base	101	523	DL+LL	Combination	-969.2698	1.078	2272.3157	-0.8971	29.5337	-0.4472
Base	102	528	DL+LL	Combination	-611.7532	7.3216	1478.3805	-5.7471	19.1715	-0.9205
Base	107	529	DL+LL	Combination	852.7779	3.8617	1949.5164	-3.2663	-19.1919	0.647
Base	110	445	DL+LL	Combination	295.7624	0.1687	892.6086	-0.3739	-20.7324	-0.017
Base	111	746	DL+LL	Combination	-0.0627	-65.6691	450.9614	1.145	0.0621	0.0103
Base	112	454	DL+LL	Combination	-0.6513	676.1951	1663.1123	7.5697	-0.074	0.1227
Base	113	460	DL+LL	Combination	-2.3757	1237.3421	2948.4518	27.6087	-0.0797	0.4872
Base	114	434	DL+LL	Combination	0.0086	-1231.856	2827.1303	-36.3638	1.6404	-0.2287
Base	115	1396	DL+LL	Combination	3.4048	1313.8335	3168.7827	131.4228	3.6244	-1.0807
Base	116	1397	DL+LL	Combination	1.2724	-1314.227	3047.3613	-121.6259	2.1708	0.7725
Base	117	539	DL+LL	Combination	-1.6235	1209.6225	2908.8381	28.5988	0.7218	0.7337
Base	118	293	DL+LL	Combination	0.035	-1216.3853	2771.8183	-34.9719	1.9102	-0.5387
Base	119	678	DL+LL	Combination	4.2777	1259.7123	3036.7642	126.4803	3.9663	-1.7437
Base	120	380	DL+LL	Combination	2.4231	-1255.932	2916.7179	-116.2413	2.704	1.4719
Base	121	534	DL+LL	Combination	-3.815	1182.1956	2846.0859	26.8643	-0.6705	1.3999
Base	122	291	DL+LL	Combination	-1.2685	-1188.7267	2707.6096	-35.054	1.164	-1.1219
Base	123	673	DL+LL	Combination	6.2457	1249.2222	2995.8962	123.3826	5.7007	-1.3768
Base	124	377	DL+LL	Combination	1.6266	-1235.5774	2878.0035	-115.3724	2.5434	0.7673

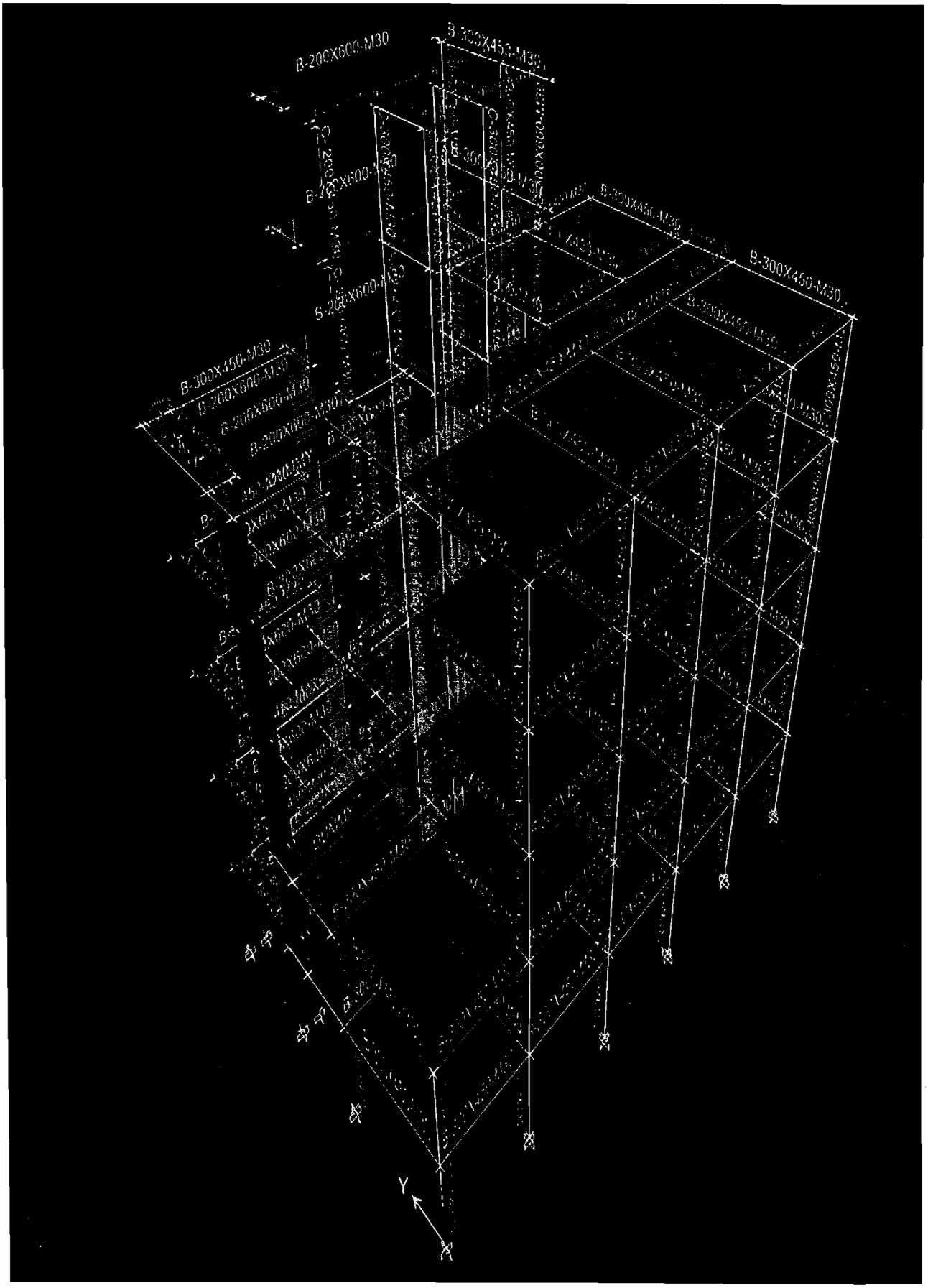
Base	125	1393	DL+LL	Combination	-30.1426	823.4423	2040.9801	89.4743	-16.6206	10.7489
Base	126	443	DL+LL	Combination	-262.3655	305.773	1694.4392	28.7228	28.3804	-0.4529
Base	143	766	DL+LL	Combination	95.0386	0.6786	555.9648	-0.6269	4.2962	0.0553
Base	144	469	DL+LL	Combination	-36.502	-291.3249	1725.4484	-22.1601	-4.5768	-0.3239
Base	145	736	DL+LL	Combination	272.725	-0.2936	842.0743	0.1007	-18.9659	-0.0435
Base	146	446	DL+LL	Combination	-244.6925	-75.5356	2406.9816	-6.4452	28.6658	0.3506
Base	147	693	DL+LL	Combination	-1035.9332	1.4572	2378.2901	-1.5834	103.5824	0.156
Base	148	389	DL+LL	Combination	1208.9199	-1.8021	2907.0386	0.6683	-107.8193	-0.5747
Base	149	1392	DL+LL	Combination	-317.1155	-3.0677	706.1917	1.8008	40.0616	0.3494
Base	150	727	DL+LL	Combination	508.3011	3.0375	1260.1703	-2.2897	-40.8828	0.4025
Base	151	698	DL+LL	Combination	-1156.8982	0.0105	2809.6839	-0.2799	129.9681	0.1117
Base	152	392	DL+LL	Combination	1424.3709	-2.0705	3298.3046	1.1446	-119.7339	-0.3767
Base	261	470	DL+LL	Combination	73.2674	0.5779	1021.6624	-0.8857	4.1368	0.0012
Base	265	274	DL+LL	Combination	5.6724	1366.9925	3163.7844	39.8995	5.7431	-1.1464
Base	326	741	DL+LL	Combination	-0.4639	-673.0016	1621.2032	-6.8762	0.0398	-0.1096
Base	327	747	DL+LL	Combination	-0.071	64.4779	448.4642	-1.037	0.0613	-0.0101
Base	627	1410	DL+LL	Combination	-2.3297	2.1013	125.6109	-2.7686	-1.5937	-0.001
Base	636	1506	DL+LL	Combination	3.7405	-89.6833	748.427	102.915	6.0629	-0.0032
Base	638	1505	DL+LL	Combination	3.8482	-92.2464	787.4251	106.0039	6.2024	-0.0032
Base	640	1502	DL+LL	Combination	-2.4805	-92.7627	770.7195	106.6742	-1.8042	-0.0032
Base	644	1501	DL+LL	Combination	31.7297	-128.4831	937.6094	148.8669	41.5237	-0.0032
Base	663	1549	DL+LL	Combination	8.2875	-10.4765	228.9783	13.0236	16.2805	-0.0022
Base	665	1548	DL+LL	Combination	9.2913	-10.7938	251.2302	13.4325	17.5041	-0.0022
Base	667	1547	DL+LL	Combination	7.9545	-10.193	260.2902	12.6808	15.8772	-0.0022
Base	669	1544	DL+LL	Combination	-10.6619	-9.6991	211.5752	12.0573	-6.788	-0.0022
Base	677	1507	DL+LL	Combination	-3.9209	-88.7329	760.3678	101.7376	-3.6262	-0.0032
Base	678	1550	DL+LL	Combination	-0.6764	-10.577	254.3387	13.1524	5.3691	-0.0022
Base	679	1508	DL+LL	Combination	3.7911	-90.1585	782.0323	103.3594	6.1307	-0.0032
Base	680	1551	DL+LL	Combination	9.8521	-10.6741	262.4722	13.2721	18.1879	-0.0022
Base	681	1509	DL+LL	Combination	3.4908	-86.9995	752.5199	99.5709	5.7486	-0.0032
Base	682	1552	DL+LL	Combination	4.3594	-10.5824	244.0312	13.1488	11.4996	-0.0022
Base	683	1510	DL+LL	Combination	-18.1612	-82.2342	886.3479	93.9011	-21.656	-0.0032
Base	684	1553	DL+LL	Combination	-6.7862	-14.0151	269.4185	17.4796	-2.0693	-0.0022
Base	689	1555	DL+LL	Combination	39.4774	-142.6178	457.9298	180.0547	54.2631	-0.0022
Base	693	1519	DL+LL	Combination	-251.2653	1.919	1137.505	-2.7187	-281.6819	-0.0032
Base	697	1521	DL+LL	Combination	-405.6713	-8.0259	1230.7568	9.8957	-463.8424	-0.0032
Base	701	1523	DL+LL	Combination	-327.4086	1.242	1373.5941	-1.8643	-371.6398	-0.0032
Base	705	1525	DL+LL	Combination	-198.5779	10.3805	1214.5807	-13.4531	-219.7209	-0.0032
Base	707	1526	DL+LL	Combination	7.1166	6.126	574.6973	-8.0171	22.8073	-0.0032
Base	709	1557	DL+LL	Combination	3.6557	54.4616	301.1873	-68.9412	10.523	-0.0022
Base	710	1558	DL+LL	Combination	-0.3897	12.4065	191.1325	-15.8508	5.5959	-0.0022
Base	728	1556	DL+LL	Combination	-18.4379	169.7803	382.9855	-214.669	-16.3775	-0.0022
Base	729	1530	DL+LL	Combination	95.5317	-51.9961	701.7458	65.4524	127.2674	-0.0032
Base	741	1559	DL+LL	Combination	32.2509	14.2475	257.5534	-18.1792	45.3345	-0.0022
Base	742	1513	DL+LL	Combination	23.8401	76.9351	777.7785	-93.7237	31.4704	-0.0032
Base	743	1560	DL+LL	Combination	-11.6496	15.738	279.3765	-20.0586	-8.1111	-0.0022
Base	744	1515	DL+LL	Combination	-8.847	57.6741	738.7512	-70.9443	-9.8763	-0.0032
Base	745	1531	DL+LL	Combination	19.9272	14.2603	234.1889	-18.2378	37.867	-0.0032
Base	746	1527	DL+LL	Combination	35.5709	20.574	699.7276	-26.2733	56.3527	-0.0032
Base	685	1512	DL+LL	Combination	-121.0757	-38.2039	655.0907	42.4846	-151.7143	-0.0032
Base	688	1511	DL+LL	Combination	-134.4418	9.9823	542.9562	-14.3157	-168.4917	-0.0032
Base	690	1500	DL+LL	Combination	-71.245	-70.1958	460.2806	80.1867	-88.6239	-0.0032
Base	704	1542	DL+LL	Combination	12.8775	-17.1245	202.2007	21.4196	21.8673	-0.0022
Base	706	1543	DL+LL	Combination	-28.9437	-2.161	46.5536	2.5493	-29.0376	-0.0022
Base	751	1563	DL+LL	Combination	-1.3192	51.0011	36.0167	-63.1445	-0.6841	-0.0022
Base	757	1533	DL+LL	Combination	-12.7432	2.3962	120.2334	-3.2588	-0.6248	-0.0032
Base	759	1534	DL+LL	Combination	22.5609	-3.7947	71.1708	4.5426	40.9739	-0.0032
Base	761	1535	DL+LL	Combination	33.4434	34.6719	542.9677	-44.0365	53.8374	-0.0032
Base	762	1536	DL+LL	Combination	37.1149	31.6532	661.9829	-40.2542	58.1715	-0.0032
Base	767	1537	DL+LL	Combination	-58.1236	24.7434	425.5768	-31.4657	-54.0897	-0.0032
Base	768	1538	DL+LL	Combination	-137.2021	26.9104	1056.9661	-34.2895	-157.9811	-0.0063

Base	769	1561	DL+LL	Combination	-20.1001	0.0222	69.4569	-0.2009	-18.3914	-0.0022
Base	771	1562	DL+LL	Combination	2.5795	25.3662	93.2715	-32.6439	4.2966	-0.0022
Base	772	1554	DL+LL	Combination	85.3233	-16.6425	97.3255	20.7566	110.0385	-0.0022
Base	775	1532	DL+LL	Combination	-20.8765	59.5224	207.0824	-72.9877	-25.0138	-0.0032
Base	778	1539	DL+LL	Combination	17.6142	-3.1686	34.0792	2.6556	-1.1663	-1.0735
Base	780	1541	DL+LL	Combination	-46.5899	0.0519	143.0757	3.1662	-0.608	0.9607
Base	670	1540	DL+LL	Combination	-2.8072	-6.1721	192.3105	5.8852	-1.9934	-0.0056

Base	1	43	DL+LL	Combination	2.8393	7.8347	211.0565	-9.9653	2.7842	-0.0077
Base	2	48	DL+LL	Combination	-4.2934	8.7333	543.0819	-11.2562	-5.6988	0.0068
Base	3	49	DL+LL	Combination	3.6688	-4.0114	312.5322	2.9143	3.5434	0.0366
Base	4	54	DL+LL	Combination	-4.8297	-6.7128	701.3166	5.3757	-6.5893	0.0397
Base	5	42	DL+LL	Combination	73.6723	-2.1988	395.2429	3.6847	0.6302	-0.6091
Base	6	44	DL+LL	Combination	-0.0282	11.1192	627.0686	-13.8237	-0.6278	0.0117
Base	9	63	DL+LL	Combination	-2.3969	-0.2926	493.1844	-0.4442	-3.4975	0.0079
Base	10	45	DL+LL	Combination	-0.6805	10.2038	917.3399	-12.7947	-1.4047	0.0075
Base	11	51	DL+LL	Combination	-2.6514	-10.7027	1128.62	10.4563	-3.9783	0.0134
Base	12	46	DL+LL	Combination	-0.7701	10.0372	921.5103	-12.6452	-1.5115	0.0086
Base	13	52	DL+LL	Combination	-1.9034	-10.2091	1111.4343	9.7552	-3.0991	0.0216
Base	14	55	DL+LL	Combination	0.9231	17.8649	1085.1787	-22.5886	0.2424	0.0028
Base	16	56	DL+LL	Combination	-1.4961	13.5295	1107.0772	-17.8238	-2.6415	0.0379
Base	17	58	DL+LL	Combination	-1.2084	-9.5216	919.5769	10.2593	-2.1208	-0.0018
Base	18	59	DL+LL	Combination	-4.3069	-7.7662	536.5485	8.1316	-5.8044	0.0269
Base	19	428	DL+LL	Combination	-5.1228	-0.1305	911.3828	-0.8986	-6.8074	0.0262
Base	20	72	DL+LL	Combination	0.5684	-243.6915	882.172	-58.6693	-0.6368	-0.0772
Base	21	61	DL+LL	Combination	-0.501	2.1099	585.8977	-3.2963	-1.2343	0.0102
Base	22	60	DL+LL	Combination	3.0663	-0.4402	594.3174	-0.2968	2.9956	0.0062
Base	26	57	DL+LL	Combination	-4.8205	9.8666	681.7495	-13.7337	-6.6001	-0.0062
Base	27	62	DL+LL	Combination	-0.4023	-2.2477	558.3442	1.8531	-1.1157	0.0165
Base	28	68	DL+LL	Combination	90.3911	2.002	480.441	-4.0781	0.4149	0.6933
Base	35	65	DL+LL	Combination	-0.5917	-18.8135	1638.9949	17.2173	-1.8338	0.0596
Base	36	47	DL+LL	Combination	-0.8218	9.9847	905.929	-12.6527	-1.573	0.0175
Base	37	53	DL+LL	Combination	-0.9537	-10.5971	1072.2423	10.0617	-1.9793	0.0157
Base	41	50	DL+LL	Combination	2.0103	-13.2595	958.3635	13.4397	1.5703	-0.0006
Base	40	66	DL+LL	Combination	-60.9236	-4.5622	379.62	3.9447	0.6524	0.673
Base	42	69	DL+LL	Combination	-75.9281	4.5088	460.1877	-4.3544	1.1177	-0.7605
Base	44	73	DL+LL	Combination	-2.5089	237.3627	899.6013	59.4016	-1.4824	0.2177

Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec												
Modal	1	0.857	0.8092	6.36E-06	0	0.8092	6.36E-06	0	9.54E-07	0.2082	0.0041	9.54E-07	0.2082	0.0041
Modal	2	0.766	0.0012	0.6011	0	0.8104	0.6011	0	0.1775	0.0008	0.1988	0.1775	0.2091	0.2029
Modal	3	0.649	0.004	0.1693	0	0.8145	0.7704	0	0.0772	0.0044	0.5753	0.2548	0.2135	0.7782
Modal	4	0.302	0.0975	1.25E-06	0	0.912	0.7704	0	0.001	0.5612	0.0033	0.2558	0.7746	0.7815
Modal	5	0.256	0.0062	0.0616	0	0.9182	0.8321	0	0.2786	0.0215	0.0262	0.5344	0.7961	0.8077
Modal	6	0.235	0.0077	0.055	0	0.9259	0.887	0	0.192	0.0199	0.07	0.7264	0.816	0.8777
Modal	7	0.196	0.0214	0.0003	0	0.9473	0.8874	0	0.0007	0.0376	0.0342	0.7271	0.8537	0.912
Modal	8	0.178	0.003	0.0236	0	0.9503	0.911	0	0.0583	0.0024	0.0007	0.7854	0.8561	0.9127
Modal	9	0.142	0.0286	0.0007	0	0.979	0.9117	0	0.0015	0.0757	0.0049	0.7869	0.9318	0.9175
Modal	10	0.126	0.0002	0.0431	0	0.9792	0.9548	0	0.0846	0.0012	0.0016	0.8715	0.933	0.9191
Modal	11	0.097	0.0189	0.0002	0	0.9981	0.955	0	0.0006	0.0608	0.0049	0.8721	0.9938	0.924
Modal	12	0.074	1.19E-05	0.0416	0	0.9981	0.9966	0	0.1179	1.94E-05	0.0009	0.99	0.9938	0.925

3D MODEL


B-200X600-M30
B-300X450-M30
B-300X450-M30
B-300X450-M30
B-300X450-M30
B-300X600-M30
B-200X600-M30
Y

TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN. Grade of Concrete = M25.

Mx = 7.1 KN-m. Grade of Steel = Fe500.

My = 26 KN-m.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the limits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum moment for which the column is to be designed is
Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN. Grade of Concrete = M30

Mx = 25.26KN-m. Grade of Steel = Fe500.

My = 83 KN-m.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

M_u / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

M_u / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

TYPICAL BEAM DESIGN

(ANALYSIS WAS DONE BY ETABS USING DIFFERENT LOAD COMBINATIONS, THE DESIGN FORCES ARE TAKEN FOR DCON2 CASE)

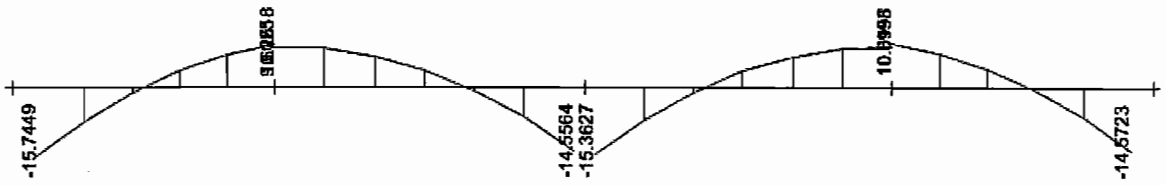
A Beam of 2 spans was considered for Typical Design Calculation.
Beam Location – Along Grid 33 to 46 (First Floor Shuttering)

Beam Size : 200mm x 450mm.

Grade of Concrete = M30;
Grade of Steel = Fe-500;
Effective depth – d' = 450-50 = 400 mm.

BENDING MOMENT, SHEAR FORCE AND TORSION DIAGRAMS TAKEN FROM ETABS

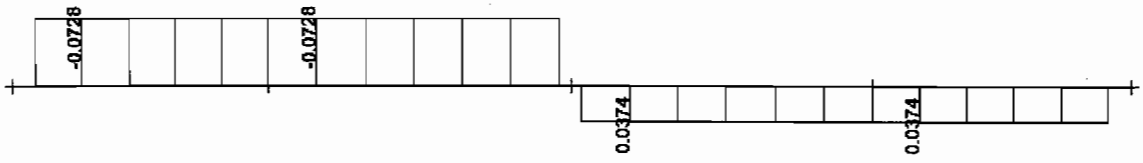
BENDING MOMENT DIAGRAM (KNm)



SHEAR FORCE DIAGRAM (KN)



TORSION DIAGRAM (KNm/m)



LEFT BEAM-(200X450)

Left End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 36KN-m. Tu = 0.2 KN-m/m

M_t = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 36 + 0.35
= 36.35 KN-m.

Mu/bd^2 = 36.35 x 10^6 /230 x 400^2
= **0.987**

Pt = 0.29 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
=0.29 x 230 x 400/ 100
= 267 mm^2.

Provide (2T16) ---- @ Top

Mid Span bottom

Mu = 41-KNm

Mu/bd^2 = 41x 10^6 /230 x 400^2
= 1.12

Pt = 1.12 % (From SP-16, Table 3)
As per IS : 13920 : 1993 minimum reinforcement provided will be 0.24%
Ast = Pt x b x D/100
= 0.24 x 230 x 450/ 100
= 249 mm^2.

Provide (2T16)

Right End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 35KN-m. Tu = 0.2 KN-m/m

M_t = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = M_u + Mt = 35 + 0.35
= 35.35 KN-m.

M_u/bd^2 = 35.35 x 10^6 /230 x 400^2
= **0.96**

P_t = 0.2789 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
= 0.2789 x 230 x 400/ 100
= 256 mm^2.
Provide (2T16) ---- @ Top

Shear Reinforcement:

V1 at Left End Support = 47 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 5.13/0.23 + 47 = 83 KN

ζv = Vu/bd = 83 x 10^3/ 230 x 400
= 0.90 N/mm^2
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm^2
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400

= .278

Therefore ζ_c = 0.39 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 83 x 10^3 – 0.39 x 230 x 400
= 47.12 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 47.12 x 10^3
= 306 mm.

V1 at Right End Support = 46 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 0.2/0.23 + 46 = 47.4 KN

ζv = Vu/bd = 47.4 x 10^3/ 230 x 400
= 0.52 N/mm²
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm²
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400
= .28

Therefore ζ_c = 0.36 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 47.41 x 10^3 – 0.36 x 230 x 400
= 14.29 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 14.29 x 10^3
= 1013 mm.

As per code IS : 13920 : 1993 minimum spacing provided should be d/4 or 8 x diameter of smaller bar or 100mm whichever is less.

Hence Provide 2L-T8@100/200/100 c/c

Check for Deflection:

Maximum allowable Elastic short term deflection = l/250 = 4512/250
= 18.048 mm.

But actual deflection from ETABS = 1.4mm.

Maximum allowable long term deflection = l/350 = 4512/350
= 12.9 mm > 1.41 mm.

Therefore within the limits.

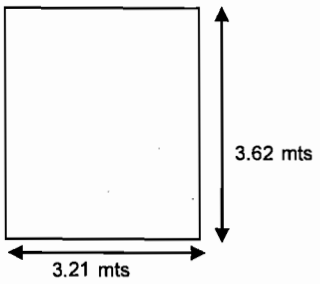
DESIGN TWOWAY SLAB

DESIGN OF TWO WAY SLAB

Short span	S=	3.21	m
Long span	L=	3.62	m
Assumed slab thickness	t=	0.125	m
Grade of concrete	fck=	25	N/mm^2
Grade of reinforcement	fy=	500	N/mm^2

Clear Span	
S	3.21
L	3.62

Type of panel One short edge discontinuous



Loads

Self weight of slab	w1=	3.13	kN/m^2	
Floor finish	w2=	1.50	kN/m^2	
Live load	w3=	2.00	kN/m^2	TOTAL
Miscellaneous	w4=	0.00	kN/m^2	6.63 kN/m^2

Ratio of long span to short span R= 1.15

Design Load with load factor of 1.5 Wu= 9.94 kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.046	**4.71**	0.46	0.11	**150.00**	8	335	101
Positive moment at midspan	0.034	**3.48**	0.34	0.08	**150.00**	8	335	101
						8	200	
Long span direction								
Negative moment at continuous edge	0.037	**3.79**	0.44	0.10	**150.00**	8	335	93
Positive moment at midspan	0.028	**2.87**	0.33	0.08	**150.00**	8	335	93

Minimum effective depth reqd	dre=	36.95 mm	
Clear cover to any reinforcement	c=	20 mm	
Minimum effective depth provided	dpr=	93 mm	greater than 'min. eff depth reqd'. Hence ok
Minimum reinforcement	Amin=	150 mm^2	

Deflection check

Reinf provided at midspan along short direction 251.33 mm^2 Dia 8 at 200 mm

Stress in reinforcement fs= 173.081 N/mm^2

Percentage of reinforcement provided pt= 0.24884 %

Modification factor as per fig 4 of IS:456-2000 MF= 2

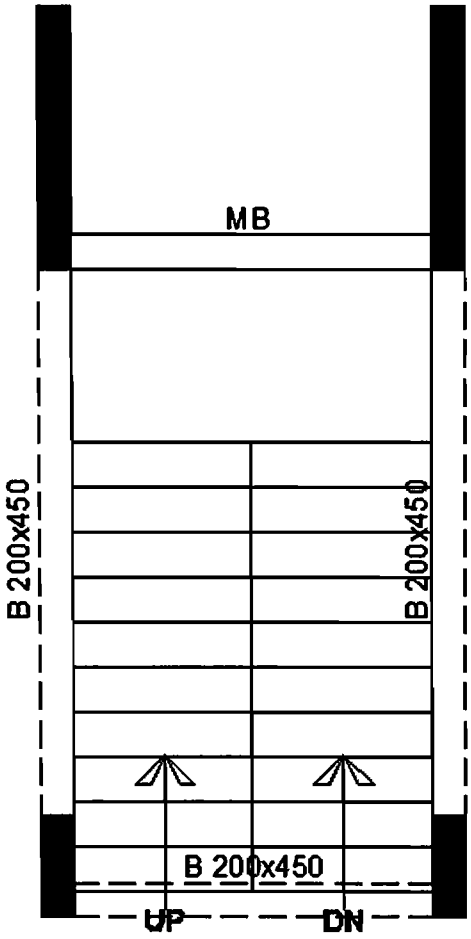
Type of slab for deflection check: Continuous

Basic span to effective depth ratio 26

Minimum effective depth reqd from deflection criteria 61.73 mm

Effective depth provided 101 mm greater than 'min. eff depth reqd'. Hence ok

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

SOIL EXPLORATION REPORT

PROJECT NO : **7364**

PROJECT NAME : **Construction of Proposed 2 Basement + Stilt + 19 Floors, Alliance Budget housing at Siruseri.**

1. INTRODUCTION

M/s. Alliance Group are proposing to construct 2 Basement + Stilt + 19 Floors Alliance Budget housing, Siruseri, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Alliance Group, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose eight boreholes were bored upto a depth varies from 6.0 to 8.5M below ground level. The boreholes were terminated after drilling for the required depth in the medium rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling techniques was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could not be collected since the soil layers met with were essentially cohesionless in nature. Core samples were collected from medium rock layers.

