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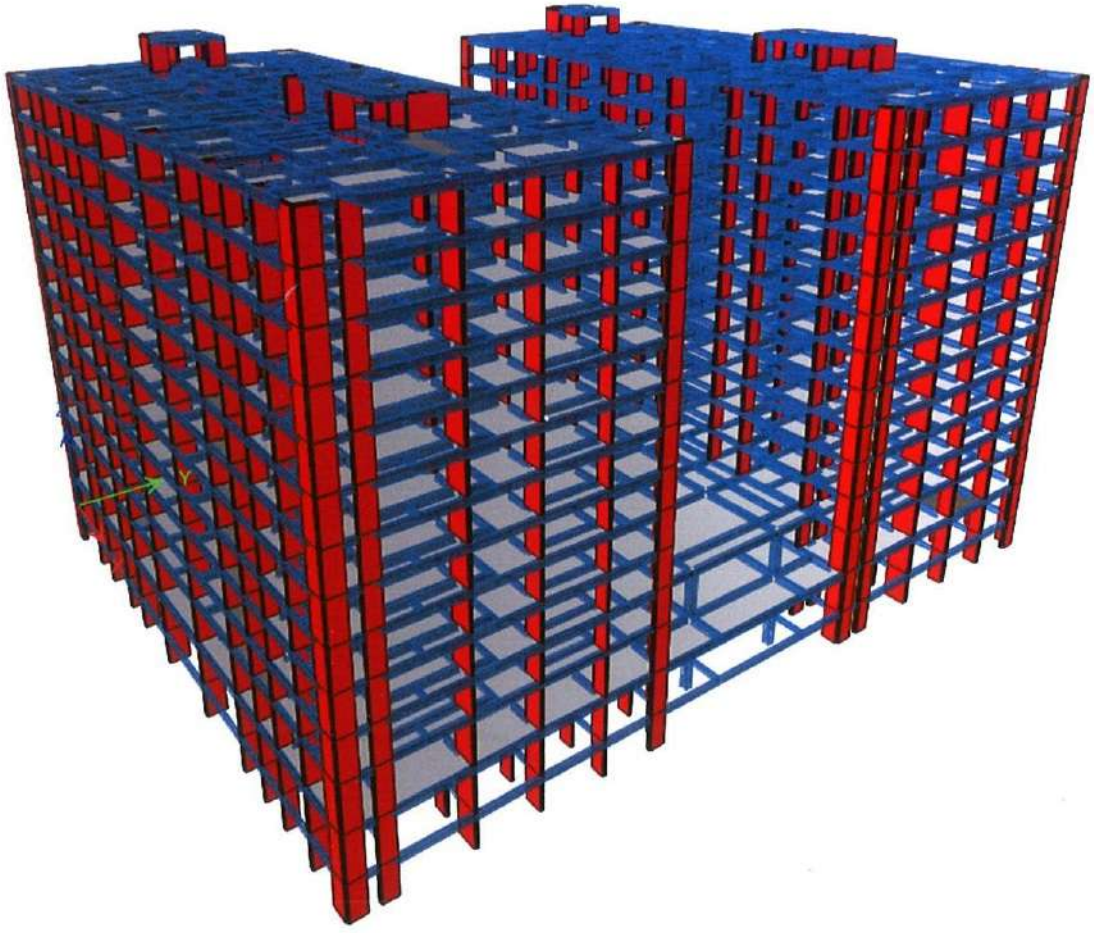
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# STRUCTURAL DESIGN REPORT

**OF RESIDENTIAL BUILDING (BASEMENT+STILT+11 UPPER FLOORS)**

**AT THANAKKANKULAM,MADURAI**

**MARCH-2026**




**STRUCTURAL CONSULTANT**

**C.KANNAN** B.E., M.E (STRUCTURE)
INDIRA NAGAR, CHENNAI-20.

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## FOREWORD

### 1.1.1 - Description of Project

M/s. Max Properties Private Limited, Madurai is developing a High rise residential building (Basement+Stilt+11 upper floors) at S.No:191/82A part, 1919/82B, 191/109 at Thanakkankulam Panchayat, Thiruparankundram Taluk, Madurai. This project is designed to provide a generous and comfortable habitat, complete with facilities that cater to a relaxed and convenient lifestyle. The project construction is carried out as RCC framed structure with Shear wall, RCC Beam and Slab system. The building is designed with accessibility in mind as well as earthquake-resistant construction to ensure the well-being of occupants.

### 1.1.2 – Objective of the Report

The objective of this report is to provide and furnish complete details related to Project and structural analysis and design considerations.

### 1.1.2 – Scope of the Report

The Structural Report covers the complete Structural Elements design considerations for analysis of lateralloads & gravity loads.

## 1.2 CODES, STANDARDS AND REFERENCES

### Statutory Requirements:

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

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

### DESIGN STANDARDS:

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

### Loads:

| | | |
|---|---|---|
| IS: 875 -2015 | - | Code of Practice for design loads (other than earthquake) for Buildings & structure (All parts) |
| IS: 1893-2016 | - | Criteria for earthquake resistant design of structure |

### Foundations:

| | | |
|---|---|---|
| IS: 1080-1985(2016) | - | Code of Practice for design and construction of shallow foundations on soils(other than raft, ring and shell) |
| IS: 1904-1986(2015) | - | Code of Practice for design and construction of foundations in soils general requirement |
| IS: 2911-1980(2013) | - | Code of Practice for design and construction of pile foundations (All parts) |
| IS: 2950-1981(2013) | - | Code of Practice for design and construction of raft foundations |
| IS: 2974-1998(2013/2015) | - | Code of Practice for design and construction of machine Foundations( All parts ) |
| IS: 8009-1976/1980(2013/2015) | - | Code of Practice for calculation of settlement of foundations (All parts ) |

**RCC:**

| | | |
|---|---|---|
| IS: 456 -2000(2016) | - | Code of Practice for plain and reinforced concrete |
| IS: 458 -1988 | - | Specification for precast concrete pipes |
| IS: 3370-2009 | - | Code of Practice for concrete structures for the storage of liquids:(All parts) |
| IS: 4326-2013 | - | Code of Practice for earthquake resistant design and construction of building |
| IS: 5525-1969(2013) | - | Recommendation for detailing of reinforced concrete works |
| IS: 1786-2008 | - | Code of Practice for design and construction of machine Foundations( All parts ) |
| IS: 5525-1969(2013) | - | Specification for high strength deformed steel bars and wires for concrete reinforcement |
| IS: 1786-2008 | - | Recommended guidelines for concrete mix design |
| IS: 10262-2009 | - | Criteria for earthquake resistant design of structures (General provisions and building). |
| IS: 1893 (Part-1)-2016 | - | Criteria for structural safety of Tall Concrete buildings |
| IS: 16700 – 2017 | - | Ductile design and Detailing of Reinforced concrete structures subjected to Seismic forces – Code of practice |
| IS: 13920 – 2016 | - | Ductile design and Detailing of Reinforced concrete structures subjected to Seismic forces – Code of practice |
| IS: 1343 – 1980 | - | Code of practice for Prestressed concrete |

**Miscellaneous:**

| | | |
|---|---|---|
| IS: 432(part 2)-1995 | - | Specification for mild steel and medium tensile steel bars and hard-drawnsteel wire for concrete reinforcement |
| IS: 6313(part II)-2001 | - | Standards for anti-termite treatment |
| IS: 1905-1998 | - | Code of Practice for structural use of unreinforced masonry |
| IS: 3067-1995 | - | Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings |
| SP: 6 -1998 | - | Handbook for structural engineers ( all parts ) |
| SP: 7 -2005 | - | National Building Code of India |
| SP: 16-1999 | - | Design Aids for reinforced concrete to IS:456-1978 |
| SP: 22-1982 | - | Explanatory handbook on codes for earthquake engineering (IS:1982-1975and IS:4326-1976 ) |
| SP: 24-1983 | - | Explanatory handbook on Indian Standard code of Practice for plain andreinforced concrete |
| SP: 34-1987 | - | Handbook of concrete reinforcement and detailing (SCIP) |

**Material:**

| | | |
|---|---|---|
| IS: 269 -2015 | - | Specification for Ordinary, rapid hardening and low heat Portland cement' |
| .IS: 455 -1995 | - | Specification for Portland blast furnace slag cement. |
| IS: 1489-1991 | - | Specification for Portland pozzolana cement |
| IS: 4031-1991 | - | Method of physical tests for Portland cement. |
| IS: 383 - 2016 | - | Specification for coarse and fine aggregates from natural sources for concrete. |
| IS: 516 – 1999 | - | Method of test for strength of concrete |
| IS: 1199-1999 | - | Method of sampling and analysis of concrete. |
| IS: 1566-2000 | - | Specification for plain hard drawn steel wire fabric for concrete reinforcement |
| IS: 4990-1998 | - | Specification for plywood for concrete shuttering works. |
| IS: 2645-1999 | - | Specification for integral cement water proofing compounds. |

## 1.3 DESCRIPTION OF STRUCTURE

### 1.3.1 Building Description

The Development consists of the following:

a. Residential building floor covered with RCC roofing.

The usages of individual floors are as given below:

| Floors | Details |
|---|---|
| Main Residential Building | Space living purpose |

### 1.3.2 Structural Arrangement:

The Structural System for the residential buildings comprises of RCC column and beam and slab.

| S.No. | Description | Details |
|---|---|---|
| 1. | Column Grids | 3.60 m x 2.10 m (Varies for some grids) |
| 2. | Structural System | RCC Shear Wall & Column |
| 3. | Slab Thickness RCC Slab | Min. 120mm (Varies on span) |
| 4. | Foundation | Raft Foundation |
| 5. | Column | As per design |
| 6. | Beams | As per design |

## 1.4 DESIGN APPROACH

### 1.4.1 – Design Life.

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

### 1.4.2 – Material Properties.

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.

**Concrete:**

All structural concrete shall have cube crushing strength of 40 N/sq.mm (M40) at 28 days.Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

**Concrete Mix:**

| Concrete Item | Grade |
|---|---|
| Raft Foundation | M30 |
| Columns | M40 |
| Slabs & Beams | M30 |

**Reinforcement steel:**

- All reinforcement shall confirm to IS: 1786 – 1985 having minimum yield strength of 500 N/sq.mm.Corrosion resistant steel is not required.

### 1.4.3 – Design loads

**Dead loads:**

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

- Floor finish of 75 mm thickness : 75 kg/sqm
- Self-weight of Plain concrete : 2400 kg/cum (24 kN/cum)
- Self-weight of RCC : 2500 kg/cum (25 kN/cum)
- Aerocon block masonry : 700 kg/cum (7 kN/cum) [For walls]
  (With additional 15mm thick plastering on external surface and 12mm plastering on internal wallsurfaces)
- Soil (Dry) : 1800 kg/cum (18 kN/cum)
- Soil (Wet) : 2000 kg/cum (20 kN/cum)
- Water : 1000 kg/cum (10 kN/cum)
- Masonry with plastering : 2200 kg/cum (22 kN/cum)
- Wall loads : As per actuals

**Live loads:**

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

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

**Floor Live loads:**

- Living Area : 200 kg/sqm (2.0 kN/sqm)
- Stairs : 300 kg/sqm (3.0 kN/sqm)
- Corridors / Balcony : 300 kg/sqm (3.0 kN/sqm)
- Toilets : 200 kg/sqm (2.0 kN/sqm)
- Terrace with Access : 200 kg/sqm (2.0 kN/sqm)
- Electrical rooms : 400 kg/sqm (4.0 kN/sqm)

**Sunken Details:**

- Toilet : 250 mm

### Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3):2015.Madurai has a high wind speed of 50m/s.

