Structural Design Details

Of

THE PROPOSED CONSTRUCTION OF HIGH-RISE RESIDENTIAL APARTMENT BUILDING AFTER DEMOLISHED THE EXISTING OLD BUILDING
T.S.No.:4/1, 4/2 & 4/3, DOOR NO :14, WARD – L, BLOCK.:17,
NATCHIYAR AMMAN KOVIL STREET, WORAIYUR,
ZONE: V, TRICHY CITY CORPORATION.

Structural Details Design by

TRICHY RG ENGINEERING EXCELLENCE
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(Structural Design Consultants)

Date :

STRUCTURAL DESIGN STABILITY CERTIFICATE

I hereby certify **the proposed construction of high-rise residential apartment building after demolished the existing old building t.s.no.:4/1, 4/2 & 4/3, door no :14, ward – I, block.:17, Natchiyarammankovil street, Woraiyur, zone: v, Trichy city corporation** The building will withstand against the Earthquake, (Seismic Zone II as per IS1893 (Part I) 2002) loading stress parameters are within limits of National Building Code and Bureau of Indian Standards code of practice for concrete and loading. The building consists of **Basement + Stilt Floor + Nine Floors.**

For external and internal partition walls 230/100mm thick AAC block work walls are used.

The R.C.C building frame of the structure is designed as per the Indian standard code of practice for concrete and loading as follows:

1. IS:456-2000 Code of Practice for Plain and Reinforced Concrete
2. IS:875-1987 Code of Practice for Design loads for Buildings and Structures
3. IS:1893-2002 Criteria for Earthquakes resistant design of structures Part -1 General Provisions and Buildings
4. IS4326-1993 Code of Practice for Earthquake resistant design & Construction of Buildings
5. IS:13920-1993 Code of Practice for Ductile detailing of concrete structures subjected to seismic forces and
6. National Building code of India -2005

It is further certified that the above structure will be constructed from foundation to roof, as per structural design and detailing of reinforcements furnished in our drawings. The building will be **SAFE and SOUND** as per the design.

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DESIGN BASIS REPORT

For

The proposed construction of high-rise residential apartment building after demolished the existing old building t.s.no.:4/1, 4/2 & 4/3, door no :14, ward – I, block.:17, natchiyarammankovil street, woraiyur, zone: v, trichy city corporation.

TABLE OF CONTENTS

1.0 OBJECTIVE

The proposed construction of high-rise residential apartment building after demolished the existing old building t.s.no.:4/1, 4/2 & 4/3, door no :14, ward – I, block.:17, natchiyarammankovil street, woraiyur, zone: v, trichy city corporation.The building is designed for basement + stilt + Nine floors. The structure is supported on column in turn resting on column footing Foundation. The Structural System comprises columns, beams, slabs and wall structure.

3-D Analysis of all the building structures will be carried out using STAAD PRO Software package and analysis results shall be used for designing the various elements.

2.0 DESIGN LOADS

2.1 Dead Loads

The Deadloads that are envisaged to act permanently are considered as per **IS:875 (Part 1) – 1987 – Dead loads.** Indian standard **"Code of Practice for Design Loads (other than earthquakes) for Buildings and Structures".**

1. Slab is assumed to be 125mm thick – 3.125 KN/m2 and 200mm thick for PT Slab (5KN/mm2).
2. Floor finish (Super Imposed Dead Load) – 1.5KN/m2
3. AAC block masonry walls 230& 100 mm thick are proposed to be used (location of walls per Architectural drawings) Unit weight is taken as 8 KN/m^3
4. Weathering course in Terrace finish –2 KN/m^2

2.2 Imposed Loads

The imposed loads that are envisaged to get permanently are considered as per **IS: 875 (part – 2) – 1987.** Indian standard **"Code of Practice for Design loads (other than earthquake) for Buildings and structures".**

1. Residential area = 2 KN/m2
2. Staircase = 3 KN/m^2
3. Toilets = 2 KN/m^2
4. Terrace floors = 1.5 KN/m^2

2.3 Load combinations

The various loads shall be combined in accordance with the stipulations in IS:875 (Part 5) – 1987. Whichever combinations produced the most unfavorable effect in the building, foundation or structural member concerned shall be adopted. The various load combinations considered in the analysis are as follows:

1. 1(DL + LL)
2. 1.5(DL + LL)
3. 1.2(DL + LL)
4. 0.9(DL)
5. 1.5(DL)
6. 1.2(DL + LL+(WL+X))
7. 1.2(DL + LL+((WL-X))
8. 1.2(DL + LL+(WL+Z))
9. 1.2(DL + LL+(WL-Z))

The above load combination will be considered and effect of worst combinations will be taken for design of various building elements.

3.0 ANALYSIS METHODS

The analysis of the structures is carried out using the STAAD PRO. The entire super structure is modeled using frame elements as appropriate. Beams and columns are modeled as frame elements. Appropriate loads and its combinations as per relevant IS code clauses, for most unfavorable effects are chosen for design. Various load cases considered in the analysis are briefed above.

4.0 DESIGN ASSUMPTION

4.1.1 The Base of the Foundation is assumed to be FIXED& PINNED.

4.1.2 All concrete elements shall be designed in accordance with IS 456:2000 Limit state design.

4.1.3 Appropriate loads and its combination as per relevant clauses, for the most unfavorable effects are chosen for design. (Refer Load Combination below).

5.0 FOUNDATION DESIGN

Type of foundation	: Isolated, Combined and Raft foundation.
Depth of foundation	: 6.0 m below natural ground level

6.0 MATERIALS

The self-weight of the various elements is computed based on the unit weight of materials as given below:

S. no	Materials	Unit weight KN / m^3
1	Reinforced Cement Concrete	25
2	Brick Work(for lift well& parapet)	20
3	Steel	78.50
4	AAC blockwork	8

Structural concrete shall be of grade M30 for all R.C.C work.

Steel reinforcement shall be of grade Fe 550 confirming to IS: 1786-2008.

7.0 NOMINAL COVER TO REINFORCEMENT

From Durability requirement, exposure condition is assumed as mild for structural elements above ground level and moderate for structural elements below ground level.

