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STRUCTURAL DESIGN BASIS REPORT

THE PROPOSED CONSTRUCTION OF HIGH RISE BUILDING CONSISTS OF EXTENDED SINGLE BASEMENT FLOOR + STILT + 5 FLOORS RESIDENTIAL BUILDING WITH 59 DWELLING UNITS AVAILING PREMIUM FSI AT SHRI DEVIKUPPAM ROAD, VALASARAVAKKAM CHENNAI-600087 AND COMPRISED IN S.NO.47/1B,2A2&2A3 OF VALASARAVAKKAM VILLAGE, MADURAVOYAL TALUK AND WITHIN THE LIMITS OF GREATER CHENNAI CORPORATION.

CLIENT:	M/S **NAVIN HOUSING & PROPERTIES (P) LTD,** CHENNAI.
ARCHITECT:	SRISHTI DESIGN CONSULTANTS, CHENNAI.
STRUCTURAL CONSULTANT:	**BURO ENGINEERS (INDIA) PRIVATE LIMITED,** Chennai

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REV NO.	DATE	DESCRIPTION	STATUS	PREPARED BY	REVIEWED BY	APPRVD. BY
R0	20-07-2025	Design Basis Report	OKAY	ARUN	YUVARAJ	PERAM

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DESIGN INFORMATION AND CRITERIA

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1.0 INTRODUCTION

M/s.NAVINS Pvt Ltd proposed a construction of Residential Building is located at Valasaravakkam village, Chennai. Architecturally it is designed with 1Basement + Stilt + 5 Floors + Roof. In which the Stilt floors are designed to facilitate car parks and two wheeler as per norms. Rest of the all floors are designed to accommodate Residential units. It is a linear rectangular building in plan.

1.1 Scope of the Report

This report provides the information on Codes of Practice, Design loads, Materials considered for the Design and Analysis of the building. In addition, this report summaries the main design criteria, Structural system, Foundation system, Parameters & Methodology to be adopted in the design.

1.2 Project Overview

The proposed development is a Residential Apartment building comprises of 1Basement + Stilt + 5 Floors + Roof. Plan dimension of the building at the Stilt level is 54.578mx36.348m respectively. Vertical access systems like Lift & Staircases are provided adequately & at the right location in order to fulfil the NBC norms and to satisfy the functional requirements as well. The building height & its storey details are as follows,

Sl. No.	No. Of storey	Building Height	Plan dimension at Basement/Stilt Level	Remarks
1	1Basement + Stilt + 5 floors + Terrace	18.3m (measuring from FGL to Terrace)	54.57mx36.35m	With car parking

Building Floor Height Details	
Basement Floor (Car Park)	3.35m
Stilt Floor (Car Park)	3.30m
1st Floor to 5th Floor	3.00m
Head Room	2.50m
LMR	5.00m (measured from Roof)

1.3 Proposed Structures and its Usage.

1.3.1 Structural Type

The building structures are mainly cast in situ reinforced concrete structure. The structural system comprises of R.C walls/Columns as vertical supporting structural elements with RC conventional Beam-slab system. Foundation is designed to be uniform Raft.

1.3.2 Foundation Type

The foundation system is to be Raft (uniform) Foundation. The Foundation is about 4m down from Existing Ground Level. The Foundation will be designed for the recommended Safe Bearing Capacity as laid down in the Soil Investigation report No. TJE/003847/2025_VALASARAVAKKAM VILLAGE dated 02th JULY 2025, was carried out by M/s. TJ ENGINEERS, Velachery, Chennai.

1.4 Concrete

Characteristic concrete strength (concrete grade) for the project shall be based on exposure condition and forces to be supported by specified structural elements. The minimum cement content and maximum water–cement ratio shall be as per IS code 456:2000. The minimum 28-day compressive strength of concrete for specified structural elements shall be as follows,

Table 1.4.1 Grade of Concrete for Individual Structural elements

Sl.No.	Structural Elements	Grade of Concrete
1.	Footings	M30
2.	**RC Shear wall**	**M30**
3.	**RC Columns**	**M30**
4.	RC Beams	M30
5.	RC Slabs	M30
6.	UG Sump & STP	M30
7.	Structural members in external services	M25

Table 1.4.2 Concrete Properties

Young's Modulus of Elasticity of Concrete	$5000\sqrt{fck}$
Poisson Ratio's Ratio v =	0.2
Coefficient of Thermal expansion	5.5x10-6

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1.4.3 Reinforcement

The characteristic tensile properties of steel used in design shall be as follows.

Reinforcement Characteristic yield strength f_{yk} (N/mm^2)	550 N/mm^2
Welded Steel Fabric yield strength $f_{0.2k}$ (N/mm^2)	485 N/mm^2
Young's Modulus E (kN/mm^2)	200 kN/mm^2
Poisson's ratio	0.3
Coefficient of Thermal expansion, α ($^oC^{-1}$)	$12x10^{-6}$

1.4.4 Structural steel

All structural steel shall conform to Indian standard IS: 2062-2011.

Structural steel	Grade E=250	Grade E-350
Tensile strength	410 N/mm^2	490 N/mm^2
Yield stress t<20mm	250 N/mm^2	350 N/mm^2
Yield stress t = 20mm to 40mm	240 N/mm^2	330 N/mm^2
Yield stress t> 40mm	230 N/mm^2	320 N/mm^2
Young's Modulus (E)	200,000 N/mm^2	200,000 N/mm^2
Density	78.5 kN/m^3	78.5 kN/m^3

1.5 SUB-SOIL CONDITION

Soil Investigation report no. TJE/003847/2025_VALASARAVAKKAM VILLAGE dated 02th JULY 2025, was carried out by M/s. TJ ENGINEERS, Velachery, Chennai. Field investigation carried out for Three (3) boreholes to ascertain subsoil condition in the proposed site. All the bore holes are terminated between 34m to 38m respectively in dense layer with "N" value more than 100 encounters. The top soil silty clay sand on 0.8m to 1.30m, Loose silty sand on 1.30m to 2.60m, Stiff sandy silty clay on 2.60m to 4.10m, Loose clayey sand on 8.90m to 9.90m, Medium stiff sandy silty clay on 9.90m to 14.30m, Medium Dense Clayey Silty Sand, 14.30m to 17.20m, Soft to Stiff Sandy Silty Clay, 17.20m to 24.70m, Medium Dense to Dense Gravelly Clayey Silty Sand, 24.70m to 32.90m, Very Dense Clayey Silty Gravelly Sand, 32.90m to 35.50m, Very Dense Silty Clayey Gravelly Sand, 35.50m to 38.00m. During the time of soil investigation (July 2025), there is no Ground water table.

The report has proposed Raft Foundation as foundation system with Safe bearing capacity of 12 t/m^2. Considering modulus of subgrade reaction of 12,000/kN/m^3.

As per the evaluation reported by the geotechnical consultant the sub-soil in the project site is not susceptibility to "Liquefaction".

Refer the soil report for profile of boreholes and the sub soil conditions.

2.0 DESIGN CRITERIA

2.1 Design Life

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

2.2 CODES, STANDARDS & REFERENCES

All design of structures shall comply with the requirements specified in the following.

a. Relevant Indian Standard Codes of Practice
b. National Building Code.
c. Local Building regulations.
d. Other relevant International codes where required.

All applicable latest editions of codes and standards will be referred and adopted in the analysis of structures and the design and detailing of structural members. All structural elements design shall be carried out primarily based on Indian Standards and Codes with latest revision, with amendments if any, as on date. In addition, other international codes and standards shall also be referred when required and relevant.

In the analysis, design and detailing of the building, the following Indian Standard codes of latest amendment will be used.

Table 2.2.1 Codes and Standards for Design Loads (Other Than Earthquake loads)

IS Code	Description
IS 875 (Part 1): 1987	Dead Loads (Unit Weight of Building Material and Stored Material)
IS 875 (Part 2): 1987	Imposed Load
IS 875 (Part 3): 2015	Wind Load
IS 875 (Part 5): 1987	Special Loads and Combinations

Table 2.2.2 Codes and Standards for Design of Earthquake Resistance structures

IS Code	Description
IS 1893(Part-1) :2016	Criteria for Earthquake Resistance design of structures.
IS 4326: 1993	Earthquake Resistant Design and Construction of Buildings – Code of Practice
IS 13920: 2016	Ductile Detailing of Reinforced Concrete Structures subject to Seismic Forces - Code of Practice.

Table 2.2.3 Codes and Standards for Design of Concrete Structures

IS Code	Description
IS 456: 2000	Plain and Reinforced Concrete - Code of practice
IS 6403 -1981	Code of practice for determination of bearing capacities of shallow foundations.
IS 8009-1976 (Part I):	Code of practice for calculation of settlement of foundations – Shallow foundation
IS 1904-1986(RA-2015)	Indian Standard Code of practice for design & construction foundations in Soil: General Requirements
IS 2950-1981(RA-2018)	Code of practice for design and construction of raft foundations : Part 1 Design (second revision).
IS 1080-1985(Raf.2011)	Code of Practice for Design and Construction of Shallow foundation in Soils
IS 6403-1981(Raf.2011)	Code of practice for determination of bearing capacity of Shallow foundations
IS 2950-1981(Raf.2011)	Code of Practice for Design and Construction of Raft foundations
SP 16	Structural use of concrete, Design charts for singly reinforced beams, doubly reinforced beams and columns.
SP 34	Hand book on Concrete Reinforcement & Detailing
SP 7(Part IV)	National Building code of India
IS 1786-2008(RA-2018)	Specification for high strength deformed bars and wires for concrete Reinforcement.
IS 432 (Part 2) 1982	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete reinforcement – Hard Drawn Steel Wire
IS 3370 (part I)-2009	Code of practice for concrete structure for the storage of liquids

Table 2.2.4 Design of Steel Structural Elements

IS Code	Description
IS 800: 2007(RA-2017)	Code of Practice for General Construction in Steel
IS 2062: 2011(RA-2016)	Steel for General structural purposes

Table 2.2.5 Design of Concrete Elements - International codes

IS Code	Description
BS 8110: 1997	Structural use of concrete. Code of Practice for design and construction
ACI 318	Building Code requirements for Structural Concrete

The building is a RCC structure designed with Structural wall System. The slabs of all floor is used as diaphragms in redistribution of lateral forces.

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.

2.3 LOADS

Table A: Unit Weight of Materials:

Material	Density
Reinforced Cement Concrete	25.00 kN/m^3
Plain Cement Concrete	24.00 kN/m^3
Screed Concrete	24.00 kN/m^3
Cement Mortar	20.00 kN/m^3
AAC Block	**7.50 kN/m^3**
Structural Steel	78.50 kN/m^3
Cinder Concrete (Filling material)	08.00 kN/m^3
Dry soil	18.00 kN/m^3
Wet Soil	22.00 kN/m^3
Landscape soil	16.00 kN/m^3
Glass	28.00 kN/m^3
water	10.00 kN/m^3

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2.3.1 Superimposed Dead Loads and Live Loads

The following are the imposed loads such as SDL and LL to be considered for the design of floor system depending usage floor. In addition to these loads, self-weight of structural elements will be considered depending on member sizes shown in the floor plans.

Stilt Floor (Parking)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.4	0.0
Services load (ceiling)	0.0	0.0
Live Load Parking	0.0	5
Partition Load	0.0	0.0
Total	**2.4**	**5**
First Floor to Fifth Floor (Living/Bedroom/Kitchen)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.8	0.0
Services load (ceiling)	0.0	0.0

Live Load	0.0	2.0
Partition/Filling Load	0.0	0.0
Total	**1.8**	**2.0**
First Floor to Fifth Floor (Toilet)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.2	0.0
Services load (ceiling)	0.0	0.0
Live Load	0.0	2.0
Partition/Filling Load	3	0.0
Total	**4.2**	**2.0**
Podium Landscape		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.4	0.0
Services load (ceiling)	0.0	0.0
Live Load	0.0	3.0
Partition/Filling Load	10	0.0
Total	**12.4**	**3.0**
Lobby /Corridor		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.4	0.0
Live Load	0.0	3.0
Partition Load	0.0	0.0
Total	**2.4**	**3.0**
Balcony		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.2	0.0
Live Load	0.0	3.0
Partition Load\ Filling	2	0.0
Total	**3.2**	**3.0**
Head Room		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.0	0.0
Live Load	0.0	2.0
Partition Load	0.0	0.0
Total	**2.0**	**2.0**
LMR		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	0.0	0.0
Live Load	0.0	3.0
Lift load	15.0	0.0
Total	**15.0**	**3.0**
Fire Tender		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.4	0.0

Services load (ceiling)	0.0	0.0
Live Load	0.0	15.0
Partition/Filling Load	15.0	0.0
Total	**2.4**	**15.0**

In the analysis and design reduction to imposed load (Live load) shall be considered as per IS 875 Part (2), clause.3.2 where it is applicable.

2.5 TEMPERATURE EFFECTS

Temperature changes can cause additional stresses to the structure and has potential to increase in loads will be considered in the design of structural elements. Temperature effects will be considered for an ambient temperature variation from temperature during construction.

The maximum and minimum temperature for city of Chennai as recorded by Indian Metrological Department is as follows.

Maximum mean Temperature	45°C
Minimum mean Temperature	15°C
Average ambient Temperature during construction	30°C

The structural system will be designed for the effect of temperature variation. A temperature variation of **±15° C** will be considered in the structural analysis over the Roof & Terraces for the consideration of thermal effect on structural elements.

2.6 WIND LOAD

Design wind load for the buildings shall be estimated as per IS 875 (Part 3): 2015. Design wind speed (Vz) is based on such as location, basic wind speed, terrain, cyclone condition and topography.

Location of the building	Chennai
Basic Wind speed - Vb m/sec	50 m/sec
Risk Coefficient (Probability factor) -k1	1.0
Terrain factor (Terrain-2) – k2 for the height of 18.3m	1.06
Topography factor – k3	1.0
Importance factor (Cyclonic region) – k4	1.0

Design wind speed (Vz) = Vb*k1*k2*k3*k4 =50x1x1.06x1.0x1.0 = 53.0m/sec

Wind pressure (Pz) = 0.6 Vz^2 = 0.6x 53^2 =1685.4 N/m^2

For design of building wind pressure 1.685 kN/m^2 is consi

Design wind pressure (P_d) = K_d*K_a*K_c*P_z

Where K_d - Wind Directionality factor = 1.0

Ka – Area averaging factor = 0.9

Kc – Combination factor = 0.9

Design Wind pressure = 1.685x1.0x0.9x0.9 = 1.3648 kN/m^2

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2.6.1 Dynamic wind analysis

As per IS 875 (Part 3) - 2015, clause 9.1 Dynamic wind analysis has to be carried out if the buildings meet the following criteria.

a). Buildings and closed structures with a height to minimum lateral dimension ratio (H/Wmin) is more than 5. (or)

b). Building and structures whose natural frequency is less than 1.0 Hz.

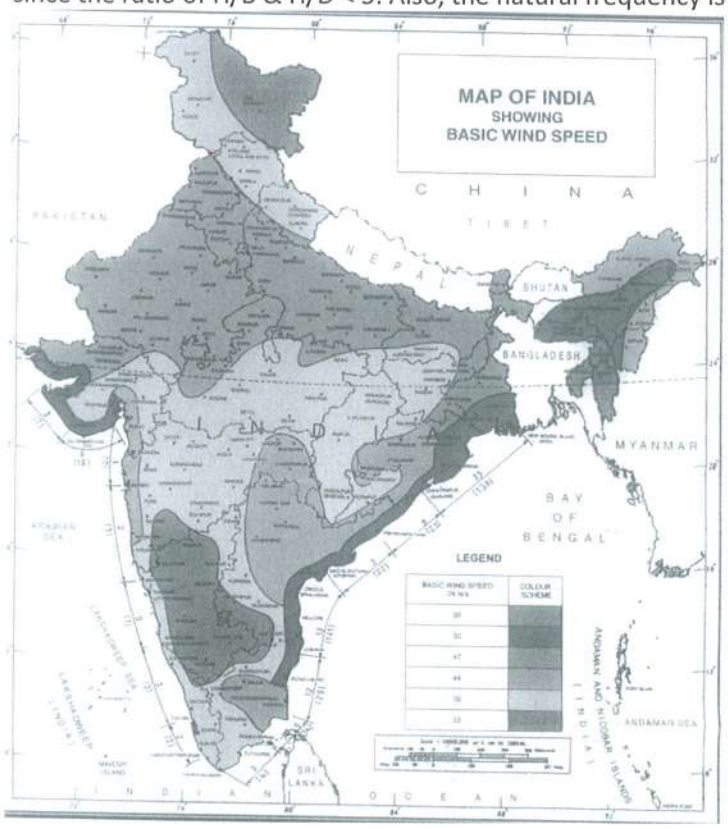
Fundamental period of the building = Ta = 0.09H/(D)^0.5. Fundamental natural frequency 1/Ta >1.0

2.6.2 Time period

Sl.No	Height(m)	B(m)	D(m)	Tax(sec)	Tay(sec)	1/Tax	1/Tay
1	18.3	54.58	36.45	0.222	0.273	4.505	3.663

Sl.No	Height(m)	B(m)	D(m)	H/B	H/D
1	18.3	54.58	36.45	0.335	0.503

From the above, it is evident that Dynamic wind analysis for the proposed building is not required, since the ratio of H/B & H/D < 5. Also, the natural frequency is 1/Ta >1.0.



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2.7 Seismic Lateral Force

Design of lateral force under seismic condition shall be as per IS1893 – 2016. Total lateral force (base shear) of the building shall be estimated as per clause 7.2.1 of IS1893 – 2016 which provides by

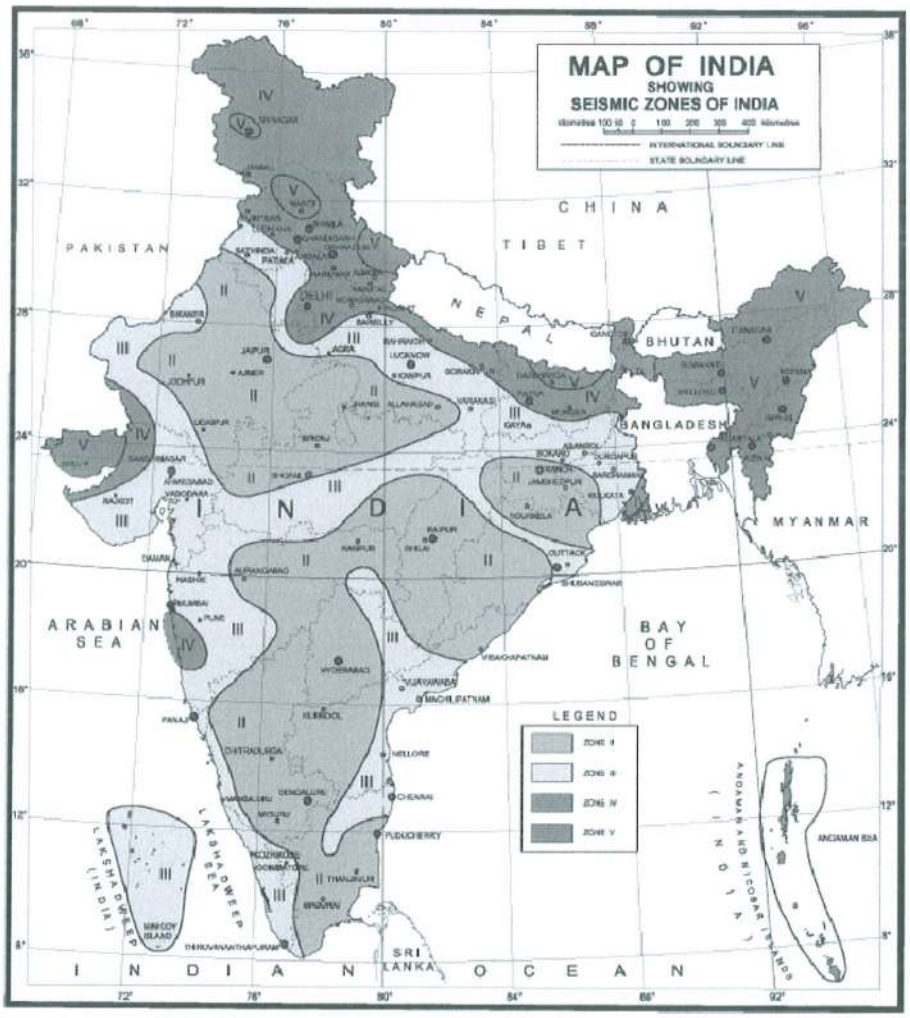
Base shear $V_b = A_h W$

A_h is horizontal seismic coefficient and W is seismic weight of the building, Horizontal seismic coefficient depends on location of the building (Zone factor Z), usage of the building (Importance factor, I), building lateral resisting system (Response reduction factor, R) and design acceleration coefficient (Sa /g) which is based on subsoil condition and fundamental natural period (Ta).

