Tribhuvan University

Institute of Engineering

Central Campus, Pulchowk

DEPARTMENT OF CIVIL ENGINEERING

Earthquake Resistant Analysis and Design of Multistoried Building
Preliminary Design Report

Submitted By:

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Submitted To:

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Building Configuration

Buildings having irregular configuration suffer much more damage during earthquakes than buildings with regular configuration. So, the provided architectural drawings were altered in order to achieve a regular configuration by avoiding the following irregularities, as stated in IS1893:2002 Tables 4 & 5.

Plan Irregularities

1. Torsion Irregularity
2. Re-entrant Corners
3. Diaphragm Discontinuity
4. Out-of-plane offsets
5. Non-Parallel Systems

Vertical Irregularities

1. Stiffness Irregularity – Soft Storey
2. Stiffness Irregularity – Extreme Soft Storey
3. Mass Irregularity
4. Vertical geometric irregularity
5. In-plane Discontinuity in vertical elements resisting lateral force
6. Discontinuity in capacity- Weak Storey

Gravity Load Assessment for Preliminary Design

The preliminary sizing of structural elements was carried out based on deflection control criteria and approximate loads obtained using the tributary area method.

The gravity loads on the structural elements are taken as per IS 875 Part I (dead loads) and IS 875 Part II (imposed loads).

The unit weights of materials taken for the calculation of dead load of the structure are as follows.

S.N.	**Material Used**	**Unit Weight**	**Type of Member**
1.	Cement Concrete for RCC	25kN/m^3	Beams, Columns, Slabs.
2.	Common Burnt Clay Bricks	20kN/m^3	Infill & Partition Walls
3.	Screed on floor 25mm	20kN/m^3	All flooring spaces
4.	Finishing in step 30 mm	20kN/m^3	All flooring spaces
5.	Floor finishing	1 kN/m^2	Load on Slab

The imposed load on the floors and roof has been taken as follows

S.N.	**Live Loads on Specified Spaces**	**Intensity of Load**	**Member Loaded**
1.	All rooms and kitchens	2.0 kN/m^2	Live loads from building are acted on floor slabs, roof slabs and staircase slab.
2.	Toilet and bath rooms	2 kN/m^2	
3.	Corridors, passages, staircases including tire escapes and store Rooms	3 kN/m^2	

Preliminary Sizing of Slab

The depth of slab is obtained from deflection control criteria.
L/d = 32 for continuous two-way slab
Or, d = L/30 = 4114.8 / 32=128.58mm

Where, L = Longest Shorter span of all slabs=4114.8mm

Adopt d = 125mm and D=150 mm with clear cover of 25mm.

Load Intensity on Slab

Self-weight = 25 * 0.150 = 3.75 kN/m^2
Imposed live load = 2kN/m^2
Floor finish = 0.3 kN/m^2
Total load intensity = 6.05 kN/m^2

Preliminary Sizing of Beam

Length of longest beam = 16'-6" = 5029.2mm

Deflection Control

For deflection control, as per IS456:2000, Clause 23.2.1,

$L/d \leq \alpha\beta\gamma\delta\lambda$

Where,

L = length of beam = 5029.2 mm

d = Effective depth of the beam

α = 26 for continuous beams

β = 1 for spans below 10m

γ = 0.8 (assuming the tensile steel percentage as 1.2%)

δ = 1 for no compression steel

λ = 1 for no flanged beams

Substituting, we get

d = 242 mm

Adopt d=300 mm and D=325 mm with clear cover 25mm. Adopt b=230mm

Flexural loads on beam

The flexural load on the beam is calculated by uniformly distributing the loads from the effective slab area and walls throughout the beam. The beam is analyzed as a simply supported beam.