Basic Wind Speed $V_b$ : 39 m/s

Risk Coefficient $k_1$ : 1.00 ($k_1$ corresponds to 50 years Mean Probable Design Life of Structure)

Terrain, height, structure size factor $k_2$ : To suit the height of the structure for terrain category 2

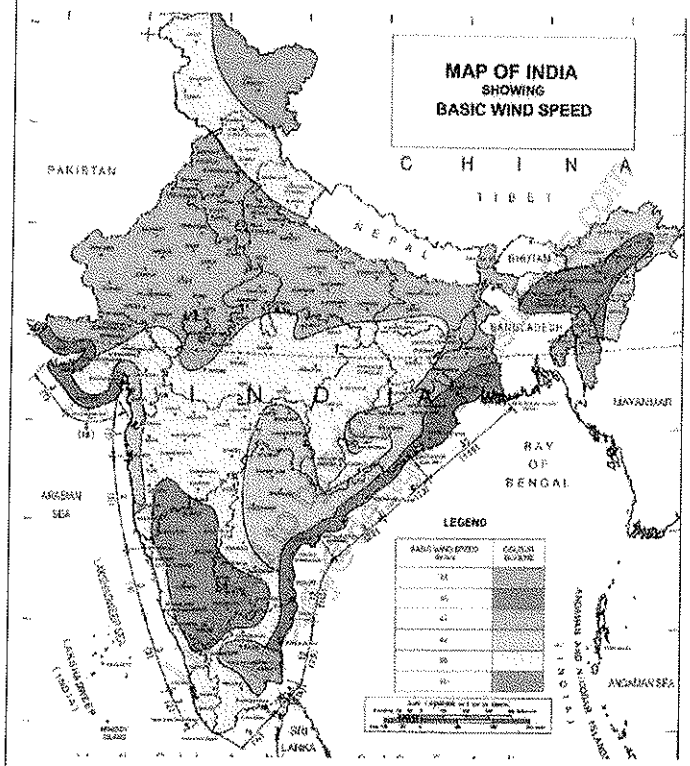
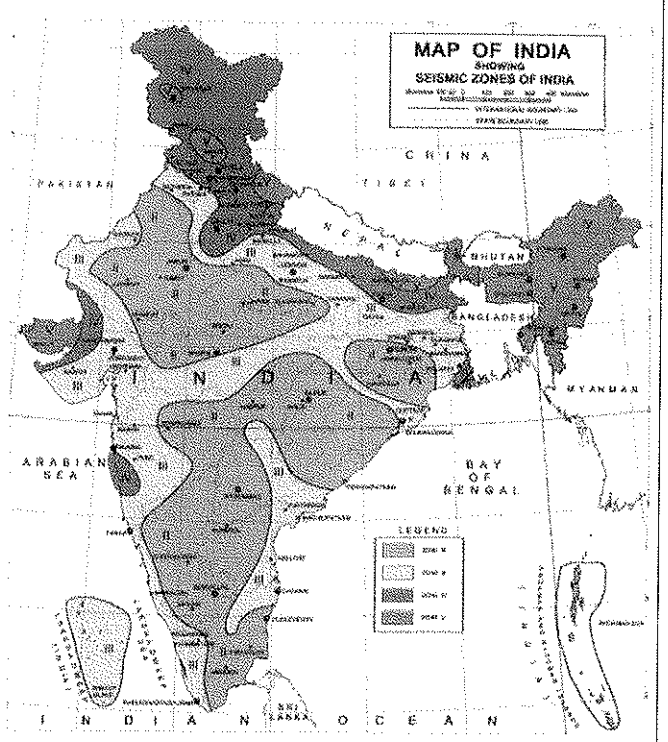
Topography factor $k_3$ : 1.0

Importance factor for cyclonic region $k_4$ : 1.00

The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3):2015 Design

Wind speed $V_z$ : $V_b \times k_1 \times k_2 \times k_3 \times k_4$

Design Wind Pressure, $P_z$ : $0.6V_z^2$

| Map showing basic wind speed | Map showing seismic zones |
|---|---|
|  |  |
| Basic wind speed in m/s (based on 50-year return period) | Seismic zones of India |



**Seismic Forces:**

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

| | |
|---|---|
| Seismic Zone | : II |
| Seismic Zone factor, Z | : 0.1 (As per Table 3; IS: 1893-2016) |
| Design horizontal seismic coefficient (Ah) | : $(Z/2)*(S_a/g)*(I/R)$ |
| I -Importance factor | : 1.2 (Ref Table 8; IS: 1893-2016) |
| Response reduction Factor | : 5 |
| Soil type | : Type -I |
| Damping Ratio for RCC | : 5 % |

Sa/g – Average response acceleration coefficient for soil sites as per Fig.2 of IS: 1893-2016 and it is arrivedbased on appropriate fundamental natural period of structure as per Cl 7.6.2 (b)

| | |
|---|---|
| Design horizontal seismic coefficient ($A_h$) | : $(Z/2)*(S_a/g)*(I/R)$ |
| | : $(0.1/2)*(1.2/5) * (S_a/g)$ |
| $A_h$ | : $0.012 * (S_a/g)$ |
| Design seismic base shear, $V_b$ | : $A_h * w$ where, $w$ - seismic weight of building |
| Effect of infill panels | : Not considered in the analysis |

**Table No : 03**

| **Seismic Zone Factor Z** | | | | |
|---|---|---|---|---|
| **( Clause 6.4.2 )** | | | | |
| **Seismic Zone** | **II** | **III** | **IV** | **V** |
| Seismic Intensity | Low | Moderate | Severe | Very Severe |
| Z | 0.10 | 0.16 | 0.24 | 0.36 |

## Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. Minimum & maximum temperatures considered are as shown in the table below. Same will be used for the analysis & design. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

| Station Name | Month | Period | No. of Years | Mean Temperature in Degree C | | Mean rainfall in mm |
|---|---|---|---|---|---|---|
| | | | | Maximum | Minimum | |
| Chennai (Minambakkam) | January | 1901-2000 | 100 | 28.8 | 20.4 | 35.3 |
| Chennai (Minambakkam) | February | 1901-2000 | 100 | 30.5 | 21.1 | 13.0 |
| Chennai (Minambakkam) | March | 1901-2000 | 100 | 32.6 | 23.0 | 14.5 |
| Chennai (Minambakkam) | April | 1901-2000 | 100 | 34.7 | 25.8 | 15.9 |
| Chennai (Minambakkam) | May | 1901-2000 | 100 | 37.4 | 27.6 | 42.4 |
| Chennai (Minambakkam) | June | 1901-2000 | 100 | 37.3 | 27.4 | 53.9 |
| Chennai (Minambakkam) | July | 1901-2000 | 100 | 35.3 | 26.1 | 99.6 |
| Chennai (Minambakkam) | August | 1901-2000 | 100 | 34.5 | 25.5 | 129.9 |
| Chennai (Minambakkam) | September | 1901-2000 | 100 | 33.9 | 25.2 | 123.5 |
| Chennai (Minambakkam) | October | 1901-2000 | 100 | 31.8 | 24.2 | 284.6 |
| Chennai (Minambakkam) | November | 1901-2000 | 100 | 29.4 | 22.6 | 353.0 |
| Chennai (Minambakkam) | December | 1901-2000 | 100 | 28.4 | 21.2 | 146.3 |

[Source: National Data Centre: ndc@imdpune.gov.in DGM (Sectt.): dgm.hq@imd.gov.in]

Considering the average **daily** maximum temperature as 34 degrees and minimum as 24 degrees, the variation in temperature for analysis is considered as **10 degrees**. [Source https://www.wunderground.com/history/airport/VOMM/2016/1/4/CustomHistory.html?dayend=5&monthend=2&yearend=2017&req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo=]

## Temperature and shrinkage effect:

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

## Exceptional Loads:

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

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental collision of vehicles on the façade of the building

### 1.4.4 Durability Considerations:

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

- Environment : Moderate
- Exposure conditions : Concrete surfaces exposed to moderate environment
- Minimum grade of Concrete : Moderate Exposure – M25

**Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size**

*(Clauses* 6.1.2, 8.2.4.1 *and* 9.1.2*)*

| Sl No. | Exposure | Plain Concrete | | | Reinforced Concrete | | |
|---|---|---|---|---|---|---|---|
| | | Minimum Cement Content kg/m³ | Maximum Free Water-Cement Ratio | Minimum Grade of Concrete | Minimum Cement Content kg/m³ | Maximum Free Water-Cement Ratio | Minimum Grade of Concrete |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| i) | Mild | 220 | 0.60 | – | 300 | 0.55 | M 20 |
| ii) | Moderate | 240 | 0.60 | M 15 | 300 | 0.50 | M 25 |
| iii) | Severe | 250 | 0.50 | M 20 | 320 | 0.45 | M 30 |
| iv) | Very severe | 260 | 0.45 | M 20 | 340 | 0.45 | M 35 |
| v) | Extreme | 280 | 0.40 | M 25 | 360 | 0.40 | M 40 |

NOTES

1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2 Minimum grade for plain concrete under mild exposure condition is not specified.

### 1.4.5 Fire Rating

Thickness of the structural elements as per table 15, 16 & 16A clause 26.4 of IS 456-2000.

| *Fire Resistance h* | *Minimum Beam Width b* | *Rib Width of Slabs $b_w$* | *Minimum Thickness of Floors D* | *Column Dimension (b or D)* | | | *Minimum Wall Thickness* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Fully Exposed | 50% Exposed | One Face Exposed | $p<0.4\%$ | $0.4\% \le p \le 1\%$ | $p>1\%$ |
| | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| 0.5 | 200 | 125 | 75 | 150 | 125 | 100 | 150 | 100 | 100 |
| 1 | 200 | 125 | 95 | 200 | 160 | 120 | 150 | 120 | 100 |
| 1.5 | 200 | 125 | 110 | 250 | 200 | 140 | 175 | 140 | 100 |
| 2 | 200 | 125 | 125 | 300 | 200 | 160 | – | 160 | 100 |
| 3 | 240 | 150 | 150 | 400 | 300 | 200 | – | 200 | 150 |
| 4 | 280 | 175 | 170 | 450 | 350 | 240 | – | 240 | 180 |

NOTES

1 These minimum dimensions relate specifically to the covers given in Table 16A.

2 $p$ is the percentage of steel reinforcement.

FIG. 1 MINIMUM DIMENSIONS OF REINFORCED CONCRETE MEMBERS FOR FIRE RESISTANCE

**Nominal covers for 2 hr. fire resistance:**

| Nominal Cover | | | | | | |
|---|---|---|---|---|---|---|
| Beams | | Slabs | | Ribs | | Columns |
| Simply supported | Continuous | Simply supported | Continuous | Simply supported | Continuous | |
| mm | mm | mm | mm | mm | mm | mm |
| 40 | 30 | 35 | 25 | 45 | 35 | 40 |

## 1.5 ANALYSIS METHODOLOGY:

This structure has a physical interface with almost all the disciplines like geotechnical works, MEP services,etc. The structure proposed is of cast in-situ concrete construction with columns suitably placed. The vertical loads including the dead and super imposed loads are transferred to the soil through columns and foundation. Foundations are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants.

### 1.5.1 Assumptions:

- The structure is idealized as 3D space frame and analyzed using ETABS software package for both vertical and lateral loads.
- The structure is analyzed for specific loads like dead load, live load, wind, and seismic loads and forthe load combinations as given in the relevant codes.
- The foundation is represented in analysis model using fixed end conditions.

### 1.5.2 Mathematical model

**Mass Modelling:**

Mass Source as per IS: 1893_2016 is considered as follows.

Mass source = DL+SDL+ 0. 5LLWhere DL - Dead Load;

SDL – Super Imposed Dead Load;LL - Live Load

### 1.5.3 Static Analysis:

The following Static loads cases are considered in the analysis.

DL - Dead Load which includes self-weight of the structure.

SDL – Super Imposed Dead Load, including load due to finishes, wall Loads, Soil filling loads etc.

LL - Live Load

## 1.6 LOAD COMBINATIONS:

Load combinations Used for Strength, Serviceability are tabulated below:

| Load Combination | Limit State of Collapse | | | Limit State of Serviceability | | |
|---|---|---|---|---|---|---|
| | *DL+SDL* | *LL* | *WL/EL/TL* | *DL+SDL* | *LL* | *WL/EL/TL* |
| DL + LL | 1.5 | 1.5 | — | 1 | 1 | — |
| DL + WL | 1.5 or 0.9* | — | 1.5 | 1 | — | 1 |
| DL + EL | 1.5 or 0.9* | — | 1.5 | 1 | — | 1 |
| DL + TL | 1.5 | — | 1.5 | 1 | — | 1 |
| DL+LL+WL | 1.2 | 1.2 | 1.2 | 1 | 0.8 | 0.8 |
| DL+LL+EL | 1.2 | 1.2 | 1.2 | 1 | 0.8 | 0.8 |
| DL+LL+TL | 1.2 | 1.2 | 1.2 | 1 | 1 | 1 |
| DL+WL+TL | 1.2 | — | 1.2 | 1 | — | 1 |
| DL+EL+TL | 1.2 | — | 1.2 | 1 | — | 1 |
| DL+LL+EL+TL | 1.2 | 1.2 | 1.2 | 1 | 1 | 1 |

### Response spectrum combinations:

- 1.2[DL+LL+(SPECX+0.3 SPECY+0.3 SPECZ)]
- 1.2[DL+LL+(SPECY+0.3 SPECX+0.3 SPECZ)]
- 1.5[DL+(SPECX+0.3 SPECY+0.3 SPECZ)]
- 1.5[DL+(SPECY+0.3 SPECX+0.3 SPECZ)]
- 0.9DL+1.5(SPECX+0.3 SPECY+0.3 SPECZ)]
- 0.9DL+1.5(SPECY+0.3 SPECX+0.3 SPECZ)]

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

*This value is to be considered when stability against overturning and stress reversal is critical where DL/LL/WL/EL denotes,DL - Dead Load; LL - Live Load; TL - Temperature Load; WL - Wind Load;EL - Earthquake Load , SPEC- Response spectrum Wind load and earthquake loads are considered for both x & y directions. Whenever imposed load is combined with earthquake load, the appropriate part of imposed load as specified in IS: 1893-2016 / Clause 7.3.3 of seismic code will be used both for evaluating earthquake effect and for combined load effects usedin such combination. Serviceability loads combinations with suitable live load reduction factor as per IS: 875(Part-2) will be used for foundation design.