The clear cover to reinforcement to meet durability requirement shall be as follows:

Footing - 50mm

Column - 40mm

Beam - 32mm

Slab -20mm

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FOOTING DESIGN CALCULATIONS

Design File : D:\wip\1 trichy based projects\rohiniramjidbr and pptt\no dynamic\31 FINALRohini_Ramji17.03.2025-Footing-1.R1.rcdx

Analysis File : D:\1PROJECTS\1 TRICHY BASED FIRMS\ROHINI HOUSING PROMOTERS\2023\ROHINI RAMJI\WITHOUT DYNAMIC\FINAL\28 FINALRohini_Ramji08.03.2025.std

Analysis Last Modified : 12-03-2025 14:10:34

Code References:

IS 456

Parameter Reference

1. Ptmax : Cl. 26.5.2.1
2. Ptmin : Cl. 26.5.2.1
3. Pt : Cl. 38
4. Tc : Cl. 40.2.1
5. Tcmax : Cl. 40.2.3
6. Asv : Cl. 40.4
7. Min Shear Reinf : Cl. 26.5.1.6
8. Max Stirrup Spacing : Cl. 26.5.1.5
9. Punching Shear design : Cl. 31.6.3
10. Load transfer : Cl. 34.4
11. Ptnominal : Cl. 34.5.2
12. Crack width calculation : Annex-F
13. Cracking : Cl. 35.3.2

BS 8007 (For Early / Initial Thermal Cracking)

1. Surface Zone for suspended slab : Figure A.1
2. Surface Zone for ground slab : Figure A.2
3. Factors for the calculation of minimum reinforcement : Table A.1

Design Code : IS 456 : 2000 + IS 13920 : 2016

Footing No : FC27

Column No : C27 (380 mm X 1100 mm)

Analysis No : 431

Concrete Grade : M30 N/sqmm

Steel Grade : Fe550 N/sqmm

Clear Cover : 50 mm

Df : 2.5 M

Dw : 5 M

Density of Soil = 18 kN/cum

Soil Bearing Capacity =300 kN/sqm

Gross Bearing Capacity = 345 kN/sqm

Permissible SBC Increase for EQ = 0 %

Permissible SBC Increase for Wind = 0 %

Live Load Reduction = 0 %

Permissible area of loss of contact = 0 %

Design cross section by : Factored SBC

Factor = 1.5

Thus factored SBC = 450 kN/sqm

Footing Type : Pad

Footing Size (L x B x D) : 3600mm X 2900mm X 900mm

Without considering Effect of Water Table

Footing Self Wt., F1 = 234.90 kN

Soil Weight, S1 = 0.00 kN

Total Weight, W1 = F1 + S1 = 234.9 kN

Offset Along L (Loff) = 1250 mm

Offset Along B (Boff) = 1260 mm

Check For Maximum Soil Pressure:

Critical Load Combination = [14] : (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +(LOAD 2: LOAD CASE 2 WALL LOAD) +(LOAD 3: LOAD CASE 3 DEAD LOAD) +(LOAD 5: LOAD CASE 5 SUNKEN FILLING) +(LOAD 4: LOAD CASE 4 LIVE LOAD) +(LOAD 12: LOAD CASE 12 WIND ALONG + Z)

Pcomb = 2905.13 kN

P = Pcomb + W1

P = 3140.03 kN

Mx = -172.16 kNm

My = 7.02 kNm

P/A = 300.77 kN/sqm

Mx/Zx = -27.48 kN/sqm

My/Zy = 1.39 kN/sqm

Maximum Soil Pressure = 329.64 kN/sqm

Allowable Soil Pressure = (1 X 300) + 45 kN/sqm = 345 kN/sqm

Check For Minimum Soil Pressure:

Critical Load Combination = [14] : (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +(LOAD 2: LOAD CASE 2 WALL LOAD) +(LOAD 3: LOAD CASE 3 DEAD LOAD) +(LOAD 5: LOAD CASE 5 SUNKEN FILLING) +(LOAD 4: LOAD CASE 4 LIVE LOAD) +(LOAD 12: LOAD CASE 12 WIND ALONG + Z)

Pcomb = 2905.13 kN

P =Pcomb + W1

P = 3140.03 kN

Mx = -172.16 kNm

My = 7.02 kNm

P/A = 300.77 kN/sqm

Mx/Zx = -27.48 kN/sqm

My/Zy = 1.39 kN/sqm

Minimum Soil Pressure = 271.9 kN/sqm > 0

Check For Sliding:

Critical Load Combination = [14] : (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +(LOAD 2: LOAD CASE 2 WALL LOAD) +(LOAD 3: LOAD CASE 3 DEAD LOAD) +(LOAD 5: LOAD CASE 5 SUNKEN FILLING) +(LOAD 4: LOAD CASE 4 LIVE LOAD) +(LOAD 12: LOAD CASE 12 WIND ALONG + Z)

Coefficient Of Friction = 0.4

Factor of safety = 1.2

Pcomb = 2905.13

Shear Vx = 6.81 kN

Shear Vy = 34.34 kN

Resultant sliding force = 35.01 kN

Downward force =Pcomb + (F1 + S1) = 3140.03 kN

Upward water pressure = 0.00 kN

Net downward force = 3140.03 kN

Force resisting sliding = Friction Coeff X Net Downward Force = 1256.01 kN

Factor of safety available = Resisting Force / Sliding Force =35.87 > 1.2

Check For Overturning:

Along Width:

Critical Load Combination = (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +(LOAD 2: LOAD CASE 2 WALL LOAD) +(LOAD 3: LOAD CASE 3 DEAD LOAD) +(LOAD 5: LOAD CASE 5 SUNKEN FILLING) +(LOAD 4: LOAD CASE 4 LIVE LOAD) +(LOAD 12: LOAD CASE 12 WIND ALONG + Z)

Factor of safety = 1.50

Pcomb = 2905.13 kN

Moment Mx = 172.16 kNm

P = Pcomb + (F1 + S1) = 3428.66 kN

Stabilizing Moment for P = 6171.59 kNm

DeStabilizingMoment = 172.16 kNm

Overturning Factor of safety = 35.85

Safe in Overturning > 1.50

Along Length:

Critical Load Combination = (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +(LOAD 2: LOAD CASE 2 WALL LOAD) +(LOAD 3: LOAD CASE 3 DEAD LOAD) +(LOAD 5: LOAD CASE 5 SUNKEN FILLING) +(LOAD 4: LOAD CASE 4 LIVE LOAD) -(LOAD 11: LOAD CASE 11 WIND ALONG - X)

Factor of safety = 1.50

Pcomb = 2842.79 kN

Moment My = 39.63 kNm

P = Pcomb + (F1 + S1) = 3366.32 kN

Stabilizing Moment for P = 4881.17 kNm

DeStabilizingMoment = 39.63 kNm

Overturning Factor of safety = 123.16

Safe in Overturning > 1.50

Design For Bending:

Bottom Reinforcement Along L:

Deff =842 mm

Beff =2900 mm

SPu =517.5 kN/sqm

Mu =SPu X B X Loff X Loff / 2= 1172.46 kNm

Pt = 0.122 %

Ast Rqd (BM) = 2977 sqmm

Ast Prv for CrackWidth = 3280 sqmm

Ast Prv (Distributed Across Total Width) = 29 - T12 @ 105 =3280 sqmm

Top Reinforcement Along L:

D = 900 mm <= 1000 mm, Hence

Ast = Min Pt For Top Reinforcement X D X B

= 0.06% X 900 X 2900 = 1566sqmm

Ast Prv (Distributed Across Total Width) = 20 - T10 @ 155 c/c = 1571sqmm

Bottom Reinforcement Along B:

Deff =826 mm

Leff =3600 mm

SPu =517.5 kN/sqm

Mu =SPu X L X Boff X Boff / 2 =1478.85 kNm

Pt =0.129 %

Ast Rqd (BM) = 3833 sqmm

Ast Prv for CrackWidth = 4185 sqmm

Ast Prv (Distributed Across Total Length) = 37 - T12 @ 100 =4185 sqmm

Top Reinforcement Along B:

D = 900 mm <= 1000 mm, Hence

Ast = Min Pt For Top Reinforcement X D X L

=0.06% X 900 X 3600 = 1944sqmm

Ast Prv (Distributed Across Total Length) = 25 - T10 @ 150 c/c = 1963 sqmm

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face = 842 mm

Deff =842 mm

Beff =2900 mm

SPu =517.5 kN/sqm

Vu =SPu X (Loff - d) X B = 612.31 kN

Tv = Vu / (Beff X Deff) = 0.25 N/sqmm

Tc = 0.27 N/sqmm

Tv < Tc

One Way Shear Along B:

Critical Section @ d from Column Face = 826 mm

Deff = 826 mm

Leff =3600 mm

SPu =517.5 kN/sqm

Vu =SPu X (Boff - d) X L =808.54 kN

Tv = Vu / (Leff X Deff) = 0.27 N/sqmm

Tc = 0.27 N/sqmm

Tv < Tc

Design For Punching Shear:

Critical Section @ d/2 from Column Face = 417 mm

Deff = 834 mm

Leff =1934 mm

Beff =1214 mm

Punching Perimeter =6296 mm

Punching Area =5250864 sqmm

SPu = Factored SBC

= 517.5 kN/sqm

Vu =SPu X ((L X B)-(Leff X Beff)) =4187.67 kN

Tv = Vu / Punching Area =0.798 N/sqmm

Tc = 1.158 N/sqmm

Tv < Tc

Load Transfer Check For Load Transfer From Column To Footing

Critical Load Combination = [18] : 1.5 (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +1.5 (LOAD 2: LOAD CASE 2 WALL LOAD) +1.5 (LOAD 3: LOAD CASE 3 DEAD LOAD) +1.5 (LOAD 5: LOAD CASE 5 SUNKEN FILLING) +1.5 (LOAD 4: LOAD CASE 4 LIVE LOAD)

Pu = 4348.75 kN

A2 = 0.42 sqm

A1 = 18.71 sqm

Base Area = 10.44 sqm

A1 > Base Area

Thus, A1 = 10.44

Modification Factor = SquareRoot(A1/A2) < = 2

SquareRoot(A1/A2) = 4.9857

Thus, Modification Factor = 2

Concrete Bearing Capacity = 0.45 X Fck X Modification Factor X Column Area =11286 kN

Concrete Bearing Capacity > Pu, Hence Safe.

Crack Width Check as per IS 456 : 2000 + IS 13920 : 2016

	Bottom Along L	Bottom Along B
Critical Load Combination	10001	10001
BM (Unfactored) (kNm)	781.64	985.9
Cmin (mm)	50	62
Reinforcement	T12 @ 105	T12 @ 100
Ast Prv (sqmm)	3279.82	4184.6
Xact (mm)	123.35	123.95
Icr (mm4)	17712372068.33	21865915884.05
Acr (mm)	70.76	78.4
Check for Stress in Steel		
Fst (N/sqmm)	296.82	297.97
fst,perm (N/sqmm)	302.5	302.5
Crack Width Check		
Epsilon-deff, ε1	0.0016	0.0016
Epsilon-m, εm	0.0004	0.0004
Wcr (mm)	0.0738	0.0933
WcrPerm (mm)	0.2	0.2

Stress Limit Check as per IS 456 : 2000 + IS 13920 : 2016

	Bottom Along L	Bottom Along B
Critical Load Combination	10001	10001
BM (Unfactored) (kNm)	781.64	985.9
Cmin (mm))	50	62
Reinforcement	T12 @ 105	T12 @ 100
Ast Prv (sqmm)	3279.82	4184.6
Check For Stress In Reinforcement		
Fst (N/sqmm)	296.82	297.97
FstPerm (N/sqmm)	302.5	302.5
Check for Stress in Concrete		
Fc (N/sqmm)	5.44	5.59
FcPerm (N/sqmm)	10	10

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COLUMN DESIGN CALCULATIONS

Design File : D:\wip\1 trichy based projects\rohini ramji dbr and pptt\no dynamic\31 FINALRohini_Ramji17.03.2025-Column-1.rcdx

Analysis File : D:\1PROJECTS\1 TRICHY BASED FIRMS\ROHINI HOUSING PROMOTERS\2023\ROHINI RAMJI \FINAL\31 FINALRohini_Ramji17.03.2025.std