For the proposed development is for residential use. Considering it, the seismic weight is summation of total dead load, 25% of live load where live load is less than 3 kN/sq.mt and 50% of live load where live load is greater than 3 kN/sq.mt. The fundamental natural period (Ta) for building

$Ta = 0.09h/(d)^{0.5}$

Where h- height of the building & d – width of the building under consideration of earthquake.



2.7.1 Design Parameters for estimation of seismic loading

Sl.No.	Description	Parameters as per IS-1893-2016
1.	Location - Chennai	Seismic zone III
2.	Seismic Zone Factor	0.16
3.	Response Reduction Factor: Structural wall system	4.0
4	Importance factor	1.2
5	Type of Soil (Medium)	Type II
6	Damping coefficient	5%

2.8 Base Shear

Height of the building (h) (measured from Stilt floor)
d (along the length of the building)
b (along the breadth of the building)

a) Ta (along x) = Refer - 2.6.2
b) Ta (along y) = Refer - 2.6.2

From IS 1893: 2002, Clause 6.4.2, Design horizontal seismic coefficient

$$Ah = \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g}$$

Where,

Z for Zone III = 0.16
I for Residential Building = 1.2 (Refer to IS 1893-2016, Table.9)
R for Structural wall system = 4.0 as per (Table 9)
Sa/g (For medium) X-direction = (Refer to IS 1893-2016, page 13, Fig 1)

Sa/g (For medium) Y-direction = (Refer to IS 1893-2016, page 13, Fig 1)

Design horizontal seismic coefficient and base shear

X- direction Vbx = Ahx * W
Y- direction Vby = Ahy * W

2.9 Dynamic Analysis

Response spectrum method of Dynamic Analysis carried out with following parameters pertaining to dynamic analysis.

Time period	: Calculated with the assumption of wall system
Number of modes Considered	: 12 Numbers (Min)
Modal Combination Method Used	: Complete Quadratic combination (CQC)
Spatial Combination Method used	: Square root of the sum of Square (SRSS)
Modal case type	: Ritz Method
Orthogonal directional seismic effect	: Not applicable

3.0 Structural Analysis and design

3.1 Assumptions considered in the design

The assumptions for structural analysis and design are as below

- Elastic analysis (plane remains plane).
- Structure shall be analysed for the most adverse load conditions and envelope of forces shall be designed for.
- Cracked section properties of structural RC structural elements are used in the analysis as per IS 16700-2017, clause 7.2, Table 6.

3.2 Concrete Cover

Concrete cover to the reinforcement in structural elements is based on durability and fire rating. The fire rating of 2hrs is considered for structural elements for the commercial development.

Sl. No.	Structural Elements	Cover in mm
1.	Raft	60
2.	RC Wall	30
3.	Column	40
4.	Beams	30
5.	Slabs	25
6.	UG Tank Base Slab/Wall	40

3.3 Method for analysis

Computer-aided analysis using finite element method (FEM) shall be carried out for the design of structural elements. For 3D or 2D structural frame analysis latest version of software ETABS, SAFE shall be used, Prokon, RCDC and verified in-house spread sheets will be used for the design of reinforced concrete (RC) and steel elements in consideration of flexure, shear and axial forces.

3.4 Assumptions for 3D model analysis using ETABS

Column: Frame Element
RC Wall: Wall (Shell) Element
Beam Element: Frame Element
Slab: Shell Element

The following are general parameters adopted in the analysis and design,

Modulus of Elasticity of Concrete -5000√fck

Consideration of Diaphragm - Rigid Diaphragm.

Slab element considered as membrane element

Stiffness modification factors are adopted in the analysis as per IS -16700-2017, Table.6.

Table 6 Cracked RC Section Properties

(Clause 7.2)

Sl No.	Structural Element	Un-factored Loads		Factored Loads	
		Area	Moment of Inertia	Area	Moment of Inertia
(1)	(2)	(3)	(4)	(5)	(6)
i)	Slabs	1.0 A_g	0.35 I_g	1.00 A_g	0.25 I_g
ii)	Beams	1.0 A_g	0.7 I_g	1.00 A_g	0.35 I_g
iii)	Columns	1.0 A_g	0.9 I_g	1.00 A_g	0.70 I_g
iv)	Walls	1.0 A_g	0.9 I_g	1.00 A_g	0.70 I_g

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The following parameters and methods are adopted in creating ETABS 3D model for the buildings and design of structural elements.

- The 3D ETABS model generated based on the preliminary floor plans (shuttering drawings) prepared using preliminary sizes.
- Sectional properties are assigned to all the structural elements as per the preliminary floor plans (shuttering drawings).
- External & Internal in fill wall loads are assigned as uniformly distributed line load on beams and as area load if the wall is intend to distribute on slab directly. These loads are assigned under SDL type load case.
- Slabs are modelled as shell element if floor system is Flat slab and the slab has been modelled as membrane in Beam-slab as floor system and slabs are assigned with horizontal diaphragms.
- Live Load reduction is considered in the design of Foundation and Column as per the Code: IS 875-1987 (Part-II), clause.3.2.1.
- Area design load i.e. Live load/SIDL or any other load is applied at floor relevant to its usage.
- All lateral loads & parameters are assigned as per Codes IS 1893-2016 & IS 875-2015.
- Temperature loads are applied on to the terraces and to areas directly exposed to sun.
- Beams under Torsion is required to maintain Equilibrium will be designed for Torsion in accordance with IS 456-2000, clause 41.1 to 41.4 and for all other beams torsional stiffness is neglected in the analysis by applying stiffness modifier as 0.0001 to torsional constant "J". Hence no specific design for Torsion is required for these beams.
- Chennai falls under zone-III. Hence ductile detailing is required to follow in the design and detailing of structural elements, is adopted.
- Concrete cover to reinforcement complied accordance with IS 456-2000, Table.16 & 16A.
- UG Sump is designed for the crack width of 0.2mm.
- Secondary beams are not designed for ductile detailing.
- Long term deflections are checked by manual calculation using excel spread sheet wherever necessary. Crack width calculation will be done using spread sheet wherever necessary.

Area Load & Application: Applied as uniformly distributed area load with intensity proportionate to its usage as mentioned in the Loading items in the DBR.

Line (Wall) Load & Application: non load bearing or infill wall loads are calculated appropriately and Applied as uniformly distributed line load.

Lateral Load Resisting Systems: The proposed structure is a Structural RC wall Building with floor system of Beam-slab system.

4.0 LOAD COMBINATIONS

The various loads shall be combined in accordance with the stipulations in IS 875 (Part 5) 1987 and IS 456: 2000. The structure will be checked for serviceability Limit State and Ultimate Limit State (Limit State of Collapse) conditions. The load factors to be used for the load combinations are shown in the Table below. The structural elements shall be designed and checked for the critical forces from the combinations.

Load Combination	D.L.	I.L.	EQX	EQY	WX	WY	SPECX	SPECY
Limit State Of Serviceability (LSS) Combinations								
LC1	1.0	-	-	-	-	-	-	-
LC2	1.0	1.0	-	-	-	-	-	-
LC3	1.0	-	1.0	-	-	-	-	-
LC4	1.0	-	-1.0	-	-	-	-	-
LC5	1.0	-	-	1.0	-	-	-	-
LC6	1.0	-	-	-1.0	-	-	-	-
LC7	1.0	-	-	-	1.0	-	-	-
LC8	1.0	-	-	-	-1.0	-	-	-
LC9	1.0	-	-	-	-	1.0	-	-
LC10	1.0	-	-	-	-	-1.0	-	-
LC11	1.0	-	-	-	-	-	1.0	-
LC12	1.0	-	-	-	-	-	-1.0	-
LC13	1.0	-	-	-	-	-	-	1.0
LC14	1.0	-	-	-	-	-	-	-1.0
LC15	1.0	0.8	0.8	-	-	-	-	-
LC16	1.0	0.8	-0.8	-	-	-	-	-
LC17	1.0	0.8	-	0.8	-	-	-	-
LC18	1.0	0.8	-	-0.8	-	-	-	-
LC19	1.0	0.8	-	-	0.8	-	-	-
LC20	1.0	0.8	-	-	-0.8	-	-	-
LC21	1.0	0.8	-	-	-	0.8	-	-
LC22	1.0	0.8	-	-	-	-0.8	-	-
LC23	1.0	0.8	-	-	-	-	0.8	-
LC24	1.0	0.8	-	-	-	-	-0.8	-
LC25	1.0	0.8	-	-	-	-	-	0.8
LC26	1.0	0.8	-	-	-	-	-	-0.8
Limit State Of Collapse (LSC) Combinations								
COMB1	1.0	-	-	-	-	-	-	-
COMB2	1.5	1.5	-	-	-	-	-	-
COMB3	1.2	1.2	1.2	-	-	-	-	-

COMB4	1.2	1.2	-1.2	-	-	-	-	-
COMB5	1.2	1.2	-	1.2	-	-	-	-
COMB6	1.2	1.2	-	-1.2	-	-	-	-
COMB7	1.2	1.2	-	-	1.2	-	-	-
COMB8	1.2	1.2	-	-	-1.2	-	-	-
COMB9	1.2	1.2	-	-	-	1.2	-	-
COMB10	1.2	1.2	-	-	-	-1.2	-	-
COMB11	1.2	1.2	-	-	-	-	1.2	-
COMB12	1.2	1.2	-	-	-	-	-1.2	-
COMB13	1.2	1.2	-	-	-	-	-	1.2
COMB14	1.2	1.2	-	-	-	-	-	-1.2
COMB15	1.5	-	1.5	-	-	-	-	-
COMB16	1.5	-	-1.5	-	-	-	-	-
COMB17	1.5	-	-	1.5	-	-	-	-
COMB18	1.5	-	-	-1.5	-	-	-	-
COMB19	1.5	-	-	-	1.5	-	-	-
COMB20	1.5	-	-	-	-1.5	-	-	-
COMB21	1.5	-	-	-	-	1.5	-	-
COMB22	1.5	-	-	-	-	-1.5	-	-
COMB23	1.5	-	-	-	-	-	1.5	-
COMB24	1.5	-	-	-	-	-	-1.5	-
COMB25	1.5	-	-	-	-	-	-	1.5
COMB26	1.5	-	-	-	-	-	-	-1.5
COMB27	0.9	-	1.5	-	-	-	-	-
COMB28	0.9	-	-1.5	-	-	-	-	-
COMB29	0.9	-	-	1.5	-	-	-	-
COMB30	0.9	-	-	-1.5	-	-	-	-
COMB31	0.9	-	-	-	1.5	-	-	-
COMB32	0.9	-	-	-	-1.5	-	-	-
COMB33	0.9	-	-	-	-	1.5	-	-
COMB34	0.9	-	-	-	-	-1.5	-	-
COMB35	0.9	-	-	-	-	-	1.5	-
COMB36	0.9	-	-	-	-	-	-1.5	-
COMB37	0.9	-	-	-	-	-	-	-1.5
COMB38	0.9	-	-	-	-	-	-	1.5

5.0 ACCEPTANCE CRITERIA

Under Serviceability Limit State the limiting structural deflection shall be as follows.

Total deflection under all imposed loads including temperature, creep and shrinkage shall not exceed **L/250.**
In the above limiting value, the deflection contribution due to temperature, creep and shrinkage shall not be more than **L/350**.

Lateral deflection (sway) due to wind shall not exceed **H/500 (0.002 H)** where H is the height of the building above ground.

5.1 Crack width Limits

The Limiting values of crack width as per clause 35.3 of IS: 456-2000 is followed in the design

- In general, for slabs crack width is limited to 0.3mm.
- For water retaining structures, sump slab crack width is limited to 0.2mm

6.0 Design of Structural Elements and Foundation

6.1. Raft Foundation

The load intensity of column is moderate. As per the soil consultant recommendation Raft (Uniform) foundation designed considering the Safe Bearing capacity (SBC) of 12 t/m^2 at a depth of 4m & below and the modulus of sub-grade reaction of 12,000 kN/m^2/m. Refer the Soil Investigation report no. No. TJE/003847/2025_VALASARAVAKKAM VILLAGE dated 02th JULY 2025 for details.

6.2. RC Walls/Column

RC walls/Columns which are supporting both vertical loads and lateral forces are designed for the most adverse load conditions and envelope of the forces which will be the maximum for that structural element from the load combinations considered in the 3D analysis. The design of structural elements are designed in ETABS for the maximum forces obtained from the load combinations. As the buildings are located in Zone III, ductile design & detailing is followed in the design & detailing.

6.3. Beams

Each Beam will be designed for maximum forces from the 3D analysis using ETABS or RCDC concrete design software shall be used to design of RC members. Also, the detailing shall be followed as per SP-34 & IS-456 etc.

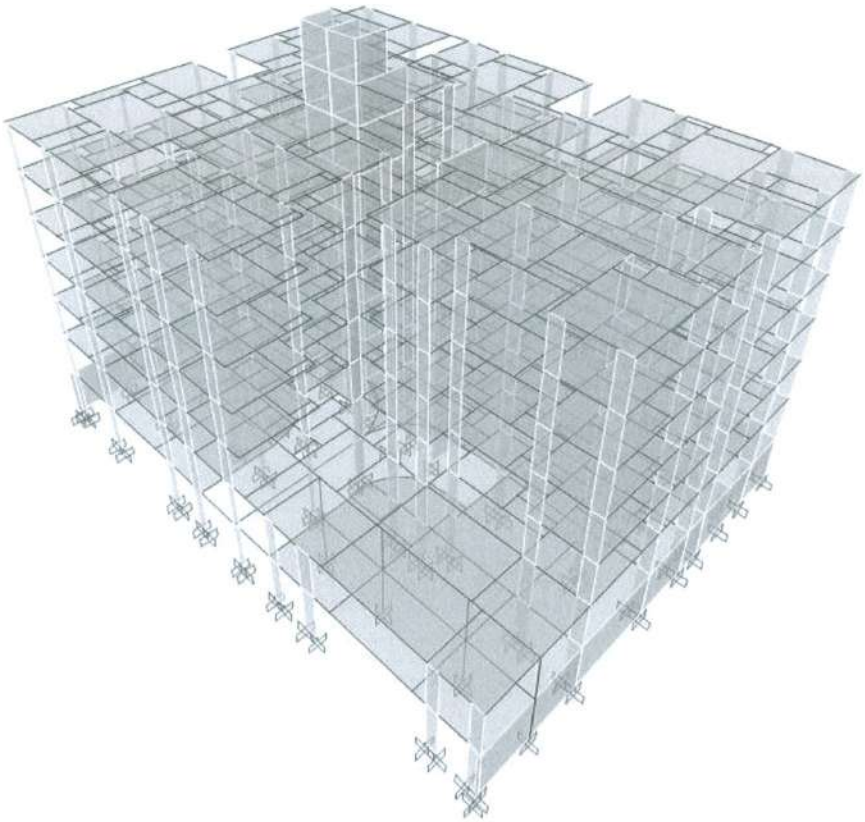
6.4. Slabs

Slabs are designed using SAFE 20 for irregular shaped slabs and regular slabs are designed using in house spread sheet formed as per IS-456 Annexe-D, Table-26.

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3D Model & Analysis summary report

ETABS®



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1 Structure Data

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

1.1 Story Data

Table 1.1 - Story Definitions

Tower	Name	Height m	Master Story	Similar To	Splice Story	Splice Height m	Color
T1	LMR Cover	2.5	No	None	No		Blue
T1	LMR Base	2.5	No	None	No		Blue
T1	Terrace	3	No	None	No		Blue
T1	5th Floor	3	No	None	No		Blue
T1	4th Floor	3	No	None	No		Blue
T1	3rd Floor	3	No	None	No		Blue
T1	2nd Floor	3	No	None	No		Green
T1	1st Floor	3.3	No	None	No		Cyan
T1	Stilt Floor	3.35	No	None	No		Red

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2 Properties

This chapter provides property information for materials, frame sections, shell sections, and links.