## 1.7 DESIGN METHODOLOGY:

- All R.C.C structures shall be designed according to the Limit State Method as specified in IS: 456 – 2000.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The foundations are designed for critical load combination.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.
- The slab is analyzed as two-way and one way slabs.
- Design of special members like retaining wall, water tanks will be done in accordance with the relevant IS Codes.

## 1.8 ACCEPTANCE CRITERIA:

### 1.8.1 Deflection Limits:

For Reinforced concrete works:

- Limiting values of deflection (Short and Long term) as per clause 35.3 of IS: 456-2000 is followed in the design.
- Limiting value for long term deflection is considered as span/250 and for the long term deflection after erection of partitions & finishes is considered as span/350 or 20mm whichever less as per IS 456 – 2000.

### 1.8.2 Cracking Limits:

- Limiting values of crack width as per clause 35.3 of IS: 456-2000 is followed in the design.In general for slabs and beams, the crack width is limited to 0.3mm.
- For water retaining structures, crack width is limited to 0.2mm.

### 1.8.3 Soil data:

Foundations are designed based on Geo Technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. The soil investigation report recommends mat foundation system.

## 1.9 DETAILING REQUIREMENTS:

RC walls, which are considered as lateral load resisting elements are detailed as ductile RC walls along with perimeter SMRFs (both columns and beams). Rest of the columns and beams are detailed as per normal detailing requirement. Detailing for all structural members shall be in accordance with IS: 456 & SP: 34.

## IS 1893:2016 Auto Seismic Load Calculation

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

**Direction and Eccentricity**

Direction = X + Eccentricity Y

Eccentricity Ratio = 5% for all diaphragms

**Structural Period**

Period Calculation Method = User Specified

| | | |
|---|---|---|
| User Period | | T=1.862 sec |

**Factors and Coefficients**

| | | |
|---|---|---|
| Seismic Zone Factor, Z [IS Table 3] | | $Z = 0.1$ |
| Response Reduction Factor, R [IS Table 9] | | $R = 5$ |
| 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] | $\frac{S_a}{g} = \frac{1.36}{T}$ | $\frac{S_a}{g} = 0.445$ |

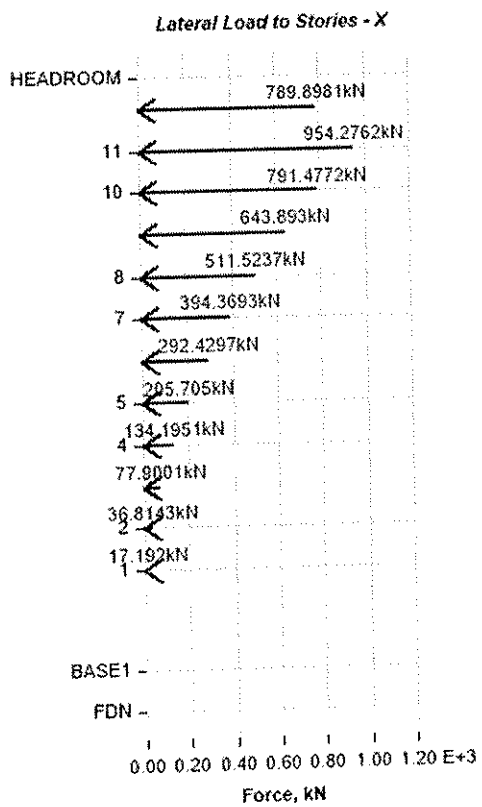
**Equivalent Lateral Forces**

| | |
|---|---|
| Seismic Coefficient, $A_h$ [IS 6.4.2] | $A_h = \frac{ZI\frac{S_a}{g}}{2R}$ |

**Calculated Base Shear**

| Direction | Period Used (sec) | W (kN) | $V_b$ (kN) |
|---|---|---|---|
| X + Ecc. Y | 3.059 | 440879.4121 | 4849.6735 |

**Applied Story Forces**




| Story | Elevation | X-Dir | Y-Dir |
|---|---|---|---|
| | m | kN | kN |
| TERRACE | 40.87 | 789.8981 | 0 |
| 11 | 37.82 | 954.2762 | 0 |
| 10 | 34.77 | 791.4772 | 0 |
| 9 | 31.72 | 643.893 | 0 |
| 8 | 28.67 | 511.5237 | 0 |
| 7 | 25.62 | 394.3693 | 0 |
| 6 | 22.57 | 292.4297 | 0 |
| 5 | 19.52 | 205.705 | 0 |
| 4 | 16.47 | 134.1951 | 0 |
| 3 | 13.42 | 77.9001 | 0 |
| 2 | 10.37 | 36.8143 | 0 |
| 1 | 7.32 | 17.192 | 0 |
| STILT | 3.66 | 0 | 0 |
| BASE1 | 0 | 0 | 0 |
| FDN | -3 | 0 | 0 |

**IS 1893:2016 Auto Seismic Load Calculation**

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

**Direction and Eccentricity**

Direction = Y + Eccentricity X

Eccentricity Ratio = 5% for all diaphragms

**Structural Period**

Period Calculation Method = User Specified

User Period T=2.166 sec

**Factors and Coefficients**

Seismic Zone Factor, Z [IS Table 3] $Z = 0.1$

Response Reduction Factor, R [IS Table 9] $R = 5$

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] $\frac{S_a}{g} = \frac{1.36}{T}$ $\frac{S_a}{g} = 0.4840$

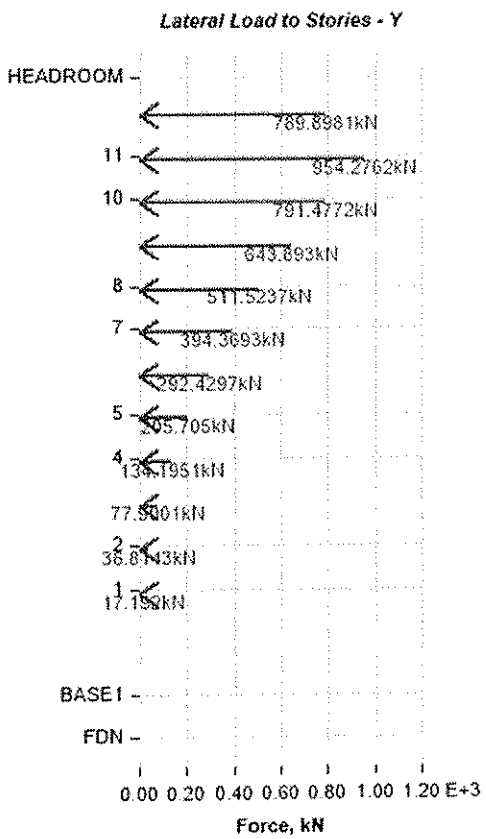
**Equivalent Lateral Forces**

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

**Calculated Base Shear**

| Direction | Period Used (sec) | W (kN) | $V_b$ (kN) |
|---|---|---|---|
| Y + Ecc. X | 2.81 | 440879.4121 | 4849.6735 |

**Applied Story Forces**




| Story | Elevation | X-Dir | Y-Dir |
|---|---|---|---|
| | m | kN | kN |
| TERRACE | 40.87 | 0 | 789.8981 |
| 11 | 37.82 | 0 | 954.2762 |
| 10 | 34.77 | 0 | 791.4772 |
| 9 | 31.72 | 0 | 643.893 |
| 8 | 28.67 | 0 | 511.5237 |
| 7 | 25.62 | 0 | 394.3693 |
| 6 | 22.57 | 0 | 292.4297 |
| 5 | 19.52 | 0 | 205.705 |
| 4 | 16.47 | 0 | 134.1951 |
| 3 | 13.42 | 0 | 77.9001 |
| 2 | 10.37 | 0 | 36.8143 |
| 1 | 7.32 | 0 | 17.192 |
| STILT | 3.66 | 0 | 0 |
| BASE1 | 0 | 0 | 0 |
| FDN | -3 | 0 | 0 |

## MODAL PARTICIPATING MASS RATIOS

| Case | Mode | Period | UX | UY | UZ | Sum UX | Sum UY | Sum UZ | RX | RY | RZ | Sum RX | Sum RY | Sum RZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | sec | | | | | | | | | | | | |
| Modal | 1 | 3.059 | 3.059 | 0.603 | 0.045 | 0.000 | 0.603 | 0.045 | 0.000 | 0.004 | 0.071 | 0.097 | 0.004 | 0.071 |
| Modal | 2 | 2.81 | 2.810 | 0.117 | 0.486 | 0.000 | 0.720 | 0.531 | 0.000 | 0.041 | 0.013 | 0.126 | 0.045 | 0.084 |
| Modal | 3 | 2.717 | 2.717 | 0.021 | 0.183 | 0.000 | 0.741 | 0.714 | 0.000 | 0.016 | 0.003 | 0.476 | 0.060 | 0.086 |
| Modal | 4 | 2.156 | 2.156 | 0.003 | 0.001 | 0.000 | 0.744 | 0.714 | 0.000 | 0.000 | 0.000 | 0.021 | 0.060 | 0.087 |
| Modal | 5 | 2.04 | 2.040 | 0.010 | 0.008 | 0.000 | 0.754 | 0.723 | 0.000 | 0.001 | 0.000 | 0.030 | 0.061 | 0.087 |
| Modal | 6 | 1.824 | 1.824 | 0.000 | 0.000 | 0.000 | 0.754 | 0.723 | 0.000 | 0.000 | 0.000 | 0.001 | 0.061 | 0.087 |
| Modal | 7 | 0.859 | 0.859 | 0.129 | 0.001 | 0.000 | 0.883 | 0.724 | 0.000 | 0.000 | 0.151 | 0.007 | 0.061 | 0.238 |
| Modal | 8 | 0.761 | 0.761 | 0.005 | 0.041 | 0.000 | 0.888 | 0.765 | 0.000 | 0.022 | 0.007 | 0.086 | 0.083 | 0.245 |
| Modal | 9 | 0.732 | 0.732 | 0.000 | 0.116 | 0.000 | 0.888 | 0.880 | 0.000 | 0.065 | 0.000 | 0.028 | 0.148 | 0.245 |
| Modal | 10 | 0.529 | 0.529 | 0.002 | 0.000 | 0.000 | 0.890 | 0.881 | 0.000 | 0.000 | 0.001 | 0.019 | 0.149 | 0.246 |
| Modal | 11 | 0.519 | 0.519 | 0.001 | 0.001 | 0.000 | 0.890 | 0.881 | 0.000 | 0.001 | 0.000 | 0.006 | 0.149 | 0.247 |
| Modal | 12 | 0.501 | 0.501 | 0.000 | 0.000 | 0.004 | 0.890 | 0.881 | 0.004 | 0.000 | 0.000 | 0.000 | 0.149 | 0.247 |
| Modal | 13 | 0.465 | 0.465 | 0.000 | 0.000 | 0.001 | 0.890 | 0.881 | 0.006 | 0.000 | 0.001 | 0.000 | 0.149 | 0.247 |
| Modal | 14 | 0.464 | 0.464 | 0.000 | 0.000 | 0.001 | 0.890 | 0.881 | 0.006 | 0.000 | 0.001 | 0.000 | 0.149 | 0.248 |
| Modal | 15 | 0.443 | 0.443 | 0.000 | 0.000 | 0.000 | 0.890 | 0.881 | 0.006 | 0.000 | 0.000 | 0.000 | 0.149 | 0.248 |
| Modal | 16 | 0.433 | 0.433 | 0.000 | 0.000 | 0.000 | 0.890 | 0.881 | 0.007 | 0.000 | 0.000 | 0.000 | 0.149 | 0.248 |
| Modal | 17 | 0.423 | 0.423 | 0.050 | 0.000 | 0.000 | 0.941 | 0.881 | 0.007 | 0.000 | 0.035 | 0.002 | 0.149 | 0.283 |
| Modal | 18 | 0.412 | 0.412 | 0.000 | 0.000 | 0.000 | 0.941 | 0.881 | 0.007 | 0.000 | 0.000 | 0.000 | 0.149 | 0.283 |
| Modal | 19 | 0.407 | 0.407 | 0.000 | 0.000 | 0.002 | 0.941 | 0.881 | 0.009 | 0.000 | 0.001 | 0.000 | 0.149 | 0.284 |
| Modal | 20 | 0.396 | 0.396 | 0.000 | 0.000 | 0.003 | 0.941 | 0.881 | 0.012 | 0.000 | 0.002 | 0.000 | 0.149 | 0.286 |
| Modal | 21 | 0.396 | 0.396 | 0.000 | 0.000 | 0.000 | 0.941 | 0.881 | 0.012 | 0.000 | 0.000 | 0.000 | 0.149 | 0.286 |
| Modal | 22 | 0.383 | 0.383 | 0.000 | 0.000 | 0.000 | 0.941 | 0.881 | 0.012 | 0.000 | 0.002 | 0.000 | 0.149 | 0.287 |
| Modal | 23 | 0.375 | 0.375 | 0.000 | 0.000 | 0.000 | 0.941 | 0.881 | 0.012 | 0.000 | 0.000 | 0.000 | 0.149 | 0.288 |
| Modal | 24 | 0.369 | 0.369 | 0.000 | 0.000 | 0.001 | 0.941 | 0.881 | 0.013 | 0.000 | 0.000 | 0.000 | 0.149 | 0.288 |
| Modal | 25 | 0.368 | 0.368 | 0.000 | 0.000 | 0.002 | 0.941 | 0.881 | 0.015 | 0.000 | 0.000 | 0.000 | 0.149 | 0.288 |
| Modal | 26 | 0.349 | 0.349 | 0.000 | 0.020 | 0.000 | 0.941 | 0.901 | 0.015 | 0.009 | 0.000 | 0.021 | 0.158 | 0.288 |