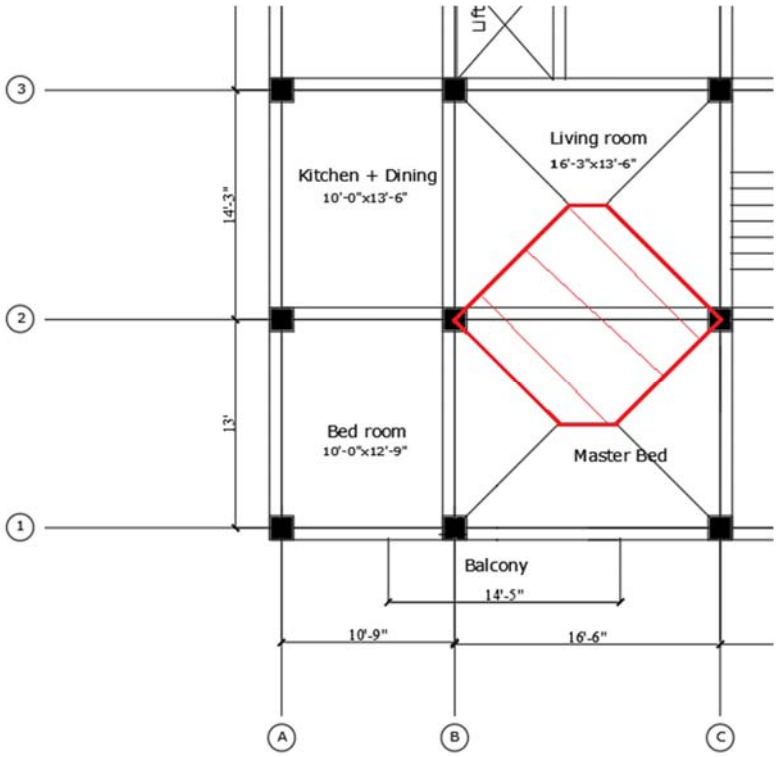
Self-weight of beam = 25×0.325×0.230=1.869 kN/m

Weight of wall, assuming 30% openings=20×0.23×3.2×0.7=10.304kN/m

Loads from Slabs

Effective Loading Area of Slabs on Beam=131.7959 ft^2=12.25 m^2

Distributed load = 12.25×6.05/5.0292 = 14.73 kN/m



Tributary area for beam 2BC

Total Distributed Load = 26.903kN/m

Design Mid-Span Moment= 1.5 $wL^2/8$ = 1.5 × 26.903 × 5.0292^2 /8 = 127.58kNm

Q= 0.36 × fck × ($X_{u,lim}$/d) (1-0.416($X_{u,lim}$/d)) = 3.3478

$$d = \sqrt{\frac{Mu}{Qb}} = \sqrt{\frac{127.58 \times 10^6}{3.3478 \times 230}} = 407mm$$

Adopt b=300mm, D=500mm

Preliminary Sizing of Columns

The column size is first assumed to be 500mm×500mm for dead load calculations.

Column 2B

Slab area = 185.6406 ft^2 = 17.26 m^2

Load of slab = 6.05 × 17.26 = 104.423kN

Load of Walls (Assuming 30% openings)

= 0.7×20×0.23×3.2× (7'1.5" + 8'3" + 6'6" + 5'4.5") = 0.7×20×0.23×3.2 ×8.3058 = 85.58kN

Load of Beam = 25×0.3× (0.5-0.15) ×8.3058 = 21.80kN

Dead Load of Columns = 25×0.500×0.500×3.2=20kN

Dead load of basement column = 25×0.500×0.500×3.05=19.06

Total load = 11×104.42 + 11×21.8 + 10×85.58 +10×20 + 19.06= 2463.28kN

Factored Load = 1.5 × 2463.28 = 3694.92kN

Taking 2% steel, M25 Concrete and Fe500 Steel,

$Pu=0.4fck\ A_c + 0.67\ fy\ A_s$

Or, 3694.92×1000 = 0.4 × 25 × (1-0.02) A + 0.67 × 500 × 0.02A

Or, A=223935mm^2

Taking a square column,

B=D=473.22mm

Column E3

Slab Area=204.3788ft^2=19.00m^2

Load of slab = 6.05 × 19.00 = 114.95kN×11

Load of Walls (Assuming 30% openings)

= 0.7×20×0.23×3.2× (8'3" + 7'10.5" + 5'4.5" + 7'1.5") = 0.7×20×0.23×3.2×8.7249=89.90kN×10