Analysis Last Modified : 17-03-2025 20:02:59

Code References:

IS 456

ELEMENT CLAUSE / table

1 Max area of reinforcement : 26.5.3.1-a & b

2 Min area of reinforcement : 26.5.3.1-a & b

3 Min number of bars : 26.5.3.1-c

4 Minimum Eccentricity Calc : 25.4 & 39.2

5 Effective Length : 25.2

6 Slenderness Moments : 25.3 & 39.7

7 Design for axial loads : 39.3

8 Design for axial loads And uniaxial bending : 39.5

9 Design for axial loads And Biaxial bending : 39.6

10 Design of horizontal links : 26.5.3.2

11 Design shear strength : 40.2

12 Stiffness Proportion Factor, β : E-1

13 Stability(Index, Q) : E -2

14 Crack width calculation : 3.8

15 Multiplying factor to Beam Stiffness for effective length calculation : SP 24 1983 APPENDIX D

IS 13920 - 2016

ELEMENT CLAUSE / table

1 Spacing of special confining reinforcement : 10.4 and 7.6

2 C/s area of special confining reinforcement : 7.6.1

3 Applicability of boundary element : 10.4.1

4 Muv-Moment Capacity of Web : Annex

5 Additional Compressive Force in BE : 10.4.2

6 Check for BE in tension and compression : 10.4.2.1 and 10.4.3

7 Shear include due to Beam : 7.5

8 Minimum Flexural Strength of Column : 7.2

9 Shear Check at Column Joint : 9.1

10 Length of wall to thickness ratio : 10.1.3

11 Type of wall & Minimum reinforcement : 10.1.4

12 Largest diameter of longitudinal steel bar : 10.1.8

13 Shear reinforcement in RC wall : 10.2.3

14 Special confinement reinforcement in Boundary Element : 10.4.4

15 Minimum vertical reinforcement across horizontal construction joint : 10.7

General Data

Column No. : C12

Level : -6 m To 3 m

Frame Type = Non-Ductile

Response Reduction Factor = 3

Design Code = IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete = M30 N/sqmm

Grade Of Steel (Main) = Fe550 N/sqmm

Grade Of Steel (Shear) = Fe550 N/sqmm

Grade Of Steel - Flexural Design = Fe550 N/sqmm

Column B = 380 mm

Column D = 1100 mm

Clear Cover = 30 mm

Live Load Reduction = 40 %

Clear Floor Height @ B = 2620 mm

Clear Floor Height @ D = 2550 mm

No Of Floors = 23

No Of Columns In Group = 1

Column Type : UnBraced

Minimum eccentricity check : Simultaneously (Both Axis)

Code defined D/B ratio : 4

D/B Ratio : 2.89 <= 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No. = 371

load Combination = [27] : 1.5 (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +1.5 (LOAD 2: LOAD CASE 2 WALL LOAD) +1.5 (LOAD 3: LOAD CASE 3 DEAD LOAD) +1.5 (LOAD 5: LOAD CASE 5 SUNKEN FILLING) +1.5 (LOAD 11: LOAD CASE 11 WIND ALONG - X)

Critical Location = Bottom Joint

Pu = 3059.87 kN

Mux = -6.59 kNm

Muy = -200.76 kNm

Vux = 127.82 kN

Vuy = -5.35 kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint Column Stiffness Beam Sizes Beam Stiffness Beta

Beam 1

(Length x Width x Depth) Beam 2

(Length x Width x Depth) Beam 1 Beam 2

N-m x 10^6 mm mm N-m x 10^6 N-m x 10^6

Bottom 3078.079 No Beam No Beam - - 0.996

Top 3078.079 265 x 230 x 450 5985 x 230 x 530 721.986 52.228 0.865

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Major Axis = 1

Calculation Along Minor Axis Of Column

Joint Column Stiffness Beam Sizes Beam Stiffness Beta

Beam 1

(Length x Width x Depth) Beam 2

(Length x Width x Depth) Beam 1 Beam 2

N-m x 10^6 mm mm N-m x 10^6 N-m x 10^6

Bottom 367.334 No Beam No Beam - - 0.941

Top 367.334 5790 x 230 x 450 3550 x 230 x 530 33.044 88.051 0.742

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Minor axis = 1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Minimum Eccentricity Along D:

Minimum Eccentricity = Unsupported Length / 500 + D / 30 = 41.77 mm

Minimum Eccentricity > 20 mm

Mminx = Pu x Minimum Eccentricity = 127.8 kNm

Minimum Eccentricity Along B :

Minimum Eccentricity = Unsupported Length / 500 + B / 30 = 17.91 mm

Mminy = Pu x Minimum Eccentricity = 61.2 kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 6.89 < 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / D = 2.32, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / B = 6.89, Column Not Slender Along B

Calculation of Design Moment

Direction Manalysis Mmin (Abs) Mdesign MsIndx (Abs) Mdesign-final

A B C E F

Major Axis - Mux -6.59 127.8 -127.8 0 -127.8

Minor Axis - Muy -200.76 61.2 -200.76 0 -200.76

Final Critical Design Forces

Pu = 3059.87 kN

Mux = -127.8 kNm

Muy = -200.76 kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated = 0.87

Reinforcement Provided = 18-T16

Load Angle = Tan-1(Muy/Mux) = 57.52 deg

MRes = 237.99 kNm

MCap = 636.45 kNm

Capacity Ratio = MRes/ MCap = 0.37 <= 1

Shear Calculation Along D Along B

Critical Load Combination [14] : 1.2 (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +1.2 (LOAD 2: LOAD CASE 2 WALL LOAD) +1.2 (LOAD 3: LOAD CASE 3 DEAD LOAD) +1.2 (LOAD 5: LOAD CASE 5 SUNKEN FILLING) +1.2 (LOAD 4: LOAD CASE 4 LIVE LOAD) +1.2 (LOAD 12: LOAD CASE 12 WIND ALONG + Z) [31] : 1.5 (LOAD 1: LOAD CASE 1 SELF WEIGHT OF BEAM & COLUMN) +1.5 (LOAD 2: LOAD CASE 2 WALL LOAD) +1.5 (LOAD 3: LOAD CASE 3 DEAD LOAD) +1.5 (LOAD 5: LOAD CASE 5 SUNKEN FILLING) +1.5 (LOAD 13: LOAD CASE 13 WIND ALONG - Z)