## STORY DRIFT

| Story | Output Case | Direction | Drift | Drift/ | X | Y | Z |
|---|---|---|---|---|---|---|---|
| TERRACE | EQ +X | X | 0.000837 | 1/1194 | 1.3 | 44.5516 | 40.87 |
| 11 | EQ +X | X | 0.000946 | 1/1057 | 6.3627 | 44.5516 | 37.82 |
| 10 | EQ +X | X | 0.001072 | 1/933 | 6.3627 | 44.5516 | 34.77 |
| 9 | EQ +X | X | 0.001199 | 1/834 | 6.3627 | 44.5516 | 31.72 |
| 8 | EQ +X | X | 0.00131 | 1/763 | 6.3627 | 44.5516 | 28.67 |
| 7 | EQ +X | X | 0.001397 | 1/716 | 6.3627 | 44.5516 | 25.62 |
| 6 | EQ +X | X | 0.001454 | 1/688 | 6.3627 | 44.5516 | 22.57 |
| 5 | EQ +X | X | 0.001474 | 1/679 | 6.3627 | 44.5516 | 19.52 |
| 4 | EQ +X | X | 0.001451 | 1/689 | 1.3 | 44.5516 | 16.47 |
| 3 | EQ +X | X | 0.001389 | 1/720 | 6.3627 | 0.00002547 | 13.42 |
| 2 | EQ +X | X | 0.001268 | 1/789 | 42.4759 | 0.00002453 | 10.37 |
| 1 | EQ +X | X | 0.001047 | 1/955 | 42.4759 | 0.00002453 | 7.32 |
| STILT | EQ +X | X | 0.000737 | 1/1356 | 0.00004929 | 1.3 | 3.66 |
| BASE1 | EQ +X | X | 0.000332 | 1/3013 | 44.4374 | 16.1544 | 0 |
| TERRACE | RSA- X | X | 0.00083 | 1/1205 | 42.4759 | 0.00002453 | 40.87 |
| 11 | RSA- X | X | 0.000912 | 1/1096 | 6.3627 | 0.00002547 | 37.82 |
| 10 | RSA- X | X | 0.000997 | 1/1003 | 6.3627 | 0.00002547 | 34.77 |
| 9 | RSA- X | X | 0.001075 | 1/930 | 6.3627 | 0.00002547 | 31.72 |
| 8 | RSA- X | X | 0.00114 | 1/877 | 6.3627 | 0.00002547 | 28.67 |
| 7 | RSA- X | X | 0.001195 | 1/837 | 6.3627 | 0.00002547 | 25.62 |
| 6 | RSA- X | X | 0.001239 | 1/807 | 6.3627 | 0.00002547 | 22.57 |
| 5 | RSA- X | X | 0.001268 | 1/789 | 6.3627 | 0.00002547 | 19.52 |
| 4 | RSA- X | X | 0.001277 | 1/783 | 42.4759 | 0.00002453 | 16.47 |
| 3 | RSA- X | X | 0.001258 | 1/795 | 6.3627 | 0.00002547 | 13.42 |
| 2 | RSA- X | X | 0.001198 | 1/835 | 42.4759 | 0.00002453 | 10.37 |
| 1 | RSA- X | X | 0.001045 | 1/957 | 42.4759 | 0.00002453 | 7.32 |
| STILT | RSA- X | X | 0.000767 | 1/1303 | 54.3052 | 0.0002 | 3.66 |
| BASE1 | RSA- X | X | 0.000325 | 1/3073 | 9.7918 | 3.8292 | 0 |
| TERRACE | EQ +Y | Y | 0.001298 | 1/770 | 54.3052 | 2.2292 | 40.87 |
| 11 | EQ +Y | Y | 0.001372 | 1/729 | 54.3052 | 2.2292 | 37.82 |
| 10 | EQ +Y | Y | 0.001461 | 1/684 | 54.3052 | 2.2292 | 34.77 |
| 9 | EQ +Y | Y | 0.001546 | 1/647 | 54.3052 | 2.2292 | 31.72 |
| 8 | EQ +Y | Y | 0.001613 | 1/620 | 54.3052 | 2.2292 | 28.67 |
| 7 | EQ +Y | Y | 0.001653 | 1/605 | 54.3052 | 2.2292 | 25.62 |
| 6 | EQ +Y | Y | 0.00166 | 1/602 | 54.3052 | 2.2292 | 22.57 |
| 5 | EQ +Y | Y | 0.001627 | 1/615 | 54.3052 | 2.2292 | 19.52 |
| 4 | EQ +Y | Y | 0.001547 | 1/647 | 54.3052 | 2.2292 | 16.47 |
| 3 | EQ +Y | Y | 0.001413 | 1/708 | 54.3052 | 2.2292 | 13.42 |
| 2 | EQ +Y | Y | 0.001209 | 1/827 | 54.3052 | 2.2292 | 10.37 |
| 1 | EQ +Y | Y | 0.000925 | 1/1081 | 54.3052 | 2.2292 | 7.32 |
| STILT | EQ +Y | Y | 0.000622 | 1/1609 | 54.3052 | 46.7808 | 3.66 |
| BASE1 | EQ +Y | Y | 0.000269 | 1/3724 | 49.6001 | 69.7738 | 0 |
| TERRACE | RSA-Y | Y | 0.000916 | 1/1092 | 54.3052 | 46.7808 | 40.87 |
| 11 | RSA-Y | Y | 0.000962 | 1/1039 | 54.3052 | 1.3002 | 37.82 |
| 10 | RSA-Y | Y | 0.001012 | 1/988 | 54.3052 | 2.2292 | 34.77 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | RSA-Y | Y | 0.001052 | 1/951 | 54.3052 | 2.2292 | 31.72 |
| 8 | RSA-Y | Y | 0.001078 | 1/927 | 54.3052 | 2.2292 | 28.67 |
| 7 | RSA-Y | Y | 0.001091 | 1/916 | 54.3052 | 2.2292 | 25.62 |
| 6 | RSA-Y | Y | 0.00109 | 1/917 | 54.3052 | 2.2292 | 22.57 |
| 5 | RSA-Y | Y | 0.001073 | 1/932 | 54.3052 | 2.2292 | 19.52 |
| 4 | RSA-Y | Y | 0.001035 | 1/966 | 54.3052 | 2.2292 | 16.47 |
| 3 | RSA-Y | Y | 0.000967 | 1/1034 | 54.3052 | 2.2292 | 13.42 |
| 2 | RSA-Y | Y | 0.000852 | 1/1173 | 54.3052 | 2.2292 | 10.37 |
| 1 | RSA-Y | Y | 0.000676 | 1/1480 | 54.3052 | 46.7808 | 7.32 |
| STILT | RSA-Y | Y | 0.000477 | 1/2095 | 54.3052 | 69.7738 | 3.66 |
| BASE1 | RSA-Y | Y | 0.000213 | 1/4704 | 49.6001 | 69.7738 | 0 |

**STORY MAX OVER AVG DISPLACEMENTS:**

| Story | Output Case | Direction | Maximum | Average | Ratio |
|---|---|---|---|---|---|
| TERRACE | EQ +X | X | 49.037 | 46.623 | 1.052 |
| 11 | EQ +X | X | 46.518 | 44.306 | 1.05 |
| 10 | EQ +X | X | 43.68 | 41.668 | 1.048 |
| 9 | EQ +X | X | 40.465 | 38.654 | 1.047 |
| 8 | EQ +X | X | 36.87 | 35.259 | 1.046 |
| 7 | EQ +X | X | 32.935 | 31.527 | 1.045 |
| 6 | EQ +X | X | 28.731 | 27.525 | 1.044 |
| 5 | EQ +X | X | 24.345 | 23.338 | 1.043 |
| 4 | EQ +X | X | 19.88 | 19.067 | 1.043 |
| 3 | EQ +X | X | 15.456 | 14.829 | 1.042 |
| 2 | EQ +X | X | 11.22 | 10.765 | 1.042 |
| 1 | EQ +X | X | 7.354 | 7.059 | 1.042 |
| STILT | EQ +X | X | 3.52 | 3.392 | 1.038 |
| TERRACE | EQ +Y | Y | 56.357 | 43.978 | 1.282 |
| 11 | EQ +Y | Y | 52.397 | 41.092 | 1.275 |
| 10 | EQ +Y | Y | 48.213 | 38.004 | 1.269 |
| 9 | EQ +Y | Y | 43.756 | 34.685 | 1.262 |
| 8 | EQ +Y | Y | 39.041 | 31.14 | 1.254 |
| 7 | EQ +Y | Y | 34.121 | 27.406 | 1.245 |
| 6 | EQ +Y | Y | 29.078 | 23.544 | 1.235 |
| 5 | EQ +Y | Y | 24.015 | 19.628 | 1.224 |
| 4 | EQ +Y | Y | 19.054 | 15.749 | 1.21 |
| 3 | EQ +Y | Y | 14.337 | 12.013 | 1.193 |
| 2 | EQ +Y | Y | 10.027 | 8.542 | 1.174 |
| 1 | EQ +Y | Y | 6.339 | 5.483 | 1.156 |
| STILT | EQ +Y | Y | 2.954 | 2.558 | 1.155 |
| TERRACE | RSA- X | X | 42.4 | 35.722 | 1.187 |
| 11 | RSA- X | X | 40.194 | 33.959 | 1.184 |
| 10 | RSA- X | X | 37.797 | 32.017 | 1.181 |
| 9 | RSA- X | X | 35.168 | 29.862 | 1.178 |
| 8 | RSA- X | X | 32.293 | 27.478 | 1.175 |
| 7 | RSA- X | X | 29.179 | 24.874 | 1.173 |
| 6 | RSA- X | X | 25.844 | 22.064 | 1.171 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | RSA- X | X | 22.318 | 19.075 | 1.17 |
| 4 | RSA- X | X | 18.645 | 15.946 | 1.169 |
| 3 | RSA- X | X | 14.885 | 12.73 | 1.169 |
| 2 | RSA- X | X | 11.128 | 9.513 | 1.17 |
| 1 | RSA- X | X | 7.507 | 6.418 | 1.17 |
| STILT | RSA- X | X | 3.694 | 3.173 | 1.164 |
| TERRACE | RSA-Y | Y | 36.905 | 31.665 | 1.165 |
| 11 | RSA-Y | Y | 34.309 | 29.525 | 1.162 |
| 10 | RSA-Y | Y | 31.605 | 27.288 | 1.158 |
| 9 | RSA-Y | Y | 28.772 | 24.937 | 1.154 |
| 8 | RSA-Y | Y | 25.818 | 22.477 | 1.149 |
| 7 | RSA-Y | Y | 22.764 | 19.92 | 1.143 |
| 6 | RSA-Y | Y | 19.638 | 17.288 | 1.136 |
| 5 | RSA-Y | Y | 16.474 | 14.606 | 1.128 |
| 4 | RSA-Y | Y | 13.32 | 11.91 | 1.118 |
| 3 | RSA-Y | Y | 10.243 | 9.254 | 1.107 |
| 2 | RSA-Y | Y | 7.339 | 6.712 | 1.093 |
| 1 | RSA-Y | Y | 4.759 | 4.401 | 1.081 |
| STILT | RSA-Y | Y | 2.293 | 2.125 | 1.079 |