Load of Beam = 25×0.3× (0.5-0.15) ×8.7249 = 22.90kN×11

Dead Load of Columns = 25×0.500×0.500×3.2=20kN×11

Dead load of basement column = 25×0.500×0.500×3.05=19.06kN×1

Load from Staircase cover

Slab = 25×6.05×64.9692ft^2=150.97kN×1

Walls = 20×0.23×3.2× (8'3" + 7'10.5") =72.35kN×1

Beam = 25×0.3× (0.5-0.15) ×4.915 = 12.90kN×1

Total load = 11×114.95 + 10×89.90 + 11×22.90+11×20 +1×19.06 + 150.97 + 72.35+12.90 = 2890.63kN

Factored Load = 1.5 × 4335.945 = 4335.945kN

Taking 2% steel, M25 Concrete and Fe500 Steel,

$Pu=0.4fck\ A_c + 0.67\ fy\ A_s$

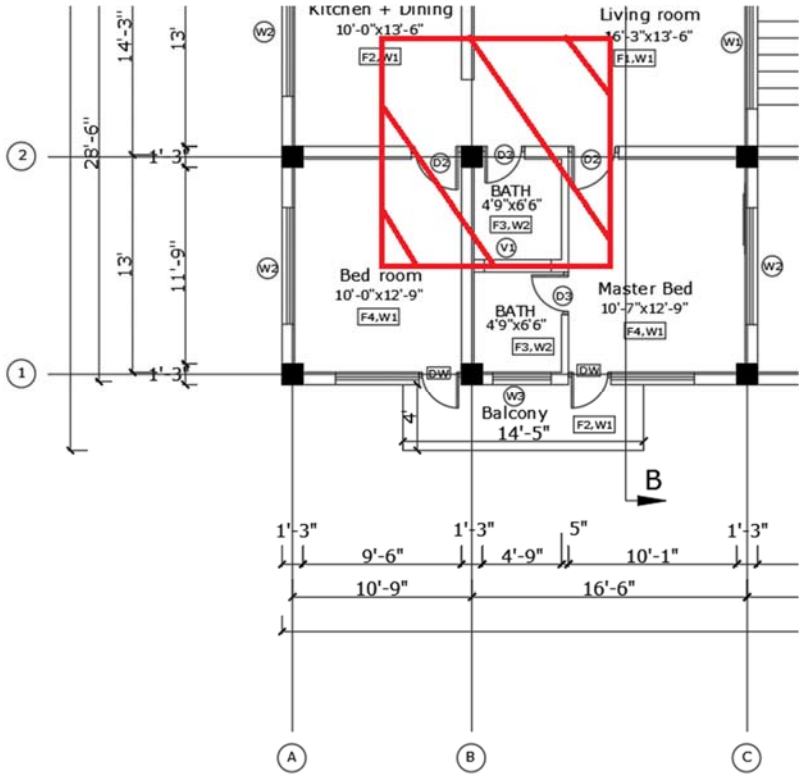
Or, 4335.945×1000 = 0.4 × 25 × (1-0.015) A + 0.67 × 500 × 0.015A