Design shear force, Vu (kN) -86.7819 127.8171

Pu (kN) 3414.6 3015.54

Deff , Beff (mm) 1062 342

Aeff (sqmm) 403560 376200

Design shear stress, Tv Vu / (B x Deff) Vu / (D x Beff)

Tv (N/sqmm) 0.215 0.3398

Pt (%) 0.433 0.433

Design shear strength, Tc (N/sqmm) 0.4676 0.4676

Shear Strength Enhancement Factor (Compressive Force) 1 + 3 x Pu / (B x D x Fck)

1.8461 1.8016

Shear Strength Enhancement Factor (Tensile Force) - -

Shear Strength Enhancement Factor (max) 1.5 1.5

Shear Strength Enhancement Factor 1.5 1.5

Enhanced shear strength, Tc-e (N/sqmm) 0.7014 0.7014

Design shear check Tv < Tc x Enhancement factor Tv < Tc x Enhancement factor

Shear Links Design Shear Links Not Required Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link = 8 mm > Max. longitudinal bar dia / 4 = 4 mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16 = 256 mm

Min. dimension of column = 380 mm

Max. 300 mm = 300 mm

Provided spacing = 250 mm

Table For Links

Required Provided

Normal Design Shear Design Ductile Design Normal Zone Ductile Zone

Link Dia. 8 --- --- 8 ---

Spacing 250 --- --- 250 ---

Crack Width Check as per IS 456 + IS 13920 - 2016

Location Top

Critical Load Combination 10001

Member Force

P (kN) 2874.8128

Mx (kNm) 14.9426

My (kNm) 1.7432

Max Corner Stress (C1) 7.13838

Min Corner Stress (C2) 6.61671

Minimum corner stress in all load cases is more than Zero, Hence Section is Uncracked.

Stress Limit Check as per IS 456 + IS 13920 - 2016

Location Bottom Top

Critical Load Combination 10001 10001

Member Force

P (kN) 2251.2396 2221.6816

Mx (kNm) 98.7261 29.0784

My (kNm) 82.4817 122.6565

Reinforcement - Total 18-T16 18-T16

Corner Reinforcement - Dia 16 16

Ast - corner reinforcement - mm2 201.0619 201.0619

Neutral Axis Angle (Deg) 50.1226 13.337

Neutral axis location from compressive corner (mm) 1705.3412 624.163

Check for Stress in Steel

Fst (N/sqmm) 36.3612 9.2252

FstPerm (N/sqmm) 302.5 302.5

Check for Stress in Concrete

Fc (N/sqmm) 7.1078 9.5444

FcPerm (N/sqmm) 10 10

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BEAM DESIGN CALCULATIONS

Design File : D:\ROHINI RAMJI\14 FINALRohini_Ramji 23.08.2024-Beam-1-2.999 m.rcdx

Analysis File : D:\ROHINI RAMJI\14 FINALRohini_Ramji 23.08.2024.std

Analysis Last Modified : 23-08-2024 14:19:54

Level Designed : 2.999 m

Code References

IS 456

Sr.No. Item Clause / Table

1 Ptmax : 26.5.1.1

2 Ptmin : 26.5.1.1

3 MTu : 41.4.2

4 VTu : 41.3.1

5 Ptclc : 38

6 Tc : 40.2.1

7 Tcmax : 40.2.3

8 Asv : 40.4

9 Min Shear Reinf : 26.5.1.6

10 Max Stirrup Spacing : 26.5.1.5

11 Shear Reinf - Torsion : 26.5.1.7

12 Side Face Reinforcement : 26.5.1.3

13 crack width calculation : Annex-F

14 cracking : Clause 35.3.2

IS 13920 - 2016

Sr.No. Item Clause / Table

1. Ptmax : 6.2.2

2. Ptmin : 6.2.1

3. Astmin : 6.2.3 & 6.2.4

4. Svclc : 6.3.5

5. Shear Capacity : 6.3.4

6. Coupling Beams : 10.5

Group : G39

Beam No : B62

Analysis Reference (Member) : 338,142 (2.999 m)

Beam Length : 2720 mm

Breadth (B) :230 mm

Depth (D) : 690 mm

Effective Depth (d) :628 mm

Design Code : IS 456

Beam Type : Regular Beam

Grade Of Concrete (Fck) : M30 N/sqmm

Grade Of Steel (Main) : Fe550 N/sqmm

Grade Of Steel (Shear) : Fe550 N/sqmm

Top/Bottom Clear Cover (Cmin) :32 mm

Side Clear Cover :32 mm

Es : 2x10^5 N/sqmm

Ptnominal (%) (Bn) : 0.2 %

Flexure Design

	Beam Bottom			Beam Top		
	Left	Mid	Right	Left	Mid	Right
Critical L/C	-	RCDC 32	-	-	28	28 28
Mu (kNm)	8.92	-	-	44.05	183.17	254.62
Tu (kNm)	0	0	0	0	0	0
MTu (kNm)	0	0	0	0	0	0
Mud (kNm)	8.92	0	0	44.05	183.17	254.62
MuLim (kNm)	354	354	354	354	354	354

R 0.098 0 0 0.486 2.019 2.807

Ptmin (%) (A) 0.2 0.2 0.2 0.2 0.2 0.2

Ptclc (%) (B') 0.2 0.2 0.2 0.2 0.461 0.669

Pcclc (%) (C) 0 0 0 0 0 0

PtPrv (%) 0.235 0.235 0.235 0.235 0.653 1.02

AstCalc (sqmm) 288.88 288.88 288.88 288.88 666.17 966.46

AstCrack (sqmm) (D) 288.88 0 0 288.88 749.7 1191.2

AstPrv (sqmm) 339.3 339.3 339.3 339.3 942.48 1472.61

Reinforcement Provided 3-Y12 3-Y123-Y123-Y12 3-Y20 3-Y25

Note: Calculation of Ast

AstCalc = Max {B',C} x B X d (for Mu >0)

AstCalc = Bn x B X d (for Mu = 0)