2.1 Materials

Table 2.1 - Material Properties - General

Material	Type	SymType	Grade	Color	Notes
HYSD415	Rebar	Uniaxial	HYSD Grade 415	Yellow	
HYSD550	Rebar	Uniaxial	HYSD Grade 550	Yellow	
M30	Concrete	Isotropic	M35	Yellow	
Tendon	Tendon	Uniaxial	Unknown	Gray8Dark	

2.2 Frame Sections

Table 2.2 - Frame Section Property Definitions - Concrete Rectangular (Part 1 of 2)

Name	Material	From File?	File Name	Section in File	Depth mm	Width mm	Rigid Zone?	Notional Size Type	Notional Auto Factor	Notional User Size mm
B 200X500	M30	No			500	200	No	Auto	1	
B 200X600	M30	No			600	200	No	Auto	1	
B 300X500	M30	No			500	300	No	Auto	1	
B 300X600	M30	No			600	300	No	Auto	1	
C 300X800	M30	No			800	300	No	Auto	1	
DB (100X100)	M30	No			100	100	No	Auto	1	

Table 2.2 - Frame Section Property Definitions - Concrete Rectangular (Part 2 of 2)

Name	Design Type	Area Modifier	As2 Modifier	As3 Modifier	J Modifier	I22 Modifier	I33 Modifier	Mass Modifier	Weight Modifier	Color
B 200X500	Beam	1	1	1	1	1	1	1	1	Red
B 200X600	Beam	1	1	1	1	1	1	1	1	Red
B 300X500	Beam	1	1	1	1	1	1	1	1	Yellow
B 300X600	Beam	1	1	1	1	1	1	1	1	Magenta
C 300X800	Column	1	1	1	1	1	1	1	1	Red
DB (100X100)	Beam	1	1	1	1	1	1	1	1	Blue

Table 2.3 - Frame Section Property Definitions - Concrete Beam Reinforcing

Name	Longitudinal Bar Material	Tie Bar Material	Top Cover mm	Bottom Cover mm	Top I-End Area cm2	Top J-End Area cm2	Bottom I-End Area cm2	Bottom J-End Area cm2
B 200X500	HYSD550	HYSD415	45	45	0	0	0	0
B 200X600	HYSD550	HYSD415	45	45	0	0	0	0
B 300X500	HYSD550	HYSD415	45	45	0	0	0	0
B 300X600	HYSD550	HYSD415	45	45	0	0	0	0
DB (100X100)	HYSD550	HYSD415	45	45	0	0	0	0

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Table 2.4 - Frame Section Property Definitions - Concrete Column Reinforcing (Part 1 of 2)

Name	Longitudinal Bar Material	Tie Bar Material	Reinforcement Configuration	Is Spiral Ties?	Is Designed?	Clear Cover to Ties mm	Number Bars 3-Dir	Number Bars 2-Dir
C 300X800	HYSD550	HYSD415	Rectangular		Yes	40	3	6

Table 2.4 - Frame Section Property Definitions - Concrete Column Reinforcing (Part 2 of 2)

Name	Number Longitudinal Bars	Longitudinal Bar Size	Corner Bar Size	Tie Bar Size	Tie Bar Spacing mm	Number Ties 3-Dir	Number Ties 2-Dir
C 300X800		20	20	10	150	3	3

2.3 Shell Sections

Table 2.5 - Slab Property Definitions (Part 1 of 3)

Name	Modeling Type	Property Type	Material	Overall Depth mm	Slab Thickness mm	Rib Width at Top mm	Rib Width at Bottom mm	Rib Spacing 1 mm	Rib Spacing 2 mm	One Way Load Distribution?
M 200	Membrane	Slab	M35		200					Yes
S 125	Shell-Thin	Slab	M35		125					
S 150	Shell-Thin	Slab	M35		150					
S 200	Shell-Thin	Slab	M35		200					

Table 2.5 - Slab Property Definitions (Part 2 of 3)

Name	Notional Size Type	Notional Auto Factor	Notional User Size mm	f11 Modifier	f22 Modifier	f12 Modifier	m11 Modifier	m22 Modifier	m12 Modifier	v13 Modifier
M 200	Auto	1		1	1	1	1	1	1	1
S 125	Auto	1		1	1	1	1	1	1	1
S 150	Auto	1		1	1	1	1	1	1	1
S 200	Auto	1		1	1	1	1	1	1	1

Table 2.5 - Slab Property Definitions (Part 3 of 3)

Name	Mass Modifier	Weight Modifier	Color	Notes
M 200	1	1	Gray8Dark	
S 125	1	1	Cyan	
S 150	1	1	Cyan	
S 200	1	1	Red	

Table 2.6 - Wall Property Definitions - Specified (Part 1 of 2)

Name	Modeling Type	Material	Wall Thickness mm	Include Auto Rigid Zone?	Notional Size Type	Notional Auto Factor	Notional User Size mm	f11 Modifier	f22 Modifier	f12 Modifier
W 200	Shell-Thin	M30	200	No	Auto	1		1	1	1
W 300	Shell-Thin	M30	300	No	Auto	1		1	1	1

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Table 2.6 - Wall Property Definitions - Specified (Part 2 of 2)

Name	m11 Modifier	m22 Modifier	m12 Modifier	v13 Modifier	v23 Modifier	Mass Modifier	Weight Modifier	Color	Notes
W 200	1	1	1	1	1	1	1	Green	
W 300	1	1	1	1	1	1	1	Green	

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3 Loads

This chapter provides loading information as applied to the model.

3.1 Load Patterns

Table 3.1 - Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
~Spx (Ser)ECC	Yes	Other	0	
~SpxECC	Yes	Other	0	
~Spy (Ser)ECC	Yes	Other	0	
~SpyECC	Yes	Other	0	
~SpzECC	Yes	Other	0	
Dead	No	Dead	1	
Eqx	No	Seismic	0	IS 1893:2016
Eqy	No	Seismic	0	IS 1893:2016
Filling	No	Super Dead	0	
Live<3	No	Reducible Live	0	
Live>3	No	Reducible Live	0	
Roof Live	No	Roof Live	0	
Sdl	No	Super Dead	0	
Temp	No	Temperature	0	
Wall	No	Super Dead	0	
Wx	No	Wind	0	Indian IS 875:2015
Wy	No	Wind	0	Indian IS 875:2015

3.2 Load Sets

Table 3.2 - Shell Uniform Load Sets

Name	Load Pattern	Load Value kN/m2
Balcony	Sdl	1.2
Balcony	Live<3	2
Balcony	Filling	3
Bed/Kit/Liv	Sdl	1.2
Bed/Kit/Liv	Live<3	2
Foyer/Lobby	Sdl	1.2
Foyer/Lobby	Live<3	3
Head Room	Sdl	1.2
Head Room	Live<3	2
LMR Base	Sdl	2.4
LMR Base	Live>3	15
Parking	Sdl	2.4
Parking	Live>3	5
Podium Landscape	Sdl	2.4
Podium Landscape	Live>3	3
Podium Landscape	Filling	10
Ramp	Sdl	2.4
Ramp	Live>3	5
Staircase	Sdl	1.7

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Table 3.2 - Shell Uniform Load Sets (continued)

Name	Load Pattern	Load Value kN/m2
Staircase	Live>3	4
Terrace	Sdl	3
Terrace	Live>3	3
Toilet	Sdl	1.2
Toilet	Live>3	2
Toilet	Filling	3
Transfomer Room	Sdl	2.4
Transfomer Room	Live>3	7.5
Utility	Sdl	1.2
Utility	Live<3	2
Utility	Filling	3

3.3 Auto Wind Loading

Table 3.3 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 1 of 3)

Name	Exposure Set	Is Auto Load	Exposure Source	Top Story	Bottom Story	Include Parapet	Parapet Height m	Cp Windward	Cp Leeward	Wind Speed meter/sec
Wx	1	No	Diaphragms	Terrace	Stilt Floor	Yes	1.35	0.8	0.5	50
Wx	1	No								
Wx	1	No								
Wx	1	No								
Wx	1	No								
Wx	1	No								
Wx	1	No								
Wy	1	No	Diaphragms	Terrace	Stilt Floor	Yes	1.35	0.8	0.5	50
Wy	1	No								
Wy	1	No								
Wy	1	No								
Wy	1	No								
Wy	1	No								
Wy	1	No								

Table 3.3 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 2 of 3)

Name	Exposure Set	Terrain Category	Importance Factor	Risk Coefficient	Topography	Width Type	Direction Angle deg	Story	Diaphragm
Wx	1	3	1.00	1.08	1	Auto	0	Terrace	D2
Wx	1							5th Floor	D1
Wx	1							4th Floor	D1
Wx	1							3rd Floor	D1
Wx	1							2nd Floor	D1
Wx	1							1st Floor	D1
Wx	1							Stilt Floor	D1
Wy	1	3	1.00	1.08	1	Auto	90	Terrace	D2
Wy	1							5th Floor	D1
Wy	1							4th Floor	D1
Wy	1							3rd Floor	D1
Wy	1							2nd Floor	D1

Table 3.3 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 2 of 3, continued)

Name	Exposure Set	Terrain Category	Importance Factor	Risk Coefficient	Topography	Width Type	Direction Angle deg	Story	Diaphragm
Wy	1							1st Floor	D1
Wy	1							Stilt Floor	D1

Table 3.3 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 3 of 3)

Name	Exposure Set	Depth m	X m	Y m
Wx	1	27.342	45.023	21.0235
Wx	1	27.342	45.023	21.0235
Wx	1	27.342	45.023	21.0235
Wx	1	27.342	45.023	21.0235
Wx	1	27.342	45.023	21.0235
Wx	1	27.342	45.023	21.0235
Wx	1	27.342	45.023	21.0235
Wy	1	36.247	45.023	21.0235
Wy	1	36.247	45.023	21.0235
Wy	1	36.247	45.023	21.0235
Wy	1	36.247	45.023	21.0235
Wy	1	36.247	45.023	21.0235
Wy	1	36.247	45.023	21.0235
Wy	1	36.247	45.023	21.0235

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3.4 Auto Seismic Loading

Table 3.4 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 1 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Is Auto Load	X Dir?	X Dir Plus Ecc?	X Dir Minus Ecc?	Y Dir?	Y Dir Plus Ecc?	Y Dir Minus Ecc?
Eqx	0.314	0.06	62960.4784	3777.6287	No	Yes	No	No	No	No	No
Eqy	0.273	0.06	62960.4784	3777.6287	No	No	No	No	Yes	No	No

Table 3.4 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 2 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Ecc Ratio	Top Story	Bottom Story	Ecc Overwrite Story	Ecc Overwrite Diaphragm	Ecc Overwrite Length m
Eqx	0.314	0.06	62960.4784	3777.6287	0.05	Terrace	Stilt Floor			
Eqy	0.273	0.06	62960.4784	3777.6287	0.05	Terrace	Stilt Floor			

Table 3.4 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 3 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Ct	User T sec	Z	Site Type	I	R
Eqx	0.314	0.06	62960.4784	3777.6287		0.314	0.16	II	1.2	4
Eqy	0.273	0.06	62960.4784	3777.6287		0.273	0.16	II	1.2	4

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IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern Eqx according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = X

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.314\ sec$

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] $Z = 0.16$

Response Reduction Factor, R [IS Table 9] $R = 4$

Importance Factor, I [IS Table 8] $I = 1.2$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] $\frac{S_a}{g} = 2.5$ $\frac{S_a}{g} = 2.5$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{Z I \frac{S_a}{g}}{2R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	0.314	62960.4784	3777.6287

Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
LMR Cover	23.3	0	0
LMR Base	20.8	0	0
Terrace	18.3	1365.4839	0
5th Floor	15.3	1068.3449	0
4th Floor	12.3	690.4605	0
3rd Floor	9.3	394.7249	0
2nd Floor	6.3	181.1381	0
1st Floor	3.3	77.4765	0
Stilt Floor	0	0	0
Base	-3.35	0	0

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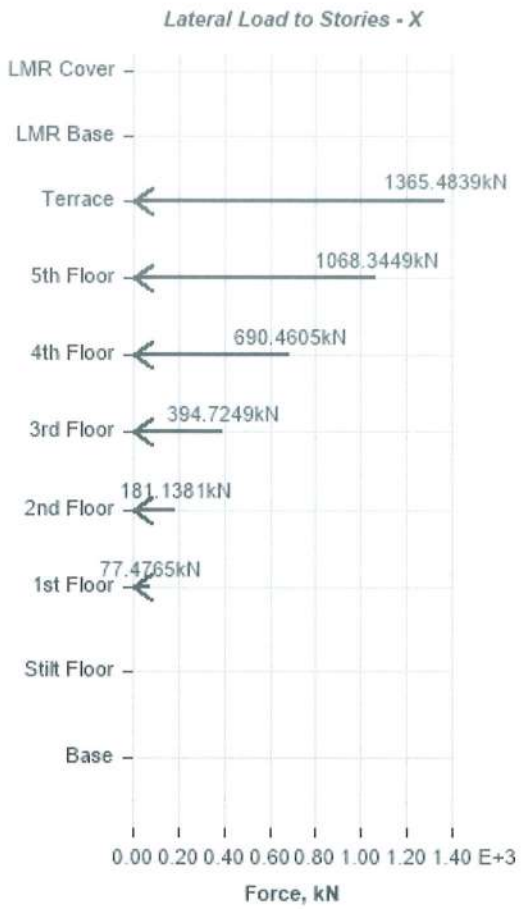


Figure 3-1-Set 1

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IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern Eqy according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = Y

Structural Period

Period Calculation Method = User Specified

User Period — $T = 0.273\ sec$

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] — $Z = 0.16$

Response Reduction Factor, R [IS Table 9] — $R = 4$

Importance Factor, I [IS Table 8] — $I = 1.2$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] — $\frac{S_a}{g} = 2.5$ — $\frac{S_a}{g} = 2.5$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2] — $A_h = \frac{Z\, I \frac{S_a}{g}}{2\, R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y	0.273	62960.4784	3777.6287

Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
LMR Cover	23.3	0	0
LMR Base	20.8	0	0
Terrace	18.3	0	1365.4839
5th Floor	15.3	0	1068.3449
4th Floor	12.3	0	690.4605
3rd Floor	9.3	0	394.7249
2nd Floor	6.3	0	181.1381
1st Floor	3.3	0	77.4765
Stilt Floor	0	0	0
Base	-3.35	0	0

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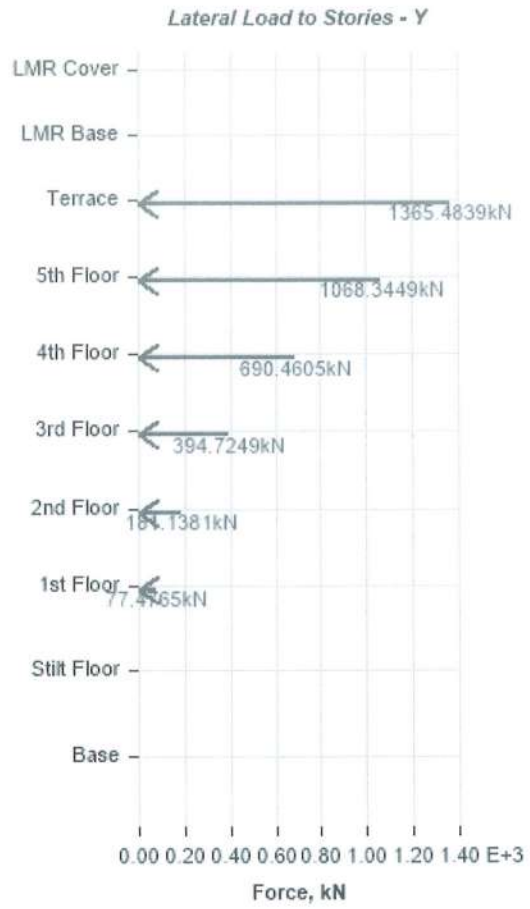


Figure 3-2-Set 1

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4 Analysis Results

This chapter provides analysis results.

4.1 Story Results

Table 4.1 - Story Stiffness (Part 1 of 2)

Story	Output Case	Case Type	Step Type	Step Number	Step Label	Shear X kN	Drift X mm	Stiff Xh kN	Stiff X kN/m	Shear Y kN
LMR Cover	Eqx	LinStatic	Step By Step			0	0.626		0	0
LMR Base	Eqx	LinStatic	Step By Step			0	2.154		0	0
Terrace	Eqx	LinStatic	Step By Step			1365.4839	6.777		201502.071	0
5th Floor	Eqx	LinStatic	Step By Step			2433.8285	10.072		241649.52	9.332E-07
4th Floor	Eqx	LinStatic	Step By Step			3124.2889	12.617		247622.553	2.326E-06
3rd Floor	Eqx	LinStatic	Step By Step			3519.0136	13.826		254522.118	2.879E-06
2nd Floor	Eqx	LinStatic	Step By Step			3700.1516	12.282		301270.835	3.146E-06
1st Floor	Eqx	LinStatic	Step By Step			3777.6282	6.612		571323.81	3.067E-06
Stilt Floor	Eqx	LinStatic	Step By Step			3777.6282	0.174		21654239.015	3.156E-06
LMR Cover	Eqy	LinStatic	Step By Step			0	1.203		0	0
LMR Base	Eqy	LinStatic	Step By Step			0	0.953		0	0
Terrace	Eqy	LinStatic	Step By Step			1.185E-06	0.309		0	1365.4838
5th Floor	Eqy	LinStatic	Step By Step			2.92E-06	0.281		0	2433.8288
4th Floor	Eqy	LinStatic	Step By Step			3.867E-06	0.386		0	3124.2893
3rd Floor	Eqy	LinStatic	Step By Step			6.256E-06	0.45		0	3519.0142
2nd Floor	Eqy	LinStatic	Step By Step			6.856E-06	0.471		0	3700.1523
1st Floor	Eqy	LinStatic	Step By Step			5.24E-06	0.273		0	3777.6288
Stilt Floor	Eqy	LinStatic	Step By Step			4.797E-06	0.043		0	3777.6288

Table 4.1 - Story Stiffness (Part 2 of 2)

Story	Drift Y mm	Stiff Yh kN	Stiff Y kN/m	Irregular	Modifier
LMR Cover	0.158		0		
LMR Base	0.799		0		
Terrace	0.233		0		
5th Floor	0.245		0		
4th Floor	0.276		0		
3rd Floor	0.249		0		
2nd Floor	0.125		0		
1st Floor	0.151		0		
Stilt Floor	0.097		0		
LMR Cover	2.641		0		
LMR Base	2.834		7.341E-06		
Terrace	2.897		471279.401		
5th Floor	3.789		642385.593		
4th Floor	4.225		739470.713		
3rd Floor	4.26		826033.407		
2nd Floor	3.72		994556.275		
1st Floor	2.264		1668246.532		
Stilt Floor	0.504		7495025.807		

4.2 Modal Results

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Table 4.2 - Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY
Modal	1	1.462	0.6197	0.0003	2.987E-05	0.6197	0.0003	2.987E-05	4.405E-05	0.1581
Modal	2	1.066	0.0004	0.0171	1.077E-06	0.6201	0.0174	3.095E-05	0.0034	0.0002
Modal	3	0.852	0.0002	0.6035	5.859E-07	0.6203	0.621	3.153E-05	0.1018	0.0001
Modal	4	0.581	0	3.956E-06	0.0003	0.6203	0.621	0.0004	2.131E-05	1.796E-05
Modal	5	0.544	7.285E-07	6.251E-06	0.0009	0.6203	0.621	0.0013	0	2.778E-05
Modal	6	0.518	3.09E-06	0	1.659E-05	0.6203	0.621	0.0013	0	0.0001
Modal	7	0.47	0.1154	3.31E-05	0.0001	0.7357	0.621	0.0014	1.822E-06	0.0773
Modal	8	0.431	7.184E-06	0	0.0005	0.7357	0.621	0.0019	0.0002	0.0004
Modal	9	0.288	0.0056	0.0055	1.139E-05	0.7413	0.6265	0.0019	0.0031	0.0005
Modal	10	0.271	0.0544	0.0016	0.0001	0.7957	0.6281	0.002	0.0008	0.014
Modal	11	0.248	0.0001	0.1505	1.354E-06	0.7958	0.7786	0.002	0.0541	1.328E-05
Modal	12	0.185	0.0304	3.231E-05	0.0086	0.8262	0.7786	0.0106	2.4E-05	0.0122
Modal	13	0.174	0.0006	2.735E-05	0.2467	0.8268	0.7786	0.2573	0.0007	0.0053
Modal	14	0.106	0.0001	0.1139	0.0251	0.8269	0.8925	0.2824	0.0388	0.0003
Modal	15	0.104	1.897E-05	0.0054	0.5061	0.8269	0.8979	0.7886	0.0013	0.0095
Modal	16	0.059	0.0742	0.0002	2.292E-05	0.9011	0.8981	0.7886	1.332E-06	0.0395

Table 4.2 - Modal Participating Mass Ratios (Part 2 of 2)