**STORY STIFFNESS:**

| Story | Output Case | Shear X | Drift X | Stiff X | Shear Y | Drift Y | Stiff Y |
|---|---|---|---|---|---|---|---|
| | | kN | mm | kN/m | kN | mm | kN/m |
| HEADROOM | EQ +X | 3.3019 | 1.522 | 2169.021 | 0.0634 | 0.179 | 0 |
| TERRACE | EQ +X | 820.1039 | 2.335 | 351187.98 | 0.8286 | 0.308 | 0 |
| 11 | EQ +X | 1813.7439 | 2.662 | 681376.412 | 1.9291 | 0.313 | 0 |
| 10 | EQ +X | 2645.2102 | 3.042 | 869666.934 | 2.9843 | 0.317 | 0 |
| 9 | EQ +X | 3329.4373 | 3.425 | 971973.504 | 3.9877 | 0.32 | 0 |
| 8 | EQ +X | 3881.2734 | 3.763 | 1031336.107 | 4.9318 | 0.321 | 0 |
| 7 | EQ +X | 4315.504 | 4.031 | 1070520.631 | 5.8084 | 0.316 | 0 |
| 6 | EQ +X | 4646.8573 | 4.21 | 1103654.258 | 6.6085 | 0.303 | 0 |
| 5 | EQ +X | 4890.0025 | 4.286 | 1140932.897 | 7.3231 | 0.283 | 0 |
| 4 | EQ +X | 5059.5409 | 4.24 | 1193314.971 | 7.9436 | 0.253 | 0 |
| 3 | EQ +X | 5169.9915 | 4.063 | 1272400.345 | 8.4638 | 0.209 | 0 |
| 2 | EQ +X | 5235.7796 | 3.706 | 1412671.189 | 8.8815 | 0.146 | 0 |
| 1 | EQ +X | 5291.5527 | 3.667 | 1443066 | 9.3283 | 0.094 | 0 |
| STILT | EQ +X | 5312.2441 | 2.55 | 2083060.526 | 9.5549 | 0.063 | 0 |
| BASE1 | EQ +X | 5315.9454 | 0.882 | 6026289.797 | 9.5895 | 0.03 | 0 |
| HEADROOM | EQ +Y | 0.1444 | 0.237 | 0 | 3.0491 | 2.076 | 1468.477 |
| TERRACE | EQ +Y | 1.4831 | 0.36 | 0 | 818.1487 | 2.885 | 283560.603 |
| 11 | EQ +Y | 3.3268 | 0.364 | 0 | 1808.8131 | 3.085 | 586282.216 |
| 10 | EQ +Y | 5.1044 | 0.369 | 0 | 2636.6537 | 3.319 | 794364.555 |
| 9 | EQ +Y | 6.8045 | 0.376 | 0 | 3316.6406 | 3.545 | 935540.514 |
| 8 | EQ +Y | 8.4135 | 0.381 | 0 | 3863.6793 | 3.734 | 1034849.715 |
| 7 | EQ +Y | 9.9154 | 0.381 | 0 | 4292.625 | 3.863 | 1111301.283 |
| 6 | EQ +Y | 11.2929 | 0.383 | 0 | 4618.2877 | 3.916 | 1179393.476 |
| 5 | EQ +Y | 12.5274 | 0.369 | 0 | 4855.4362 | 3.879 | 1251868.084 |
| 4 | EQ +Y | 13.6004 | 0.352 | 0 | 5018.7977 | 3.736 | 1343229.802 |
| 3 | EQ +Y | 14.4954 | 0.34 | 0 | 5123.0594 | 3.471 | 1475856.464 |
| 2 | EQ +Y | 15.2009 | 0.321 | 0 | 5182.8709 | 3.059 | 1694505.829 |
| 1 | EQ +Y | 16.0337 | 0.339 | 0 | 5229.8581 | 2.92 | 1791099.803 |
| STILT | EQ +Y | 16.4574 | 0.238 | 0 | 5245.4575 | 1.954 | 2684951.008 |
| BASE1 | EQ +Y | 16.5266 | 0.078 | 0 | 5248.1213 | 0.648 | 8102107.986 |

On behalf of DTCP HRR Panel, the detailed Structural design calculations are reviewed and found in order.

13/3/26

Superintending Engineer, P.W.D.,
Planning and Designs Circle,
Chepauk, Chennai-5.

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**STORY FORCES:**

| Story | Output Case | P | VX | VY | T | MX | MY |
|---|---|---|---|---|---|---|---|
| TERRACE | EQ +X | 0 | -820.104 | -0.8286 | 29375.04 | 2.6793 | -2509.24 |
| TERRACE | EQ +Y | 0 | -1.4831 | -818.149 | -24225.3 | 2502.671 | -4.87 |
| TERRACE | RSA- X | 3.4187 | 1031.581 | 121.9434 | 34409.11 | 429.3668 | 3350.62 |
| TERRACE | RSA-Y | 2.227 | 100.5492 | 1020.822 | 30992.06 | 3523.919 | 364.251 |
| 11 | EQ +X | 0 | -1813.74 | -1.9291 | 65171.34 | 8.5631 | -8041.16 |
| 11 | EQ +Y | 0 | -3.3268 | -1808.81 | -53912.5 | 8019.551 | -15.0169 |
| 11 | RSA- X | 3.1224 | 1917.03 | 261.777 | 64789.66 | 1224.424 | 8971.347 |
| 11 | RSA-Y | 5.8747 | 214.5497 | 1877.643 | 58798.17 | 9404.576 | 950.1241 |
| 10 | EQ +X | -9.4E-07 | -2645.21 | -2.9843 | 95105.86 | 17.6653 | -16109.1 |
| 10 | EQ +Y | 0 | -5.1044 | -2636.65 | -78718.6 | 16061.35 | -30.5854 |
| 10 | RSA- X | 3.1551 | 2444.147 | 383.918 | 83641.25 | 2397.09 | 16159.44 |
| 10 | RSA-Y | 10.1126 | 315.1049 | 2374.875 | 75872.3 | 16712.33 | 1865.183 |
| 9 | EQ +X | -1.3E-06 | -3329.44 | -3.9877 | 119718.5 | 29.8276 | -26263.8 |
| 9 | EQ +Y | 0 | -6.8045 | -3316.64 | -99091.5 | 26177.1 | -51.3391 |
| 9 | RSA- X | 3.0438 | 2723.945 | 490.3296 | 94462.22 | 3889.249 | 24042.61 |
| 9 | RSA-Y | 14.2177 | 402.7919 | 2619.252 | 85372.11 | 24558.79 | 3047.468 |
| 8 | EQ +X | -2.1E-06 | -3881.27 | -4.9318 | 139548.5 | 44.8696 | -38101.7 |
| 8 | EQ +Y | 0 | -8.4135 | -3863.68 | -115482 | 37961.32 | -77.0002 |
| 8 | RSA- X | 2.6686 | 2914.277 | 583.4897 | 102222.2 | 5656.264 | 32139.49 |
| 8 | RSA-Y | 18.1085 | 479.1987 | 2754.386 | 91529.61 | 32399.14 | 4460.173 |
| 7 | EQ +X | -3.1E-06 | -4315.5 | -5.8084 | 155130.6 | 62.5851 | -51264 |
| 7 | EQ +Y | 0 | -9.9154 | -4292.63 | -128334 | 51053.83 | -107.242 |
| 7 | RSA- X | 2.3651 | 3127.866 | 665.8207 | 110414.1 | 7662.614 | 40343.25 |
| 7 | RSA-Y | 21.8632 | 546.4528 | 2892.384 | 97606.34 | 40045.83 | 6071.421 |
| 6 | EQ +X | -3.1E-06 | -4646.86 | -6.6085 | 166998.6 | 82.7411 | -65436.9 |
| 6 | EQ +Y | 0 | -11.2929 | -4618.29 | -138093 | 65139.6 | -141.686 |
| 6 | RSA- X | 3.0691 | 3367.501 | 739.1812 | 119187.6 | 9876.485 | 48750.78 |
| 6 | RSA-Y | 25.49 | 606.6025 | 3063.984 | 104456.5 | 47530.43 | 7859.257 |
| 5 | EQ +X | -4.3E-06 | -4890 | -7.3231 | 175684.2 | 105.0765 | -80351.4 |
| 5 | EQ +Y | 0 | -12.5274 | -4855.44 | -145203 | 79948.69 | -179.894 |
| 5 | RSA- X | 4.7206 | 3582.942 | 804.62 | 127033.2 | 12272.58 | 57467.73 |
| 5 | RSA-Y | 28.9338 | 661.1846 | 3254.546 | 111592 | 54992.02 | 9801.864 |
| 4 | EQ +X | -3.8E-06 | -5059.54 | -7.9436 | 181716.6 | 129.3046 | -95783 |
| 4 | EQ +Y | 0 | -13.6004 | -5018.8 | -150107 | 95256.02 | -221.376 |
| 4 | RSA- X | 6.5588 | 3770.151 | 862.333 | 133788.3 | 14826.85 | 66539.24 |
| 4 | RSA-Y | 32.0412 | 710.8897 | 3473.345 | 119228 | 62604.6 | 11881.72 |
| 3 | EQ +X | -3.7E-06 | -5169.99 | -8.4638 | 185622.4 | 155.119 | -111552 |
| 3 | EQ +Y | 0 | -14.4954 | -5123.06 | -153244 | 110881.3 | -265.587 |
| 3 | RSA- X | 8.1042 | 3990.759 | 911.7174 | 141260.7 | 17516.14 | 76027.04 |
| 3 | RSA-Y | 34.6109 | 755.3117 | 3759.123 | 128548.3 | 70603.11 | 14082.67 |
| 2 | EQ +X | -3.7E-06 | -5235.78 | -8.8815 | 187924.7 | 182.2076 | -127521 |
| 2 | EQ +Y | 0 | -15.2009 | -5182.87 | -155055 | 126689.1 | -311.949 |
| 2 | RSA- X | 9.0413 | 4293.968 | 951.5519 | 150948.9 | 20316.82 | 86090.27 |
| 2 | RSA-Y | 36.4895 | 792.9734 | 4118.216 | 139911.3 | 79294 | 16388.12 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | EQ +X | 8.83E-07 | -5291.55 | -9.3283 | 189890.5 | 216.3492 | -146888 |
| 1 | EQ +Y | 6.15E-07 | -16.0337 | -5229.86 | -156411 | 145830.4 | -370.633 |
| 1 | RSA- X | 9.2643 | 4875.678 | 994.5296 | 170710.3 | 23814.73 | 99306.38 |
| 1 | RSA-Y | 36.5634 | 839.0918 | 4728.715 | 158151.1 | 91088.18 | 19305.85 |
| STILT | EQ +X | -7.5E-06 | -5312.24 | -9.5549 | 190588.1 | 251.3198 | -166331 |
| STILT | EQ +Y | 0 | -16.4574 | -5245.46 | -156883 | 165028.8 | -430.867 |
| STILT | RSA- X | 15.0778 | 5184.492 | 1012.449 | 181172.1 | 27411.12 | 114094.5 |
| STILT | RSA-Y | 35.8353 | 858.267 | 5028.728 | 167374.5 | 104697.3 | 22313.33 |
| BASE1 | EQ +X | -7.8E-06 | -5315.95 | -9.5895 | 190712 | 280.0882 | -182278 |
| BASE1 | EQ +Y | 0 | -16.5266 | -5248.12 | -156968 | 180773.1 | -480.447 |
| BASE1 | RSA- X | 16.9781 | 5216.092 | 1014.2 | 182117.4 | 30381.51 | 127089 |
| BASE1 | RSA-Y | 35.6979 | 860.242 | 5057.502 | 168203.5 | 116877.6 | 24812.72 |