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 9 The top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

4. ANALYSIS OF TEST RESULTS

1. Standard Penetration Test
2. Grain Size Analysis
3 Determination of Specific Gravity
4. Crushing Strength of Rock

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 2 to 9. The relative density of the cohesionless layers obtained from the N values are given in the bore logs.

4. 2 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart .

4.3 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.4 Crushing Strength of Rock

Core samples collected from medium rock layers were tested for determining crushing strength of rock. The results are given in Table – 2.

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock / medium rock layer.

The safe bearing capacity of these cohesionless layers could be computed using the formula,

$$Q_a = (0.5\gamma \times B \times N_\gamma + \gamma D_f N_q) \div 2.5$$

Where,

B	=	Width of footing
γ	=	Submerged unit weight of soil taken as 1 gm/cc,
D_f	=	Depth of surcharge
$N\gamma$ Nq	=	Bearing capacity factors based on the N values taken from Fig 10

For an N value of over 50 the SBC computed over 5.0kg/cm^2 for the foundations are placed on the disintegrated rock layer. However, the SBC may be limited to 5.0kg/c^2 to allow for any non-uniformity.

When the foundations are taken to medium rock layer the SBC that could be adopted is 10kg/cm^2.

The settlement would be elastic and of small order.

Over excavations in disintegrated rock should be refilled by 1:3:6 concrete and in medium rock by 1:2:4 concrete.

6. EXCAVATION PROCEDURE

1. Vertical cuts could be given for excavation.

2. Normal excavators would be required for excavation in disintegrated rock and jack hammers would be required for excavation in medium rock.

3. Slush formed by any water accumulation should be removed and refilled by lean concrete.

4. If water accumulates in the foundation trenches, dewatering should be done by pumping out water from a level lower than the foundation level to maintain downward flow of water.

5 The exposed side of excavation should be covered by plastic sheet during rainy season and surface drain provided to prevent water from flowing on the cut surface.

8. CONCLUSIONS

1. The area explored has got top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

2. For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock /medium rock layer. The SBC that could be adopted is 5.0kg/cm^2 when the foundations are placed on the disintegrated rock layer and 10.0kg/cm^2 when the foundations are on the medium rock layer.

3. The settlement of the shallow foundation would be of small order and elastic in nature.

4. Over excavations in the foundation trenches should be refilled as suggested.

5. Suggested excavation procedure should be adopted while undertaking the construction.

F.S.ENGINEERS PVT.LTD
NEW NO.98,(Old No.109) VELACHERY ROAD
GUINDY
CHENNAI – 600 032

(Dr.A. Verghese Chummar)
Director
Dated: Feb 5th , 2018

P.N.7364

ALLIANCE SIRUSERI, CHENNAI

BLOCK-A

STRUCTURAL DESIGN CALCULATIONS

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I(SE)
Regn.No.SE/Gr.I /19/05/008
180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone - 97411 10384

DesignTree Service Consultants Pvt Ltd
Consulting Engineers
7 Laxmi Narasimha Complex
15th Cross 100 Feet Road 4 Phase,
J.P.Nagar, Bangalore 560 078. INDIA
T: +91 80 4122 5481 F: +918041225479
EMAIL: info@designtreeconsultants.com
www.designtreeconsultants.com

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    - BEAM DESIGN
    - SLAB DESIGN
    - STAIR CASE DESIGN
5. STRUCTURAL DRAWINGS
6. SOIL REPORT

ALLIANCE SIRUSERI, CHENNAI

DESIGN BRIEF REPORT

Client	:	**ALLIANCE GROUP** Chennai
SMEP Consultants	:	**Design Tree Service Consultants Pvt Ltd** # 7, Laxmi Narasimha Complex 15th Cross, 100ft Ring Road, 4th Phase, JP Nagar Bangalore - 560 078
Architects	:	**LAVANYA & SHANKAR ARCHITECTS** Chennai

ISSUE RECORD

PROJECT : **ALLIANCE SIRUSERI , CHENNAI**

TITLE : **Preliminary Design Brief Report**

DOCUMENT NO : **DTSC / 406 F**

1. STRUCTURAL

DATE	ISSUE	PREPARED	CHECKED	REMARKS / REVISION
20.02.19	Prelim report	SWAPNA	B.SRINIVASARAO	R0
22.07.19	Prelim report	SUNIL	B.SRINIVASARAO	R1
25.10.21	Prelim report	SUNIL	B.SRINIVASARAO	R2

1. STRUCTURE

CONTENTS

1- STRUCTURE

1.1 Project Brief/Introduction

1.2 Design standards

1.3 Design Data

1.4 Materials

1.5 Structural concept

1.6 Water Proofing

1.7 Design Philosophy

1.1 PROJECT BRIEF

The clients M/S ALLIANCE GROUP Intends to develop residential building, at Chennai. Project is architectured by LAVANYA & SHANKAR ARCHITECTSChennai.Structures, Plumbing, Fire Protection, HVAC and Electrical Engineering Services are provided by M/S Design Tree Service Consultants Pvt. Ltd, Bangalore.
All service facilities like underground sump and pump are to be provided as per the requirements given by clients.

The proposed residential building having 10 blocks A,B,C,D, E,F,G,H,I &J.

- Residential blocks A,B,C,D,E,F& G having 1 Basement + stilt+19 upper floors+Terrace floor.
- Residential block H having 1 Basement + stilt+17 upper floors+Terrace floor.
- Block I (Club house) having1 Basement + Ground +3+Terrace.
- Block J (Learning hub) having Ground+3+Terrace.

The height of the proposed Building from FGL is up to 59.85 /53.90/ 22.05 / 14.85 mts.

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- National Building Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

1.2 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.

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.
IS: 6313 (part II)	: Standards for anti-termite treatment.
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 -2012	: Code of practice for pre stressed concrete.
IS: 14268 - 1995	: Uncoated stress relieved low relaxation seven-ply strand for pre stressed 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: 13920-2016 : Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice.
IS: 16700 -2017 : Criteria for structural safety of tall 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 - 1984 (reaffirmed 1998): 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.

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

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 hard drawn 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 DATA:

Loads:

1.3.1 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 : 120kg/sq.m (1.2kN/sq.m).
- Floor finish of 75mm thick for Parking Areas : 180kg/sq.m (1.8kN/sq.m).
- False ceiling + ducting + Sprinklers(services) : 40 kg/sq.m (0.4 kN/sq.m).
- Partitions : 100kg/sq.m (1.0kN/sq.m).
- Wall loads : As per actuals.
- 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 : 1900 kg/cu.m (19 kN/cu.m).

• Aerated block masonry	:	865 kg/cu.m (8.65 kN/cu.m).
• Soil (Dry)	:	1800 kg/cu.m (18 kN/cu.m).
• Soil (Saturated)	:	2000 kg/cu.m (20 kN/cu.m).
• Water	:	1000 kg/cu.m (10 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)
• Waterproofing (membrane).	:	15kg/sq.m (0.15kN/sq.m).
• External finishes	:	As per actuals.
• Gardening/Landscape loads	:	As per actuals
• Equipment loads	:	As per Vendor details.

1.3.2 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.

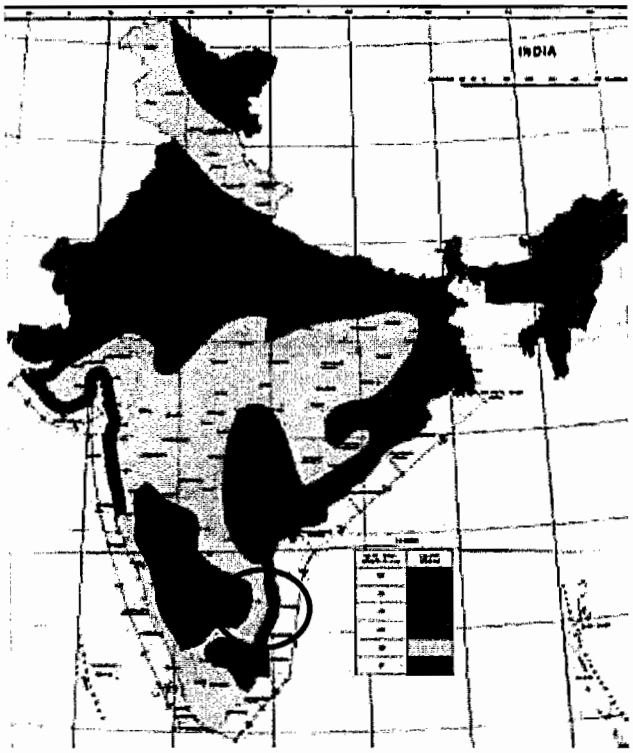
Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Living /Dining hall/ kitchens/Bed rooms	: 200 kg/sq.m (2.0 kN/sq.m)
Toilet and bathrooms	: 200 kg/sq.m (2.0 kN/sq.m)
Stairs	: 300 kg/sq.m (3.0 kN/sq.m)
Corridors / Balcony/utility	: 300 kg/sq.m (3.0 kN/sq.m)
Lift Machine room	: 1000 kg/ sq.m or as per actuals.
Balconies	: 300 kg/ sq.m or as per actuals.
Parking Area	: 250 kg/ sq.m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 1500 kg/sq.m (15.0 kN/sq.m).
Ramps	: 300 kg/sq.m (3 kN/sq.m)+ 25% Impact (Without fire truck movement
Communication Room /Meter Room	: 300 kg/sq.m (3.0 kN/sq.m)

1.3.3 Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3).

Chennai, which is located in Tamil nadu, is having wind speed of 50m/sec.

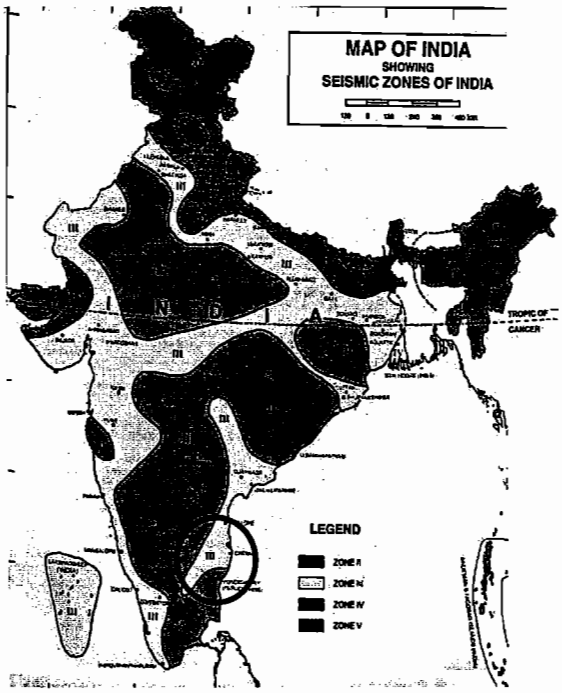


- Basic Wind Speed Vb : 50 m/sec
- Risk Coefficient K1 : 1.00 (k1 corresponds to 50 years Mean Probable Design Life of Structure)
- Terrain, height, structure size factor K2 : To suit the height of the structure for terrain Category 3 & Class C and also it varies with the height of the structure.
- Topography factor K3 : 1.00
- Importance factor for the cyclonic region K4 : 1.00
- The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)
- Design wind speed Vz : Vb x k1 x k2 x k3 x k4
- Design wind pressure Pz : $0.6 \times Vz^2$

Height of the building (m)	K2	Vz = Vb x k1 x k2 x k3 xk4 (m/s)	Pz = 0.6 x Vz^2 (kN/m^2)

10	0.91	45.5	1.242
20	1.01	50.5	1.53
30	1.06	53	1.68
40	1.09	54.5	1.78
50	1.12	56	1.88
60	1.136	56.8	1.94
70	1.152	57.6	1.99
80	1.168	58.4	2.05
100	1.2	60.0	2.16

Seismic Forces



1.3.4 Seismic Forces

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

Seismic Zone : III
Seismic Zone factor, Z : 0.16 (As per Table 2, IS: 1893-2016)
Design horizontal seismic coefficient (Ah) : (Z/2)*(Sa/g)*(I/R)

I -Importance factor : 1.2 (Ref Table 6, IS: 1893-2016)
Response reduction Factor : 4 (SMRF)

R as per Table 7 of IS: 1893-2016 is based on Special moment RC Moment -Resisting Frame (SMRF), with ductile detailing.

Sa/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 (Ah)		: (Z/2)*(Sa/g)*(I/R)
		: (0.16/2)*(1.2/4) * (Sa/g)
	Ah	: 0.016 * (Sa/g)
Design seismic base shear, Vb		: Ah * W where, W - seismic weight of building
Detailing as per IS-13920-2002		: Special moment resistant frame with ductile detailing

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	0.36

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

- Environment : Moderate
- 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.
- Minimum grade of concrete : Moderate exposure - M30
- Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 30 mm
- Nominal covers for 2 hr. fire resistance :

Nominal Cover

Beams		Slabs		Ribs		Columns/Shear walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.3.6 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

1.3.7 Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

1.3.8 Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design.

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental hitting of vehicle on the façade
- Snow Load

1.4 MATERIALS:

Materials specified will 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.

1.4.1 Concrete:

- All structural concrete shall have cube crushing strength of M35 to M25 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation / Retaining Walls	M35/M30
Columns & Walls	M50 to M30
Girder beam	M40
Slab, beams & Ramps	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 415 N/sq.mm.
- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 500 N/sq.mm.

Structural Steel

All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm.

1.5 STRUCTURAL CONCEPT

- The Structural System comprises of regular Beam, slab and shear walls system for both car park and residential floors. Floor slabs and beams are considered to act as a rigid diaphragm to transfer the lateral forces to the columns.

- The slabs for toilet area sunk by 250mm. Balconies are sunk by 150mm.The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	
a)	Column grids	Varies
b)	Structural system	R.C.C Column and Girder Beam in 1st floor level and RC wall up to Terrace
c)	Slab thickness	175/150/125mm
d)	Column/RC Wall size	As per the design
g)	Peripheral beams	As per the design

Structural analysis and design:

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 2016** software package for both vertical and lateral loads.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, and seismic loads and for the load combinations as given in the relevant codes.
- The slabs are analyzed as two-way and one way slabs

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 deflection is considered as span/250

As per IS1893 (Part1) :2016, Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height design.

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 water retaining structures, crack width is limited to 0.2mm.

Load Combinations:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	EL	DL	LL	EL
DL + LL	1.5	1.5	–	1	1	–
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8

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

***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; EL - Earthquake Load

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 combination.

Expansion joint/Separation joint:

Expansion / separation joint is provided in this building.

1.6 WATERPROOFING:

Toilets and Balconies:

Water proofing is done with Acrylic cementitious coating, made on all wall faces and one coat crystallization method with water is made on floor areas.

Terrace:

In the Terrace areas, water proofing is done with Acrylic cementitious coating as first layer & 100mm thick (Average thickness) screed concrete or brick coba as a topping layer shall be used.

1.7 DESIGN PHILOSOPHY:

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 are required for all replaceable material for longer life.

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 to resist lateral forces. 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. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns. The type of footings proposed will be individual or Raft based on actual design

Foundation:

Foundations are designed depending upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. Individual / Combined footings is envisaged depending on the soil report.

On behalf of DTCP HRB Panel (structural) the Structural Design calculations are generally reviewed 18/3/22

Superintending Engineer,
Planning and Designs Circle (Buildings),
Chepauk, Chennai-600 005.

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I(SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone-97411 10384

Table: Centers of Mass and Rigidity

Story	Diaphragm	Mass X	Mass Y	XCM	YCM	Cum Mass X	Cum Mass Y	XCCM	YCCM	XCR	YCR
		kg	kg	m	m	kg	kg	m	m	m	m
LMR TOP	D1	73653.07	73653.07	3.5305	27.748	73653.07	73653.07	3.5305	27.748	5.9788	19.4828
LMR BOTTOM	D1	123905.59	123905.59	3.8976	27.3286	197558.66	197558.66	3.7607	27.485	4.8977	14.8661
TERRACE	D1	1383131.73	1383131.73	-1.0348	5.8276	1580690.39	1580690.39	-0.4354	8.5344	3.6057	4.5496
19TH	D1	1541370.1	1541370.1	-1.0865	5.8587	3122060.49	3122060.49	-0.7569	7.2134	3.6264	4.5597
18TH	D1	1541370.1	1541370.1	-1.0865	5.8587	4663430.59	4663430.59	-0.8658	6.7656	3.6506	4.572
17TH	D1	1541370.1	1541370.1	-1.0865	5.8587	6204800.69	6204800.69	-0.9206	6.5403	3.6795	4.5875
16TH	D1	1541370.1	1541370.1	-1.0865	5.8587	7746170.79	7746170.79	-0.9536	6.4047	3.7115	4.6064
15TH	D1	1541370.1	1541370.1	-1.0865	5.8587	9287540.89	9287540.89	-0.9757	6.3141	3.7456	4.6289
14TH	D1	1541370.1	1541370.1	-1.0865	5.8587	10828910.99	10828910.99	-0.9915	6.2493	3.7803	4.655
13TH	D1	1541370.1	1541370.1	-1.0865	5.8587	12370281.09	12370281.09	-1.0033	6.2006	3.814	4.685
12TH	D1	1541370.1	1541370.1	-1.0865	5.8587	13911651.19	13911651.19	-1.0125	6.1627	3.8451	4.7189
11TH	D1	1541370.1	1541370.1	-1.0865	5.8587	15453021.29	15453021.29	-1.0199	6.1324	3.8714	4.7571
10TH	D1	1541370.1	1541370.1	-1.0865	5.8587	16994391.39	16994391.39	-1.0259	6.1076	3.8906	4.7996
9TH	D1	1541370.1	1541370.1	-1.0865	5.8587	18535761.49	18535761.49	-1.031	6.0869	3.8999	4.8467
8TH	D1	1541370.1	1541370.1	-1.0865	5.8587	20077131.59	20077131.59	-1.0352	6.0694	3.896	4.8979
7TH	D1	1541370.1	1541370.1	-1.0865	5.8587	21618501.69	21618501.69	-1.0389	6.0543	3.8757	4.9526
6TH	D1	1541370.1	1541370.1	-1.0865	5.8587	23159871.79	23159871.79	-1.0421	6.0413	3.8361	5.0087
5TH	D1	1541370.1	1541370.1	-1.0865	5.8587	24701241.89	24701241.89	-1.0448	6.0299	3.7772	5.0611
4TH	D1	1541370.1	1541370.1	-1.0865	5.8587	26242611.99	26242611.99	-1.0473	6.0199	3.7073	5.0994
3RD FLOOR	D1	1540906.77	1540906.77	-1.0868	5.8528	27783518.76	27783518.76	-1.0495	6.0106	3.6596	5.1039
2ND FLOOR	D1	1625738.36	1625738.36	-1.0749	4.3208	29409257.12	29409257.12	-1.0509	5.9172	3.7636	5.0687
1ST FLOOR	D1	2018773.53	2018773.53	-0.9795	3.9673	31428030.65	31428030.65	-1.0463	5.7919	4.3614	5.0303
STILT	D1	4660976.01	4660976.01	-8.323	0.2346	36089006.66	36089006.66	-1.9861	5.0742	3.3182	4.5133
LMR TOP	D2	103266.33	103266.33	3.2689	-19.1144	103266.33	103266.33	3.2689	-19.1144	5.6515	-12.3344
LMR BOTTOM	D2	120639.54	120639.54	3.2866	-18.9705	223905.87	223905.87	3.2785	-19.0369	4.6189	-7.7663

Story	Label	Unique Name	Output Case	Case Type	Ux	Uy	Uz
					mm	mm	mm
TERRACE	1	14617	DL+LL	Combination	-8.328	-0.276	-7.986
TERRACE	2	14619	DL+LL	Combination	-8.296	-0.176	-6.498
TERRACE	3	14620	DL+LL	Combination	-8.296	-0.155	-8.264
TERRACE	4	14622	DL+LL	Combination	-8.263	-0.071	-6.808
TERRACE	5	14623	DL+LL	Combination	-8.281	-0.116	-11.283
TERRACE	6	14624	DL+LL	Combination	-8.281	-0.063	-12.049
TERRACE	7	14546	DL+LL	Combination	-8.261	-0.094	-16.393
TERRACE	8	14545	DL+LL	Combination	-8.261	-0.116	-13.953
TERRACE	9	14548	DL+LL	Combination	-8.261	-0.215	-14.069
TERRACE	10	14547	DL+LL	Combination	-8.261	-0.237	-17.286
TERRACE	11	14628	DL+LL	Combination	-8.25	-0.063	-16.819
TERRACE	12	14625	DL+LL	Combination	-8.25	-0.155	-14.561
TERRACE	13	14632	DL+LL	Combination	-8.25	-0.176	-13.483
TERRACE	14	14629	DL+LL	Combination	-8.25	-0.268	-18.206
TERRACE	15	14549	DL+LL	Combination	-8.236	-0.176	-13.543
TERRACE	16	14550	DL+LL	Combination	-8.236	-0.155	-14.599
TERRACE	17	14636	DL+LL	Combination	-8.209	-0.063	-14.945
TERRACE	18	14633	DL+LL	Combination	-8.209	-0.155	-14.845
TERRACE	19	14642	DL+LL	Combination	-8.209	-0.176	-13.484
TERRACE	20	14637	DL+LL	Combination	-8.209	-0.268	-15.158
TERRACE	21	14809	DL+LL	Combination	-8.183	-0.063	-13.542
TERRACE	22	14820	DL+LL	Combination	-8.183	-0.114	-14.052
TERRACE	23	14786	DL+LL	Combination	-8.183	-0.176	-13.5
TERRACE	24	14821	DL+LL	Combination	-8.183	-0.227	-14.878
TERRACE	25	14647	DL+LL	Combination	-8.157	-0.056	-9.266
TERRACE	26	14643	DL+LL	Combination	-8.161	-0.155	-10.776
TERRACE	27	14651	DL+LL	Combination	-8.161	-0.176	-11.354
TERRACE	28	14648	DL+LL	Combination	-8.161	-0.268	-12.729
TERRACE	29	14768	DL+LL	Combination	-8.145	-0.268	-14.1
TERRACE	30	14772	DL+LL	Combination	-8.145	-0.215	-13.701
TERRACE	31	14804	DL+LL	Combination	-8.141	-0.111	-10.81
TERRACE	32	14799	DL+LL	Combination	-8.141	-0.155	-11.116
TERRACE	33	14654	DL+LL	Combination	-8.124	-0.07	-10.037
TERRACE	34	14652	DL+LL	Combination	-8.124	-0.155	-11.082
TERRACE	35	14658	DL+LL	Combination	-8.114	-0.176	-11.176
TERRACE	36	14655	DL+LL	Combination	-8.114	-0.268	-14.571
TERRACE	37	14662	DL+LL	Combination	-8.084	-0.07	-10.437
TERRACE	38	14659	DL+LL	Combination	-8.084	-0.155	-11.168
TERRACE	39	14668	DL+LL	Combination	-8.073	-0.176	-11.394
TERRACE	40	14663	DL+LL	Combination	-8.073	-0.268	-12.754
TERRACE	41	14813	DL+LL	Combination	-8.056	-0.07	-9.143
TERRACE	42	14823	DL+LL	Combination	-8.056	-0.115	-9.69
TERRACE	43	14783	DL+LL	Combination	-8.047	-0.176	-11.742
TERRACE	44	14824	DL+LL	Combination	-8.047	-0.227	-13.211

TERRACE	45	14674	DL+LL	Combination	-8.04	-0.048	-7.28
TERRACE	46	14669	DL+LL	Combination	-8.039	-0.155	-8.78
TERRACE	47	14678	DL+LL	Combination	-8.025	-0.176	-10.167
TERRACE	48	14675	DL+LL	Combination	-8.025	-0.268	-11.531
TERRACE	49	14679	DL+LL	Combination	-8.011	-0.155	-8.917
TERRACE	50	14682	DL+LL	Combination	-8.011	-0.066	-7.351
TERRACE	51	14552	DL+LL	Combination	-7.99	-0.215	-12.645
TERRACE	52	14551	DL+LL	Combination	-7.99	-0.237	-14.693
TERRACE	53	14686	DL+LL	Combination	-7.978	-0.176	-10.933
TERRACE	54	14683	DL+LL	Combination	-7.978	-0.268	-14.179
TERRACE	55	14689	DL+LL	Combination	-7.974	-0.066	-7.44
TERRACE	56	14687	DL+LL	Combination	-7.974	-0.155	-8.835
TERRACE	57	14695	DL+LL	Combination	-7.938	-0.176	-11.179
TERRACE	58	14690	DL+LL	Combination	-7.938	-0.268	-12.612
TERRACE	59	14700	DL+LL	Combination	-7.927	-0.066	-7.555
TERRACE	60	14696	DL+LL	Combination	-7.927	-0.155	-8.917
TERRACE	61	14814	DL+LL	Combination	-7.912	-0.227	-13.345
TERRACE	62	14780	DL+LL	Combination	-7.912	-0.176	-11.827
TERRACE	63	14827	DL+LL	Combination	-7.912	-0.122	-10.249
TERRACE	64	14805	DL+LL	Combination	-7.912	-0.069	-10.193
TERRACE	65	14554	DL+LL	Combination	-7.893	-0.1	-13.557
TERRACE	66	14553	DL+LL	Combination	-7.893	-0.122	-11.659
TERRACE	67	14704	DL+LL	Combination	-7.889	-0.176	-10.63
TERRACE	68	14701	DL+LL	Combination	-7.889	-0.268	-11.92
TERRACE	69	14708	DL+LL	Combination	-7.88	-0.069	-12.36
TERRACE	70	14705	DL+LL	Combination	-7.88	-0.155	-11.796
TERRACE	71	14829	DL+LL	Combination	-7.874	-0.268	-13.664
TERRACE	72	14774	DL+LL	Combination	-7.874	-0.215	-13.207
TERRACE	73	14556	DL+LL	Combination	-7.855	-0.215	-13.091
TERRACE	74	14555	DL+LL	Combination	-7.855	-0.237	-15.175
TERRACE	75	14712	DL+LL	Combination	-7.843	-0.176	-11.314
TERRACE	76	14709	DL+LL	Combination	-7.843	-0.268	-14.671
TERRACE	77	14713	DL+LL	Combination	-7.843	-0.155	-12.018
TERRACE	78	14716	DL+LL	Combination	-7.843	-0.069	-11.254
TERRACE	79	14806	DL+LL	Combination	-7.817	-0.069	-11.673
TERRACE	80	14832	DL+LL	Combination	-7.817	-0.116	-12.332
TERRACE	81	14722	DL+LL	Combination	-7.802	-0.176	-11.54
TERRACE	82	14717	DL+LL	Combination	-7.802	-0.268	-12.78
TERRACE	83	14727	DL+LL	Combination	-7.795	-0.069	-9.177
TERRACE	84	14723	DL+LL	Combination	-7.795	-0.155	-10.463
TERRACE	85	14815	DL+LL	Combination	-7.776	-0.227	-13.216
TERRACE	86	14833	DL+LL	Combination	-7.776	-0.176	-12.118
TERRACE	87	14728	DL+LL	Combination	-7.776	-0.155	-11.073
TERRACE	88	14729	DL+LL	Combination	-7.776	-0.111	-10.692
TERRACE	89	14730	DL+LL	Combination	-7.759	-0.155	-11.069
TERRACE	90	14732	DL+LL	Combination	-7.759	-0.07	-9.943
TERRACE	91	14733	DL+LL	Combination	-7.754	-0.268	-11.6