Case	Mode	RZ	SumRX	SumRY	SumRZ
Modal	1	0.0005	4.405E-05	0.1581	0.0005
Modal	2	0.5795	0.0034	0.1583	0.58
Modal	3	0.0113	0.1052	0.1583	0.5913
Modal	4	3.039E-06	0.1052	0.1583	0.5913
Modal	5	3.654E-05	0.1052	0.1584	0.5914
Modal	6	0.0033	0.1052	0.1584	0.5946
Modal	7	0.0002	0.1052	0.2357	0.5948
Modal	8	4.854E-05	0.1054	0.2361	0.5949
Modal	9	0.0915	0.1085	0.2366	0.6864
Modal	10	0.003	0.1093	0.2506	0.6894
Modal	11	0.0206	0.1634	0.2506	0.71
Modal	12	0.0017	0.1635	0.2628	0.7118
Modal	13	0.0001	0.1642	0.268	0.7119
Modal	14	0	0.2029	0.2683	0.7119
Modal	15	1.064E-05	0.2042	0.2778	0.7119
Modal	16	0.0001	0.2042	0.3173	0.712

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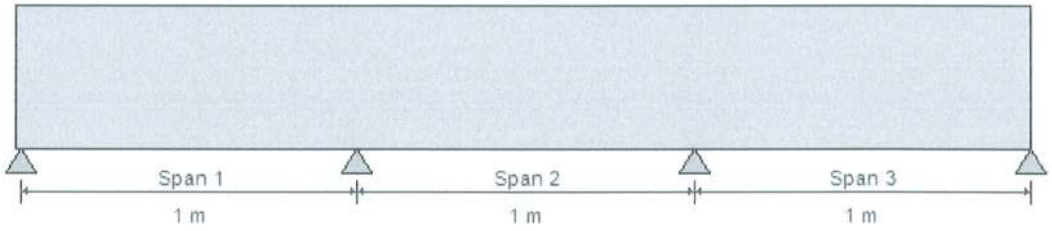
DESIGN OF RAFT

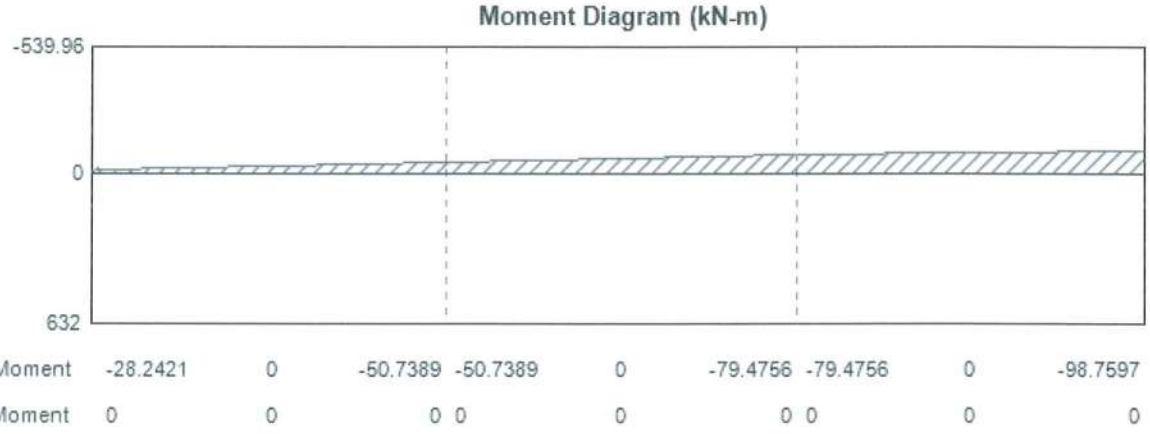
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IS 456:2000 Concrete Strip Design

Geometric Properties
Combination = Overall Envelope
Strip Label = SB4
Length = 33 m
Distance to Top Rebar Center = 57 mm
Distance to Bot Rebar Center = 77 mm

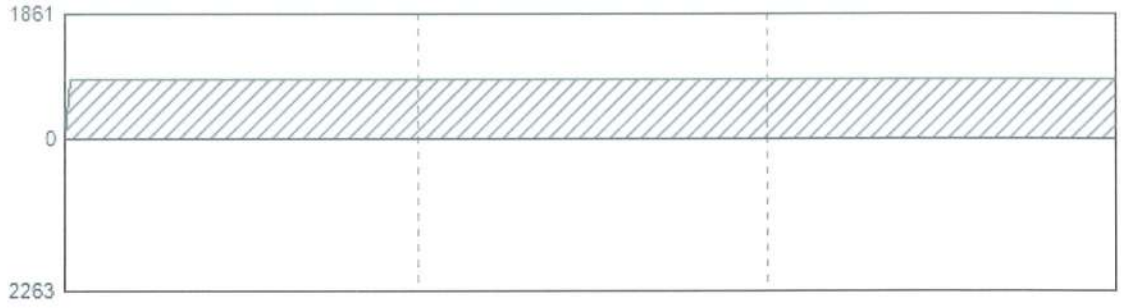
Material Properties
Concrete Comp. Strength = 30 MPa
Concrete Modulus = 29580.4 MPa
Longitudinal Rebar Yield = 500 MPa





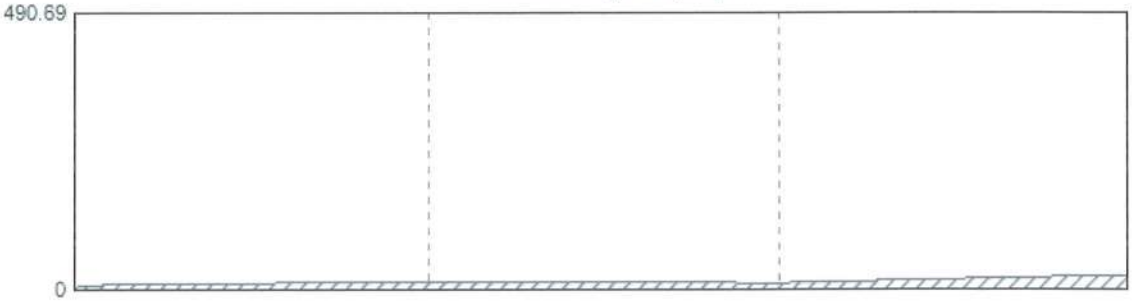
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Longitudinal Reinforcement (mm²)



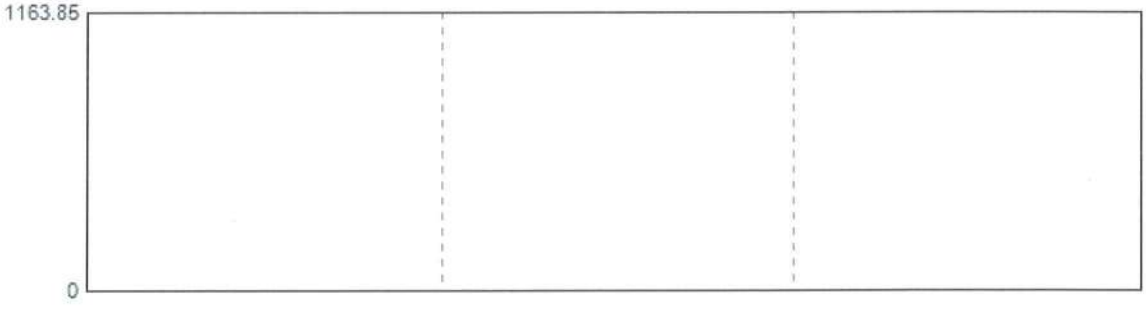
As (top)	94	0	169	169	0	265	265	0	330			
As (bot)	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL			
	0	0	0	0	0	0	0	0	0			
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL			

Shear Diagram (kN)



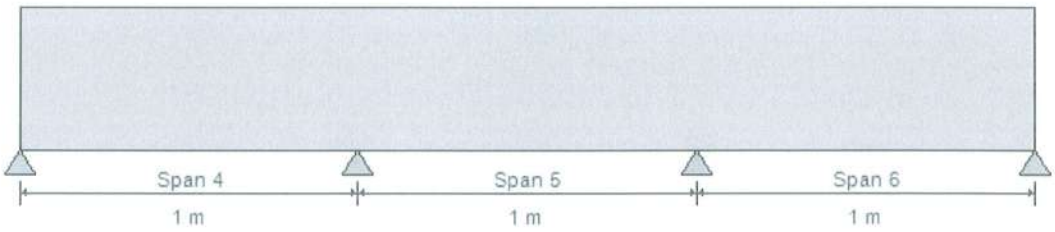
Shear	7.1763	0	14.8613	14.8613	0	11.6886	11.6886	0	24.0564

Transverse Reinforcement (mm²/m)

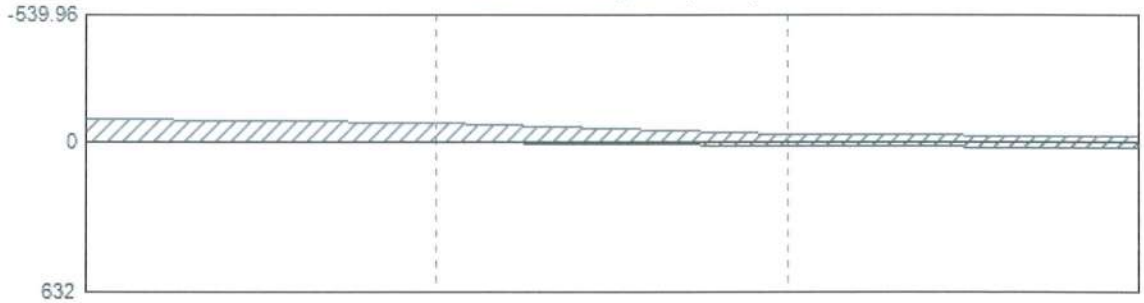


Asv/s reqd	0	0	0	0	0	0	0	0	0

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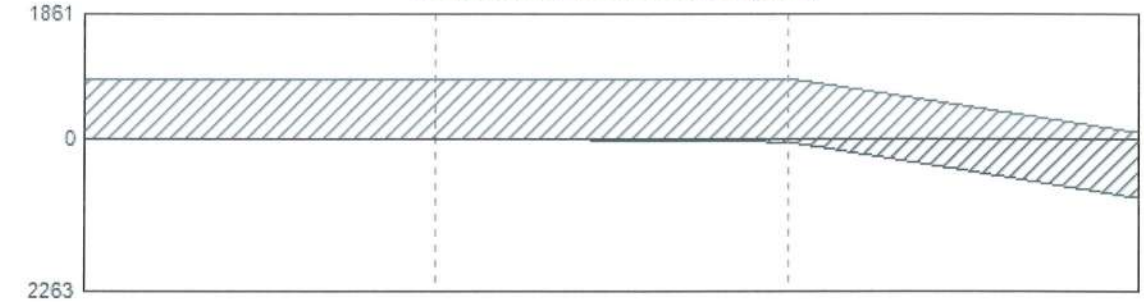


Moment Diagram (kN-m)



(-)Moment	-98.7597	0	-84.3532	-84.3532	0	-31.8826	-31.8826	0	-24.177
(+)Moment	0	0	0.6465	0.6465	0	14.1723	14.1723	0	27.2508

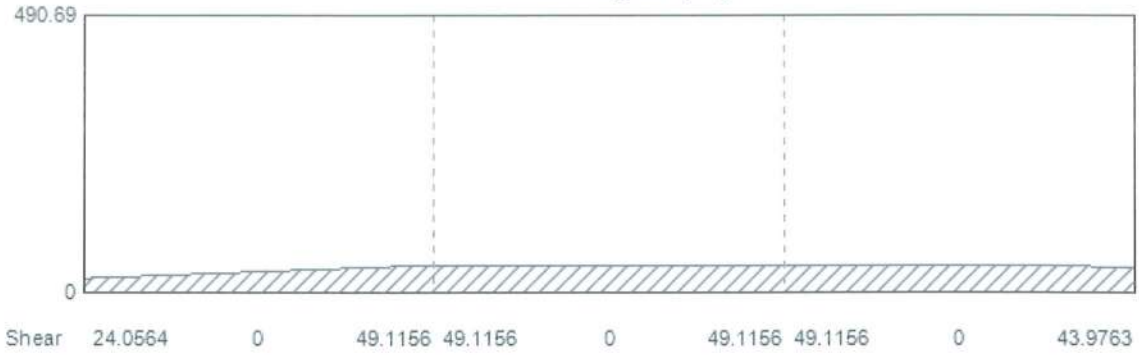
Longitudinal Reinforcement (mm²)



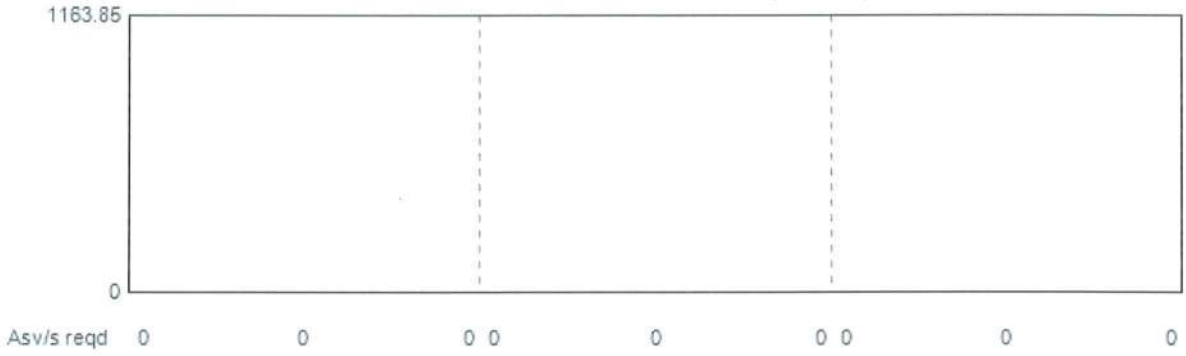
As (top)	330	0	282	282	0	106	106	0	80
As (bot)	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL
	0	0	0	0	0	48	48	0	93
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL

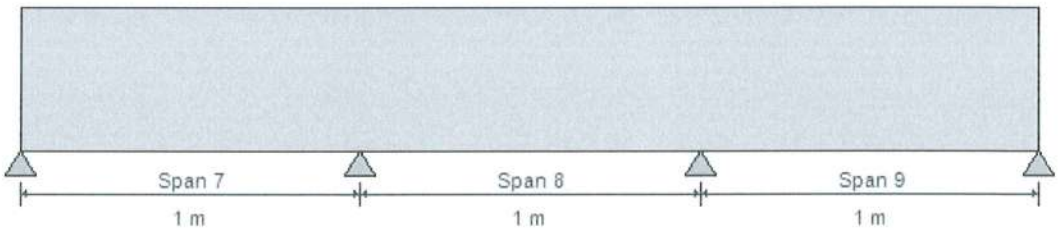
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Shear Diagram (kN)



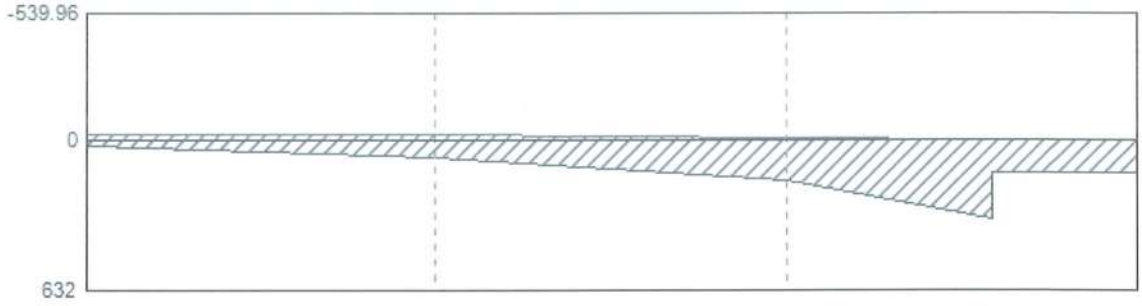
Transverse Reinforcement (mm²/m)





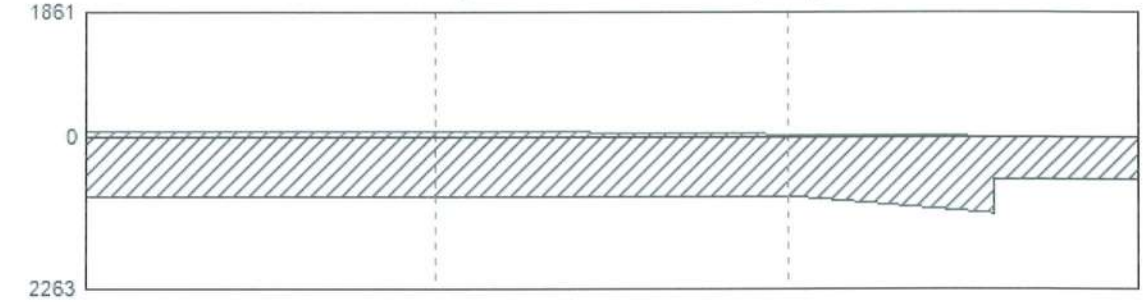
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Moment Diagram (kN-m)



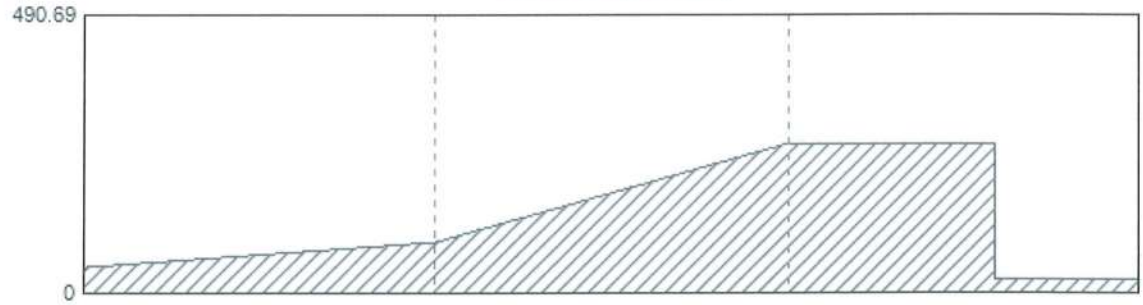
(-)Moment	-24.177	0	-25.1707	-25.1707	0	-4.5175	-4.5175	0	0
(+)Moment	27.2508	0	75.309	75.309	0	174.5855	174.5855	329.9048	137.1104

Longitudinal Reinforcement (mm²)



As (top)	80	0	84	84	0	15	15	0	0
As (bot)	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		
	93	0	259	259	0	605	605	1156	476
	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		

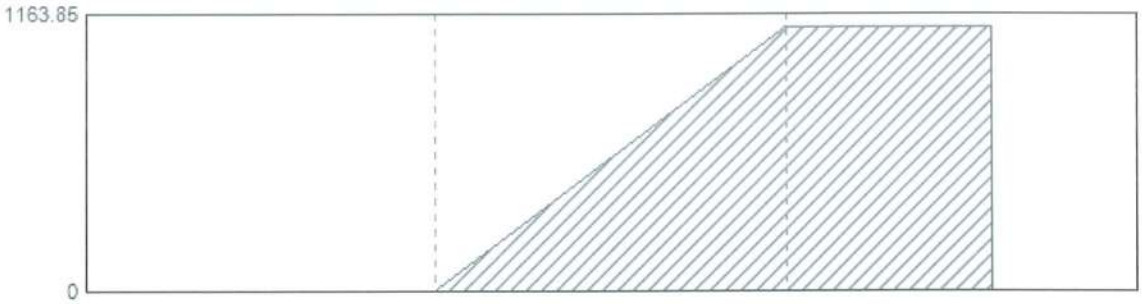
Shear Diagram (kN)