# ETABS Shear Wall Design (C1)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P28 | 18326.2 | 49129.4 | 900 | 300 | Special Wall | 0.6 |

### Material Properties

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

### Design Code Parameters

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 18326.2 | 48679.4 | 18326.2 | 49579.4 | 900 | 300 |
| Bottom | Leg 1 | 18326.2 | 48679.4 | 18326.2 | 49579.4 | 900 | 300 |

### Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 4184 | 0.0155 | 0.0233 | 101 1.5 DL+1.5 LL | 4987.6921 | -99.7538 | -106.0999 | 269999 |
| Bottom | 5522 | 0.0205 | 0.0233 | 129 1.5 DL+1.5 WL +Y | 4949.9492 | 98.999 | 387.8177 | 269999 |

### 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 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3759.5757 | -125.3466 | 125.0427 | 196.9786 | 391.8482 |
| Bottom | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3789.9417 | 248.557 | 125.0427 | 204.9156 | 399.7852 |

### 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 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 4685.6859 | -11.252 | 17.63 | 8 |
| Top–Right | Leg 1 | 300 | 120 0.45 SL X+1.5 SL Y+0 9 DL | 2764.7621 | 0.8572 | 10.26 | 8 |
| Bottom–Left | Leg 1 | 300 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 4613.7849 | -17.4535 | 17.52 | 8 |
| Botttom–Right | Leg 1 | 450 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 4716.0519 | 244.5977 | 23.51 | 8 |

# ETABS Concrete Frame Design (C2)

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

### Column Element Details

| Level | Element | Unique Name | Section ID | Combo ID | Station Loc | Length (mm) | LLRF | Type |
|---|---|---|---|---|---|---|---|---|
| BASE1 | C15 | 3184 | 600*900 | 101 1.5 DL+1.5 LL | 2400 | 3000 | 0.6 | Ductile Frame |

### Section Properties

| b (mm) | h (mm) | dc (mm) | Cover (Torsion) (mm) |
|---|---|---|---|
| 600 | 900 | 60 | 30 |

### Material Properties

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

### Design Code Parameters

| ɣc | ɣs |
|---|---|
| 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 mm² | Rebar % % |
|---|---|---|---|---|---|---|
| 9098.1799 | -225.6349 | -10.0199 | 225.6349 | 316.6167 | 4320 | 0.8 |

### Axial Force and Biaxial Moment Factors

| | K Factor Unitless | Length mm | Initial Moment kN-m | Additional Moment kN-m | Minimum Moment kN-m |
|---|---|---|---|---|---|
| Major Bend(M3) | 0.691213 | 2400 | 33.953 | 0 | 316.6167 |
| Minor Bend(M2) | 0.686663 | 2400 | -6.8749 | 0 | 225.6349 |

### 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, $V_{u2}$ | 30.5368 | 357.4804 | 201.6005 | 32.6272 | 665.06 |
| Minor, $V_{u3}$ | 4.609 | 350.7306 | 194.4007 | 47.5895 | 997.59 |

### 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 |
|---|---|---|---|---|---|
| 5400 | 43.2 | 11340 | 4531.696 | 9098.1799 | 0.329277 |

### 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 | 0.8 | 900 | 1.843 | 12 | No | 0 |
| Minor Bending ($M_2$ ) | Yes | 0.8 | 600 | 2.747 | 12 | No | 0 |

# ETABS Shear Wall Design (C3)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| 1 | P119 | 35403 | 16154.4 | 1000 | 230 | Special Wall | 0.6 |

### Material Properties

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 34903 | 16154.4 | 35903 | 16154.4 | 1000 | 230 |
| Bottom | Leg 1 | 34903 | 16154.4 | 35903 | 16154.4 | 1000 | 230 |

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

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Top | 1327 | 0.0058 | 0.0301 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 2384.8613 | 81.9971 |
| Bottom | 2673 | 0.0116 | 0.0301 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 2416.4195 | 82.9161 |

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

| $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|
| -312.0012 | 230000 |
| 445.1182 | 230000 |

**Shear Design**

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 575 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 1938.4036 | 73.9983 | 210.0322 | 110.3947 | 276.3948 |
| Bottom | Leg 1 | 575 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 1969.9618 | 458.0811 | 210.0322 | 148.8135 | 314.8136 |

**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 | 345 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 2384.8613 | -312.0012 | 18.51 | 8 |
| Top–Right | Leg 1 | 230 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 2384.8613 | 78.4878 | 12.42 | 8 |
| Bottom–Left | Leg 1 | 230 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 2416.4195 | -205.2708 | 15.86 | 8 |
| Botttom–Right | Leg 1 | 345 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 2416.4195 | 445.1182 | 22.12 | 8 |

# ETABS Shear Wall Design (C4)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P137 | 49504.6 | 2828.9 | 1200 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 49504.7 | 2228.9 | 49504.5 | 3428.9 | 1200 | 300 |
| Bottom | Leg 1 | 49504.7 | 2228.9 | 49504.5 | 3428.9 | 1200 | 300 |

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

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Top | 3637 | 0.0101 | 0.0227 | 129 1.5 DL+1.5 WL +Y | 5842.0466 | -127.7052 |
| Bottom | 3840 | 0.0107 | 0.0227 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4840.3253 | 133.5553 |

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

| $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|
| 324.9546 | 360000 |
| -751.6003 | 360000 |

**Shear Design**

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3480.0645 | 507.5341 | -336.6924 | 221.1085 | 480.9346 |
| Bottom | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3529.4599 | -328.7056 | -336.6924 | 225.5107 | 485.3368 |

**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 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Top–Right | Leg 1 | 450 | 113 -0.45 SL X+1.5 SL Y+1.5 DL | 5167.7732 | 322.419 | 18.83 | 8 |
| Bottom–Left | Leg 1 | 450 | 113 -0.45 SL X+1.5 SL Y+1.5 DL | 5217.1686 | -2.1246 | 14.52 | 8 |
| Botttom–Right | Leg 1 | 300 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 5130.2919 | 9.6309 | 14.38 | 8 |

# ETABS Shear Wall Design (C5)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P20 | 9791.8 | 45151.6 | 1200 | 230 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 9791.8 | 44551.6 | 9791.8 | 45751.6 | 1200 | 230 |
| Bottom | Leg 1 | 9791.8 | 44551.6 | 9791.8 | 45751.6 | 1200 | 230 |

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

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Top | 6469 | 0.0234 | 0.0296 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4638.4979 | 147.0165 |

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Bottom | 7068 | 0.0256 | 0.0296 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4676.3677 | 148.1193 |

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

| $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|
| -219.4939 | 276000 |
| 317.1764 | 276000 |

**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 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4109.3835 | -69.3399 | 115.3048 | 209.4694 | 408.6696 |
| Bottom | Leg 1 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4147.2533 | 317.1764 | 115.3048 | 209.4694 | 408.6696 |

**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 | 345 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4638.4979 | -69.3399 | 18.06 | 8 |
| Top–Right | Leg 1 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Bottom–Left | Leg 1 | 345 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 4338.6549 | -2.9404 | 15.77 | 8 |
| Botttom–Right | Leg 1 | 460 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4676.3677 | 317.1764 | 22.69 | 8 |

# ETABS Shear Wall Design (C6)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P12 | 6362.8 | 59956 | 1500 | 230 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 6362.8 | 59206 | 6362.8 | 60706 | 1500 | 230 |
| Bottom | Leg 1 | 6362.8 | 59206 | 6362.8 | 60706 | 1500 | 230 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 8160 | 0.0237 | 0.0291 | 101 1.5 DL+1.5 LL | 6021.1774 | -171.5236 | 345.1335 | 345000 |
| Bottom | 8335 | 0.0242 | 0.0291 | 101 1.5 DL+1.5 LL | 6068.5146 | 172.9021 | -347.8469 | 345000 |

**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 | 575 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4808.49 | 220.4798 | -129.6612 | 261.8362 | 510.8359 |
| Bottom | Leg 1 | 575 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4855.8272 | 223.2449 | -129.6612 | 261.8362 | 510.8359 |

**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 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Top–Right | Leg 1 | 460 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 5447.4694 | 235.403 | 18.52 | 8 |
| Bottom–Left | Leg 1 | 575 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 5436.5985 | -379.3526 | 20.16 | 8 |
| Botttom–Right | Leg 1 | 460 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 5494.8066 | 232.2937 | 18.62 | 8 |

# ETABS Shear Wall Design (C7)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P14 | 5762.8 | 69773.8 | 1200 | 230 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 5162.8 | 69773.8 | 6362.8 | 69773.8 | 1200 | 230 |
| Bottom | Leg 1 | 5162.8 | 69773.8 | 6362.8 | 69773.8 | 1200 | 230 |

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

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Top | 4525 | 0.0164 | 0.0296 | 110 1.5 SL X+0.45 SL Y+1.5 DL | 4408.3057 | -116.9028 |
| Bottom | 5130 | 0.0186 | 0.0296 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4378.143 | 116.819 |

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

| $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|
| 208.601 | 276000 |
| -365.4259 | 276000 |

**Shear Design**

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3502.4795 | 119.0502 | -124.2487 | 206.1191 | 405.3191 |
| Bottom | Leg 1 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3540.3493 | 102.2007 | -124.2487 | 209.4692 | 408.6692 |

**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 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Top–Right | Leg 1 | 345 | 110 1.5 SL X+0.45 SL Y+1.5 DL | 4408.3057 | 79.0475 | 17.4 | 8 |
| Bottom–Left | Leg 1 | 460 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4378.143 | -365.4259 | 22.48 | 8 |
| Botttom–Right | Leg 1 | 460 | 111 1.5 SL X+-0.45 SL Y+1.5 DL | 4385.1751 | 172.8983 | 19.02 | 8 |

# ETABS Shear Wall Design (C8)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P15 | 11582.5 | 69273.8 | 1000 | 300 | Special Wall | 0.6 |

### Material Properties

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

### Design Code Parameters

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 11582.5 | 68773.8 | 11582.5 | 69773.8 | 1000 | 300 |
| Bottom | Leg 1 | 11582.5 | 68773.8 | 11582.5 | 69773.8 | 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 | 5003 | 0.0167 | 0.023 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5278.2917 | 143.2551 |
| Bottom | 5133 | 0.0171 | 0.023 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5319.4549 | 144.1741 |

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

| $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|
| 214.5819 | 300002 |
| -216.2553 | 300002 |

### 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 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5020.9499 | 126.5655 | -66.1558 | 225.6645 | 442.1884 |
| Bottom | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5062.1132 | -46.8511 | -66.1558 | 227.6863 | 444.2102 |

### 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 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Top–Right | Leg 1 | 300 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5278.2917 | 126.5655 | 20.13 | 8 |
| Bottom–Left | Leg 1 | 300 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5319.4549 | -46.8511 | 18.67 | 8 |
| Botttom–Right | Leg 1 | 300 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 5165.4281 | 37.8076 | 17.97 | 8 |

# ETABS Shear Wall Design (C9)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P121 | 36440 | 24722.2 | 1000 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 36440 | 24222.2 | 36440 | 25222.2 | 1000 | 300 |
| Bottom | Leg 1 | 36440 | 24222.2 | 36440 | 25222.2 | 1000 | 300 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 4960 | 0.0165 | 0.023 | 101 1.5 DL+1.5 LL | 5704.7096 | -114.0942 | 6.7442 | 300000 |
| Bottom | 5017 | 0.0167 | 0.023 | 101 1.5 DL+1.5 LL | 5738.4497 | 114.769 | 42.5605 | 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 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4889.8021 | 113.3846 | 34.9555 | 224.8307 | 441.3525 |
| Bottom | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4923.5421 | 216.6128 | 34.9555 | 225.9318 | 442.4535 |

**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 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5211.0584 | -53.2842 | 18.44 | 8 |
| Top–Right | Leg 1 | 300 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5211.0584 | 77.7198 | 18.92 | 8 |
| Bottom–Left | Leg 1 | 300 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5244.7985 | -55.906 | 18.6 | 8 |
| Botttom–Right | Leg 1 | 450 | 113 -0.45 SL X+1.5 SL Y+1.5 DL | 5178.089 | 234.3983 | 21.95 | 8 |