Shear Design

Left Mid Right

Critical L/C - RCDC 32 32 32

PtPrv (%) 0.653 0.653 1.02

Vu (kN) 85.08 107.99 128.13

Tu (kNm) 0 0 0

VTu (kN) 0 0 0

Vut (kN) 85.08 107.99 128.13

Tv (N/sqmm) 0.59 0.75 0.89

Tc (N/sqmm) 0.55 0.55 0.66

Vc (kN) 80.04 80.04 95.43

Vus=Vut-Vc (kN) 5.04 27.95 32.7

Legs 2 2 2

Stirrup Rebar 10 10 10

Asv Torsion (sqmm) - - -

Asv Torsion Prv (sqmm) - - -

AsvReqd (sqmm/m) 254.81 254.81 254.81

SvCalc (mm) 300 300 300

SvPrv (mm) 300 300 300

Asv Total Prv (sqmm) 523.6 523.6 523.6

Maximum Spacing Criteria

Basic

Spc1 =0.75d = 471 mm

Spc2 = 300 mm

SFR Design

Beam Width = 230 mm

Beam Depth = 690 mm

Web Depth = 690 <= 750 mm

Side Face Reinforcement not required.

Crack width as per IS 456 : 2000 + IS 13920 : 2016

	Beam Bottom			Beam Top		
	Left	Mid	Right	Left	Mid	Right
Critical L/C - RCDC - - - -				10001	10001	
BM (Unfactored) (kNm)	0	0	0	0	105.8	149.42
Reinf. In 1st layer				3-Y20	3-Y25	
sp (mm)				73	70.5	
AstPrv (sqmm)				942.48	1472.61	
Xact (mm)				184.2	220.6	
Icr (mm4)				2211695278.58	3104260807.24	

Check for Stress in Concrete

σcbc (N/sqmm) 8.81 10

σcbc(Actual) (N/sqmm) 10 10

Check for Stress in Reinforcement

Fst (N/sqmm) 198.13 183

FstPerm (N/sqmm) 302.5 302.5

Crack Width Check

Location Edge (Bottom/Top)

acr (mm) 45.64 44.27

Epsilon-deff, ε1 0.001129 0.001054

Epsilon-m, εm 0.000895 0.000914

Wcr (mm) 0.1162 0.1153

WcrPerm (mm) 0.2 0.2

Stress Limit Check as per IS 456 : 2000 + IS 13920 : 2016

Beam Bottom Beam Top

Left Mid Right Left Mid Right

Critical L/C - RCDC 10001 - - 10001 10001 10001

BM (Unfactored) (kNm) 4.94 0 0 23.79 105.8 149.42

Reinf. In 1st layer 3-Y12 3-Y12 3-Y20 3-Y25

sp (mm) 65 65 53 45.5

AstPrv (sqmm) 339.3 339.3 942.48 1472.61

Check for Stress in Concrete

σcbc (N/sqmm) 0.62 2.97 8.81 10

σcbc(Actual) (N/sqmm) 10 10 10 10

Check for Stress in Reinforcement

Fst (N/sqmm) 24.76 119.16 198.13 183

FstPerm (N/sqmm) 302.5 302.5 302.5 302.5

Group : G39

Beam No : B63

Analysis Reference (Member) : 117 (2.999 m)

Beam Length : 970 mm

Breadth (B) :230 mm

Depth (D) : 680 mm

Flexure Design

Beam Bottom Beam Top

Left Mid Right Left Mid Right

Critical L/C - RCDC 8 32 56 52 52 28

Mu (kNm) 244.95 179.24 55.23 160.95 141.6 118.46

Tu (kNm) 0 0 0 0 0 0

MTu (kNm) 0 0 0 0 0 0

Mud (kNm) 244.95 179.24 55.23 160.95 141.6 118.46

MuLim (kNm) 343 343 343 343 343 343

I 2.789 2.04 0.629 1.832 1.612 1.349

Ptmin (%) (A) 0.2 0.2 0.2 0.2 0.2 0.2

Ptclc (%) (B') 0.664 0.467 0.2 0.415 0.361 0.298

Ptclc (%) (C) 0 0 0 0 0 0

PtPrv (%) 0.707 0.707 0.283 1.036 0.442 0.663

AstCalc (sqmm) 943.82 663.12 284.28 589.28 512.96 423.88

AstCrack (sqmm) (D) 943.82 663.12 0 0 512.96 423.88

AstPrv (sqmm) 1005.3 1005.3 402.12 1472.61 628.32 942.48

Reinforcement Provided 3-Y16

2-Y16 3-Y16

2-Y16 2-Y16 3-Y25 2-Y20 3-Y20

Shear Design

Left Mid Right

Critical L/C - RCDC 8 8 8

PtPrv (%) 0.707 0.707 0.283

Vu (kN) 275.17 283 289.4

Tu (kNm) 0 0 0

VTu (kN) 0 0 0

Vut (kN) 275.17 283 289.4

Tv (N/sqmm) 1.94 1.99 2.04

Tc (N/sqmm) 0.57 0.57 0.39

Vc (kN) 81.36 81.36 55.36

Vus=Vut-Vc (kN) 193.81 201.64 234.04

Legs 2 2 2

Stirrup Rebar 10 10 10

Asv Torsion (sqmm) - - -

Asv Torsion Prv (sqmm) - - -

AsvReqd (sqmm/m) 868.57 903.69 1048.9

SvCalc (mm) 175 170 145

SvPrv (mm) 175 145 145

Asv Total Prv (sqmm) 897.6 1083.31 1083.31

Maximum Spacing Criteria

Basic

Spc1 =0.75d = 464 mm

Spc2 = 300 mm

SFR Design

Beam Width = 230 mm

Beam Depth = 680 mm

Web Depth = 680 <= 750 mm

Side Face Reinforcement not required.