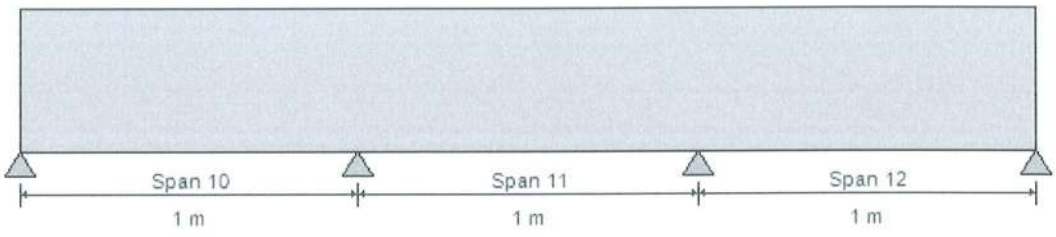
Shear	43.9763	0	89.856	89.856	0	263.4518	263.4518	263.4518	23.87

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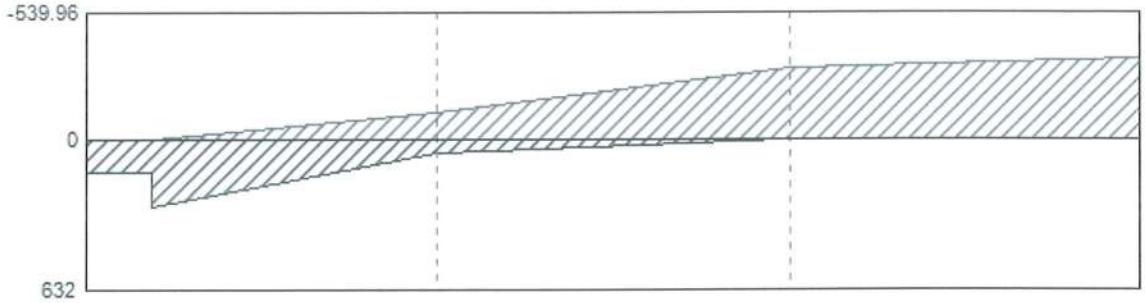
Transverse Reinforcement (mm²/m)



Asv/s reqd	0	0	0	0	0	1108.43	1108.43	1108.43	0



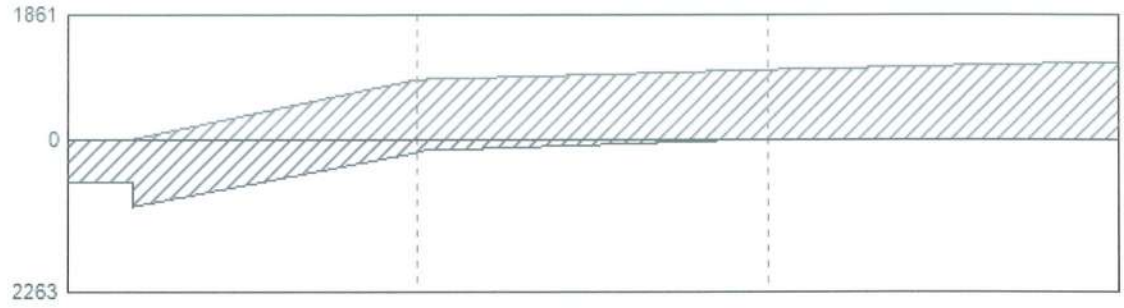
Moment Diagram (kN-m)



(-)Moment	0	0	-114.199	-114.199	0	-301.5156	-301.5156	0	-339.2251
(+)Moment	284.3189	0	54.5236	54.5236	0	0	0	0	0

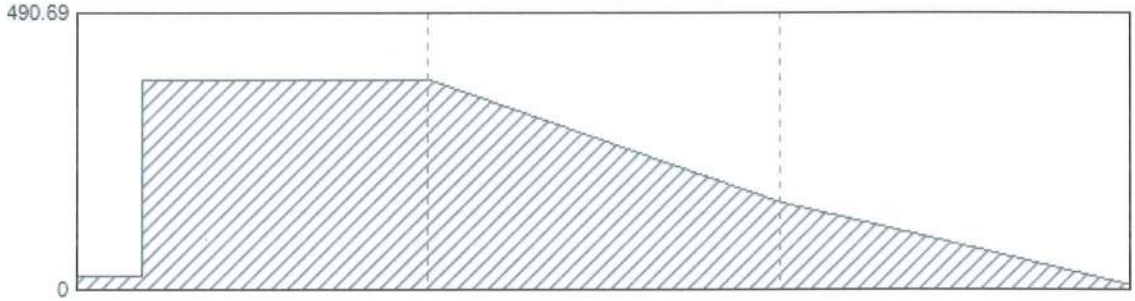
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Longitudinal Reinforcement (mm²)



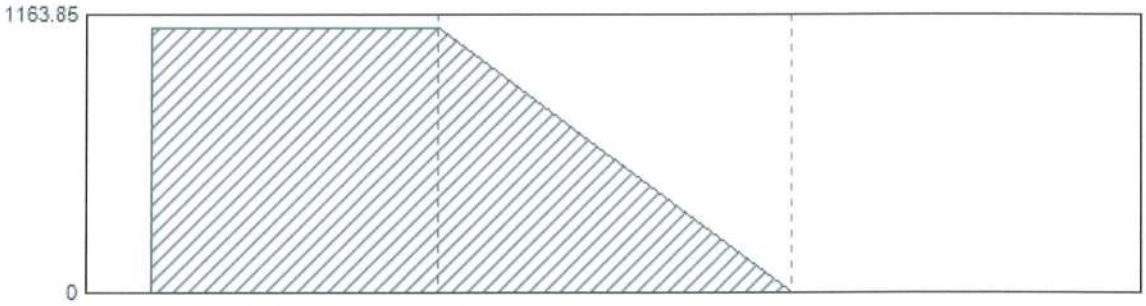
As (top)	0	0	382	382	0	1023	1023	0	1154
As (bot)		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL
	993	0	187	187	0	0	0	0	0
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL

Shear Diagram (kN)



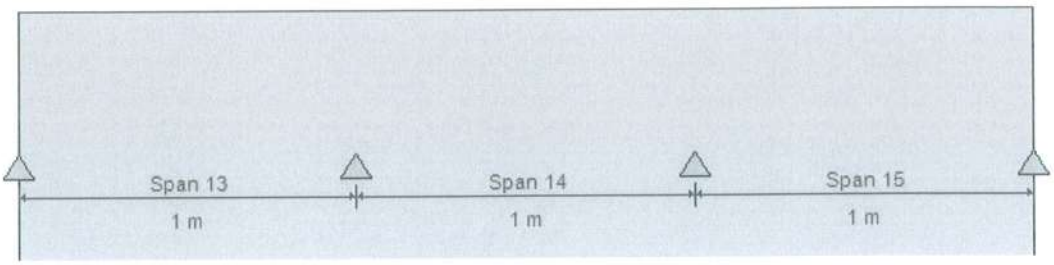
Shear	370.6255	0	370.6255	370.6255	0	154.3503	154.3503	0	6.4279

Transverse Reinforcement (mm²/m)

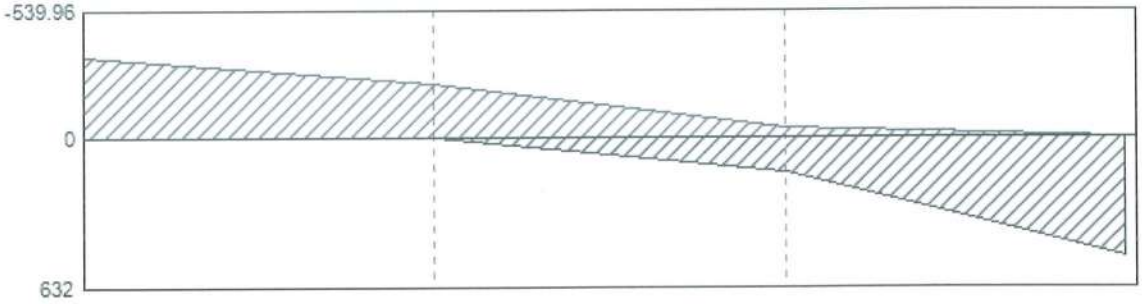


Asv/s reqd	1108.43	0	1108.43	1108.43	0	0	0	0	0

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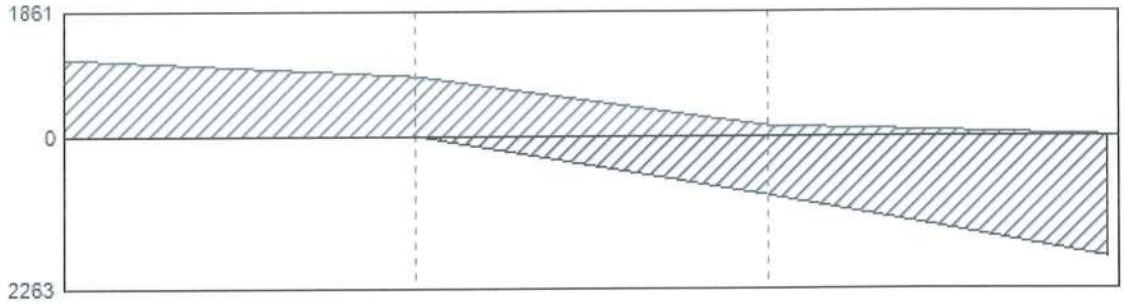


Moment Diagram (kN-m)



(-)Moment	-339.2251	0	-225.5851	-225.5851	0	-43.9936	-43.9936	0	0
(+)Moment	0	0	0	0	0	148.6665	148.6665	0	503.5759

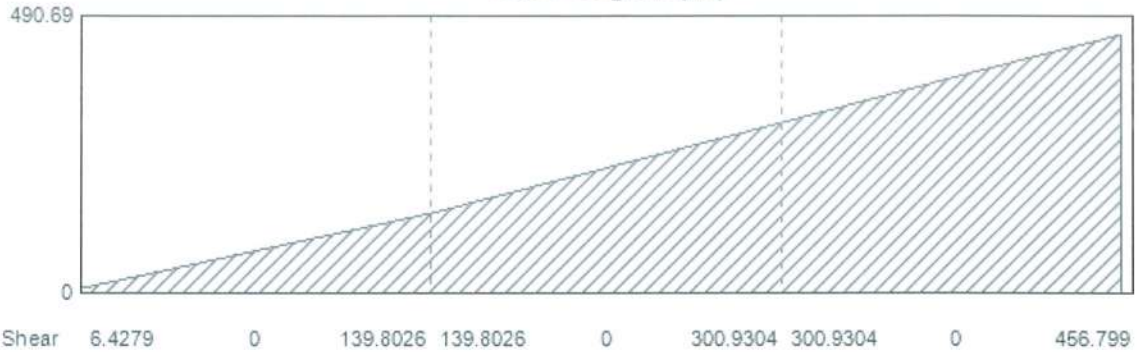
Longitudinal Reinforcement (mm²)



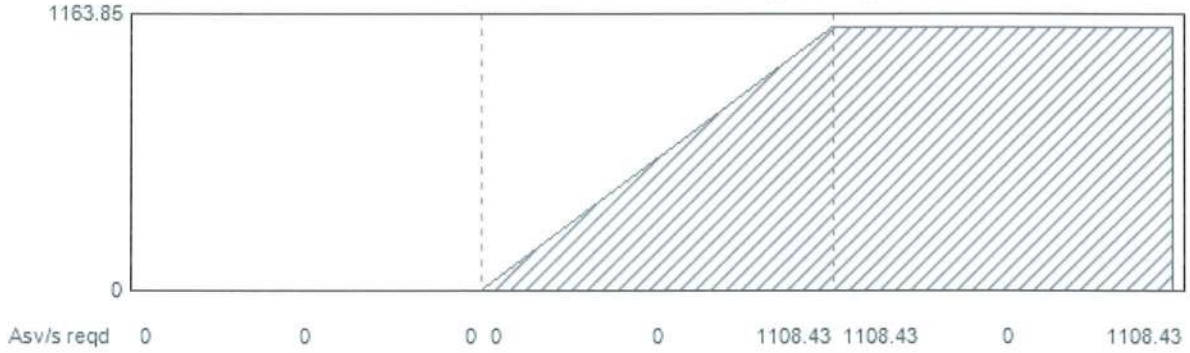
As (top)	1154	0	761	761	0	146	146	0	0
As (bot)	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		
	0	0	0	0	0	514	514	0	1790
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL

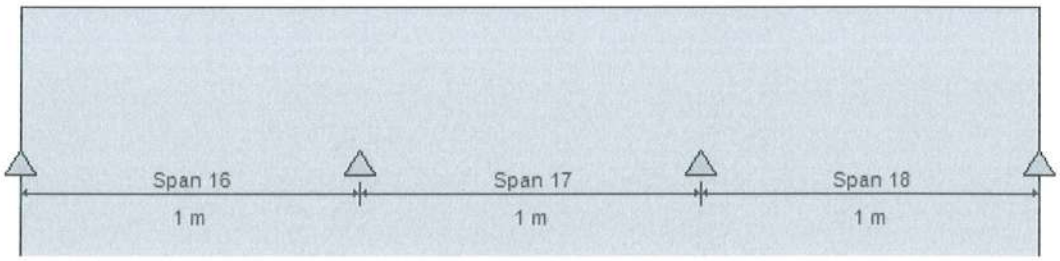
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Shear Diagram (kN)



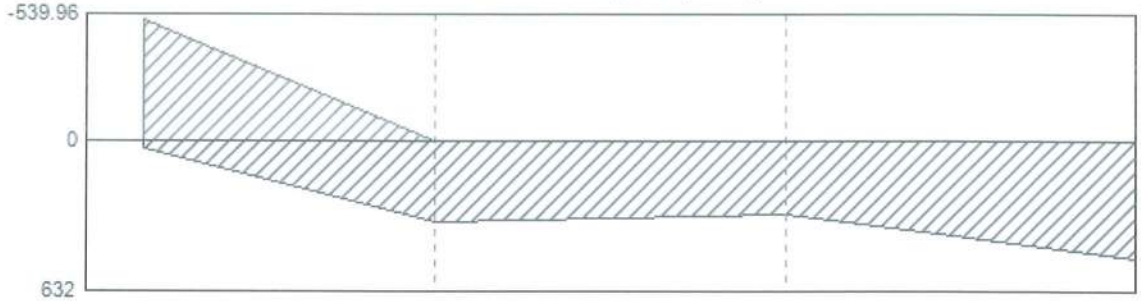
Transverse Reinforcement (mm²/m)





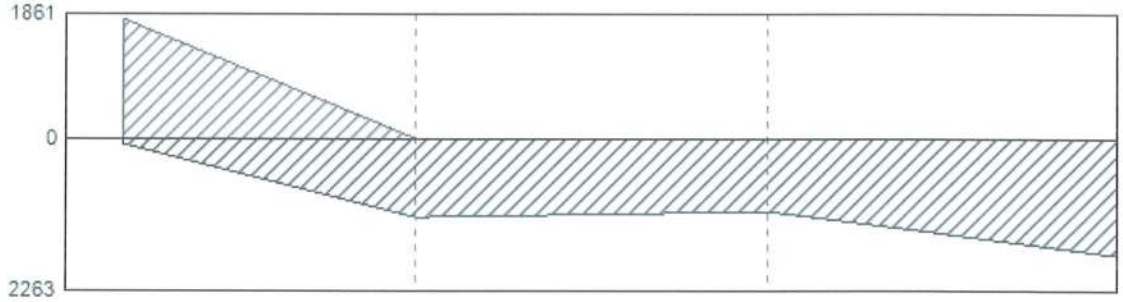
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Moment Diagram (kN-m)



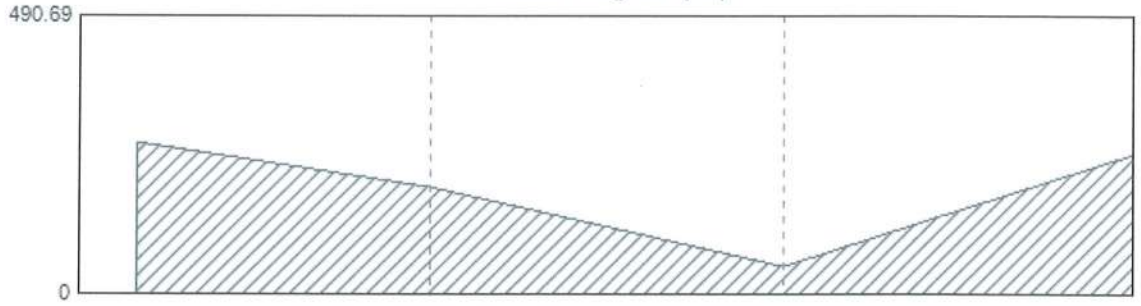
(-)Moment	-514.2455	0	0	0	0	0	0	0	0
(+)Moment	29.155	0	338.5425	338.5425	0	312.9332	312.9332	0	495.5398

Longitudinal Reinforcement (mm²)



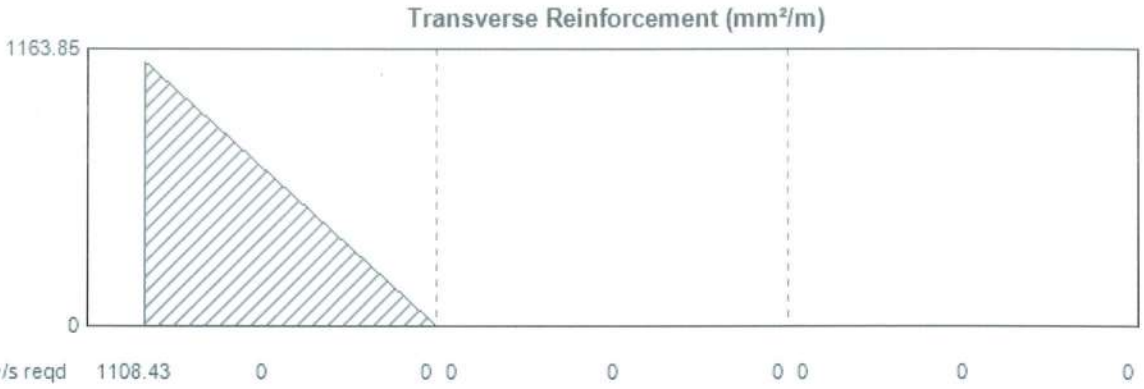
As (top)	1772	0	0	0	0	0	0	0	0
As (bot)	02) 1.5DL+1.5LL								
	100	0	1187	1187	0	1095	1095	0	1760
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	

Shear Diagram (kN)