# ETABS Shear Wall Design (C9)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P121 | 36440 | 24722.2 | 1000 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 36440 | 24222.2 | 36440 | 25222.2 | 1000 | 300 |
| Bottom | Leg 1 | 36440 | 24222.2 | 36440 | 25222.2 | 1000 | 300 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 4960 | 0.0165 | 0.023 | 101 1.5 DL+1.5 LL | 5704.7096 | -114.0942 | 6.7442 | 300000 |
| Bottom | 5017 | 0.0167 | 0.023 | 101 1.5 DL+1.5 LL | 5738.4497 | 114.769 | 42.5605 | 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 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4889.8021 | 113.3846 | 34.9555 | 224.8307 | 441.3525 |
| Bottom | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4923.5421 | 216.6128 | 34.9555 | 225.9318 | 442.4535 |

**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 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5211.0584 | -53.2842 | 18.44 | 8 |
| Top–Right | Leg 1 | 300 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5211.0584 | 77.7198 | 18.92 | 8 |
| Bottom–Left | Leg 1 | 300 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 5244.7985 | -55.906 | 18.6 | 8 |
| Botttom–Right | Leg 1 | 450 | 113 -0.45 SL X+1.5 SL Y+1.5 DL | 5178.089 | 234.3983 | 21.95 | 8 |

# ETABS Shear Wall Design (C10)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P35 | 29807 | 69273.8 | 1000 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 29807 | 68773.8 | 29807 | 69773.8 | 1000 | 300 |
| Bottom | Leg 1 | 29807 | 68773.8 | 29807 | 69773.8 | 1000 | 300 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 7285 | 0.0243 | 0.023 | 101 1.5 DL+1.5 LL | 6187.7658 | 140.2543 | 251.5533 | 300000 |
| Bottom | 7409 | 0.0247 | 0.023 | 101 1.5 DL+1.5 LL | 6228.9286 | -141.1733 | -253.2267 | 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 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 5209.4416 | 108.6721 | -56.4848 | 227.684 | 444.2057 |
| Bottom | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 5250.6044 | 37.7026 | -56.4848 | 227.684 | 444.2057 |

**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 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |

| Station Location | ID | Edge Length (mm) | Governing Combo | $P_u$ kN | $M_u$ kN-m | Stress Comp MPa | Stress Limit MPa |
|---|---|---|---|---|---|---|---|
| Top–Right | Leg 1 | 450 | 113 -0.45 SL X+1.5 SL Y+1.5 DL | 5582.5392 | 124.7983 | 21.1 | 8 |
| Bottom–Left | Leg 1 | 450 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 5486.924 | -10.2843 | 18.5 | 8 |
| Botttom–Right | Leg 1 | 450 | 113 -0.45 SL X+1.5 SL Y+1.5 DL | 5623.702 | 59.2649 | 19.93 | 8 |

# ETABS Shear Wall Design (C11)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P132 | 42062.5 | 24722.2 | 1000 | 300 | Special Wall | 0.6 |

### Material Properties

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

### Design Code Parameters

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 42062.5 | 24222.2 | 42062.5 | 25222.2 | 1000 | 300 |
| Bottom | Leg 1 | 42062.5 | 24222.2 | 42062.5 | 25222.2 | 1000 | 300 |

### Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 10616 | 0.0354 | 0.023 | 101 1.5 DL+1.5 LL | 7368.204 | -147.3641 | -58.7748 | 300000 |
| Bottom | 10556 | 0.0352 | 0.023 | 101 1.5 DL+1.5 LL | 7401.9441 | 148.0389 | 104.3992 | 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 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6527.7332 | -9.0395 | 94.2864 | 227.684 | 444.2057 |
| Bottom | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6561.4732 | 273.1535 | 94.2864 | 227.684 | 444.2057 |

### 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 | 450 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6675.6629 | -9.0395 | 22.43 | 8 |
| Top–Right | Leg 1 | 450 | 113 -0.45 SL X+1.5 SL Y+1.5 DL | 6566.2599 | 73.7458 | 23.36 | 8 |
| Bottom–Left | Leg 1 | 450 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 6558.5571 | -91.7796 | 23.7 | 8 |
| Botttom–Right | Leg 1 | 450 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6709.4029 | 273.1535 | 27.83 | 8 |

# ETABS Shear Wall Design (C12)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P2 | 600.1 | 64287.4 | 1200 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 0.1 | 64287.4 | 1200.1 | 64287.4 | 1200 | 300 |
| Bottom | Leg 1 | 0.1 | 64287.4 | 1200.1 | 64287.4 | 1200 | 300 |

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

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Top | 900 | 0.0025 | 0.0227 | 131 0.9 DL+1.5 WL +Y | 2275.7979 | -45.516 |
| Bottom | 1737 | 0.0048 | 0.0227 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4659.6985 | 93.194 |

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

| $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|
| 82.2612 | 360000 |
| -657.4035 | 360000 |

**Shear Design**

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4044.094 | 400.0504 | -206.0064 | 129.6 | 389.4261 |
| Bottom | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4084.5821 | 178.3107 | -206.0064 | 161.1359 | 420.9619 |

**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 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4619.2104 | -41.3834 | 13.41 | 8 |
| Top–Right | Leg 1 | 450 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4619.2104 | 400.0504 | 18.39 | 8 |
| Bottom–Left | Leg 1 | 450 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4659.6985 | -657.4035 | 22.07 | 8 |
| Botttom–Right | Leg 1 | 300 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4659.6985 | 178.3107 | 15.42 | 8 |

# ETABS Shear Wall Design (C13)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P13 | 5762.8 | 64287.4 | 1200 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 5162.8 | 64287.4 | 6362.8 | 64287.4 | 1200 | 300 |
| Bottom | Leg 1 | 5162.8 | 64287.4 | 6362.8 | 64287.4 | 1200 | 300 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 4690 | 0.013 | 0.0227 | 101 1.5 DL+1.5 LL | 6106.4673 | 146.6012 | 288.958 | 360000 |
| Bottom | 4854 | 0.0135 | 0.0227 | 101 1.5 DL+1.5 LL | 6155.8627 | -147.704 | -291.2954 | 360000 |

**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 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4415.8153 | 123.7017 | -131.752 | 243.8649 | 503.691 |
| Bottom | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 4465.2107 | 145.2501 | -131.752 | 247.4037 | 507.2298 |

**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 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 5096.3845 | -28.7235 | 14.56 | 8 |
| Top–Right | Leg 1 | 300 | 111 1.5 SL X+-0.45 SL Y+1.5 DL | 5144.674 | 55.0634 | 15.06 | 8 |
| Bottom–Left | Leg 1 | 450 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 5145.7799 | -327.8711 | 18.85 | 8 |
| Botttom–Right | Leg 1 | 300 | 111 1.5 SL X+-0.45 SL Y+1.5 DL | 5194.0694 | 270.9892 | 18.19 | 8 |

# ETABS Shear Wall Design (C14)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| 2 | P50 | 38976.4 | 55079.1 | 1500 | 230 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 38976.4 | 54329.1 | 38976.4 | 55829.1 | 1500 | 230 |
| Bottom | Leg 1 | 38976.4 | 54329.1 | 38976.4 | 55829.1 | 1500 | 230 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 8110 | 0.0235 | 0.0291 | 101 1.5 DL+1.5 LL | 6262.7271 | 156.3039 | -351.339 | 345000 |
| Bottom | 8242 | 0.0239 | 0.0291 | 101 1.5 DL+1.5 LL | 6302.1748 | -157.1016 | 353.552 | 345000 |

**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 | 575 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 5223.7285 | -36.0884 | 167.6642 | 261.8366 | 510.8366 |
| Bottom | Leg 1 | 575 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 5263.1762 | 475.2873 | 167.6642 | 261.8366 | 510.8366 |

**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 | 575 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 5647.7645 | -235.2018 | 19.1 | 8 |
| Top–Right | Leg 1 | 345 | 122 1.5 RSA X+0.45 RSA Y+0.9 DL | 3371.0979 | 6.2219 | 9.84 | 8 |
| Bottom–Left | Leg 1 | 460 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 5687.2122 | -100.6932 | 17.65 | 8 |
| Botttom–Right | Leg 1 | 575 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 5687.2122 | 395.9198 | 21.08 | 8 |

# ETABS Shear Wall Design (C15)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P50 | 38976.4 | 55079.1 | 1500 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 38976.4 | 54329.1 | 38976.4 | 55829.1 | 1500 | 300 |
| Bottom | Leg 1 | 38976.4 | 54329.1 | 38976.4 | 55829.1 | 1500 | 300 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|---|---|---|---|---|---|---|
| Top | 5539 | 0.0123 | 0.0223 | 101 1.5 DL+1.5 LL | 7484.2677 | 182.7114 | 428.9982 | 450000 |
| Bottom | 5730 | 0.0127 | 0.0223 | 101 1.5 DL+1.5 LL | 7546.012 | -184.0899 | -432.5374 | 450000 |

**Shear Design**

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 6182.5978 | 265.4847 | -112.0307 | 297.8413 | 622.6239 |
| Bottom | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 6244.3421 | 356.4269 | -112.0307 | 301.9573 | 626.7399 |

**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 | 450 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 6590.9179 | -45.2441 | 15.05 | 8 |
| Top–Right | Leg 1 | 450 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 6590.9179 | 265.4847 | 17.01 | 8 |
| Bottom–Left | Leg 1 | 450 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 6652.6622 | -426.2495 | 18.57 | 8 |
| Botttom–Right | Leg 1 | 450 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 6652.6622 | 356.4269 | 17.95 | 8 |

# ETABS Shear Wall Design (C16)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P38 | 28608.9 | 55029 | 1600.2 | 300 | Special Wall | 0.6 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 11411 | 0.0238 | 0.0223 | 101 1.5 DL+1.5 LL | 10140.1071 | -202.8021 | 76.6441 | 480000 |
| Bottom | 11650 | 0.0243 | 0.0223 | 101 1.5 DL+1.5 LL | 10194.0912 | -203.8818 | 36.4166 | 480000 |

**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 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 8736.1521 | 485.7032 | -89.7947 | 364.2944 | 710.7292 |
| Bottom | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 8790.1361 | 681.0019 | -89.7947 | 364.2944 | 710.7292 |

**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 | 600 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 9048.8669 | -150.9991 | 20.03 | 8 |
| Top–Right | Leg 1 | 600 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 9048.8669 | 287.5005 | 21.1 | 8 |
| Bottom–Left | Leg 1 | 600 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 9102.851 | -306.6417 | 21.36 | 8 |
| Botttom–Right | Leg 1 | 750 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 9009.227 | 681.0019 | 24.09 | 8 |

# ETABS Shear Wall Design (C18)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P69 | 53304.9 | 53695.6 | 2000 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 52304.9 | 53695.6 | 54304.9 | 53695.6 | 2000 | 300 |
| Bottom | Leg 1 | 52304.9 | 53695.6 | 54304.9 | 53695.6 | 2000 | 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 | 9661 | 0.0161 | 0.022 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 10335.9215 | -206.7184 |
| Bottom | 13266 | 0.0221 | 0.022 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 10403.4011 | -208.068 |

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

| $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|
| -1584.5143 | 599995 |
| 2554.8015 | 599995 |

**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 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 7768.249 | 381.0735 | 729.0659 | 444.6851 | 877.7253 |

| 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 |
|---|---|---|---|---|---|---|---|---|
| Bottom | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 7835.7286 | 2554.8015 | 729.0659 | 507.8238 | 940.864 |

**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 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 10335.9215 | -1584.5143 | 25.15 | 8 |
| Top–Right | Leg 1 | 750 | 110 1.5 SL X+0.45 SL Y+1.5 DL | 9405.6322 | 803.0397 | 19.69 | 8 |
| Bottom–Left | Leg 1 | 750 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 10403.4011 | -1175.7897 | 23.22 | 8 |
| Botttom–Right | Leg 1 | 900 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 10403.4011 | 2554.8015 | 30.11 | 8 |

# ETABS Shear Wall Design (C19)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| STILT | P109 | 30707 | 16154.4 | 1800 | 230 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 29807 | 16154.4 | 31607 | 16154.4 | 1800 | 230 |
| Bottom | Leg 1 | 29807 | 16154.4 | 31607 | 16154.4 | 1800 | 230 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|---|---|---|---|---|---|---|
| Top | 10636 | 0.0257 | 0.0288 | 101 1.5 DL+1.5 LL | 7341.8057 | 217.3639 | -494.2506 | 414000 |
| Bottom | 10875 | 0.0263 | 0.0288 | 101 1.5 DL+1.5 LL | 7398.6105 | -219.0181 | 498.0747 | 414000 |