TERRACE	92	14737	DL+LL	Combination	-7.754	-0.176	-10.362
TERRACE	93	14837	DL+LL	Combination	-7.74	-0.262	-12.887
TERRACE	94	14808	DL+LL	Combination	-7.74	-0.209	-12.545
TERRACE	95	14558	DL+LL	Combination	-7.72	-0.209	-12.663
TERRACE	96	14557	DL+LL	Combination	-7.72	-0.231	-14.95
TERRACE	97	14738	DL+LL	Combination	-7.718	-0.155	-11.225
TERRACE	98	14741	DL+LL	Combination	-7.718	-0.07	-10.704
TERRACE	99	14742	DL+LL	Combination	-7.707	-0.262	-13.909
TERRACE	100	14745	DL+LL	Combination	-7.707	-0.176	-11.177
TERRACE	101	14812	DL+LL	Combination	-7.69	-0.07	-11.135
TERRACE	102	14836	DL+LL	Combination	-7.69	-0.115	-11.042
TERRACE	103	14746	DL+LL	Combination	-7.674	-0.155	-10.432
TERRACE	104	14750	DL+LL	Combination	-7.667	-0.066	-9.264
TERRACE	105	14751	DL+LL	Combination	-7.67	-0.262	-12.477
TERRACE	106	14756	DL+LL	Combination	-7.67	-0.176	-11.388
TERRACE	107	14775	DL+LL	Combination	-7.644	-0.176	-11.586
TERRACE	108	14835	DL+LL	Combination	-7.644	-0.223	-12.603
TERRACE	109	14761	DL+LL	Combination	-7.633	-0.084	-9.682
TERRACE	110	14757	DL+LL	Combination	-7.633	-0.155	-10.48
TERRACE	111	14762	DL+LL	Combination	-7.622	-0.262	-10.445
TERRACE	112	14764	DL+LL	Combination	-7.622	-0.176	-9.275
TERRACE	113	14560	DL+LL	Combination	-7.616	-0.084	-9.393
TERRACE	115	14607	DL+LL	Combination	-7.592	-0.176	-9.845
TERRACE	116	14767	DL+LL	Combination	-7.592	-0.084	-7.443
TERRACE	117	14608	DL+LL	Combination	-7.608	-0.176	-9.234
TERRACE	118	14807	DL+LL	Combination	-7.611	-0.262	-12.47
TERRACE	119	14562	DL+LL	Combination	-8.25	-0.253	-17.98
TERRACE	120	14561	DL+LL	Combination	-8.209	-0.253	-14.914
TERRACE	121	14564	DL+LL	Combination	-8.114	-0.253	-14.35
TERRACE	122	14563	DL+LL	Combination	-8.073	-0.253	-12.521
TERRACE	123	14566	DL+LL	Combination	-7.978	-0.253	-13.964
TERRACE	124	14565	DL+LL	Combination	-7.938	-0.253	-12.384
TERRACE	125	14568	DL+LL	Combination	-7.843	-0.253	-14.467
TERRACE	126	14567	DL+LL	Combination	-7.802	-0.253	-12.561
TERRACE	127	14818	DL+LL	Combination	-8.281	-0.237	-15.558
TERRACE	128	14817	DL+LL	Combination	-8.25	-0.237	-17.193
TERRACE	129	14822	DL+LL	Combination	-8.145	-0.237	-17.169
TERRACE	130	14826	DL+LL	Combination	-8.114	-0.237	-13.94
TERRACE	131	14771	DL+LL	Combination	-8.01	-0.237	-15.803
TERRACE	132	14770	DL+LL	Combination	-7.978	-0.237	-13.532
TERRACE	133	14831	DL+LL	Combination	-7.874	-0.237	-16.458
TERRACE	134	14834	DL+LL	Combination	-7.843	-0.237	-14.094
TERRACE	135	14618	DL+LL	Combination	-8.296	-0.215	-7.122
TERRACE	136	14631	DL+LL	Combination	-8.25	-0.215	-14.217
TERRACE	137	14650	DL+LL	Combination	-8.161	-0.215	-11.884
TERRACE	138	14657	DL+LL	Combination	-8.114	-0.215	-11.869
TERRACE	139	14677	DL+LL	Combination	-8.025	-0.215	-10.704

TERRACE	140	14685	DL+LL	Combination	-7.978	-0.215	-11.616
TERRACE	141	14703	DL+LL	Combination	-7.889	-0.215	-11.126
TERRACE	142	14711	DL+LL	Combination	-7.843	-0.215	-11.962
TERRACE	143	14639	DL+LL	Combination	-8.209	-0.227	-14.486
TERRACE	144	14649	DL+LL	Combination	-8.161	-0.227	-12.062
TERRACE	145	14570	DL+LL	Combination	-8.073	-0.207	-11.831
TERRACE	146	14569	DL+LL	Combination	-8.047	-0.207	-14.38
TERRACE	147	14572	DL+LL	Combination	-7.938	-0.207	-11.704
TERRACE	148	14571	DL+LL	Combination	-7.912	-0.207	-14.45
TERRACE	149	14574	DL+LL	Combination	-7.802	-0.207	-11.919
TERRACE	150	14573	DL+LL	Combination	-7.776	-0.207	-14.494
TERRACE	151	14575	DL+LL	Combination	-8.183	-0.207	-16.106
TERRACE	152	14576	DL+LL	Combination	-8.209	-0.207	-14.157
TERRACE	153	14765	DL+LL	Combination	-7.592	-0.155	-8.392
TERRACE	154	14680	DL+LL	Combination	-8.011	-0.148	-8.817
TERRACE	155	14670	DL+LL	Combination	-8.039	-0.148	-8.65
TERRACE	156	14803	DL+LL	Combination	-8.026	-0.124	-8.282
TERRACE	157	14796	DL+LL	Combination	-8.026	-0.155	-8.824
TERRACE	158	14578	DL+LL	Combination	-7.962	-0.132	-8.457
TERRACE	159	14577	DL+LL	Combination	-7.962	-0.155	-8.845
TERRACE	160	14621	DL+LL	Combination	-8.296	-0.116	-7.633
TERRACE	161	14626	DL+LL	Combination	-8.25	-0.116	-14.081
TERRACE	162	14715	DL+LL	Combination	-7.843	-0.116	-11.61
TERRACE	163	14724	DL+LL	Combination	-7.795	-0.116	-9.85
TERRACE	164	14645	DL+LL	Combination	-8.161	-0.111	-10.031
TERRACE	165	14653	DL+LL	Combination	-8.124	-0.111	-10.652
TERRACE	166	14725	DL+LL	Combination	-7.795	-0.111	-9.78
TERRACE	167	14731	DL+LL	Combination	-7.759	-0.111	-10.521
TERRACE	168	14580	DL+LL	Combination	-7.843	-0.098	-11.44
TERRACE	169	14579	DL+LL	Combination	-7.817	-0.098	-13.367
TERRACE	170	14581	DL+LL	Combination	-7.843	-0.087	-11.483
TERRACE	171	14582	DL+LL	Combination	-7.88	-0.087	-12.645
TERRACE	172	14583	DL+LL	Combination	-7.843	-0.073	-11.305
TERRACE	173	14584	DL+LL	Combination	-7.88	-0.073	-12.417
TERRACE	174	14699	DL+LL	Combination	-7.927	-0.069	-7.612
TERRACE	175	14748	DL+LL	Combination	-7.674	-0.103	-9.718
TERRACE	176	14760	DL+LL	Combination	-7.633	-0.103	-9.908
TERRACE	177	14585	DL+LL	Combination	-7.927	-0.103	-8.127
TERRACE	178	14586	DL+LL	Combination	-7.974	-0.103	-8.037
TERRACE	179	14749	DL+LL	Combination	-7.674	-0.084	-9.444
TERRACE	180	14588	DL+LL	Combination	-7.657	-0.084	-10.124
TERRACE	181	14587	DL+LL	Combination	-7.657	-0.103	-10.122
TERRACE	182	14763	DL+LL	Combination	-7.622	-0.223	-9.848
TERRACE	183	14753	DL+LL	Combination	-7.67	-0.223	-11.986
TERRACE	184	14734	DL+LL	Combination	-7.754	-0.262	-11.515
TERRACE	185	14589	DL+LL	Combination	-8.183	-0.094	-15.687
TERRACE	186	14590	DL+LL	Combination	-8.209	-0.094	-14.532

TERRACE	187	14592	DL+LL	Combination	-8.141	-0.125	-11.414
TERRACE	188	14591	DL+LL	Combination	-8.124	-0.125	-10.666
TERRACE	189	14594	DL+LL	Combination	-8.126	-0.215	-13.13
TERRACE	190	14593	DL+LL	Combination	-8.126	-0.237	-15.529
TERRACE	191	14595	DL+LL	Combination	-7.759	-0.125	-10.669
TERRACE	192	14596	DL+LL	Combination	-7.776	-0.125	-11.37
TERRACE	193	14838	DL+LL	Combination	-7.74	-0.231	-16.097
TERRACE	194	14839	DL+LL	Combination	-7.707	-0.231	-13.382
TERRACE	195	14736	DL+LL	Combination	-7.754	-0.209	-10.762
TERRACE	196	14744	DL+LL	Combination	-7.707	-0.209	-11.737
TERRACE	197	14810	DL+LL	Combination	-8.25	-0.094	-16.586
TERRACE	198	14811	DL+LL	Combination	-8.281	-0.094	-14.76
TERRACE	199	14726	DL+LL	Combination	-7.795	-0.07	-9.19
TERRACE	200	14769	DL+LL	Combination	-8.281	-0.268	-13.432
TERRACE	201	14819	DL+LL	Combination	-8.281	-0.215	-11.234
TERRACE	202	14825	DL+LL	Combination	-8.01	-0.268	-13.143
TERRACE	203	14773	DL+LL	Combination	-8.01	-0.215	-12.735
TERRACE	204	14597	DL+LL	Combination	-7.67	-0.258	-12.426
TERRACE	205	14598	DL+LL	Combination	-7.707	-0.258	-13.882
TERRACE	206	14673	DL+LL	Combination	-8.041	-0.066	-7.353
TERRACE	207	14646	DL+LL	Combination	-8.161	-0.07	-9.362
TERRACE	208	14661	DL+LL	Combination	-8.084	-0.115	-10.704
TERRACE	209	14672	DL+LL	Combination	-8.039	-0.115	-8.11
TERRACE	210	14697	DL+LL	Combination	-7.927	-0.132	-8.559
TERRACE	211	14688	DL+LL	Combination	-7.974	-0.132	-8.418
TERRACE	212	14698	DL+LL	Combination	-7.927	-0.122	-8.406
TERRACE	213	14706	DL+LL	Combination	-7.88	-0.122	-11.419
TERRACE	214	14681	DL+LL	Combination	-8.011	-0.124	-8.351
TERRACE	215	14671	DL+LL	Combination	-8.039	-0.124	-8.253
TERRACE	216	14599	DL+LL	Combination	-8.209	-0.078	-15.096
TERRACE	217	14600	DL+LL	Combination	-8.25	-0.078	-17.051
TERRACE	218	14665	DL+LL	Combination	-8.073	-0.227	-12.14
TERRACE	219	14676	DL+LL	Combination	-8.025	-0.227	-10.879
TERRACE	220	14601	DL+LL	Combination	-8.056	-0.097	-11.048
TERRACE	221	14602	DL+LL	Combination	-8.084	-0.097	-10.518
TERRACE	222	14635	DL+LL	Combination	-8.209	-0.114	-14.701
TERRACE	223	14644	DL+LL	Combination	-8.161	-0.114	-10.074
TERRACE	224	14692	DL+LL	Combination	-7.938	-0.227	-12.007
TERRACE	225	14702	DL+LL	Combination	-7.889	-0.227	-11.292
TERRACE	226	14830	DL+LL	Combination	-7.88	-0.1	-12.646
TERRACE	227	14828	DL+LL	Combination	-7.912	-0.1	-13.635
TERRACE	228	14719	DL+LL	Combination	-7.802	-0.227	-12.208
TERRACE	229	14735	DL+LL	Combination	-7.754	-0.227	-11.003
TERRACE	230	14604	DL+LL	Combination	-7.718	-0.097	-10.694
TERRACE	231	14603	DL+LL	Combination	-7.69	-0.097	-12.63
TERRACE	232	14740	DL+LL	Combination	-7.718	-0.115	-10.842
TERRACE	233	14747	DL+LL	Combination	-7.674	-0.115	-9.885

TERRACE	234	14606	DL+LL	Combination	-7.759	-0.084	-10.126
TERRACE	235	14605	DL+LL	Combination	-7.718	-0.084	-10.84
TERRACE	236	14609	DL+LL	Combination	-8.011	-0.095	-7.868
TERRACE	237	14610	DL+LL	Combination	-8.046	-0.078	-7.762
TERRACE	238	14759	DL+LL	Combination	-7.633	-0.109	-9.968
TERRACE	239	14766	DL+LL	Combination	-7.592	-0.109	-7.76
TERRACE	240	14612	DL+LL	Combination	-7.707	-0.243	-13.692
TERRACE	241	14611	DL+LL	Combination	-7.67	-0.243	-12.231
TERRACE	242	14613	DL+LL	Combination	-8.084	-0.084	-10.617
TERRACE	243	14614	DL+LL	Combination	-8.124	-0.084	-10.24
TERRACE	244	14615	DL+LL	Combination	-7.644	-0.205	-13.607
TERRACE	245	14616	DL+LL	Combination	-7.67	-0.205	-11.735
TERRACE	246	14788	DL+LL	Combination	-8.226	-0.176	-13.535
TERRACE	248	14787	DL+LL	Combination	-8.214	-0.176	-13.478
TERRACE	250	14801	DL+LL	Combination	-8.226	-0.155	-14.662
TERRACE	252	14800	DL+LL	Combination	-8.214	-0.155	-14.792
TERRACE	254	14638	DL+LL	Combination	-8.209	-0.238	-14.654
TERRACE	256	14798	DL+LL	Combination	-8.12	-0.155	-11.062
TERRACE	258	14797	DL+LL	Combination	-8.107	-0.155	-11.088
TERRACE	260	14785	DL+LL	Combination	-8.091	-0.176	-11.243
TERRACE	262	14784	DL+LL	Combination	-8.078	-0.176	-11.307
TERRACE	264	14660	DL+LL	Combination	-8.084	-0.126	-10.786
TERRACE	266	14664	DL+LL	Combination	-8.073	-0.238	-12.283
TERRACE	268	14782	DL+LL	Combination	-7.955	-0.176	-11.007
TERRACE	270	14781	DL+LL	Combination	-7.942	-0.176	-11.087
TERRACE	274	14795	DL+LL	Combination	-7.942	-0.155	-8.863
TERRACE	276	14691	DL+LL	Combination	-7.938	-0.238	-12.151
TERRACE	278	14794	DL+LL	Combination	-7.861	-0.155	-11.871
TERRACE	280	14793	DL+LL	Combination	-7.848	-0.155	-11.955
TERRACE	282	14714	DL+LL	Combination	-7.843	-0.127	-11.665
TERRACE	285	14779	DL+LL	Combination	-7.82	-0.176	-11.377
TERRACE	287	14778	DL+LL	Combination	-7.807	-0.176	-11.446
TERRACE	289	14718	DL+LL	Combination	-7.802	-0.238	-12.339
TERRACE	291	14792	DL+LL	Combination	-7.754	-0.155	-11.063
TERRACE	293	14791	DL+LL	Combination	-7.741	-0.155	-11.12
TERRACE	295	14739	DL+LL	Combination	-7.718	-0.126	-10.894
TERRACE	297	14777	DL+LL	Combination	-7.688	-0.176	-11.234
TERRACE	299	14776	DL+LL	Combination	-7.675	-0.176	-11.304
TERRACE	301	14752	DL+LL	Combination	-7.67	-0.234	-12.1
TERRACE	303	14790	DL+LL	Combination	-7.668	-0.155	-10.384
TERRACE	305	14789	DL+LL	Combination	-7.656	-0.155	-10.414
TERRACE	307	14758	DL+LL	Combination	-7.633	-0.119	-10.051
TERRACE	310	14666	DL+LL	Combination	-8.073	-0.197	-11.671
TERRACE	312	14667	DL+LL	Combination	-8.073	-0.185	-11.519
TERRACE	314	14684	DL+LL	Combination	-7.978	-0.248	-13.883
TERRACE	316	14710	DL+LL	Combination	-7.843	-0.248	-14.402
TERRACE	318	14743	DL+LL	Combination	-7.707	-0.242	-13.663

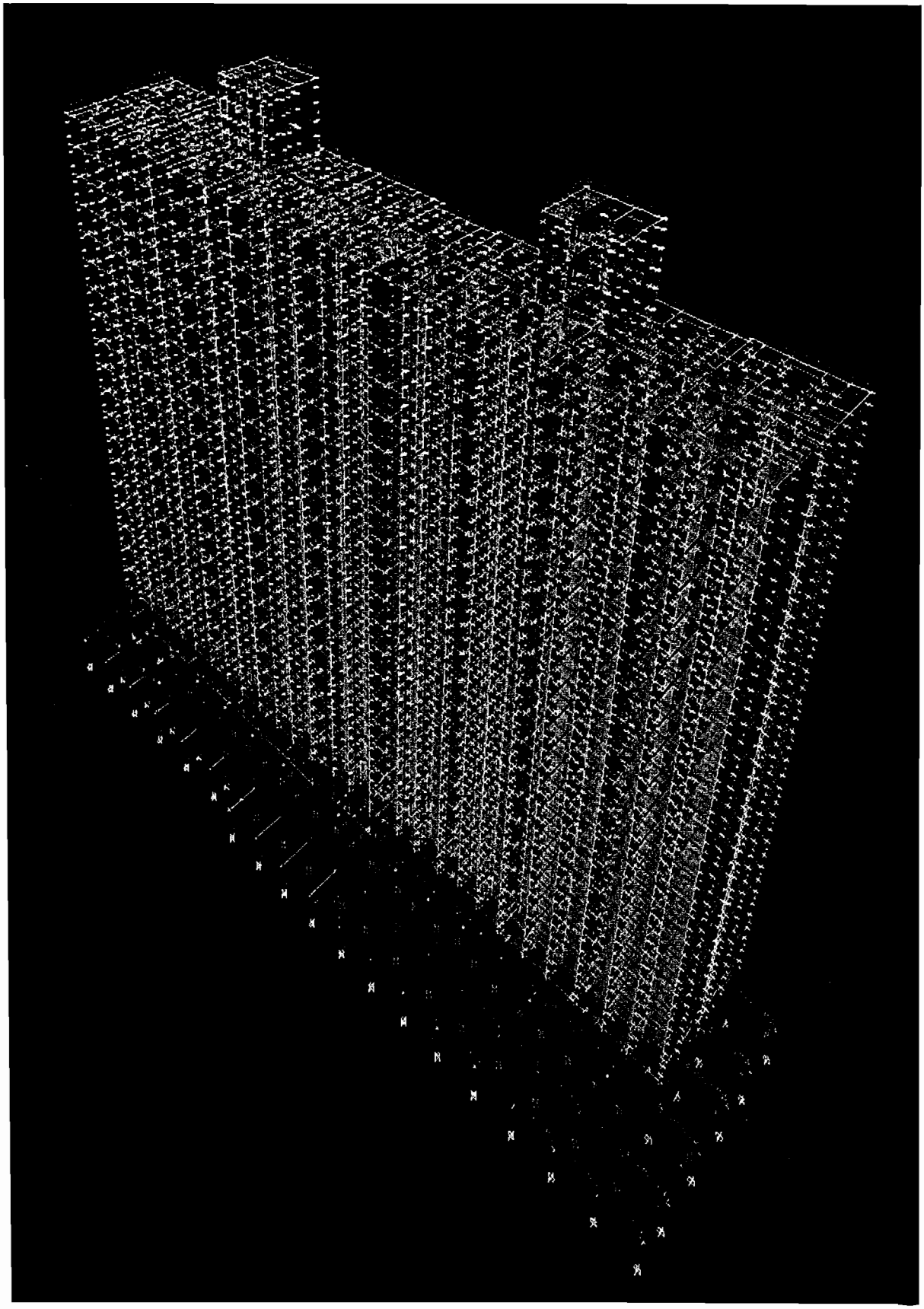
TABLE: Modal Participating Mass Ratios

Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec												
Modal	1	2.179	0.0002	0.6152	0	0.0002	0.6152	0	0.3466	0.0002	0.017	0.3466	0.0002	0.017
Modal	2	1.699	0.5243	0.0014	0	0.5244	0.6165	0	0.0008	0.3823	0.0598	0.3474	0.3825	0.0768
Modal	3	1.614	0.0535	0.0276	0	0.5779	0.6441	0	0.0136	0.0385	0.487	0.361	0.421	0.5637
Modal	4	0.617	1.17E-05	0.1659	0	0.578	0.81	0	0.2738	6.25E-06	0.0017	0.6348	0.421	0.5655
Modal	5	0.385	0.1609	0.0001	0	0.7389	0.8101	0	0.0001	0.1413	0.0057	0.6349	0.5623	0.5711
Modal	6	0.373	0.0049	0.0043	0	0.7438	0.8144	0	0.0067	0.0048	0.1514	0.6416	0.5671	0.7226
Modal	7	0.31	7.67E-07	0.074	0	0.7438	0.8884	0	0.1124	6.35E-06	0.0042	0.754	0.5671	0.7268
Modal	8	0.197	3.26E-06	0.0494	0	0.7438	0.9378	0	0.105	1.67E-06	0.0003	0.859	0.5671	0.7271
Modal	9	0.166	0.0711	0.0004	0	0.8149	0.9382	0	0.0007	0.0847	9.89E-06	0.8597	0.6518	0.7271
Modal	10	0.123	0.0081	0.0289	0	0.823	0.9672	0	0.0634	0.0111	0.0005	0.9231	0.6629	0.7276
Modal	11	0.09	0.04	0.0207	0	0.863	0.9878	0	0.0478	0.0657	0.006	0.9709	0.7285	0.7336
Modal	12	0.065	0.0938	0.0056	0	0.9568	0.9934	0	0.0136	0.1726	4.02E-06	0.9845	0.9012	0.7336

TABLE: Story Stiffness

Story	Output Case	Case Type	Shear X	Drift X	Stiff X	Shear Y	Drift Y	Stiff Y	
LMR TOP	SPECX-P	LinRespSpec	209.851	1.379	152133.569	24.7947	0.067	368756.338	#DIV/0!
LMR BOTTOM	SPECX-P	LinRespSpec	441.5718	1.225	360494.082	47.7423	0.068	706529.1	2.369589331
TERRACE	SPECX-P	LinRespSpec	1452.1084	1.264	1148777.585	117.0162	0.065	0	3.186675295
19TH	SPECX-P	LinRespSpec	2304.0976	1.278	1802434.881	138.4584	0.06	0	1.569002481
18TH	SPECX-P	LinRespSpec	2896.3459	1.29	2244532.686	112.0199	0.057	0	1.245278101
17TH	SPECX-P	LinRespSpec	3258.8388	1.298	2511010.23	76.3898	0.057	0	1.118722951
16TH	SPECX-P	LinRespSpec	3438.7127	1.298	2650181.536	113.1072	0.059	0	1.055424428
15TH	SPECX-P	LinRespSpec	3496.2235	1.291	2707169.555	180.4278	0.062	0	1.02150344
14TH	SPECX-P	LinRespSpec	3496.7425	1.279	2734885.204	221.283	0.064	0	1.01023787
13TH	SPECX-P	LinRespSpec	3500.0187	1.259	2779412.696	218.1381	0.063	0	1.016281302
12TH	SPECX-P	LinRespSpec	3550.2115	1.234	2876907.094	181.9291	0.062	0	1.035077338
11TH	SPECX-P	LinRespSpec	3671.6286	1.203	3051763.228	163.0325	0.062	0	1.060779208
10TH	SPECX-P	LinRespSpec	3871.9414	1.166	3319859.775	204.6388	0.064	0	1.087849721
9TH	SPECX-P	LinRespSpec	4148.6148	1.123	3694881.131	258.0911	0.066	0	1.112963011
8TH	SPECX-P	LinRespSpec	4493.0961	1.071	4194482.211	273.3601	0.064	0	1.135214385
7TH	SPECX-P	LinRespSpec	4891.769	1.009	4846765.683	249.6441	0.061	0	1.155509891
6TH	SPECX-P	LinRespSpec	5325.6456	0.934	5702339.513	243.5381	0.059	0	1.176524694
5TH	SPECX-P	LinRespSpec	5769.5231	0.841	6861860.751	293.5874	0.059	0	1.203341319
4TH	SPECX-P	LinRespSpec	6190.1805	0.719	8603753.02	333.8304	0.055	0	1.2538513
3RD FLOOR	SPECX-P	LinRespSpec	6546.2723	0.558	11741041.46	337.0716	0.075	0	1.364641853
2ND FLOOR	SPECX-P	LinRespSpec	6815.0722	0.406	16796855.01	446.4251	0.048	0	1.430610314
1ST FLOOR	SPECX-P	LinRespSpec	7085.8614	0.351	20200441.77	722.7297	0.068	10564275.96	1.202632383
STILT	SPECX-P	LinRespSpec	8155.7528	0.159	51366452.69	1224.1651	0.061	19943470.57	2.542838087
LMR TOP	SPECY-P	LinRespSpec	64.5684	0.369	175081.33	169.0804	1.377	122790.807	#DIV/0!
LMR BOTTOM	SPECY-P	LinRespSpec	122.2545	0.358	341693.404	358.1323	1.28	279792.469	2.278610882
TERRACE	SPECY-P	LinRespSpec	281.6057	0.413	681435.83	1215.1841	1.372	885647.844	3.165374133
19TH	SPECY-P	LinRespSpec	337.2853	0.417	808670.731	1942.6386	1.417	1370706.331	1.547687764
18TH	SPECY-P	LinRespSpec	281.5131	0.422	667798.898	2450.1231	1.474	1662065.824	1.212561572
17TH	SPECY-P	LinRespSpec	159.2085	0.426	0	2766.0304	1.521	1818125.697	1.093895122
16TH	SPECY-P	LinRespSpec	171.1034	0.429	0	2941.4489	1.556	1890225.172	1.039655935
15TH	SPECY-P	LinRespSpec	350.6689	0.432	812522.385	3040.4955	1.58	1924658.316	1.018216424
14TH	SPECY-P	LinRespSpec	506.6484	0.432	1171817.002	3122.5204	1.594	1958572.45	1.01762086
13TH	SPECY-P	LinRespSpec	575.8147	0.431	1335894.173	3223.9504	1.601	2013179.253	1.027880921
12TH	SPECY-P	LinRespSpec	531.6565	0.426	1247021.219	3352.076	1.602	2092905.009	1.039601916
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10TH	SPECY-P	LinRespSpec	242.035	0.409	0	3640.0289	1.583	2299467.046	1.049973086
9TH	SPECY-P	LinRespSpec	361.6241	0.397	0	3782.601	1.562	2422392.917	1.053458418
8TH	SPECY-P	LinRespSpec	588.2615	0.381	1544384.729	3931.7711	1.53	2569066.414	1.060549012
7TH	SPECY-P	LinRespSpec	725.805	0.359	2021219.308	4103.8017	1.488	2757867.902	1.07349031
6TH	SPECY-P	LinRespSpec	694.7116	0.33	2104914.615	4312.2622	1.431	3012845.508	1.092454612
5TH	SPECY-P	LinResp5pec	488.5116	0.295	1658176.266	4557.5979	1.355	3363621.639	1.116426856
4TH	SPECY-P	LinRespSpec	331.5178	0.253	0	4825.7952	1.242	3884028.243	1.154716154
3RD FLOOR	SPECY-P	LinRespSpec	649.8281	0.204	3182530.365	5102.0947	1.059	4816658.476	1.240119323
2ND FLOOR	SPECY-P	LinRespSpec	1037.1888	0.155	6678776.318	5405.0876	0.957	5646449.759	1.1722753
1ST FLOOR	SPECY-P	LinRespSpec	1216.582	0.113	10743705.04	5898.7172	1.203	4903092.047	0.868349539
STILT	SPECY-P	LinRespSpec	1768.2139	0.058	30646795.93	6621.9894	0.81	8170995.847	1.666498562

3D MODEL



TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN. Grade of Concrete = M25.