Or, A=262785mm^2

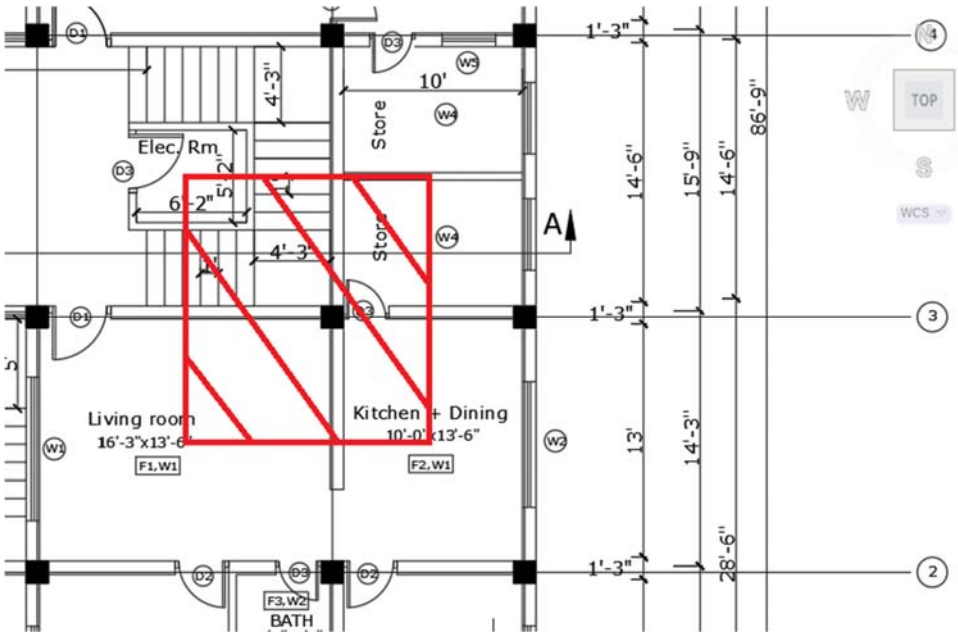
Taking a square column,

B=D=512.63mm^2

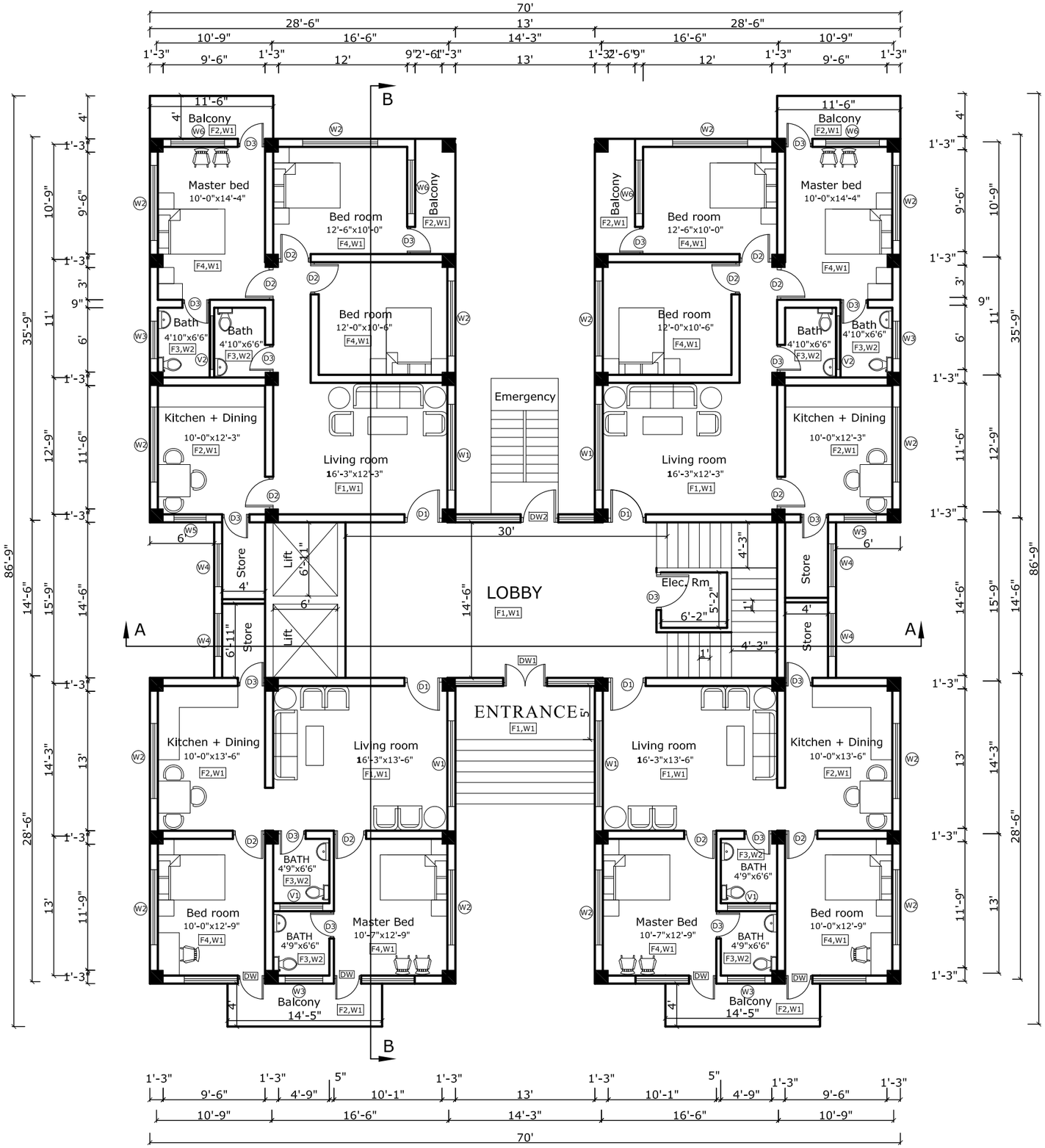
Adopt column size of 560mm×560mm