**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 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6026.4044 | 263.1226 | 168.0389 | 314.2041 | 613.0042 |
| Bottom | Leg 1 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6083.2092 | 808.9477 | 168.0389 | 314.2041 | 613.0042 |

**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 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6828.087 | -406.724 | 19.77 | 8 |
| Top–Right | Leg 1 | 575 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6828.087 | 263.1226 | 18.61 | 8 |
| Bottom–Left | Leg 1 | 690 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6884.8918 | -705.0566 | 22.31 | 8 |
| Botttom–Right | Leg 1 | 690 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 6884.8918 | 808.9477 | 23.14 | 8 |

# ETABS Shear Wall Design (C20)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P57 | 44437.4 | 59829.7 | 1752.6 | 300 | Special Wall | 0.6 |

### Material Properties

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

### Design Code Parameters

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 44437.4 | 58953.4 | 44437.4 | 60706 | 1752.6 | 300 |
| Bottom | Leg 1 | 44437.4 | 58953.4 | 44437.4 | 60706 | 1752.6 | 300 |

### Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|---|---|---|---|---|---|---|
| Top | 1314 | 0.0025 | 0.0227 | 131 0.9 DL+1.5 WL +Y | 3052.5231 | 61.0505 | 1407.7396 | 525779 |
| Bottom | 2264 | 0.0043 | 0.0227 | 129 1.5 DL+1.5 WL +Y | 4972.091 | 99.4418 | 1946.7824 | 525779 |

### Shear Design

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4429.3993 | 738.382 | -120.8712 | 189.2806 | 568.7562 |
| Bottom | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 4488.532 | 1019.8203 | -120.8712 | 222.2173 | 601.6928 |

### 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 | 450 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 4797.2381 | -548.6522 | 12.7 | 8 |
| Top–Right | Leg 1 | 450 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 4907.0209 | 848.9985 | 14.86 | 8 |
| Bottom–Left | Leg 1 | 450 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 4940.0778 | -576.3716 | 13.15 | 8 |
| Botttom–Right | Leg 1 | 450 | 112 0.45 SL X+1.5 SL Y+1.5 DL | 4966.1536 | 1108.4513 | 16.66 | 8 |

# ETABS Shear Wall Design (C21)

## IS 456:2000 Pier Design

### Pier Details

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P67 | 53655.2 | 44551.8 | 1300 | 300 | Special Wall | 0.6 |

### Material Properties

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

### Design Code Parameters

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 53005.2 | 44551.8 | 54305.2 | 44551.8 | 1300 | 300 |
| Bottom | Leg 1 | 53005.2 | 44551.8 | 54305.2 | 44551.8 | 1300 | 300 |

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

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Top | 8989 | 0.023 | 0.0226 | 131 0.9 DL+1.5 WL +Y | -2349.8504 | 46.997 |
| Bottom | 10592 | 0.0272 | 0.0226 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | -195.6756 | -44.0324 |

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

| $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|
| -730.23 | 390000 |
| 1866.7812 | 390000 |

**Shear Design**

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 1964.93 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | -239.5377 | -911.9397 | 961.0238 | 223.5758 | 961.0238 |
| Bottom | Leg 1 | 1927.53 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | -195.6756 | 1866.7812 | 961.0238 | 237.6139 | 961.0238 |

**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 | 450 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3366.8183 | -911.9397 | 19.43 | 8 |
| Top--Right | Leg 1 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Bottom--Left | Leg 1 | 300 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 3576.0244 | -16.361 | 9.36 | 8 |
| Botttom--Right | Leg 1 | 450 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 3576.0244 | 1262.3692 | 24.11 | 8 |

# ETABS Shear Wall Design (C22)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P1 | 750.1 | 69773.8 | 1500 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 0.1 | 69773.8 | 1500.1 | 69773.8 | 1500 | 300 |
| Bottom | Leg 1 | 0.1 | 69773.8 | 1500.1 | 69773.8 | 1500 | 300 |

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

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|

| Station Location | Required Rebar Area (mm²) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m |
|---|---|---|---|---|---|---|
| Top | 6237 | 0.0139 | 0.0223 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 1705.8251 | -46.8747 |
| Bottom | 11872 | 0.0264 | 0.0223 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3615.1122 | 72.3022 |

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

| $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|
| 1978.271 | 450000 |
| -2809.3347 | 450000 |

**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 | 2637.15 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 1705.8251 | 1978.271 | -1409.9222 | 267.9215 | 1409.9222 |
| Bottom | Leg 1 | 2467.18 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 1756.4351 | -1015.8991 | -1409.9222 | 341.5259 | 1409.9222 |

**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 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Top–Right | Leg 1 | 450 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3564.5022 | 1978.271 | 25.51 | 8 |
| Bottom–Left | Leg 1 | 600 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 3615.1122 | -2809.3347 | 33.01 | 8 |
| Botttom–Right | Leg 1 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |

# ETABS Shear Wall Design (C23)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P139 | 53555.2 | 0.2 | 1500 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 52805.2 | 0.2 | 54305.2 | 0.2 | 1500 | 300 |
| Bottom | Leg 1 | 52805.2 | 0.2 | 54305.2 | 0.2 | 1500 | 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 | 10382 | 0.0231 | 0.0223 | 131 0.9 DL+1.5 WL +Y | -2897.1506 | 57.943 |
| Bottom | 15936 | 0.0354 | 0.0223 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | -1092.288 | -57.3603 |

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

| $M_{u3}$ kN-m | Pier $A_g$ mm² |
|---|---|
| -864.4324 | 450000 |
| 2853.5657 | 450000 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 28609 | 54228.8 | 28608.8 | 55829.1 | 1600.2 | 300 |
| Bottom | Leg 1 | 28609 | 54228.8 | 28608.8 | 55829.1 | 1600.2 | 300 |

**Flexural Design for $P_u$, $M_{u2}$ and $M_{u3}$**

| Station Location | Required Rebar Area ($mm^2$) | Required Reinf Ratio | Current Reinf Ratio | Flexural Combo | $P_u$ kN | $M_{u2}$ kN-m | $M_{u3}$ kN-m | Pier $A_g$ $mm^2$ |
|---|---|---|---|---|---|---|---|---|
| Top | 10557 | 0.022 | 0.0223 | 101 1.5 DL+1.5 LL | 9241.5544 | 240.1859 | 560.605 | 480073 |
| Bottom | 10768 | 0.0224 | 0.0223 | 101 1.5 DL+1.5 LL | 9307.4249 | -241.6565 | 564.6008 | 480073 |

**Shear Design**

| Station Location | ID | Rebar $mm^2/m$ | Shear Combo | $P_u$ kN | $M_u$ kN-m | $V_u$ kN | $V_c$ kN | $V_c + V_s$ kN |
|---|---|---|---|---|---|---|---|---|
| Top | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 7963.5581 | 289.1563 | -74.54 | 364.349 | 710.8358 |
| Bottom | Leg 1 | 750 | 117 -0.45 RSA X+1.5 RSA Y+1.5 DL | 8029.4285 | 500.9523 | -74.54 | 364.349 | 710.8358 |

**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 | 600 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 8163.5906 | -37.6615 | 17.3 | 8 |
| Top–Right | Leg 1 | 600 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 8163.5906 | 199.6618 | 18.56 | 8 |
| Bottom–Left | Leg 1 | 600 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 8229.4611 | -166.0857 | 18.44 | 8 |
| Botttom–Right | Leg 1 | 600 | 116 0.45 RSA X+1.5 RSA Y+1.5 DL | 8159.3268 | 500.9523 | 20.91 | 8 |

# ETABS Shear Wall Design (C17)

## IS 456:2000 Pier Design

**Pier Details**

| Story ID | Pier ID | Centroid X (mm) | Centroid Y (mm) | Length (mm) | Thickness (mm) | Pier Ductility | LLRF |
|---|---|---|---|---|---|---|---|
| BASE1 | P111 | 28613.4 | 10479.9 | 1600 | 300 | Special Wall | 0.6 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 31622.78 | 40 | 1 | 500 | 500 |

**Design Code Parameters**

| $\Gamma_S$ | $\Gamma_C$ | $IP_{MAX}$ | $IP_{MIN}$ | $P_{MAX}$ | 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 | 28613.4 | 9679.9 | 28613.4 | 11279.9 | 1600 | 300 |
| Bottom | Leg 1 | 28613.4 | 9679.9 | 28613.4 | 11279.9 | 1600 | 300 |

**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 | 2451 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | -1142.8981 | -1042.1087 | 1319.4583 | 258.0666 | 1319.4583 |
| Bottom | Leg 1 | 2345.88 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | -1092.288 | 2853.5657 | 1319.4583 | 303.5908 | 1319.4583 |

**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 | 450 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 4131.0505 | -1088.3096 | 18.85 | 8 |
| Top–Right | Leg 1 | 0 | 101 1.5 DL+1.5 LL | 0 | 0 | 0 | 0 |
| Bottom–Left | Leg 1 | 300 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 4181.6605 | -415.3526 | 12.98 | 8 |
| Botttom–Right | Leg 1 | 600 | 114 1.5 RSA X+0.45 RSA Y+1.5 DL | 4181.6605 | 2102.6959 | 27.98 | 8 |

# ETABS Concrete Frame Design (FB11)

## 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) |
|---|---|---|---|---|---|---|
| 5 | B124 | 3969 | B230X600 | 115 1.5 RSA X+-0.45 RSA Y+1.5 DL | 0 | 6731 |

**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) |
|---|---|---|---|---|---|
| 230 | 600 | 230 | 0 | 60 | 60 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 27386.13 | 30 | 1 | 500 | 500 |

**Design Code Parameters**

| $\gamma_C$ | $\gamma_S$ |
|---|---|
| 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 |
|---|---|---|---|
| -191.3446 | 8.4226 | 131.1048 | 1768.7057 |

**Design Moments, $M_{u3}$ & $M_t$**

| Factored Moment kN-m | Factored $M_t$ kN-m | Positive Moment kN-m | Negative Moment kN-m |
|---|---|---|---|
| -191.3446 | 17.8792 | 0 | -209.2238 |

**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) | -209.2238 | | 1038 | 0 | 1038 | 327 |
| Bottom (-2 Axis) | | 0 | 519 | 0 | 229 | 519 |

**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 |
|---|---|---|---|---|
| 183.5459 | 0 | 242.1379 | 64.7086 | 1242.56 |

**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 |
|---|---|---|---|---|
| 8.4226 | 131.1048 | 130 | 500 | 649.71 |

# ETABS Concrete Frame Design (FB16)

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

**Beam Element Details**

| Level | Element | Unique Name | Section ID | Combo ID | Station Loc | Length (mm) | LLRF | Type |
|---|---|---|---|---|---|---|---|---|
| 1 | B375 | 5398 | B300*600 | 101 1.5 DL+1.5 LL | 8996.3 | 9296.3 | 1 | Ductile Frame |

**Section Properties**

| b (mm) | h (mm) | $b_f$ (mm) | $d_s$ (mm) | $d_{ct}$ (mm) | $d_{cb}$ (mm) |
|---|---|---|---|---|---|
| 300 | 600 | 300 | 0 | 60 | 60 |

**Material Properties**

| $E_c$ (MPa) | $f_{ck}$ (MPa) | Lt.Wt Factor (Unitless) | $f_y$ (MPa) | $f_{ys}$ (MPa) |
|---|---|---|---|---|
| 27386.13 | 30 | 1 | 500 | 500 |

**Design Code Parameters**

| ɣc | ɣs |
|---|---|
| 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 |
|---|---|---|---|
| -451.9534 | 8.0767 | 336.49 | 1153.5037 |

**Design Moments, $M_{u3}$ & $M_t$**

| Factored Moment kN-m | Factored $M_t$ kN-m | Positive Moment kN-m | Negative Moment kN-m |
|---|---|---|---|
| -451.9534 | 14.2529 | 0 | -466.2063 |

**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) | -466.2063 | | 2400 | 0 | 2400 | 600 |
| Bottom (-2 Axis) | | 0 | 1200 | 0 | 1106 | 1200 |

**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 |
|---|---|---|---|---|
| 336.49 | 183.7803 | 195.7853 | 123.9494 | 1004.7 |

**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 |
|---|---|---|---|---|
| 8.0767 | 336.49 | 200 | 500 | 969.77 |

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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

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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.