Mx = 7.1 KN-m. Grade of Steel = Fe500.

My = 26 KN-m.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the limits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum moment for which the column is to be designed is
Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN.
Mx = 25.26KN-m.
My = 83 KN-m.

Grade of Concrete = M30
Grade of Steel = Fe500.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

M_u / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

M_u / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

TYPICAL BEAM DESIGN

(ANALYSIS WAS DONE BY ETABS USING DIFFERENT LOAD COMBINATIONS, THE DESIGN FORCES ARE TAKEN FOR DCON2 CASE)

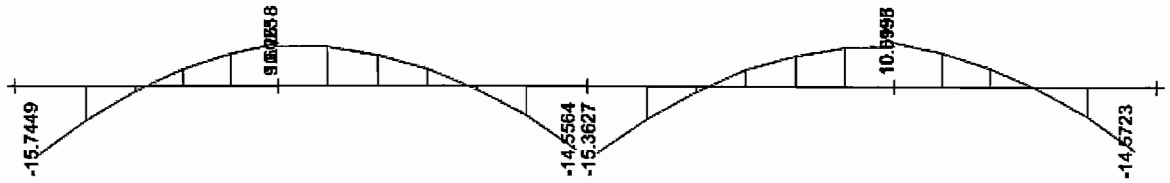
A Beam of 2 spans was considered for Typical Design Calculation.
Beam Location – Along Grid 33 to 46 (First Floor Shuttering)

Beam Size : 200mm x 450mm.

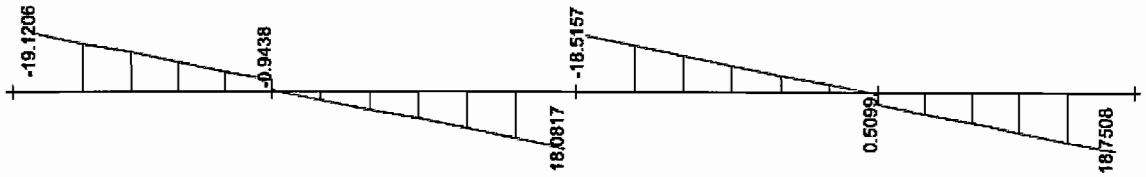
Grade of Concrete = M30;
Grade of Steel = Fe-500;
Effective depth – d' = 450-50 = 400 mm.

BENDING MOMENT, SHEAR FORCE AND TORSION DIAGRAMS TAKEN FROM ETABS

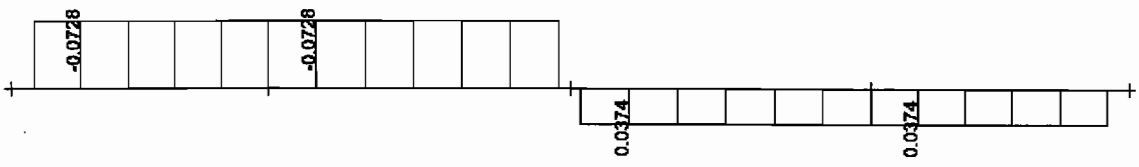
BENDING MOMENT DIAGRAM (KNm)



SHEAR FORCE DIAGRAM (KN)



TORSION DIAGRAM (KNm/m)



LEFT BEAM-(200X450)

Left End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 36KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 36 + 0.35
= 36.35 KN-m.

Mu/bd^2 = 36.35 x 10^6 /230 x 400^2
= **0.987**

Pt = 0.29 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
=0.29 x 230 x 400/ 100
= 267 mm^2.

Provide (2T16) ---- @ Top

Mid Span bottom

Mu = 41-KNm

Mu/bd^2 = 41x 10^6 /230 x 400^2
= 1.12

Pt = 1.12 % (From SP-16, Table 3)
As per IS : 13920 : 1993 minimum reinforcement provided will be 0.24%
Ast = Pt x b x D/100
= 0.24 x 230 x 450/ 100
= 249 mm^2.

Provide (2T16)

Right End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 35KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 35 + 0.35
= 35.35 KN-m.

Mu/bd^2 = 35.35 x 10^6 /230 x 400^2
= **0.96**

Pt = 0.2789 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
= 0.2789 x 230 x 400/ 100
= 256 mm^2.
Provide (2T16) ---- @ Top

<u>Shear Reinforcement:</u>

V1 at Left End Support = 47 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 5.13/0.23 + 47 = 83 KN

ζv = Vu/bd = 83 x 10^3/ 230 x 400
= 0.90 N/mm^2
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm^2
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400

= .278

Therefore ζ_c = 0.39 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 83 x 10^3 – 0.39 x 230 x 400
= 47.12 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 47.12 x 10^3
= 306 mm.

V1 at Right End Support = 46 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 0.2/0.23 + 46 = 47.4 KN

ζv = Vu/bd = 47.4 x 10^3/ 230 x 400
= 0.52 N/mm²
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm²
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400
= .28

Therefore ζ_c = 0.36 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 47.41 x 10^3 – 0.36 x 230 x 400
= 14.29 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 14.29 x 10^3
= 1013 mm.

As per code IS : 13920 : 1993 minimum spacing provided should be d/4 or 8 x diameter of smaller bar or 100mm whichever is less.

Hence Provide 2L-T8@100/200/100 c/c

Check for Deflection:

Maximum allowable Elastic short term deflection = l/250 = 4512/250
= 18.048 mm.

But actual deflection from ETABS = 1.4mm.

Maximum allowable long term deflection = l/350 = 4512/350
= 12.9 mm > 1.41 mm.

Therefore within the limits.

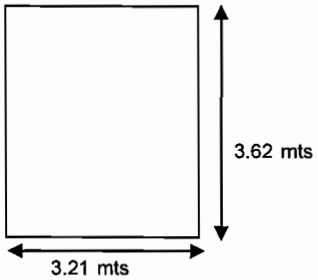
DESIGN TWOWAY SLAB

DESIGN OF TWO WAY SLAB

Short span	S=	3.21	m
Long span	L=	3.62	m
Assumed slab thickness	t=	0.125	m
Grade of concrete	fck=	25	N/mm^2
Grade of reinforcement	fy=	500	N/mm^2

Clear Span	
S	3.21
L	3.62

Type of panel One short edge discontinuous



Loads

Self weight of slab	w1=	3.13	kN/m^2	
Floor finish	w2=	1.50	kN/m^2	
Live load	w3=	2.00	kN/m^2	TOTAL
Miscellaneous	w4=	0.00	kN/m^2	6.63 kN/m^2

Ratio of long span to short span R= 1.15

Design Load with load factor of 1.5 Wu= 9.94 kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.046	**4.71**	0.46	0.11	**150.00**	8	335	101
Positive moment at midspan	0.034	**3.48**	0.34	0.08	**150.00**	8	335	101
						8	200	
Long span direction								
Negative moment at continuous edge	0.037	**3.79**	0.44	0.10	**150.00**	8	335	93
Positive moment at midspan	0.028	**2.87**	0.33	0.08	**150.00**	8	335	93

Minimum effective depth reqd	dre=	36.95 mm	
Clear cover to any reinforcement	c=	20 mm	
Minimum effective depth provided	dpr=	93 mm	greater than 'min. eff depth reqd'. Hence ok
Minimum reinforcement	Amin=	150 mm^2	

Deflection check

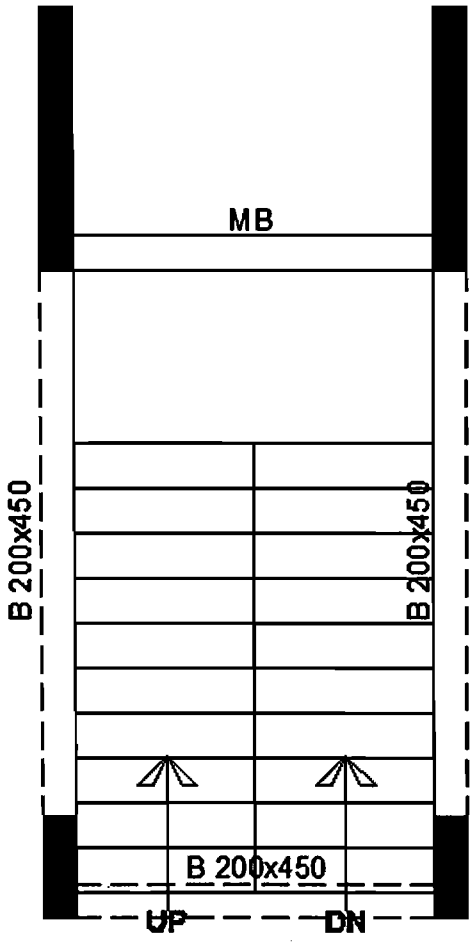
Reinf provided at midspan along short direction 251.33 mm^2 Dia 8 at 200 mm

Stress in reinforcement	fs=	173.081	N/mm^2
Percentage of reinforcement provided	pt=	0.24884	%
Modification factor as per fig 4 of IS:456-2000	MF=	2	

Type of slab for deflection check: Continuous

Basic span to effective depth ratio	26	
Minimum effective depth reqd from deflection criteria	61.73 mm	
Effective depth provided	101 mm	greater than 'min. eff depth reqd'. Hence ok

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

SOIL EXPLORATION REPORT

PROJECT NO : **7364**

PROJECT NAME : **Construction of Proposed 2 Basement + Stilt + 19 Floors, Alliance Budget housing at Siruseri.**

1. INTRODUCTION

M/s. Alliance Group are proposing to construct 2 Basement + Stilt + 19 Floors Alliance Budget housing, Siruseri, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Alliance Group, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose eight boreholes were bored upto a depth varies from 6.0 to 8.5M below ground level. The boreholes were terminated after drilling for the required depth in the medium rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling techniques was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could not be collected since the soil layers met with were essentially cohesionless in nature. Core samples were collected from medium rock layers.

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 9 The top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

4. ANALYSIS OF TEST RESULTS

1. Standard Penetration Test
2. Grain Size Analysis
3 Determination of Specific Gravity
4. Crushing Strength of Rock

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 2 to 9. The relative density of the cohesionless layers obtained from the N values are given in the bore logs.

4. 2 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart .

4.3 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.4 Crushing Strength of Rock

Core samples collected from medium rock layers were tested for determining crushing strength of rock. The results are given in Table – 2.

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock / medium rock layer.

The safe bearing capacity of these cohesionless layers could be computed using the formula,

$$Q_a = (0.5\gamma \times B \times N_\gamma + \gamma D_f N_q) \div 2.5$$

Where,

B	=	Width of footing
γ	=	Submerged unit weight of soil taken as 1 gm/cc,
D_f	=	Depth of surcharge
$N\gamma$ Nq	=	Bearing capacity factors based on the N values taken from Fig 10

For an N value of over 50 the SBC computed over 5.0kg/cm^2 for the foundations are placed on the disintegrated rock layer. However, the SBC may be limited to 5.0kg/c^2 to allow for any non-uniformity.

When the foundations are taken to medium rock layer the SBC that could be adopted is 10kg/cm^2.

The settlement would be elastic and of small order.

Over excavations in disintegrated rock should be refilled by 1:3:6 concrete and in medium rock by 1:2:4 concrete.

6. EXCAVATION PROCEDURE

1. Vertical cuts could be given for excavation.

2. Normal excavators would be required for excavation in disintegrated rock and jack hammers would be required for excavation in medium rock.

3. Slush formed by any water accumulation should be removed and refilled by lean concrete.

4. If water accumulates in the foundation trenches, dewatering should be done by pumping out water from a level lower than the foundation level to maintain downward flow of water.

5 The exposed side of excavation should be covered by plastic sheet during rainy season and surface drain provided to prevent water from flowing on the cut surface.

8. CONCLUSIONS

1. The area explored has got top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

2. For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock /medium rock layer. The SBC that could be adopted is 5.0kg/cm^2 when the foundations are placed on the disintegrated rock layer and 10.0kg/cm^2 when the foundations are on the medium rock layer.

3. The settlement of the shallow foundation would be of small order and elastic in nature.

4. Over excavations in the foundation trenches should be refilled as suggested.

5. Suggested excavation procedure should be adopted while undertaking the construction.

F.S.ENGINEERS PVT.LTD
NEW NO.98,(Old No.109) VELACHERY ROAD
GUINDY
CHENNAI – 600 032

(Dr.A. Verghese Chummar)
Director
Dated: Feb 5th , 2018

P.N.7364

ALLIANCE SIRUSERI, CHENNAI

BLOCK-H

STRUCTURAL DESIGN CALCULATIONS

DesignTree Service Consultants Pvt Ltd
Consulting Engineers
7 Laxmi Narasimha Complex
15th Cross 100 Feet Road 4 Phase,
J.P.Nagar, Bangalore 560 078. INDIA
T: +91 80 4122 5481 F: +918041225479
EMAIL: info@designtreeconsultants.com
www.designtreeconsultants.com

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade - I (SE)
Regn.No. SE/Gr.I /19/05/008
180/84, Third Floor, Trunk Road,
Porur, Chennai -600 116.
Phone - 97411 10384

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   - BEAM DESIGN
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   - STAIR CASE DESIGN
5. STRUCTURAL DRAWINGS
6. SOIL REPORT

ALLIANCE SIRUSERI, CHENNAI

DESIGN BRIEF REPORT

Client :

ALLIANCE GROUP
Chennai

SMEP Consultants :

Design Tree Service Consultants Pvt Ltd
7, Laxmi Narasimha Complex
15th Cross, 100ft Ring Road,
4th Phase, JP Nagar
Bangalore - 560 078

Architects :

LAVANYA & SHANKAR ARCHITECTS
Chennai

ISSUE RECORD

PROJECT : ALLIANCE SIRUSERI , CHENNAI

TITLE : Preliminary Design Brief Report

DOCUMENT NO : DTSC / 406 F

1. STRUCTURAL

DATE	ISSUE	PREPARED	CHECKED	REMARKS / REVISION
20.02.19	Prelim report	SWAPNA	B.SRINIVASARAO	R0
22.07.19	Prelim report	SUNIL	B.SRINIVASARAO	R1
25.10.21	Prelim report	SUNIL	B.SRINIVASARAO	R2

1. STRUCTURE

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1- STRUCTURE

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1.7 Design Philosophy

1.1 PROJECT BRIEF

The clients M/S ALLIANCE GROUP Intends to develop residential building, at Chennai. Project is architectured by LAVANYA & SHANKAR ARCHITECTSChennai.Structures, Plumbing, Fire Protection, HVAC and Electrical Engineering Services are provided by M/S Design Tree Service Consultants Pvt. Ltd, Bangalore.

All service facilities like underground sump and pump are to be provided as per the requirements given by clients.

The proposed residential building having 10 blocks A,B,C,D, E,F,G,H,I &J.

- Residential blocks A,B,C,D,E,F& G having 1 Basement + stilt+19 upper floors+Terrace floor.
- Residential block H having 1 Basement + stilt+17 upper floors+Terrace floor.
- Block I (Club house) having1 Basement + Ground +3+Terrace.
- Block J (Learning hub) having Ground+3+Terrace.

The height of the proposed Building from FGL is up to 59.85 /53.90/ 22.05 / 14.85 mts.

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- NationalBuilding Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

1.2 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.

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.
IS: 6313 (part II)	: Standards for anti-termite treatment.
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 -2012	: Code of practice for pre stressed concrete.
IS: 14268 - 1995	: Uncoated stress relieved low relaxation seven-ply strand for pre stressed 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: 13920-2016	: Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice.
IS: 16700 -2017	: Criteria for structural safety of tall 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 - 1984 (reaffirmed 1998)	: 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.

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

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 hard drawn 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 DATA:

Loads:

1.3.1 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	:	120kg/sq.m (1.2kN/sq.m).
• Floor finish of 75mm thick for Parking Areas	:	180kg/sq.m (1.8kN/sq.m).
• False ceiling + ducting + Sprinklers(services)	:	40 kg/sq.m (0.4 kN/sq.m).
• Partitions	:	100kg/sq.m (1.0kN/sq.m).
• Wall loads	:	As per actuals.
• 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	:	1900 kg/cu.m (19 kN/cu.m).

- Aerated block masonry : 865 kg/cu.m (8.65 kN/cu.m).
- Soil (Dry) : 1800 kg/cu.m (18 kN/cu.m).
- Soil (Saturated) : 2000 kg/cu.m (20 kN/cu.m).
- Water : 1000 kg/cu.m (10 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)
- Waterproofing (membrane). : 15kg/sq.m (0.15kN/sq.m).
- External finishes : As per actuals.
- Gardening/Landscape loads : As per actuals
- Equipment loads : As per Vendor details.

1.3.2 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.

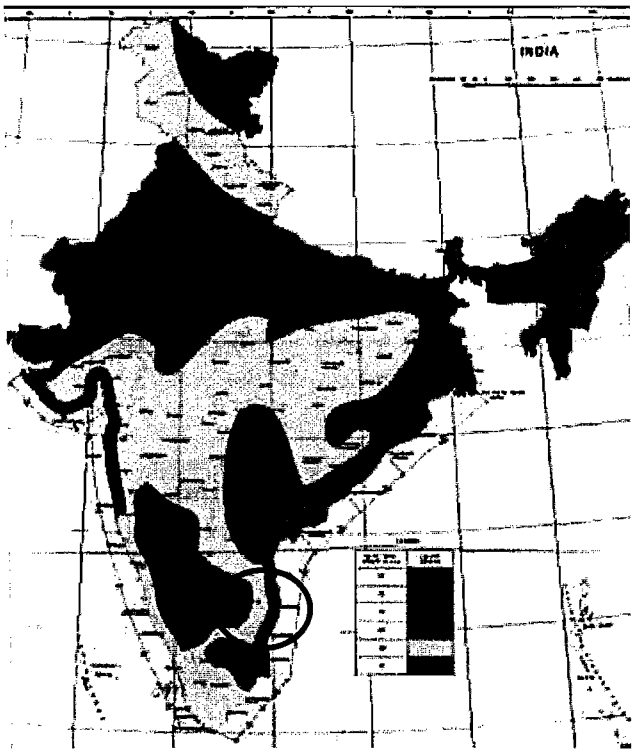
Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Living /Dining hall/ kitchens/Bed rooms	: 200 kg/sq.m (2.0 kN/sq.m)
Toilet and bathrooms	: 200 kg/sq.m (2.0 kN/sq.m)
Stairs	: 300 kg/sq.m (3.0 kN/sq.m)
Corridors / Balcony/utility	: 300 kg/sq.m (3.0 kN/sq.m)
Lift Machine room	: 1000 kg/ sq.m or as per actuals.
Balconies	: 300 kg/ sq.m or as per actuals.
Parking Area	: 250 kg/ sq.m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 1500 kg/sq.m (15.0 kN/sq.m).
Ramps	: 300 kg/sq.m (3 kN/sq.m)+ 25% Impact (Without fire truck movement
Communication Room /Meter Room	: 300 kg/sq.m (3.0 kN/sq.m)

1.3.3 Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3).

Chennai, which is located in Tamil nadu, is having wind speed of 50m/sec.

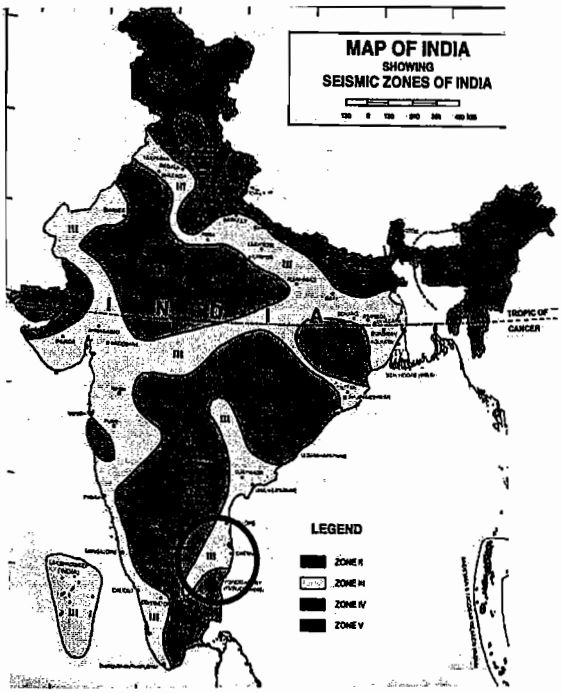


- Basic Wind Speed Vb : 50 m/sec
- Risk Coefficient K1 : 1.00 (k1 corresponds to 50 years Mean Probable Design Life of Structure)
- Terrain, height, structure size factor K2 : To suit the height of the structure for terrain Category 3 & Class C and also it varies with the height of the structure.
- Topography factor K3 : 1.00
- Importance factor for the cyclonic region K4 : 1.00
- The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)
- Design wind speed Vz : $Vb \times k1 \times k2 \times k3 \times k4$
- Design wind pressure Pz : $0.6 \times Vz^2$

Height of the building (m)	K2	$Vz = Vb \times k1 \times k2 \times k3 \times k4$ (m/s)	$Pz = 0.6 \times Vz^2$ (kN/m^2)

10	0.91	45.5	1.242
20	1.01	50.5	1.53
30	1.06	53	1.68
40	1.09	54.5	1.78
50	1.12	56	1.88
60	1.136	56.8	1.94
70	1.152	57.6	1.99
80	1.168	58.4	2.05
100	1.2	60.0	2.16

Seismic Forces



1.3.4 Seismic Forces

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

Seismic Zone : III
Seismic Zone factor, Z : 0.16 (As per Table 2, IS: 1893-2016)
Design horizontal seismic coefficient (Ah) : (Z/2)*(Sa/g)*(I/R)

I -Importance factor : 1.2 (Ref Table 6, IS: 1893-2016)
Response reduction Factor : 4 (SMRF)

R as per Table 7 of IS: 1893-2016 is based on Special moment RC Moment -Resisting Frame (SMRF), with ductile detailing.

Sa/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 (Ah)		: (Z/2)*(Sa/g)*(I/R)
		: (0.16/2)*(1.2/4) * (Sa/g)
	Ah	: 0.016 * (Sa/g)
Design seismic base shear, Vb		: Ah * W where, W - seismic weight of building
Detailing as per IS-13920-2002		: Special moment resistant frame with ductile detailing

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	0.36

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

- Environment : Moderate
- 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.
- Minimum grade of concrete : Moderate exposure - M30
- Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 30 mm
- Nominal covers for 2 hr. fire resistance :

Nominal Cover

Beams		Slabs		Ribs		Columns/Shear walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.3.6 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

1.3.7 Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

1.3.8 Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design.

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental hitting of vehicle on the façade
- Snow Load

1.4 MATERIALS:

Materials specified will 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.

1.4.1 Concrete:

- All structural concrete shall have cube crushing strength of M35 to M25 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation / Retaining Walls	M35/M30
Columns & Walls	M50 to M30
Girder beam	M40
Slab, beams & Ramps	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 415 N/sq.mm.
- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 500 N/sq.mm.

Structural Steel

All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm.

1.5 STRUCTURAL CONCEPT

- The Structural System comprises of regular Beam, slab and shear walls system for both car park and residential floors. Floor slabs and beams are considered to act as a rigid diaphragm to transfer the lateral forces to the columns.

- The slabs for toilet area sunk by 250mm. Balconies are sunk by 150mm.The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	
a)	Column grids	Varies
b)	Structural system	R.C.C Column and Girder Beam in 1st floor level and RC wall up to Terrace
c)	Slab thickness	175/150/125mm
d)	Column/RC Wall size	As per the design
g)	Peripheral beams	As per the design

Structural analysis and design:

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 2016** software package for both vertical and lateral loads.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, and seismic loads and for the load combinations as given in the relevant codes.
- The slabs are analyzed as two-way and one way slabs

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 deflection is considered as span/250

As per IS1893 (Part1) :2016, Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height design.

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 water retaining structures, crack width is limited to 0.2mm.

Load Combinations:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	EL	DL	LL	EL
DL + LL	1.5	1.5	–	1	1	–
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8

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

***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; EL - Earthquake Load

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 combination.

Expansion joint/Separation joint:

Expansion / separation joint is provided in this building.

1.6 WATERPROOFING:

Toilets and Balconies:

Water proofing is done with Acrylic cementitious coating, made on all wall faces and one coat crystallization method with water is made on floor areas.

Terrace:

In the Terrace areas, water proofing is done with Acrylic cementitious coating as first layer & 100mm thick (Average thickness) screed concrete or brick coba as a topping layer shall be used.

1.7 DESIGN PHILOSOPHY:

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 are required for all replaceable material for longer life.

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 to resist lateral forces. 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. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns. The type of footings proposed will be individual or Raft based on actual design

Foundation:

Foundations are designed depending upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. Individual / Combined footings is envisaged depending on the soil report.

ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No. SE/Gr.I /19/05/008
#180/84, Third Floor, Trunk Road,
Porur, Chennai -600 116.
Phone - 97411 10384

TABLE: Centers Of Mass And Rigidity

Story	Diaphragm	Mass X	Mass Y	XCM	YCM	Cum Mass X	Cum Mass Y	XCCM	YCCM	XCR	YCR
		kg	kg	m	m	kg	kg	m	m	m	m
Terrace	D1	404474.95	404474.95	6.1074	18.7663	404474.95	404474.95	6.1074	18.7663	7.5139	17.9323
17	D1	475777.3	475777.3	6.1989	18.8443	880252.25	880252.25	6.1569	18.8084	7.509	17.915
16	D1	475845.65	475845.65	6.1988	18.8416	1356097.9	1356097.9	6.1716	18.8201	7.5023	17.8991
15	D1	475845.65	475845.65	6.1988	18.8416	1831943.55	1831943.55	6.1787	18.8257	7.4938	17.8834
14	D1	475845.65	475845.65	6.1988	18.8416	2307789.2	2307789.2	6.1828	18.8289	7.4838	17.8673
13	D1	475845.65	475845.65	6.1988	18.8416	2783634.84	2783634.84	6.1856	18.8311	7.4725	17.8502
12	D1	475845.65	475845.65	6.1988	18.8416	3259480.49	3259480.49	6.1875	18.8326	7.4604	17.8311
11	D1	475845.65	475845.65	6.1988	18.8416	3735326.14	3735326.14	6.1889	18.8338	7.4479	17.8094
10	D1	475845.65	475845.65	6.1988	18.8416	4211171.78	4211171.78	6.1901	18.8347	7.4359	17.784
9	D1	475845.65	475845.65	6.1988	18.8416	4687017.43	4687017.43	6.1909	18.8354	7.4252	17.7541
8	D1	475845.65	475845.65	6.1988	18.8416	5162863.08	5162863.08	6.1917	18.8359	7.4176	17.7185
7	D1	475845.65	475845.65	6.1988	18.8416	5638708.72	5638708.72	6.1923	18.8364	7.4156	17.6765
6	D1	475845.65	475845.65	6.1988	18.8416	6114554.37	6114554.37	6.1928	18.8368	7.4232	17.6276
5th Floor	D1	475845.65	475845.65	6.1988	18.8416	6590400.02	6590400.02	6.1932	18.8372	7.4475	17.5732
Forth Floor	D1	475845.65	475845.65	6.1988	18.8416	7066245.67	7066245.67	6.1936	18.8374	7.5017	17.5189
Third Floor	D1	475845.65	475845.65	6.1988	18.8416	7542091.31	7542091.31	6.1939	18.8377	7.6156	17.4805
TYPICAL	D1	475845.65	475845.65	6.1988	18.8416	8017936.96	8017936.96	6.1942	18.8379	7.8877	17.4948
First Floor	D1	529846.54	529846.54	6.217	18.8373	8547783.5	8547783.5	6.1956	18.8379	8.8121	17.7339
STILT	D1	1792280.99	1792280.99	6.9318	12.3648	10340064.5	10340064.5	6.3232	17.7159	9.6689	17.8764

TABLE: Modal Participating Mass Ratios

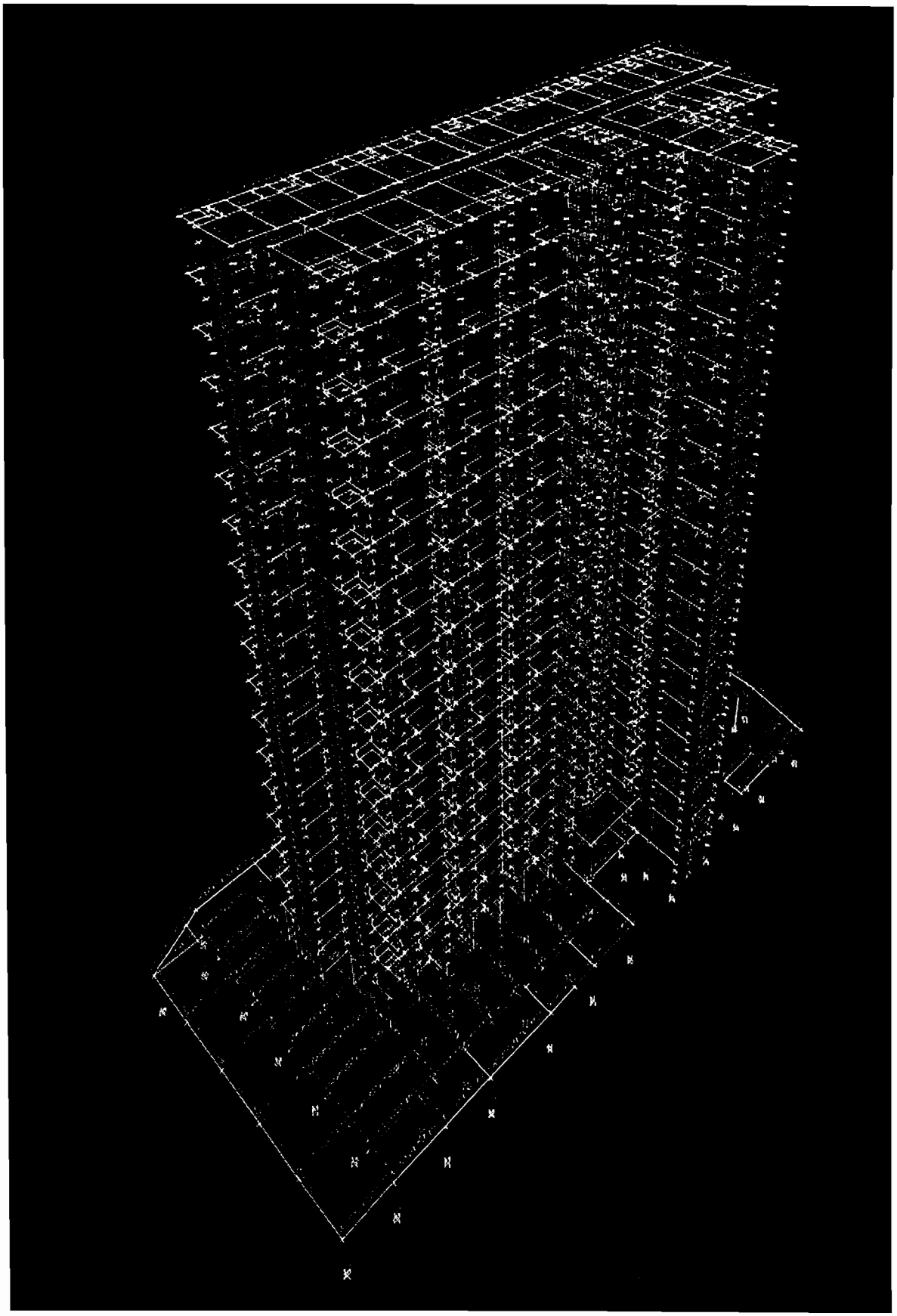
Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec												
Modal	1	1.722	0.4546	0.0001	0	0.4546	0.0001	0	0.0001	0.2801	0.1275	0.0001	0.2801	0.1275
Modal	2	1.616	0.0521	0.4098	0	0.5066	0.4099	0	0.3027	0.0327	0.1094	0.3027	0.3128	0.2369
Modal	3	1.553	0.1168	0.1668	0	0.6235	0.5767	0	0.1231	0.0712	0.2455	0.4259	0.384	0.4824
Modal	4	0.456	0.1558	2E-05	0	0.7792	0.5767	0	0.0001	0.2299	0.0049	0.4259	0.6139	0.4873
Modal	5	0.355	0.0029	0.0897	0	0.7821	0.6665	0	0.0823	0.0031	0.0689	0.5083	0.617	0.5562
Modal	6	0.34	0.0024	0.0781	0	0.7845	0.7446	0	0.0698	0.0028	0.0774	0.5781	0.6198	0.6337
Modal	7	0.26	0.0002	7.93E-06	0	0.7847	0.7446	0	6.63E-06	0.0003	0.0001	0.5781	0.6201	0.6338
Modal	8	0.221	0.0758	0	0	0.8605	0.7446	0	0	0.1052	0.0017	0.5781	0.7253	0.6355
Modal	9	0.145	0.0012	0.0712	0	0.8617	0.8158	0	0.0882	0.0024	0.0013	0.6663	0.7277	0.6368
Modal	10	0.138	0.0615	0.0034	0	0.9233	0.8192	0	0.0042	0.1159	0.002	0.6705	0.8436	0.6388
Modal	11	0.083	0.0624	0.01	0	0.9856	0.8292	0	0.0163	0.1244	0.0048	0.6867	0.968	0.6436
Modal	12	0.069	0.0045	0.1306	0	0.9902	0.9599	0	0.2271	0.0094	0.0033	0.9139	0.9774	0.6469

Table: Story Stiffness

Story	Output Case	Case Type	Shear X	Drift X	Stiff X	Shear Y	Drift Y	Stiff Y	
Terrace	SPECXP	LinRespSpec	487.4472	1.192	408972.301	62.2531	0.677	91988.466	#DIV/0!
17	SPECXP	LinRespSpec	948.6263	1.281	740647.593	107.6702	0.686	156870.673	1.810996958
16	SPECXP	LinRespSpec	1279.0839	1.341	953990.847	128.0014	0.696	183990.312	1.288049615
15	SPECXP	LinRespSpec	1488.0267	1.385	1074224.167	139.3891	0.703	0	1.126031943
14	SPECXP	LinRespSpec	1599.2684	1.407	1136802.746	160.8712	0.707	227622.889	1.058254674
13	SPECXP	LinRespSpec	1648.1944	1.416	1164094.176	194.8425	0.707	275610.641	1.024007182
12	SPECXP	LinRespSpec	1672.76	1.417	1180152.014	226.6776	0.705	321378.992	1.013794277
11	SPECXP	LinRespSpec	1700.938	1.412	1204647.116	242.6368	0.699	347123.331	1.020755887
10	SPECXP	LinRespSpec	1743.4035	1.4	1245622.857	241.4648	0.687	351423.391	1.034014726
9	SPECXP	LinRespSpec	1799.6122	1.381	1303561.297	239.1179	0.669	357320.669	1.046513629
8	SPECXP	LinRespSpec	1872.0303	1.354	1382354.014	258.4579	0.645	400768.772	1.060444198
7	SPECXP	LinRespSpec	1972.8478	1.318	1496406.078	298.548	0.614	486525.097	1.082505684
6	SPECXP	LinRespSpec	2113.7879	1.272	1661578.069	331.4434	0.574	577213.532	1.110379123
5	SPECXP	LinRespSpec	2289.1305	1.213	1887733.522	332.8579	0.525	634215.096	1.136108834
4	SPECXP	LinRespSpec	2475.1502	1.134	2181931.874	309.9634	0.463	668947.8	1.155847395
3	SPECXP	LinRespSpec	2652.6589	1.036	2561442.778	317.8001	0.388	819871.808	1.173933434
TYPICAL	SPECXP	LinRespSpec	2824.9614	0.791	3570175.774	386.2655	0.3	1287389.472	1.393814379
First Floor	SPECXP	LinRespSpec	3064.9927	0.882	3474923.508	454.8226	0.248	1834020.589	0.973320007
STILT	SPECXP	LinRespSpec	3530.067	0.595	5932964.454	660.0554	0.153	4304243.512	1.707365483
Terrace	SPECYP	LinRespSpec	37.4353	0.257	0	531.0594	1.504	353097.142	#DIV/0!
17	SPECYP	LinRespSpec	73.568	0.259	0	1020.0923	1.543	660940.414	1.871837337
16	SPECYP	LinRespSpec	101.0675	0.259	0	1363.5966	1.557	875559.995	1.324718502
15	SPECYP	LinRespSpec	122.9933	0.258	0	1575.0806	1.565	1006681.07	1.149756814
14	SPECYP	LinRespSpec	143.2405	0.256	0	1679.4773	1.564	1073729.873	1.066603818
13	SPECYP	LinRespSpec	164.0631	0.253	0	1713.0255	1.555	1101581.64	1.025939268
12	SPECYP	LinRespSpec	184.5828	0.248	744220.187	1719.2877	1.537	1118654.127	1.015498159
11	SPECYP	LinRespSpec	201.9914	0.242	833953.817	1739.4984	1.51	1152251.229	1.030033503
10	SPECYP	LinRespSpec	214.4427	0.236	907296.134	1799.6017	1.473	1221461.741	1.06006547
9	SPECYP	LinRespSpec	223.5042	0.231	968015.745	1903.9876	1.427	1333885.777	1.092040571
8	SPECYP	LinRespSpec	234.0656	0.225	1039102.173	2043.2634	1.371	1490414.247	1.117347731
7	SPECYP	LinRespSpec	250.0887	0.22	1136564.713	2208.2806	1.302	1695905.503	1.137875263
6	SPECYP	LinRespSpec	269.1998	0.214	1260491.653	2397.0842	1.218	1967615.083	1.160215047
5	SPECYP	LinRespSpec	283.7353	0.203	1394640.813	2610.0063	1.117	2337456.28	1.187964201
4	SPECYP	LinRespSpec	289.9639	0.187	1546557.852	2838.1061	0.992	2861815.948	1.224329187
3	SPECYP	LinRespSpec	298.569	0.167	0	3055.8937	0.84	3637523.912	1.271054456
TYPICAL	SPECYP	LinRespSpec	325.5207	0.14	2330709.72	3226.397	0.649	4970286.728	1.366392867
First Floor	SPECYP	LinRespSpec	349.8359	0.128	2735300.623	3382.1469	0.537	6296640.439	1.266856579
STILT	SPECYP	LinRespSpec	566.3248	0.075	7554261.937	4121.0096	0.285	14442333.97	2.293657087

3D MODEL

W



TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN. Grade of Concrete = M25.

Mx = 7.1 KN-m. Grade of Steel = Fe500.

My = 26 KN-m.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the lirnits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum morneni for which the column is to be designed is
Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN. Grade of Concrete = M30

Mx = 25.26KN-m. Grade of Steel = Fe500.

My = 83 KN-m.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

M_u / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

M_u / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

TYPICAL BEAM DESIGN

(ANALYSIS WAS DONE BY ETABS USING DIFFERENT LOAD COMBINATIONS, THE DESIGN FORCES ARE TAKEN FOR DCON2 CASE)

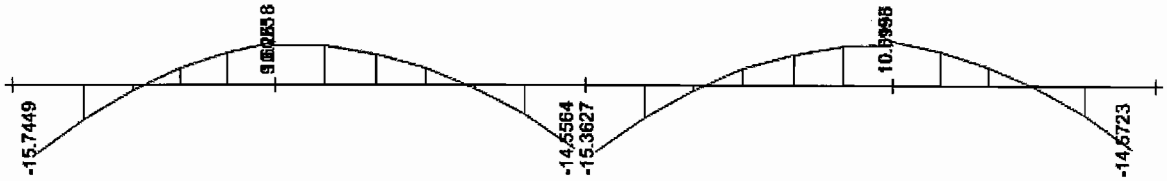
A Beam of 2 spans was considered for Typical Design Calculation.
Beam Location – Along Grid 33 to 46 (First Floor Shuttering)

Beam Size : 200mm x 450mm.

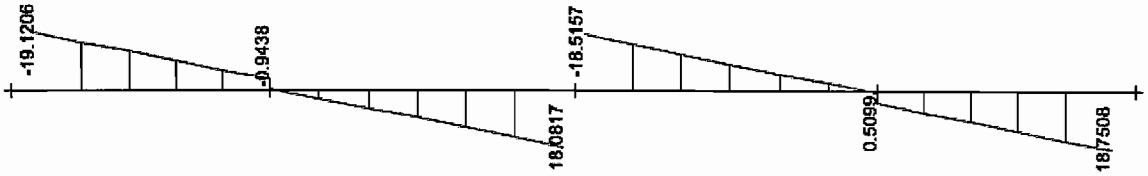
Grade of Concrete = M30;
Grade of Steel = Fe-500;
Effective depth – d' = 450-50 = 400 mm.

BENDING MOMENT, SHEAR FORCE AND TORSION DIAGRAMS TAKEN FROM ETABS

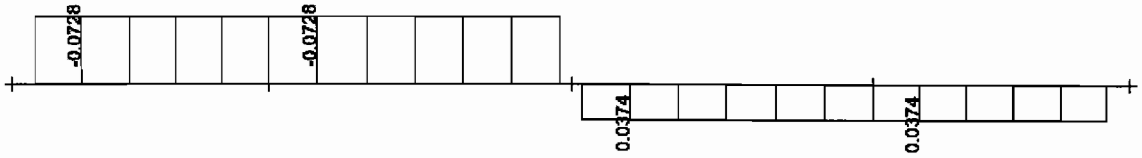
BENDING MOMENT DIAGRAM (KNm)



SHEAR FORCE DIAGRAM (KN)



TORSION DIAGRAM (KNm/m)



LEFT BEAM-(200X450)

Left End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 36KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 36 + 0.35
= 36.35 KN-m.

Mu/bd^2 = 36.35 x 10^6 /230 x 400^2
= **0.987**

Pt = 0.29 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
=0.29 x 230 x 400/ 100
= 267 mm^2.

Provide (2T16) ---- @ Top

Mid Span bottom

Mu = 41-KNm

Mu/bd^2 = 41x 10^6 /230 x 400^2
= 1.12

Pt = 1.12 % (From SP-16, Table 3)
As per IS : 13920 : 1993 minimum reinforcement provided will be 0.24%
Ast = Pt x b x D/100
= 0.24 x 230 x 450/ 100
= 249 mm^2.

Provide (2T16)

Right End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 35KN-m. Tu = 0.2 KN-m/m

M_t = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 35 + 0.35
= 35.35 KN-m.

Mu/bd^2 = 35.35 x 10^6 /230 x 400^2
= **0.96**

P_t = 0.2789 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
= 0.2789 x 230 x 400/ 100
= 256 mm^2.
Provide (2T16) ---- @ Top

Shear Reinforcement:

V1 at Left End Support = 47 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 5.13/0.23 + 47 = 83 KN

ζv = Vu/bd = 83 x 10^3/ 230 x 400
= 0.90 N/mm^2
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm^2
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400

= .278

Therefore ζ_c = 0.39 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 83 x 10^3 – 0.39 x 230 x 400
= 47.12 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 47.12 x 10^3
= 306 mm.

V1 at Right End Support = 46 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 0.2/0.23 + 46 = 47.4 KN

ζv = Vu/bd = 47.4 x 10^3/ 230 x 400
= 0.52 N/mm²
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm²
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400
= .28

Therefore ζ_c = 0.36 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 47.41 x 10^3 – 0.36 x 230 x 400
= 14.29 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 14.29 x 10^3
= 1013 mm.

As per code IS : 13920 : 1993 minimum spacing provided should be d/4 or 8 x diameter of smaller bar or 100mm whichever is less.

Hence Provide 2L-T8@100/200/100 c/c

Check for Deflection:

Maximum allowable Elastic short term deflection = l/250 = 4512/250
= 18.048 mm.

But actual deflection from ETABS = 1.4mm.

Maximum allowable long term deflection = l/350 = 4512/350
= 12.9 mm > 1.41 mm.

Therefore within the limits.

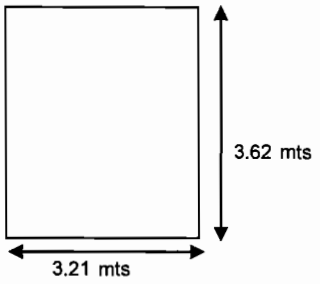
DESIGN TWOWAY SLAB

DESIGN OF TWO WAY SLAB

Short span	S=	3.21	m
Long span	L=	3.62	m
Assumed slab thickness	t=	0.125	m
Grade of concrete	fck=	25	N/mm^2
Grade of reinforcement	fy=	500	N/mm^2

Clear Span	
S	3.21
L	3.62

Type of panel One short edge discontinuous



Loads

Self weight of slab	w1=	3.13	kN/m^2	
Floor finish	w2=	1.50	kN/m^2	
Live load	w3=	2.00	kN/m^2	TOTAL
Miscellaneous	w4=	0.00	kN/m^2	6.63 kN/m^2

Ratio of long span to short span R= 1.15

Design Load with load factor of 1.5 Wu= 9.94 kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.046	**4.71**	0.46	0.11	**150.00**	8	335	101
Positive moment at midspan	0.034	**3.48**	0.34	0.08	**150.00**	8	335	101
						8	200	
Long span direction								
Negative moment at continuous edge	0.037	**3.79**	0.44	0.10	**150.00**	8	335	93
Positive moment at midspan	0.028	**2.87**	0.33	0.08	**150.00**	8	335	93

Minimum effective depth reqd	dre=	36.95	mm
Clear cover to any reinforcement	c=	20	mm
Minimum effective depth provided	dpr=	93	mm greater than 'min. eff depth reqd'. Hence ok
Minimum reinforcement	Amin=	150	mm^2

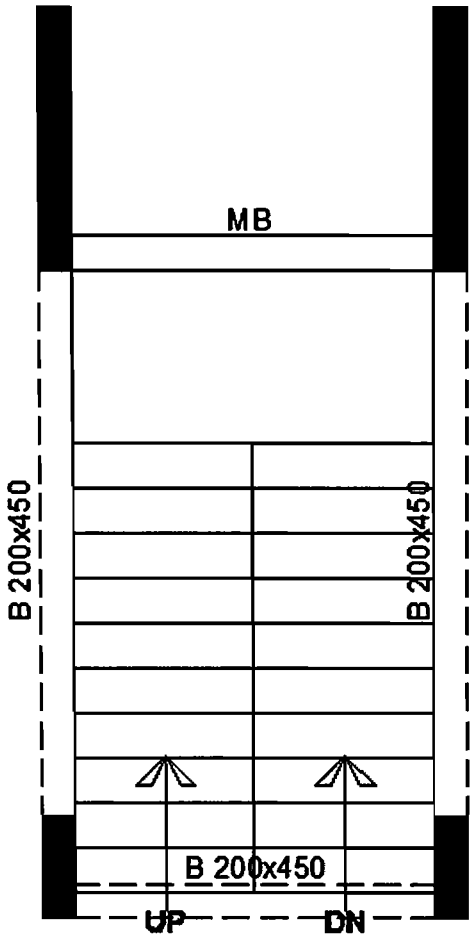
Deflection check

Reinf provided at midspan along short direction 251.33 mm^2 Dia 8 at 200 mm

Stress in reinforcement	fs=	173.081	N/mm^2
Percentage of reinforcement provided	pt=	0.24884	%
Modification factor as per fig 4 of IS:456-2000	MF=	2	

Type of slab for deflection check	Continuous	
Basic span to effective depth ratio	26	
Minimum effective depth reqd from deflection criteria	61.73	mm
Effective depth provided	101	mm greater than 'min. eff depth reqd'. Hence ok

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

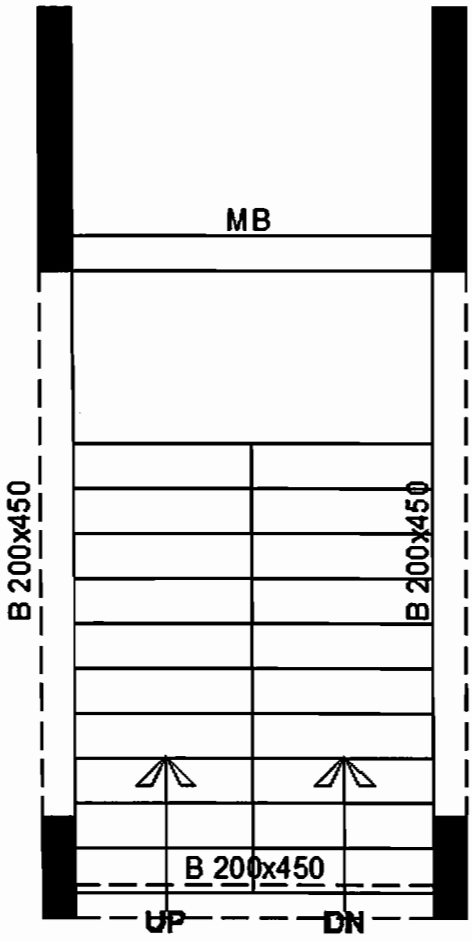
Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

SOIL EXPLORATION REPORT

PROJECT NO : **7364**

PROJECT NAME : **Construction of Proposed 2 Basement + Stilt + 19 Floors, Alliance Budget housing at Siruseri.**

1. INTRODUCTION

M/s. Alliance Group are proposing to construct 2 Basement + Stilt + 19 Floors Alliance Budget housing, Siruseri, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Alliance Group, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose eight boreholes were bored upto a depth varies from 6.0 to 8.5M below ground level. The boreholes were terminated after drilling for the required depth in the medium rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling techniques was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could not be collected since the soil layers met with were essentially cohesionless in nature. Core samples were collected from medium rock layers.

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 9 The top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

4. ANALYSIS OF TEST RESULTS

1. Standard Penetration Test
2. Grain Size Analysis
3 Determination of Specific Gravity
4. Crushing Strength of Rock

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 2 to 9. The relative density of the cohesionless layers obtained from the N values are given in the bore logs.

4. 2 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart .

4.3 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.4 Crushing Strength of Rock

Core samples collected from medium rock layers were tested for determining crushing strength of rock. The results are given in Table – 2.

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock / medium rock layer.

The safe bearing capacity of these cohesionless layers could be computed using the formula,

$$Q_a = (0.5\gamma \times B \times N_\gamma + \gamma D_f N_q) \div 2.5$$

Where,

B	=	Width of footing
γ	=	Submerged unit weight of soil taken as 1 gm/cc,
D_f	=	Depth of surcharge
$N\gamma$ Nq	=	Bearing capacity factors based on the N values taken from Fig 10

For an N value of over 50 the SBC computed over 5.0kg/cm^2 for the foundations are placed on the disintegrated rock layer. However, the SBC may be limited to 5.0kg/c^2 to allow for any non-uniformity.

When the foundations are taken to medium rock layer the SBC that could be adopted is 10kg/cm^2.

The settlement would be elastic and of small order.

Over excavations in disintegrated rock should be refilled by 1:3:6 concrete and in medium rock by 1:2:4 concrete.

6. EXCAVATION PROCEDURE

1. Vertical cuts could be given for excavation.

2. Normal excavators would be required for excavation in disintegrated rock and jack hammers would be required for excavation in medium rock.

3. Slush formed by any water accumulation should be removed and refilled by lean concrete.

4. If water accumulates in the foundation trenches, dewatering should be done by pumping out water from a level lower than the foundation level to maintain downward flow of water.

5 The exposed side of excavation should be covered by plastic sheet during rainy season and surface drain provided to prevent water from flowing on the cut surface.

8. CONCLUSIONS

1. The area explored has got top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

2. For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock /medium rock layer. The SBC that could be adopted is 5.0kg/cm^2 when the foundations are placed on the disintegrated rock layer and 10.0kg/cm^2 when the foundations are on the medium rock layer.

3. The settlement of the shallow foundation would be of small order and elastic in nature.

P.N.7364

4. Over excavations in the foundation trenches should be refilled as suggested.

5. Suggested excavation procedure should be adopted while undertaking the construction.

F.S.ENGINEERS PVT.LTD
NEW NO.98,(Old No.109) VELACHERY ROAD
GUINDY
CHENNAI – 600 032

(Dr.A. Verghese Chummar)
Director
Dated: Feb 5th , 2018

P.N.7364

ALLIANCE SIRUSERI, CHENNAI

BLOCK-B

STRUCTURAL DESIGN CALCULATIONS

DesignTree Service Consultants Pvt Ltd
Consulting Engineers
7 Laxmi Narasimha Complex
15th Cross 100 Feet Road 4 Phase,
J.P.Nagar, Bangalore 560 078. INDIA
T: +91 80 4122 5481 F: +918041225479
EMAIL: info@designtreeconsultants.com
www.designtreeconsultants.com

N. ARUN KARANTH, M.Tech
Structural Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone - 97411 10384

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3. 3D-MODEL
4. TYPICAL DESIGN CALCULATION OF STRUCTURAL MEMBERS
   - COLUMN DESIGN
   - BEAM DESIGN
   - SLAB DESIGN
   - STAIR CASE DESIGN
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6. SOIL REPORT

ALLIANCE SIRUSERI, CHENNAI

DESIGN BRIEF REPORT

Client	:	**ALLIANCE GROUP** Chennai
SMEP Consultants	:	**Design Tree Service Consultants Pvt Ltd** # 7, Laxmi Narasimha Complex 15th Cross, 100ft Ring Road, 4th Phase, JP Nagar Bangalore - 560 078
Architects	:	**LAVANYA & SHANKAR ARCHITECTS** Chennai

ISSUE RECORD

PROJECT : **ALLIANCE SIRUSERI , CHENNAI**

TITLE : **Preliminary Design Brief Report**

DOCUMENT NO : **DTSC / 406 F**

1. STRUCTURAL

DATE	ISSUE	PREPARED	CHECKED	REMARKS / REVISION
20.02.19	Prelim report	SWAPNA	B.SRINIVASARAO	R0
22.07.19	Prelim report	SUNIL	B.SRINIVASARAO	R1
25.10.21	Prelim report	SUNIL	B.SRINIVASARAO	R2

1. STRUCTURE

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1- STRUCTURE

1.1 Project Brief/Introduction

1.2 Design standards

1.3 Design Data

1.4 Materials

1.5 Structural concept

1.6 Water Proofing

1.7 Design Philosophy

1.1 PROJECT BRIEF

The clients M/S ALLIANCE GROUP Intends to develop residential building, at Chennai. Project is architectured by LAVANYA & SHANKAR ARCHITECTSChennai.Structures, Plumbing, Fire Protection, HVAC and Electrical Engineering Services are provided by M/S Design Tree Service Consultants Pvt. Ltd, Bangalore.

All service facilities like underground sump and pump are to be provided as per the requirements given by clients.

The proposed residential building having 10 blocks A,B,C,D, E,F,G,H,I &J.

- Residential blocks A,B,C,D,E,F& G having 1 Basement + stilt+19 upper floors+Terrace floor.
- Residential block H having 1 Basement + stilt+17 upper floors+Terrace floor.
- Block I (Club house) having1 Basement + Ground +3+Terrace.
- Block J (Learning hub) having Ground+3+Terrace.

The height of the proposed Building from FGL is up to 59.85 /53.90/ 22.05 / 14.85 mts.

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- NationalBuilding Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

1.2 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.

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.
IS: 6313 (part II)	: Standards for anti-termite treatment.
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 -2012	: Code of practice for pre stressed concrete.
IS: 14268 - 1995	: Uncoated stress relieved low relaxation seven-ply strand for pre stressed 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: 13920-2016	: Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice.
IS: 16700 -2017	: Criteria for structural safety of tall 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 - 1984 (reaffirmed 1998)	: 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.

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

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 hard drawn 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 DATA:

Loads:

1.3.1 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	:	120kg/sq.m (1.2kN/sq.m).
• Floor finish of 75mm thick for Parking Areas	:	180kg/sq.m (1.8kN/sq.m).
• False ceiling + ducting + Sprinklers(services)	:	40 kg/sq.m (0.4 kN/sq.m).
• Partitions	:	100kg/sq.m (1.0kN/sq.m).
• Wall loads	:	As per actuals.
• 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	:	1900 kg/cu.m (19 kN/cu.m).

• Aerated block masonry	:	865 kg/cu.m (8.65 kN/cu.m).
• Soil (Dry)	:	1800 kg/cu.m (18 kN/cu.m).
• Soil (Saturated)	:	2000 kg/cu.m (20 kN/cu.m).
• Water	:	1000 kg/cu.m (10 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)
• Waterproofing (membrane).	:	15kg/sq.m (0.15kN/sq.m).
• External finishes	:	As per actuals.
• Gardening/Landscape loads	:	As per actuals
• Equipment loads	:	As per Vendor details.