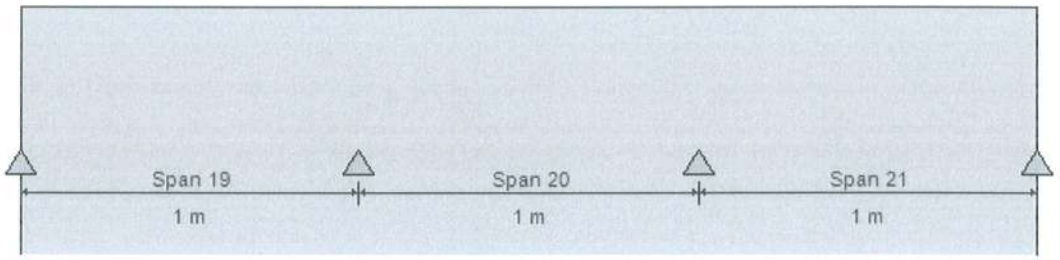


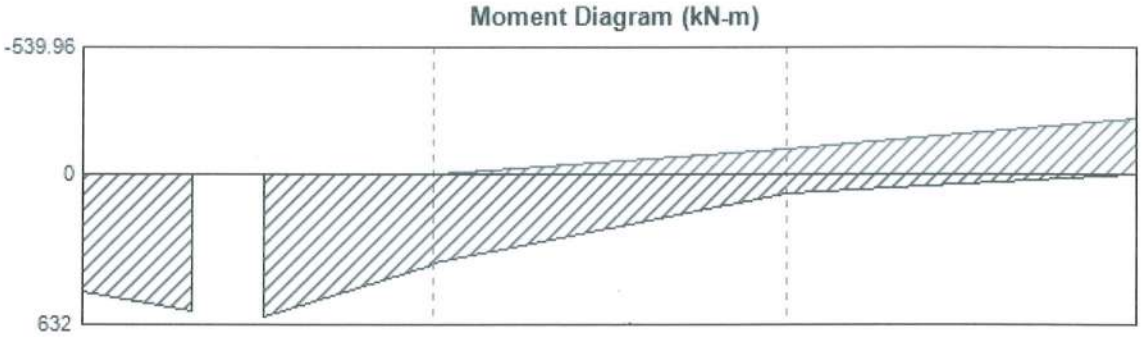
Shear	265.037	0	188.7377	188.7377	0	48.3434	48.3434	0	246.6828

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Asv/s reqd	1108.43	0	0	0	0	0	0	0

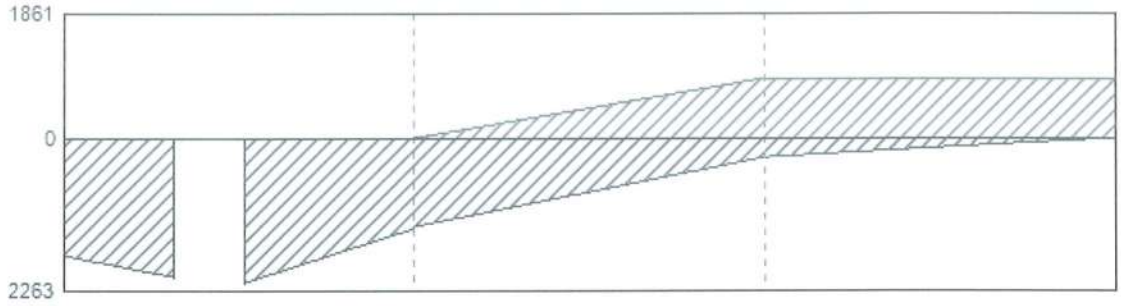




(-)Moment	0	0	0	0	0	-107.287	-107.287	0	-237.7796
(+)Moment	495.5398	601.3542	378.6964	378.6964	0	85.2982	85.2982	0	0

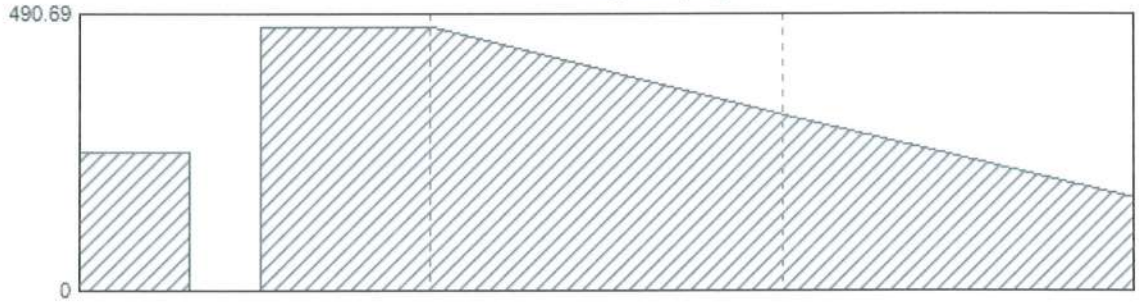
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Longitudinal Reinforcement (mm²)



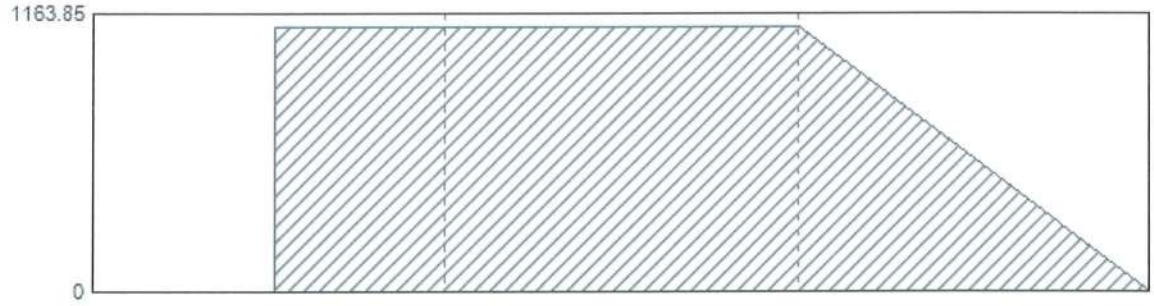
As (top)	0	0	0	0	0	359	359	0	803
As (bot)					02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	
	1760	2155	1332	1332	0	293	293	0	0
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL

Shear Diagram (kN)



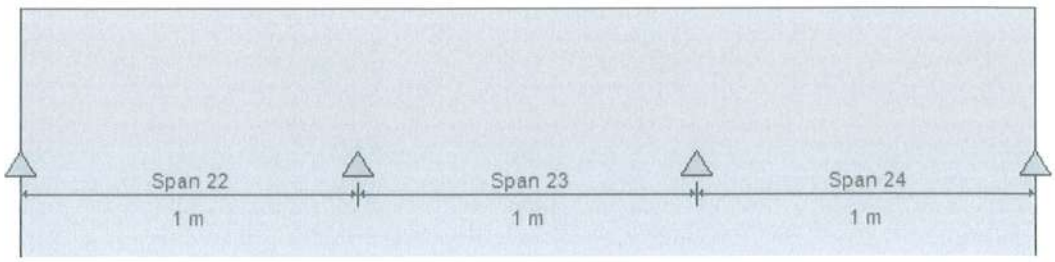
Shear	246.6828	467.3207	467.3207	467.3207	0	309.37	309.37	0	163.9218

Transverse Reinforcement (mm²/m)

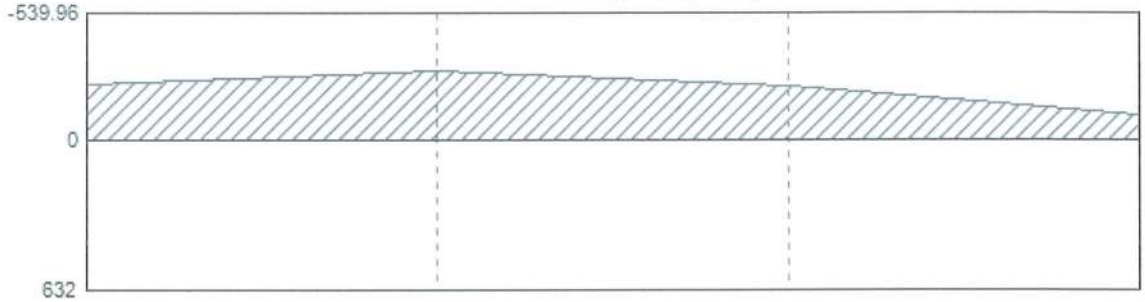


Asv/s reqd	0	1108.43	1108.43	1108.43	0	1108.43	1108.43	0	0

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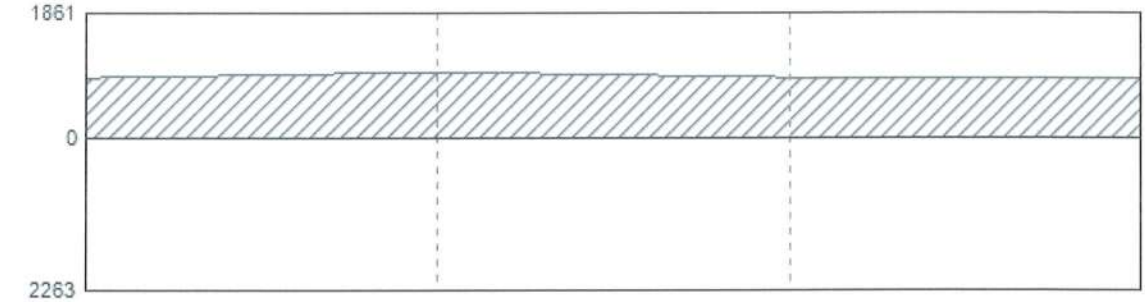


Moment Diagram (kN-m)



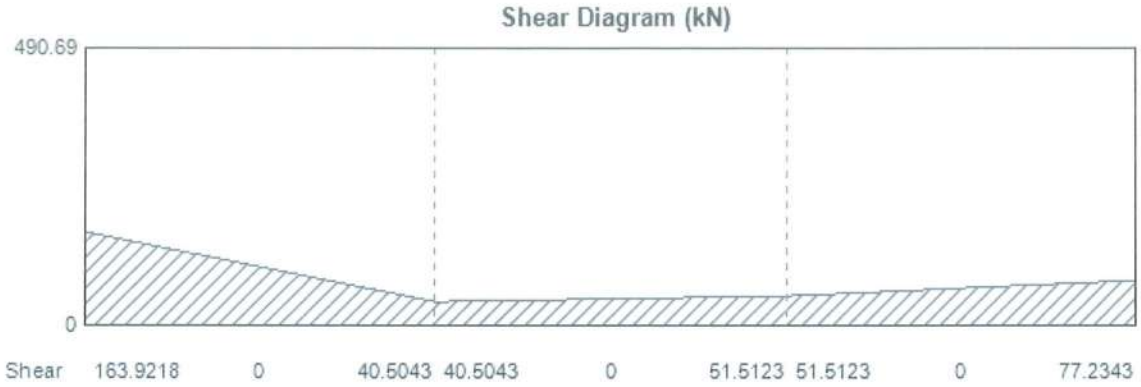
(-)Moment	-237.7796	0	-289.7179	-289.7179	0	-224.7116	-224.7116	0	-103.0606
(+)Moment	0	0	0	0	0	0	0	0	3.5895

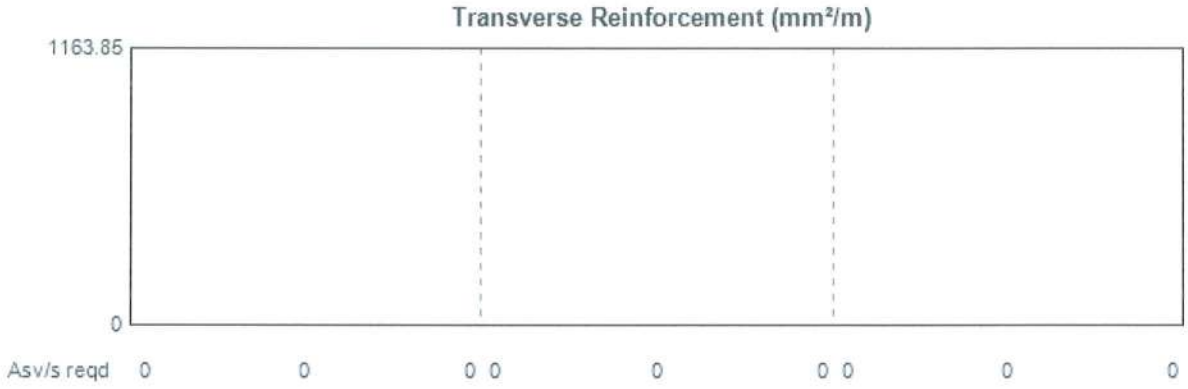
Longitudinal Reinforcement (mm²)

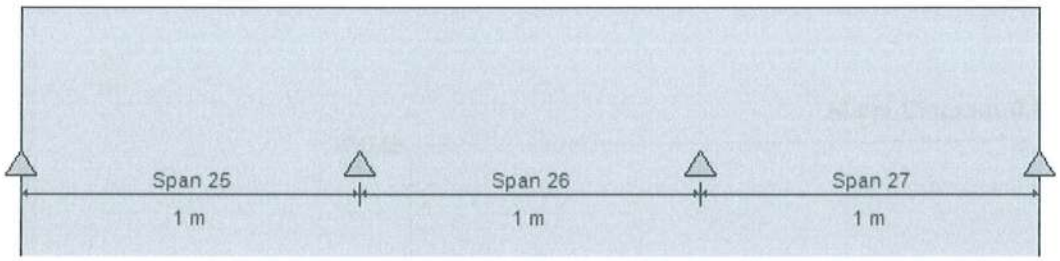


As (top)	803	0	982	982	0	758	758	0	345
As (bot)	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL
	0	0	0	0	0	0	0	0	0
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL

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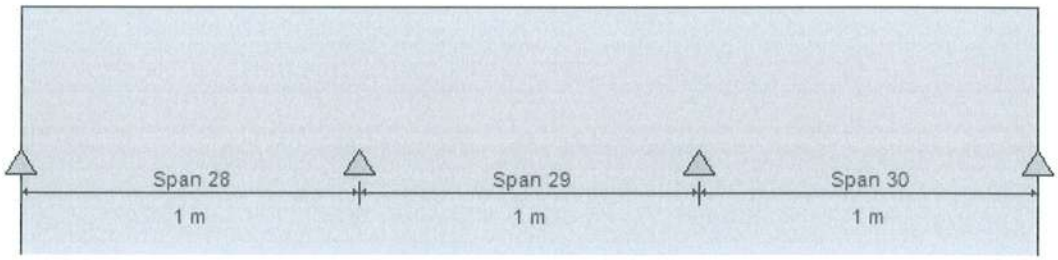


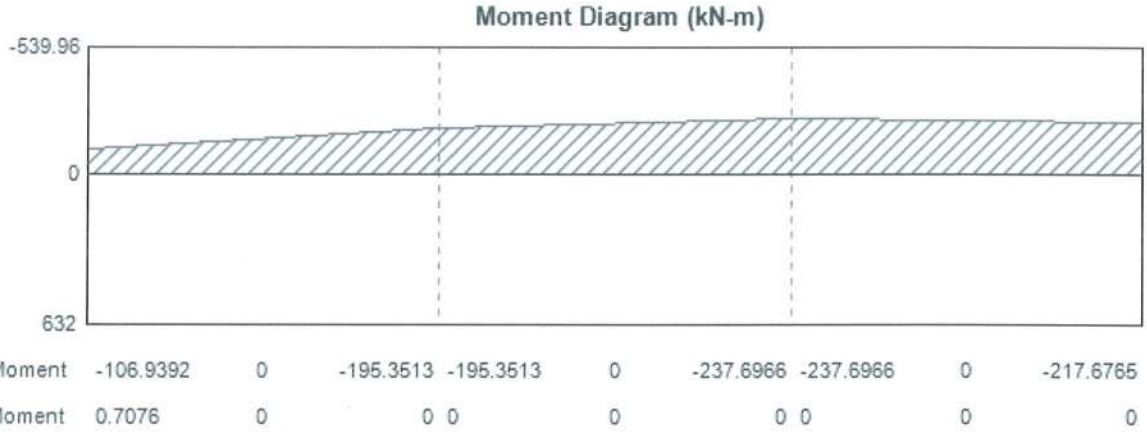




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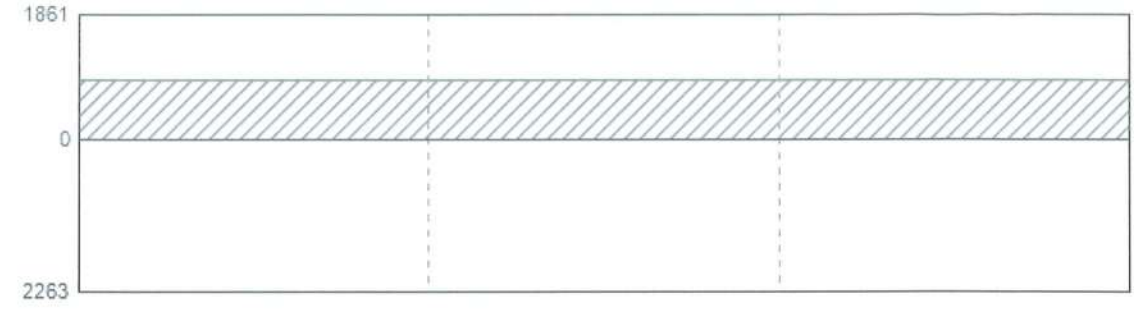






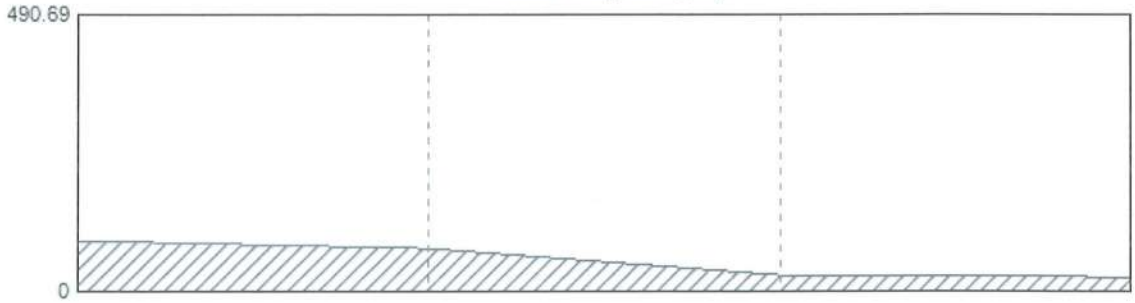
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Longitudinal Reinforcement (mm²)



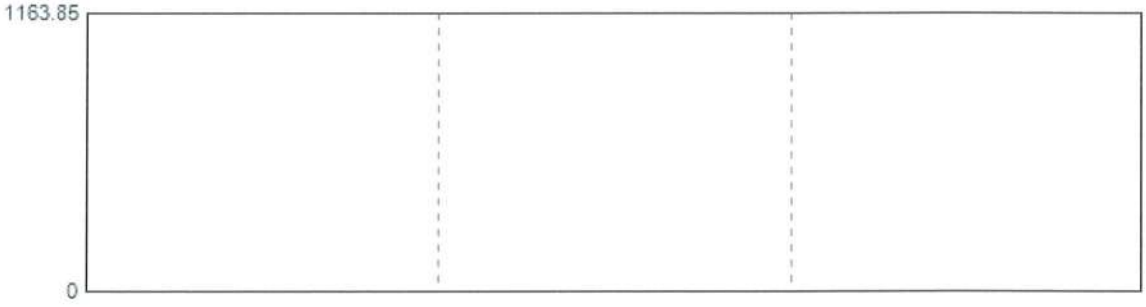
As (top)	358		0		657	657		0		802	802		0		734
As (bot)	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL
	0		0		0	0		0		0	0		0		0
	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL		02) 1.5DL+1.5LL

Shear Diagram (kN)