Tributary Area for Column B2



Tributary Area for Column E3



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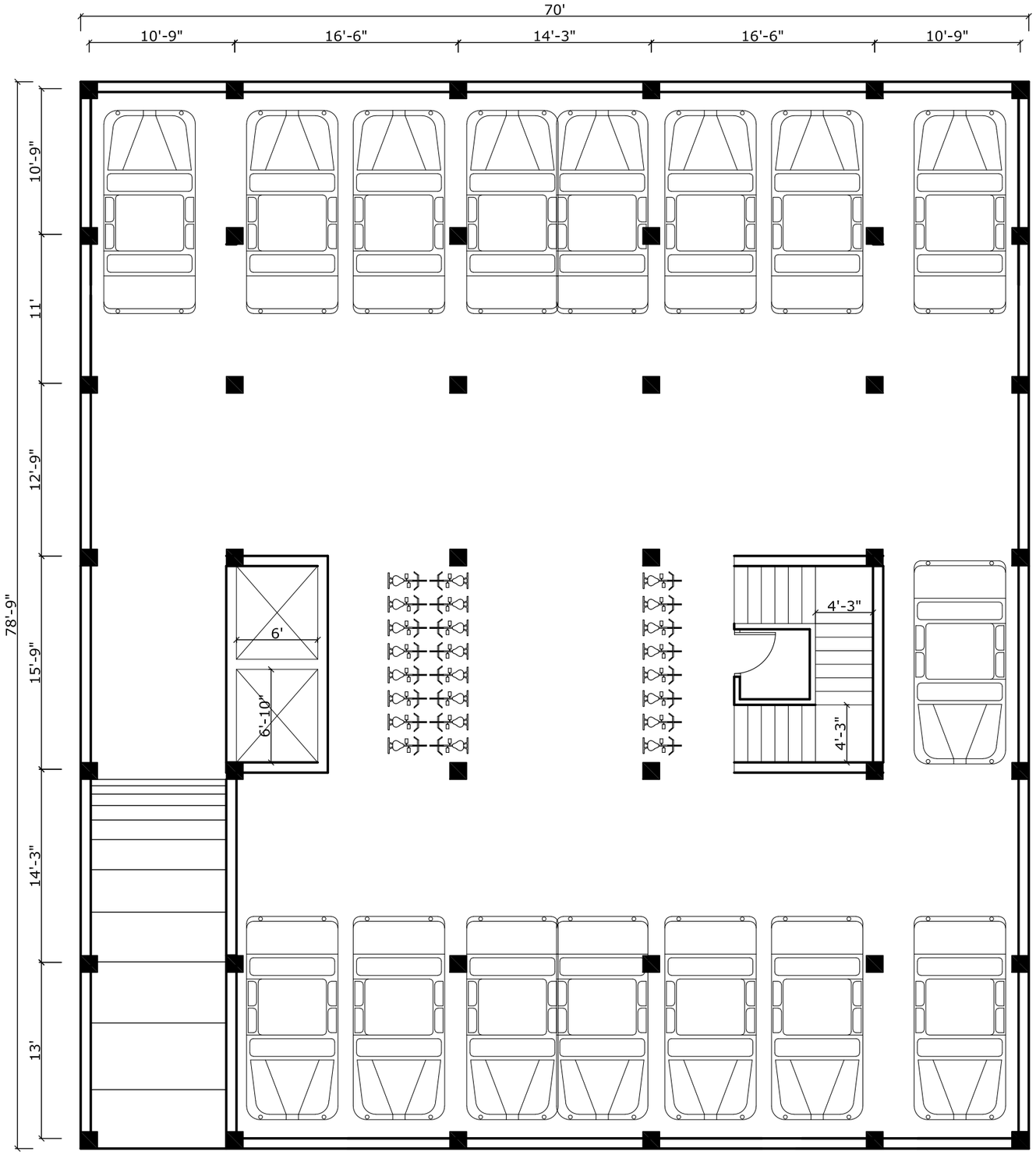