Crack width as per IS 456 : 2000 + IS 13920 : 2016

Beam Bottom Beam Top

Left Mid Right Left Mid Right

Critical L/C - RCDC 10001 10001 - - - 10001

BM (Unfactored) (kNm) 77.85 45.52 0 0 0 22.5

Reinf. In 1st layer 3-Y16 3-Y16 3-Y20

sp (mm) 75 75 73

AstPrv (sqmm) 1005.3 1005.3 942.48

Xact (mm) 187.4 187.4 182.5

Icr (mm4) 2244287506.44 2244287506.44 2134352535.56

Check for Stress in Concrete

σcbc (N/sqmm) 6.5 3.8 1.92

σcbc(Actual) (N/sqmm) 10 10 10

Check for Stress in Reinforcement

Fst (N/sqmm) 139.39 81.51 42.84

FstPerm (N/sqmm) 302.5 302.5 302.5

Crack Width Check

Location Edge (Bottom/Top)

acr (mm) 46.83 46.83 45.64

Epsilon-deff, ε1 0.000797 0.000466 0.000245

Epsilon-m, εm 0.000582 0.000251 0.000014

Wcr (mm) 0.0772 0.0333 0.0018

WcrPerm (mm) 0.2 0.2 0.2

Stress Limit Check as per IS 456 : 2000 + IS 13920 : 2016

Beam Bottom Beam Top

Left Mid Right Left Mid Right

Critical L/C - RCDC 10001 10001 - - 10001 10001

BM (Unfactored) (kNm) 77.85 45.52 0 0 10.82 46.27

Reinf. In 1st layer 3-Y16 3-Y16 2-Y20 3-Y20

sp (mm) 59 59 126 53

AstPrv (sqmm) 1005.3 1005.3 628.32 942.48

Check for Stress in Concrete

σcbc (N/sqmm) 6.5 3.8 1.08 3.96

σcbc(Actual) (N/sqmm) 10 10 10 10

Check for Stress in Reinforcement

Fst (N/sqmm) 139.39 81.51 30.39 88.12

FstPerm (N/sqmm) 302.5 302.5 302.5 302.5

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Design of slab

Four Edges Discontinuous

Fck	30	N/mm^2
Fy	500	N/mm^2
Dia of bar (Lx Direction)	12	mm
Dia of bar (Ly Direction)	12	mm
Clear cover	20	mm
Clear span Lx	4230	mm
Clear span Ly	4025	mm
Width of Beam	300	mm
Slab tk	150	mm
Floor Finish	50	mm
Weathering Coarse	25	mm
LIVE LOAD	3	KN/m2
Length of slab (lx)	4143	mm
Length of slab (ly)	4354	mm
Dead Load	5.20	KN/m2
LIVE LOAD	3	KN/m2
FD DL	7.8	KN/m2
FD LL	4.5	KN/m2
ly/lx	1.0509	IT IS TWO WAY SLAB

Bending Moment Coeffecient for Rectangular Panels Supported on Four Sides with Provision for Torsion at Corners (IS 456-2000 Table 26)

	short span		long span	
	(-ve Mx)	(+ve Mx	(-ve My)	(+ve My)
	0	0.0687	0	0.062193

support moment	Mx	0	KN.m
	My	0	KN.m
span moment	Mx	14.502	KN.m
	My	13.13	KN.m

Xu max/d	0.46	
Q	4.0082	
d rquired	60.15	The depth provided is suffcient
Effective depth shorter span	124	
Effective depth longer span	112	
Ast (+ ve Shorter span)	279.49	mm^2
Ast (+ ve Longerer span)	281.43	mm^2
Ast (- ve Shorter span)	0	mm^2
Ast (- ve Longerer span)	0	mm^2
Min Ast	180	mm^2

SPAN REINFORCEMENT

TO PROVIDE 12 mm DIA OF BAR @300 mm SPACING IN 4025 mm DIRECTION

TO PROVIDE 12 mm DIA OF BAR @300 mm SPACING IN 4230 mm DIRECTION

SUPPORT REINFORCEMENT

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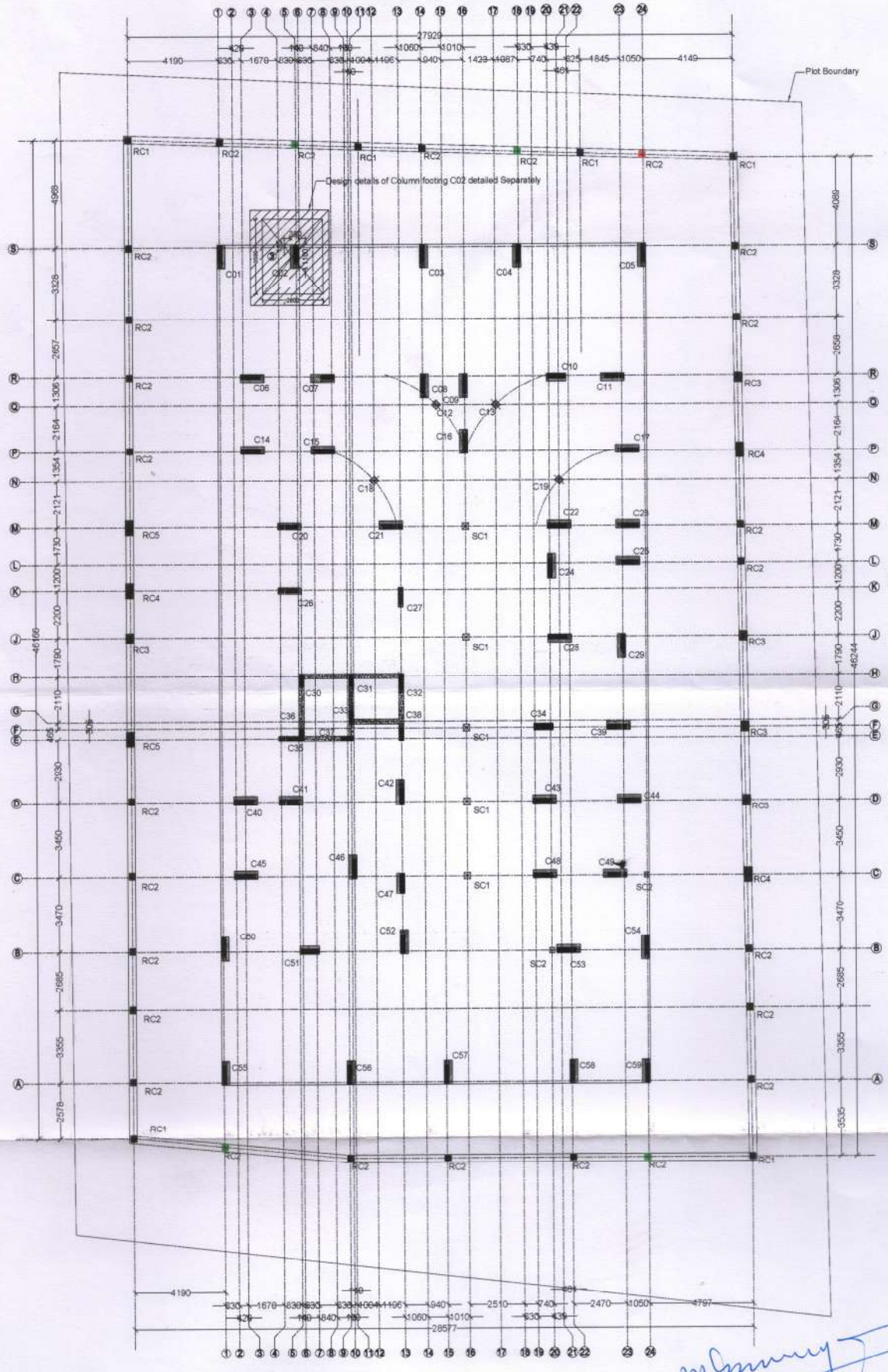
Column & Footing Layout @ (-)6000 Level from N.G.L.