1.3.2 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.

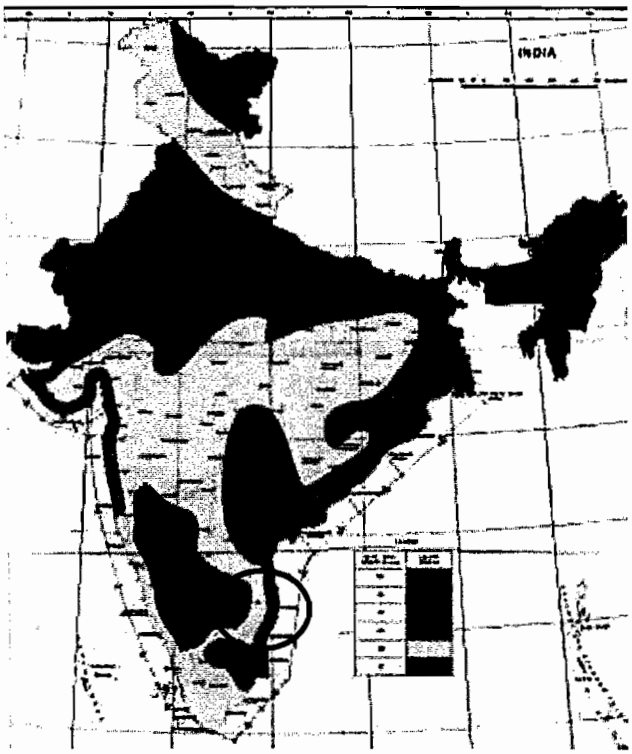
Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Living /Dining hall/ kitchens/Bed rooms	: 200 kg/sq.m (2.0 kN/sq.m)
Toilet and bathrooms	: 200 kg/sq.m (2.0 kN/sq.m)
Stairs	: 300 kg/sq.m (3.0 kN/sq.m)
Corridors / Balcony/utility	: 300 kg/sq.m (3.0 kN/sq.m)
Lift Machine room	: 1000 kg/ sq.m or as per actuals.
Balconies	: 300 kg/ sq.m or as per actuals.
Parking Area	: 250 kg/ sq.m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 1500 kg/sq.m (15.0 kN/sq.m).
Ramps	: 300 kg/sq.m (3 kN/sq.m)+ 25% Impact (Without fire truck movement
Communication Room /Meter Room	: 300 kg/sq.m (3.0 kN/sq.m)

1.3.3 Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3).

Chennai, which is located in Tamil nadu, is having wind speed of 50m/sec.

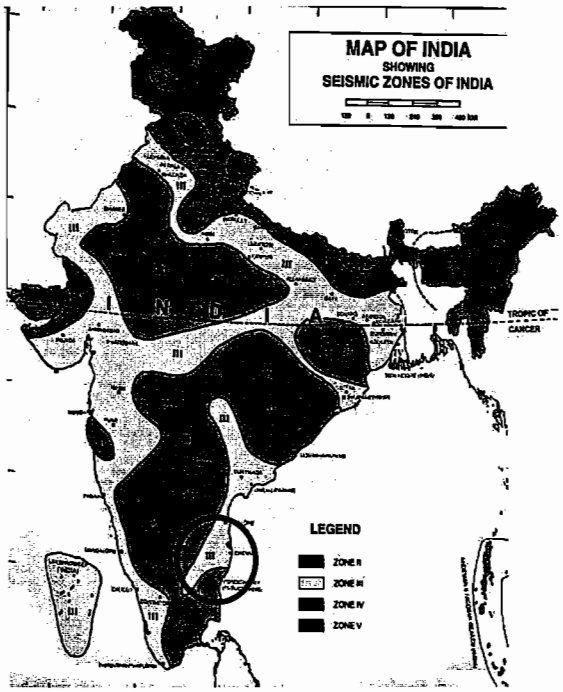


- Basic Wind Speed Vb : 50 m/sec
- Risk Coefficient K1 : 1.00 (k1 corresponds to 50 years Mean Probable Design Life of Structure)
- Terrain, height, structure size factor K2 : To suit the height of the structure for terrain Category 3 & Class C and also it varies with the height of the structure.
- Topography factor K3 : 1.00
- Importance factor for the cyclonic region K4 : 1.00
- The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3)
- Design wind speed Vz : Vb x k1 x k2 x k3 x k4
- Design wind pressure Pz : $0.6 \times Vz^2$

Height of the building (m)	K2	Vz = Vb x k1 x k2 x k3 xk4 (m/s)	Pz = 0.6 x Vz^2 (kN/m^2)

10	0.91	45.5	1.242
20	1.01	50.5	1.53
30	1.06	53	1.68
40	1.09	54.5	1.78
50	1.12	56	1.88
60	1.136	56.8	1.94
70	1.152	57.6	1.99
80	1.168	58.4	2.05
100	1.2	60.0	2.16

Seismic Forces



1.3.4 Seismic Forces

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

Seismic Zone : III
Seismic Zone factor, Z : 0.16 (As per Table 2, IS: 1893-2016)
Design horizontal seismic coefficient (Ah) : (Z/2)*(Sa/g)*(I/R)

I -Importance factor : 1.2 (Ref Table 6, IS: 1893-2016)
Response reduction Factor : 4 (SMRF)

R as per Table 7 of IS: 1893-2016 is based on Special moment RC Moment -Resisting Frame (SMRF), with ductile detailing.

Sa/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 (Ah)		: (Z/2)*(Sa/g)*(I/R)
		: (0.16/2)*(1.2/4) * (Sa/g)
	Ah	: 0.016 * (Sa/g)
Design seismic base shear, Vb		: Ah * W where, W - seismic weight of building
Detailing as per IS-13920-2002		: Special moment resistant frame with ductile detailing

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	0.36

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

- Environment : Moderate
- 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.
- Minimum grade of concrete : Moderate exposure - M30
- Nominal cover to reinforcement : For Moderate Exposure Nominal cover should not be less than 30 mm
- Nominal covers for 2 hr. fire resistance :

Nominal Cover

Beams		Slabs		Ribs		Columns/Shear walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.3.6 Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing or designing structural members for the additional moments caused by the temperature and shrinkage effects. Pour strips at suitable locations shall also be considered where required.

1.3.7 Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

1.3.8 Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design.

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental hitting of vehicle on the façade
- Snow Load

1.4 MATERIALS:

Materials specified will 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.

1.4.1 Concrete:

- All structural concrete shall have cube crushing strength of M35 to M25 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix

Concrete item	Grade
Foundation / Retaining Walls	M35/M30
Columns & Walls	M50 to M30
Girder beam	M40
Slab, beams & Ramps	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 415 N/sq.mm.
- All reinforcement shall confirm to IS: 1786 - 2008 having minimum yield strength of 500 N/sq.mm.

Structural Steel

All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm.

1.5 STRUCTURAL CONCEPT

- The Structural System comprises of regular Beam, slab and shear walls system for both car park and residential floors. Floor slabs and beams are considered to act as a rigid diaphragm to transfer the lateral forces to the columns.

- The slabs for toilet area sunk by 250mm. Balconies are sunk by 150mm.The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	
a)	Column grids	Varies
b)	Structural system	R.C.C Column and Girder Beam in 1st floor level and RC wall up to Terrace
c)	Slab thickness	175/150/125mm
d)	Column/RC Wall size	As per the design
g)	Peripheral beams	As per the design

Structural analysis and design:

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 2016** software package for both vertical and lateral loads.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, and seismic loads and for the load combinations as given in the relevant codes.
- The slabs are analyzed as two-way and one way slabs

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 deflection is considered as span/250

As per IS1893 (Part1) :2016, Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height design.

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 water retaining structures, crack width is limited to 0.2mm.

Load Combinations:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	EL	DL	LL	EL
DL + LL	1.5	1.5	–	1	1	–
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8

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

***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; EL - Earthquake Load

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 combination.

Expansion joint/Separation joint:

Expansion / separation joint is provided in this building.

1.6 WATERPROOFING:

Toilets and Balconies:

Water proofing is done with Acrylic cementitious coating, made on all wall faces and one coat crystallization method with water is made on floor areas.

Terrace:

In the Terrace areas, water proofing is done with Acrylic cementitious coating as first layer & 100mm thick (Average thickness) screed concrete or brick coba as a topping layer shall be used.

1.7 DESIGN PHILOSOPHY:

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 are required for all replaceable material for longer life.

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 to resist lateral forces. 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. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns. The type of footings proposed will be individual or Raft based on actual design

Foundation:

Foundations are designed depending upon Geo technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. Individual / Combined footings is envisaged depending on the soil report.

UN KARANTH, M.Tech
al Engineer-Grade-I (SE)
Regn.No.SE/Gr.I /19/05/008
#180/84,Third Floor, Trunk Road,
Porur,Chennai -600 116.
Phone - 97411 10384

TABLE: Centers Of Mass And Rigidity

Story	Diaphragm	Mass X	Mass Y	XCM	YCM	Cum Mass X	Cum Mass Y	XCCM	YCCM	XCR	YCR
		kg	kg	m	m	kg	kg	m	m	m	m
TERRACE	D1	1770315.29	1770315.29	0.8103	52.8234	1770315.29	1770315.29	0.8103	52.8234	5.0364	53.7281
19TH	D1	1951414.45	1951414.45	0.7417	52.9549	3721729.74	3721729.74	0.7743	52.8924	5.0557	53.751
18TH	D1	1951414.45	1951414.45	0.7417	52.9549	5673144.19	5673144.19	0.7631	52.9139	5.0754	53.7728
17TH	D1	1951414.45	1951414.45	0.7417	52.9549	7624558.64	7624558.64	0.7576	52.9244	5.0987	53.795
16TH	D1	1951414.45	1951414.45	0.7417	52.9549	9575973.09	9575973.09	0.7544	52.9306	5.1257	53.8182
1STH	D1	1951414.45	1951414.45	0.7417	52.9549	11527387.54	11527387.54	0.7522	52.9347	5.1565	53.8432
14TH	D1	1951414.45	1951414.45	0.7417	52.9549	13478801.99	13478801.99	0.7507	52.9376	5.1906	53.8704
13TH	D1	1951414.45	1951414.45	0.7417	52.9549	15430216.44	15430216.44	0.7496	52.9398	5.2276	53.9004
12TH	D1	1951414.45	1951414.45	0.7417	52.9549	17381630.89	17381630.89	0.7487	52.9415	5.2673	53.9338
11TH	D1	1951414.45	1951414.45	0.7417	52.9549	19333045.34	19333045.34	0.748	52.9429	5.3095	53.9707
10TH	D1	1951414.45	1951414.45	0.7417	52.9549	21284459.79	21284459.79	0.7474	52.944	5.3547	54.0112
9TH	D1	1951414.45	1951414.45	0.7417	52.9549	23235874.23	23235874.23	0.7469	52.9449	5.4036	54.0548
8TH	D1	1951414.45	1951414.45	0.7417	52.9549	25187288.68	25187288.68	0.7465	52.9457	5.4583	54.0999
7TH	D1	1951414.45	1951414.45	0.7417	52.9549	27138703.13	27138703.13	0.7462	52.9463	5.5228	54.1429
6TH	D1	1951414.45	1951414.45	0.7417	52.9549	29090117.58	29090117.58	0.7459	52.9469	5.6043	54.1762
5TH	D1	1951414.45	1951414.45	0.7417	52.9549	31041532.03	31041532.03	0.7456	52.9474	5.7155	54.1846
4TH	D1	1951857.66	1951857.66	0.7423	52.9482	32993389.69	32993389.69	0.7454	52.9475	5.8746	54.1401
3RD FLOOR	D1	1951439.04	1951439.04	0.7417	52.9545	34944828.73	34944828.73	0.7452	52.9478	6.1214	53.9934
2ND FLOOR	D1	1954759.47	1954759.47	0.7464	52.9751	36899588.2	36899588.2	0.7453	52.9493	6.5377	53.6953
1ST FLOOR	D1	2417109.46	2417109.46	0.8539	55.1514	39316697.66	39316697.66	0.752	53.0847	7.1706	53.4021
STILT	D1	5657848.85	5657848.85	-8.4659	55.9512	44974546.51	44974546.51	-0.4077	53.4453	5.4501	52.6047
LMR TOP	D2	21606.12	21606.12	4.5777	58.8748	21606.12	21606.12	4.5777	58.8748	9.61	58.7842
LMR BOTTOM	D2	59551.48	59551.48	4.9662	58.8266	81157.6	81157.6	4.8628	58.8394	8.9583	58.7147
LMR TOP	D3	81293.95	81293.95	5.0798	20.5967	81293.95	81293.95	5.0798	20.5967	7.7766	29.515
LMR BOTTOM	D3	122715.78	122715.78	5.4581	21.1141	204009.74	204009.74	5.3074	20.9079	6.602	35.7683
LMR TOP	D4	82618.57	82618.57	5.211	86.3709	82618.57	82618.57	5.211	86.3709	7.9517	79.2252
LMR BOTTOM	D4	118167.6	118167.6	5.3934	86.2471	200786.17	200786.17	5.3184	86.298	6.7777	73.5945

TABLE: Modal Participating Mass Ratios

Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec												
Modal	1	2.203	0.0001	0.6165	0	0.0001	0.6165	0	0.3528	4.95E-05	0.0141	0.3528	4.95E-05	0.0141
Modal	2	1.762	0.5144	0.002	0	0.5145	0.6185	0	0.0011	0.3599	0.0777	0.3539	0.3599	0.0919
Modal	3	1.7	0.0733	0.0208	0	0.5878	0.6394	0	0.0118	0.0524	0.4934	0.3656	0.4123	0.5852
Modal	4	0.599	1.74E-05	0.1628	0	0.5878	0.8022	0	0.2549	3.34E-05	0.0012	0.6206	0.4123	0.5865
Modal	5	0.396	0.1556	7.01E-06	0	0.7434	0.8022	0	3.34E-05	0.148	0.0088	0.6206	0.5604	0.5953
Modal	6	0.383	0.0089	0.0021	0	0.7524	0.8043	0	0.003	0.008	0.1539	0.6236	0.5684	0.7491
Modal	7	0.296	3.74E-05	0.0742	0	0.7524	0.8785	0	0.1111	3.53E-05	0.0011	0.7346	0.5684	0.7503
Modal	8	0.193	0.0003	0.0449	0	0.7527	0.9234	0	0.0914	0.0003	0.0006	0.826	0.5687	0.7508
Modal	9	0.168	0.0706	0.0008	0	0.8232	0.9242	0	0.0019	0.0879	2.63E-05	0.8279	0.6566	0.7509
Modal	10	0.145	0.002	0.0303	0	0.8252	0.9545	0	0.0645	0.0027	0.0001	0.8923	0.6593	0.7509
Modal	11	0.089	0.0041	0.0381	0	0.8294	0.9926	0	0.0892	0.0071	0.0045	0.9816	0.6664	0.7554
Modal	12	0.077	0.1217	0.0009	0	0.951	0.9935	0	0.0022	0.2198	0.0003	0.9838	0.8862	0.7557

ABR Story Stiffness

Story	Output Case	Case Type	Shear X	Drift X	Stiff X	Shear Y	Drift Y	Stiff Y	
LMR TOP	SPECX-P	LinRespSpec	199.041	1.248	159482.511	17.7261	0.147	0	#DIV/0!
LMR BOTTOM	SPECX-P	LinRespSpec	455.0725	1.187	383388.967	38.0984	0.14	0	2.403956174
TERRACE	SPECX-P	LinRespSpec	1640.988	1.216	1349811.551	80.3099	0.043	0	3.520736555
19TH	SPECX-P	LinRespSpec	2651.7142	1.226	2163366.361	100.739	0.043	0	1.602717327
18TH	SPECX-P	LinRespSpec	3372.7964	1.238	2723949.783	101.4608	0.044	0	1.259125515
17TH	SPECX-P	LinRespSpec	3826.4351	1.246	3070902.585	100.4414	0.044	0	1.127371218
16TH	SPECX-P	LinRespSpec	4053.6391	1.247	3251370.047	115.178	0.045	0	1.058766912
15TH	SPECX-P	LinRespSpec	4115.3556	1.241	3315926.343	139.9896	0.046	0	1.019855106
14TH	SPECX-P	LinRespSpec	4089.4147	1.229	3328162.581	158.5906	0.047	0	1.003690142
13TH	SPECX-P	LinRespSpec	4060.1552	1.21	3354662.943	165.0373	0.047	0	1.00796246
12TH	SPECX-P	LinRespSpec	4099.0495	1.186	3454856.335	168.4109	0.047	0	1.029866903
11TH	SPECX-P	LinRespSpec	4243.9874	1.158	3666258.56	183.268	0.047	0	1.061189874
10TH	SPECX-P	LinRespSpec	4494.534	1.124	4000290.886	207.4319	0.047	0	1.091109866
9TH	SPECX-P	LinRespSpec	4829.3459	1.084	4456432.965	221.3523	0.046	0	1.114027228
8TH	SPECX-P	LinRespSpec	5229.0223	1.037	5044112.682	211.8543	0.044	0	1.131872222
7TH	SPECX-P	LinRespSpec	5685.1963	0.98	5798480.169	195.2339	0.043	0	1.149554051
6TH	SPECX-P	LinRespSpec	6191.6264	0.912	6788766.133	217.5176	0.043	0	1.170783711
5TH	SPECX-P	LinRespSpec	6726.517	0.828	8124614.353	276.4062	0.042	0	1.196773345
4TH	SPECX-P	LinRespSpec	7241.8281	0.717	10098831.99	310.7324	0.039	0	1.242992165
3RD FLOOR	SPECX-P	LinRespSpec	7673.6701	0.602	12747939.11	287.4325	0.086	0	1.262318169
2ND FLOOR	SPECX-P	LinRespSpec	7981.4234	0.436	18287965.08	281.2462	0.031	0	1.434582087
1ST FLOOR	SPECX-P	LinRespSpec	8355.6779	0.347	24069884.22	451.0454	0.036	0	1.316159787
STILT	SPECX-P	LinRespSpec	10157.8713	0.156	65157069.47	652.3059	0.033	0	2.706995549
LMR TOP	SPECY-P	LinRespSpec	74.1389	0.369	200924.249	270.3222	2.466	109610.157	#DIV/0!
LMR BOTTOM	SPECY-P	LinRespSpec	155.5149	0.356	436832.945	607.0972	2.372	255971.029	2.335285671
TERRACE	SPECY-P	LinRespSpec	417.8103	0.445	938236.368	1974.7747	1.78	1109551.224	4.334675015
19TH	SPECY-P	LinRespSpec	531.8135	0.45	1183080.068	3097.7985	1.817	1705266.401	1.536897409
18TH	SPECY-P	LinRespSpec	480.7788	0.454	1059810.201	3853.3866	1.879	2051166.301	1.202842148
17TH	5PECY-P	LinRespSpec	312.4665	0.457	0	4310	1.931	2232155.986	1.088237451
16TH	SPECY-P	LinRespSpec	210.7678	0.461	0	4570.0491	1.97	2319943.619	1.039328628
15TH	SPECY-P	LinRespSpec	408.2197	0.463	0	4738.3099	1.996	2373486.619	1.02307944
14TH	SPECY-P	LinRespSpec	634.0407	0.464	1365726.614	4887.7045	2.012	2429182.685	1.023465928
13TH	SPECY-P	LinRespSpec	757.4518	0.464	1632342.839	5047.6865	2.018	2501200.254	1.029646831
12TH	SPECY-P	LinRespSpec	734.832	0.459	1599614.638	5222.4889	2.016	2590821.876	1.035831446
11TH	SPECY-P	LinRespSpec	574.7656	0.451	1273524.85	5415.0305	2.006	2699917.97	1.042108682
10TH	SPECY-P	LinRespSpec	377.5123	0.441	0	5631.3314	1.987	2834408.71	1.049812899
9TH	SPECY-P	LinRespSpec	418.1511	0.428	0	5870.5202	1.958	2998177.725	1.057778899
8TH	SPECY-P	LinRespSpec	650.3866	0.411	1583255.328	6125.5756	1.918	3194519.151	1.06548692
7TH	SPECY-P	LinRespSpec	801.4118	0.388	2063817.516	6402.4149	1.863	3437109.553	1.075939567
6TH	SPECY-P	LinRespSpec	756.6231	0.359	2107139.311	6730.0519	1.79	3760113.606	1.09397549
5TH	SPECY-P	LinRespSpec	514.2647	0.323	0	7132.9862	1.692	4216116.496	1.1212737
4TH	SPECY-P	LinRespSpec	374.7939	0.283	0	7591.2567	1.546	4910950.396	1.164804246
3RD FLOOR	SPECY-P	LinRespSpec	741.7427	0.236	0	8056.8019	1.351	5961453.143	1.213910274
2ND FLOOR	SPECY-P	LinRespSpec	1077.2358	0.18	5975370.319	8523.5549	1.112	7662404.271	1.285324918
1ST FLOOR	SPECY-P	LinRespSpec	1049.1197	0.134	7829755.716	9273.7385	1.227	7555043.285	0.985988603
STILT	SPECY-P	LinRespSpec	1988.7862	0.062	32111839.73	10363.097	0.843	12298357.65	1.627834175

TABLE: Joint Displacements

Story	Label	Unique Name	Output Case	Case Type	Ux	Uy	Uz
					mm	mm	mm
TERRACE	1	16864	DL+LL	Combination	-7.583	-3.786	-8.828
TERRACE	2	16866	DL+LL	Combination	-7.583	-3.936	-8.368
TERRACE	3	16767	DL+LL	Combination	-7.609	-3.818	-9.742
TERRACE	4	16768	DL+LL	Combination	-7.609	-3.835	-9.602
TERRACE	5	16869	DL+LL	Combination	-7.618	-3.786	-7.823
TERRACE	6	16867	DL+LL	Combination	-7.617	-3.676	-8.659
TERRACE	7	16870	DL+LL	Combination	-7.636	-3.818	-9.981
TERRACE	8	16873	DL+LL	Combination	-7.632	-3.945	-8.789
TERRACE	9	16874	DL+LL	Combination	-7.67	-3.673	-11.786
TERRACE	10	16877	DL+LL	Combination	-7.67	-3.786	-10.518
TERRACE	11	16878	DL+LL	Combination	-7.703	-3.818	-12.153
TERRACE	12	16816	DL+LL	Combination	-7.703	-3.945	-13.914
TERRACE	13	16817	DL+LL	Combination	-7.658	-3.945	-12.175
TERRACE	14	16882	DL+LL	Combination	-7.658	-3.869	-11.461
TERRACE	15	16770	DL+LL	Combination	-7.684	-3.901	-14.923
TERRACE	16	16769	DL+LL	Combination	-7.684	-3.869	-12.359
TERRACE	17	16889	DL+LL	Combination	-7.729	-3.786	-10.981
TERRACE	18	16883	DL+LL	Combination	-7.729	-3.663	-12.066
TERRACE	19	16893	DL+LL	Combination	-7.761	-3.945	-11.82
TERRACE	20	16890	DL+LL	Combination	-7.761	-3.818	-12.467
TERRACE	21	16894	DL+LL	Combination	-7.794	-3.663	-10.745
TERRACE	22	16897	DL+LL	Combination	-7.794	-3.786	-9.758
TERRACE	23	17075	DL+LL	Combination	-7.831	-3.818	-11.627
TERRACE	24	16899	DL+LL	Combination	-7.798	-3.946	-10.481
TERRACE	25	16901	DL+LL	Combination	-7.799	-3.945	-11.345
TERRACE	26	16900	DL+LL	Combination	-7.799	-3.873	-12.637
TERRACE	27	16902	DL+LL	Combination	-7.823	-3.663	-11.638
TERRACE	28	16903	DL+LL	Combination	-7.823	-3.724	-11.433
TERRACE	29	16904	DL+LL	Combination	-7.846	-3.663	-12.115
TERRACE	30	16907	DL+LL	Combination	-7.846	-3.786	-10.915
TERRACE	31	16909	DL+LL	Combination	-7.853	-3.945	-11.587
TERRACE	32	16908	DL+LL	Combination	-7.853	-3.869	-12.229
TERRACE	33	16771	DL+LL	Combination	-7.879	-3.869	-12.491
TERRACE	34	16772	DL+LL	Combination	-7.879	-3.901	-12.753
TERRACE	35	16912	DL+LL	Combination	-7.898	-3.945	-11.428
TERRACE	36	17074	DL+LL	Combination	-7.898	-3.818	-12.294
TERRACE	37	16918	DL+LL	Combination	-7.905	-3.786	-11.664
TERRACE	38	16913	DL+LL	Combination	-7.905	-3.663	-13.068
TERRACE	39	16920	DL+LL	Combination	-7.942	-3.786	-16.238
TERRACE	40	16919	DL+LL	Combination	-7.942	-3.719	-17.343
TERRACE	41	16924	DL+LL	Combination	-7.957	-3.946	-11.971
TERRACE	42	16921	DL+LL	Combination	-7.957	-3.818	-12.77
TERRACE	43	16925	DL+LL	Combination	-7.973	-3.658	-19.354
TERRACE	44	16929	DL+LL	Combination	-7.972	-3.786	-18.073

TERRACE	45	16931	DL+LL	Combination	-7.994	-3.946	-12.857
TERRACE	46	16930	DL+LL	Combination	-7.994	-3.873	-13.216
TERRACE	47	16773	DL+LL	Combination	-8.021	-3.703	-18.843
TERRACE	48	16774	DL+LL	Combination	-8.021	-3.735	-15.582
TERRACE	49	16861	DL+LL	Combination	-8.011	-3.955	-11.062
TERRACE	50	17071	DL+LL	Combination	-8.026	-3.818	-12.358
TERRACE	51	16932	DL+LL	Combination	-8.04	-3.659	-16.572
TERRACE	52	16936	DL+LL	Combination	-8.04	-3.786	-12.608
TERRACE	53	16938	DL+LL	Combination	-8.048	-3.949	-14.249
TERRACE	54	16937	DL+LL	Combination	-8.048	-3.873	-13.097
TERRACE	56	16775	DL+LL	Combination	-8.076	-3.873	-13.262
TERRACE	57	16939	DL+LL	Combination	-8.093	-3.818	-12.827
TERRACE	58	16942	DL+LL	Combination	-8.093	-3.949	-14.909
TERRACE	59	17093	DL+LL	Combination	-8.098	-3.659	-13.559
TERRACE	60	17053	DL+LL	Combination	-8.098	-3.786	-12.837
TERRACE	61	16946	DL+LL	Combination	-8.136	-3.715	-14.347
TERRACE	62	16947	DL+LL	Combination	-8.136	-3.786	-13.779
TERRACE	63	16951	DL+LL	Combination	-8.152	-3.949	-13.292
TERRACE	64	16948	DL+LL	Combination	-8.152	-3.818	-13.093
TERRACE	65	16955	DL+LL	Combination	-8.168	-3.786	-12.059
TERRACE	66	16952	DL+LL	Combination	-8.168	-3.659	-12.897
TERRACE	67	16956	DL+LL	Combination	-8.19	-3.659	-14.508
TERRACE	69	16777	DL+LL	Combination	-8.216	-3.703	-16.06
TERRACE	70	16778	DL+LL	Combination	-8.216	-3.735	-13.33
TERRACE	71	16863	DL+LL	Combination	-8.221	-3.949	-7.416
TERRACE	72	17068	DL+LL	Combination	-8.222	-3.818	-8.694
TERRACE	73	16958	DL+LL	Combination	-8.235	-3.659	-14.944
TERRACE	74	16962	DL+LL	Combination	-8.235	-3.786	-11.478
TERRACE	75	16779	DL+LL	Combination	-8.273	-3.818	-8.894
TERRACE	76	16780	DL+LL	Combination	-8.273	-3.85	-8.579
TERRACE	77	16963	DL+LL	Combination	-8.289	-3.818	-8.989
TERRACE	78	16965	DL+LL	Combination	-8.289	-3.946	-7.738
TERRACE	79	16794	DL+LL	Combination	-8.294	-3.659	-13.083
TERRACE	80	16970	DL+LL	Combination	-8.294	-3.786	-11.791
TERRACE	81	16971	DL+LL	Combination	-8.331	-3.715	-13.529
TERRACE	82	16972	DL+LL	Combination	-8.331	-3.786	-12.268
TERRACE	83	16973	DL+LL	Combination	-8.343	-3.818	-9.335
TERRACE	84	16976	DL+LL	Combination	-8.343	-3.946	-7.939
TERRACE	85	16977	DL+LL	Combination	-8.364	-3.655	-12.124
TERRACE	86	16980	DL+LL	Combination	-8.363	-3.786	-10.971
TERRACE	87	16981	DL+LL	Combination	-8.384	-3.818	-9.47
TERRACE	88	16985	DL+LL	Combination	-8.383	-3.958	-8.112
TERRACE	89	16986	DL+LL	Combination	-8.412	-3.818	-10.937
TERRACE	90	16987	DL+LL	Combination	-8.412	-3.88	-10.275
TERRACE	91	16988	DL+LL	Combination	-8.43	-3.655	-15.087
TERRACE	92	16992	DL+LL	Combination	-8.43	-3.786	-11.701
TERRACE	93	16995	DL+LL	Combination	-8.436	-3.94	-10.269