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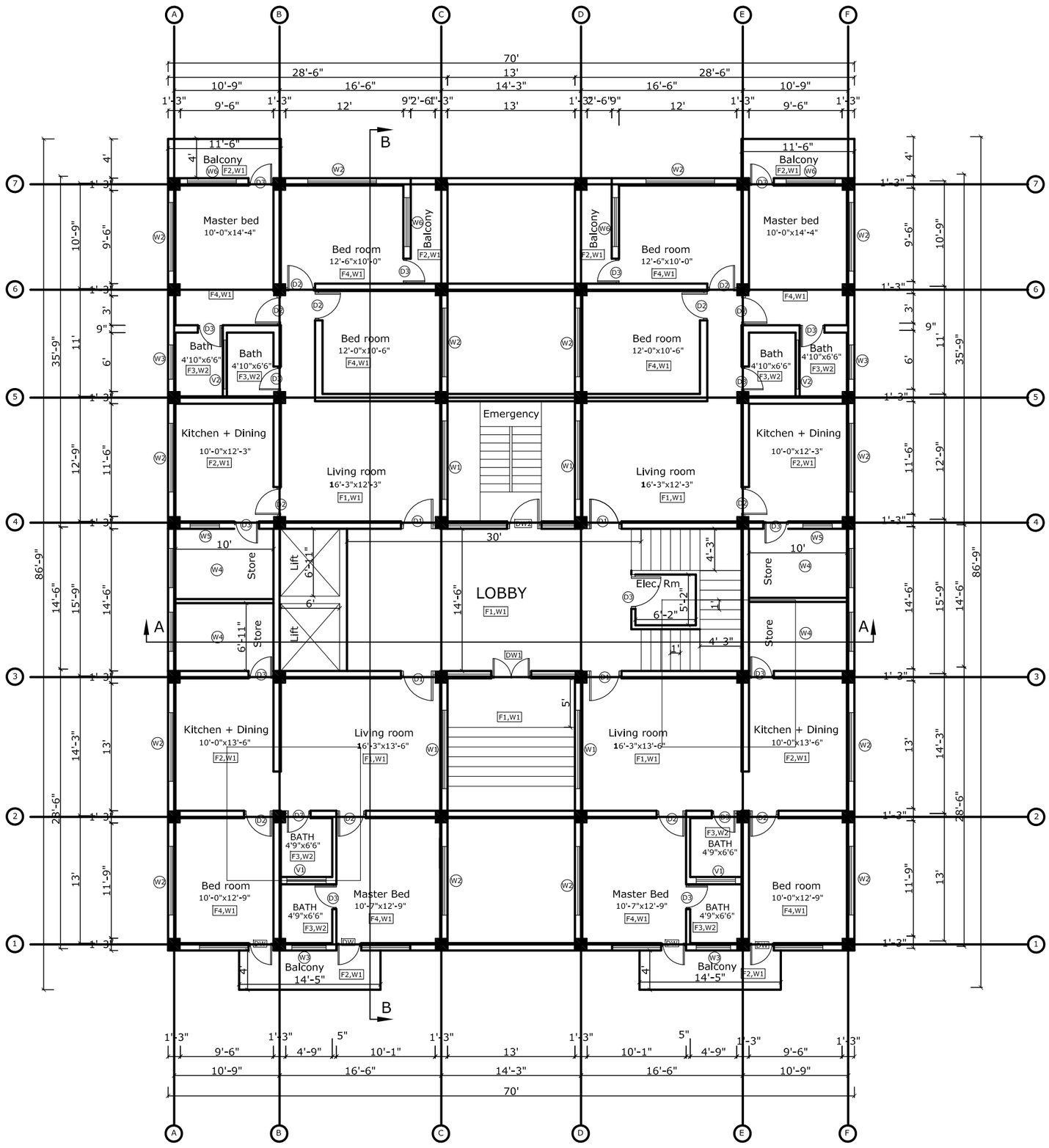