■ - Regular column up to terrace	▦ - Shear Wall @ Basement Floor Roof Level	▩ - Column to be Terminated @ Basement Floor Roof
⊠ - Stub Column upto Basement floor Level	▦ - Column to be Terminated @ Sixth Floor Roof	▨ - Column to be Terminated @ Silt Floor Roof
▨ - Column in retaining wall to be Terminated @ Basement Floor Roof		

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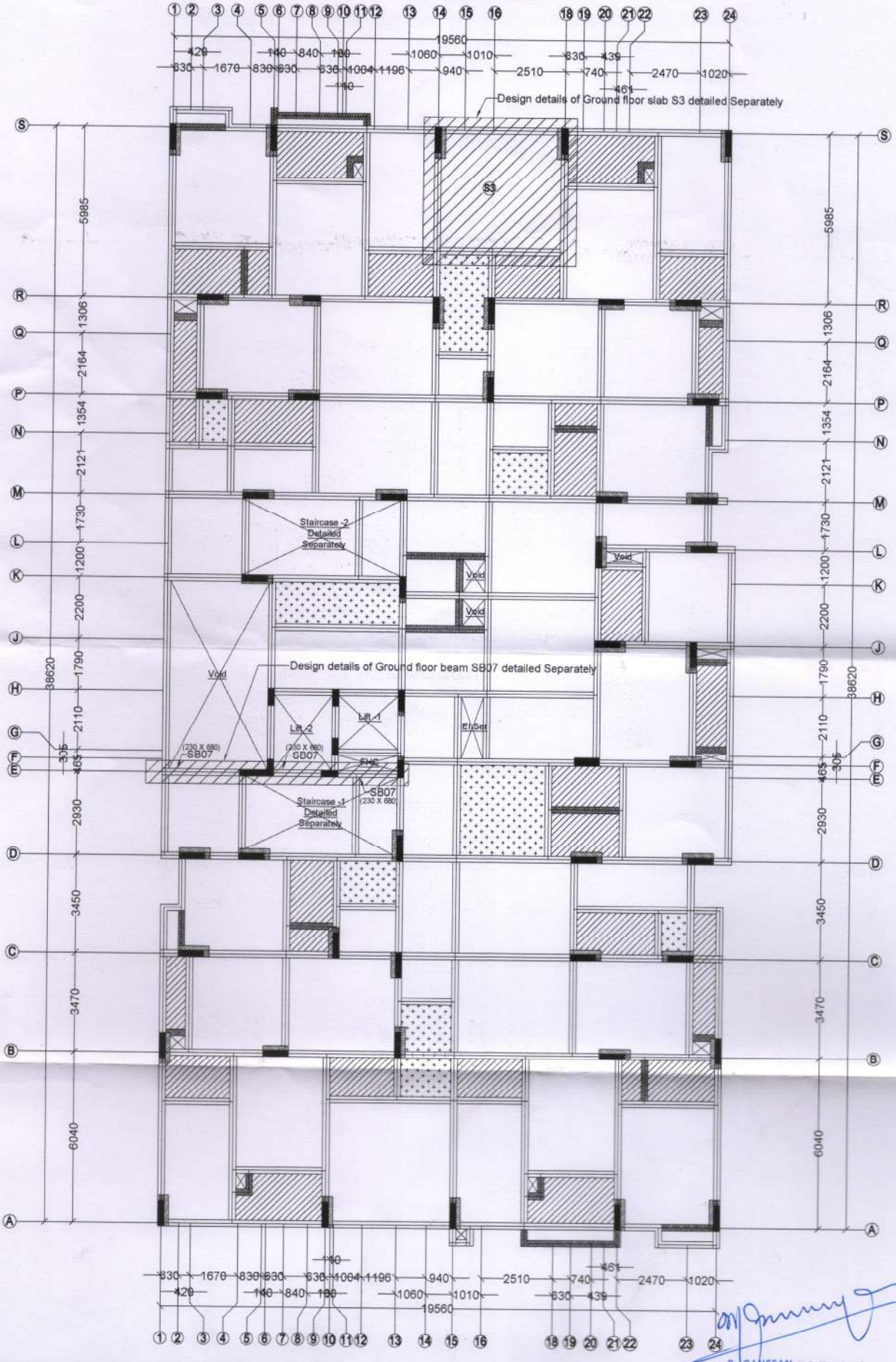
Stilt Floor Roof Beam & Slab Layout.



- Regular column up to terrace
- Column to be Terminated @ Stilt Floor Roof
- Column to be Terminated @ Sixth Floor Roof
- (-)150 Sunken Slab
- Slab @ Beam Bottom
- Concealed Beam

Important Note :

1. For Cantilever Portion of Beam & Slab, Please extend both top & bottom reinforcements up to free end.
2. For Cantilever Beam & Slab, Sufficient development length for reinforcements should be given in main beam or column.

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