TERRACE	94	16993	DL+LL	Combination	-8.436	-3.818	-11.488
TERRACE	95	16996	DL+LL	Combination	-8.489	-3.655	-13.308
TERRACE	96	17001	DL+LL	Combination	-8.489	-3.786	-12.104
TERRACE	97	17006	DL+LL	Combination	-8.494	-3.94	-11.195
TERRACE	98	17002	DL+LL	Combination	-8.494	-3.818	-11.826
TERRACE	99	17008	DL+LL	Combination	-8.527	-3.786	-13.385
TERRACE	100	17007	DL+LL	Combination	-8.527	-3.713	-13.906
TERRACE	101	17010	DL+LL	Combination	-8.535	-3.94	-11.417
TERRACE	103	17011	DL+LL	Combination	-8.559	-3.655	-13.433
TERRACE	104	17014	DL+LL	Combination	-8.559	-3.786	-12.155
TERRACE	105	17015	DL+LL	Combination	-8.581	-3.655	-15.17
TERRACE	106	17016	DL+LL	Combination	-8.581	-3.731	-13.906
TERRACE	107	17104	DL+LL	Combination	-8.581	-3.873	-13.596
TERRACE	108	17084	DL+LL	Combination	-8.581	-3.949	-13.645
TERRACE	109	16782	DL+LL	Combination	-8.609	-3.904	-16.451
TERRACE	110	16781	DL+LL	Combination	-8.609	-3.873	-14.393
TERRACE	111	17017	DL+LL	Combination	-8.626	-3.655	-16.639
TERRACE	112	17021	DL+LL	Combination	-8.626	-3.786	-12.491
TERRACE	113	17022	DL+LL	Combination	-8.626	-3.818	-14.209
TERRACE	114	17025	DL+LL	Combination	-8.626	-3.949	-15.765
TERRACE	115	17026	DL+LL	Combination	-8.684	-3.655	-14.821
TERRACE	116	17035	DL+LL	Combination	-8.684	-3.949	-14.711
TERRACE	117	17037	DL+LL	Combination	-8.722	-3.949	-12.385
TERRACE	118	17036	DL+LL	Combination	-8.722	-3.876	-12.47
TERRACE	119	17039	DL+LL	Combination	-8.722	-3.786	-12.012
TERRACE	120	17038	DL+LL	Combination	-8.722	-3.713	-12.155
TERRACE	121	17040	DL+LL	Combination	-8.754	-3.655	-7.777
TERRACE	122	17042	DL+LL	Combination	-8.725	-3.776	-6.494
TERRACE	123	17043	DL+LL	Combination	-8.754	-3.818	-8.032
TERRACE	124	17045	DL+LL	Combination	-8.729	-3.939	-6.736
TERRACE	125	16783	DL+LL	Combination	-8.684	-3.676	-14.603
TERRACE	126	16784	DL+LL	Combination	-8.626	-3.676	-16.443
TERRACE	127	17041	DL+LL	Combination	-8.754	-3.713	-7.23
TERRACE	128	17028	DL+LL	Combination	-8.684	-3.713	-14.196
TERRACE	129	17012	DL+LL	Combination	-8.559	-3.713	-12.845
TERRACE	130	16998	DL+LL	Combination	-8.489	-3.713	-12.74
TERRACE	131	16785	DL+LL	Combination	-8.527	-3.742	-15.349
TERRACE	132	16786	DL+LL	Combination	-8.489	-3.742	-12.461
TERRACE	133	16787	DL+LL	Combination	-8.136	-3.742	-15.615
TERRACE	134	16788	DL+LL	Combination	-8.098	-3.742	-12.821
TERRACE	135	16865	DL+LL	Combination	-7.583	-3.818	-9.347
TERRACE	136	16950	DL+LL	Combination	-8.152	-3.876	-12.992
TERRACE	137	17078	DL+LL	Combination	-8.222	-3.876	-8.128
TERRACE	138	17019	DL+LL	Combination	-8.626	-3.699	-15.931
TERRACE	139	17080	DL+LL	Combination	-8.581	-3.699	-17.449
TERRACE	140	16789	DL+LL	Combination	-8.294	-3.663	-13.045
TERRACE	141	16790	DL+LL	Combination	-8.235	-3.663	-14.931

TERRACE	143	16792	DL+LL	Combination	-8.04	-3.663	-16.562
TERRACE	144	16926	DL+LL	Combination	-7.972	-3.663	-19.316
TERRACE	145	16793	DL+LL	Combination	-8.363	-3.659	-12.101
TERRACE	146	16978	DL+LL	Combination	-8.363	-3.715	-11.552
TERRACE	147	16967	DL+LL	Combination	-8.294	-3.715	-12.572
TERRACE	148	16935	DL+LL	Combination	-8.04	-3.735	-13.207
TERRACE	149	16928	DL+LL	Combination	-7.972	-3.735	-18.585
TERRACE	150	17082	DL+LL	Combination	-7.995	-3.703	-22.433
TERRACE	151	16934	DL+LL	Combination	-8.04	-3.703	-15.758
TERRACE	152	16795	DL+LL	Combination	-8.294	-3.685	-12.838
TERRACE	153	16796	DL+LL	Combination	-8.235	-3.685	-14.746
TERRACE	154	16797	DL+LL	Combination	-8.098	-3.685	-13.318
TERRACE	155	16798	DL+LL	Combination	-8.04	-3.685	-16.368
TERRACE	156	17083	DL+LL	Combination	-8.222	-3.85	-8.371
TERRACE	157	16964	DL+LL	Combination	-8.289	-3.85	-8.648
TERRACE	158	16800	DL+LL	Combination	-8.222	-3.892	-7.98
TERRACE	159	16799	DL+LL	Combination	-8.289	-3.892	-8.317
TERRACE	160	17085	DL+LL	Combination	-8.537	-3.954	-11.097
TERRACE	161	16975	DL+LL	Combination	-8.343	-3.862	-8.839
TERRACE	162	16982	DL+LL	Combination	-8.384	-3.862	-8.987
TERRACE	163	16801	DL+LL	Combination	-8.384	-3.904	-8.547
TERRACE	164	16802	DL+LL	Combination	-8.343	-3.904	-8.383
TERRACE	165	17020	DL+LL	Combination	-8.626	-3.731	-13.174
TERRACE	166	17013	DL+LL	Combination	-8.559	-3.731	-12.685
TERRACE	167	16991	DL+LL	Combination	-8.43	-3.731	-12.344
TERRACE	168	16979	DL+LL	Combination	-8.363	-3.731	-11.479
TERRACE	169	16804	DL+LL	Combination	-8.626	-3.928	-15.973
TERRACE	170	16803	DL+LL	Combination	-8.684	-3.928	-14.845
TERRACE	171	16805	DL+LL	Combination	-8.152	-3.928	-13.417
TERRACE	172	16806	DL+LL	Combination	-8.093	-3.928	-15.154
TERRACE	173	16984	DL+LL	Combination	-8.384	-3.94	-8.177
TERRACE	174	17089	DL+LL	Combination	-8.538	-3.937	-11.235
TERRACE	175	16898	DL+LL	Combination	-7.831	-3.873	-11.111
TERRACE	176	16892	DL+LL	Combination	-7.761	-3.873	-12.121
TERRACE	177	16807	DL+LL	Combination	-8.494	-3.919	-11.375
TERRACE	178	16808	DL+LL	Combination	-8.436	-3.919	-10.46
TERRACE	179	16871	DL+LL	Combination	-7.636	-3.869	-9.504
TERRACE	180	16879	DL+LL	Combination	-7.703	-3.869	-11.846
TERRACE	181	16905	DL+LL	Combination	-7.846	-3.724	-11.463
TERRACE	182	16896	DL+LL	Combination	-7.794	-3.724	-10.203
TERRACE	183	16895	DL+LL	Combination	-7.794	-3.719	-10.249
TERRACE	184	16886	DL+LL	Combination	-7.729	-3.719	-11.606
TERRACE	185	16809	DL+LL	Combination	-7.942	-3.744	-17.792
TERRACE	186	16810	DL+LL	Combination	-7.905	-3.744	-12.279
TERRACE	187	16811	DL+LL	Combination	-7.764	-3.744	-13.301
TERRACE	188	16812	DL+LL	Combination	-7.729	-3.744	-11.371
TERRACE	189	16814	DL+LL	Combination	-7.67	-3.69	-11.63

TERRACE	190	16813	DL+LL	Combination	-7.729	-3.69	-11.834
TERRACE	191	16815	DL+LL	Combination	-7.583	-3.835	-9.2
TERRACE	192	16910	DL+LL	Combination	-7.898	-3.901	-11.649
TERRACE	193	17091	DL+LL	Combination	-7.853	-3.901	-14.48
TERRACE	194	17061	DL+LL	Combination	-8.559	-3.818	-12.394
TERRACE	195	16872	DL+LL	Combination	-7.636	-3.936	-8.862
TERRACE	196	16884	DL+LL	Combination	-7.729	-3.673	-11.976
TERRACE	197	17090	DL+LL	Combination	-7.764	-3.719	-12.329
TERRACE	198	17056	DL+LL	Combination	-7.764	-3.786	-11.509
TERRACE	200	17081	DL+LL	Combination	-7.995	-3.735	-18.571
TERRACE	201	17094	DL+LL	Combination	-7.995	-3.659	-20.172
TERRACE	203	16819	DL+LL	Combination	-7.761	-3.901	-11.969
TERRACE	204	16821	DL+LL	Combination	-8.152	-3.905	-12.867
TERRACE	205	16820	DL+LL	Combination	-8.19	-3.905	-13.717
TERRACE	206	17086	DL+LL	Combination	-8.19	-3.949	-12.025
TERRACE	207	17079	DL+LL	Combination	-8.19	-3.876	-11.645
TERRACE	208	16923	DL+LL	Combination	-7.957	-3.873	-12.35
TERRACE	209	16940	DL+LL	Combination	-8.093	-3.873	-12.449
TERRACE	210	16822	DL+LL	Combination	-8.722	-3.742	-14.261
TERRACE	211	16823	DL+LL	Combination	-8.684	-3.742	-13.91
TERRACE	212	16824	DL+LL	Combination	-8.722	-3.905	-14.498
TERRACE	213	16825	DL+LL	Combination	-8.684	-3.905	-14.262
TERRACE	214	16826	DL+LL	Combination	-8.535	-3.9	-13.344
TERRACE	215	16827	DL+LL	Combination	-8.494	-3.9	-11.295
TERRACE	216	16983	DL+LL	Combination	-8.384	-3.88	-8.799
TERRACE	217	16994	DL+LL	Combination	-8.436	-3.88	-10.849
TERRACE	218	17046	DL+LL	Combination	-8.385	-3.655	-13.983
TERRACE	219	17088	DL+LL	Combination	-8.385	-3.731	-13.363
TERRACE	220	17099	DL+LL	Combination	-8.385	-3.699	-16.976
TERRACE	221	16990	DL+LL	Combination	-8.43	-3.699	-14.494
TERRACE	222	16828	DL+LL	Combination	-8.489	-3.676	-13.092
TERRACE	223	16829	DL+LL	Combination	-8.43	-3.676	-14.932
TERRACE	224	16830	DL+LL	Combination	-8.413	-3.699	-15.835
TERRACE	225	16831	DL+LL	Combination	-8.413	-3.731	-13.359
TERRACE	226	17064	DL+LL	Combination	-8.364	-3.818	-9.385
TERRACE	227	17087	DL+LL	Combination	-8.364	-3.862	-8.911
TERRACE	229	16974	DL+LL	Combination	-8.343	-3.827	-9.277
TERRACE	230	16832	DL+LL	Combination	-8.331	-3.742	-14.682
TERRACE	231	16833	DL+LL	Combination	-8.294	-3.742	-12.305
TERRACE	232	16953	DL+LL	Combination	-8.168	-3.715	-12.381
TERRACE	233	16944	DL+LL	Combination	-8.098	-3.715	-13.063
TERRACE	234	16835	DL+LL	Combination	-8.048	-3.905	-16.919
TERRACE	235	16834	DL+LL	Combination	-8.093	-3.905	-14.81
TERRACE	236	16836	DL+LL	Combination	-7.994	-3.901	-14.761
TERRACE	237	16837	DL+LL	Combination	-7.957	-3.901	-12.179
TERRACE	238	16838	DL+LL	Combination	-7.957	-3.919	-12.194
TERRACE	239	16839	DL+LL	Combination	-7.898	-3.919	-11.646

TERRACE	240	16915	DL+LL	Combination	-7.905	-3.719	-12.532
TERRACE	241	16927	DL+LL	Combination	-7.972	-3.719	-18.81
TERRACE	242	16841	DL+LL	Combination	-7.823	-3.698	-12.194
TERRACE	243	16840	DL+LL	Combination	-7.846	-3.698	-11.816
TERRACE	244	16843	DL+LL	Combination	-7.823	-3.714	-11.8
TERRACE	245	16842	DL+LL	Combination	-7.846	-3.714	-11.569
TERRACE	246	16844	DL+LL	Combination	-7.761	-3.919	-12.046
TERRACE	247	16845	DL+LL	Combination	-7.703	-3.919	-14.152
TERRACE	248	16846	DL+LL	Combination	-7.67	-3.702	-11.507
TERRACE	249	16847	DL+LL	Combination	-7.647	-3.702	-11.248
TERRACE	250	17097	DL+LL	Combination	-7.647	-3.673	-10.961
TERRACE	251	17102	DL+LL	Combination	-7.647	-3.726	-10.46
TERRACE	252	16868	DL+LL	Combination	-7.618	-3.726	-8.234
TERRACE	253	16875	DL+LL	Combination	-7.67	-3.726	-11.141
TERRACE	254	17103	DL+LL	Combination	-7.658	-3.901	-15.179
TERRACE	255	16880	DL+LL	Combination	-7.703	-3.901	-13.896
TERRACE	256	17030	DL+LL	Combination	-8.684	-3.773	-13.261
TERRACE	258	17029	DL+LL	Combination	-8.684	-3.757	-13.714
TERRACE	260	17027	DL+LL	Combination	-8.684	-3.698	-14.367
TERRACE	262	17048	DL+LL	Combination	-8.659	-3.786	-12.718
TERRACE	264	17047	DL+LL	Combination	-8.677	-3.786	-13.024
TERRACE	268	17060	DL+LL	Combination	-8.659	-3.818	-14.334
TERRACE	270	17033	DL+LL	Combination	-8.684	-3.861	-14.136
TERRACE	272	17034	DL+LL	Combination	-8.684	-3.876	-14.391
TERRACE	274	16997	DL+LL	Combination	-8.489	-3.698	-12.873
TERRACE	278	17000	DL+LL	Combination	-8.489	-3.773	-12.178
TERRACE	280	17049	DL+LL	Combination	-8.482	-3.786	-11.966
TERRACE	282	17050	DL+LL	Combination	-8.464	-3.786	-11.838
TERRACE	284	16989	DL+LL	Combination	-8.43	-3.684	-14.839
TERRACE	286	17063	DL+LL	Combination	-8.443	-3.818	-11.529
TERRACE	288	17062	DL+LL	Combination	-8.461	-3.818	-11.641
TERRACE	290	16968	DL+LL	Combination	-8.294	-3.756	-12.16
TERRACE	292	16969	DL+LL	Combination	-8.294	-3.773	-11.948
TERRACE	294	17052	DL+LL	Combination	-8.268	-3.786	-11.596
TERRACE	296	17051	DL+LL	Combination	-8.287	-3.786	-11.703
TERRACE	298	16954	DL+LL	Combination	-8.168	-3.735	-12.479
TERRACE	299	16961	DL+LL	Combination	-8.235	-3.735	-12.089
TERRACE	300	16849	DL+LL	Combination	-8.412	-3.86	-11.18
TERRACE	301	16848	DL+LL	Combination	-8.436	-3.86	-11.097
TERRACE	302	16966	DL+LL	Combination	-8.294	-3.699	-12.698
TERRACE	304	17067	DL+LL	Combination	-8.243	-3.818	-8.76
TERRACE	306	17066	DL+LL	Combination	-8.259	-3.818	-8.838
TERRACE	308	17069	DL+LL	Combination	-8.145	-3.818	-13.063
TERRACE	310	17070	DL+LL	Combination	-8.127	-3.818	-12.956
TERRACE	312	16943	DL+LL	Combination	-8.098	-3.699	-13.183
TERRACE	314	17054	DL+LL	Combination	-8.091	-3.786	-12.729
TERRACE	316	17055	DL+LL	Combination	-8.073	-3.786	-12.667

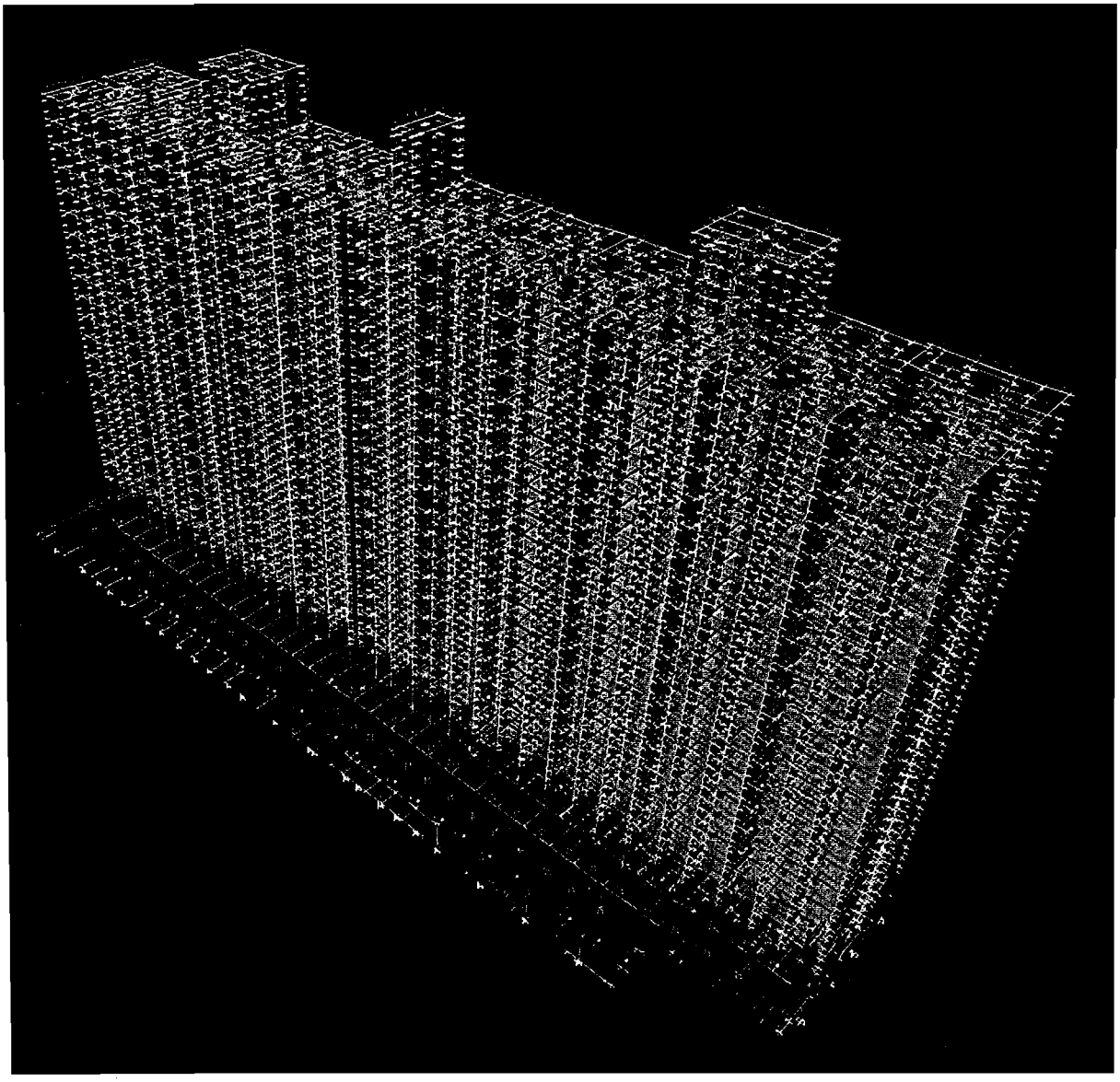
TERRACE	318	16941	DL+LL	Combination	-8.093	-3.92	-15.166
TERRACE	320	16949	DL+LL	Combination	-8.152	-3.861	-12.791
TERRACE	322	16945	DL+LL	Combination	-8.098	-3.756	-12.738
TERRACE	324	16933	DL+LL	Combination	-8.04	-3.688	-16.317
TERRACE	326	16922	DL+LL	Combination	-7.957	-3.858	-12.413
TERRACE	328	17072	DL+LL	Combination	-7.95	-3.818	-12.643
TERRACE	330	17073	DL+LL	Combination	-7.931	-3.818	-12.466
TERRACE	332	16914	DL+LL	Combination	-7.905	-3.703	-12.667
TERRACE	334	16916	DL+LL	Combination	-7.905	-3.759	-12.099
TERRACE	336	16917	DL+LL	Combination	-7.905	-3.776	-11.736
TERRACE	338	16906	DL+LL	Combination	-7.846	-3.74	-11.314
TERRACE	340	16891	DL+LL	Combination	-7.761	-3.858	-12.167
TERRACE	342	17076	DL+LL	Combination	-7.754	-3.818	-12.397
TERRACE	344	17077	DL+LL	Combination	-7.736	-3.818	-12.288
TERRACE	346	16887	DL+LL	Combination	-7.729	-3.756	-11.26
TERRACE	348	16888	DL+LL	Combination	-7.729	-3.773	-11.054
TERRACE	350	17057	DL+LL	Combination	-7.722	-3.786	-10.855
TERRACE	352	17058	DL+LL	Combination	-7.704	-3.786	-10.704
TERRACE	354	16885	DL+LL	Combination	-7.729	-3.703	-11.716
TERRACE	356	16850	DL+LL	Combination	-7.67	-3.716	-11.285
TERRACE	358	16876	DL+LL	Combination	-7.67	-3.742	-10.935
TERRACE	360	17096	DL+LL	Combination	-7.593	-3.936	-8.455
TERRACE	362	17095	DL+LL	Combination	-7.626	-3.936	-8.777
TERRACE	364	17044	DL+LL	Combination	-8.754	-3.876	-7.453
TERRACE	365	17023	DL+LL	Combination	-8.626	-3.873	-13.805
TERRACE	366	17105	DL+LL	Combination	-8.559	-3.873	-11.869
TERRACE	367	17092	DL+LL	Combination	-8.559	-3.875	-11.854
TERRACE	368	17004	DL+LL	Combination	-8.494	-3.875	-11.444
TERRACE	369	17003	DL+LL	Combination	-8.494	-3.859	-11.496
TERRACE	371	17005	DL+LL	Combination	-8.494	-3.917	-11.377
TERRACE	375	16959	DL+LL	Combination	-8.235	-3.688	-14.705
TERRACE	377	16851	DL+LL	Combination	-7.647	-3.716	-10.87
TERRACE	378	17024	DL+LL	Combination	-8.626	-3.92	-16.053
TERRACE	380	17018	DL+LL	Combination	-8.626	-3.684	-16.373
TERRACE	387	16853	DL+LL	Combination	-7.703	-3.941	-13.954
TERRACE	389	16855	DL+LL	Combination	-7.898	-3.941	-11.467
TERRACE	390	16857	DL+LL	Combination	-7.846	-3.684	-11.989
TERRACE	391	16856	DL+LL	Combination	-7.905	-3.684	-12.857
TERRACE	392	16960	DL+LL	Combination	-8.235	-3.703	-14.284
TERRACE	394	16859	DL+LL	Combination	-8.609	-3.731	-14.017
TERRACE	395	16858	DL+LL	Combination	-8.609	-3.699	-16.749
TERRACE	396	16911	DL+LL	Combination	-7.898	-3.916	-11.656
TERRACE	398	16881	DL+LL	Combination	-7.703	-3.916	-14.167
TERRACE	401	16852	DL+LL	Combination	-7.761	-3.941	-11.866
TERRACE	402	16818	DL+LL	Combination	-7.799	-3.901	-13.769
TERRACE	403	16854	DL+LL	Combination	-7.957	-3.941	-12.013
TERRACE	202	16860	DL+LL	Combination	-8.012	-3.936	-11.087

TERRACE	386	16862	DL+LL	Combination	-8.222	-3.946	-7.448
TERRACE	388	16999	DL+LL	Combination	-8.489	-3.757	-12.319
TERRACE	404	17009	DL+LL	Combination	-8.535	-3.875	-12.245
TERRACE	405	17031	DL+LL	Combination	-8.684	-3.786	-13.174
TERRACE	406	17032	DL+LL	Combination	-8.684	-3.818	-14.43
TERRACE	407	17059	DL+LL	Combination	-8.677	-3.818	-14.415
TERRACE	408	17065	DL+LL	Combination	-8.271	-3.818	-8.886
TERRACE	409	17098	DL+LL	Combination	-8.026	-3.873	-11.795
TERRACE	410	17100	DL+LL	Combination	-8.364	-3.827	-9.331
TERRACE	415	17114	DL+LL	Combination	-8.626	-3.904	-15.864
TERRACE	416	17116	DL+LL	Combination	-8.581	-3.904	-16.763
TERRACE	417	17115	DL+LL	Combination	-8.489	-3.818	-11.76
TERRACE	102	17108	DL+LL	Combination	-8.3	-3.946	-7.778
TERRACE	257	17107	DL+LL	Combination	-8.333	-3.946	-7.899
TERRACE	261	16791	DL+LL	Combination	-8.098	-3.663	-13.522
TERRACE	263	17109	DL+LL	Combination	-8.098	-3.773	-12.845
TERRACE	265	17111	DL+LL	Combination	-7.898	-3.869	-11.875
TERRACE	266	17110	DL+LL	Combination	-7.831	-3.869	-11.159
TERRACE	267	17112	DL+LL	Combination	-7.898	-3.786	-11.412
TERRACE	269	17113	DL+LL	Combination	-7.88	-3.786	-11.14
TERRACE	281	16776	DL+LL	Combination	-8.076	-3.905	-15.997
TERRACE	283	17117	DL+LL	Combination	-7.636	-3.835	-9.811
TERRACE	285	17118	DL+LL	Combination	-8.363	-3.818	-9.382
TERRACE	287	17119	DL+LL	Combination	-8.294	-3.818	-9.055
TERRACE	289	17120	DL+LL	Combination	-8.235	-3.818	-8.713
TERRACE	305	17121	DL+LL	Combination	-8.168	-3.818	-12.881
TERRACE	307	17122	DL+LL	Combination	-8.098	-3.818	-12.826
TERRACE	370	17123	DL+LL	Combination	-8.04	-3.818	-12.488
TERRACE	372	17124	DL+LL	Combination	-7.972	-3.818	-13.438
TERRACE	373	17125	DL+LL	Combination	-7.905	-3.818	-12.289
TERRACE	374	17126	DL+LL	Combination	-7.831	-3.786	-10.74
TERRACE	379	17127	DL+LL	Combination	-7.794	-3.818	-12.702
TERRACE	383	17128	DL+LL	Combination	-7.67	-3.818	-11.891
TERRACE	385	17129	DL+LL	Combination	-7.636	-3.786	-8.728
TERRACE	411	17130	DL+LL	Combination	-7.618	-3.818	-9.796
TERRACE	55	16957	DL+LL	Combination	-8.19	-3.735	-13.998
TERRACE	68	17101	DL+LL	Combination	-8.384	-3.827	-9.364
TERRACE	142	17106	DL+LL	Combination	-8.19	-3.703	-17.56
TERRACE	228	17643	DL+LL	Combination	-8.737	-3.918	-6.721
TERRACE	259	17638	DL+LL	Combination	-8.626	-3.758	-12.783
TERRACE	271	17619	DL+LL	Combination	-8.559	-3.758	-12.393
TERRACE	279	17650	DL+LL	Combination	-8.754	-3.846	-7.734
TERRACE	291	17633	DL+LL	Combination	-8.626	-3.846	-13.955
TERRACE	293	17626	DL+LL	Combination	-8.559	-3.846	-12.08
TERRACE	297	17614	DL+LL	Combination	-8.436	-3.846	-11.219
TERRACE	323	17575	DL+LL	Combination	-7.794	-3.758	-9.904
TERRACE	325	17585	DL+LL	Combination	-7.846	-3.758	-11.154