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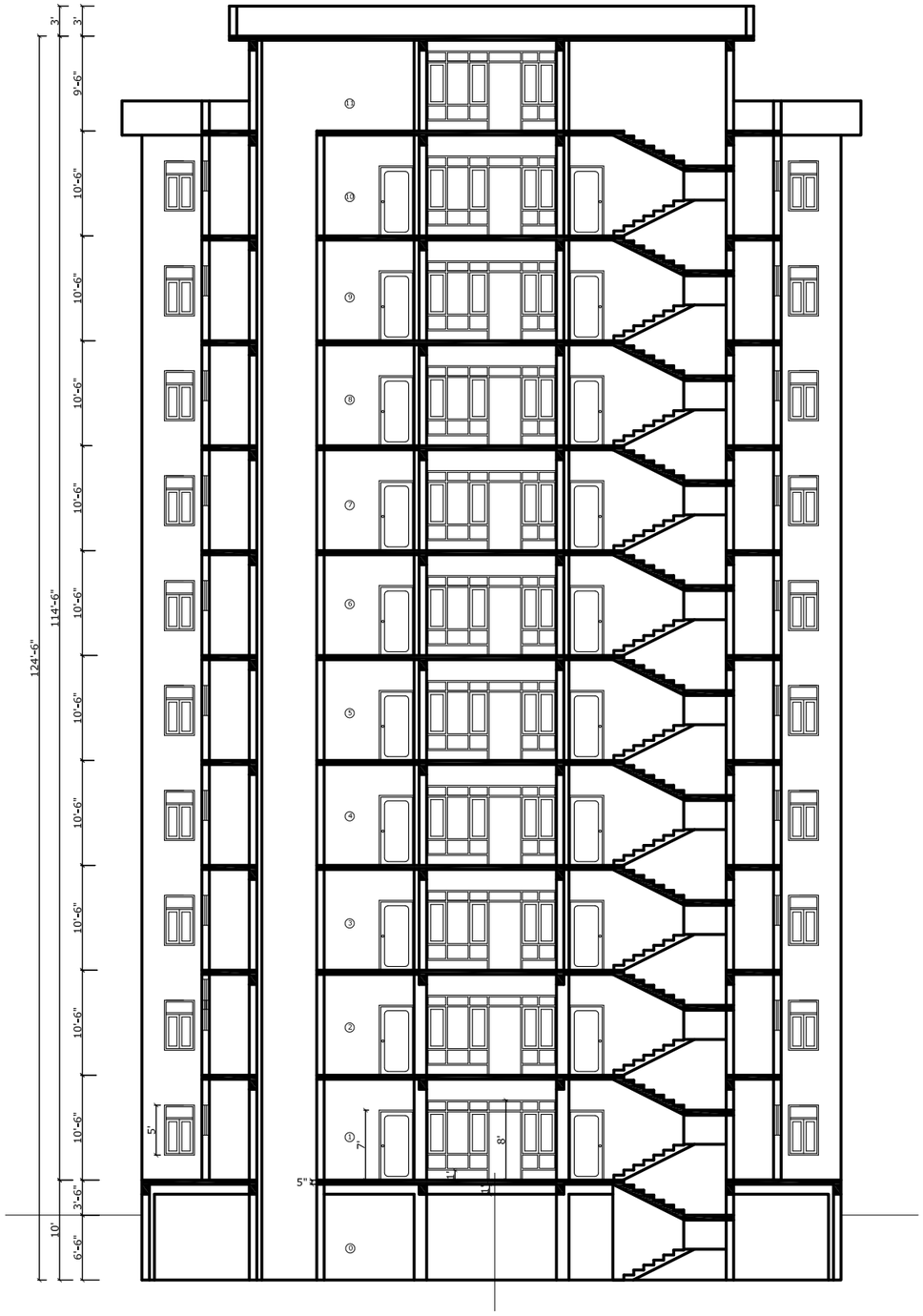
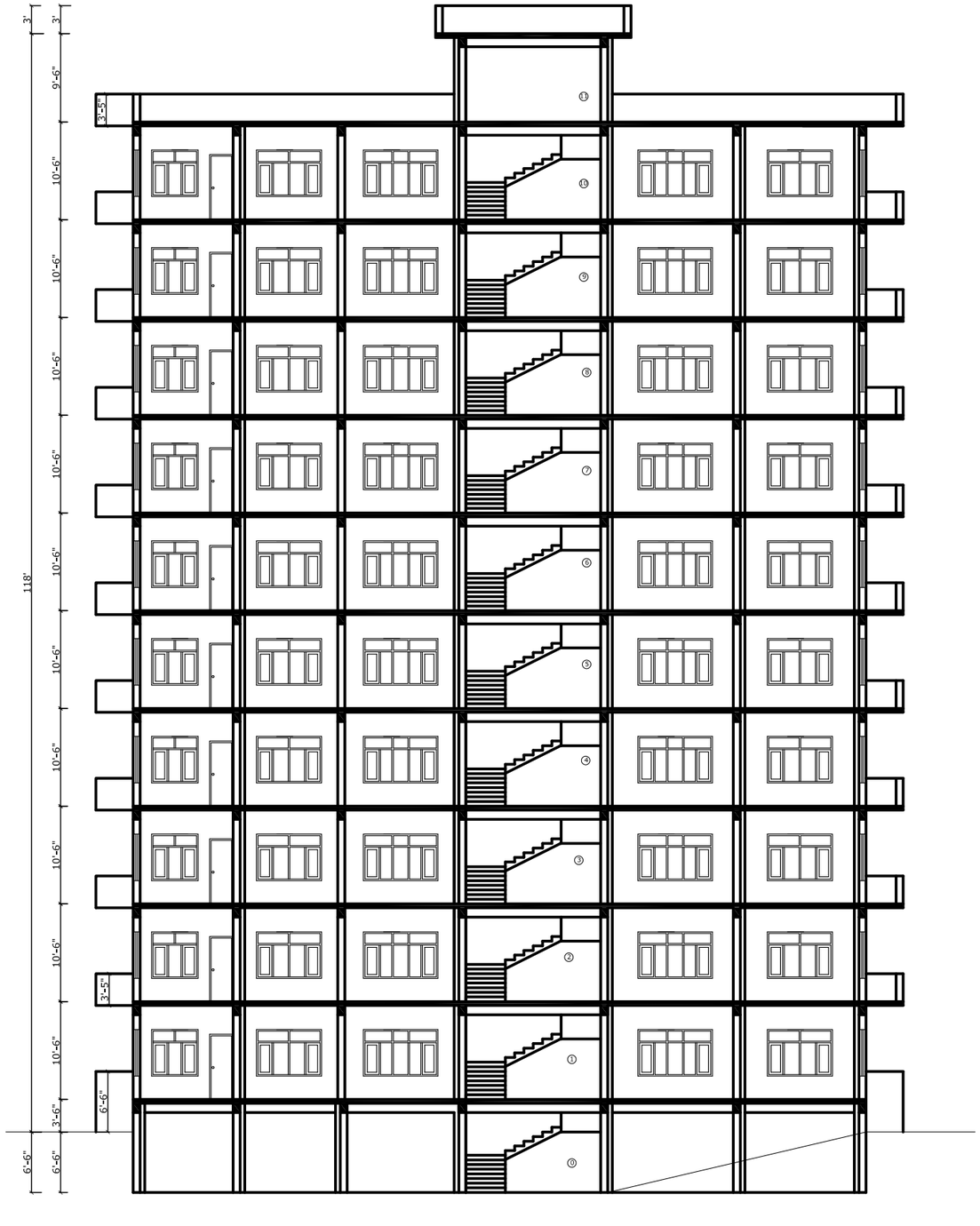


SECTION A-A



SECTION B-B

TRIBHUVAN UNIVERSITY **INSTITUTE OF ENGINEERING** **DEPARTMENT OF CIVIL ENGINEERING** Central Campus, Pulchowk	**Project Title:** EARTHQUAKE RESISTANT ANALYSIS AND DESIGN OF MULTI-STOREYED BUILDING	**Sheet Title:** Vertical Section of Building	**SUBMITTED BY :** Aayush Phuyal (070BCE158) Abhash Acharya (070BCE166) Ajar Lal Shrestha (070BCE169) Alisha Siwakoti (070BCE171) Anupam Bhattarai (070BCE179) Avinab Malla (070BCE180)	**Project Supervisor:** Er. Sujan Tripathi	**Date of Submission:** 2017 April 24 **Scale:** Not to scale **Checked By:**	**Sheet No.:** 4