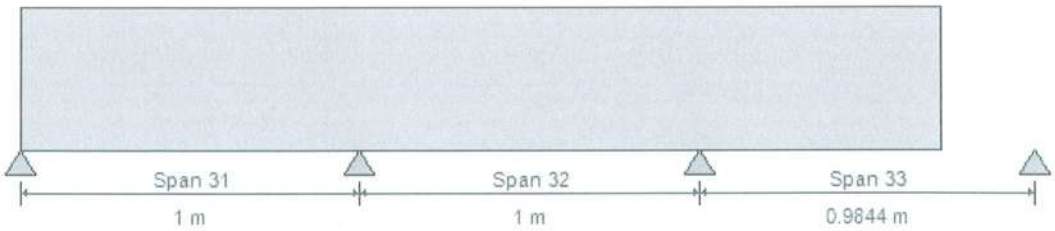
Shear	87.7425	0	75.4034	75.4034	0	26.6264	26.6264	0	23.1752

Transverse Reinforcement (mm²/m)

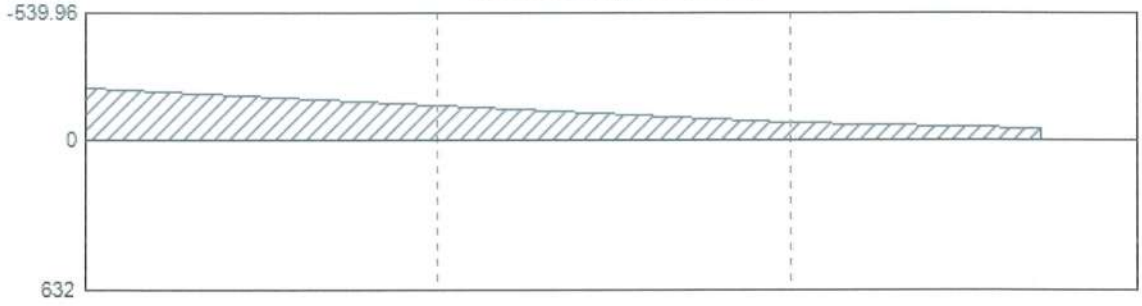


Asv/s reqd	0	0	0	0	0	0	0	0	0

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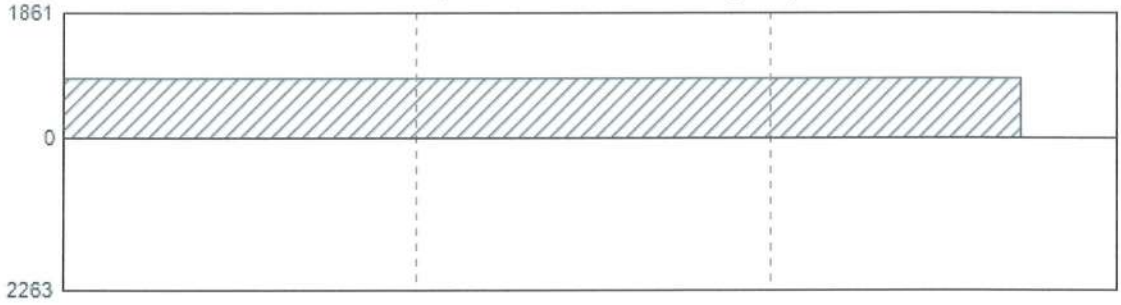


Moment Diagram (kN-m)



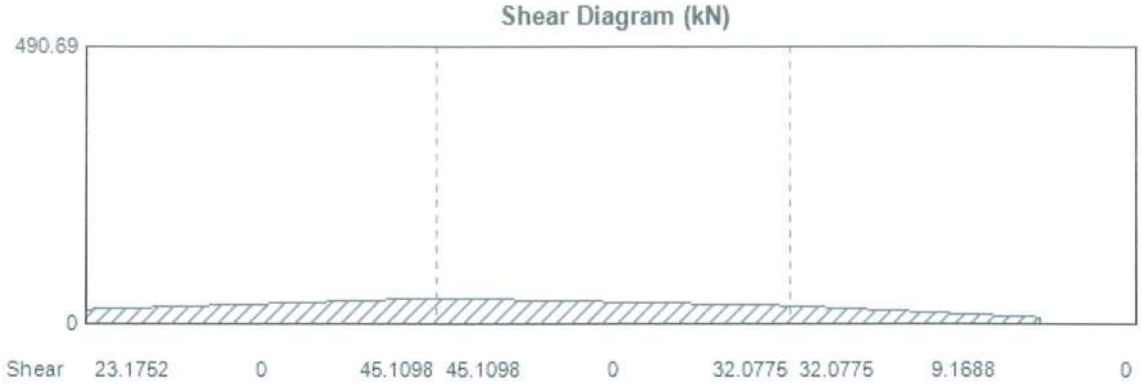
(-)Moment	-217.6765	0	-144.615	-144.615	0	-76.5759	-76.5759	-47.9478	0
(+)Moment	0	0	0	0	0	0	0	0	0

Longitudinal Reinforcement (mm²)



As (top)	734	0	485	485	0	256	256	160	0
As (bot)	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	
	0	0	0	0	0	0	0	0	0
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	

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DESIGN OF SHEAR WALL

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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	Pier Ductility	LLRF
1st Floor	P81	31352	14795	1000	300	Special Wall	1

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	30	1	550	415

Design Code Parameters

Γ_S	Γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	31352	14295	31352	15295	1000	300
Bottom	Leg 1	31352	14295	31352	15295	1000	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	3117	0.0104	0.0032	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	179.4628	-80.6288
Bottom	3273	0.0109	0.0032	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	214.9806	73.4844

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
-577.9373	300000
625.392	300000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	817.49	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	179.4628	-52.4326	363.9333	127.9268	363.9333
Bottom	Leg 1	804.95	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	214.9806	625.392	363.9333	131.547	363.9333

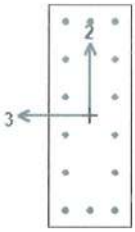
Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	300	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	451.279	-577.9373	13.06	7
Top–Right	Leg 1	0	28) 0.9DL+1.5Spy+0.45Spx+0.45Spz	325.0997	73.5923	2.56	7
Bottom–Left	Leg 1	300	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	489.9892	-272.8377	7.09	7
Botttom–Right	Leg 1	300	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	489.9892	625.392	14.14	7

DESIGN OF COLUMN

ETABS Concrete Frame Design

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



Column Element Details (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)
1st Floor	C1	1367	C 300X800	27) 0.9DL+1.5Spx+0.45Spy+0.45Spz	0	3300

Column Element Details (Part 2 of 2)

LLRF	Type
1	Ductile Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
300	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	30	1	550	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

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

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm^2	Rebar % %
276.7002	175.1257	148.4659	5.534	8.8729	3920	1.63

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	0.976538	2700	75.2834	0	8.8729
Minor Bend(M2)	0.869633	2700	70.0503	0	5.534

Axial Compression Check for Seismic Design per IS 13920:2016 Section 7.1

Limit Compression Factor Unitless	Limit Compression Strength kN	Compression D/C Ratio Unitless	Status
0.4	3360	0.105789	OK

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

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
Major, V_{u2}	139.6384	154.3	88.8002	139.6384	332.53
Minor, V_{u3}	104.1638	142.4104	76.8006	84.0354	886.75

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm²	Shear Ratio Unitless
Major Shear, V_{u2}	N/N	N/N	N/N	N/N	N/N	N/N
Minor Shear, V_{u3}	N/N	N/N	N/N	N/N	N/N	N/N

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/N	N/N

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
2400	39.2	5397.0764	1575.1461	276.7002	1

Additional Moment (IS 39.7.1)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_a Moment (kN-m)
Major Bending (M_3)	Yes	0.818	800	3.296	12	No	0
Minor Bending (M_2)	Yes	0.818	300	7.827	12	No	0

Notes:

N/A: Not Applicable

N/C: Not Calculated

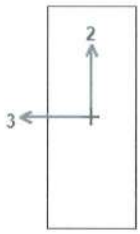
N/N: Not Needed

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DESIGN OF BEAM

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design (Summary)



Beam Element Details (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)
1st Floor	B612	1038	B 200X500	24) 1.5DL+1.5Spx+0.45Spy+0.45Spz	0	3550

Beam Element Details (Part 2 of 2)

LLRF	Type
1	Ductile Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
200	500	200	0	45	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	30	1	550	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-63.2889	0.004	59.4243	0

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-63.2889	0.0082	10.3844	-63.2971

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

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-63.2971		307	0	307	235
Bottom (-2 Axis)		10.3844	235	48	0	235

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

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm²/m
75.099	0	75.1309	39.2146	457.57

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

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt}/s mm²/m
0.0036	59.4243	130	430	0

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DESIGN OF SLAB

SRI DEAVI KUPPAM GROUND FLOOR LEVEL SLAB

	DESIGN OF SLAB No:				
1.00	Grade of concrete	=	30.00	N/mm2	
2.00	Grade of steel	=	*550.00*	N/mm^2	
3.00	Cover to reinforcement	=	*25.00*	mm	
	Diameter of bar		*8.00*	mm	
4.00	Aspect ratio $\frac{l_y}{l_x}$ *4.25* / *3.35*	4.35 / 3.45	1.261	< 2	
5.00	Edge condition: One Short Edge Continuous		Two way slab		
6.00	Modification factor assumed		*1.60*		
		93.64			
7.00	Depth required for deflection:	D =	*125.00*	mm	
			125.00	mm	
		d =	96.00	mm	ok
8.00	Dead Load	=	3.00	kN/m^2	
9.00	Live load	=	*1.80*	kN/m^2	
10.00	Partitions & FF	=	*2.00*	kN/m^2	
11.00	Total load	=	6.80	kN/m^2	
12.00	Factored load	=	10.20	kN/m^2	

Case No: 8

D+(□-0)*(E-A)/(□-A)

	Negative	Positive
A	*1.20000*	*1.20000*
B	*1.30000*	*1.30000*
C	*0.00000*	*0.05900*
D	*0.00000*	*0.06500*
E	*1.26117*	*1.26117*
Value	**0.00000**	**0.06267**

STEP 1	Details	S- SPAN (-ve) support(α_x)	S- SPAN (+ve) span(α_x)	L-SPAN (-ve) support(α_y)	L-SPAN (+ve) span (α_y)
	Co-efficent (IS:456, Table 2	0.000	0.063	0.057	0.043
	M_u=Co-efficient*w* l_x^2	0.00	*7.59*	6.90	5.21
	K= Mu/bd2	0.00	0.82	0.75	0.57
	Percentage of steel required	0.00	0.18	0.16	0.12
	Ast required(in mm^2)	*0.00*	*169.99*	*154.20*	*115.58*
	Ast min (in mm^2)	150.00	150.00	150.00	150.00
	Ast to be provided (in mm2)	150.00	169.99	154.20	150.00
	Provided bars spacing (c/c)	335.24	295.82	326.11	335.24
	max spacing	250.00	250.00	250.00	250.00
	spacing	250.00	250.00	250.00	250.00
	Reqd bars spacing (c/c)	**250.00**	**250.00**	**250.00**	**250.00**
	Pvd bars spacing (c/c)	*200.00*	*150.00*	*200.00*	*200.00*
	Ast Provided(in mm^2)	**251.43**	**335.24**	**251.43**	**251.43**
	Percentage of steel provided	**0.26**	**0.35**	**0.26**	**0.26**

STEPII	F_s=0.58 *f_y * (Ast required/ Ast provided)		
	F_s	161.76	
	M.F	*1.80*	
	if assumed modification factor is less than or equal to calculated the section is safe for deflection	safe	
	OVERALL DEPTH D	**125.00 mm**	
	EFFECTIVE DEPT d	**96.00 mm**	

STEPIII	Crack width calculation		
	m	=	6.8
	E_s	=	200000.0
	Ec	=	29580.4
	Pt	=	0.3
	k	=	0.2
	x	=	18.7
	A_{st}	=	335.2
	I_{cr}	=	15723459.04
	M	=	7.6
	f_{st}	=	252.3
	ε_m	=	0.0
	Spacing		150.0
	a_{cr}	=	79.1
	ω_{cr}	=	0.12
			<
			0.20 mm (safe)

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ALL SETTING OUT DIMENSION SHOWN IN THE STRUCTURAL DRAWINGS, SHALL BE VERIFIED WITH THE LATEST ARCHITECTURAL DRAWING BEFORE COMMENCEMENT OF CONSTRUCTION. IF THERE IS ANY DISCREPANCY, IT SHOULD BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE ARCHITECT/ENGINEER. THE CONSTRUCTION CAN ONLY PROCEED UPON RECEIVING THE CONFIRMATION FROM THE ARCHITECT ON THE DIMENSIONS.

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. FOR GENERAL NOTES REFER TO DWG. NO. BE1765_S-/NT/--/01.
3. FOR STANDARD DETAILS REFER TO DWG. NO. BE1765_S-/SD/--/01. AND BE1765_S-/SD/--/02.
4. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE KEY PLAN, ARCHITECTURAL AND ALL OTHER RELEVANT DRAWINGS.
5. GRADE OF CONCRETE:
   1) M30 – RC COLUMNS & RC SHEAR WALLS
   2) M30 – RC BEAM & RC SLAB
   3) M30 – RAFT FOUNDATION
6. CLEAR COVER FOR RAFT–50mm, COLUMN–40mm, SHEAR WALL–40mm, R.C. WALL–30mm, BEAM–30mm, SLAB–25mm, UG SUMP WALL & BASE SLAB–40mm & 30mm FOR 200mm THICK.
7. STEEL GRADE, Fe 550 CONFIRMING TO IS:1786–2008
8. UNLESS OTHERWISE SPECIFIED, LAP/DEVELOPMENT LENGTH SHALL NOT BE LESS THAN 50 X DIA OF BAR
9. SEISMIC LOAD HAS BEEN CONSIDERED AS PER IS:1893–2016 WITH THE SEISMIC ZONE III. DUCTILE DETAILING CARRIED OUT AS PER THE STIPULATIONS MADE IN IS:13920–2016
10. STRUCTURE TO BE CONSTRUCTED IN ACCORDANCE WITH I.S.456–2000, NBC–2016 AND RELAVANT INDIAN CODE STIPULATIONS
11. ONUS OF CONSTRUCTION LIES WITH CONTRACTOR/PROMOTOR/BUILDER/OWNER
12. APPROVED WATER PROOFING SHALL BE APPLIED FOR THOSE RC ELEMENTS IN CONTACT WITH WATER /SOIL SUCH AS RAFT, BASEMENT WALL, UG TANKS, BASE SLAB & WALLS, LIFT PIT ETC.

NOTES

UNLESS OTHERWISE SPECIFIED

1. GRADE OF CONCRETE :–

COLUMN, SHEAR WALL AND & LIFT WALL	– M30
RAFT SLAB & BASEMENT RC WALLS	– M30
RC BEAM & RC SLAB	– M30

2. GRADE OF STEEL Fe550
3. ALL LIFT R.C. WALLS ARE TO BE 200mm THICK.
4. APPROVED WATER PROOFING SHALL BE APPLIED FOR BASEMENT SLAB, BASEMENT WALLS, SUMP PITS, TRENCHES, UNDER GROUND WATER TANK WALL AND BASE SLAB AS PER THE APPROVED METHODOLOGY
5. THE SAFE BEARING CAPACITY CONSIDERED AS PER THE SOIL INVESTIGATION REPORT IS 11OKN/M² AT A DEPTH OF 3.0m FROM EGL (EXISTING GROUND LEVEL)
6. IN CASE LOOSE SOIL ENCOUNTERED AT THE BEARING LEVEL, THE SAME SHALL BE REMOVED AND THE OVER EXCAVATED AREA SHALL BE FILLED WITH LEAN CONCRETE.
7. STRUCTURAL ENGINEER IS TO BE CONSULTED IN CASE LOOSE SOIL/ROCKET IS ENCOUNTERED AT FOUNDING DEPTH.
8. WHILE EXCAVATING FOR THE CONSTRUCTION OF FOOTINGS/RAFT, THE CONTRACTOR SHALL PROVIDE ALL THE NECESSARY AND ADEQUATE TEMPORARY SHORING SYSTEM, TO ENSURE STABILITY OF EXCAVATION.
9. THE FOUNDATION SHOULD BE REST AT THE MEDIUM DENSE SILTY SAND/ CLAY LAYER AS PER THE SOIL REPORT NO TJE/003841/2025, DATED JULY 02, 2025. IN CASE OF LOOSE SOIL ENCOUNTERED WITHIN THE FOUNDING DEPTH, THE SAME SHALL BE REMOVED AND THE OVER EXCAVATED DEPTH SHALL BE FILLED USING LEAN CONCRETE
10. PROVIDE 100mm THICKNESS RIVER SAND (GN) M–SAND BELOW THE PCC IF THE SOIL IS FOUND TO BE SILTSH.
11. SUITABLE TENSION PILES/GROUND ANCHORING SHALL BE DONE IN THE NON TOWER AREA WHICH SHALL BE DESIGNED FOR UPLIFT WATER PRESSURE UPTO GROUND LEVEL.
12. UPON REACHING THE SPECIFIED FORMATION LEVEL, THE BEARING LAYER SHALL BE IMMEDIATELY PROTECTED WITH LEAN CONCRETE (P.C.C).
13. WHENEVER THE EXCAVATION IS CARRIED OUT BEYOND THE DEPTH OF FORMATION LEVEL, OVER EXCAVATED AREA SHALL BE FILLED WITH LEAN CONCRETE, UP TO THE REQUIRED FORMATION LEVEL.
14. ALL EXCAVATED AREA SHALL BE KEPT DRY UNTIL THE RAFT CONCRETE IS COMPLETED AND IF IS SET.
15. EXCAVATION USING MECHANICAL EQUIPMENT LIKE POCKLINE TO BE STOPPED WELL ABOVE 300mm FROM THE FORMATION LEVEL TO AVOID BEARING LAYER DISTURBED BY THE POCKLINE TEETH AND THE REMAINING SOIL TO BE EXCAVATED BY MANUAL.