TERRACE	329	17556	DL+LL	Combination	-7.618	-3.758	-7.974
TERRACE	333	17607	DL+LL	Combination	-8.152	-3.846	-12.844
TERRACE	335	17602	DL+LL	Combination	-8.093	-3.846	-12.576
TERRACE	337	17599	DL+LL	Combination	-8.026	-3.846	-12.027
TERRACE	339	17566	DL+LL	Combination	-7.703	-3.846	-11.929
TERRACE	341	17571	DL+LL	Combination	-7.761	-3.846	-12.24
TERRACE	343	17582	DL+LL	Combination	-7.831	-3.846	-11.345
TERRACE	345	17590	DL+LL	Combination	-7.898	-3.846	-12.059
TERRACE	347	17593	DL+LL	Combination	-7.957	-3.846	-12.48
TERRACE	349	17553	DL+LL	Combination	-7.584	-3.828	-9.261
TERRACE	351	17563	DL+LL	Combination	-7.636	-3.828	-9.882
TERRACE	363	17131	DL+LL	Combination	-8.299	-3.423	-14.353
TERRACE	376	17132	DL+LL	Combination	-8.303	-3.302	-14.783
TERRACE	381	17133	DL+LL	Combination	-8.535	-3.774	-14.366
TERRACE	412	17134	DL+LL	Combination	-8.544	-3.846	-14.804
TERRACE	413	17135	DL+LL	Combination	-8.305	-3.58	-13.713
TERRACE	414	17136	DL+LL	Combination	-8.302	-3.501	-14.156
TERRACE	418	17137	DL+LL	Combination	-8.528	-3.65	-13.725
TERRACE	423	17138	DL+LL	Combination	-8.538	-3.728	-14.183
TERRACE	424	17139	DL+LL	Combination	-8.308	-3.603	-13.074
TERRACE	425	17140	DL+LL	Combination	-8.313	-3.61	-13.246
TERRACE	426	17141	DL+LL	Combination	-8.577	-3.586	-13.125
TERRACE	427	17142	DL+LL	Combination	-8.579	-3.602	-13.253
TERRACE	428	17143	DL+LL	Combination	-8.296	-3.6	-13.114
TERRACE	429	17144	DL+LL	Combination	-8.603	-3.586	-13.061
TERRACE	430	17145	DL+LL	Combination	-8.238	-3.614	-12.48
TERRACE	431	17146	DL+LL	Combination	-8.265	-3.622	-12.661
TERRACE	432	17147	DL+LL	Combination	-8.483	-3.721	-12.487
TERRACE	433	17148	DL+LL	Combination	-8.585	-3.686	-12.7
TERRACE	434	17149	DL+LL	Combination	-8.246	-3.463	-16.394
TERRACE	435	17150	DL+LL	Combination	-8.251	-3.465	-16.598
TERRACE	436	17151	DL+LL	Combination	-8.486	-3.719	-16.427
TERRACE	437	17152	DL+LL	Combination	-8.492	-3.663	-16.625
TERRACE	438	17153	DL+LL	Combination	-8.244	-3.456	-16.318
TERRACE	439	17154	DL+LL	Combination	-8.484	-3.748	-16.348
TERRACE	440	17155	DL+LL	Combination	-8.258	-3.655	-14.316
TERRACE	441	17156	DL+LL	Combination	-8.249	-3.647	-14.186
TERRACE	442	17157	DL+LL	Combination	-8.617	-3.758	-14.333
TERRACE	443	17158	DL+LL	Combination	-8.495	-3.757	-14.199
TERRACE	444	17161	DL+LL	Combination	-8.284	-3.641	-14.392
TERRACE	445	17159	DL+LL	Combination	-8.585	-3.764	-14.406
TERRACE	446	17160	DL+LL	Combination	-8.299	-3.642	-14.428
TERRACE	447	17162	DL+LL	Combination	-8.56	-3.765	-14.44
TERRACE	448	17163	DL+LL	Combination	-8.289	-3.646	-14.063
TERRACE	449	17164	DL+LL	Combination	-8.557	-3.821	-14.087
TERRACE	450	17165	DL+LL	Combination	-8.293	-3.656	-14.157
TERRACE	451	17166	DL+LL	Combination	-8.299	-3.642	-14.422

TERRACE	452	17167	DL+LL	Combination	-8.568	-3.891	-14.194
TERRACE	453	17168	DL+LL	Combination	-8.575	-3.844	-14.433
TERRACE	454	17169	DL+LL	Combination	-8.303	-3.619	-14.635
TERRACE	455	17170	DL+LL	Combination	-8.299	-3.622	-14.847
TERRACE	456	17171	DL+LL	Combination	-8.555	-4.021	-14.667
TERRACE	457	17172	DL+LL	Combination	-8.569	-3.982	-14.863
TERRACE	458	17173	DL+LL	Combination	-8.246	-3.749	-15.924
TERRACE	459	17174	DL+LL	Combination	-8.249	-3.731	-16.003
TERRACE	460	17175	DL+LL	Combination	-8.484	-3.927	-15.956
TERRACE	461	17176	DL+LL	Combination	-8.487	-3.935	-16.033
TERRACE	462	17177	DL+LL	Combination	-8.242	-3.797	-15.723
TERRACE	463	17178	DL+LL	Combination	-8.478	-3.913	-15.75
TERRACE	464	17179	DL+LL	Combination	-8.117	-3.48	-13.057
TERRACE	465	17180	DL+LL	Combination	-8.12	-3.429	-13.261
TERRACE	466	17181	DL+LL	Combination	-8.349	-3.65	-13.081
TERRACE	467	17182	DL+LL	Combination	-8.353	-3.689	-13.286
TERRACE	468	17183	DL+LL	Combination	-8.112	-3.523	-12.843
TERRACE	469	17184	DL+LL	Combination	-8.349	-3.597	-12.868
TERRACE	470	17185	DL+LL	Combination	-8.114	-3.636	-12.426
TERRACE	471	17186	DL+LL	Combination	-8.118	-3.593	-12.702
TERRACE	472	17187	DL+LL	Combination	-8.347	-3.54	-12.449
TERRACE	473	17188	DL+LL	Combination	-8.354	-3.554	-12.727
TERRACE	474	17189	DL+LL	Combination	-8.111	-3.661	-12.288
TERRACE	475	17190	DL+LL	Combination	-8.345	-3.532	-12.308
TERRACE	476	17191	DL+LL	Combination	-8.108	-3.648	-12.01
TERRACE	477	17192	DL+LL	Combination	-8.109	-3.662	-12.157
TERRACE	478	17193	DL+LL	Combination	-8.368	-3.646	-12.043
TERRACE	479	17194	DL+LL	Combination	-8.374	-3.58	-12.183
TERRACE	480	17195	DL+LL	Combination	-8.102	-3.645	-12.017
TERRACE	481	17196	DL+LL	Combination	-8.351	-3.647	-12.016
TERRACE	482	17197	DL+LL	Combination	-8.062	-3.449	-14.779
TERRACE	483	17198	DL+LL	Combination	-8.062	-3.446	-15.054
TERRACE	484	17199	DL+LL	Combination	-8.29	-3.783	-14.814
TERRACE	485	17200	DL+LL	Combination	-8.306	-3.709	-15.079
TERRACE	486	17201	DL+LL	Combination	-8.055	-3.61	-11.678
TERRACE	487	17202	DL+LL	Combination	-8.075	-3.474	-12.255
TERRACE	488	17203	DL+LL	Combination	-8.285	-3.728	-11.691
TERRACE	489	17204	DL+LL	Combination	-8.27	-3.919	-12.291
TERRACE	490	17205	DL+LL	Combination	-8.092	-3.624	-11.81
TERRACE	491	17206	DL+LL	Combination	-8.309	-3.713	-11.832
TERRACE	492	17207	DL+LL	Combination	-8.077	-3.644	-11.484
TERRACE	493	17208	DL+LL	Combination	-8.069	-3.643	-11.465
TERRACE	494	17209	DL+LL	Combination	-8.309	-3.736	-11.518
TERRACE	495	17210	DL+LL	Combination	-8.301	-3.735	-11.48
TERRACE	496	17213	DL+LL	Combination	-8.084	-3.644	-11.634
TERRACE	497	17211	DL+LL	Combination	-8.329	-3.748	-11.645
TERRACE	498	17212	DL+LL	Combination	-8.129	-3.661	-11.794

3D MODEL



TYPICAL BEAM DESIGN

(ANALYSIS WAS DONE BY ETABS USING DIFFERENT LOAD COMBINATIONS, THE DESIGN FORCES ARE TAKEN FOR DCON2 CASE)

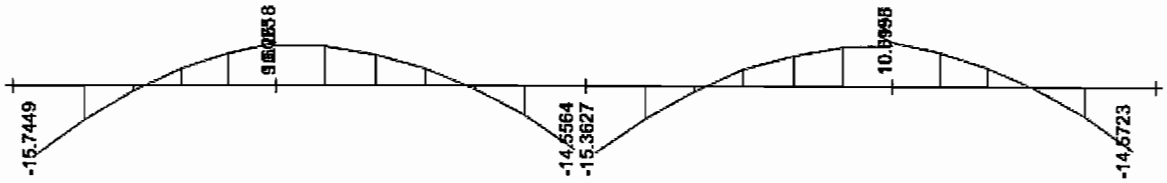
A Beam of 2 spans was considered for Typical Design Calculation.
Beam Location – Along Grid 33 to 46 (First Floor Shuttering)

Beam Size : 200mm x 450mm.

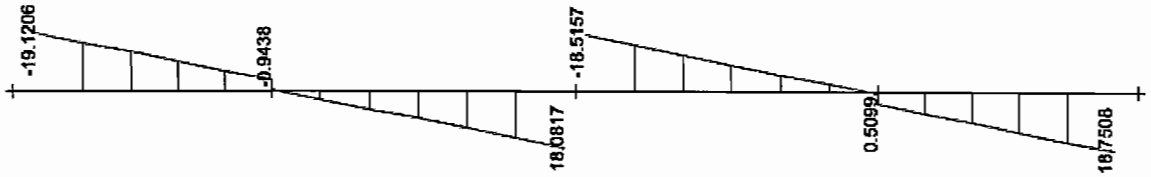
Grade of Concrete = M30;
Grade of Steel = Fe-500;
Effective depth – d' = 450-50 = 400 mm.

BENDING MOMENT, SHEAR FORCE AND TORSION DIAGRAMS TAKEN FROM ETABS

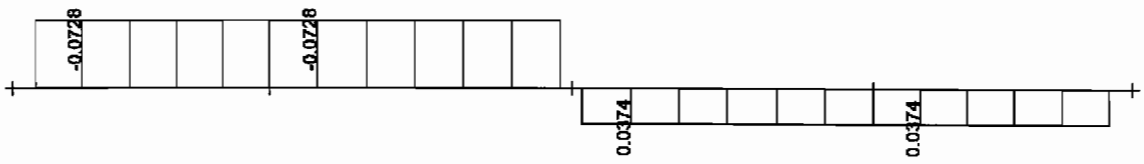
BENDING MOMENT DIAGRAM (KNm)



SHEAR FORCE DIAGRAM (KN)



TORSION DIAGRAM (KNm/m)



LEFT BEAM-(200X450)

Left End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 36KN-m. Tu = 0.2 KN-m/m

Mt = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = Mu + Mt = 36 + 0.35
= 36.35 KN-m.

Mu/bd^2 = 36.35 x 10^6 /230 x 400^2
= **0.987**

Pt = 0.29 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
=0.29 x 230 x 400/ 100
= 267 mm^2.

Provide (2T16) ---- @ Top

Mid Span bottom

Mu = 41-KNm

Mu/bd^2 = 41x 10^6 /230 x 400^2
= 1.12

Pt = 1.12 % (From SP-16, Table 3)
As per IS : 13920 : 1993 minimum reinforcement provided will be 0.24%
Ast = Pt x b x D/100
= 0.24 x 230 x 450/ 100
= 249 mm^2.

Provide (2T16)

Right End Support

Total Moment = Mu + Mt (Torsional Moment).

Mu = 35KN-m. Tu = 0.2 KN-m/m

M_t = T x (1+ (D/b))/1.7
= 0.2 x (1+ (450/230))/1.7
= 0.35 KN-m.

Total Moment = M_u + Mt = 35 + 0.35
= 35.35 KN-m.

M_u/bd^2 = 35.35 x 10^6 /230 x 400^2
= **0.96**

P_t = 0.2789 % (From SP-16, Table 3)
Pc = 0.0 % (From SP-16, Table 3)

Ast = Pt x b x D/100
= 0.2789 x 230 x 400/ 100
= 256 mm^2.
Provide (2T16) ---- @ Top

Shear Reinforcement:

V1 at Left End Support = 47 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 5.13/0.23 + 47 = 83 KN

ζv = Vu/bd = 83 x 10^3/ 230 x 400
= 0.90 N/mm^2
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm^2
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400

= .278

Therefore ζ_c = 0.39 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 83 x 10^3 – 0.39 x 230 x 400
= 47.12 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 47.12 x 10^3
= 306 mm.

V1 at Right End Support = 46 KN, T = 0.2 KNm/m
Vu = Vt + V1 = 1.6 x T/b + V1
= 1.6 x 0.2/0.23 + 46 = 47.4 KN

ζv = Vu/bd = 47.4 x 10^3/ 230 x 400
= 0.52 N/mm²
Max Allowable shear stress for M25 grade (ζ_{cmax}) = 3.1 N/mm²
Therefore $\zeta v < \zeta_{cmax}$, **hence safe.**

100 x Ast / b x d = 100 x 256 / 230 x 400
= .28

Therefore ζ_c = 0.36 N/mm²; (From SP-16, Table 61)

Balanced Shear Force = $V_{us} = V_u - \zeta_c \times b \times d$
= 47.41 x 10^3 – 0.36 x 230 x 400
= 14.29 KN.

S_v = 0.87 x fy x As x d / V_{us} (IS : 456 2000 Clause 40.4)
= 0.87 x 415 x 2 x 50 x 400 / 14.29 x 10^3
= 1013 mm.

As per code IS : 13920 : 1993 minimum spacing provided should be d/4 or 8 x diameter of smaller bar or 100mm whichever is less.

Hence Provide 2L-T8@100/200/100 c/c

Check for Deflection:

Maximum allowable Elastic short term deflection = l/250 = 4512/250
= 18.048 mm.

But actual deflection from ETABS = 1.4mm.

Maximum allowable long term deflection = l/350 = 4512/350
= 12.9 mm > 1.41 mm.

Therefore within the limits.

TYPICAL COLUMN DESIGN

Column Size = 200mm x 450mm

(LOAD CASE 0.5(DL+LL))

Location GRID X – 11

Height of Column = 2.950m

Pu = 4261 KN.

Mx = 7.1 KN-m.

My = 26 KN-m.

Grade of Concrete = M25.

Grade of Steel = Fe500.

Clear Cover = 40mm.

Floor Height = 2850mm.

Length of the column: l_x = 2950- 450 (Beam depth)

= 2500 mm.

l_y = 2950 - 450

= 2500 mm.

Moment due to minimum eccentricities:

e_{min} = l/500 + b/30 (From IS:456 2000; Clause 25.4)

e_{xmin} = 2400/500 +230/30 = 12.46mm < 20mm.

Therefore e_{xmin} = 12.46mm.

M_{xmin} = 0.02 x 1263 = 25.26 KN-m.

e_{ymin} = 2400/500 + 600/30 = 24.80mm > 20mm.

M_{ymin} = 0.025 x 1263 = 31.575 KN-m.

Moment due to Slenderness:

l_{ex} /b = 2400/230 = 10.43 < 12mm: Therefore within the limits.
l_{ey} /D = 2400/600 = 4 < 12mm ; Therefore within the limits.

For first trail, assume P = 2.0% (with reinforcement equally on two faces)

P_{uz} = (0.45 x fck x b x D) + (0.75 x fy x Ast)
= (0.45 x 35 x 230 x 600) + (0.75x 500 x 1104)
= 2587.5KN

Therefore Maximum moment for which the column is to be designed is
Maximum of moment due to:
Along X direction,

a. Moments due to Analysis. = 7 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

Mx = 25.26 KN-m

Similarly, along y direction
Maximum of moment due to:

a. Moments due to Analysis. = 83 KN-m
b. Moments due to Eccentricity = 25.26 KN-m

My = 83 KN-m

Design Forces
Pu = 1263 KN.
Mx = 25.26KN-m.
My = 83 KN-m.

Grade of Concrete = M30
Grade of Steel = Fe500.

The section is to be checked for biaxial bending

As First Trial assume the reinforcement Percentage, p = 0.8

P_u / fck x b x D = 1263 x 10^3 / 35 x 230 x 600 = 0.262

p/fck = 0.8/35 = 0.023

Referring to Chart 38, d' / D = 0.173, of SP: 16;

M_u / fck x b x D^2 = 0.06

M_{ux1} = 0.06 x 35 x 230 x 230 x 600 = 66.66 KN-m.

Referring to Chart 36; d' / D = 0.08.

M_u / fck x b x D^2 = 0.08 x 35 x 230 x 600 x 600 = 232 KN-m

M_{uy1} =232KN-m.

Mux / Mux1 = 25.26 / 66.66= 0.378.

Muy / Muy1 = 83/ 232 = 0.357

Pu / Puz = 1263 / 2587 = 0.488

Stirrup Reinforcement Calculations as per IS: 456:2000

As per IS: 456, Clause 26.5.3.2 c, For Compression members, Diameter of lateral ties shall not be less than 1/4th of the largest longitudinal bars and in no case less than 6mm

Pitch

a. The least lateral dimension of the compression member
b. Sixteen times the smallest diameter of the longitudinal bar to be tied
c. 300mm
d. Hence provide Y8@200mm c/c

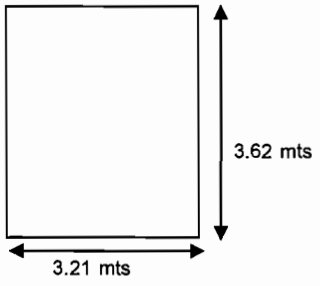
DESIGN TWOWAY SLAB

DESIGN OF TWO WAY SLAB

Short span	S=	3.21	m
Long span	L=	3.62	m
Assumed slab thickness	t=	0.125	m
Grade of concrete	fck=	25	N/mm^2
Grade of reinforcement	fy=	500	N/mm^2

Clear Span	
S	3.21
L	3.62

Type of panel One short edge discontinuous



Loads

Self weight of slab	w1=	3.13	kN/m^2	
Floor finish	w2=	1.50	kN/m^2	
Live load	w3=	2.00	kN/m^2	TOTAL
Miscellaneous	w4=	0.00	kN/m^2	6.63 kN/m^2
Ratio of long span to short span			R=	1.15
Design Load with load factor of 1.5			Wu=	9.94 kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.046	**4.71**	0.46	0.11	**150.00**	8	335	101
Positive moment at midspan	0.034	**3.48**	0.34	0.08	**150.00**	8	335	101
						8	200	
Long span direction								
Negative moment at continuous edge	0.037	**3.79**	0.44	0.10	**150.00**	8	335	93
Positive moment at midspan	0.028	**2.87**	0.33	0.08	**150.00**	8	335	93

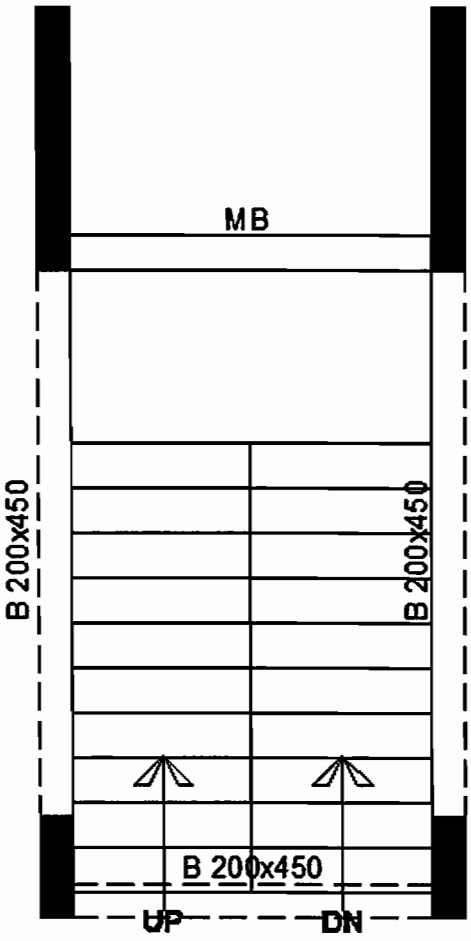
Minimum effective depth reqd	dre=	36.95	mm	
Clear cover to any reinforcement	c=	20	mm	
Minimum effective depth provided	dpr=	93	mm	greater than 'min. eff depth reqd'. Hence ok
Minimum reinforcement	Amin=	150	mm^2	

Deflection check

Reinf provided at midspan along short direction		251.33	mm^2	Dia	8	at	200	mm
Stress in reinforcement	fs=	173.081	N/mm^2					
Percentage of reinforcement provided	pt=	0.24884	%					
Modification factor as per fig 4 of IS:456-2000	MF=	2						

Type of slab for deflection check	Continuous		
Basic span to effective depth ratio	26		
Minimum effective depth reqd from deflection criteria	61.73	mm	
Effective depth provided	101	mm	greater than 'min. eff depth reqd'. Hence ok

TYPICAL STAIRCASE DESIGN



Riser	=	150 mm
Tread	=	300 mm
Waist slab	=	200 mm

Loading on Going Slab

Waist slab	=	5.605 KN/m^2
Weight of Steps	=	1.9 KN/m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4KN/ m^2
Total	=	13.005 KN/ m^2

Loading on landing slab :

Self-weight	=	5 KN/ m^2
Finishes	=	1.5 KN/ m^2
Live Load	=	4 KN/ m^2
Total	=	10.5 KN/ m^2

Typical Flight Design:

Mu	=	54.34 X 1.5 = 83 KNm
Ast	=	1278 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

Landing slab Design:

Mu	=	50.4 X 1.5 = 75.6 KNm
Ast	=	1140 mm^2

Provide T16@150 c/c (main reinforcement)
Provide T8@200 c/c (distribution reinforcement)

SOIL EXPLORATION REPORT

PROJECT NO : **7364**

PROJECT NAME : **Construction of Proposed 2 Basement + Stilt + 19 Floors, Alliance Budget housing at Siruseri.**

1. INTRODUCTION

M/s. Alliance Group are proposing to construct 2 Basement + Stilt + 19 Floors Alliance Budget housing, Siruseri, at the location shown in Fig.1 Soil Exploration work was referred to this firm by M/s. Alliance Group, with a view to determining the soil properties of the area and to arrive at the most suitable foundation system for the proposed structure. For this purpose eight boreholes were bored upto a depth varies from 6.0 to 8.5M below ground level. The boreholes were terminated after drilling for the required depth in the medium rock layer. The boreholes locations are given in Fig.1. The work comprised of conducting Standard Penetration Tests in the field and collecting samples for testing in the laboratory. The report presents the details of the work, analysis of test results and foundation recommendations made based on the analysis.

2. EXPLORATION TECHNIQUE

Rotary Drilling techniques was adopted for boring in this area. Casing pipes and bentonite slurry were used to protect the sides of the boreholes. Standard Penetration Tests were conducted at change of layers and at specified intervals Disturbed samples were collected in plastic bags from all the layers for visual observation and classification tests. Undisturbed samples could not be collected since the soil layers met with were essentially cohesionless in nature. Core samples were collected from medium rock layers.

3. SOIL PROFILE

The profile of the area as observed in the boreholes is given in Figs. 2 to 9 The top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

4. ANALYSIS OF TEST RESULTS

1. Standard Penetration Test
2. Grain Size Analysis
3 Determination of Specific Gravity
4. Crushing Strength of Rock

An analysis of the results of these tests were presented in this section of the report

4.1 Standard Penetration Test

These tests were conducted at change of layers and at specified intervals, commencing the test at 1.5 M below ground level. The results are presented graphically in Figs. 2 to 9. The relative density of the cohesionless layers obtained from the N values are given in the bore logs.

4. 2 Grain Size Analysis

Combined sieve and hydrometer analyses were conducted on the various samples collected. The results are given in Table-1. Based on the proportion of the different soil constituents, the soil is classified using the Triangular Chart .

4.3 Determination of Specific Gravity

The specific gravities of the soil grains were determined from the various samples collected. The results are given in Table-1. No abnormal value is noted in the test results.

4.4 Crushing Strength of Rock

Core samples collected from medium rock layers were tested for determining crushing strength of rock. The results are given in Table – 2.

5. FOUNDATION ANALYSIS

5.1 Shallow Foundations

For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock / medium rock layer.

The safe bearing capacity of these cohesionless layers could be computed using the formula,

$$Q_a = (0.5\gamma \times B \times N_\gamma + \gamma D_f N_q) \div 2.5$$

Where,

B	=	Width of footing
γ	=	Submerged unit weight of soil taken as 1 gm/cc,
D_f	=	Depth of surcharge
$N\gamma$ Nq	=	Bearing capacity factors based on the N values taken from Fig 10

For an N value of over 50 the SBC computed over 5.0kg/cm^2 for the foundations are placed on the disintegrated rock layer. However, the SBC may be limited to 5.0kg/c^2 to allow for any non-uniformity.

When the foundations are taken to medium rock layer the SBC that could be adopted is 10kg/cm^2.

The settlement would be elastic and of small order.

Over excavations in disintegrated rock should be refilled by 1:3:6 concrete and in medium rock by 1:2:4 concrete.

6. EXCAVATION PROCEDURE

1. Vertical cuts could be given for excavation.

2. Normal excavators would be required for excavation in disintegrated rock and jack hammers would be required for excavation in medium rock.

3. Slush formed by any water accumulation should be removed and refilled by lean concrete.

4. If water accumulates in the foundation trenches, dewatering should be done by pumping out water from a level lower than the foundation level to maintain downward flow of water.

5 The exposed side of excavation should be covered by plastic sheet during rainy season and surface drain provided to prevent water from flowing on the cut surface.

8. CONCLUSIONS

1. The area explored has got top soil of 0.5 to 1.50M is non-uniform. The underlying layer is disintegrated rock with medium rock appearing at the depth varies from 2.0 to 4.3M below ground level. Water table was met with at 1.0 to 2.6M below ground level at the time of exploration.

2. For the proposed structure shallow foundations can be given at any depth from 1.5M, resting the foundation on the disintegrated rock /medium rock layer. The SBC that could be adopted is 5.0kg/cm^2 when the foundations are placed on the disintegrated rock layer and 10.0kg/cm^2 when the foundations are on the medium rock layer.

3. The settlement of the shallow foundation would be of small order and elastic in nature.

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4. Over excavations in the foundation trenches should be refilled as suggested.

5. Suggested excavation procedure should be adopted while undertaking the construction.

F.S.ENGINEERS PVT.LTD
NEW NO.98,(Old No.109) VELACHERY ROAD
GUINDY
CHENNAI – 600 032

(Dr.A. Verghese Chummar)
Director
Dated: Feb 5th , 2018

P.N.7364



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