FOUNDATION AND COLUMN DESIGNED FOR BASEMENT+ GROUND + 5 FLOORS + ROOF

AAC BLOCK WALL IS USED ON THE PLACE OF EXTERNAL AND INTERNAL WALL & PARTITION WALL. WHOSE DENSITY SHALL NOT BE MORE THAN 750Kg/m³

SHRIDEVIKUPPAM MAIN ROAD

RAFT FOUNDATION FRAMING PLAN
SCALE – 1:100

IMPORTANT NOTES:

1. SHORING:
   APPROVED, SUITABLE RETAINING SYSTEM SHALL BE INSTALLED TO RESIST ALL POSSIBLE DESIGN PRESSURE SUCH AS WATER PRESSURE TO BE CONSIDERED UPTO GROUND LEVEL, SOIL PRESSURE, SURCHARGE ETC., TO PREVENT THE EXCAVATED SIDES ARE FROM COLLAPSING AND THERE BY PREVENT THE ADJACENT BUILDING/ROAD ARE PREVENTED FROM SETTLEMENT.
2. DEWATERING:
   SUITABLE WELL POINT DEWATERING SYSTEM SHALL BE INSTALLED AND NEED TO ENSURE THERE IS NO SEEPAGE ON SIDES AND SCOURING OF SOILS WHICH WOULD LEAD TO SLIDING OF EXCAVATED SIDES AND MAY CAUSE SERIOUS SETTLEMENT OF ADJACENT PROPERTY/BUILDING. HENCE THE DEWATERING SHALL BE CONTINUED TILL ADEQUATE SELF WEIGHT ACHIVE TO COUNTER THE GROUND WATER TABLE (GWT) EXIST AT THAT POINT OF TIME.
3. BACK FILLING:
   THE BASEMENT RETAINING WALL IS TO BE CONNECTED TO THE BASEMENT FLOOR ROOF NECESSARILY FOR COMMENCEMENT OF BACK FILLING AS THE BASEMENT RETAINING WALL IS DESIGNED AS PROPPED CANTILEVER AND IT IS NOT DESIGNED AS CANTILEVER

SECTION (D)
SCALE 1:50

COLLECTION PIT DRAIN REINFORCEMENT DETAILS
SCALE : 1:50

SECTION (E)
SCALE 1:50

SECTION (A)
SCALE 1:50

SECTION (B)
SCALE 1:50

SECTION (C)
SCALE 1:50

TYPICAL STORM WATER DRAIN REINFORCEMENT DETAILS
SCALE : 1:50

R1	ISSUED FOR CONSTRUCTION DRAWING	Punitha	31/10/25
–	ISSUED FOR ADVANCE DRAWING	Punitha	27/10/25
NO.	AMENDMENTS	BY	DATE

Landscape Consultant :
CHENNAI MASTER PLAN BANGALORE

Project Managers & Quantity Surveyors :

Electrical Consultant :

Client :
NAVIN HOUSING & PROPERTIES (P)LTD
NAVIN'S Triumph

A. YUVARAJ, M.E., (Struct.)
REGISTERED STRUCTURAL ENGINEER
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
CMDA REGN. No. SE/GR-I/19/03/03
NEW No. 31 (OLD No.14), BESANT AVENUE
ADYAR, CHENNAI-600 020.
E-Mail: ayuvaraj77us@gmail.com
Mobile: +91 99625 45635

SDC

Civil & Structural Engineer:
BURO ENGINEERS (I) PRIVATE LTD
Civil & Structural Consultants

CONSTRUCTION DRAWING

STRUCTURAL

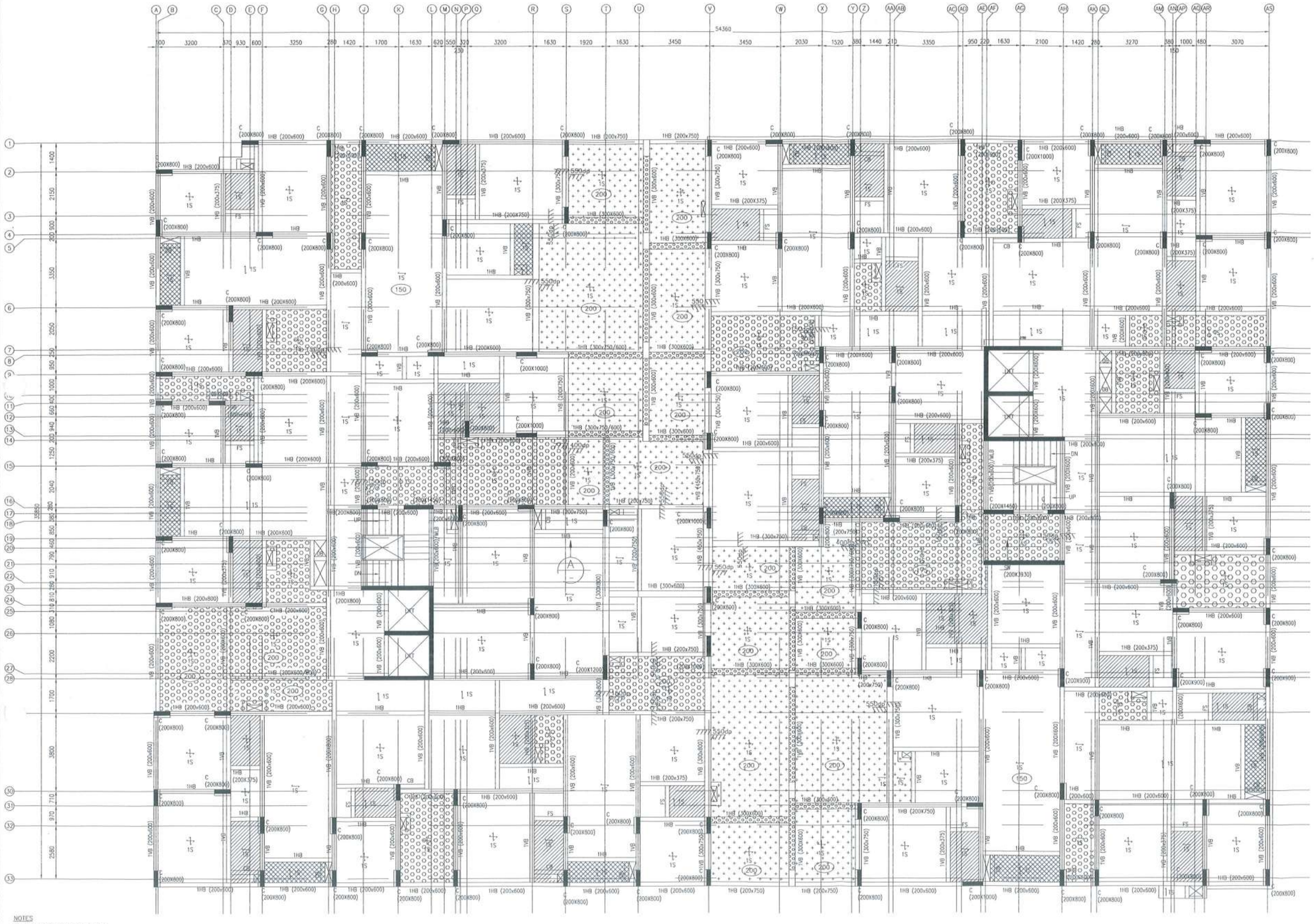
project title:
PROPOSED RESIDENTIAL BUILDING AT SHRI DEVIKUPPAM ROAD, VALASARAVAKKAM CHENNAI-600087.

drawing title:
RAFT FOUNDATION FRAMING PLAN

scale	AS SHOWN	design by	Arun
drawn by	Punitha	checked by	Arun
date	JAN 2025	approved by	AP
drawing no.	BE1765_S-/FT/--/01		revision –

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CAD FILE NAME: BE1765_S-/FT/--/01.dwg

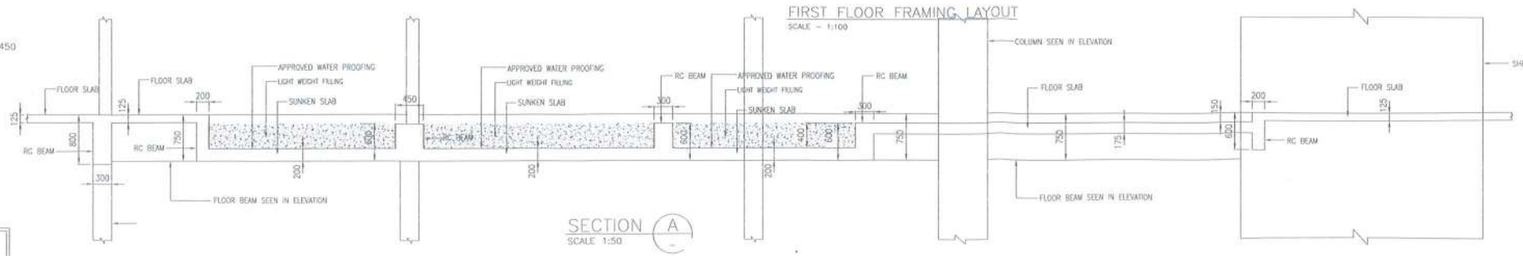


NOTES
UNLESS OTHERWISE SPECIFIED

1. GRADE OF CONCRETE GRADE TO BE M30
2. GRADE OF STEEL Fe550
3. ALL RC BEAMS ARE TO BE (WIDTHxDEPTH) 200x450
4. ALL RC SLAB THICKNESS 125mm.
5. ALL TOILET SUNKEN BY 125mm
6. ALL BALCONY SUNKEN BY 50mm
7. LANDSCAPE SUNKEN BY 400mm
8. OPEN TERRACE SUNKEN BY 150mm
9. BEAM TOP (-150mm)

THE LANDSCAPE FILLING SHOULD DONE WITH THE 18KN/M² DENSITY MATERIALS

FIRST FLOOR FRAMING LAYOUT
SCALE - 1:100



SECTION A
SCALE 1:50

REFER & VERIFY WITH RELEVANT ARCHITECTURAL GFC/MEP GFC DRAWINGS FOR ALL SERVICES SLEEVES/CUT-OUTS DIMENSIONS SHOWN IN THIS DRAWING.

ALL SETTING OUT DIMENSION SHOWN IN THE STRUCTURAL DRAWINGS, SHALL BE VERIFIED WITH THE LATEST ARCHITECTURAL DRAWING BEFORE COMMENCEMENT OF CONSTRUCTION. IF THERE IS ANY DISCREPANCY, IT SHOULD BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE ARCHITECT/ENGINEER.THE CONSTRUCTION CAN ONLY PROCEED UPON RECEIVING THE CONFIRMATION FROM THE ARCHITECT ONTHE DIMENSIONS.

NOTES:

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2. FOR GENERAL NOTES REFER TO DWG. NO. BEI765_S-/NT/--/01.
3. FOR STANDARD DETAILS REFER TO DWG. NO. BEI765_S-/SD/--/01. AND BEI765_S-/SD/--/02.
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FOUNDATION AND COLUMN DESIGNED FOR BASEMENT+ GROUND + 5 FLOORS + ROOF

AAC BLOCK WALL IS USED ON THE PLACE OF EXTERNAL AND INTERNAL WALL & PARTITION WALL WHOSE DENSITY SHALL NOT BE MORE THAN 750Kg/m³

NO.	AMENDMENTS	BY	DATE
R1	ARCHITECT COMMENTS UPDATED	Punitha	08.10.25
-	ISSUED FOR ADVANCE DRAWING	Punitha	18.09.25

Landscape Consultant :
CHENNAI MASTER PLAN BANGALORE LANDSCAPE ARCHITECTS

Project Managers & Quantity Surveyors :

Electrical Consultant :

Client :
NAVIN HOUSING & PROPERTIES (P)LTD.
NAVIN'S Triumph
[Opposite to Cosmopolitan Golf Ground Annex, Near GR Complex] No.8024804, Anna Salai, Nandanam, Chennai - 600 035 INDIA.
web site: www.navinhousing.com

Architect :
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SH Enclave, No-38/5,1st A, 1st floor, Velan Nagar,Valluvar Road, Arumbakkam, Chennai-600106.
E-mail : sriarchdes@gmail.com
Ph. no : 044-42553458
www.sdcindia.in

Civil & Structural Engineer:
BURO ENGINEERS (I) PRIVATE LTD.
Civil & Structural Consultants
New No. 31, Old No. 14, Besant Avenue, Adyar, Chennai - 600 020. 91-44-2491 2754/5/55.
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Mobile: +91 9962245859

ADVANCE DRAWING
STRUCTURAL

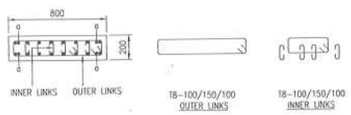
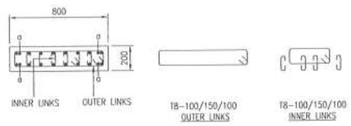
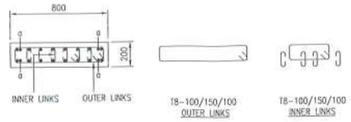
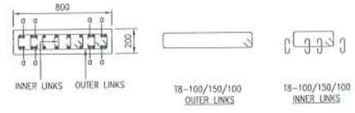
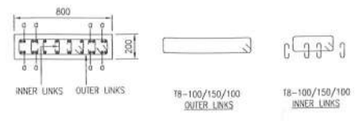
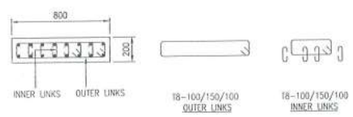
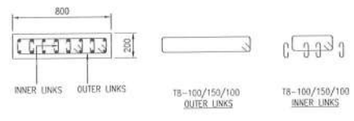
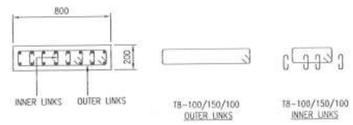
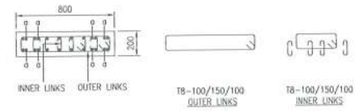
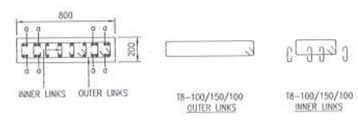
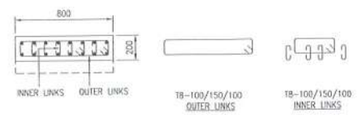
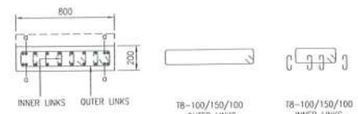
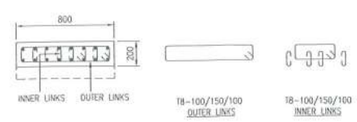
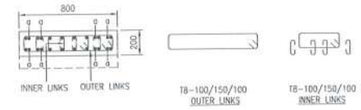
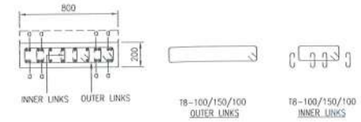
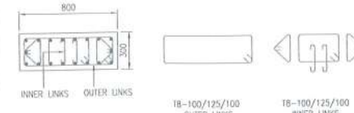
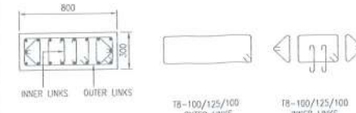
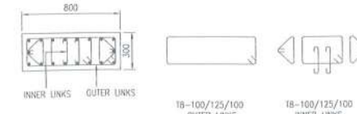
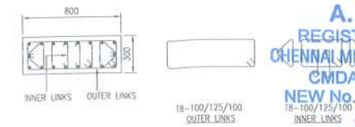
project title:
PROPOSED RESIDENTIAL BUILDING AT SRI DEVIKUPPAM ROAD, VALASARAVAKKAM CHENNAI-600087.

drawing title:
FIRST FLOOR FRAMING PLAN

scale	AS SHOWN	design by	Arun
drawn by	Punitha	checked by	Arun
date	JAN 2025	approved by	AP
drawing no.	BEI765_S-FP01/--/01	revision	-

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CAD FILE NAME: BEI765_S-FP01/--/01.dwg

TERRACE TO LMR					
3RD FLOOR TO TERRACE					
SIZE	200X800	200X800	200X800	200X800	200X800
CONCRETE GRADE/COVER	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm
REINFORCEMENT/STEEL GRADE Fe	16T16+4T12(a)Addl./Fe 550	12T16+4T12(a)Addl./Fe 550	12T16+4T12(a)Addl./Fe 550	8T16+8T12(a)Addl./Fe 550	8T16+8T12(a)Addl./Fe 550
LINKS/TIES/STEEL GRADE Fe	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550
2ND FLOOR TO 3RD FLOOR					
SIZE	200X800	200X800	200X800	200X800	200X800
CONCRETE GRADE/COVER	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm
REINFORCEMENT/STEEL GRADE Fe	16T16/Fe 550	16T16/Fe 550	16T16/Fe 550	8T16+8T12(a)Addl./Fe 550	8T16+8T12(a)Addl./Fe 550
LINKS/TIES/STEEL GRADE Fe	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550
1ST FLOOR TO 2ND FLOOR					
SIZE	200X800	200X800	200X800	200X800	200X800
CONCRETE GRADE/COVER	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm
REINFORCEMENT/STEEL GRADE Fe	16T16/Fe 550	16T16+4T16(a)Addl./Fe 550	16T16/Fe 550	8T16+8T12(a)Addl./Fe 550	8T16+8T12(a)Addl./Fe 550
LINKS/TIES/STEEL GRADE Fe	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550
RAFT TO 1ST FLOOR					
SIZE	300X800	300X800	300X800	300X800	300X800
CONCRETE GRADE/COVER	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm	M.30/40mm
REINFORCEMENT/STEEL GRADE Fe	18T16/Fe 550	18T16/Fe 550	18T16/Fe 550	18T16/Fe 550	18T16/Fe 550
LINKS/TIES/STEEL GRADE Fe	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550	AS SHOWN/Fe 550
COLUMN MARK	SW1, SW4, SW8, SW14, SW16, SW19, SW31, SW33, SW41 & SW50	SW35, SW36, SW48 & SW57	SW44, SW58 & SW59	SW43, SW72, SW79 & SW95	SW47 & SW56

NOTES:

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AAC BLOCK WALL IS USED ON THE PLACE OF EXTERNAL AND INTERNAL WALL & PARTITION WALL WHOSE DENSITY SHALL NOT BE MORE THAN 750Kg/m³

NO.	AMENDMENTS	BY	DATE
–	ISSUED FOR ADVANCE DRAWING	Punitha	27/10/25

Landscape Consultant :

CHENNAI MASTER PLAN BANGALORE LANDSCAPE ARCHITECTS

Project Managers & Quantity Surveyors :

Electrical Consultant :

Client :

NAVIN HOUSING & PROPERTIES (P)LTD.
NAVIN'S Triumph
[Opposite to Cosmopolitan Golf Ground Annex, Near GR Complex] No.802&804, Anna Salai, Nandanam, Chennai – 600 035. INDIA.
web site: www.navinhousing.com

Architect :

SDC
124 Enclave, No–28/3,1st A, 1st floor, Velan Nagar,Valluvar Road, Arumbakkam, Chennai–600106.
E–mail : sranti.design@gmail.com
Ph no : 044–43533458
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Civil & Structural Consultants
New No. 31, Old No. 14, Besant Avenue, Adyar, Chennai - 600 020. 4044-2491 2754/55/56.
e-Mail ID: buroindia@buroengineers.in

CONSTRUCTION DRAWING

STRUCTURAL

project title:

PROPOSED RESIDENTIAL BUILDING AT SHRI DEVIKUPRAM ROAD, VALASARAVAKKAM CHENNAI-600087.

A. YUVARAJ, M.E., (Struct.)
REGISTERED STRUCTURAL ENGINEER
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
CMDA REGN. No.
NEW No. 31 (OLD No.14), BESANT AVENUE,
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scale	AS SHOWN	design by	Arun
drawn by	Punitha	checked by	Arun
date	JAN 2025	approved by	AP
drawing no.	BEI765_S-/SW/DT/--/01	revision	–

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CAD FILE NAME: BEI765_S-SWDT/--/01.dwg

THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

LandLens One
Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

FREE TOOLS · NO ACCOUNT NEEDED

Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

Every free tool
/tools

Services we run for you
/services

The LandLens suite
/landlens/one

Verified RealEstate™

Every claim in this document traces back to a government record.

- Legal opinions, due diligence and title verification
- Building plan, layout and sub-division approvals
- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
- Land survey, soil testing, architecture and construction

Verified RealEstate
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OMR Thoraipakkam,
Chennai 600 097, India
hello@verified.realestate
+91 9996 12 9996

Prepared from the registers named on the page each finding sits on. Where a register could not be read, this document says so in its place rather than leaving the gap to be read as a clean result.